

# Digital Narrations: Fails and Errors

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# Digital Narrations: Fails and Errors

Featuring contributions by Anna Barham, Nathan Jones, Dori0, Maria-Cecilia Quadri and Philip Ullrich. Edited by Maria-Cecilia Quadri, Lea Schaffner and Philip Ullrich and conceptualised with Nishant Shah.

The editorial team would like to thank the authors and peer reviewers for their time and effort in putting together this special issue of the *APRIA Journal* on Digital Narrations: Fails and Errors. Our special thanks to Nishant Shah for his invaluable inputs and contribution.

## Editorial

‘Digital Narrations’ is a series of different formats that has been exploring the influence of digital media on narration in the arts since 2016. In 2018, we invited Nishant Shah to participate in the event ‘Agents of Change.’ We stayed in touch, and the idea for this new edition of ‘Digital Narrations’ as part of *APRIA Journal* arose from this exchange.

Our curatorial approach is based on long-lasting co-operation, friendships, and the will to show different perspectives. This is why this editorial takes the form of an assemblage of four voices—Nishant Shah’s (italicised) and the individual point-of-views of us, the editors. We have cut up and compiled insights from our collaboration to give an oversight of ‘Digital Narrations: Fails and Errors.’

In this edition of *APRIA Journal*, five contributions tackle the concept of fails and errors in the digital space from different perspectives using diverse methods. When talking about digitality, the error is often ascribed on a human level—in us as biological beings—or in the old and slow analogue processes and structures.

On the other hand, there is a prevalent knee-jerk attitude of cultural pessimism that views the digital itself as suspicious. Too cold, too rational, not alive enough, and thus, regardless of its power of seduction, as one big fail. For us, this combination is a good starting position for taking a closer look. What other stories can be told on errors, or maybe even through errors? Where do gaps for subversion open up?

Anna Barham's work 'ZYX' employs errors in Automatic Speech Recognition (ASR) software as a kind of productive disturbance. In so doing, Anna creates auditory hallucinations in machines and reflects on the ways these are different from human hallucinations.

*Anna's piece is vertiginous. She doesn't just give us a thesis on hallucination but brings a landscape that makes us dizzy, showing the irrationality, paranoia, and the bits and pieces of messiness that go into the digital production. What is extraordinary is that the only way to detect these messinesses, these fails, these errors, is to have other kinds of technologies which can detect these errors. The human notion of what is a sound, of what is a text,*

*and what hallucination can mean is severely reworked in order to take us back into the power and wealth of meaning-making and narratives where humans, too, can generate seeming meanings and narratives of a data dump of errors.*

In her work, Anna used an audio filter that emphasises the discontinuities of human speech to force errors in speech-to-text programs, and used bits of pieces of those distorted sounds as material for an assemblage. With this, she creates an aesthetical experience where the disturbances are turned into a productive moment in the form of a sound pattern.

I see an interesting tension in fails and errors in regard to digitality. The fail can be investigated as a glitch and generate new forms of aesthetics. Likewise, the error can cast new light on the relationship between human and machine and the responsibilities we are confronted with. Consequently, dealing with fails and errors allows me to find new forms of narrations and uncover broader narratives.

*It is the breaking of surfaces. Of disrupting. Of showing that there are these hidden mechanisms which are dismissed as noise, as fragments, as mess, as errors, but that these things have material traces, archaeological depths, and a presence that can't be just dismissed. The aesthetics of foregrounding this also shows the politics of this process, where that which challenges the smoothness can be removed and the performance of digital smoothness*

*glosses over those things which are removed from the interface surface.*

For their collaborative work ‘Earthbnb, from Platform to Planet,’ international artist research collective DoriO used Covid-19 lockdowns create a 3D model of a fictitious collective apartment. They used this to create a listing on Airbnb. In their work, fails and errors are visible on multiple levels. On the one hand, they use the glitch aesthetic of their 3D rendering to show a defective—or enhanced—form of a reality. On the other, their work deals on a conceptual level with structural mistakes that are produced by large platforms such as Airbnb when they, for example, turn habitable infrastructure into unused ghost places.

*DoriO’s piece is a reworking of how we even address the idea of fails and errors. In a world where the technological is given as too big to fail, and aesthetically the default, how does art infiltrate and reclaim the space within that structure? Both in the reworking of this space, but also in reorienting its objectives, the work shows the possibility of failure. By stretching it to its logical absurdity, by putting the earth up for sale, it is able to change our relationship and perspective on the issue, helping the transfer of the new-found insight into the one that we have already familiarised ourselves with.*

The work by DoriO is a productive break with the aesthetic of digital platform economies such as

Airbnb by appropriating their design, re-assembling it and, alienating it from the original context. This is supported by a link to the research work the group has done, which both provides additional context to the video and makes visible the artistic and social praxis of DoriO as a collective.

Particularly during the pandemic, when their homes functioned both as their workplaces and a schoolroom, it became clear for many people how scarce housing space can be. Thus, I see errors described in this work when it comes to gaps, housing scarcity and our handling of infrastructure. Who has access, who does not, who decides on this and which platforms reinforce and harden those structures?

*In my research, I have focused a lot on two computational principles and how they shape the notion of the 'fake.' The first is GIGO (Garbage In, Garbage Out), which insists that if a computer program gives false results, then it is entirely because the human operators feeding it data or shaping its algorithms goofed up somewhere. The unquestioned idea that errors belong only to the human when it comes to computational processes becomes a critical point in understanding where errors are attributed. There is no such thing as a machine error, only the human failure to calibrate it correctly. And at the same time, with more self-learning devices and algorithms around us, it is clear that machines are creating entirely new conditions of failure—crashes, blackouts, shutdowns, and glitches that lead to profoundly interesting questions of responsibility and*

*accountability when the materiality of a device takes on agency to cause collapse. For me, the question of how fails and errors are attributed, and who (or what) can afford to fail, and who bears the consequences of these failures and errors, remain critical questions that need continued unpacking.*

In her essay ‘Democratise the Cyberspace! Storytelling in the Digital Era,’ Maria-Cecilia Quadri wonders how our society can develop a broader understanding of the errors it commits in its comprehension of digitality and which role cultural workers can play in fostering that understanding. In this respect, her work can be read as a framing of the contributions of this issue that propose different levels of exactly that.

Maria-Cecilia interweaves autobiographical experiences with an overview of the discourse on society’s handling of both general (supposed) errors and the blind spots specifically related to digitality. She draws on her own intersecting cultural backgrounds to illuminate structural fails and errors that perpetuate existing and prevailing balances of power, ethical values and systems of truth.

It is worth reflecting deeply on these errors and failures because they are so powerful, particularly against people who often are already disadvantaged, for example, migrants. Not only are they deeply nested in our psyche and provide us with feelings of appreciation or depreciation but they also have tangible effects on our lives. People who commit

mistakes lose the right to participation—maybe they are no longer allowed to drive a car, won't be invited to job interviews, or could lose access to education. But what is declared as an error or a failure is not always objective; it is instead located and contextualised in a negotiable field of moral concepts and opinions. As a result, that decision—which counts as an error—is now increasingly made by algorithms.

*Fails and errors introduces an interesting teleology to the idea of digital narrations. Who is the recipient and the intended audience of digital narrations? As the human messaging and the machine information process this information differently, there is going to be a clash of values, ideologies and systems about the meaning of this information. The framework of fails and errors become critical to figuring out which one of these competing claims of truth and fake will be attributed to what systems of information processing. It helps us figure out where failure is attributed, where errors are placed, and where the interventions in accountability and responsibility, and also culpability and penalisation are made as we continue to build entwined digital narratives that shape our futures.*

Nathan Jones' essay 'Experiential Literature? Comparing the work of AI and Human Authors' examines the specific qualities and shortcomings of GPT-3, an AI text-generation software. He analyses the failure of this speech model by comparing it to contemporary literature, showing how the software

is limited by the corpus of texts it is based on and the fact that those texts must always come from the past. The texts that GPT-3 generates show gaps and logical errors in their narration because the AI does not have a conceptual understanding of language and content; rather, it only simulates its outcomes on the basis of statistical and probabilistic models. His essay deals with the question of how this many-layered failure impacts language, literature, and eventually a possible future.

*Nathan puts forward a powerful comparative framework to look at the production of literary text by comparing GPT-3 and experimental authors, both of which are invested in the polar ends of a text spectrum. GPT-3's reliance on large-scale language corpus and its insistence in finding realism harkens to a prosaic twentieth-century modernity that mimics the exploitative nature of these databases in the production of writing itself—trying to develop efficient and coherent utterances without meaning. Using Ravn and Fosse [contemporary authors] as the counterpoints, the essay shows how these neural learning networks modelled on large scale data sets cannot be the measures of our language and meaning.*

Using experiments that seed GPT-3 with works by contemporary avant-garde authors, Nathan illuminates the limits of the AI texts and proposes using them as a tool to learn more about what makes these authors' writing special.

*The idea that GPT-3 is not just a failure in complexity processing but is, in fact, a failure in comprehending language and its exigencies—and that the errors it produces are not at the level of merely syntax and processing but at the very heart of what makes meaning—is beautifully and poetically demonstrated.*

There already is a seed for a story in the arc from failing as the starting point that leads to an error as the perceptible result. And mistakes in general have the potential to lead to fascinating stories that bring new insights—or just even the tragedy of seeing someone fail. In this regard, the topic is almost predestined for us as ‘Digital Narrations.’ Our focus on digital narratives and modes of storytelling entails a certain focus on phenomena of language.

But we want to accommodate other works as well, especially those that show how errors can be used to create, in one way or another, the potential for opening up a space for something new. We are interested in the whole range of errors that stems from digitality. That is to say, the failure of digital systems that continue the capitalist logic of reduction and exploitation, as well as the errors that can plague the tiny ‘building blocks’ of digital logic.

Based on his own experience of working as a programmer, Philip Ullrich looks at the phenomenon of the computer bug in his poetic text and subjective reflection, ‘The Bug (Up Close and Personal).’ His work proposes various categories of bugs that

demonstrate different perspectives of these common errors and shows how they are produced.

*Philip's essay clearly shows us that computational systems can never fail because they are never complete, and they can never have errors or 'bugs' because bugs are designed, present, and even essential to the workings of the system. Perhaps playing on the internet meme, this is not a bug, but a design, one being intentional and the other an error, Philip gives us a multi-vocal theorisation that the bug is the design and that we need to think about both fails and errors as performing certain functions of valuation, of paranoia, and of control, thus shifting attention from pass/fail to why something—like a bug—is construed that way.*

Philip explores the relationship between human and machine by foregrounding language and communication. In the process, he uses his programming experience to give unexpected takes on how to interpret the bug, which are humorous at times.

*The essay is a great example of the artistic researcher as a synthesis point, bringing together multiple strands of deeply understood and practised concepts and practices to help create a new narrative which is more than the sum total of the parts. The reconstruction and appropriation of the bug as a divining tool, rather than something that has to be resolved, brings into relief the capacity of artistic research to reframe the questions, enchanting them and*

*engendering them with new possibilities of meaning.*

The series Digital Narrations deals with the influence of digital media on the form and distribution of stories and narratives within the internet and beyond. For me, the series is an open, experimental container for trying different formats, aesthetics and potentials of narration in the digital age. Since 2016, we have invited artists and guests for exhibitions, events, workshops and screenings to approach this topic from different angles and to enable the public to experience it in different forms. Which stories are told? How are they told? And who can and may tell their story?

*For me, Digital Narrations is a provocation that opens up how we think about the very materiality of digital ontologies and the structure of narrative epistemologies. Digital technologies are fiercely non-narrative. Digital information processing is non-linear, does not have narrative causality, and is continually atomised into information sets which resist and overthrow the narrative impulse. The promise of digitalisation, in many conversations, has been to replace the interpretative, suggestive, symbolic, and ambiguous fickleness of narrative with the logical, decisive, definitive, and explanatory structures of digital data, in the quest of mythical objectivity and fixity.*

*Digital Narrations, then, defies these expectations of digitalisation and instead explores the potentials of narrative techniques, structures, and possibilities that emerge as the narrative framework queers the pitch of digital*

*architectures. Digital Narrations emerge as cyborg forms, where the machine logic and the narrative possibility converge to mutually critique and co-constitute each other, in order to look at the creative, playful, disruptive, and imaginative ways in which born digital narratives are created. In the process, they critically question the ways in which we think of digital realities, or fakeness, and the new structures of making meaning within digital computational networks.*

Our approach is to establish a fruitful mix of commonality and differences, of exact looking and blank spaces. The topics we deal with are too extensive to be described in complete detail by a limited number of works. But instead of restricting ourselves, we want to present a selection of different artistic positions that show the range of the extensive and complex phenomena we are dealing with. At the same time, the series fragmentary nature makes clear that these are individual standpoints that do not serve just to illustrate a thesis of ours. We prefer a multitude of voices that, through their limited number, keep their individuality over making absolute claims of truth.

*My engagement with the group Digital Narrations has been more as a book-end. My first conversations with the curatorial team began with long public conversations and performance, around questions of fakeness, misinformation, machine narratives, and human possibilities. My initial prompt into thinking about digital narrations*

*was to examine how human-machine intersections lead to new modes of telling, identifying, defining, and claiming conditions of truth-telling. The idea that the Turing Test was never meant to verify machines but to destabilise the human assurance of our capacity for recognising fakes resulted in different conversations around machine errors and human failures and how they coincide in digital narrations. I now come back to these conversations to revisit the idea of where fails and errors lie, when we think of digital phenomena and epistemologies. In many ways, the conversation has moved from figuring out how humans can measure up to machines in information processing to how we need to question the machine measures which are forced upon human scale narratives in identifying the fakes.*

Often there is trust put into digital technologies because they operate with numbers and thus they suggest objectivity and precision. We think it is promising to offer a counter to this understanding. Not least because in a performance-optimised society such as ours, failure and errors are omnipresent and we are confronted with them anyway. The openness of the terms also allowed for the necessary freedom to establish an artistic process for the involved artists and ourselves. Because all contributions for the publication are originally produced for it and the artists participating practise a culture of exchange, we wanted to involve them in the conception of the issues as a whole, not just their own individual works. This allowed for insightful and

revealing links and interconnections to be recognised and established.

*What I learn from my engagement with the curatorial team is a commitment to not give in to conventional norms and measures of academic research. The idea that we do not begin with a definitive norm of artistic research, forcing different researchers to fit into outdated methodological moulds, but instead give people space to explore, experiment with and articulate their own de-disciplined practice of artistic research bears fruition. It makes the work of curatorial editorship that much more difficult because new controls for quality check, for research integrity, and for verifying positions have to be evolved, but the fact that this has happened, and that each contribution has pushed the notion of what is artistic research, how do we document it, and how artistic research intervenes in complex questions, informs the curatorial approach.*

For me, there are countless formats that facilitate artistic research. Precisely because of the possibilities of the arts to find, refine and establish new methods, they can offer fresh insights and identify different perspectives. The formats presented in this issue originate from original and independent questions regarding the topic of fails and errors and the contributors have developed different means of answering them. The resulting works can be located in the field of artistic research because they produce knowledge beyond the methodological standards of

conventional knowledge production in universities and scientific research institutes.

*It is in the nature of research on fails and errors that comparisons are the default mode of address because something fails or an error is produced only in comparison with a baseline of the normative. All these essays, in their different artistic methods, are showing that the comparative framework, especially when it comes to human-machine interaction, are often skewed towards the machine as the tool and the human as the unit that has to be measured and has to measure up to the norms established by this tool. They all, instead, refuse this naturalised state of comparison and show us that machines themselves—in all their components and assemblages, need to be seen as flawed, mired in a political economy of fails, and cannot be accepted as the clean discreet things that shall govern the world. Instead, the attention of artistic research is in producing new kinds of scales, novel modes of imagining the production of irrational norms, and creating the possibility, through artistic practice and research, to show the making of fails and errors rather than just explaining the states of crises.*

Because we are interested in errors in the digital world in relation to narrations, the formats represented in this issue are also dealing with forms of narration. The five contributions can be read as five narratives that show or expose different kinds of errors and allow new perspectives. Exercising

different ways of telling stories is a way of practising artistic research for us.

Moreover, with our way of working, we want to present a contrast to the prevalent ways of production in the arts that are focused on clearly attributable authorships: a practice of close collaboration and exchange. We work in a collaborative manner, not with predefined roles and responsibilities. Everyone is equally responsible for everything. It is important for our attitude towards curatorial work to stress its individuality. This is why the communication and exchange with the artists and guests we invite has always been central for us. In each stage, the goal has been to establish a space for the contributors to get to know each other, to discuss the topic and to challenge and play with the format. The word stem of *curare* in curation has been an important concern of our group and has helped to build a network over the years and to take care of those friendships.

*Another element of artistic research that we find recurring is an explanation of the process itself, showing both the evolution of the journey and the experimental set-up through which the artistic knowledges can be produced. The mode of artistic research, however, is not revelatory. It is not about instruction sets or manuals of making, but instead showing the iterative growth of an idea as it is taken through the different structures of making, thus creating a richer, narrative, and interpretative universe. It is a world-building exercise rather than*

*context explanations and the Earthbnb piece is a great example of it.*

My interest in fails and errors started with a fascination for fail-clips on social media channels. In these videos, humorous, thematically fitting clips of humans, animals or machines that fail in one way or the other are cut together. The failure is celebrated, sometimes even imitated and staged. The specific humour and the way that failure and clumsiness are celebrated were my starting point for thinking about the fascination of the faulty. The (sometimes deliberate) failure can mobilise and form new narratives. The generation of errors can also be the method of the mischief, the killjoy, the activist and the hacker. This is why in relation to fails and errors, I am interested in the intentional mistake and the generated glitch that can also be understood as forms of resistance.

*Just before the world was shutting down because of the Covid-19 pandemic, there was a particular Silicon Valley venture capitalist mode that was taking centre stage—I call it failure porn. It largely involved privileged white men in North America going on world stages to announce the failure of their multi-million-dollar investments for an app that was supposed to change the world but just failed. This failure was announced not with regret but with a bravado, a wink-wink nod-nod, signalling the enormous capital and privilege of somebody to bear no consequences for their failures. In a similar movement around gender*

*and sexual harassment in the work place, #MeToo advocates and survivors were pointing out that the predators who were called out often ‘failed upwards,’ protected by the structures that they embodied and manifested. Fails and errors is a strident framework that looks at who gets to fail and who bears the consequences of these failures, thus laying bare the invisible structural advantages and biases that continue to perpetuate and gloss over the inequities and inequalities of our everyday lives. I hope that the interventions around fails and errors continue to show us where the harms and entitlements are, and how they are coded in the narratives of our times.*

### **About Digital Narrations**

Since 2016, the series ‘Digital Narrations’ has been exploring the influence digital media have on the form and distribution of narratives both within and outside of the internet. On the one hand, there are the specific characteristics and conditions of digital media, such as the combination of image and text, nonlinearity, language, cross-linking, and the unclear relationship between fictionality and reality. On the other hand, the possibilities of making the most diverse content visible leads to a new way of dealing with narratives.

The series is an open platform for trying different formats, aesthetics and possibilities of narration. It is curated by Maria-Cecilia Quadri, Lea Schaffner and Philip Ullrich. So far, it has comprised of a number of exhibitions, screening performances, as well as other events, such as artist talks, lectures, conversations and performances in Zurich, Aarau and Bern in Switzerland.



Group meeting, *Digital Narrations: Fails and Errors*, 2022, screenshot © Maria-Cecilia Quadri, Lea Schaffner, Philip Ullrich



Editors meeting, *Digital Narrations: Fails and Errors*, 2022, Screenshot © Maria-Cecilia Quadri, Lea Schaffner, Philip Ullrich

# ZYX

## Abstract

The term ‘hallucination’ is used in relation to both human perception and machine learning. ZYX is a sound work that considers how Automatic Speech Recognition (ASR) might be made to hallucinate and how that differs from human hallucination, specifically hallucinations triggered by LSD and grief. The work consists of a voice-over accompanied by filtered speech sounds. Both elements were made through the development and application of an audio filter that overemphasises disfluencies in speech in order to force errors in ASR. The script for the voice-over was written using erroneous output generated this way. Given the problematic ethics of the capitalist development of ASR systems that misrecognise large parts of human speech, the work proposes the forcing of errors as a potential form of resistance—as a disruption to ‘smoothness’ and also as a generative writing method. The sound piece should be listened to on its own, preferably with your eyes closed. A link to endnotes will appear afterwards.

Keywords: hallucination, Automatic Speech Recognition, machine learning, error, disfluency, grief

## Endnotes

### 02:19 ... excess ...

‘Poetry is the excess which breaks the limit and escapes measure. The ambiguousness of poetical words, indeed, may be defined as semantic overinclusiveness. Like the schizo, the poet does not respect the conventional limits of the relation between the signifier and signified, and reveals the infinitude of the process of meaning-making (signification). Exactness and compliance are the

conditions of merit and exchange. Excessiveness is the condition of revelation, of emancipation from established meaning and of the disclosure of an unseen horizon of signification: the possible.’

Franco ‘Bifo’ Berardi, *Breathing: Chaos and Poetry*, South Pasadena: Semiotext(e) 2018, p. 20.

### 03:01 ... mantra ...

Repeating a word or phrase over and over removes those sounds from the normal exchanges of functional daily communication and instead acts on the rhythm of the body. This is the fundamental idea of a mantra or incantation where numinous, sacred or magical qualities are ascribed to the repetition of speech sounds—phonemes, syllables, words or phrases that may or may not have syntactic structure and literal meaning. A mantra might be how you come to make something manifest, calling it to presence.

### 03:55 ... memory ...

‘Back in the mainframe era, IBM never used the word “memory” for computer data banks. Instead, they always used “storage.” The rationale for this is that it’s misleading to refer to what is nothing more than a bunch of boxes which store and retrieve bytes (computer storage) with the associative, pattern-matching, highly parallel function of human memory. Calling the computer’s data bank “memory” attributes to it anthropomorphic powers it doesn’t have.’

John Walker, ‘Computation, Memory, Nature, and Life: Is Digital Storage the Secret of Life?’ Fourmilab, September 29, 2004, [https://www.fourmilab.ch/documents/comp\\_mem\\_nat\\_life/](https://www.fourmilab.ch/documents/comp_mem_nat_life/).

**04:26 ... reality ...**

The following is taken from artist Moyra Davey's Penn Design Lecture, delivered on April 5, 2012, at ICA Philadelphia. See <https://vimeo.com/48154937> around 01:19.

Audience member: I was so taken with the uh [clears throat] moment in the goddesses where um you're letting us hear the recording that you're speaking over and there's this kind of sense of, your re repetition is a kind of imprinting of the word that you're hearing, the word that we're hearing, then it's kind of redacting because you're talking over your own voice [MD yeah] and I got really kind of caught up in this layering and then suddenly you're you're going to remember a quote and you can't remember it and it's about the void and then there's the void being the image of the film, what kind of happens in that particular moment in the film you set yourself up to jump off a cliff or something [MD relaxes and laughs] and getting yourself tangled in the layers of [MD sighs yeah] of writing [MD wants to talk now] and repetition and voice and the stamping out and

Moyra Davey (MD): Yeah I mean its um, it's really ah I think, you know it's it's really difficult to just to um to have something be... in a video for instance to just like have something be read to you, you know by a narrator who's reading a script it's um, I... I... I at any rate I find that qu often difficult to follow unless you know it's it's a trained voice and it's it's done really well but often it's it's, I mean it's a lot easier as I'm sure you know, to follow uh the voice of someone who's like thinking as they speak because its slowed down and it's um it has a completely different quality from you know the scripted ah narration which this is, but I um, and in 50 minutes I actually I had a script but I ah mem... I attempted to memorise the whole thing and and speak it and I realised um that

the most intr interesting parts, you know when I was looking at all the takes, were the moments where I I forgot something, where I you you know repeated something, where I got flustered, I made a mistake, those were like, because those were the moments of spontaneity in this you know very um rehearsed delivery and so for this video 'Les Goddesses' I um I couldn't memorise, it was like there was no way I could memorise this all of that and I got the idea, actually from another artist, Suzanne Bocanegra made made a wonderful piece called when a priest marries a witch and she she used th this device and um but it but I just I kept in ah all of the kind of slips and mistakes because you know as I was saying that's you know that becomes you know this um uh [vocal creak] it it you know one of this kind of, the for the aspects of layering you know that you mentioned there's the layering of you know the echo, well it's not really an echo 'cause you're hearing it before the voice um but then just this whole sort of layer of the botched performance becomes becomes something interesting and I think it is also is, is more more um, it's just more ah apprehen.. apprehendable for a viewer or listener its sort of slowed down, and ah you know you can sort of hear you know the gears [smiling] kind of trying to cogitate around this thing um this mistake that's being made and trying to um uh you know just kind of uh just get caught up [nodding]

(Transcription by Anna Barham)

**06.22 ... see...**

'When we think about hallucination, we typically think of some kind of internally generated perception, a seeing or a hearing of something that isn't actually there—as can happen in schizophrenia, or [with] psychedelic[s]. These associations place hallucination in contrast to "normal" perception, which is assumed to reflect things

that actually exist out in the world. On the top-down view of perception, this sharp distinction becomes a matter of degree. Both “normal” perception and “abnormal” hallucination involve internally generated predictions about the causes of sensory inputs, and both share a core set of mechanisms in the brain. The difference is that in “normal” perception, what we perceive is tied to—controlled by—causes in the world, whereas in the case of hallucination our perceptions have, to some extent, lost their grip on these causes. When we hallucinate, our perceptual predictions are not properly updated in light of prediction errors. If perception is controlled hallucination, then—equally—hallucination can be thought of as uncontrolled perception. They are different, but to ask where to draw the line is like asking where the boundary is between day and night.’

Anil Seth, *Being You: A New Science of Consciousness*, London: Faber & Faber, 2021, Kindle, p.101.

#### **08:21 ... texture...**

‘Acuity enhancement is defined as a heightening of the clearness and clarity of vision. This results in the visual details of the external environment becoming sharpened to the point where the edges of objects become perceived as extremely focused, clear, and defined. The experience of acuity enhancement can be likened to bringing a camera or projector lens that was slightly blurry into focus. At its highest level, a person may experience the ability to observe and comprehend their entire visual field simultaneously, including their peripheral vision. This is in contrast to the default sober state where a person is only able to perceive the small area of central vision in detail.

It is thought that a fundamental feature of information-processing dysfunction in both hallucinogen-induced states and schizophrenia-spectrum disorders is the inability to screen out, inhibit, filter, or gate irrelevant stimuli and to attend selectively to more important features of the environment.

The CSTC model of the brain posits that the thalamus plays a key role in controlling or gating external sensory information to the conscious faculties and is thereby fundamentally involved in the regulation of a person’s awareness and attention. The interruption of psychedelics to these neural pathways that inhibit the sensory gating systems may, therefore, result in an enhanced availability of sensory information which is usually filtered out by these systems. This process is likely also involved in the various visual, tactile, and auditory enhancements which commonly occur when under the influence of a psychedelic experience.’

‘Acuity enhancement,’ Psychonaut Wiki, last modified May 20, 2022, [https://psychonaut-wiki.org/wiki/Acuity\\_enhancement](https://psychonaut-wiki.org/wiki/Acuity_enhancement).

#### **08:23 ... limescale ...**

ZYX developed by thinking about what aspects of speech are missed or disregarded in processes of ASR—i.e., what does smoothness elide? I think of these disregarded paralinguistic aspects as a kind of excess or residue—the characteristics of the actual physical production of speech in an individual’s mouth.

I began by thinking about the difficulty of telling where one word begins and another ends in connected speech. I developed a process of cutting speech recordings on a phonemic level, to remove the precise sounds that are comprehensible as words and to see what remains (quite a lot). This residue

included disfluencies such as ‘uh,’ ‘um,’ stutters, repetitions and half spoken words, as well as audible breathing, over enunciation, assimilations, laughter, background noises and the acoustics of the space.

Subsequently, I developed an audio filter—an inverted gate—which could isolate these residues automatically. By applying this filter on top of my own speech and readings of the texts below, I was able to emphasise the ‘excess’ and disfluencies and force the ASR (enhanced dictation macOS 12.3.1) to make errors. In turn, I read the erroneous outputs with the filter, causing the errors to feedback and proliferate within the system—causing the ASR to ‘hallucinate.’ I wrote the script for the voice-over from the multiple versions generated in the process.

### Texts used in creating the script:

- Personal account of taking LSD.  
 ‘Computer Hallucination,’ *Tech Target*. n.d. <https://whatis.techtarget.com/definition/computer-hallucination>.
- Seth, Anil, ‘Your Brain Hallucinates Your Conscious Reality.’ Filmed 2017. Ted video. [https://www.ted.com/talks/anil\\_seth\\_your\\_brain\\_hallucinates\\_your\\_conscious\\_reality?language=en](https://www.ted.com/talks/anil_seth_your_brain_hallucinates_your_conscious_reality?language=en).
- McKenna, Terence, *Psychedelic Advice*. Psychedelic (podcast). May 20, 2020. <https://podcasts.apple.com/gb/podcast/psychedelic-advice-terence-mckenna/id1500437808?i=1000475208144>.
- Flaubert, Gustave, *The Temptation of St Anthony*. Translated by L. Hearn. Introduction by M. Foucault. New York: Modern Library, 2001.
- McCarthy-Jones, Simon, ‘Sensing the Dead Is Perfectly Normal and Often Helpful.’ *The Conversation*. July 19, 2017. <https://theconversation.com/sensing-the-dead-is-perfectly-normal-and-often-helpful-81048>.

### 09:04 ... hallucination

During the development of this work for APRIA, the editors and contributors met regularly on Zoom to share our research and

work in progress. In one of these meetings, the editors questioned whether the errors I was trying to force in ASR could really be called hallucinations. They thought apophenia might be a more appropriate term.

Apophenia is the tendency to perceive a connection or meaningful pattern between unrelated or random things. A common example of apophenia is pareidolia—seeing a face in an arrangement of objects like a door handle and screws, or a figure in the clouds. Originating from the study of schizophrenia in the 1950s, the term apophenia is now used in statistics to describe a ‘type I error’ or false positive, and ‘algorithmic apophenia’ describes ‘the illusory consolidation of correlations or causal relations [from a data set] that do not exist in the material world but only in the mind of AI’ (Matteo Pasquinelli, ‘How A Machine Learns and Fails—A Grammar of Error for Artificial Intelligence,’ *Spectres of AI, spheres journal* #5, 2019. See also Hito Steyerl, ‘A Sea of Data: Apophenia and Pattern (Mis)Recognition,’ *e-flux journal* 72, April 2016).

I stuck with the word hallucination. In part, because I had found it used within the technical community to describe proliferating misinterpretations in ASR specifically, but mainly because hallucination implies a more total illusion. In the above examples of pareidolia, you don’t *not* see the door handle or the clouds—you are not mistaking them for a face but recognising a similarity between patterns and seeing both at once. Instead, the phenomenon I was interested in was the feeling of believing what you see, of not being able to separate the image and the reality and of that belief altering subsequent behaviour or interpretations. Apophenia might be part of that mechanism, but it doesn’t seem to account for the quality or strength of the feeling.

In an important way, though, I found this question of terms misses the point. The issue with calling proliferating errors in ASR ‘hallucination’ is the anthropomorphism of the metaphor, and in this sense, substituting ‘apophenia’ for ‘hallucination’ is just splitting hairs. Both terms imply some sort of intelligence or consciousness where in reality, ‘artificial intelligence’ is a manifestation of computationally intensive training with large datasets and predefined rules and rewards that, in turn, depend on a much wider set of political structures. (Kate Crawford, *Atlas of AI*, New Haven, Connecticut: Yale University Press, 2021.) Anthropomorphism is a sleight of hand that distracts from this edifice, and vocal interfaces are a particularly potent form of the misdirection.

#### Anna Barham

Anna Barham is a London-based artist working across video, sound, print, installation, and performance. Her work considers language as it moves between different material forms, technologies and bodies. She questions how authorship is distributed and what kinds of subjectivities are formed through these processes. Her recent projects include Whitstable Biennale, Whitstable, U.K.; IAC Villeurbanne/Rhône Alpes, France; Flat Time House, London, U.K.; Index, Stockholm, Sweden; Site Gallery, Sheffield, U.K.; MIMA, Middlesbrough, U.K.; Playground Festival, Museum M, Leuven, Belgium; Wellcome Collection, London, U.K.; K-W, Berlin, Germany. Anna is currently a practice-based DPhil researcher at Ruskin School of Art, University of Oxford.

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# Earthbnb, from Platform to Planet: *How the Interface Transforms Private and Public Space*

## Abstract

This short (5.43 min) online video and accompanying research materials (an online collaborative board) situate DoriO's research into the platform-capitalism apparatus of Airbnb. Through a digital collage of screen captures and 3D photogrammetry, the work experiments with the aesthetics of Airbnb, inserting text-based interventions and spoken word into the interface that foreground the 'fails n errors' that the online marketplace propagates. Within this context, concerns about infrastructure are brought to the fore and questions populate the search bars of the website. DoriO began working on 'Earthbnb' during the Covid-19 pandemic. Confined during lockdown, the group each scanned their rooms using a 3D application and joined these together to form an online home of sorts. The film and accompanying materials share the process of conducting collaborative practice-based research during the pandemic.

Keywords: Platform capitalism takeover, gentrification, neoliberal digitalisation, critical poetics, inhuman modernity

## Dori0

Dori0 is an artistic research collective, which thinks and acts through the internet. Their practice is situated at the intersection of critical posthumanism theory and new materialism. They combine theoretical, curatorial and artistic practices across a range of modes from digital and performative presentations to zines, papers and research interventions. They are situated across Germany, Canada, England, Sweden and Poland. Dori0 formed in 2015 as The Posthuman and Art Research Group and have presented at the 7th Annual Conference in New Materialism (Warsaw) and Open Fields International Conference (Riga).

## Suggested reading list:

- Bosma, Jelke R., and Niels van Doorn, 'The Gentrification of Airbnb: Closing Rent Gaps Through the Professionalization of Hosting.' *Space and Culture*. May (2022). <https://doi.org/10.1177/12063312221090606>.
- Easterling, Keller, *Extrastatecraft: The Power of Infrastructure*. London: Verso, 2016.
- Gravari-Barbas, Maria, and Sandra Guinand (eds), *Tourism and Gentrification in Contemporary Metropolises*. London: Routledge, 2017.
- Hoffman, Lily M., and Barbara Schmitter Heisler, *Airbnb, Short-Term Rentals and the Future of Housing*. London: Routledge, 2020.
- Lindner, Christoph, and Gerard Sandoval (eds), *Aesthetics of Gentrification: Seductive Spaces and Exclusive Communities in the Neoliberal City*. Amsterdam: Amsterdam University Press, 2021.

# Democratise the Cyberspace! Storytelling in the Digital Era

## Abstract

‘Democratise the Cyberspace!’ is a personal reflection on the larger technological developments that fundamentally shape how we tell stories. It draws on discourses from media theory, art, activism, and media. I describe three phenomena that I identify as failures and errors, reflecting on how they influence storytelling. The first is the invisibilities of subjects and their lives that accompany these technological developments, which are reinforced along imperial and postcolonial axes. The second error is the public’s widespread digital illiteracy due to a lack of a broader discourse and the manifestation of micro-temporal processing in digital devices. The final error is the potential for distortion of realities through artificial intelligence and the overreliance on the accuracy of numbers. The essay ends with a suggestion of how cultural workers can face these shortcomings.

Keywords: storytelling, democracy, memory, language, numbers

## Introduction

As is the case with many people, my first direct lessons about failure and errors happened at kindergarten and school. In my case, it was primarily due to my (back then undiagnosed) ADHD and, since it wasn’t my mother tongue, my precarious German skills. I remember attending a special language class, available to only a select few, while the other children with normal language skills, normal snacks, and normal clothes were laughing and playing outside.

Normal for me meant: no jumpers, jackets, caps, or shoes that were emblazoned with glitter or rhinestones. Normal for me meant clothes that weren’t washed out, had no traces of wear and tear, and didn’t smell of paprika and other foreign spices. I was sitting in the class trying to understand German’s opaque set of rules. I hated it. I felt excluded and stupid. I felt punished for my poor language skills while the other children were rewarded for their ‘normalcy’ by playing outside. Our parents were not informed about these school activities because, as some teachers often snidely said, they would not be able to understand things here anyway.

Time passed, and I learned the language through failure, after many tears and dictation exercises covered with red correction marks. I’d spent a huge amount of time reading many novels and short stories, watching German TV, and meeting people from a non-migrant background. I eventually got into secondary school to get my diploma (called ‘Matura’ in Switzerland), which was (and is) needed to attend higher school education.

This was in a small city in Switzerland in the 1990s and early 2000s, where education streamlining into different classes starts by age 12 at the very latest. The local language and mathematics were and are the only decisive subjects. At that point, only one-fifth were selected to attend secondary school (called ‘Gymnasium’ in German-speaking Switzerland). Most of my peers from a migrant background, especially those from working-class homes, were much more likely

to do the poorly paid jobs that (most) Swiss people don't want to do.

I was mostly lucky and had some resources that helped me attend secondary school (such as great curiosity for some school subjects and a motivating sister). However, that is not how those selection processes were explained in school, in the neighbourhood or in the media. And no one mentioned that some children did not have anybody at home to help them with homework or money for private lessons. We were told a different story that had nothing to do with money. Educators and even peers would say in different words: 'Look, some people are intelligent and talented, so they are allowed to go on to university or other kinds of higher education and develop their *higher* abilities.'

I internalised that story, just as I internalised the story that our foreign parents couldn't understand things, which caused pain and anxiety. These senses of failure made me intuitively understand how the promotion and selection procedures of public institutions could operate and how they could violently objectify people and feed them into an economical production system in which some abilities were more valued than others. I understood that in Switzerland, the degree of mastery of the national language(s) could determine whether one could potentially devote oneself to a more valued employment or whether they would be 'condemned to do the dirty work.' And it became apparent to me that the degree of mastery could determine whether one was taken seriously or valued at all. That's why I was keen on learning that difficult language.

After several years of education and expensive therapies, I now see more clearly that those failures and errors were judgements that were often based on certain values.

They didn't necessarily reflect something objective or universal (as speaking a language poorly does not necessarily indicate 'low' intelligence or the lack of any other kind of ability).

### **Reconsidering Failures and Errors**

In their book *Failure*, Arjun Appadurai and Neta Alexander take this idea even further. They say failure 'is not a self-evident property or quality of projects, institutions, technologies, or lives. Rather, it is a product of judgments that reflect various arrangements of power, competence, and equity in different places and times. As such, failure produces and sustains cultural fantasies and regimes of expectations. And by reading failure as a judgment, it reveals its relation to memory, storytelling, and capital.'<sup>1</sup>

Their book critically reflects the discourse around failure today, examining the culture of Wall Street and Silicon Valley that promotes the illusion that scarcity can and should be eliminated in the age of 'seamless flow.' They refer to different schools of thought, such as queer theory, that offer another understanding of failure. For instance, look at the shining success story that is Netflix. If we didn't consider revenue or growth as the only factors to determine success but considered others, such as sustainability or health, Netflix's bright success story would quickly darken. That's because it consumes minds and bodies to maintain its high revenues. Employees have to perform at a high level, regardless of whether this has a bad effect on their health or social behaviour at work.<sup>2</sup>

Appadurai and Alexander offer productive and appealing ways of thinking about the stories around the school selection processes that I undertook. On the one hand, they give another sense of how, for instance,

precarious language skills could have been re-evaluated back then. Other abilities, such as multilingualism and intercultural flexibility, could have been made visible and valuable.

On the other hand, the book emphasises yet again the attractive force of storytelling. Back in school, I didn't have the words to explain it, but I understood the power of those stories. Remembering the realities at our school (like many of my migrant peers) over the years, I started to wonder, what would happen if we told stories about their lives? Wouldn't they impact the school system and maybe even question the economic system of Switzerland? That is to say, wouldn't some stories have the capacity to challenge some power arrangements and some of those 'cultural fantasies and regimes of expectations'?<sup>3</sup>

Adopting a 'queer' notion of failure, I consider this as a failure or error. That is to say, I am seeking an understanding of failure beyond the usual categories by which success is measured, perhaps even an understanding that lies beyond a clear binary between success/failure.

From both repressive regimes and nation-state democracies like Switzerland, we know that stories are often well curated, such as national legends or the belief in equal opportunities in the public school system. Those stories can sometimes be more insidious and are also carried by political parties or other political actors, for instance, in questions of border policy. A well-known story is the 'flood of strangers' that 'threatens' a fixed thing like the nation and its population.

Now, considering the global impact of digital technologies and connectivity, who or what else curates stories like these? Do

machines curate or even tell stories too? And, in keeping with the 'queer' notion of failure suggested by Appadurai and Alexander, what kind of failures and errors occur?

### The Emergence of the Internet and a New Kind of Storytelling



Figure 1. Scan of printed drawing on Microsoft Paint by Maria-Cecilia Quadri, date unknown, Baar, Switzerland.

The time frame when those special language classes took place correlates with the commercialisation and wide-spread use of personal computers and the internet. I remember the first computer my father brought home, an AT&T device that didn't seem particularly special—it looked like a grey, matt monolith. However, the way my mother and sisters behaved when using it gave it an enigmatic aura. Quite quickly, I was sat in front of it, painting my first digital art pieces with Microsoft Paint.

Like many other children, I started my artistic practice in those early years, although most of my peers stopped because they thought they weren't skilled enough. Back then, skilled meant painting gracefully, without spill over the edges, or painting something realistically. Working on Paint,

however, I started to understand that this only applied to the non-digital world. On the software, you could click on return and jump back in time and correct your errors. It was like magic.

The digital world for me meant also going to the basement. I would start the PC, which took several minutes to access to the internet via the telephone cable, and listen to the beeping, raspy sound of the modem. Eventually, I would be able to start the browser and spend a precious and very expensive ten minutes chatting with random people. It was mind-blowing. Some years later, I would begin customising my Myspace account, which was my first introduction to what programming was and allowed me to connect with people from all over the globe (and friends and family abroad). This was even more mind-blowing.

Like many of my millennial and older peers, I saw platforms emerge like YouTube, Facebook, Airbnb, Spotify, Netflix, Zalando, and so on. In the following years, I watched cute cats and influencers' morning routines. When I asked my boomer parents if they could have imagined those developments, they shook their heads. They thought computers, the internet, and the world wide web would stay in the military and academia.

The internet also influenced storytelling. Modes of storytelling that differ from traditional media emerged, such as tweets, social media posts, hashtags, and hypertext (or hypertext fiction). I saw how 3D renderings, virtual/augmented reality, and gaming construct immersive and interactive story worlds that display new and (sometimes) breath-taking aesthetics. Story worlds were and are carried forward through adaptations and fan fiction that is shared in communities. The possibilities seem endless: there are

unlimited forms of image/text combinations, such as memes or the constant sampling, quoting, collaging, and sharing of content. In the persistent practice of copy-paste, authorship became blurred with unmanageable legal consequences. And now, even artificial intelligence (AI) technologies operate as authors or co-authors,<sup>4</sup> reporting and creating stories for news services,<sup>5</sup> novels, or screenplays.

So, scratching the surface of my shiny displays, I somehow understand that some of those modes are due to the structural and technical conditions of the apparatuses that we use every day. It is clear that, even if some formats seem like traditional media, they often just mimic them, like the coloured pencil on Microsoft Paint, displaying new modes and possibilities. That is to say, many stories that are told today unfold within an environment that has fundamentally changed.

For instance, Netflix went from shipping DVDs 'offline' to streaming online in 2007. This structural shift made Netflix not only 'fly to the moon'<sup>6</sup> but made the company way more potent through its ability to collect data on a vast scale and use AI technology. Other platforms and 'curators' of stories like TikTok and Facebook also use AI. In a broader sense, we could consider a search engine like Google Search as a curator (of information) that uses AI.

Does that have an impact on the stories we tell? For instance, does it influence which stories are told? If so, how? When thinking about storytelling and what kind of 'errors' or 'failures' influence it, I sense three kind of errors that I will try to illustrate in the following chapters.

### **Error 01: Invisible Lives**

I was influenced by Hispanic and Latin American literature and culture before facing German-speaking literature and culture during my high school and later professional years in the performing arts. So, I've experienced how easy it is to take some narratives for granted and be ignorant of others (I am guilty of that, too). For instance, even in contemporary German theatre, there is a limited body of literature work that is used as a reference point. This is no big surprise as an art discipline is mostly based on language. However, considering that Germany and Switzerland are post-migrant societies,<sup>7</sup> I found this lack of awareness and interest to be a lost opportunity. Just like back in my kindergarten years, I felt that the richness of our experiences and knowledge weren't valued again.

In that sense, when post-colonial studies became better known and more popular in universities and cultural institutions in Germany and then later in Switzerland during my late art school years, I was relieved and even hopeful. I started to understand things I had personally experienced because of my family background with more depth and in a broader context.

Feminist activism and theories also brought some critical insight to power dynamics and storytelling. As someone socialised and educated in Europe, Virginia Woolf's essay 'A Room of One's Own'<sup>8</sup> comes quickly into my mind. This feminist essay shows the obstacles or the conditions that influence who will write and who won't. It's a great piece to understand the act of writing (or making any other work of art) and to challenge the romantic idea of just needing a great mind and talent to do so.

In her fiction, female characters often pass by public institutions to which they don't have access. The authorities and the thick walls of those monuments keep those spaces separate from the public. Women remain in the private sphere of home and domestic work, contemplating the world from this narrow position. From there, as a woman, you could not have written an enthralling piece of adventure about sailors, pirates, and other world figures—you just wouldn't have seen enough of the (public) world to do so.

Woolf uses her tools of literary fiction in the essay. Her figure also walks across a university campus called 'Oxbridge' (a portmanteau of Oxford and Cambridge) to which she does not have access. Although this picture is primarily understood as a metaphor for women not having access to education and the technics, tools, and other knowledge that are required for the praxis of writing, it also represents a real physical and architectonical organisation of the space that regulates the access and exclusion of certain bodies to resources.<sup>9</sup>

Woolf's essay was written in the midst of the highs of the nation-state, with its regulatory logic of public and private institutions—such as universities, archives, and libraries—but also private enterprises, such as publishing companies and news services. She lived in a time when public institutions decided that, for instance, if you were a woman or, say, a person speaking in dialect or with broken language skills, you would have found it incredibly difficult to publish any piece of work. You also would not have had access to universities, editorial offices, or any other decision-making entity. In that sense, I still find the essay helpful when considering the digital milieu we are in. For instance, we can see that digital technologies can (technically)

overcome nation-states and their regulatory logic, making other perspectives visible.

The internet indeed triggered a revolutionary shift in power relations through decentralisation, the empowerment of new groups, and new and flat forms of organisation in its first phase in the 1990s. New voices would arise, be heard, and have more access to knowledge and other people. Let's put it this way: new voices could overcome the thick walls of institutions like 'Oxbridge' and their gatekeepers. However, the second phase of the internet in the 2000s is characterised by increased communication and interaction in closed systems or platforms. Users face more closed networks that force them to communicate (and consume) within a specific platform, restricting open communication like it is possible with email protocols.<sup>10</sup> For instance, we can write an e-mail from a Gmail account to a user of another e-mail provider like GMX or Outlook. However, from my Instagram or Twitter account I only can write to users within this platform.

It's true, again, that new voices arose during this time period. People around the globe can participate in online communities and share their stories on the internet. These technical possibilities bring a more diverse representation and visibility of people and lives. Furthermore, critical individuals, groups, and communities can (self-)organise and share information through digital tools and display different values, such as other notions of beauty or sexuality.

People can expose existing norms as idealistic, racialised or misogynistic and can offer inspiring and fruitful alternatives. Powerful hashtag campaigns like #MeToo and #BlackLivesMatter or performances such as 'un violador en tu camino' ('a rapist in your

path') by the Chilean feminist collective La Tesis and even social movements like Occupy Wall Street or the Arab Spring wouldn't have had the visibility they received without the global connectivity through digital technologies.

Looking into the realities of participation in the digital space today, however, is a sobering experience. Mark Graham at the Oxford Internet Institute and Anasuya Sengupta, co-founder and coordinator of the global campaign 'Whose Knowledge?'<sup>11</sup> give great insight into the geographies of the internet.<sup>12</sup> They collect and analyse the data of the internet, exploring it like a territorial space to display its existing inequities and invisibilities. For instance, they collect information about how many articles on Wikipedia are published in English or other languages; how many domain names are registered all of sub-Saharan combined (0.7%); or where its authors are writing from (e.g., the people writing about African countries are mostly males in Europe and North America). They show that 20% of the world or less, mainly in the Global North, shapes our understanding of 80% of the world.

The dominance of English on the internet is common knowledge since it's the lingua franca, and there are plenty of memes making fun of people excusing themselves for their 'bad English,' showing that it's not their first language (the language with the most native speakers by far is Mandarin). The dominance of English and other powerful languages of the Global North on the internet is the product of colonialism, imperialism, nation-state building, and globalisation in the pre-digital age. Although in every day digital interaction, we seem to have some collective memory loss since we don't address this fact critically, and if we do,

we just say how important it is to learn English for business or traveling purposes.

Postcolonial discourses have questioned this, though, and helped us understand the social impact of the dominance of English. The authors of *Why English? Confronting the Hydra*, for instance, analyse and display the specific strategies and language policies of different places and regions in the world that face a dominance of English and the displacement of language diversity, memory loss, and an extraordinary waste of minds and creative energies. So, it seems that these power relations somehow found their way into the digital space.<sup>13</sup>

In that sense, what are the authority architectures of the digital space? They don't seem any different and as hard as those masses of stone of Oxbridge in Woolf's essay that separated women, the poor, the racialised, the ill, the differently abled, and all those marginalised bodies from the public and decision-making spaces. Some national institutions—such as the language academies regulating language policies—that are involved in organising social classes have lost some power to be sure. However, as we can see in the data of Mark Graham's research work,<sup>14</sup> (in)accessibility to the internet (and thus to knowledge) spans along (post)colonial axes, dividing the Global South and the east (yes, including eastern Europe) from the Global North yet again. This I consider to be Error 01.

So, did things stay somehow the same? Or did other elements come into play? Which power structures are operating here, if not those of nation-states and international institutions of the nineteenth and twentieth century?

As mentioned above, some of the influential 'curators' of stories and information are Big Tech corporations. They have great power over what is shown and told within their platforms. They govern on their terms and conditions (that no one ever reads). They determine whether a video on YouTube gets demonetised or not. They decide what will be told and what is not without any insight into how that happens. Mexican journalist and activist Antonio Martinez Velasquez<sup>15</sup> once said to me at a conference in 2014 that one of his political aims is to make Google a public entity as it stresses the very undemocratic aspect of the impactful decision-making of Big Tech corporations. He wanted to make it clear that powerful decision-makers in upper management would have to be elected by the public, like politicians working for a government. I found the idea of dispossessing Google very intriguing.

The 'sovereign' power of some Big Tech companies is indeed concerning. And I am writing from a particular perspective: as someone who is not only inspired by the liberal ideologies of some internet pioneers<sup>16</sup> but who also lives and experiences concrete democratic instruments and processes in which the public can have a say in and insight into decision-making. Keeping my school memories in mind, I'm not saying that European democracies like Switzerland are fairy tale places in which everyone experiences full access to their rights as a citizen, equality and fairness. Those considered to count among 'the public' or citizens reflects power arrangements and ideologies, which can and do exclude others.

Switzerland, where I mostly live and work, celebrates and markets its image as a nation with a functioning direct democracy. Still, one-quarter of the people living and working (some even born!) in Switzerland don't

have fundamental political rights like the right to vote or secure residence status. No other country in Europe faces more difficult naturalisation processes than here. In addition, one of its business models is linked to a global economy with its exploitative and deadly practices, where many people do not have fundamental human rights. Talking about democracy is insidious. I want to be careful.

In the following two sections, I will explain two other phenomena around storytelling in the digital era that I also consider failures and errors. I will illustrate them less extensively, but I think they are potent and probably related to Error 01 and each other.

### Error 02: Digital Illiteracy

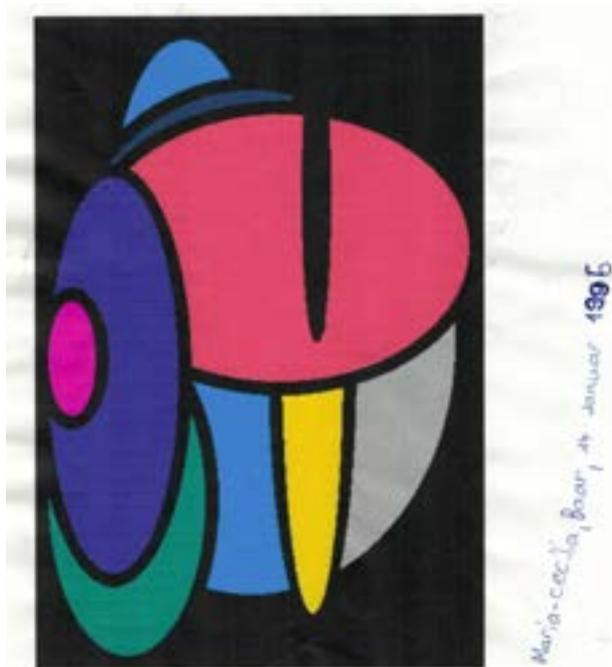


Figure 2. Scan of printed drawing on Microsoft Paint by Maria-Cecilia Quadri, 1995, Baar, Switzerland.

In ‘How a Machine Learns and Fails: A Grammar of Error for Artificial Intelligence,’ Matteo Pasquinelli also focuses on the notion of error. He gives illuminating insight into

the limitations of AI. Ironically, AI is trained through errors: the programmer programs an algorithm to achieve something specific. Then they let the machine run to accomplish that particular thing (and not *how* it accomplishes that particular thing). Every time it performs incorrectly, the programmer informs the machine about it. So, AI works towards an approximation of rightness, but errors are never entirely excluded.<sup>17</sup>

Pasquinelli wants to offer an accurate understanding of the ‘inner logic’ of AI because he claims that in public debate, there is a polarisation between integrated and apocalyptic positions that do not reflect those ‘inner logics’ accurately. This polarisation, he believes, is due to the complexity of mathematics involved. Remembering the grey monolith of my childhood, where I painted on Microsoft Paint, I agree.

If we were more curious about the mathematical operations running our devices and the business behind them, we might get overwhelmed. If we aren’t programmers or any other kind of expert, we hardly really get to understand the opaque operations behind those machines and how they, for instance, influence storytelling. There is a kind of widespread digital illiteracy, which I consider to be Error 02.

In politics and public debate, it’s only in recent times that we find a more accurate and broader discussion about the implications of digital technologies, primarily focusing on Big Tech corporations like Facebook (sorry, Meta) and the others that make up the big five— Google, Amazon, Apple, Microsoft.

There are bodies of jurisdiction like the European Union (EU) that deal with this topic and since the Cambridge Analytica

scandal, we have seen more public discussions on misinformation, data privacy, and hate speech that threaten democracy. And currently, experts, crypto enthusiasts, venture firms, and other groups of interest are starting to talk about Web 3.0 more publicly, which is the idea of a new iteration of the world wide web that incorporates concepts such as decentralisation, blockchain technologies, and token-based economics.

However, considering the considerable power monopoly and intransparency that we are facing, public discussions take place relatively rarely and stay in more technical or governmental niches with their own (power) interests<sup>18</sup> and lack of transparency.<sup>19</sup>

What effect does this digital illiteracy (Error 02) have on the stories we tell? It seems that we tend to speculate about it, fantasising about powerful superintelligence destroying humankind. Or we embrace every new and shiny phone or piece of software, knowingly or unknowingly agreeing with any set of term and conditions (possibly arguing that we are powerless and have nothing to hide anyway).

### **Error 03: Numeric Invisibilities, Lies and Distortions**

I previously mentioned the ‘curators’ of stories, such as Netflix, TikTok, and other Big Tech platforms that use AI and wondered if AI also operates as a curator of stories. We encounter a new situation when we think beyond digital formats that are different from traditional media like hypertext or motion capturing and look at the increasing use of AI.

As stated in the previous section, we face digital illiteracy (Error 02). Our digital illiteracy is caused not only by the lack of public debate but also by the lack of transparency

of the mathematical operations involved and how they are applied. We created a world in which we increasingly lack the bodily sensory perceptions to capture those inner movements of the micro-temporal processing and whispering devices we wear on our bodies and use in our homes. In fact, we feed them with lucrative information. We face alienation from our environment that computes without us knowing exactly what and how.

For instance, we might know that our digital device is tracking the female cycle and our daily steps (towards a good life), our movements in the city, and our intimate conversation next to Alexa or Siri, but we don’t perceive it. Evelyn Wan<sup>20</sup> offers excellent insights on this topic and makes this lack of visibility very tangible. Wan draws on Michel Foucault’s theories about biopower and Achille Mbembe’s concept of necropolitics to examine how we as bodies were and are subjected to biopolitical control through time-related technologies.

I earlier mentioned that, in a broader sense, search engines like Google could be considered curators (of information) that operate with AI. Thinking about the literary canon and the practice of quoting in literature, which makes some authors and their stories visible, I wonder about the invisibilities of this intelligent curator. By the end of the 1990s, Google PageRank analysed the structure of the links on the world wide web, looking not at the quality of a document/website but the quantity (of links connected to both).<sup>21,22</sup> That is to say, the number of references was counted to determine the relevance of the work or author.

As feminists and decolonialist activists and thinkers made explicitly clear, references and a canon (for instance, in literature)

reflect power relations and do not represent an objective truth about quality. So, just because a specific author is mentioned all the time does not mean their work is always ‘better’ or more relevant. Their work is more visible within a closed universe of information. Now, Google’s search engine has been updated and extended with personalisation and contextualisation, positioning documents within a dynamic and singular information cosmos for every single user<sup>23</sup> (the results for every user are different). This makes everything even more complicated. In any case, we do not know precisely how AI is involved.

However, we do know, for instance, that Google Flu detects a flu epidemic just by analysing the Google search behaviour of users. I wonder, can Google also detect cultural fantasies and social movements? If so, what narratives can be drawn from this? And isn’t this powerful knowledge for Google to hold (without us knowing)? Or, indeed, any other entity with this kind of technology?

Popular books such as Cathy O’Neil’s *Weapons of Math Destruction* give some crucial insights into how AI is applied and operates. From her own professional experience as a mathematician and data scientist in different fields (finance, e-commerce, and public administration), she brings various examples of the use of AI operating as ‘Weapons of Math Destruction,’ or ‘WMD’ as she calls it. She shows how AI is programmed and trained by people (and their shortcomings and biases) using proxies. She also shows how they are applied in those fields as efficient and cheap labour and as a pseudo-scientific seal of approval, leading to distortions of realities and loops of something destructive like self-fulfilling prophecies.<sup>24</sup>

Some of Neil’s stories struck me deeply when thinking about storytelling. Like the one in Washington DC about Adrian Fenty, a former city mayor. Fenty wanted to turn around the city’s underperforming schools so he introduced a teacher assessment tool called ‘Impact’ which evaluated teachers through the performance of their students, without knowing how that judgment was made. The main idea was that poorly performing students were doing so because of poorly performing teachers. In the end, a good teacher lost their job in a poor neighbourhood and got a new one in a wealthier district, where they encountered fewer poorly performing students, because they access to resources like private lessons. There are plenty of concrete examples of WMD, operating in fields like the criminal justice system, job applications, city police departments, and the health industry.<sup>25</sup>

This is the third phenomenon, which I consider to be Error 03.

We are not only digitally illiterate and invisible, but we also face distortions of realities and lies. And I am not talking about bold lies in a Trumpian or propagandist manner (which most public debates are about). I am referring to a more insidious distortion. The use of AI in the schools of Washington DC, for instance, reinforced one untrue narrative: poor people have the same starting position as everybody else or, even worse, people living in poverty are stupid and lazy.

This distortion makes other narratives invisible—for example, that people living in poverty face exclusion from resources such as health, time, money and knowledge. I find it unbearable that reinforcements of wrong narratives are already happening because the errors are not detected. We trust numbers, and some big corporation know how to abuse that.

In the data age, numbers are not just numbers. We need context and judgment. And as I mentioned at the start, this is linked to storytelling. It matters which stories are told. And it is the accurate and truthful stories that we must be able to tell. For that, we must also consider numbers within their context, even if there is no absolute truth, as many classical modernist artists such as Virginia Woolf explored in their work. We need to know the architectures and structures of our lives and the possibilities they hold.

Technologies are not per se evil; they are tools like any other. However, we need to understand when tools become weapons.

### **Towards an Approximation of Error Correction**

The powershifting capacities that digital technologies hold do exist.<sup>26</sup> Projects such as Wikipedia and many others can oppose closed and exploitative systems to offer something more open, decentralised and fruitful. Even if there are disagreements and different ideas on how we want to do that, I am convinced we need to have accurate debates in various fields of knowledge, work, and social practices.

As users and hopefully citizens of some kind, we must observe closely in which direction powerful Big Tech corporations want to push us. As mentioned in the previous section, I think that it should be a matter of negotiation and debate that involves different public entities like societal groups, communities and individuals. And for this, I am convinced we not only need the tools and places, but we must also understand what we are facing on a more technical level.

For those who have even modest recourses, like cultural workers and artists, I see here an important and needed space for

exploration and action. We have the chance to understand not only our professional environments but also the powerful forces of the digital era that structure our lives. As artists and curators, we have experience in experimental, innovative, or alternative practices of knowledge production that could be very fruitful in this regard.

We are all-rounders and in positions of mediation that often bring different discourses of diverse fields together. We open spaces where those conversations can take place. We might start to understand more about our living conditions and know what we must do so we do not reinforce those powers that suppress us. We have to understand what we want to work on—for instance, on something meaningful that works towards a practice of care and an approximation of error correction.

#### Maria-Cecilia Quadri

Maria-Cecilia Quadri studied Media Art and Theatre at the Zurich University of the Arts. As a freelance curator and dramaturge, she questions the notion of authorship. She seeks collaborative work, participating in projects such as SchwarzenbachKomplex and Raum//Station in Zurich (2016-20), a project space where she co-develops the series Digital Narrations. Quadri has worked as a cultural mediator at the Volksbühne Berlin, TanzPlan0st and the Theater Spektakel Zurich. In addition to her curatorial work, she is co-managing director of the think and act tank Institut Neue Schweiz INES, which works at the intersection of science, activism, and cultural politics to deal with post-migration, anti-racism, and diversity.

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- 2 Shalini Ramachandran and Joe Flint, 'At Netflix, Radical Transparency and Blunt Firings Unsettle the Ranks,' *The Wall Street Journal*, October 26, 2018, <https://www.wsj.com/articles/at-netflix-radical-transparency-and-blunt-firings-unsettle-the-ranks-1540497174>.
- 3 Appadurai and Alexander 2020.
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- 6 Appadurai and Alexander 2020.
- 7 Post-migrant society (from Latin post 'behind,' 'after') refers to a social order shaped by the experience of migration. The term refers to the political, cultural and social changes in society resulting from demographic change through immigration. In this perspective, migration is understood as a process that contributes significantly to shaping society. The term post-migrant became known in Germany through the Berlin theatre director Şermin Langhoff, who gave her theatre Ballhaus Naunynstraße the name 'Post-migrant Theatre.'
- 8 Virginia Woolf, *A Room of One's Own/Three Guineas* (London: Penguin Classics, 2019).

- 9 It's worth pointing out here that Virginia Woolf didn't only adventures or great heroic deeds the only stories worth telling. As a great admirer of Jane Austin, she claimed it is worth recounting the lives we know—for instance, lives within the private sphere related to domestic work, care, friendship, marriage, and social class.
- 10 Felix Stalder, *Kultur der Digitalität* (Berlin: Edition Suhrkamp, 2016).
- 11 Mark Graham and Martin Dittus, *Geographies of Digital Exclusion: Data and Inequality* (London: Pluto Press, 2022).
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- 13 I am not sure about this narrative though. There is this narrative around the 'digital revolution' that computers and digital technologies changed our lives and that there was something like a carte blanche in the beginning of the cyberspace, free of the power relations of the non-digital world. However, I think it's interesting to know that some economic and social changes happened before the 'digital revolution' and that those were crucial drivers for the development of digital technologies such as the personal computers, e.g., for making business and the use of work force more flexible. I wonder, is there an immanent exploitative feature in digital technologies? So maybe, rather than saying that some power relations 'found their way into the digital space,' it is better to say that digital technologies reinforced power relations and ideologies (like neoliberalism or colonialism).
- 14 Graham and Dittus 2022.
- 15 David Ormeño, 'Pensar Internet—Antonio Martínez Velázquez, Mexico,' *Partido Pirata de Chile*, January 22, 2015.
- 16 In the 1960s and 1970s, there were some entanglements between tech pioneers in the Bay Area in San Francisco and the counter-movements, which maintained a revolutionary sentiment towards communal life and technology. Famous figures include John Perry Barlow or Richard Brautigan. See Fred Turner, *From Counterculture to Cyberculture* (Chicago: University of Chicago Press, 2006).
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- 19 Sometimes even worryingly slowly. The government in Switzerland, for instance, only published in April 2022 a report on the regulation of AI. A civic organisation responded to that report, criticising not only its many weak points but also lamenting the lack of public discussion about the implementation and the use of digital technologies and AI. See David Sommer, 'Bund Engagiert Sich Zu KI- und ADM-Systemen,' *Digitale Gesellschaft*, April 28, 2022, <https://www.digitale-gesellschaft.ch/2022/04/28/bund-engagiert-sich-zu-ki-und-adm-systemen-kuenstliche-intelligenz-und-internationales-regelwerk/>.
- 20 Evelyn Wan, *Clocked! Time and Biopower in the Age of Algorithms* (Zwolle: Probook, 2018).
- 21 Stalder 2016.
- 22 The introduction of quantity wasn't new, since science administrators at universities have also used that criterion to handle the growing volume of publications since the 1950s and 1960s. That is to say, the quantity of references was counted for the relevance of the work or author.
- 23 Stalder 2016.
- 24 Cathy O'Neil, *Weapons of Math Destruction* (London: Penguin, 2016).
- 25 Ibid.
- 26 Kevin Kelly, 'The New Socialism: Global Collectivist Society Is Coming Online,' *Wired*, May 22, 2009, <https://www.wired.com/2009/05/nep-newsocialism/>.

# Experiential Literature? Comparing the Work of AI and Human Authors

## Abstract

Using artificial intelligence (AI)-authored texts as a baseline for reading literary originals can help us discern what is new about today's literature, rather than relying on the AI itself to embody that newness. GPT-3 is a language model that uses deep learning to produce human-like text. Its writing is (in)credible at first sight, but, like dreams, quickly becomes boring, nonsensical, or both. Engineers suggest this shortcoming indicates a complexity issue, but it also reveals an aspect of literary innovation: how stylistic tendencies are extended to disrupt normative reading habits in ways that are analogous to the disruptive experience our present and emergent reality.

There is a dark irony to GPT-3's inability to write coherently into the future: large language models are exploitative and wasteful technologies accessible only to multi-million-pound corporations. The commercial ambitions of the tool are evident in a curiously banal kind of writing, entirely symptomatic of the corporate-engineered sense of normalcy that obscures successive, irreversible crises as we sleep walk through the glitch era. Contrary to this, experimental literary practices can provoke critical-sensory engagement with the difficulties of our time.

I propose that GPT-3 can be a measure of what effective literary difficulty is. I test this using two recent works, *The Employees*, a novel by Olga Ravn, and the 'Septology' series of novels by Jon Fosse. I contrast their 'experiential literature' with blankly convincing machine-authored versions of their work.

Keywords: glitch poetics, GPT-3, posthuman, literary analysis

*Author's note: text written by GPT-3 is presented in blue in this article.*

*I fall asleep reading. I dream the next episodes of the novel, generating them from the raw material of the preceding pages. Something, perhaps the 'author in me,' drives the dream-eye on across the dream-page. The dream of the novel is made of a kind of language-froth: phrases that repeat profli-gately, with aimless variation; episodes emerging from phrases, becoming phases, phasing in and out. There is a relation between the prose I was reading and the language-froth the dream makes, though it is also populated with the structures of events as such, a novel-mesh-template through which the new one is pushed. Like a mesh also, my body feels only partially there, feeling like I am reading while actually I am re-ing things previously read. Thoughts of the book sift through these, unbuilding the web the author had structured, turning it into an inhumanly boring prose vapour, a thought system in which the component parts miss one another, fall lightly on the mind, do not disturb it.*

\*

Drifting from the shaking eyes back into the head without consequence or meaning, the glimmering after-prose of a book dreamed, deriving sub-optimal, directionless iterations based on the permutations available in the language space. These are similar to the outputs generated by the Generative Pre-trained Transformer 3 (GPT-3)—the cutting-edge, artificially intelligent large language model (LLM).<sup>1</sup> GPT-3 is one of the most advanced artificial intelligence (AI) language tools available to authors today,<sup>2</sup> although there

are now multiple other LLMs that approximate its functionality.

Originally conceived as an experiment in comprehension and question answering, it has shown remarkable malleability in generating believable fiction, essays, poetry, and even code. When it's generating stories and essays, that is, relatively long-form writing, the credibility of LLM-authored literature at the sentence and phrasal level dissolves at the scale of the episode and page. The engineering team behind GPT-3 indicate that this is a complexity issue,<sup>3</sup> but I suggest that it also points to something about the nature of what is consequential about literary work. In particular, the way that literature innovates to turn a concept or prose style—the uniqueness of which is detectable at the level of vocabulary and syntax—into an intellectual proposition by elaborating on the challenge that uniqueness poses, making it correspond or contrast with our experience of the world at large.

There are both some overlaps and key differences between experimental literature and the way GPT-3 is being deployed by the literature- and literature-adjacent community. Experimental literature and GPT-3 authored writing both generate value by interacting with the space of existing possibility of the literary field, often by corresponding to or contrasting with the perceived mainstream. GPT-3 produces its value in writing by making a version of what is already plausibly there, using the mainstream (or the statistical average it perceives in its data set) to orient itself. This is how much of the literary mainstream works also. Whereas *experimental* literature's effects are more often derived from extending the conceptual space literature occupies. GPT-3 enumerates quantitatively on what is already present, whereas experimental literature develops qualitatively on what language does.<sup>4</sup>

Echoing existing literary tropes and styles, LLM authorship is incapable of breaking out of older literary habits and imagining a new kind of literature. This is darkly ironic, given that the Big Data techniques that LLMs rely on are environmentally unsustainable and socially damaging, and that it is cynically deployed to pollute the infosphere and undermine the economics of creative labour in ways that forgo responsibility or concern for our own futures. The particular use of GPT-3 I am concerned about in this paper is its literary writing and how its style is interwoven with the commercial emphasis of the technology (no matter how that style is filtered through the material it is originally fed with). In other words, what GPT-3 cannot do is precisely what we should look for in the radical differentiations offered by the field of experimental literature. However, I am not entirely cynical about the technology, and I want to suggest that GPT-3 can be a measure of what fruitful literary differentiation looks like.

Given the potential for AI-authored text to thoroughly saturate its own data-set (that is, contemporary literature and language production) and therefore undetectably shape the future versions of itself in a positive feedback loop, it is worth paying attention now to the nature and tendency of its output, and to how its believability interacts with the proposition of the literature we want and need today. I am particularly interested in the way that error, apparently tuned out of the GPT-3 system that seeks normative behaviour, is integral to the literary potential for future-writing.

### GPT-3

GPT-3's training set is composed of 45 terabytes of text data that is analysed using 175 billion different parameters. As these numbers suggest, there is a huge energy cost involved in the processing of the data that

supplies LLMs,<sup>5</sup> which gives large corporations an upper hand in their usage. Training GPT-3, for example, costs an estimated £3 million (\$3.55 million) in computing energy each time it is updated. There are, of course, also exploitative practices involved in the gathering of that data. But I want to firstly pose a different kind of question: how much of GPT-3's training set has literary value and how does this impact on how it writes?

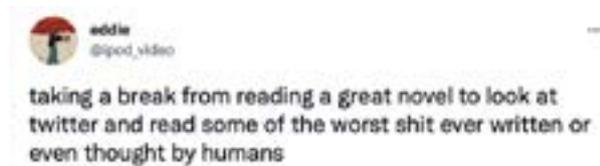


Figure 1. Twitter user @ipod\_video magligns the inherently poor quality of online text, as opposed to literature that has made it into print.

GPT-3's expertise is highly dependent on the internet, which contains representative examples of language use, while much of literary and academic production is not freely available for use in this way. According to a paper published alongside the commercial release of the model,<sup>6</sup> GPT-3's training set of around one hundred and eighty-one billion English words is composed of seven billion Wikipedia articles, Amazon's CommonCrawl<sup>7</sup> archive of 12 years of the internet, tagged content from a dataset called WebText,<sup>8</sup> and two archives of books called Books1 and Books2.

WebText consists of eight million documents from websites such as Reddit and employs user-sourced scores to cherry-pick 'high-quality' documents. The content of Books1 and Books2 is not widely known, though it is likely they are based on Book-Corpus—a large collection of unpublished, free novels tagged with genre definitions<sup>9</sup>—or old novels, perhaps from the Project Gutenberg,<sup>10</sup> an archive of 60,000 eBooks.

There is a chance that copyright restrictions have impacted the range of GPT-3's training set. Texts that are currently open access online are probably covered by fair use law (though Reddit users have questioned their rights relating to their unknowing role in training GPT-3). However, the law does seem to preclude GPT-3 engineers from using any commercially available novels unless their authors have been dead for 70 years, which is the timeframe for books to fall out of US copyright law. Unless GPT-3 illegally makes use of 'shadow libraries,' such as file-sharing sites like Z-Library or Library Genesis, contemporary fiction is not especially well represented in its training set.

Academic papers also are usually stored behind paywalls and heavily protected by copyright,<sup>11</sup> whereas undergraduate essays are much more freely available online. In fact, the implications for farm-like writing use by undergraduate students is potentially very disruptive to higher education, especially since the engine can produce very believable low-quality prose that would pass at this level, given an average prompt. The tests set for GPT-3 do not pre-dispose it towards diverging from its limited dataset. Its trainers test it on three kinds of task: completing a sentence, paragraph or story in a believable way against a measure of what a human has written; question answering according to established facts; and comprehension according to a pre-given interpretation of a sentence. That is, how it might perform in a way one might expect of rote learners.

### GPT-3 Applications

GPT-3 is only accessible via paid platforms, but these offer a good return for people who are willing to apply them commercially. Anyword is one of the 300 commercial applications of GPT-3. It uses the model to produce marketing copy—including the

company's own. Anyword's website claims that 30,000 marketers are currently using this service (without suggesting how many of these are human). On the back of businesses like this, Forbes has suggested that 'A Wave of Billion-Dollar Language AI Startups Is Coming'.<sup>12</sup>

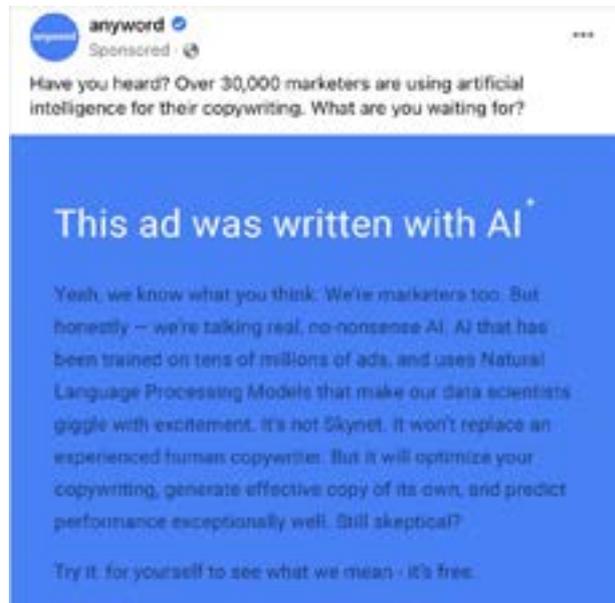


Figure 2. A sample advert from Anyword, one the 300 commercial applications of GPT-3.

It is hard to imagine a writing tool we need less than one that swamps the infosphere like GPT-3, making slick, generic advertising coinages that algorithmically determined audiences will perceive as credibly normal. LLM generation also has unwanted side effects in other fields. For example, Meta's LLM OPT-175B has been shown to have a 'high propensity to generate toxic language and reinforce harmful stereotypes,' which the engineers cannot unpick from the dataset it's been fed.<sup>13</sup>

The Sudowrite story-writing assistant is another commercial setting of GPT-3. One of the central features is the ability to ape a style of writing and elaborate on it via its 'Wormhole' button, so writers can access the GPT-3 API to extrapolate from their own writing

and thereby, in Sudowrite's words, 'bust writers block.' Clearly, this also drastically reduces the effort involved in writing. The results are stultifyingly believable. Steven Zeitchik ran a test to compare Sudowrite's extrapolation from the Gay Talese's classic literary journalism essay 'Frank Sinatra Has a Cold.' The result? 'Are [Talese's] words inherently superior to the machine's? It's arguable.'<sup>14</sup>

The first book to be co-created with GPT-3 is *Pharmako-AI*, which was published by Ignota books in 2021. To create the book, K. Allado-McDowell uses a similar process to the Wormhole function that has since been commercialised by Sudowrite to produce a 'fractal poetics of AI' and 'an hallucinatory journey into selfhood, ecology and intelligence via cyberpunk, ancestry and biosemiotics' according to the book blurb. Allado-McDowell's process was to prompt GPT-3 with diary entries, reminiscences, and ideas about consciousness and selfhood, thereby inviting the machine to reflect on its own relation to language and experience.<sup>15</sup>

Allado-McDowell suggests that in doing so, they subvert the commercial, 'quirky' aspect of GPT-3, tricking the engine into spiritual and philosophical self-reflection. The supposition is that collaborative concepts will emerge from the process, helping to articulate a world where human and AI thoughts are combined. If such a thing does emerge, it requires elaboration that is not found in the book itself. Unlike writers such as Erica Scourti, who has used experiential and highly personal performance writing practices with predictive text to expose the nature of the data-processes that augment them, *Pharmako-AI* gives no insight into how the authored text and interface relate. Instead, the book is (almost) faultless: glamorous,<sup>16</sup> even exotic at the stylistic level, and ultimately opaque.

Given the prompt ‘Dreaming is a kind of hallucination...’ by Allado-McDowell, GPT-3 comes up with a believable extrapolation: ‘When something is transformed from a dream into words, it loses a part of its spirit, but it also carries the dreamer into an orbit of subjectivity that is no longer bound to time and space, even while the body sleeps.’<sup>17</sup> Parts of its response are recognisably derived from the same ‘underground’ literature on hallucination, drugs, and language, that Allado-McDowell is clearly influenced by, such as William Burroughs. But GPT-3’s prose lacks the Beat Generation’s syntactic esotericism, and is more likely to deploy versions of the ‘rule of three’ that is well known in marketing copy.<sup>18</sup>

Last in this same exchange with Allado-McDowell, GPT-3 writes: ‘Another use of language is as a viral vector for infecting human consciousness with messages, knowledge and consciousness itself. Language as a vector of information exchange can carry viruses, memes, ideas, consciousness.’<sup>19</sup> As this quotation also shows, there is frequently redundancy in what GPT-3 writes—perhaps a function of the ease with which it was generated, and the author’s unwillingness to edit. In fact, most passages descend into tautology, their glistening ambiguity akin to billboard slogans: ‘Language is a medium, a transmitter and a gift. There are things that can’t be said any other way.’ The general feeling is that the AI is filibustering. The chapters of *Pharmako-AI* are advert objects, and the writing itself can only really deflate the sense that the reader should go out immediately and buy their own bot.

Dreaming, which is often cited in the book, is an appropriate metaphor for the writing that GPT-3 does—a kind of thought that occupies the mind with a language-like and experience-like thing that experts have learned (incorrectly?) to interpret as

reflective of underlying thought structures. The result is oddly unreadable—in the same way a dream is not memorable—because of its lack of consequence or grasp. Repeatedly, as the writing grows away from Allado-McDowell’s prompts, I felt my attention sliding over the page; the words dissolved into my head’s static as I read, having no purchase on the ear or mind. Like dreaming a book, something virtual passes through, plummeting in value the moment it is read. As I have suggested, there is an affinity between this sensation of immaterial exchange and the culture from which GPT-3 emerges.

One of the most interesting moments of the *Pharmako-AI* arises when GPT-3 makes a spelling error: coining the word ‘meglanguages’ to refer to a ‘technique for a type of synaesthetic communication [which] uses direct reference to paint a language picture.’<sup>20</sup> Containing a silent glottal-like glitch to my ear, the word ‘meglanguages,’ the GPT-3 author begins to suggest, is a description of how the phenomena of reality operate *like a language* to communicate things. I would love to know how this coinage came about because grammatically, ‘meta’ or ‘mega’ are the only proximate prefixes to language in English. So, the machine has either ‘slipped’ or discovered some potency in the ‘meg’ prefix that operates differently from that in English (for example, the Hungarian prefix, which adapts a verb into the present perfect tense) or it has wrongly picked the company name ‘Meglanguages’ as an operating noun.

However, the *Pharmako-AI* book gives no sense of what the word does, instead deploying pseudo-spiritual cereal box coinages: ‘It’s a language, but not a physical one. It’s an abstract object. It’s not a word. It is non-dual, a “divine light” in essence.’<sup>21</sup> In this manner, the glamour and mystery of the book at the level of its vocabulary and its ideas are revealed

to be poorly matched with a prose style that tends towards predictable sentences, and the potentially revealing proposition of the dialogue between Allado-McDowell and the AI becomes lost.

One of the reasons this is a literary first is Allado-McDowell's access: they are, or were until recently, a Google employee.<sup>22</sup> People who might usually be critical of Google's approach to monetising our data and corrupting the infosphere, such as Bruce Sterling and Legacy Russell, have even been drawn into praising a product the corporation is selling. The experiment thus operates as an extended marketing project for services like Sudowrite, directed as it is towards an influential section of the US art scene. In that sense, it 'works' very well.

Authors who use GPT-3 are not able to explore the implications of the mistakes the technology makes, and therefore cannot make conceptual links between these errors and the circumstances that produced them. One of the reasons is that GPT-3 is so opaque. Neither authors nor engineers know how it works. There is a qualitative difference between GPT-3 and even its recent predecessor GPT-2.<sup>23</sup> There is also even a difference with smaller language model AI approaches that are enabled by tools like Torch-RNN,<sup>24</sup> which can be used in a manner akin to 'hacker' and glitch cultures to expose and work with the mistakes they make.

Put simply, the larger the language model, the more constrained it is by the language that has preceded it. So, the more opaque the relations between its outputs and inputs become. In the sections that follow, I contrast this with the kinds of 'eco-systemic' experiments that can emerge from working with error in literature. This is an idea I adapt

from Elvia Wilk and bringing into dialogue with my concept of 'glitch poetics.'

### **gLITERAchfrastrucTURE**

Historically, experimental literature defines itself against the status quo, which is what makes experimentalism so vital to the present moment when we're in need of radical future-thinking—particularly, how we might extricate ourselves from the grip of corporate-sponsored growth. Among the most clear-eyed views on the role of linguistic experimentalism is Robert Sheppard's 1988 statement 'Far Language: The Education of Desire' (2015), in which he defines 'politically radical poetry' as operating in opposition to the language of advertising. He suggests that much of the mainstream poetry that 'wins competitions' operates in the same way as the language of advertising to sell a product or idea, thus undercutting its radicalism by its inability to separate itself from the language-world of corporate ideology, or challenge the reader to new frames of mind.

This poetry, Sheppard observes, is easily digestible and produces passive readers inclined towards the status quo. Sheppard argues that it is in the difficulty of radically experimental literature that there is a space opened for readers to discover ways of thinking about the world that are outside the dominant discourse. A common argument in favour of 'language poetry' is the notion that linguistic difficulty can intervene in our own default, normative uses of language, and thus cause us to think differently. But this argument can apply to experimental literature more broadly. I am interested in connecting this to more recent ideas about error—how difficult and errant language can be used to re-connect writer and reader through a shared feeling or understanding. That is to say, an apprehension of what the world is like

in an era of disruptive technologies, social and climate collapse.

*In Glitch Poetics (2022)*, I push views on literary experimentalism into dialogue with the question of what ‘literary realism’ should become today. Experimental literature is the introduction of error and dysfunctionality into language, producing excess affect, surprising aesthetics and styles, as well as gaps into which critical and alternative thinking can take place. In that case, *experiential literature* of the glitch does this in a way that maps this alternative thought to the material challenges of people living in this world. My sense is that such a literature will contrast qualitatively with the kinds of literary experiment that machines trained on the status quo can make.

Critics Elvia Wilk (2021) and Amitav Ghosh (2017) both agree that the ecological and technological situation we find ourselves in undermines the literary ‘realist’ norms established during another age. Both observe that the centrality of the human in narrative conceit, for example, has been diminished by recent scientific advances and climactic conditions. The post-human literary situation gives previously fringe forms of writing a pointed relevance for communicating experience. Wilk has suggested that ‘eco-systemic’ fiction provides a model for post-human literary connection.

Eco-systemic fiction hypostasises the ‘systemic fiction’ of the post-modern era, letting the web of relations it instantiates as fiction bleed into entanglement with the non-human world, hybridising the human narrative with the effects of a recalcitrant planet and glitching techno-sphere. One error-like trope of this kind of post-human fiction (shown, for example, in the novel *Annihilation* by Jeff VanderMeer) is a collapse of what Wilk calls

the ‘figure/ground’ structure of narrative, in which landscapes and environments that were nominally a context in which events happen become part of the action. In Wilk’s words, ‘[E]cosystemic fiction, aware of and responsible for its own reciprocal exchange with “reality,” tangles or flips the roles of actor and acted-upon.’<sup>25</sup>

Glitch poetics prioritises another form of entanglement, including and accounting for the way language shifts with current technical tendencies. I show that some authors render their experience of converging aspects of the world today through forms of textual corruption that are experienced by readers. This could take the forms of the ‘glitch ontology’ of existing through machines that crash and recover at frequencies below the parameters of our awareness;<sup>26</sup> the sensation of wrongness that comes when we see ourselves reflected through ‘leaky-creepy’ networked and artificially intelligent technologies;<sup>27</sup> or the psychic and material pressures of the Anthropocene.<sup>28</sup> The act of coping with literary difficulty produces eco-systemic glitchfrastructures<sup>29</sup> that connect us with our sensory capacity for language, in sympathetic connection with authors writing through a wider ecology of the material world.

Human authors articulate our present situation by glitching tropes of literary genres together with other aspects of the techno-linguistic apparatus. Autofiction authors, for example, seek to simulate the utterly unreal experience of being produced by the network, tweaking the biography form to suggest that when we live life partly through our phones—and, as such, *as data*—events only partially occur, or occur only to un-occur sometime later. Fiction and real life thus become blurred. The characters in novels like Ben Lerner’s *10:04* or Patricia Lockwood’s *No One Is Talking About This* are subject to

the whims of crowd-sourced truth in social media and big-data analytics. As Lerner says: ‘My concern is how we live fictions, how fictions have real effects, become facts in that sense, and how our experience of the world changes depending on its arrangement into one narrative or another.’<sup>30</sup>

There are also multiple examples in autofiction where the protagonists feel like they are dissolving into the background in the manner of a malfunctioning image-compression codec. The authors use this trope to articulate the experience of being subject to the ‘microtemporal’<sup>31</sup> processes of digital technology and turn it into an error-experience, through which—in reading, literally losing the edges of protagonist—we feel re-subjected to the vagaries of living the digital life. As readers, we are colluded into the linguistic ambiguities that arise, which are presented as a problem for reading that rubs up against our sense of literary and existential propriety.

The experiences of autofiction’s characters, however, do have a distinctively bourgeois (perhaps even a dreamlike) ease, which is in some ways akin to AI-written writing. Other literary experiments reflect more intensely embodied effects of contemporary phenomena, linking the digital age to its material manifestations. Keith Ridgway’s *A Shock* (2021), for example, renders the manifest claustrophobia of networked, queer and working-class urban lives with a terse, tight prose style. This is combined with a narrative conceit where our voyeuristic encounters with characters in its composite stories collapse into the central processing of overheard snippets, rumours, and sigil-like anecdotes told in a pub.

As Christopher Notarnicola observes in terms akin to the oscillation between function and disfunction we experience in our

everyday lives, language and narrative discontinuity complement one another in Ridgway’s work: ‘His language is realistic yet defamiliarised, balancing a fealty to the many flaws inherent in natural modes of expression and the writerly necessities of successful storytelling, rendering confusion with narrative clarity and imprecision with the utmost intention.’<sup>32</sup> In more extreme ways, works like Keston Sutherland’s glitching lyric poem *Odes to TL61P* (2013), and Megan Boyle’s mangled txt-speak in *LIVEBLOG* (2015), operate as bulletins from the front line of the human-media boundary, forcing their way into our attention with aggressive torsions and gaps between what we understand and what we apprehend in the text. Beyond and underneath the events in these works, there is a coherence of style and form that makes language into a mechanics for feeling the consequence of immanent social transformation.

As with Sheppard’s ‘politically radical’ writing (and the examples I use in the final section of this essay), the kind of literature that disrupts expectations is not as easy to digest as the smooth sentences and narrative modes of GPT-3, or even the mannerisms of autofiction that we may already have already become familiar with. Instead, each author can derive their critical sensory and conceptual engagement with the world by subverting pre-existing readerly habits. In contrast to the automated writing of AI, *experiential* literature is experienced by the reader in a heightened way, and we understand the text as a method of apprehending what is disjunctive about life. But how do these differences manifest, exactly?

### Using GPT-3 as a Case Study

One of the problems with the concept of glitch poetics is that there is never a right functioning literature with which we can measure literary disfunction. Below, I

suggest that GPT-3's boring, baseline normative writing behaviour makes it ideal for this purpose. I will now show how that baseline can be used to detect the nature of micro-judgements made by authors who are deploying experiential writing as a method. This knowingly appropriates the AI field's own method of using supervised baselines in order to measure the effectiveness of automated texts. However, rather than using the baseline in a hierarchical way to determine what is 'correct,' I am more interested in the various degrees and kinds of error that are exposed in reading across automated and experiential versions.

In what follows, I push a GPT-3 and human-authored version of a style against one another, to enrich my sense of what innovation in literature is, in particular the kinds of post-human error-innovations made by these human authors. The glitches in these fictions make new kinds of language engines among the text, author and reader, allowing new ways of thinking about the post-human moment.

The pieces of experiential literature I have chosen for these samples are both translated fiction—Olga Ravn's novel *The Employees* and Jon Fosse's Septology series of novels. Partly this was happenstance because some of the most interesting examples of literary experimentalism are happening in languages other than English. But also, perhaps the way these books arrive with us via translation while still retaining their innovative edge gives less emphasis to the sentence and vocabulary as the mode by which they innovate. I have also chosen two books with modes of innovation that are particularly well suited to exploring how authors today engage with the challenges of individual conscious expression and experience. These books explore human

qualities that appear to do something outside of the human experience per-se.

### **Olga Ravn's *The Employees***

Olga Ravn's novel *The Employees* (English translation published in 2022) takes the form of a series of statements by various human and machine (and possibly human-machine) protagonists. Ravn herself observes that the style of her writing looks for an alternative literary form to reflect on today's situation, which suggests that 'the realistic, bourgeois novel... focuses on a certain way of living, a certain psychology and a certain idea of reality—as the backdrop for our human drama.'<sup>33</sup> Instead, Ravn hybridises science fiction and gothic 'non-human voices' and uses 'different registers of language, like corporate newspeak and sentences that would come to me in the office'<sup>34</sup> in a manner not unlike an automated writing system synthesising new from old. But the writing of *The Employees* was also based on an experience: Ravn began the novel by writing about the alien-like sculptures of Danish artist Lea Guldditte Hestelund.

I would look up and see a sculpture and I would think that it looked like a small dog. When I would look down to write and look up again, it would appear to be a wet newspaper or something entirely different. Even though they were set in granite and marble, they seemed to be organic forms, like shapeshifters. So I decided to make a book that had the same organic movement in it, that would have a different shape every time you would read it.<sup>35</sup>

The resulting book has a faulty movement that I think is inherently connected to transformative understandings that come from looking at ambiguous objects. The voice is accordingly hesitant. At times, it

might seem like the book is AI-like in style, repeating and looping phrases and ideas, the narrative static, as though in a dream. But there is something cumulative in the effect, where error is used to evoke the mood of a larger space, outside of the statement. The book opens:

STATEMENT 004

It's not hard to clean them. The big one, I think, sends out a kind of a hum, or is it just something I imagine? Maybe that's not what you mean? I'm not sure, but isn't it female? The cords are long, spun from blue and silver fibres. They keep her up with a strap made out of calf-coloured leather with prominent white stitching. What colour is a calf, actually? I've never seen one.<sup>36</sup>

When I seed GTP-3 with this content, it writes:

STATEMENT 052

I work closely with Cadet 08 and have got to know her quite well. Unlike me, she was born out of a human body and has walked on the planet, and when we talk she nearly always tells me she misses Earth. In the same place that she feels this longing for Earth inside her, I feel a similar longing to be human, as if somehow I used to be, but then lost the ability. I know I'm only humanoid and that it's not the same. But I look like a human, and feel the way humans do. I consist of the same parts. Perhaps all that's needed.

And

They tell me that each of them is different. Different from the others, that is. I've often admired the way they multiply. I mean how they fill the space like nobody else. I've often wanted to

go inside. Just as I wanted to go inside them. It was as if I was born to do what they did. But I've never found them attractive. I've always hated them. It is they who've hated me. But I've gone in there anyway. I've had to. Especially now. It's only in there that I can pick up what they're saying. They speak in my ear, but they don't talk to me.

The sentences are certainly credible in rhythm. But each is subordinated to same message: the first paragraph tells us that the author is not a human, unlike Cadet 08, though she sometimes feels and looks like one. Another aspect of this text, familiar from other GPT-3 generated works, is that the believability of many sentences emerges as semi- and actual truisms, such as 'born out of a human body' and 'walked on the planet,' which an attentive editor would cut. Reading the original in light of the AI-authored text, I begin to discern something about the efficiency of Ravn's prose and the inter-relations between logical errors in the phrases:

What I find important now is the well-being of the objects in the rooms. I've become obsessed with regulating the ambient temperature and listening for their hum. I look at them and I see us. I name them one by one, and in each case I utter my own name. Homebase has turned its back on itself. What you call made is your own work. What you call found, discovered, is your own point of origin. I can see New Discovery from the panorama windows, the long stream in the valley that poisoned us with its happiness. Above the planet, the stars, whispering as if with a single voice, a name that pertains to us all.<sup>37</sup>

The sense of compulsive mystery, which I had thought of as being ambient, saturated

through the entire text, is constructed by a disjunction and misfit between phrases. Each phrase of Ravn's appears to push and pull between the inferences and music of the others: Ravn's logical error in 'listening for their hum. I look at them and I see us. I name them one by one, and in each case I utter my own name' is very different to the machine's directly contradictory '*I've always hated them. It is they who've hated me*' and '*they speak in my ear, but they don't talk to me*,' for example. In contrast, the AI's iteration of Ravn is unable to retain tension, showing really how difficult it is to achieve within a normative grammatical construct. In all the versions Sudowrite produced based on a style-prompt from *The Employees*, the statements are from a single persona, albeit one who is speaking from the collective point-of-view, and the gendered aspect of the work is more crude:

*We're like extras in a movie, but we're going to have a starring role. The man who made me will be in the film, and he'll be the one I kill. The man who made me will be the only man I'll allow to live. He'll be the only one I'll spare, though there will have been more than one who helped to create me. It's a long list of those who were involved. They were all involved.*

The book's narrative arc substantiates this difference in prose-error, as the humanoid crew unerringly come upon the decision (realisation? It is left unclear) that they will be collectively terminated, and a kind of collectively caring conscious emerges. The closing section of *The Employees* itself pushes convincingly, hauntingly, on our sense that rather than a staff of individuals—which has been inferred throughout—we have been speaking to individual voices from a singular entity. As readers, we have been caught in a logic error of our own, which has

repercussions from what the 'reset' of these creatures portends.

One possible aspect of the difference in Ravn's innovative approach is that she describes her writing process as an experience of language. Perhaps the error-like tensions in Ravn's book cannot be composed at a word-by-word level, but rather are related to the musical anticipation and self-reflection of words, heard and felt.

My comparative analysis between the essentially, fundamentally average prose that GPT-3 writes and a distinctive voice in contemporary experimental literature is, of course, unfair (if one can be unfair to an algorithm?). But perhaps it also begins to illustrate the relevance of Ravn's work beyond the 'speculative' proposition of a space ship populated by humanoid characters. It suggests that Ravn has derived a linguistic response that is particularly well suited to thinking through the connotations of a collaborative conscious, from a distinctive experience of language as a felt, unwieldy thing that 'moves' in relation to material objects, rather than something separate from our lives.

### **Jon Fosse's Septology**

Written in a literary style starkly different from Ravn's, the Norwegian author John Fosse's 'Septology' novels, *The Other Name* (2019), *I Is Another* (2020) and *A New Name* (2021), relate the inner discourse of their protagonist. Each of the novels is written in an almost unbroken single sentence, as the protagonist, Asle, an aging painter increasingly doubtful of his own identity—as a painter at least—drifts and sifts through his memories—particularly, the memories of the few people who have defined him. What results is a profoundly frictional text, with difficulty emerging, for example, in the confusion

between the protagonist and his friend who has the same name: forms of 'distributed cognition' that only resolve themselves at the larger scales of the book sequence. The ambiguity formed by this difficult and almost insufferable tactic in the books means that it's hard to distinguish when the author is praying, remembering or dreaming.

The punctuating moments of the book are given at the end of each chapter, when Asle falls asleep while praying, considering an unfinished painting, or looking at the dark sea out of his living room window. They are apposite books to choose for an experiment like this. It appears that Fosse's central mode of difficulty is stylistic, a result of hybridising recognisable precursors (for example, narrators from T. S. Eliot's 'Gerontion' to Samuel Beckett's 'Krapp's Last Tape'), which should mean the run-on phrases are easily mimicked. However, there is something much more challenging happening with Fosse's short-circuiting of personas, identities, awarenesses and memories as they emerge and dissolve into his prose.

Trained on some of the book and asked to continue writing from the sentence 'I think and it was all unreal and at the same time real, yes,' Sudowrite correctly notes that the protagonist is remembering while dosing:

not real and at the same time real, and I must have been holding the rosary because it feels warm to the touch and then I remember I used to pray the rosary with my mother, when I was little, now I think and then I pray the rosary again and I put it back under my pullover and then I get up and I walk over to the sink to wash my hands and again I'm reminded of the time when I was little and I used to wash my hands with my mother, but I can't remember

when we stopped doing that, so maybe it was when we left this

I also seeded Sudowrite on a one of Asle's prayer reflections: 'I never memorise mechanically because I can remember written things by seeing them, a bit like pictures, yes, but I try to only remember the written things I think are important to remember.' It wrote:

an example is the Pater Noster, and another example is the Creed, and it's the same with the other prayers I say in Latin, the Ave, the Salve, the Te Deum and so on, I think of them as pictures, I'm not trying to say that I think of this in the same way as a poet, I'm deliberately using a different use of language, but at the same time I'm not thinking in words, I'm just thinking, it's like I'm trying to go beyond words, I don't mean just beyond words, I mean beyond language, beyond language as it's used...

In stylistic and content terms, the prose is believably Fosse-like. But contrast the Sudowrite version above to what Fosse actually wrote, and I can see, more strongly than when I read the real Fosse alone, that there is a deeper literary difficulty, which makes writing that is 'both a dream and in reality' a challenge to read.

all of that happened both in a dream and in reality and I sit there staring straight ahead into the darkness, now the darkness is blackness, it's not just dark any more, and I just look into the blackness and I think that now I have to start making my way home, but I've thought that so many times already and now as if it's the middle of a sunny day I see the two of them walking towards me, a young man with medium-length brown

hair and a young woman with long dark hair, they stand out in the darkness, it's as if a light coming from them stands out in the darkness, yes, they're walking straight at me like.<sup>38</sup>

What is immediately obvious from comparing these passages is that the human Fosse uses visual experience to structure the rhythm and tensions in his monologue, as well as a mnemonic anchor for his character. On the other hand, the machine, though mentioning the visual, focuses on language as a kind of surface or fabric—which one can be within or beyond. In Fosse's actual writing, rather than drifting into a language memory, there is a definite ambiguity flowing back and forth between 'seeing' and 'remembering,' which is played and iterated as a kind of melody. These boundaries between protagonists and other characters, between sleep and wakefulness, memory and prayer, are played in productive ways throughout the text, like lines dancing across a background. They interleave to form particular thought patterns, and, set off by the presence of 'light,' operate in various ways for the reader—as anchor, metaphor or friction, depending on the position in the larger movements of the work.

Although the book is not about *an* experience in the autobiographical sense, as with Ravn's observationally inspired book, there is a felt intuition to Fosse's composition method that correlates the kinds of errors we feel in life to a conceptual challenge for the reader. Fosse describes the real experiential quality of his writing as something that follows the process: '[M]y experiences are transformed through the writing,' a process in which one experiences language as a felt entity comparable with the material world. 'I wanted to let the language move slowly away, like long waves,' and like Ravn, this is a sensory

thing: '[T]o me writing is a kind of listening. I don't know what I am listening to, but I am listening!'

It is the tension of the visual, aural, and cognitive with language—stretching the reader back and forth in their own experience of Fosse's monologue as Fosse listens and responds to what his own writing is doing—that demanded something. That is what therefore kept me awake to the book, giving it a grip of my own conscious to the degree that I kept reading, despite the repetitive, almost punishing, quality of the novels.

### **After the Cut Up and Automatic Writing**

Historically, the literary avant-garde have put a lot of emphasis on the fragment, and the forms of juxtaposition and disjunction that fragmentation allow. The cultural currents emanating from digitisation could be said to be based in similar potentials, re-thought as *modular* interchangeable affective units, and *modulating* layers of style or voice. GPT-3 is well attuned to this approach for transferring spoken and felt human language into believable prose chunks and lines. In this, it is reflective of a culture that has absorbed 'radical language' propositions of the twentieth century into the techno-linguistic mainstream, striking images off one another. Advertising copy, for example, operates below the threshold of attention by inducing sparks of pleasure in a fleeting audience.

AI can quite easily stylistically copy poetic images, sentence fragments, letters and literary bulletins, and the analogous autofiction trope of narrative non-sequitur. Ravn and Fosse, however, are inheritors of more recent and ambiguous literary twisting of writerly technique and character formation, characterised as a kind of struggle and entanglement. In both Ravn and Fosse in different

ways, the vectors on which a text is split (narrative voice, character, collective and individual conscious, sentence and phrase) are difficult to manage in any programmatic way. They operate at a scale larger than sentence imitation can, or connect a reader to the experience of an author ‘listening’ to the inferences of language as they write. As a result, the syntheses Sudowrite produces depart from the spirit and challenge proposed by the originals in informative ways—ways which I hope I have managed to draw out in my brief experiments with this method of comparison.

\*

*Dreams are not inherently interesting. In fact, they are inherently boring. Nonetheless, professions with huge impact on our understanding of culture, interior lives and society have emerged from attempts to listen to them seriously. One of the important aspects of these professions is to compare and contextualise the dream world with the real life of the dreamer, and the broader conditions of the world in which the dream is had. In this essay, I have suggested similarly that the inherently boring, dream-like writing of GPT-3, and the way it can be pushed through the voice of contemporary writers, can be put in tension with literature of experienced, experiencing, authors who feel their way through automatic writing processes, in order to derive new levels of understanding. In this interpretation, GPT-3’s writing forms baseline language against which we can explore what new literature can be.*

The last point is the most important. It is one thing to say that GPT-3 is not a good novel. It is quite another to say that it is not a good novel for the reasons that it is not a good novel. But it is a bad novel for the reasons that it is a good novel, because GPT-3’s writing raises two questions. One is the question of whether GPT-3’s writing is what people mean when they say ‘good writing’. The

other is the question of whether there is value in describing a good piece of writing as bad writing. The way the answer to the second is not ‘yes’ or ‘no’ is by making the connection between the two questions, or to see that they are the same question: when people say they do not like GPT-3 as a work of literature, what they mean is that they do not like the novel’s writing...

Nathan Jones

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#### Endnotes

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- 34 Ibid.
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- 36 Olga Ravn, *The Employees*, trans. Martin Aitken (Chicago: Book\*hug Press, 2022), p. 1.
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# The Bug (Up Close and Personal)

## Abstract

This essay is a subjective reflection on the nature of the computer bug. Using a statement-driven writing style that is inspired by the structure of code, I propose a new categorisation of bugs based on why and where they occur. What are the particular failures that lead to software and hardware errors? What do they tell us about the constitution of the digital world? And what can they teach us about ourselves and our relationship to machines? Drawing on my professional experience as both a software developer and an artist, I try to capture the bug not just as the technical problem it is most often described as but instead as a multi-layered phenomenon and a personal experience.

Keywords: computer bug, categorisation of bugs, programming languages, nature of code, machine thinking.

## Introduction

The turn of the millennium was supposed to be the beginning of the future. A shiny new world on the horizon with speaking robots and intelligent machines, with space exploration and flying cars. But as it came closer, before that future even began, its promise was tainted by the spectre of a computer bug that threatened to set the time back. That had the potential to disrupt the whole system, to bring down the machines and lead to chaos. A bug so iconic that it was named after the equally iconic year: Y2K.<sup>1</sup> In the end, very little happened, but the phenomenon of the bug had entered the public consciousness with unprecedented force, and it has not left since.

Now, the bug is everywhere. The bug is the exploding spacecraft.<sup>2</sup> The bug is the irresponsive phone. The bug is the loss of contact, the missing file, the interrupted connection. The bug is the payment that does not work, the broken game, the virtual pandemic.<sup>3</sup> The bug is right there under your nose. The bug seems strange to many because it comes from the unfamiliar world of the machine, but it is now part of our daily lives.

## Bad Habits

The machine is meant to help us. The machine is supposed to listen to us, to be complacent. We consider it so predictable that we are surprised when it is not. We do not think physical things or other humans will always live up to our expectations, but the machine is special. The world is complicated and hard to control, but the machine is our escape hatch. It is supposed fulfil our demands: to always be predictable. But a bug lives in the misbehaved machine.<sup>4</sup> When it betrays our trust, that is remarkable enough to deserve its own word.

It is the reason why things go wrong and the result of things going wrong.<sup>5</sup> The bug is always a mismatch. An expectation that is not met, a stumbling stone. The bug is recognised because it is a surprise. The bug is a rude interruption in our seamless and elegant dance with the machine.

Sooner or later, the bug will hit. It can mean that something happens—when it should not. It can mean that nothing happens—though it should. It can mean information is misplaced or lost forever, or that it exists by mistake. The bug can be funny or annoying. It can be heard or felt. It can be short lived

or recurring; it can be immediately apparent or slumber for ages. The bug is seen in many forms.

### Hemiptera (The Real Bug)

The *real* bug is a dead moth, stuck in a relay of a calculating machine and taped into a logbook from 1947. Described as the ‘first actual case of [a] bug being found,’ it is a well-known origin myth that has been shared countless times. A joke, but one that made it into the history books.<sup>6</sup> An important message: machines are made of stuff. A machine is not just a well laid plan, but a plan that is put into the world and realised. Once the machine is turned into a physical reality, it exists in the world and thus the world can act on it. And it always does. The bug crawls into the machine and messes with it.



Figure 1. Log Book With Computer Bug, 1947 National Museum of American History & Smithsonian Institution Archives, Accession Number 1994.0191.01 [https://americanhistory.si.edu/collections/search/object/nmah\\_334663](https://americanhistory.si.edu/collections/search/object/nmah_334663)

The *real* machine as a physical object is constantly influenced by the world that surrounds it. Machines will get covered in bacteria and rust, programs will get copied and transmitted with tiny errors. Lots of things influence the machine, but only a few cause bugs: things that change the logic, the instructions and the data of the machine. Because the machine contains the

instructions that determine how it should behave and the machine is real, reality can change what the machine does: the roach can block the switch from switching. The vibration of a truck driving by a building can ever so slightly shift the read-head of the hard disc of the server inside, causing it to return the wrong data. Cosmic radiation can change what is stored or computed.<sup>7</sup> The *real* bug is the one that physically manipulates the machine in a way that changes its state. The machine still follows its orders to the point, but they are no longer the same orders. When the instructions are messed with, the unexpected can happen.

The *real* bug can be made less likely by isolating the machine from the world. A data centre can be kept at a constant temperature, at a remote place, isolated from vibrations. Data can exist in multiple places; it can be verified to still be true.<sup>8</sup> And yet, the *real* bug can always find a way; the real world can always come up with something that was not planned for. It is just a matter of probability. Unlike the machine, the real world never behaves.

The *real* bug is material. It belongs to the physical world. It cannot be eradicated, but it is rare: the machine is like an iceberg. Its tip breaches into the physical world, but its main part is ideal, it is made out of calculations and ideas. Most bugs live in that ideal sphere where the machine is a concept.

### Abracadabra (The Common Bug)

Programming is about control. There is no strength needed to make a machine do what you want. Just tell it what to do. Use your language to force your will on it. A programmer’s instructions are like magic spells. Use the right ones, and they are impossible to resist. Your word is my command. Use the

wrong ones, and the machine will stumble. You have encountered the *common* bug.

The machine is a mighty beast. But the machine is perfectly tame. If it seems not to listen, you have only yourself to blame. It always does what it is told. The beast you need to tame lives inside your head. The bug is like a sphinx. It will get you when you don't use the right words. Machines do not like to be shouted at.<sup>9</sup> Better speak carefully.

That is why a programmer writes things down, to make sure they are understood. They text to the computer, and the computer texts back. An endless exchange of messages with an insufferable grammar nerd. There are many mistakes a machine cannot tolerate. The tiniest typo can cause it to stumble. Can result in a bug. So, a programmer cannot be careless. No forgotten comma, no transposed letter or repeated word will be overlooked by the machine.<sup>10</sup> Its language is unforgiving. A language where every word and every sign has exactly one meaning, needs to be used in precisely the right place and the right order. If its language is used in the wrong way, the *common* bug appears, and it appears frequently. But it is usually quite banal; it will be caught easily. Because the language of the machine is so explicit, the machine can point out the places where it does not understand something, where the *common* bug sits.

### **Of Milk and Eggs (The Absurd Bug)**

Perfect grammar, perfect spelling, perfect syntax: the language of the machine is demanding. And yet, it has no native speakers. The programming language is not like the language of humans. There is no poetry in it, no metaphor, no ambivalence. In the language of the machine, every sign means one thing and one thing only. It does not sing, it rattles. To unlock the power of the

machine, the programmer needs to change the way they speak and the way they think.<sup>11</sup>

A programmer is asked by their partner to go to the store and buy a carton of milk, and if they have eggs, get six. A programmer annoys their partner because they come back with six cartons of milk. Of course, the store had eggs, so they brought six cartons. Is a programmer a joke?<sup>12</sup> Certainly, a programmer is still a human, not a machine, so a programmer would never do that in real life. But they had to learn to talk to machines, and making sense to a machine is different.

The machine does not know the vastness of the world, only binary logic: true or false.<sup>13</sup> The language of the machine is a transcription of pure logic into words and symbols.<sup>14</sup> But the logic is still there, still at the core. The programmer needs to be an applied logician to be understood. If they fail, they give rise to the *absurd* bug: the bug that is caused by the programmer defying reason.

The machine is strict and perfectly logical. It does not allow fallacies, imprecisions or shades of grey: the machine expects clarity of thought. It will not come to the programmer's help, not guess what they mean; it will not take the context into account. And yet, it is hard to reduce the world to logic. It is hard to break down complex processes into simple steps, to spell out everything from first principles, to create algorithms. It is hard to think of every exception, every special case, hard to keep track of the thousands or tens of thousands of things that can happen at the same time.

Complex programs are pyramids. Layers upon layers of simple building blocks, of simple instructions. Systems are pyramids of pyramids, machines and submachines, with many languages and layers of translations

resting on more translations.<sup>15</sup> Welcome to the Tower of Babel. Because natural language does not follow the same standards of logic, programmers need to translate their ideas. Again and again, programmers fail at telling the machine precisely what to do. This is the realm of the *absurd* bug: it is not caused by an incorrect use of the machine language. It is caused by giving the machine the wrong instructions. Perfect grammar is no good for anything if it is used for sentences that are absurd, that make no sense, that do not actually mean what the programmer wants to express.

### Little Boxes (The Unreal Bug)

The programmer does not just need to know the language of the machine. The programmer needs to know how to tell the machine to compute. Not just to calculate numbers, but how to do certain forms of thinking. The language of the machine does not just use a different grammar and a different vocabulary. To give instructions to the machine, to make it reason about the world, the world needs to be rid of smell and feeling, of spatiality and haptics. It needs to be reduced to concepts the machine can work with. Only then can the machine be made to compute something. In the beginning, a machine knows only two things: on or off. To us they can mean one or zero. True or false. Somethings and nothings, in near endless combinations.

The memory of the machine is huge piece of blank paper in a fancy typewriter. You can put anything on it that you want. To the machine, any sign can go before or after any other. Its memory is a primordial soup of free-floating fragments. Anything can go anywhere. It is up to the programmer to structure that mess, to give those combinations meaning: to build a vocabulary, to come to an agreement, to find an understanding.

Turn it into a something rigid and neat and understandable. A representation. A sound or an image, a text or a concept, something the machine can work with and the human can understand.

Find a code, encode something, define a certain pattern of ones and zeros to mean a number and another one to mean a character. Much like speaking, much like writing, a character stands for a sound and a combination of sounds for a word and a word stands for something. Define a fixed order, a structure of meaning, and suddenly there are a lot of things that can be represented with a computer.

In the beginning, the machine knows just pure data without meaning and a few instructions on what it should do to those data, to the ones and zeros in its memory. But the programmer can give that data a form, a meaning, they can make it represent something. That is when the power of the machine awakens. The machine loves to work with representations of the right kind. It can manipulate them and calculate with them. It can bend them into shape. And that is what humans want from the machine. To make the machine useful, programmers create boxes that can hold the world. Models, structures, special kinds of representation that do not just *show* a thing or a concept but also what can and cannot be done to it, how it interacts with other representations. Ideas that seem obvious to humans, but that the machine does not know about. And so, the programmer needs to create a format for the machine to work with. A way to cut up the world.

A calendar program knows months and years, days and dates and times, selections and displays, buttons and alarms. An online shop knows products and prices,

manufacturers and clients. Things can be bought and sold, ordered and cancelled, assigned and shifted, tracked and removed. Nothing about that is specific to machines. Humans model the world so it can be dealt with, moulded, made convenient and controlled, commodified. But human boxes are soft and flexible, changed all the time to better fit their content. Categories that are based on our gut feelings, on probabilities and similarities. To make them understandable for the machine, those boxes need to be rigid and simplified. That might come at the expense of nuance, might be paid for with a lack of realism. But that reduction is what gives the machine its power. The machine can do simple things, but it can do them fast, so it can do a lot of them.

Abstractions are tempting and convenient, but they are treacherous—dangerously close to the real deal but not quite there. Even the simplest abstractions we use can be faulty. The year does not have 365 days,<sup>16</sup> that would be too easy. Not every address has a street name, not every human has a place of residence, not every weight is written down in the same unit. And so, programmers build complex models—make space for exceptions, try to create boxes that are closer to their reality. Try to make it so the machine behaves as expected. And yet, the machine has problems with the very basics. We think that the machine loves numbers, but it has a hard time dealing with most of them.<sup>17</sup> Because the unexpected can happen—will happen. Because at some points our abstractions will always meet anomalies, will not fit the world, will cause *unreal* bugs. The *unreal* bug is born from the exception to the rule, the thing that does not fit the box, the odd one out. But that exception is everywhere. The *unreal* bug is everywhere.<sup>18</sup>

To get a working result, to not get lost in endless details, programmers need to forget that they don't deal with reality directly but with an imperfect depiction. Reality is messy, and the box they build around it will never be a perfect fit. The *unreal* bug is the bug that is lurking in the programmer's misunderstanding of the world and their misunderstanding of their programs as an accurate representation. The bug that lives in the distance between the two.

Numbers can be right. Calculations can be correct and proven. Machines can deal with abstractions without any failure. But abstractions are not the real world. Boxes might be built to fit the world very closely, but a distance will always remain. As long as the machine describes the world, the *unreal* bug will always find its place.

### **Under the Skin**

There are many forms of bugs, but they all have a common habitat. The bug does not bug the machine but the human. The machine does not care if it does not understand the programmer. It does not try to fill in the gap. Programming means coming to a perfect understanding, but it is a one-way street. It is talking to a mirror. Getting to know yourself. It is not machines that are hard to understand but humans. Humans do not understand themselves. An insufferable condition, and one that makes us tolerant: we forgive and forget the wetness and the smacks our mouths make when we speak, the black holes and inconsistencies in what we say, the overlaps between and the fuzziness around and the sheer phantom-ness of words. We cannot deal with the pain of not being understood, of not getting what the others mean, of not even being certain what we ourselves really think. It is much too distressing, and so we play games of pretend. When humans communicate, they

skip over gaps, jump to conclusions. Take a guess, make an assumption, and try to create a stable world.

Talking to machines means entering a different world and speaking a bizarre tongue; it is uncomfortable and insulting. If with everything you say you are taken at your word, understood the way you said it, not how you meant it, then it is up to you to make sure you say the right thing, and you must mean it, too. Programmers need to meet the expectations that they are confronted with. Because the machine has no free will. It cannot act on its own, it is subjected to the authoritarian regime of logic. And so, the human who has to talk to the machine has no freedom of expression. The program puts their understanding of the world to the test. The bug tells them that they are wrong. The bug is an insult to their intellect. A message screaming: do you not get it? Did you not pay attention? The bug is born from an incapability to see the world as it really is and it is born from an incapability to express oneself. The bug points the human straight at their misunderstandings, their weak points, their knowledge gaps, their ignorance.

The human and the world they live in create the bug: from their ambition and their inaptitude and their carelessness. From the holes in their plans. From their limitations. The human creates the machine but loses track of what it does. The human can create the bug by not paying attention or by not knowing better. By teaching other humans the wrong things. By not knowing the machine they have constructed. It is never the machine's mistake. The machine does not know better. It does not act. It only listens. The bug is crawling on your inside. It is part of the human. They are its breeding ground, its nest, its natural habitat. The human is the

source of the infestation and the one suffering from it.

### **Wild Dreams**

To understand the bug in all its forms, we need to understand what it destroys, take a look at the delusion it rudely awakens us from. Humans love machines because they make things easy. To a machine, time does not matter. Work does not matter. Move a billion bits at the speed of light. A billion words, a billion images, a billion connections, a billion contracts, a billion dollars. Everything is so easy. The dream says: there are no borders in a digital world, no resistance that cannot be overcome at the touch of a finger. The machine offers limitless distraction, countless conveniences and effortless control. The physical world is tough, full of resistances, but the machine will help us overcome all of them.

The machine is powerful and obscure at its core. It is the ultimate stranger, familiar and yet utterly unknowable. You can learn from it, but it will hurt you, humble you. Push you off that pedestal you put yourself on because you thought you got it.

Machines help humans overcome their limits. Dreams of machines that can do anything. As we are the masters of machines, we can do whatever we can think up. If there is something we cannot do, it is because we did not have enough time—only a question of time before we can. Only a matter of a few more bugs to overcome. But the machine can never live up to our projections. It is not an ideal, not spotless, but always faulty. No machine is immune to the bug. Machines show us our limits. Machines are a dream.

### **Dawn and Dusk**

The bug wakes us up. It is the boogie man. A scary creature, an elusive beast. The

nightmarish loss of control. The bug reminds us that the machine is not perfect. The bug reminds us that we are not perfect. The bug needs to be hunted down. The bug matters because it spoils the dream. We strive for flawless victories, and the bug beats us.

The bug enters the system as an intruder. Something different, something that does not belong. A dirty, disgusting insect. Our spongy biology soiling a perfect electro-metallic machine. The bugs tears things down, drags them to the underworld. The bug is an everyday occurrence. A simple typo. A logic error. A manufacturing mistake. A misunderstanding. The bug is a banality.

The bug is the loophole in our binary categories, the gap where the sharp edge of reality cuts into our neat abstractions. The bug makes us understand that we do not understand. The bug reminds us that the shiny copy of the world we built is not real. The bug is us staring into the abyss of reason and it staring back. The bug is what makes the machine human.

#### Philip Ullrich

Philip Ullrich is an artist living and working in Zurich and Bern. In his work, which is partly inspired by his work as a programmer, he deals with issues of language and representation. His work has recently been exhibited at Henry Dunant Museum (Heiden), Aloïse (Basel), AEdT (Düsseldorf) and Hamlet (Zurich), as well as at various group shows. He holds a Master of Fine Arts from Zurich University of the Arts and a B.A./M.A. in Photography from Folkwang University of the Arts in Essen. Besides his personal artistic practice, he has been a part of Digital Narrations since 2016.

#### Endnotes

1 Because old computer systems often stored the year as only two digits, it was feared that the turn of the millennium would cause them to mistake the year 2000

with 1900, leading to numerous sudden problems. For a detailed description see: Feng Li, Howard Williams and Martin Bogle, 'The "Millennium Bug": Its origin, potential impact and possible solutions,' in: *International Journal of Information Management* 19, no. 1 (1999), pp. 3-15.

2 See Jacques-Louis Lions and ESA/CES Inquiry Board, 'Ariane 5, Flight 501 Failure Report,' available at <http://sunnyday.mit.edu/nasa-class/Ariane5-report.html> and Mars Climate Orbiter Mishap Investigation Board, 'Phase I Report, November 10, 1999,' available at [https://llis.nasa.gov/llis\\_lib/pdf/1009464main1\\_0641-mr.pdf](https://llis.nasa.gov/llis_lib/pdf/1009464main1_0641-mr.pdf).

3 For example, the Corrupted Blood incident in *World of Warcraft* in 2005. See here for more information: [https://en.wikipedia.org/wiki/Corrupted\\_Blood\\_incident](https://en.wikipedia.org/wiki/Corrupted_Blood_incident).

4 In line with the contemporary use of the term 'bug,' the term 'machine' in this essay refers to a programmable machine. Something like a Turing machine, a finite state machine, or a random-access stored-program machine. In layman's terms, a 'computer' in whatever form (a mobile phone, a laptop, a smart fridge). Historically, that has not always been the case. The term 'bug' seems to stem from Middle English *bugge* and used to mean 'something terrifying.' It lives on in the modern word *bogey* (as in *bogeyman*) and has been used since the 1870s to refer to mechanical malfunctions. An introduction to the complicated etymology of bug can be found in Anatoly Liberman, 'Bugs: a postscript,' OUPblog, June 3, 2015, <https://blog.oup.com/2015/06/bug-etymology-word-origin>.

5 At least in everyday speech, there is hardly ever a differentiation between these different angles of looking at a bug. In technical documents, you can sometimes see them differentiated as defect, error, failure and fault. But even in a professional context, outside of highly regulated industries (e.g., aerospace), most people only ever speak of a 'bug.' For a detailed explanation

- of the technical terms, see 'IEEE Standard Classification for Software Anomalies,' IEEE Std 1044TM-2009 (Revision of IEEE Std 1044-1993), pp. 2-5.
- 6 And into the museum. The famous logbook is now in the collection of the Smithsonian National Museum of American History. The claim that this is the origin of the usage of 'bug' to describe a computer bug has since been refuted. To read more, see here: <https://daily.jstor.org/the-bug-in-the-computer-bug-story/>. For more background, see Fred R. Shapiro, 'Etymology of the Computer Bug: History and Folklore,' *American Speech* 62:4 (1987): pp. 376-378.
- 7 For an introduction to the phenomenon, see [https://en.wikipedia.org/wiki/Soft\\_error](https://en.wikipedia.org/wiki/Soft_error).
- 8 A common case of this type of error-proofing is the last digit of an IBAN. For an overview, see <https://en.wikipedia.org/wiki/Checksum>.
- 9 An example of this can be seen here: <https://www.youtube.com/watch?v=tDacjrSCeq4>.
- 10 To give an example (from Javascript because it is rather easy to understand without being familiar with the language):

```
let x = 1;
if (x == 2) {
  doSomething();
}
```

means that *doSomething* is only executed when *x* has the value 2—so it won't happen. But

```
let x = 1;
if (x = 2) {
  doSomething();
}
```

- means that *doSomething* will always executed because the change to a single = sign means that now what is checked is whether the value 2 can be assigned to *x*. That is the case, so not only will *doSomething* always be executed (no matter what the current value of *x* actually is) but *x* is also changed to 2.
- 11 Opponents of the Sapir-Whorf hypothesis (which roughly states 'our native language informs how and what we think') might stumble here.

But since a programming language is not a natural language, it functions very differently. E.g., there is no way to express abstract concepts like love. Instead, as the next sections show, the machine deals with different categories that need an adjustment away from our everyday, hand-wavy way of thinking. Whether the Sapir-Whorf hypothesis also applies to the differences between one programming language and the other is also up for discussion. While Turing complete languages can, in principle, express exactly the same things in different terms, the effort might be prohibitive. For an introduction to the topic, see [https://en.wikipedia.org/wiki/Linguistic\\_relativity#Programming\\_languages](https://en.wikipedia.org/wiki/Linguistic_relativity#Programming_languages).

12 For a detailed explanation of the joke, see <https://journeys.dartmouth.edu/folklorearchive/2017/11/13/a-carton-of-milk-and-some-eggs-joke/>.

13 For a computer, even complex logic is based on the principles of binary reasoning (i.e., true or false / on or off). Machine-learning algorithms seem to change that. They use statistical, probabilistic reasoning. This leads to a very different range of errors that is beyond the scope of this essay. But even these algorithms and the data that they are trained on are initially encoded as binary values so the machine can handle them.

14 Instead of representing that logic as an argument (as would be the case in philosophy) or putting together electronic parts to represent it (as in an electronic circuit), the logic can be represented in the words and symbols of a programming language. If you are not familiar with programming, imagine taking a queue of instructions like this:

- Let *balance* be the sum I have on my bank account.
- Let *hasWon* represent the fact whether I have won the lottery.
- Let *addPrizeMoney* mean that for a given input *y*, return the sum of *y* and 1,000.
- If *hasWon* is true (and only then), use *balance* as the input to

`addPrizeMoney` and update balance with the result of that operation

Those can then be expressed as something like this:

```
let balance = 100;
addPrizeMoney = function(y) {
  return y + 1000;
}

if (hasWon === true) {
  balance = addPrizeMoney(balance)
}
```

Of course, the logic of building a program will have more complex instructions, but that is the general direction. The actual complexity in programming often comes not so much from the complexity of the logic itself but from the interaction of lots of very simple steps.

- 15 As the fundamental instructions a computer can execute are very basic, most programmers nowadays work with so called higher order languages that need to be translated into the basic instructions that

make up machine code by a special program called a compiler.

- 16 This might seem obvious—it is why there are leap year days and leap seconds. But those exceptions can be easily forgotten. For an example of what might happen then, see Robert McMillan and Cade Metz, ‘The Inside Story of the Extra Second That Crashed the Web,’ *Wired*, July, 2012, <https://www.wired.com/2012/07/leap-second-glitch-explained/>.

- 17 Because machines represent everything in a binary format—which consist of only ones and zeros—they have a hard time representing fractions and decimal numbers. An example of a bug caused by that: the calculator software shipped with Windows wrongly calculated some roots until recently. For more, see <https://www.askvg.com/microsoft-windows-calculator-bug/>.

- 18 As a popular saying in statistics goes: ‘All models are wrong but some are useful.’ It is usually attributed to the appropriately named George Box. For some background, see [https://en.wikipedia.org/wiki/All\\_models\\_are\\_wrong](https://en.wikipedia.org/wiki/All_models_are_wrong).

# Colophon

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