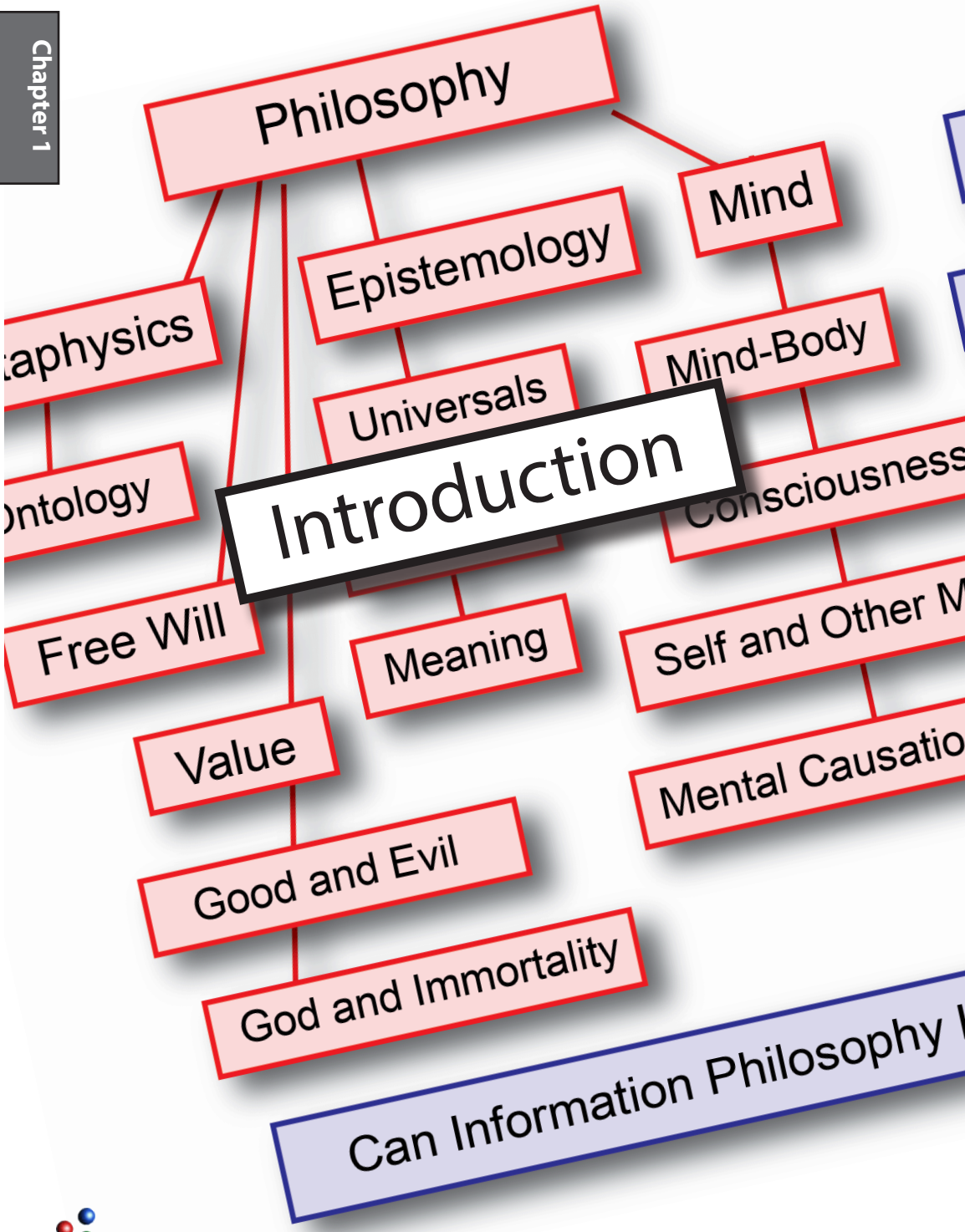
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Introduction

Information philosophy is a new methodology for diagnosing and analyzing plausible solutions for several great philosophical problems, many with us since antiquity. It hopes to take philosophy, and the philosophy of sciences like physics and biology, beyond logical puzzles and language games.

The information philosopher proposes information as the preferred basis for examining current problems in a wide range of disciplines - from information creation in cosmology to measurement information in quantum physics, from the emergence of information in biology to its role in psychology, where it offers a solution to the classic mind-body problem and the "hard" problem of consciousness. And of course in philosophy, where failed language analysis can be replaced or at least augmented by the analysis of *immaterial* information content as the basis for justified (if not "true") beliefs and as a ground for objective values.

The immodest goal of information philosophy is to restore philosophy to its ancient role as the provider of first principles to all other systems of thought.

Information philosophy is a *philosophical system,* the first since the nineteenth century, because it makes the somewhat extravagant claim that analysis of the information content, its creation, processing, and communication, can provide profound insight into problems of philosophy, physics and biology that have so far not yielded acceptable solutions.

Just as analytical language philosophy is not the philosophy *of* language, so information philosophy is not the philosophy *of* information, with its focus on the philosophy of computers and the proper uses of information technology.

Information is physical, but it is *immaterial*, and as such, it enters the realm of the *metaphysical*. Information is neither matter nor energy, though it needs matter for its embodiment and energy for its communication. Information is the modern *spirit*.

Although the tagline of information philosophy is "beyond logic and language," the information philosopher uses logic (while noting that logic alone can tell us nothing about the physical world) and of course information philosophy is written in a language, despite the fact that the fundamental ambiguity of words makes precise communication difficult and despite the inability of twentieth-century linguistic analysis to make much progress in philosophy.

As the possible ground for all thought, information philosophy may be a sort of metaphilosophy. Quantitative information comes close to Gottfried Leibniz's ideal ambiguity-free language, though the problem of meaning[1] remains irreducibly contextual.

The strength of information philosophy comes from embracing and incorporating quantitative new knowledge from physics, biology, and neuroscience - but above all, from the fields of information theory and information science.

This raises the bar for young philosophers. In addition to doing clear conceptual analysis of problems and knowing the history of classic philosophical problems, they may now have to master some concepts from quantum mechanics, thermodynamics, molecular biology, neuroscience, and cosmology.

So beyond the words and images in this book, the I-Phi website provides animated visualizations of the most basic concepts that you will need to become an information philosopher.

These visualizations are dynamical and interactive models of what is going on at the most fundamental level of reality. They let us directly *show* concepts that may not be easily *said*.

Some of these concepts are familiar philosophical ones that we hope information will explain more clearly. Some are scientific concepts that every philosopher should know today. Other ideas are novel and unique to information philosophy.

1 See chapter 11 for more on the meaning in information.

The New Ideas of Information Philosophy

Here is a quick summary of several key ideas you should know which play major roles in the rest of this book.

1) *Possibilities exist*. Their existential status is problematic, because possibilities are not things, not physical material objects. They belong to the Platonic realm of ideas, an "ideal world" contrasted with the "material world." We will discuss the status of possibilities as a problem in metaphysics. Metaphysicians today defend *necessitism*, especially the necessity of identity. We will defend a *metaphysical possibilism*.

Note that the "possible worlds" of metaphysicians like David Lewis and the "many worlds" of physicists like Hugh Everett III are perfectly deterministic. Actual possibilities mean there is more than one possible future.

2) *Chance is real*. Without chance and the generation of possibilities, no new information can come into the world. Without chance, there can be no creativity. Without the creation of new information, new ideas, the information content of the universe would be a constant - "nothing new under the sun." In such an eliminatively materialist and determinist world, there is but one possible future. Possibilities are metaphysical and chance is ontological.

3) *Determinism is an illusion*. Determinism has had a long and successful history in philosophy and physics, but it is an unwarranted assumption, not supported by the evidence. The material world is quantum mechanical, and ontological chance is the result of quantum indeterminacy. An *adequate* and *statistical* determinism does *appear* when macroscopic objects contain large numbers of microscopic particles so that quantum events can be averaged over.

4) *Knowledge is an isomorphism*. Information *represents* a concept or an object better than an imprecise description in language. Information is the *form* in all concrete objects as well as the *content* in non-existent, merely possible, *abstract entities*. Knowledge is an *information structure* in a mind that is a partial *isomorphism*

(a mapping) of an information structure in the external world. Information philosophy is the ultimate *correspondence* theory.

4) *Beyond language*. But there is no isomorphism, no information in common, no necessary connection, between *words and objects*. Although language is an excellent tool for human communication, its arbitrary and ambiguous nature makes it ill-suited to represent the world directly. Language does not picture reality. Is is not the best tool for solving philosophical problems.

5) *The experience recorder and reproducer.* The extraordinarily sophisticated connection between words and objects is made in human minds, mediated by the brain's experience recorder and reproducer (ERR). Words stimulate neurons to start firing and to play back relevant experiences that include the objects. The neuroscientist Donald Hebb famously said that "neurons that fire together get wired together." Our ERR model says neurons that were wired together by old experiences will fire together again when a new experience resembles the old in any way, instantly providing guidance to deal with the new.

6) *Dynamic models*. The elements of information philosophy, *dynamical models of information structures*, go far beyond logic and language as a *representation* of the fundamental, metaphysical, nature of reality. They "write" directly into our mental experience recorders. By contrast, words must be *interpreted* in terms of earlier experiences. Without words and related experiences previously recorded in your mental experience recorder, you could not comprehend spoken or written words. They would be mere noise, with no meaning. Compare these two representations of a cat.

Figure 1-1. Linguistic and picture/model representations compared.

Compared to a spoken or printed word, a photograph or a moving picture with sound can be seen and mostly understood by human beings, independent of their native tongue.

Computer animated dynamical models can incorporate all the laws of nature, from the differential equations of quantum physics to the myriad processes of biology. At their best, such simulations are not only our most accurate knowledge of the physical world, they are the best teaching tools ever devised. We can transfer knowledge non-verbally to coming generations and most of the world's population via the Internet and ubiquitous smartphones.

A dynamic information model of an information structure in the world is presented immediately to the mind as a look-alike and act-alike simulation, which is experienced for itself, not mediated through ambiguous words.

7) *Laws of nature are statistical*. Because microscopic atomic processes are governed by quantum physics, which is a *statistical* theory, all laws of nature are in fact statistical laws. They give us probabilities, not certainties. When material objects contain large numbers of atomic particles, the statistical uncertainty approaches zero and the laws are *adequately but only statistically deterministic*.

Quantum mechanical *probabilities* (Erwin Schrödinger's wave functions) evolve deterministically and continuously according to the Schrödinger equation, but the *actual* outcomes occur discontinuously and *statistically*. While this may seem like a logical contradiction, it is not.

The average value of *possible* particle positions moves according to classical mechanical laws, but the *actual* positions where particles are found are indeterminate (random), following quantum mechanical laws. The "determinism" we have is only an "adequate" *statistical determinism*.

8) *Entropy and the Second Law*. Abstract immaterial information is mathematically, phenomenologically, and experimentally related to a physical quantity in thermodynamics and statistical mechanics called the entropy. The second law of thermodynamics

says that, left to itself, a closed system approaches a state of maximum entropy, or disorder. This change is "irreversible," without an input of free energy and information (negative entropy) from outside the system.

A *closed system* cannot spontaneously increase its information structure, rearranging its material to contain more information. It can of course spontaneously decay, and will do so according to the second law. The approach to equilibrium destroys information. The lost information equals the amount of entropy (disorder) that is gained. Information is sometimes called *negative entropy*, the amount by which a system is below the maximum entropy possible.

9) *The universe is open*. It began in a state of total disorder, with the maximum entropy possible for the initial conditions, some 13.75 billion years ago. How then can the universe today contain such rich information structures as galaxies, stars, and planets like Earth, with its rich biological information-processing systems? This is the fundamental question of information philosophy.

The answer is that the maximum entropy of the early universe was tiny compared to the maximum possible entropy today, as a result of the expansion of the universe. And because the universe has not had time to reach its potential maximum of disorder, new information (negative entropy) has been and is now being created.

The expansion of the universe is the fundamental *arrow of time*.

10) *Negative entropy has value*. The source for all potential information can be a basis for objective value.

11) *The cosmic creation process*. Information philosophy explains the creation, the *emergence* of new information in the universe as a two-step process beginning with a quantum event (in which possibilities become actualized) and ending with some positive entropy carried away from the resulting low-entropy information structure, to satisfy the second law. [2]

This process explains the creation of every single bit of information, whether the formation of a hydrogen atom from a proton

2 See appendix F for more details.

and electron, a complex physical measurement like discovering the Higgs boson, or the creation of a new idea in a human mind.

12) *The two-stage model of free will*. Since every free act creates information, free will is intimately related to cosmic creation, beginning with the generation of *alternative possibilities* for action.

13) *Information is history*. The material particles of physics and chemistry carry no history. Their paths do not tell us where they have been in the past, though some deterministic physicists think so. Cosmological objects do have an evolutionary history. And so does biology. Matter and energy (with low entropy) flows through living things, maintaining their dynamical information structures.

To discover the origin of life, it will be easier to work backwards in time through the history of biological evolution than to start from physics and chemistry that knows nothing of information.

The Three Worlds of Information Philosophy

There is an over arching idea that provides a high-level view of the role of information. It is the notion that the "world" can be divided into "worlds" based on the ancient dualist view, a material world in the here and now and an ideal world above and beyond it, "outside space and time," some think.

Beyond the dualism, many philosophers have argued for a "third world" between these two. Information philosophy strongly defends this notion of a third world, which is distinguished by the interaction of abstract information processing and concrete information structures in the world of living things.

The great logician Gottlob Frege distinguished three "realms;" an external realm of public physical things and events, an internal subjective realm of private thoughts, and an "objective" Platonic realm of ideal "senses" (to which sentences refer, providing their meaning).

Karl Popper (very likely influenced by Frege) made the case for a World I - the realm of physical things and processes, a World II - the realm of subjective human experience, and a World III - the realm of culture and objective knowledge.

Charles Sanders Peirce proposed a triad of Objects, Percepts, and Concepts, which maps well onto the realms and worlds of Frege and Popper.

Information philosophy agrees with these fundamental divisions, but defines them based on the different roles played by information in each world. The three "worlds" of information philosophy are symbolized in our tricolor logo (the colors are visible on the book cover and on our website). The material world is the lower green ball. The biological world is the middle red ball, and the ideal or mental world is the upper blue ball.

We see the biological world as mixing matter from the material world and form from the ideal world. It is much larger than Popper's world of subjective human experience. All living things have experiences and the experience recorder and reproducer (ERR) model of information philosophy lets us understand better "what it's like to be" a conscious living thing by analyzing its experiences.

The biological world is unique in that it not only creates but also processes and communicates information.

The mental world is an *immaterial* world, a world of pure information, the stuff of thought and of philosophy.

We can identify three different roles for information in these three worlds - the purely material, the biological, and the mental.

But we shall see in appendix F that information creation in all three worlds involves the same fundamental process of physical information creation that is common to all creation processes, from the largest galaxies down to the composite matter of nucleons, atoms, and molecules built up from the fundamental particles of physics - quarks, gluons, photons and electrons,

We will show that this cosmic creation process is also present in all biological information creation, including the creation of new ideas in human minds. Understanding this process is vital to the solutions of several of our problems in philosophy and the philosophy of physics.

Information Creation in the Material World

The physical world of material objects, often described by philosophers as the "external world," could not be perceived or distinguished as individual objects if it did not have observable shapes or forms. If the matter were in a state of thermal equilibrium, maximum disorder or entropy, it might resemble the interior of a cloud, uniform in appearance in all directions. The early universe was just such a haze for the first few hundred thousand years. There was no permanent information structure larger than sub-atomic matter and energy particles (quarks, electrons, gluons, photons, protons, and neutrons).

The physical shapes that we do see - the sun, moon, and stars, the mountains and rivers - are the result of physical processes that created the quantifiable information in those shapes and forms. Cosmologists, astrophysicists, and geophysicists have specific models of how visible material objects like galaxies, stars, and planets came into existence and evolved over time.

But, and this is new and philosophically significant, the early universe did not contain the information of later times, just as early primates do not contain the information structures for intelligence and verbal communication that humans do, and infants do not contain the knowledge and remembered experience they will have as adults.

Creation of information in the material world can be described as the "order out of chaos" when matter and radiation first appeared and the expansion of the early universe led to the gravitational attraction of randomly distributed matter into highly organized galaxies, stars, and planets. The expansion - the increasing space between material objects - drove the universe away from thermodynamic equilibrium, increasing the positive entropy and, somewhat paradoxically, at the same time creating negative entropy, a quantitative measure of the order that is the basis for all information. Material information structures were *emergent*.

Information Creation in the Biological World

A qualitatively different second kind of information creation was when the first molecule on earth replicated itself and went on to duplicate its information exponentially. Accidental errors in the duplication provided variations in reproductive success, the basis for evolution. But most important, besides being information creators, biological systems are also *information processors*. Living things use information to guide their actions. All biological systems are built from communicating "cognitive" elements.

Biology is physics and chemistry plus information.

Many biologists have explored the role of information in biological processes. We want to emphasize that all living things are biological information processors, precursors of our man-made information-processing machines. Whereas computers are assembled by humans, even in the case of computers that we design to assemble other computers, biological information processors assemble themselves from atoms and molecules.

Biological evolution can be viewed as a story of information-processing systems becoming steadily more powerful and sophisticated. With the appearance of life in the universe came *teleonomic* purpose. This biological purpose is not a *telos*, an essence preceding the existence of life, but life, once existing, striving to maintain and improve itself. The earliest philosophers, especially Aristotle, recognized this as a unique characteristic, perhaps the defining characteristic, of living things. He called it "*entelechy*," meaning "to have a purpose within."

Matter and energy are conserved. There is the same amount of $E + mc^2$ today as there was at the universe origin. But information is not conserved. It has been increasing since the beginning of time. Everything emergent[3] is new information.

Living things are dynamic and growing information structures, *forms* through which matter and energy continuously flow.

And it is information processing that controls those flows, usually putting each atom or molecule in an appropriate place!

3 See chapter 27 on emergence

Information Creation in the World of Ideas

The third process of information creation, and the most important to philosophy, is human creativity. Almost every philosopher since philosophy began has considered the mind as something distinct from the body. Information philosophy provides a new explanation for that critical distinction.

We see the concrete physical information structures of the universe evolving to create abstract information creation and processing systems. Human beings are the current pinnacle of that evolutionary process, especially as we are conscious, indeed self-conscious, of our role externalizing information, sharing knowledge with our fellow human beings and guarding it as our most important gift to future generations.

For better or worse, it is knowledge, pure information, that provides humanity with the Baconian power we have to dominate our planet. Subverting traditional notions of economic scarcity and of fundamental limits to material resources, information creation has continuously provided new and different ways to use the existing material of our planet as new resources.

We identify the mind with the *immaterial* information in the material brain, the knowledge acquired through a combination of heredity and experience. The brain, part of the material body, we see as a biological information processor. As many philosophers and cognitive scientists have speculated in recent decades, the mind is indeed software in the brain hardware.

What Does Creation of Information Mean?

Creation means the coming into existence, the "emergence," of recognizable information structures, from a prior chaotic state in which there was little recognizable order or information.

This fact of increasing information describes very well an undetermined universe with an open future that is still creating itself. Stars are still forming, biological systems are creating new species, and intelligent human beings are co-creators of the world we live in. We are the authors of our lives.