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Digital Depth: A Volumetric Speculation

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Abstract Counter commonplace associations with superficial mediation and networked flatness, the digital seems to have its own peculiar depths, which range from the infrastructural (deep sea cables, deep packet inspection, crawl depth) to the metaphorical (Deep Web, deep learning, deepfakes). This article reviews recent discussions of digital depth and argues that this concept is central to understanding multiple aspects of digital media ranging from folk theorizations to technical expertise. What is digital depth? What is deep about digital media? How does this depth interface with volumes and scales beyond the digital? Through this effort, depth emerges as an underlying feature of deeply mediatized societies.

Keywords Depth. Digital media. Dungeons. Imaginary. Machine learning. Metaphors. Topology. Volumetry.

Summary 1 -35,756 Feet: Depth as Metaphor and Imaginary. – 2 7th Layer: Cyberspace Deep. – 3 96% Submerged: The Deep, Dark Web. – 4 Just Add One More Layer: The Depths of Machine Learning. – 5 Volumetrically Digital.

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1 -35,756 Feet: Depth as Metaphor and Imaginary

Depth, it could be argued, is a peculiarly modernist refuge. Coming a long way from its ontological opposition to the surface of earthly existence – the depths of *avernus*, Dante's infernal gyres, the Chinese subterranean courts of hell –, terrestrial depth (along with its oceanic and outer space correlates) has risen (or has been tethered) back to the ground level of human experience and given a rich variety of metaphoric and epistemological roles across discourses. Cognizant of the risk of generalizing, one could tie the return of depth to metrological efforts characterizing both the scientific revolution and modern positivism, which oriented the production of knowledge towards the charting of dimensions and distances of the empirical world. From a critical theory perspective, a fascination with depth could be identified as a response to the rise of popular culture as industry and economy of distinction, in the context of which a deep engagement with cultural products determines the social standing of modern subjects. This epistemological connotation of depth translates the invention of perspective into domains beyond the reach of human lines of sight; the optical depth of field, in a sense, extends the reach of scientific discovery into the oceanic abyss and the planetary crust, and outward into space, from local cluster to cosmic radiation background. In epistemological terms, this depth is diametrically opposed to Plato's 'cave deep underground' where knowledge is forcibly mediated by a superficial play of shadows. Regardless of the direction of its vector, vertical depth becomes mapped onto the linear logics of progress and innovation, with expeditions inching towards the farthest reaches of reality exemplifying the cumulative, asymptotic, anthropocentric and gendered quest for knowledge. While these examples might be Anglocentric peculiarities (which would not lessen their significance, but tie them to colonial legacies and sociolinguistic subjectivities), take the adjective 'deep' and some of its most commonly paired nouns: deep sea and deep space, obviously; the deep structure of linguistics and the deep unconscious of cognitive psychology; deep time, more recently, situating the human in a much longer planetary history; deep listening, expanding human perception beyond its everyday boundaries; deep politics and the deep state, probing hidden governmental processes and networks of power. In all these cases, the *deep* characterizes something beyond the fully known that can be probed and surveyed, an extension of common, everyday, superficial domains of experience into more exceptional, extreme, explorable unknowns.

Cultural analysts have recognized this return of depth (Williams 2008) and correlated it to the postmodern celebration of the surface, the "new depthlessness" that Frederic Jameson (1990, 56) identified as a constitutive feature of postmodernity. If postmodern depthlessness emphasized the superficiality of simulacra and the withdrawal of semiotic referents, depth seems to have reemerged in contemporary art and theory as an active practice of 'depthing', the making or performing of depth, or as a 'depthiness' that combines "the epistemological reality of depthlessness with the performative possibility of depth" (Vermeulen 2015).

In the 2021 edited volume *Deep Mediations*, dedicated to charting "the meanings, paths, and valuations of depth that have historically accompanied the concept in order to understand its significance today" (Redrobe, Scheible 2021, XI),several authors approach this new depthiness from different aspects of cinematic and digital culture, probing depth "as a visual concept, as a medial concept, and as a philosophical concept" (XVII).

Departing from Thomas Friedman's 2019 declaration of *deep* as his choice for word of the year ("Everything is going deep," XI), the collection's editors propose to embrace Kathryn Yusoff's "stratigraphic imagination" as a way to tease apart this return to depth while also recognizing its historical complexity (XIII) without definitive judgements about its positive or negative value (XVI). The 'volumetric turn' articulated by human geographers and anthropologists grapples with a similar recognition of the relevance of depth from a parallel conceptual rubric: that of *volume*. Embracing Jeremy Crampton's definition of the volumetric (2011), human geographer Stuart Elden (2013) revisits Virilio's conception of a World War II battlespace characterized by "distance, depth, three-dimensionality," as well as Sloterdijk's spherological thought, to argue for an understanding of territory beyond the flatness of surface and the measure of area. Elden's key question builds upon Eyal Weizman's account of the politics of verticality, correlating questions of volumetry to the securitization of both aerial spaces and tunneled undergrounds: "how does thinking about volume – height as depth instead of surface, three dimensions instead of areas – change how we think about the politics of space?" (1), he asks. Two special collections edited by Franck Billé gather anthropological responses to the volumetric turn, charting the development of this interdisciplinary effort. Far from being merely phenomenological investigations of the depths and heights of volume, these essays exemplify a shared concern for how volumetry complicates the topology of sovereignty without weakening the control and colonization of territory (Billé 2017). Intersecting with materialist and more-than-human perspectives on the anthropocene, these efforts in volumetric scholarship chart the dynamic and heterogeneous topologies of warrens, fissures, seepages, gyres, sinkholes, reservoirs and vortexes, seeking to find ways of representing volume beyond cartographic practices. Billé (2019) argues:

> It is perhaps here, at the juncture between political theory and the more-than-human, that a volumetric imaginary is especially critical.

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This essay departs precisely from this juncture, delving towards volumes yet uncharted.

One aspect of contemporary social worlds that has received less attention from volumetric scholarship – perhaps as a consequence of its common correlation with superficial mediation and networked flatness – is the digital. Broadly intended in theoretical terms as the representation of information in strings of discrete symbols, the digital is at the center of most developments in media and communication systems of the last century.[1] The most pragmatic recognition of the volumetric relevance of the digital – which Virilio would find vindicating – is perhaps to be found in the U.S. army's addition of 'cyber' as a domain of military activity beyond the existing arenas of land, air, sea and space. The digital further complicates volumetry and its intersections with representation, sovereignty and governance: the imaginary of flat communication networks is unsettled by the unruly magma roiling right outside of their two-dimensional conduits (Venturini 2009); the orderly layering of computational infrastructures is upended by topological transformations (Cavia, Reed 2023); and the high-dimensional data spaces that machine learning models are trained on challenge human cognition at unprecedented scales (Belisle 2021). More mundanely, one can expand the linguistic exercise proposed above to the digital realm: deep sea cables sustaining most of global data flows; deep packet inspections managing this traffic; the crawl depth of search engines and the enticing lure of the Deep Web; deep learning and its products like Deep Blue, DeepDream and deepfakes. The digital, in short, seems to have its own peculiar depths. This article reviews recent discussions of digital depth and argues that this concept is central to understanding multiple aspects of digital media ranging from folk theorizations to technical expertise. What is digital depth? What is deep about digital media? How does this depth interface with volumes and scales beyond the digital? In search of answers, I offer a volumetric speculation on digital depth, articulated as a non-linear movement between physical profundities and conceptual strata, that seeks to model different aspects of the digital as they are related to verticality, layeredness, and three-dimensionality – a *deep dive*, if you will. Through this effort, depth emerges as a metaphor and, perhaps, even as a consistent imaginary (Taylor 2004) of the digital, working alongside other conceptualizations through overlaps and complementarities, and expanding the implications of this volumetry for increasingly mediatized societies.

1 Ontological discussions of the digital, which is one of the most widely dissected terms in media studies and adjacent disciplines, are beyond the scope of this essay; readers can find useful pointers to the topic in recent debates around computation (Galloway, Geoghegan 2021).

2 7th Layer: Cyberspace Deep

Since the early years of digital computation, the flattening of screens and two-dimensional interfaces has been accompanied by the yearning for the new depths of virtuality. Perhaps not surprisingly, the earliest probes into digital depth are to be found in playful and social interactions with personal computers – first in games and narratives, then in chatrooms and virtual worlds. At a time when the capabilities of computers were mainly limited to the textual realm, creative programmers developed forms of interactive fiction that took advantage of the affordances of random number generators, coding languages, parsers, and hyperlinks to push text beyond linearity (Reed 2023, 2). It is not a coincidence that many of these creations developed along the branching structures of decision trees and the winding corridors of imaginary dungeons – as Aaron A. Reed notes, the 1970s were a pivotal decade for digital narratives to develop around shared cultural referents like *Star Trek* and *Dungeons & Dragons*:

> The release of *Dungeons & Dragons* in 1974 spawned at least three digital game genres as early hackers tried various ways of digitizing the immersive tabletop game with its numerical systems for simulating fantasy adventures: roguelikes and computer roleplaying games, which trended more toward graphics and action, and prose-based text adventures focused on puzzle and immersion. (28)

Even before the internet, text-based games like *Caves1*, *Castle*, *The Dungeon, DND*, *Dungeon*, *DUNGEON*, *Moria*, and *Oubliette* prefigure the subterranean lure of the digital, inviting players to explore sprawling cavern systems and connected chambers in explicitly spatial germs (Giddings 2016). As *Adventure*, released in 1976 by Will Crowther and Don Woods, informs the player: “You are in a maze of twisty little passages, all different” (87).

Abstracted from the dungeon archetype, branching structures of rooms connected by corridors became the standard for games and narratives situated in other settings. As the internet reached increasing numbers of users, Multi-User Dungeons (MUDs) like *Scepter* (also known as *Scepter of Goth* and *Milieu*), released by Alan E. Klietz in 1978, transformed the single-player experience of dungeon crawling, with its puzzles and monster fights, into a social space of freedom, a dynamic world to be explored with others through real-time communication (Reed 2023, 138). From experimental spaces inspired by shared cultural references, MUDs developed a culture of their own:

> A dialect called mudspeke appeared, where *t* meant treasure, *snif* meant sadness, and countless in-jokes were enshrined in shorthand and slang. (141)

In 1979, an important change pulled MUDs away from fantasy gaming and towards more open-ended, collaborative endeavors. James Aspnes, a graduate student at Carnegie Mellon University, developed a MOO – an 'object-oriented' MUD, in which rather than fighting dragons and collecting magical items, users were encouraged to build their virtual worlds through object-oriented programming (hence the acronym). This shift was pivotal in bringing users to the digital surface: exiting their underground dungeons, players could build their own dwellings in the new frontier spaces of the internet. With the advent of MOOs, as Amy Bruckman puts it, new architectural forms become relevant: "if virtual communities are buildings, then right now we are living in the equivalent of thatched huts" (Bruckman 1996).

These new frontiers of the digital started to be discussed using a term popularized by William Gibson's sci-fi novel *Neuromancer*: cyberspace. Howard Rheingold, who describes the WELL (Whole Earth 'Lectronic Link) virtual community in terms of a homestead, highlights the fluid, under-construction nature of these spatial imaginaries: "No single metaphor completely conveys the nature of cyberspace" (2000, 50).

In the mid-1990s, cyberspace metaphors were clearly shaped by U.S. frontier imaginaries close to libertarianism (Paasonen 2009, 15). "Cyberspace does not lie within your borders," John Perry Barlow's famed manifesto (1996) reads:

> Do not think that you can build it, as though it were a public construction project. You cannot. It is an act of nature, and it grows itself through our collective actions.

Far from being the "placeless place" proposed by Manuel Castells (1999, 294) or the non-place theorized by Marc Augé (1995), cyberspace developed across sites and addresses, rooms and homepages, a "language of entry and travel that positions the user *within* the medium" (Nunes 2006, xiv).

While the dungeon metaphor is gradually abandoned, its key traits of immersion, exploration, random generation, depth and branching structure remain central for a more pervasive and malleable imaginary of cyberspace.

To be sure, this imaginary also preserved colonial and extractive dynamics; Wendy Chun tracks how the fantasy of cyberspace as an "endless freedom frontier" has been overlaid onto the actually existing internet:

> like all explorations, charting cyberspace entailed uncovering what was already there and declaring it new […]. Those interested in 'wiring the world' reproduced – and still reproduce – narratives of 'darkest Africa' and civilizing missions. (Chun 2006, 51)

Romantic visions of expeditions into the 'virgin territory' of cyberspace are reflected by the names of early browsers like Microsoft Internet Explorer and Netscape Navigator (Morozov 2012). Eventually, as legal scholars argued, these new social spaces would develop not only architectural structures for dwelling but also laws and regulatory frameworks grounded in territorial sovereignty, bringing an end to the libertarian neofeudalism of coding wizards (Gaitenby 1996):

> Much as in the tradition of territorial definition during the Age of Discovery, Wizards and users came from established sociopolitical traditions. The explorers of cyberspace, like their predecessors in mercantile and imperial Europe are formed and informed by those traditions, and act to shape what they find accordingly. The earlier explorers claimed and named, delineated and surveyed; they were terrified by the unknown, the incalculability, the sheer dimension of what they encountered. (141)

In the span of a decade, the uncharted vertical depths of generative caves were reconfigured onto the horizontal plane of the civilizing frontier; cyberspace transformed into a code/space that is increasingly entangled with everyday life (Kitchin, Dodge 2011); communities and laws tethered the online to offline social spaces. In the words of Lawrence Lessig (1996), the logic of the zone progressively subsumed that of the dungeon:

> Zoning will replace the present wilderness of cyberspace, and this zoning will be archived through code – a tool […] more perfect that any equivalent tool of zoning in real space. (1409)

The complex processes of zoning happening in parallel with network-building, protocol standardization and software development resulted in an explosion of efforts to map these new spaces. The *Atlas of Cyberspace* compiled by Martin Dodge and Rob Kitchin (2001), collecting more than a decade of examples across disciplines and communities, is perhaps the most comprehensive account of these efforts. The *Atlas* includes more standard geographical representations of traffic, cables and routing stations, but also more abstract and experimental visualizations ranging from historical maps of computer networks like ARPANET, website maps of hyperlink structures, 3D environments mapping information spaces, and topological maps of mailing lists **[fig. 1]**. It is striking how many of these maps and visualizations – particularly the ones that move away from geography and physical infrastructures – resonate with the structures of text-based dungeon games and MUDs: rooms and spaces connected by links and pathways, branching tree structures, and layered levels. The way in which network expansion and interoperability requires complex and overlapping layers is perhaps most iconically enshrined in the OSI model, a framework for networking systems developed since the 1970s as a way out from the 'protocol wars', which was published as a ISO standard in 1984 (ISO/IEC 7498), offering a conceptual map for network architecture as a stack of seven abstraction layers: Physical, Data Link, Network, Transport, Session, Presentation, and Application **[fig. 2]**. In the OSI model, physical infrastructure is the deepest, first layer, while higher layers point upwards to the seventh layer of software operations and user interfaces, articulating the simplest and most general stratigraphic chart of digital networks. The tense stratification of real and virtual, online and offline spaces, with its own plate tectonics and fault lines, was diagnosed by science fiction author Neal Stephenson in his 1996 essay "Mother Earth Mother Board," which chronicles the installation of the longest (at the time) submarine communication cable. In the essay, Stephenson notes the parallels between virtual and geological spaces:

> Wires warp cyberspace in the same way wormholes warp physical space: the two points at opposite ends of a wire are, for informational purposes, the same point, even if they are on opposite sides of the planet.

The deep branches of network diagrams are mirrored by the undersea depths where fiber optic cables have to be installed in order to span across continents: "if the network is The Computer, then its motherboard is the crust of Planet Earth," Stephenson continues. The emergent process through which a planetary network infrastructure came into being (Bratton 2015) relied on a set of reductive spatial metaphors like 'information superhighway' and 'global village', which were still rooted in regional discursive regimes (Paasonen 2009, 20). As geographers have recognized, it is critical to question the spatial metaphors of information networks and the imaginaries developing around concepts like cyberspace, as they can easily lead to inaccurate or even harmful governance policies (Graham 2013, 177). As the geopolitics of infrastructure, internet service providers, search engines, social media companies and other forces complicate the global, regional and national scale of the internet, its spatial imaginaries are witnessing a "revenge of geography on cyberspace" (Rogers 2013, 40), in which "each network redoes network space in ways that are often different from the infrastructural network models that preceded them" (56). And this reconfiguration is not only infrastructural and geographical, but reaches down into the 'further hidden depths' of geology, where the digital is shaped by forces operating at new material and temporal scales (Parikka 2015).

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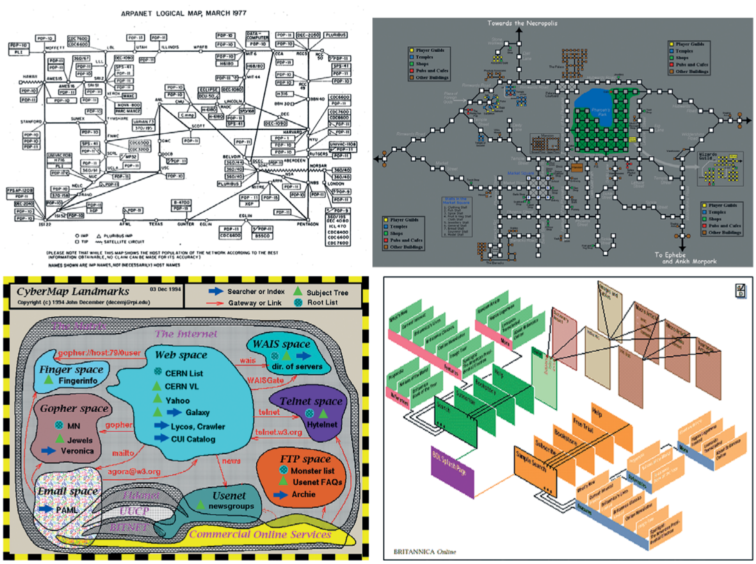

Figure 1 Network topology of ARPANET from the 1997 *ARPANET Completion Report*, topological map of the Discworld MUD created by player 'choppy', a 1994-95 conceptual map of cyberspace by John December, and an interactive website map by Dynamic Diagrams. All reproduced from Martin Dodge's Cybergeography Research website (1997-2004)

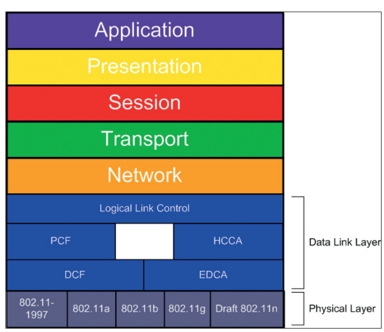

Figure 2 Diagram of the 7-layer OSI model as of 2009, including modifications made by 802.11 standard and 802.11e amendment. Creative Commons: https://commons.wikimedia.org/wiki/File:OSI-80211e.png

3 96% Submerged: The Deep, Dark Web

“You have finally reached the end of the internet!”, the page says.

> There’s nothing more to see, no more links to visit. You’ve done it all. This is the very last page on the very last server at the very far end of the internet.

The HTML file accessible at the address `www.hmpg.net` is one of the many ends of the internet, web pages humorously purporting to be the most faraway places in the world wide web.

“Wow!!! You have reached the very last page of the Internet. We hope you have enjoyed your browsing. Now turn off your computer, and go have fun,” another one found at `www.internetlastpage.com` reads. “In case you are wondering, the end of the Internet is located way up in the cloud. You can’t go any further from here. YOU MUST NOW START BACK AT THE VERY BEGINNING!”, adds `www.endoftheinternet.com`. As website KnowYourMeme reports, the ‘Last page of the internet’ phenomenon emerged in the late 1990s as a parody of the web’s seemingly endless nature and has remained surprisingly relevant across the subsequent decades.[2] Folklorist Lynne S. McNeill (2009, 86) has theorized that this phenomenon evidences the conflation between web and internet fueled by the ten-fold explosion of web servers in 1997, which resulted in large numbers of users experiencing this new information system as their main interface with the internet. She argues:

> If the Internet were a book, actually able to have a last page, its hyperlinked nature – where within a given page there are one or more links to other pages containing related information – makes the Internet read less like a novel and more like a Choose Your Own Adventure book. […] I believe that it is this quality of the Internet, the overabundance of options, which made the idea of the ‘end’ of the Internet such an appalling one to early users. (90-1)

As the World Wide Web expanded the internet through a sprawling mesh of servers, its spatial imaginary shifted towards a different set of metaphors, and older referents like the dungeon persisted as parodies in phenomena like the ‘end of the internet’ or ‘final boss of the internet’ memes. This new web imaginary was largely horizontal – a seemingly endless sprawl of *home*pages (Chandler 1998)

2 “The Last Page of the Internet”. *KnowYourMeme*. `https://knowyourmeme.com/memes/the-last-page-of-the-internet`.

characterized by the amateur aesthetics of 'under construction' signs and starry sky backgrounds (Lialina 2009), organized in communities and neighborhoods on hosting services like GeoCities: web addresses, access counters, guestbooks and web rings functioned as the social "wiring" (Kirshenblatt-Gimblett 1996) that supported an imaginary of surface zoning clearly patterned on the American suburb (Mitton 2015). Cyberspace and its dungeons had been successfully flattened.

And yet, around the turn of the millennium, depth returned under a new guise: the web had become *too* sprawling, and an increasing amount of information was unindexed and hence unretrievable. Jill Ellsworth referred to this unindexed information as the "hidden web" (1994), and various proposals outlined measures to address the problem (Kautz, Selman, Shah 1997). In a white paper written for his internet content company BrightPlanet, Michael K. Bergman drew on oceanic metaphors and coined the term 'Deep Web' to describe a similar layer of unindexed information and dynamically created pages:

> Searching on the Internet today can be compared to dragging a net across the surface of the ocean. While a great deal may be caught in the net, there is still a wealth of information that is deep, and therefore, missed. The reason is simple: Most of the Web's information is buried far down on dynamically generated sites, and standard search engines never find it. […] Because traditional search engine crawlers can not probe beneath the surface, the deep Web has heretofore been hidden. (Bergman 2000, III)

Bergman's Deep Web concept outlined a clear value proposition: if information is a commodity, the Deep Web contains a lot more of it than the surface web – 400 to 550 times more, according to his estimates; around 7,500 terabytes, 550 billion individual documents and 200,000 websites (IV). Search engine crawlers only skim the surface web, ignoring the "tremendous amount of high quality content 'hidden' behind search forms, in large searchable electronic databases" (Raghavan, Garcia-Molina 2001, 1).

In the early years of the commercial Web, depth became synonymous with data quality, and new techniques were developed to extract value from this 'deepened' reservoir of information (He et al. 2007), including vertical search engines and web surfacing systems (Madhavan et al. 2008). By the end of the 2000s, post-9/11 securitization had caught up with the internet and studies highlighted how terrorist groups used the 'Dark Web' to recruit, communicate and share information online (Chen et al. 2008). This discursive chain – from hidden to deep to dark – highlights a recurring pattern in which technical aspects and emerging features of information systems are imagined in spatial terms and then correlated to value judgments. By the mid-2010s, popular coverage around the dark web was characterized by the typical traits of moral panics about the internet, while more tech-savvy users started exploring it as an option for privacy in a post-Snowden world (Gehl 2016, 1222-3). Often conceptualized as the further corner, deeper segment or bottom layer of the Deep Web, the Dark Web is a "treasure trove" (Weimann 2016, 197) of content that is intentionally concealed (Finklea 2017). In the most common visual metaphor used to explain this vertical layering, the Surface Web is depicted as the tip of an iceberg, the Deep Web as the bulk of its submerged part, and the Dark Web as a very small portion of its lower reaches (Chertoff 2017, 27). Rather than open databases and platform content, the Dark Web is made of purposefully encrypted information provided by "hidden services" (Faizan, Khan 2019) with private IP addresses and unintelligible URLs, which can be accessed through VPNs, the Tor browser and its Onion routing protocol, or other web tunneling solutions. On the Dark Web, hidden services like Silk Road facilitate the purchase of drugs, weapons, child pornography or even assassinations (Kaur, Randhawa 2020). Much like the abyssal and hadal zones of the ocean, the lowest reaches of the Web became associated with the darkness and murkiness of inhospitable depths (Hatta 2020).

While both the Deep Web and the Dark Web remain rather irrelevant (or, at least, infrastructurally invisible) for most everyday internet users, the imaginary of vertical depth and progressively mysterious abysses has become a popular theme in digital folklore. One key example is the 'Iceberg Tier' exploitable meme format, which revolves around an image or rendering of an iceberg floating in the ocean that is captioned with various terms, topics, names, or objects and divided in vertical tiers going in a descending order from the commonly known (the tip of the iceberg) to more and more obscure knowledge (the lower, submerged parts). According to popular histories of this exploitable format, the Iceberg Tier was used since at least 2011, has then become widespread on message boards like 4chan, and has eventually been adopted across multiple fandoms and social media publics.[3] The first reported example of the Iceberg Tier meme is clearly connected to the Deep Web and Dark Web, as it is titled *The Internet (more or less)* and humorously maps various social media platforms and services popular in the early 2010s (Facebook, YouTube, Reddit, Digg, 4chan, Tumblr, LiveLeak, etc.) all floating near the sea surface, while services like PedoPlanet, Hidden Wiki, Hard Candy and OnionChan occupy the lower half of the iceberg **[fig. 3]**. At the very bottom, a small ice protuberance is captioned with "Has anyone really been far even as decided to use even go want to do look

3 "Iceberg Tiers Parodies". *KnowYourMeme*. `https://knowyourmeme.com/memes/iceberg-tiers-parodies`.

more like?" – a nonsensical sentence meant to convey the abstract semantic horror of the utmost internet depths. Other examples from the mid-2010s expand on the imaginary of the Deep Web by going far deeper than the bottom of the iceberg into a black abyss featuring captions like 'gore', 'exotic animals trade', 'headhunting', 'sex tourism', 'AIM/MSN/YIM/Skype Log Database', 'bugchasing/STD', 'snuff', 'human trafficking', 'corpse disposal instruction', 'alternative energy research' and, at the very bottom, 'classified government documents'.

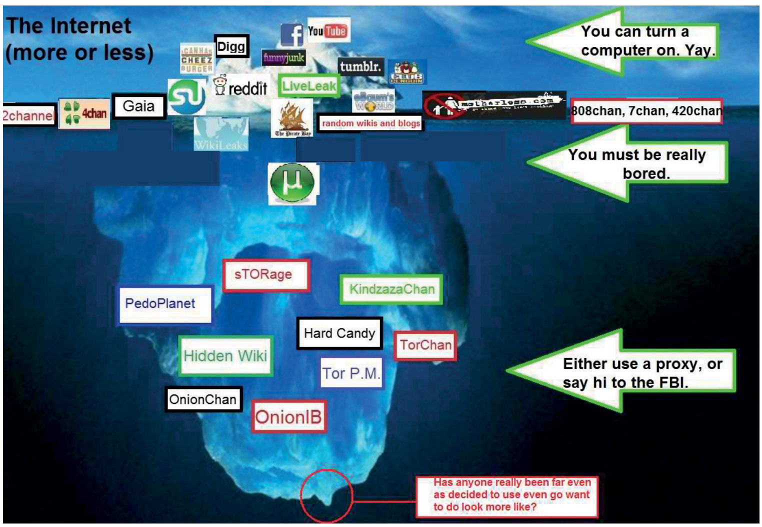

Figure 3 The first documented 'Iceberg Tier' meme, uploaded to image hosting website Imgur on May 31st, 2011 by an anonymous user. `https://imgur.com/oD0R4`

Over more than a decade, iceberg memes have been used to ironically map cultures of distinction and specialist knowledge across countless domains – from music and YouTube personalities to horror video games and Google Maps anomalies – but their origin in the Deep Web mythos preserves a generalized logic that equates the surface with commonplace knowledge and layered depth with technical skill, hidden information, prized data, murky ethics, esoteric literacies and government secrecy. This mythos is not limited to the iceberg format, but expands into creepypasta texts and urban legends like the 'Mariana's Web' myth (Violet Blue 2015), a purported deepest level of the internet accessible only via quantum computers running a complex algorithm called 'Polymeric Falcighol Derivation', where one can find 'WW2 Experiment Successes', the 'Location of Atlantis', 'CAIMEO (AI Superintelligence)' and 'Geometric Algorthymic [*sic*] Shortcuts', among many other more or less fictional things. Another explainer details three more layers accessible beyond the Mariana's Web:

> Level 6, The Fog/Virus Soup and the Primarch System. Accessing these last layers are reserved for the ultra brave, as it may pose some risk to your own life mostly because of the types of information floating around here (think human trafficking and drug lords). The last layer is as mysterious as the Matrix. For our purposes, you may think of it as the Matrix 3 movie and you require Neo type awakened skills (plus Max Plank [*sic*] level of genius –he was credited with the birth of quantum theory) to access this level. (du Rand 2022)

This sort of digital folklore operates by recursively intensifying the Deep and Dark Web debates of the 2010s while also harking back to the early technical explorations of the hidden web – a wholly fictional layer like the Primarch System is described as an information environment beyond human comprehension and governmental control, “an anomaly at the heart of the Deep Web that was discovered by super Deep Web scans in the early 2000s” (Joshi 2021).

At these depths, networked web imaginaries overlap with the repertoire of conspiracy theory – for example, the complex charts created by the Deep State Mapping Project and disseminated by the U.S.-based QAnon political movement **[fig. 4]** rely on similar vertical levels of depth (historical, ideological, or technological) to expand the flat network metaphor into intricate webs of political power, religious cults, or COVID-19 conspiracies (Monroe 2022). It is not a coincidence that these diagrams purport to map the ‘deep state’ – a term popularized in the U.S. during the Trump presidency to indicate a purported network of actors exercising power from inside the federal government: Dylan Louis Monroe, the designer of these charts also known as ‘The Mapmaker’, describes his work as part of a combined effort to defeat a ‘Luciferian Cabal’ that successfully installed itself into power (Paul 2020). In the span of three decades, digital depth shifts from being a fortuitous explanatory metaphor to a generative logic for folk theorizations emerging in response to sociotechnical worlds of increasing complexity.

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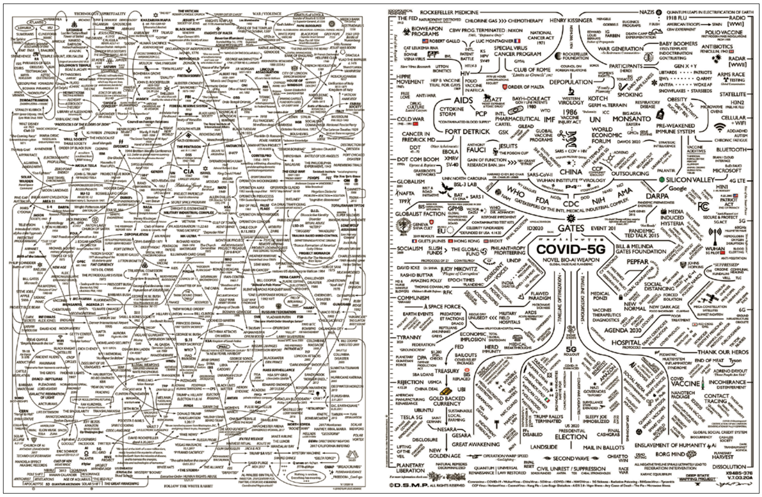

Figure 4 Two intricate conspiracy flowcharts combining vertical depth (historical time and technological progress) with sprawling connections between actors. Q-WEB v.1.22.23 (2018, left) and COV1D-5G V.40721 (2021, right), both by Dylan Louis Monroe's Deep State Mapping Project

4 Just Add One More Layer: The Depths of Machine Learning

The obscure algorithms and sentient AIs found in myths about the deepest levels of the dark web are not simply science-fictional tropes imported into digital folklore but are also grounded in a domain in which depth plays an important conceptual role: machine learning. While deep learning has entered popular debate in the early 2010s, the developments of deep neural networks have a century-long history beginning with the Ising model from the 1920s and the connectionist Perceptron model outlined by McCulloch and Pitts in the 1940s. In 1959, mathematician and artificial intelligence pioneer Oliver Selfridge proposed a theoretical model of how the brain processes visual perception. This model, called Pandemonium, was based on a key idea: having multiple systems processing information in parallel, breaking down an image into its constituent patterns and relying on the recognition of these features to output a decision. In keeping with its name, the Pandemonium architecture was populated by 'demons' – a fantastical equivalent to neurons – arranged in four independent groups layered from bottom to top: an image demon, feature demons, cognitive demons, and a decision demon [fig. 5]. After identifying an image, the feature demons in the second layer would scream accordingly to the feature they detected; hearing their yelling, the cognitive demons would in turn start wailing depending on

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which image they thought the features composed; eventually, the decision demon on top would evaluate the loudest screaming from the cognitive demons, and come up with a decision, predicting the most likely content of the input image (Boden 2018, 13-14). This pandemonium of demons, with its four layered groups of independent processing units, is one of the earliest computational models of pattern recognition; while its theoretical solidity has been questioned, its key intuition of parallel information processing has been confirmed by neuroscience and its innovative architecture has inspired decades of artificial intelligence research culminating in recent machine learning advancements. Despite its groundbreaking architectural features, the Pandemonium would not achieve the same popularity as the Perceptron model implemented by Frank Rosenblatt in 1958, which was similarly organized in layers of perception, association and response units. The Perceptron did not need a pre-analysis of its inputs, and was capable of a form of self-organizing learning based on neurodynamics. After being at the center of theoretical controversies (Olazaran 1996), it was rediscovered in 1986 with the return of connectionism after decades of symbolic artificial intelligence research and is today recognized as a pioneering example of 'parallel distributing processing' and the first modern artificial neural network (Boden 2018, 15-16).

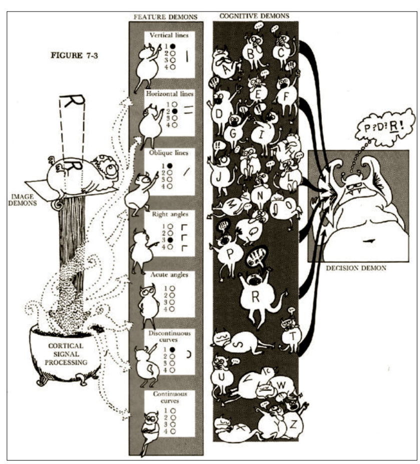

Figure 5
Illustration of Selfridge's 1959 Pandemonium model architecture, drawn by Leanne Hinton (Lindsay, Norman 1972). Demon layers, or groups, are stacked from left to right

While the second wave of connectionism improved the perceptron model by adding intermediate hidden layers, the third wave gathered momentum in the early 2010s thanks to the availability of large datasets and powerful GPUs (graphics processing units) that could allow the training of models with multiple hidden layers (Rella 2023). It is these multilayered models that have formalized the use of depth as an explanatory and structural metaphor in artificial intelligence research: *deep neural networks* consisting of multiple stacked layers of artificial neurons enable *deep learning*, the capability to extract high-level features from a low-level input. As computer science researchers realized, machine learning algorithms developed for shallow architectures could be easily applied to neural networks, since

> deep architectures seem a natural choice in hard AI tasks which involve several *sub-tasks* which can be coded into the layers of the architecture. (Weston et al. 2012, 2)

The introduction of convolutional neural networks (ConvNets or CNNs) allowed performance improvements by simply increasing the width and depth of the neural network. As the authors of Inception,[4] a milestone in CNN architecture, explain:

> the word 'deep' is used in two different meanings: first of all, in the sense that we introduce a new level of organization in the form of the 'Inception module' and also in the more direct sense of increased network depth. (Szegedy et al, 2015, 2)

The advantages of network depth have been widely recognized, and yet some researchers questioned the need for neural networks to be deep, demonstrating that shallow networks could perform as well as deep ones, and that "depth may make learning easier but may not always be essential" (Ba, Caruana 2014, 9).

Research has proven how the depth of convolutional neural networks has an effect on accuracy in tasks like image recognition (Simonyan, Zisserman 2015), while others have argued that increasing network depth does not necessarily improve performance (Sun et al. 2015). If the role of depth in deep learning remains a contested attribute, computer scientists seem to agree on its straightforward, technical meaning: "Deep learning isn't really deep in thinking terms, as these networks utterly lack any ability to deal in abstract concepts" (Buchanan 2018, 326).

In a comprehensive 2022 volume titled *The Principles of Deep Learning Theory*, Daniel A. Roberts and Sho Yaida connect most of the successes of contemporary artificial intelligence to depth:

> The real power of the deep learning framework comes from *deep* neural networks with many neurons in parallel organized into

4 Szegedy and coauthors have named their CNN architecture after Christopher Nolan's *Inception* movie because of its "we need to go deeper" line of dialogue.

> sequential computational layers, *learning* useful representations of the world. Such representation learning transforms data into increasingly refined forms that are helpful for solving an underlying task and is thought to be a hallmark of success in intelligence, both artificial and biological. (1)

And yet, despite these successes, the authors note that deep learning is still lacking a solid theory of depth, as "very little theoretical work directly confronts the *deep* of deep learning" (2).

In search of an effective theoretical description of deep neural networks, Roberts and Yaida focus on large networks with finite width, going back to the multilayer perceptron as the most basic model of a network iteratively composed of structurally similar layers (37). "Depth," they conclude, "is a double-edged sword" (64), as deeper networks tend to have higher margins of error and are less stable; overall, the pursuit of deeper neural networks remains an empirical preference grounded in the observable results of multilayer architectures rather than on a solid theory of how learning works at these depths (191).

This overreliance on depth has become the punchline for several computer science jokes, including the *Inception* reference mentioned above or the *Stack More Layers* meme depicting a concerned computer scientist giving precise technical instructions trying to fix an overgeneralizing statistical learning model while a cross-eyed jester working with neural networks simply prescribes the simplest iterative solution **[fig. 6]**. Regardless of how undertheorized depth is in machine learning research, it is undeniable that computer scientists and artificial intelligence companies rely on its semantic mystique to promote products and services. Through his comparative study of IBM's Deep Blue and DeepMind's AlphaGo, Paolo Bory (2019) demonstrates how companies "used the human-machine competition to narrate the emergence of a new, deeper, form of AI" (627).

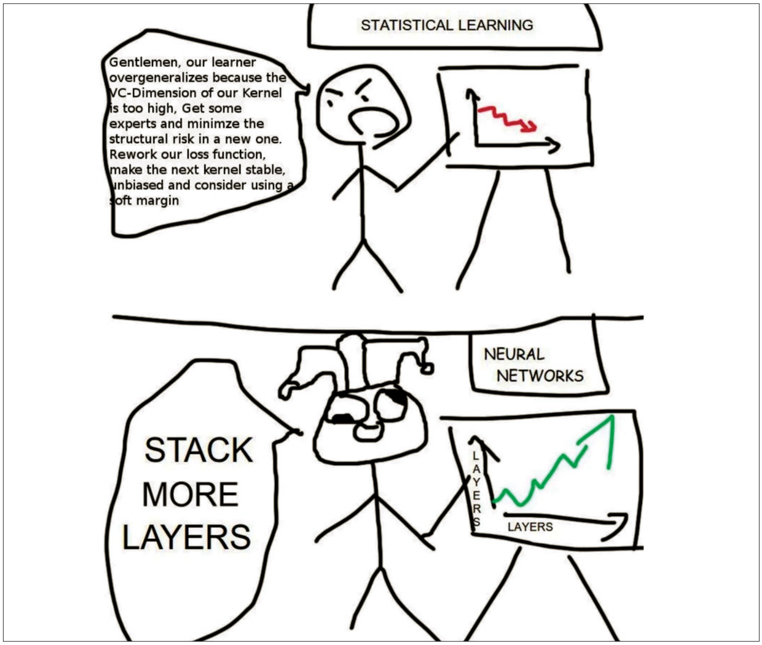

Figure 6 *Stack More Layers* meme, posted on the r/ProgrammerHumor subreddit in 2018 by an unnamed user, now deleted. https://www.reddit.com/r/ProgrammerHumor/comments/8c1i45/stack_more_layers/

IBM and AlphaGo mobilized different strategies to stage the 'deep new' of artificial intelligence – the former, in 1997, relied on secrecy and hardware blackboxing, while the latter, in 2016, openly showcased software visualizations and dynamic data feeds. Their intent was similar: foregrounding the deep knowledge and creativity that their AI agents were capable of displaying. Even when depth is understood in its metaphorical sense as the spatial relationship between stacked layers, which many technical diagrams model on the visual vocabulary of stratigraphy **[fig. 7]**, the depth of neural networks is by necessity more abstract, since "binary and linear forms of classification are compounded into hyperplanes of multidimensional classification" (Belisle 2021, 339) that transcend the human capacity to visualize their structure. As Taylor Arnold and Lauren Tilton (2021) argue, depth in machine learning transcends its technical meaning and diffracts into at least three connotations:

> *knowledgeable*, the accuracy displayed in the model's ability to excel in certain image process tasks; *layered*, a visualization of the learned hierarchical structures; and *impenetrable*, the inherent lack of interpretability and understanding (such as in the 'deep sea' or 'deep space') of their algorithmic operations. (310)

While the stacked layer structure is likely to have been the origin of the term 'deep neural networks', it is also the case that this structure is conducive to solving tasks, like image recognition or voice synthesis, that are deep in complexity; similarly, the depth of multilayered neural network architectures results in their opacity to human interpretability (319). In short, deep network structures lead to both deep knowledge and deep opacity, relating different kinds of depth beyond their shared English-language term (321). This multilayered connotation of depth in machine learning helps explaining the complex mixture of fascination and fear, realism and uncanniness, perfection and faultiness that characterize cultural phenomena like deepfakes and corporate products like DeepDream – applications of deep learning that bring the unfathomable depths of parallel distributed processing to a user-friendly surface of inputs and outputs.

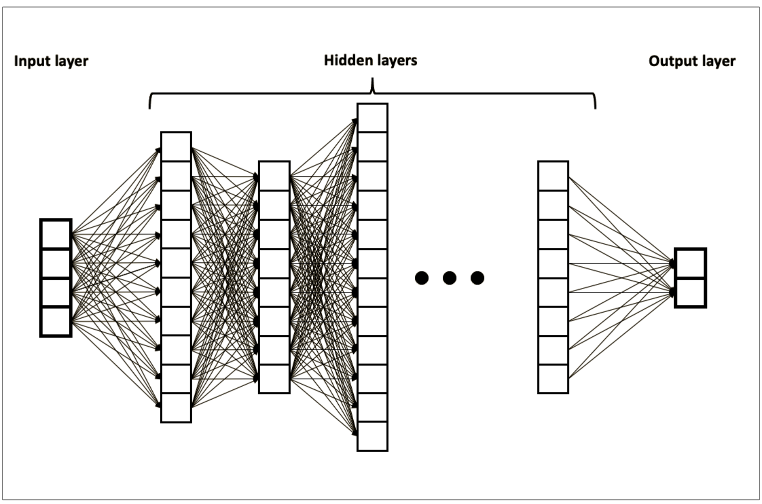

Figure 7 Simplified structure of a deep neural network. Diagram by BrunelloN (2021). Wikimedia Commons, licensed under the Creative Commons Attribution-Share Alike 4.0 International. Source: https://commons.m.wikimedia.org/wiki/File:Example_of_a_deep_neural_network.png

5 Volumetrically Digital

The vectors orienting the various sections of this article, pointed up and downward vertical volumes and cutting across multidimensional strata support the claim that, contrary to commonplace imaginations of digital media as mirroring surfaces and of digital communications as flattening forces, the digital does indeed have its own peculiar depths. Without falling into the fallacy of opposing surface and depth as an ontological binary, it can be recognized that digital depth is profoundly entangled with its corresponding surfaces (Parikka 2021, 290). From a volumetric perspective, digital depth is not vertical in a strictly three-dimensional sense; lacking a consistent ground or territory to anchor it, neither is it limited to a single directional vector or spatial variable. There are the material, structural depths of digital data and infrastructures, as well as the metaphorical, imaginary depths of digital media and artificial neural networks, all coexisting and resonating with, reinforcing and disrupting one another in mutable ways. This multiplicity of depths corresponds to a multiplicity of volumes. In the most basic material sense of physical computing, a *volume* is an identifiable area of data storage – usually a hard drive – with a single file system recognizable by an operating system. The exponential growth of computational capacity has led to the need for new measures of the information produced and stored on a global scale: *data volume*, the total amount of data created, copied and consumed globally, has reached 64.2 zettabytes in 2020, and is projected to exceed 180 zettabytes by 2025 (Statista 2023). These volumetries are mathematically quantifiable and yet often exceed the grasp of human perception, demanding new ways to probe and make them interpretable, or at least explainable. At the same time, as demonstrated by the early experiments with textual games and narratives, users actively create new depths through the affordances of interactive media, carving volumes into programmable interfaces and establishing dwellings at the frontiers of digital spaces. The history of cyberspace, from its dungeon-like precursors to its sovereign zoning by code and law, outlines a recurring historical pattern of digital depth: a surface is breached, its interior domesticated through iteration and experimentation, its farthest reaches deemed too deep for mass adoption, and its verticality reined in through connections and synchronizations with orthogonal systems (sovereign states, laws, economies, etc.). This dynamic is evidenced by the parallels between the wizard-ruled MUDs and the hidden services of the Dark Web, which both pitch irreducible depths of arcane knowledge and illicit practices against the layered regimentation of infrastructural protocols like the OSI framework or megastructural models like the Stack (Bratton 2015).

As illustrated in this article, digital depth both derives from and defies established conceptions of volumetry: from databases to datasets, from randomly-generated corridors to machine learning algorithms, the *deep* runs in parallel with the *digital*, continuously yet unpredictably oscillating between structural description and metaphorical explanation, technical aspiration and mystifying imaginary. Even at its most fictional, digital depth is irrevocably patterned on the terrestrial, oceanic and cosmic depths that have structured modern and postmodern debates around the topic. Cyberspaces riddled by caves, corridors and dungeons, Deep Web icebergs floating over oceanic dark web abysses, computational systems spanning cloud servers and undersea cables, and stacked layers of artificial neurons hidden in the architectures of machine learning models. And yet, a remainder of epistemological incommensurability persists at the core of every aspect of digital depth, an uncomputable kernel that attracts attention and dares delving towards it: the perfect, infinite dungeon game; the bottom layer of the dark web; the hidden layer where the machine learns. This kernel, shared by many varieties of digital depth, is likely to be a trick of perspective, an externality of non-Euclidean dataspaces conceptualized through mundane spatial metaphors, but it still functions as an attractor around which imaginaries from folk theories to technical epistemes orbit, perturbing and influencing one another as their trajectories intersect. Andreas Hepp (2019) has suggested that the transformative relationship between media and society has entered a new historical moment:

> digitalization has seen us emerge into a new stage of mediatization which we can identify as *deep mediatization* […] an advanced stage of the process in which all elements of our social world are intricately related to digital media and their underlying infrastructures. (5)

According to Hepp, deep mediatization results from a combination of two features of the digital: increased interconnectivity and systemic layering (3-4). Digital media are not limited to communication, but their layered infrastructures afford the generation of data and the automation of large technical systems: depth is a feature of the current condition of mediation at large. Jeff Scheible (2021) has proposed that this new stage of mediation correlates to a substantively different "modality of depth," one that is "quantitative, datafied, and a dominant characteristic of computing technologies and epistemologies of the early twenty-first century," which he proposes to call "informatic depth" (106). This article concludes by combining these two concepts and arguing that the deep mediatization brought about by pervasive informatization has been accompanied by new varieties of digital depth. Thinking about the digital in volumetric terms helps avoiding binary oppositions and allows the multiplicity of different kinds of depth to unfold – some alongside diverging vectors, others across parallel or intersecting planes. From the narrative descents of text-based adventures to the multidimensional vector spaces of machine learning models, this multiple depth anchored by layering and interconnection might be an emergent and pervasive feature of the digital. As planetary computation and deep mediatization reshape societies around the globe, new models are necessary to conceptualize digital depth; combining megastructural scale and layered verticality, procedural generation and endless variation, the expanded concept of megadungeon proposed by this special issue might be a productive blueprint to speculate about depth and its relationship to the digital.

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