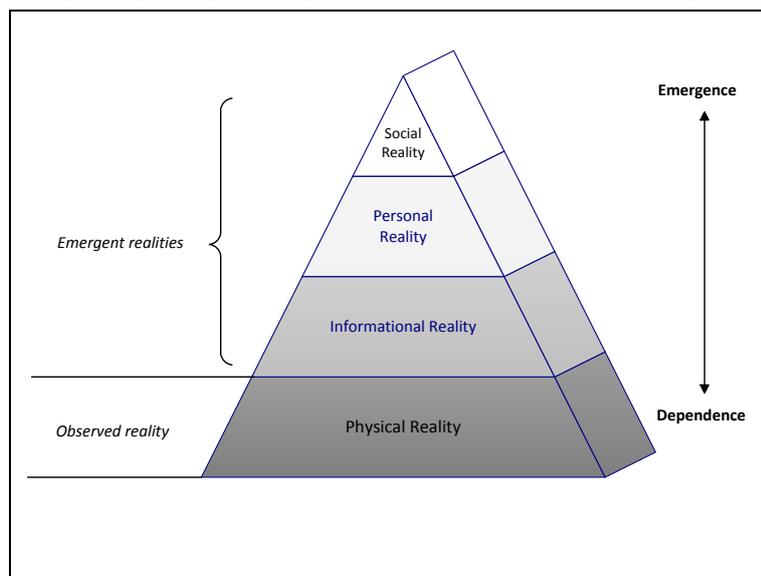


What is reality?

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We see a physical world around us but disciplines like sociology, psychology and computer science study social, human and information systems that are also real. The physical world underlies all science, but all science does not describe physical things, so modern computing design recognizes the four *levels* of reality shown in Figure 1 [1], where each is an



observer-selected *world view*. Each level depends on the one below to exist, but emerges as a new system when an observer sees the world in a new way. In this way, social structures emerge from personal meaning [2], meaning emerges from neural data and information emerges from physical brain events. In simple *reductionism*, all reality reduces to physical reality, then along comes a theory of quantum states that perfectly predict physical events given an observation. What this model represents, if anything,

Figure 1. Scientific realities emerge from physical reality

has been unclear for a century, but the options are as follows:

1. **Physicalism.** In this, the currently accepted view, the physical world is all there is, so the quantum states that predict physical events don't actually exist. They are just a fiction that happens to work, so as Bohr said: "*There is no quantum world*". Yet physicalism implies a weird world where one can detect object without physical touch [3], where time can flow backwards and things can instantly affect each other at any distance [4]. Physicalism not only contradict the facts of physics, it also defines quantum theory as a "theory of nothing" and light as a "wave of nothing", even though this makes no sense:

"... we accept as nonexistent the medium that moves when waves of quantum mechanics propagate." (Laughlin, 2005) p56.

Philosophical implications. In this view, everything is physical and so are we. Our *consciousness* is an epiphenomenon of neural complexity, so by 2050 robots will take over from us [5], and the end-state of the universe is, as Cox says, a cold, dark, lifeless emptiness¹. In this scientific nihilism, people are pointless, consciousness is a trick and the universe is doomed². Yet if the world *is* a machine, those who say so are machines too, so why listen to them? If we all really are machines, why bother to argue? To say we are all machines is like saying everyone is a figment of my imagination, futile.

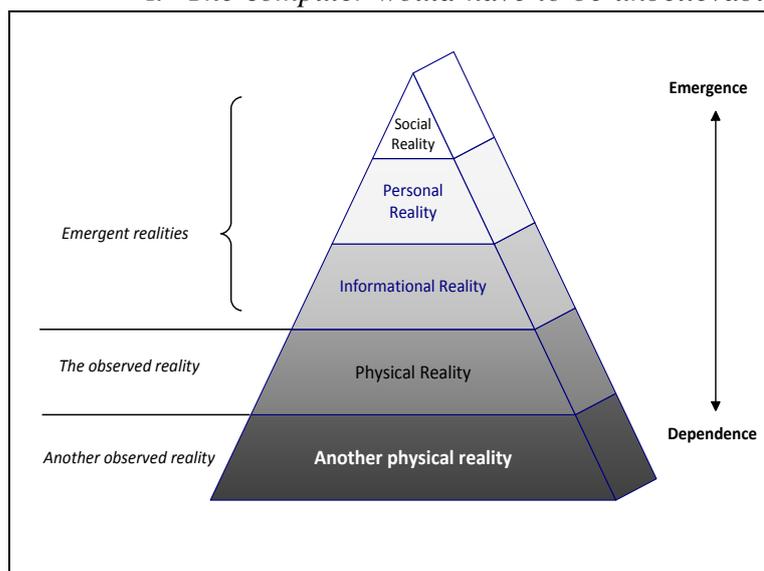
¹ By the second law of thermodynamics, the universe is expanding into disorder.

² So as in the Queen song: "*Nothing really matters – at all.*"

2. **Virtualism.** In this alternate view, the physical world we see is a *virtual construct* created by processing. As the *virtual reality conjecture*, it is a testable hypothesis that the physical world is just another reality view. It is a form of *idealism*, that physical world reflects a more fundamental reality. If the physical world is virtual then *there is a quantum world*, but views what it could be vary, as follows:

a. **Physical virtualism**, as in the movie *The Matrix*, another physical world, just like ours but apart, created the universe as a virtual construct (Figure 2). In this “other” world, some programmer wrote the code, set the initial conditions then ran it on a *really big computer*. The problems with this view are:

i. *The computer would have to be unbelievably big.* To handle the quantum processing of even a few molecules, a physical computer:



processing of even a few molecules, a physical computer:

“... would need more memory space that there are atoms in the universe as a whole, and would take more time to complete the task than the current age of the universe.” (Lloyd, 2006) p53.”

By the Church-Turing thesis, a finite program can simulate any specifiable output [6], and by quantum

Figure 2. Physical reality emerges from another physical reality

theory every output is specifiable, so a large physical universe *could* generate ours. Equally, our virtual time could be stopped and restarted unknown to us, so it *could* take a billion years to process a second of our time. In both cases, the magnitudes involved make these options unlikely.

ii. *Physical operations cannot do what quantum states do.* Quantum states in general don't act in physical ways, because they:

“... appear and disappear in a way that physical states can't, entangled quantum entities ignore the speed of light constraint, quantum entities tunnel past barriers no physical particle can pass ...” [Chap 1, p6.](#)

If what quantum theory describes is physically impossible, physicality cannot be its base

iii. *The turtle problem.* If our physical world by its nature is a virtual reality, the “other” physical world in Figure 2 needs another below it, and so on, giving a “turtles all the way down”³ problem.

³ In an apocryphal story, a scientist lecturing that the universe depended on nothing else was challenged by a little old lady who said it sat on the back of a giant turtle. He laughed, and asked her what the turtle was standing on, but got the reply “Sonny, it's turtles all the way down”. In this model, that answer fails.

Philosophical implications. In this view, we are in a *fake copy* of another real world, perhaps run by machines, aliens or beings from the future (maybe even us). We could be advanced beings on a “virtual trip”, but why come to our world of suffering? Unless it is a reform facility, where when we die we get a debrief (the last judgement) and are either sent back (reincarnate), retire to a rest home (heaven) or get penal servitude (hell). As anyone can make up any story they like about this other world, the reader is free to believe what they wish.

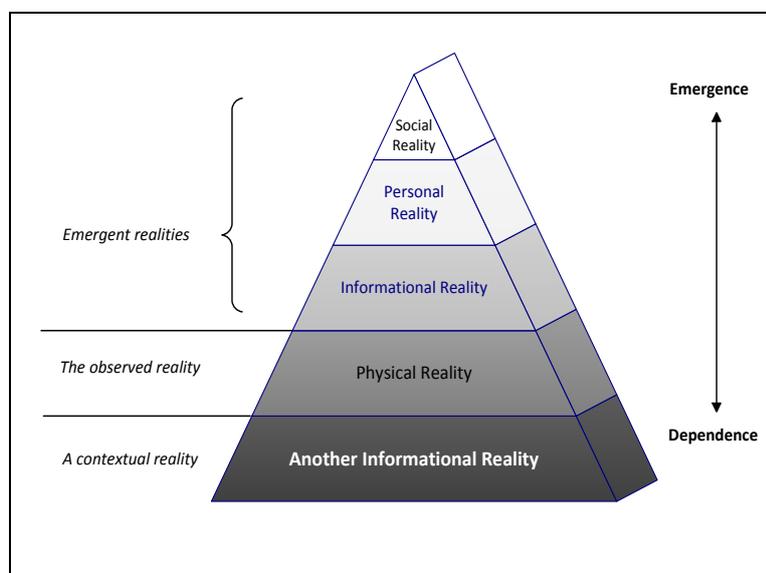


Figure 3. Physical reality emerges from another information reality

b. **Information virtualism.** Is that a *big program* creates a physical world, but its base is either non-existent or irrelevant. We write code without stating the platform, so why can't a program exist without an implementation? In this view, *below physical reality is an information reality* again just like ours but apart (Figure 3). In support, a classical program can simulate a quantum logic gate, which in theory allows quantum collapse, entanglement and superposition, so the quantum world *could* be classical processing in another context.

The problems now are:

- i. **Performance.** In theory, the only difference between classical and quantum processing is magnitude, but if an electron quantum wave spread over a galaxy collapses to a random point, that one event is beyond our best supercomputers⁴. Suppose a ton of earth came over a wall we could not see beyond. If our only tool was a teaspoon, we could argue that many teaspoons did it, but the more likely answer is a dump-truck on the other side. Classical processing, based on the bit-teaspoon, explains quantum mechanics *in theory* but not *in practice*⁵.
- ii. **Software needs an implementation base.** Software can be *specified* without hardware but requires hardware to *run*. It alone is just a set of symbols, no different from Egyptian hieroglyphics. Processing *by definition* changes information that *by definition* has implementation states, so there can be no processing without *some* implementation base. So the “other” information level in Figure 3 needs a physical level below it, raising the issues of #2a.
- iii. **Classical processing can't do what quantum states do.** The nature of any processing depends on its implementation base. *Classical processing* is based on the *bit*, a choice of one of *two* physical states each in one place at

⁴ A Milky Way volume of 1.6×10^{60} cubic meters divided by a Planck volume of 4.2×10^{-105} cubic meters is about 551 bits, which for a 10^{-43} seconds Planck time is over 5×10^{45} Hertz of processing power for one quantum event. As our best supercomputers are only just breaking the PetaHertz barrier (10^{15} Hertz), to calculate even the simplest quantum processes takes months or even years.

⁵ As Yogi Berra said: “*In theory, there is no difference between theory and practice. In practice, there is.*”

one time. *Quantum processing* is based on the *qubit*, a choice that includes both physical states. If this makes no sense, join the club, but *a quantum state can be two physical states at once*. Quantum processing is so powerful because quantum states are not limited to physical states.

- iv. *A simulation is not evidence*. Simulations that do not expose themselves to the rigor of prediction are not scientific theories. Saying a model describes reality when it works but tweaking it when it doesn't isn't science, as the standard model forgot (see [Chap 4.6.4](#)). That a classical program can emulate a quantum logic gate is not admissible as evidence in the court of science unless a new prediction is made.
- v. *The context problem*. Classical processing changes information that by definition needs a context [7]. A bit as the OR choice of two physical states is contextual, as it only exists relative to the *state not chosen*. If quantum processing were so, it would need a context to hold the non-chosen states, giving another infinite regress, but a qubit that includes the AND of the options is context free ([Chap 2.2.1](#)).

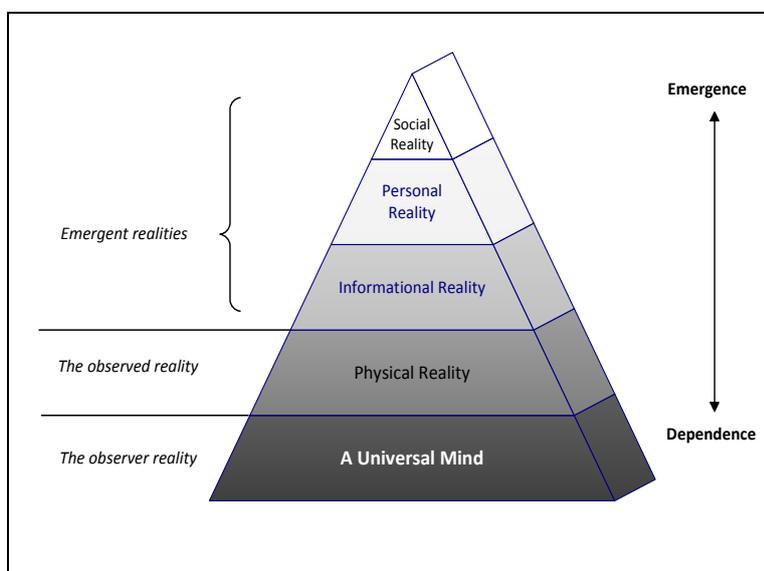


Figure 4. Physical reality emerges from a universal mind

Philosophical implications. In this view, reality comes from a *big program* but where *it* comes from doesn't matter. Some grand designer made the rules, wrote the code, set the start parameters "just right" [8], then booted it up at the big bang. It's been running since then, apart from the odd "tweak" miracle or saint to realign it. If all is software the paranormal is possible and if *everything is code*, I could be uploaded and downloaded⁶ to my own virtual "heaven", with spouse and kids at my preferred age of say 35, or with the 72 virgins the Hadith writers added

to the Koran. Yet isn't a virtual heaven still a fake? And isn't a world run by code mechanics just as deterministic as one run by physical mechanics? Did the system designer start it up then walk away for 14 billion of our years, like an absentee landlord, or watch it the whole time, like the ultimate voyeur? Is our world the last update, or an early beta release put out for user testing? Do later versions have better rules, like not rewarding evil say? Again, anyone can take any view, so the reader can believe as they wish.

- c. **Mind virtualism.** Is that a *universal mind*, like ours but bigger, creates reality (Figure 4). In traditions like the Vedas, reality is the dream not of a personal mind, as in solipsism, but of a *universal mind*, that somehow feeds information channels to its sub-minds to give the reality we see. The problems here are:

⁶ See http://en.wikipedia.org/wiki/Mind_uploading

- i. *Performance.* Feeding billions of people a “story” of a universe of billions of galaxies interacting for billions of years of history is a multi-person dream of staggering proportions. How is consistency maintained?
- ii. *What is real?* If you and I are part of the universal mind, what about dogs? Are they just in of our imagination? If not, what about insects? A psychopath treats other *people* as unreal, so is killing an insect like that? Yet as Rumi said: “*I was a mineral that became a plant that became an animal that is now a man*”, so are rocks an aspect of the universal mind? If we are players fed a data-stream background, where is the line between player and data?
- iii. *How come the quantum?* If a higher mind is projecting a lower world, why invent quantum states that create physical states? It seems unnecessary for a mind that just says “be” and it is. Does the universal mind *tailor* the data channel detail, so simple people get a simply story while physicists get the complexity of quantum theory?

Philosophical implications. If the world is a multi-player dream, what we do in it doesn’t really matter, although a law of karma could feed our past acts back to us in the future. Yet why would a supreme mind torture itself with the story of our world, of disease, murder and accident? If I dreamt a world, it would be better than this one. It also assumes a universe that can be bothered to make up a big story to fool us, cf. one got along fine for billions of years before we came along and will barely notice if we die out, as we may be one of many conscious beings it has thrown up. Again in this theory, one can invent what the supreme mind does without limits.

- d. **Virtual realism.** In this view, a quantum world exists but it isn’t physical, nor does it emerge from the physical, as classical processing or a brain-based mind. It is something else entirely, that quantum theory describes even as it denies it exists. Not assuming a physical base avoids the performance problems that gives. A non-physical grid avoids a physical regress, quantum processing avoids the contextual regress and an observer-based reality level avoids an observer regress. This *monism*

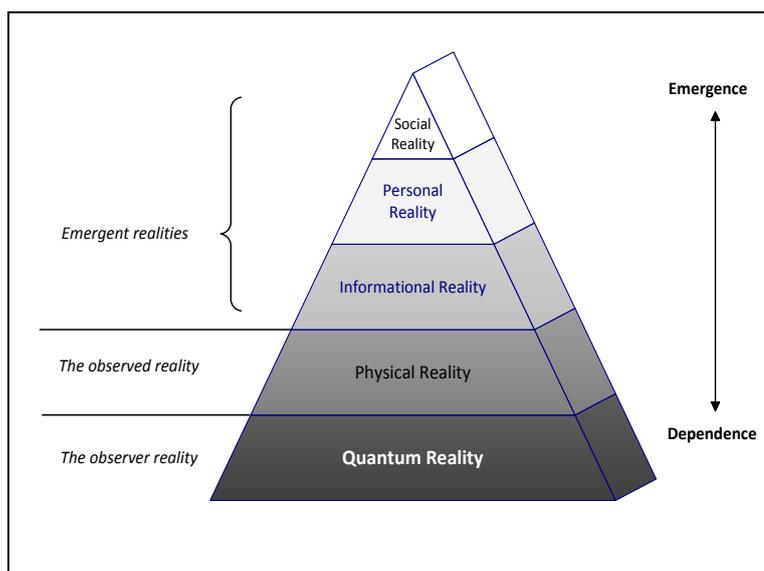


Figure 5. Physical reality emerges from quantum reality

has only *one* reality, but the physical world isn’t it. If all reality is *the observer and the observed, the self and things*, nothing else is needed, so this model has:

- i. *No other place.* If there is no other place for a programmer, program, or data to reside, there is no uploading or downloading, as there is nowhere to upload to or download from. This quantum flux is processing without storage, yet if it stopped,

the mountains, seas and sky we take for granted would disappear instantly, like a movie that is over.

- ii. *No parameters.* Some say the universe is just right for life [8] by accident while others see a beneficent creator, but this model has neither. The first event created one photon in one volume of space, and everything else evolved from that, with no need to “set” anything.
- iii. *No central control.* Like an orchestra with no conductor, this system has no central processing unit (CPU) to keep time, or direct events. Each node, or point of space, does its own thing, with no central control.
- iv. *No errors.* If I pick option A over B and it fails, it is an error, but an evolution given options A and B takes both, so if one doesn’t survive there is no error, and if both fail there was no alternative. Likewise, quantum processing tries all *possible* physical options, so it doesn’t err in our sense but creates: “*the best of all possible worlds*”. Matter is here a “glitch” in the sense of a system overload, not an error.

So far, this project suggests some rather startling conclusions:

- i. *Everything is a free actor/observer.* By Conway’s Free Will theorem [9], if any part of the universe, like us, has free will, then it all does, while if any part, like an electron, doesn’t, then none of it does. So in this model, everything is a free observer, including an electron. The difference between us, animals, insects and rocks is *self-awareness*, and is a continuum.
- ii. *Empty space is full.* This model has no emptiness, as empty space is a null program not nothing. We see space as nothing, but as a blank screen is still a screen, not nothing at all. Likewise space is just no output, not nothing.
- iii. *Matter is light condensed.* In the current view, particles are fundamental but in this view matter evolved from light. The prediction that everything began with light is fundamental to this model ([Chapter 4](#)).
- iv. *We are the programmers.* If the physical world is an output who is writing the program? If each choice made, random or not, is the program, we are all on this programming team.

This bottom up approach is not speculative, as it starts with what we see. To *reverse engineer the physical world* is not to make things up, as the model must match both empirical science and a program logic. Working back from physical reality can deduce reality and satisfy science.

Philosophical implications

This monism has no heavenly place apart from here, no program apart from our now choices, and no control levers apart from those of the virtual construct, so we are both puppet *and* puppeteer. This dynamic processing can’t be saved, uploaded or rerun, because in our world:

“The moving finger writes, and having writ moves on, nor all thy piety nor wit can lure it back to cancel half a line.”

The physical world is an interface that mediates reality, not a fake version of some other reality. The manifest world *mediates* the real so it is virtual not fake, just as an email created from information can mediate a real friend. Nor

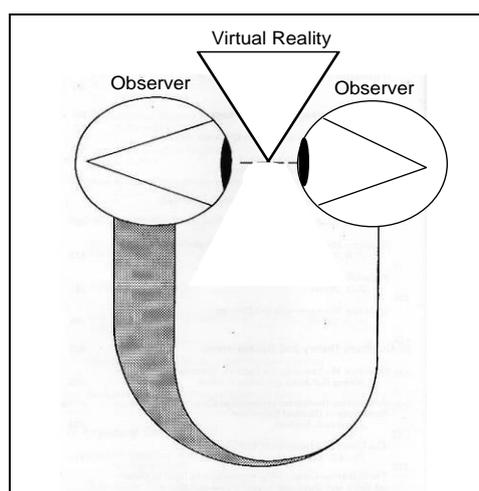


Figure 6. A quantum reality sees itself
observed is just imagination.

That there is *universally* only the observer and the observed is supported by quantum and relativity theory. So if the observer is virtual, science must ask: “*What is the observer?*” This question has baffled humanity for millennia, and the question “*What does quantum theory represent?*” is the same in physics today, as no progress has been made on it in a century. This model doesn’t answer these questions, as quite frankly we don’t know, but it implies that they are the same question. If a quantum reality observing itself is creating a physical construct in order to do that (Figure 6), then to ask “Who am I?” and “What is reality?” is to ask the same question. In this approach, rather than being inside a body looking out, one is outside a virtual world looking in.

The bottom line for physics is that what quantum theory describes is neither magical nor lawless, so why can’t it exist? The tradition of physicality is not a reason in science, and no case has ever been made for it [10]. If it is not so, it shouldn’t be a surprise that what creates the physical is not itself physical. Equally, to see quantum reality as deriving in any way from physical reality is to repeat the same error⁷. A better approach is to accept the quantum world as something entirely new, and try to understand it.

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⁷ Which is anthropomorphism, to see everything in our terms, so what we see is real because *we* see it.

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This project currently has the following parts:

1. [The physical world as a virtual reality](http://brianwhitworth.com/BW-VRT1.pdf). Link: <http://brianwhitworth.com/BW-VRT1.pdf>
2. [Simulating space and time](http://brianwhitworth.com/BW-VRT2.pdf) Link: <http://brianwhitworth.com/BW-VRT2.pdf>
3. [The light of existence](http://brianwhitworth.com/BW-VRT3.pdf). Link: <http://brianwhitworth.com/BW-VRT3.pdf>
4. [The matter glitch](http://brianwhitworth.com/BW-VRT4.pdf). Link: <http://brianwhitworth.com/BW-VRT4.pdf>

The following parts are not yet completed:

5. Bit-shifting space (gravity and how matter moves)
6. The ego illusion (the psychology of the “self”)
7. Who am I and what is real? (the philosophy of quantum theory)