

An Introduction to The Art of Logic

(pre-print publication, January 2024)

This essay is a theoretical *introduction* to the art of logic, and serves only as a base.

Not many 'accepted sources' provide any explanation of "what logic is" starting at the *proper starting point* (e.g. those who take "set-theory", a branch of Mathematics, in the form of the "null-set" as the base of logic.) Also: many of the classical and contemporary works of logicians contain errors, contradictions (e.g. those who attack "ostensive definition", those who attack "the validity of the senses", etc.), or their theories are simply formed 'in a vacuum', meaning *without any connection to reality*.

Logic is properly the subject of the branch of Philosophy called "epistemology", i.e. the science that studies the methods of acquiring and validating knowledge.

I stand with *Aristotle* and *Ayn Rand* on the definition, positioning and validity of the Laws of Logic, and (as later explained) with *Richard Feynman* on the scientific method.

I term the demarcation of the perspective on science that follows from the integration of these two perspectives as the "*Rand-Feynman demarcation*"; and its function is to demarcate and integrate *Philosophy* and the *Philosophy of Science*. Let's however start at the beginning.

What are the laws of logic? There are three classical laws of logic: one, with two corollaries:

1. *The Law of Identity* (which states that "A is A")

and its two corollaries:

2. *The Law of Excluded Middle* (which states that something either *is* or *is not*, also known as "either-or")

3. *The Law of Non-Contradiction* (which states that A cannot be A and non-A at the same time, in the same respect)

These are the classical laws of logic as formulated by *Aristotle*. There exist many corollaries and derivations, but these are merely *applications*. These three laws cover the base of logic.

All knowledge, including any knowledge of method, is knowledge *of things relating to reality*.

The concept of "logic" therefore needs to be *based on reality* to be considered a valid concept.

The concept, like any other, does not form in a vacuum, nor can it be defined 'mid-stream'.

To analyze where in reality the concretes exist that give rise to such a concept as logic, we will apply *Ayn Rand's "power question"*: What facts of reality give rise to the need for such a concept?

The facts of reality that give rise to the need for the concept of "logic" are:

- *The Primacy of Existence*: wishes and beliefs do not change facts.

- Perception only *perceives* reality, i.e. what is there 'already'; perception does not *create* reality;

- *The specific identity of Man's consciousness*:

- Man is born "tabula rasa" (without any 'inborn' or 'automatic' knowledge);
- Man has "volition": Man must choose to think and to judge (e.g. integrating his percepts into concepts); Therefore,
- Man is not omniscient nor infallible (ignorance and error is possible);

Man needs a method of validating his conclusions – a way to avoid conceptual errors.

This method is what is denoted by the term "logic". (NB: this is not a definition, only its setup)

Logic as such is not an empirical science – and it does not make any concrete statements about reality. It is a *science of method*, in the same way and for the same function as Mathematics is.

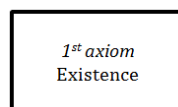
Logic is the cognitive method that guides Man to take the right mental steps to gain correct knowledge of reality. In *Ayn Rand's* formulation: "Logic is the art of non-contradictory identification".

The method of mathematics concerns itself with *steps of measurement* to arrive at conclusions. The method of logic concerns itself with *steps of logical inference* to arrive at conclusions.

Now let's build up logic all the way from its base in Metaphysics:

In the same way and for the same reason the concept "logic" cannot be formed mid-stream or 'in a vacuum', so it is true for the concept of "philosophy". The (only) valid *starting point* of philosophy as such, i.e. of the entire system of philosophy, is:

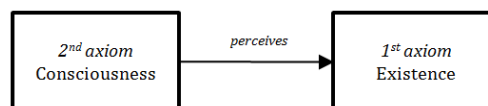
Ayn Rand: "Existence exists."
(in the words of ancient Greek *Parmenides*: "What is, is.")



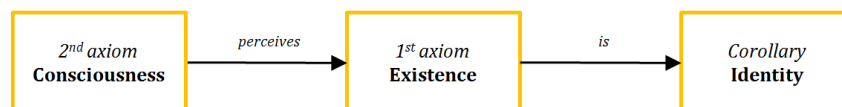
"Existence" is *ostensively identified*, meaning: by pointing your finger out in front of you, sweep your arm around making a circle and saying: "I mean *this*". The "existence axiom" is the first- and base axiom, the primary identification on which the entirety of the *system of Philosophy* rests.

"Existence exists, and the act of grasping this statement implies a second axiom: that one exists possessing consciousness. Consciousness being the faculty which perceives that which exists."

- *Ayn Rand, Atlas Shrugged, Galt's Speech*



Simultaneously one can conclude that "to exist" means "to possess identity". This is the *Law of Identity*, in the traditional formula: *A is A*. A thing is itself. And to be, is to be *something*. This fundamental fact can not be broken in two. This forms the three foundational *axiomatic concepts*: "Existence", "Identity" and "Consciousness".



The units of the concepts "existence" and "identity" are every entity, attribute, action, event or phenomenon (including consciousness) that exists, has ever existed or will ever exist.

The units of the concept "consciousness" are every state or process of awareness that one experiences, has ever experienced or will ever experience (as well as similar units, a similar faculty, which one infers in other living entities).

One can study what exists and how consciousness functions; but one cannot analyze (or "prove") existence as such, or consciousness as such. These are *irreducible primaries*.

(An attempt to "prove" them is self-contradictory: it is an attempt to "prove" existence by means of nonexistence, and consciousness by means of unconsciousness.)

Another formulation: you *cannot escape* axioms, any attempt to deny them involves their use. These most broadest of concepts, implicit in all knowledge, are termed "axiomatic concepts".

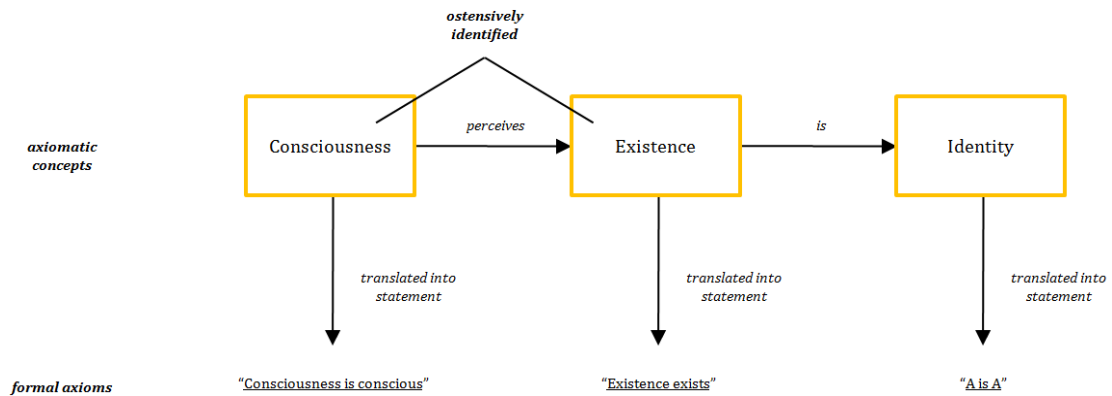
The concept "identity" does not indicate the particular natures of the existents it subsumes; it merely underscores the primary fact that *they are what they are*.

Ayn Rand's summarizing formula: "*Existence is Identity, Consciousness is Identification*"

Converting ostensive definitions to formal axioms

"[The] underscoring of primary facts is one of the crucial *epistemological functions* of axiomatic concepts. It is also the reason why they can be translated into a statement only in the form of a repetition (as a base and a reminder): Existence exists—Consciousness is conscious—A is A."

– Ayn Rand, Introduction to Objectivist Epistemology, Axiomatic Concepts



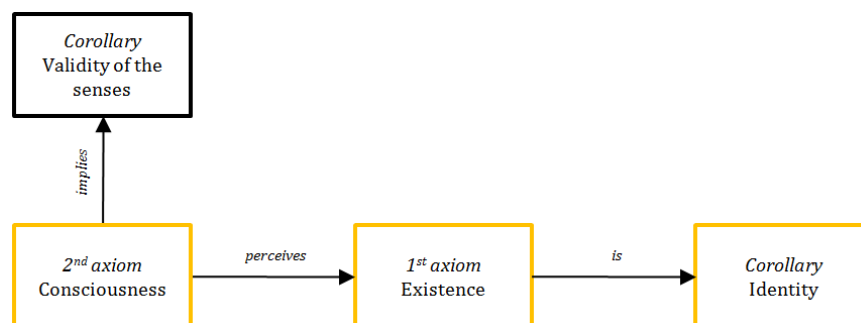
This converts axiomatic concepts into formal axioms:

"Existence exists", "Consciousness is conscious" and "A is A" (The Law of Identity).

NB: Here, on this fundamental a level of formal philosophy, *a great many* people already start rebelling against reality and won't accept nor integrate these axioms to be the base of their knowledge – and will instead psychologically opt to *rewrite reality* to rationalize their feelings, wishes and whims e.g. (falsely) asserting that consciousness *creates* reality.

The validity of the senses as an axiom (anteroom of epistemology)

Widespread rebellion also exists towards the *validity* of the material provided by the senses. Sense-perception however is an *axiom* – and it is the foundation for all knowledge of reality. Reason is not omniscient nor infallible, but to deny one's *point of contact* with reality, is to evict your consciousness from reality completely. Any denial of the validity of the senses is merely a form of the conceptual fallacy of the "stolen concept" (the attempt to use a concept in a way that ignores or denies the prior concepts on which it depends for its meaning) – as it will necessarily involve its use.



Here we'll end the discussion on the axioms of Metaphysics. (Metaphysics is essentially the step-by-step development of the corollaries of the existence axiom, and a strictly delineated field.)

Differentiating Philosophy from Cosmology:

Let's observe what happens when *detailing* the concept of "existence":

Existence: - everything that exists, has ever existed or will ever exist

Nature: - adds the notions of existence as structured, active, interrelated processes

Reality: - adds the notion that a consciousness is witness to existence existing (real to whom?), "reality" denotes existence as perceived by a certain consciousness.

Universe: - adds the notions of a certain *spatial* expansiveness of existence. It also forms the base of an astronomical perspective on the concept "existence" (Cosmology).

"Nature", "reality" and "universe" are simply more detailed, more specific *designations* of the concept "existence". More information, i.e. more identifications are added.

It represents *more specific* identifications – which *from a certain point on* is properly no longer the subject of Philosophy, but of the Natural Sciences. Philosophy is the fundamental science which deals only with the most broadest of abstractions, in this case: it merely underscores that existence *exists* – that to be, is to be *something* of a specific identity, i.e. that all the existents *are what they are* – and that *entities* are the *primary existents* that make up the reality we perceive, to which the Law of Identity and the Law of Causality apply as absolute principles. No more.

"The universe is the total of that which exists—not merely the earth or the stars or the galaxies, but everything. Obviously then there can be no such thing as the "cause" of the universe . . .

Is the universe then unlimited in size? No. Everything which exists is finite, including the universe. What then, you ask, is outside the universe, if it is finite? This question is invalid. The phrase "outside the universe" has no referent. The universe is everything. "Outside the universe" stands for "that which is where everything isn't." There is no such place. There isn't even nothing "out there": there is no "out there." "

– Leonard Peikoff, *The Philosophy of Objectivism* lecture series, Lecture 2

Historically, philosophers have often considered "Cosmology" as a branch of Philosophy, but it should not be classified as such, as it properly does not belong to the science of Philosophy, which deals only with the most fundamental abstractions and integrations. Properly it is the task of physicists, specifically of astronomers to study the *specific constituents* of which the Universe consists.

Differentiating Philosophy from Physics:

"Universe" is *almost* a synonym for "existence", but not quite. As said, the concept of "universe" adds the notion of a certain *spatial expansiveness* to the concept of "existence".

"To grasp the axiom that existence exists, means to grasp the fact that nature, i.e., the universe as a whole, cannot be created or annihilated, that it cannot come into or go out of existence.

Whether its basic constituent elements are atoms, or subatomic particles, or some yet undiscovered forms of energy, it is not ruled by a consciousness or by will or by chance, but by the Law of Identity."

– Ayn Rand, *Philosophy: Who Needs It, The Metaphysical Versus the Man-Made*

Philosophy identifies that *entities* are the primary existents – that no attribute, action nor relationship can exist without its primary entities. The identification however that these entities consist of "planets", "atoms" and "elementary particles", or that their relationships can be explained as "gravity", "electromagnetism" and "nuclear forces" *is the task of the Natural Sciences*, specifically of Physics (and these identifications are *much later discoveries*).

Philosophy merely *lays down the metaphysical and epistemological foundations and criteria* for all of the Natural Sciences.

In the very same way, Philosophy lays down the foundations for Mathematics, meaning it states that Mathematics is *objective* (i.e. based on reality), not subjective (to be defined at whim) nor intrinsic (numbers as "entities" in nature) and explains that the foundation for mathematics is the concept of "unit" (which is already grasped on the perceptual level). An entity, on the perceptual level, is perceived by a human consciousness as a "unit" – which forms the base for the concept of "number" – meaning: the concept "unit" is the base for the number "1" – which is then the base for the concept of "quantity", by which, in Mathematics, relations between concretes, quantities and theory (qualities) can be established and expressed. The specific *number system* however, is something Philosophy does not concern itself with, meaning it does not say anything about whether the concept "unit" should be expressed and represented as "I", "1", "1" or "one". This belongs to the domain of Mathematics and by association, of Linguistics.

The Law of Identity is not only at the foundation of Philosophy, it is also a base axiom underlying all propositions of the Natural Sciences. The Natural Sciences *cannot contradict* the metaphysical axioms they are *dependent on*. Here anyone has to choose for themselves, volitionally, to be "fully-Aristotelian". Many scientists however still opt to rewrite reality instead, e.g. those who define "space" as a type of entity (space however can only be defined as a relational concept), those who define "time" as a separate, physical dimension (time is also merely a relational concept), those who define "numbers" to be a kind of 'physical entities' which would 'be at the source and make-up the whole of reality' (the 'Pythagoreans'), those who claim to have found contradictions to the axiom of Causality (various interpretations of quantum mechanics), etc...

There are several different forms of not understanding, e.g. not having enough prior knowledge to grasp a certain phenomenon, or language confusions. This kind of error can be resolved by a proficient physics teacher. There is another kind of error however, no scientific Man must sanction nor condone:

"Then, there's a kind of saying you don't understand it, meaning: "I don't believe it, it's too crazy, it's the kind of thing I... I'm just not going to accept it!" *This* kind, I hope, you'll come along with me: and you'll *have to* accept it. Because *this is the way nature works!* If you wanna know the way nature works... we looked at it, *carefully*, looked at it: see? *That's* the way it looks! You don't like it? *Go somewhere else!* To another Universe, where the rules are simpler, philosophically more pleasing, more psychologically easy."

– Richard Feynman, Introduction to Quantum Mechanics part 1 - Photons: Corpuscles of Light

The "*Rand-Feynman demarcation*" is meant to clearly distantiate from these fallacies, separate these perspectives on the Natural Sciences, and identify which side one is on: *accepting* metaphysical- and experimental facts of reality – not *rebellig against* them, nor *rewriting* them. Now let's switch back to Philosophy, the science of the most broadest abstractions – and the epistemological concept of "logic" more specifically:

Logic rests on the axiom "existence exists".

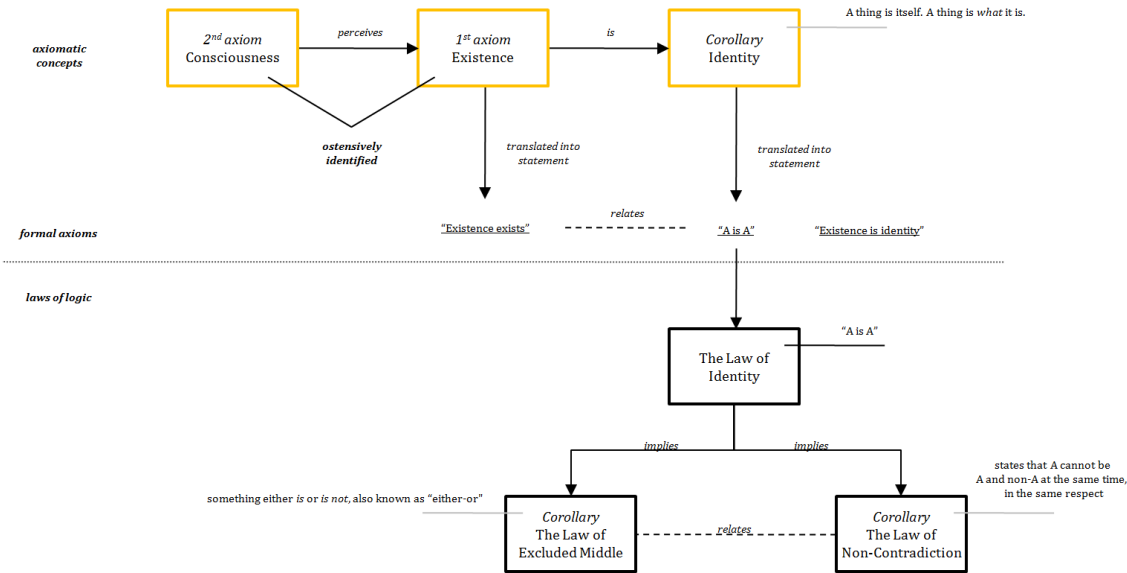
To reiterate: The first and primary axiomatic concepts are "existence," "identity" (which is a corollary of "existence") and "consciousness." Existence is ostensibly identified, i.e. by pointing your finger forward, sweeping it around and saying "I mean *this*". Consciousness is identified by *direct experience*. Identity is a corollary of existence: to exist, is to be *something*, i.e. of a specific nature, i.e. of a specific "identity".

Now, equipped with an already pre-formed set of metaphysical identifications, we can now establish the position and function of "logic":

Logic is man's method of reaching conclusions *objectively* by deriving them without contradiction from the facts of reality – ultimately, from the evidence provided by man's senses. Logic is the art of non-contradictory identification of existence, i.e. of the facts of reality.

The metaphysical base of the laws of logic

The laws of logic are the Law of Identity (A is A), and its two corollaries: the Law of Excluded Middle, and the Law of Non-Contradiction. The principle *at the base* of the proper method of logic is the fundamental principle of metaphysics: the Law of Identity:



This is the complete metaphysical base for the correct positioning and definition of the concept of "logic". It starts with the identification and ostensive definition of the primary axiomatic concepts. These axiomatic concepts are then converted into formal axioms. These *metaphysical* axioms then form and establish the base for the *epistemological* laws of logic. (NB: as a reminder: axioms, laws, propositions... are (of course) *all* composed of concepts.)

As an exercise: *try* to position and define the concept of "logic" using a *differing* metaphysical starting point (or starting from anywhere else than from metaphysics). You will not be able to do it without contradicting yourself somewhere, or without using "stolen concepts" in your chain of reasoning. An example would for instance be using the metaphysics of "consciousness having primacy over existence". If consciousness would create reality, a definition of a thing such as "logical absolutes" would make (absolutely) no sense. Logic namely, would then *also* need to follow as the result of an act (of creation) of a consciousness. It would not be definable as "the primary method human beings use to correctly identify an independent reality" – as consciousness (according to this type of metaphysics) *creates reality*, instead of merely *perceiving* reality. One discovers, (any kind of) "consciousness" cannot be correctly defined (meaning without contradictions) without *first* defining "something to be conscious of".

Contemplating this for a little while is useful, because as the laws of logic themselves are at the base of further, much more complex concepts – such as "mathematics" and "the scientific method" as foundational concepts of science, and e.g. "set theory", "recursion theory" (computation) and many others specialized sciences.

Given that even on *such an elementary level* as Metaphysics, so many laymen and experts already start to *rebel against reality* – e.g. denying existence exists, or that anyone could identify existence to 'exist for certain'; denying consciousness exists, or that one could validate consciousness to exist; denying existence exists independently from (any) consciousness; denying the validity of the senses – all the way to flat out denying there is such a thing as non-

subjective logic or "the laws of logic" – remember that this is merely foundation-level Metaphysics and Epistemology, and one may start to grasp how profoundly anti-philosophy, anti-knowledge, anti-cognition and anti-science many people (still) are.

One may designate them to still be in a "pre-philosophic stage of cognitive development".

Now, let's describe each of the laws of logic separately:

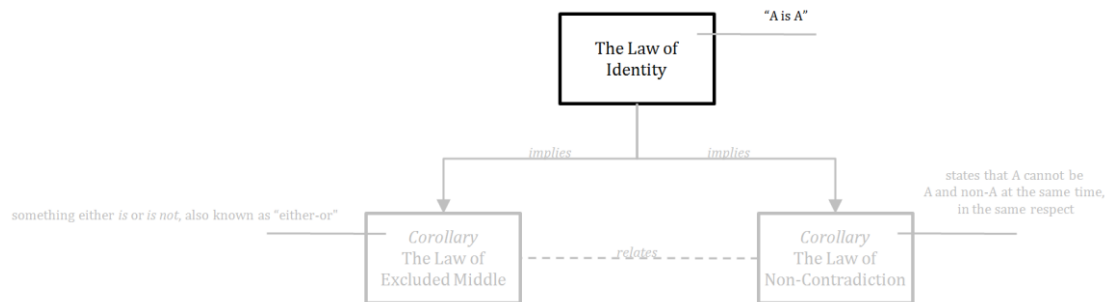
The Laws of Logic

1. The Law of Identity

A is A. A thing is itself.

Whatever you choose to consider, be it an object, an attribute or an action, the law of identity remains the same. A leaf cannot be a stone at the same time, it cannot be all red and all green at the same time, it cannot freeze and burn at the same time. A is A.

– Ayn Rand, Atlas Shrugged, Galt's Speech

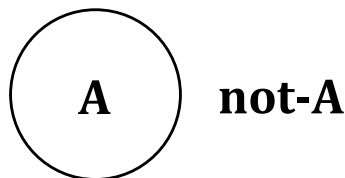


Logic as such is not empirical and does not make statements about reality, just like mathematics. Both are cognitive sciences of *method*.

The concept "identity" does not indicate the particular natures of the existents it subsumes; it merely underscores the primary fact that *they are what they are*.

– Ayn Rand, Introduction to Objectivist Epistemology, Axiomatic Concepts

The units of the concepts "existence" and "identity" are every entity, attribute, action, event or phenomenon (including consciousness) that exists, has ever existed or will ever exist.



The Law of Identity is the principle that *formulates explicitly* that human cognition identifies existence by means of the fundamental differentiation of specific existents from other existents: "something *exists* of which I am *conscious*; I must discover its *identity*."

The concept "identity" does not have a contrary – only a void. The contrary of "A" is everything else (every other existent).

("not-A" must not be interpreted as an independent existent. That is perpetrating the fallacy of "Reification of Zero", i.e. regarding "nothing" as a thing, as a special, different kind of existent)

Something is what it is and isn't what it isn't.
is versus *is-not*, means: the difference between existence and non-existence.

Aristotle on the Law of Identity:

It is used explicitly only once in Aristotle's remaining works, in a proof in the *Prior Analytics*:

"When A belongs to the whole of B and to C and is affirmed of nothing else, and B also belongs to all C, it is necessary that A and B should be convertible: for since A is said of B and C only, and B is affirmed both of itself and of C, it is clear that B will be said of everything of which A is said, except A itself."

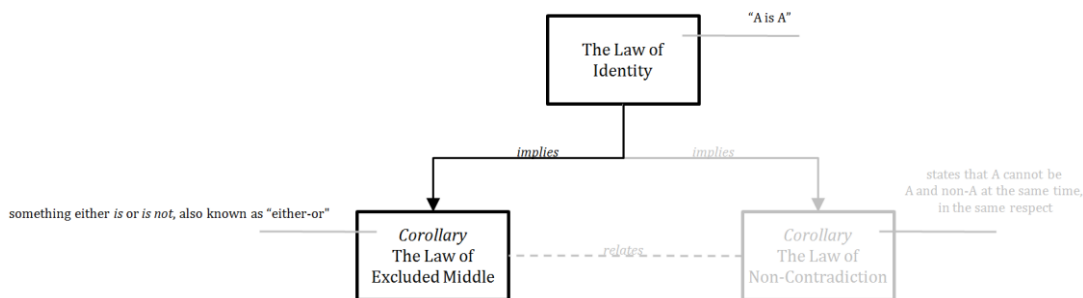
–Aristotle, *Prior Analytics*, Book II, Part 22, 68a

Leibniz on the Law of Identity:

Gottfried Wilhelm Leibniz claimed that the law of identity, which he expresses as "Everything is what it is", is the first primitive truth of reason which is affirmative, and the law of non-contradiction is the first negative truth (Nouv. Ess. IV, 2, § i), arguing that "the statement that a thing is what it is, is prior to the statement that it is not another thing" (Nouv. Ess. IV, 7, § 9). (*Wilhelm Wundt* credits Gottfried Leibniz with the symbolic formulation, "A is A".)

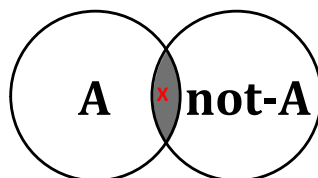
2. The Law of the Excluded Middle

Nothing can exist in between A and not-A.
Also known as "either-or".



The earliest known formulation of the Law of Excluded Middle is in Aristotle's discussion of the principle of non-contradiction, first proposed in *On Interpretation*, where he says that of two contradictory propositions (i.e. where one proposition is the negation of the other) one must be true, and the other false.

A either *is* or *is not*, there exists nothing in between.



He also states it as a principle in the *Metaphysics* book 3, saying that it is necessary in every case to affirm or deny, and that it is impossible that there should be anything between the two parts of a contradiction. (As an aside: This is also the basis for Ayn Rand's *moral* principle: "There are two sides to every issue: one side is right and the other is wrong, but the middle is always evil." This is an instance of the application of logical absolutes to Ethics)

Aristotle wrote that ambiguity can arise from the use of ambiguous names, but cannot exist in the facts themselves:

"It is impossible, then, that "being a man" should mean precisely "not being a man", if "man" not only signifies something about one subject but also has one significance. ... And it will not be possible to be and not to be the same thing, except in virtue of an ambiguity, just as if one whom we call "man", and others were to call "not-man"; but the point in question is not this, whether the same thing can at the same time be and not be a man in name, but whether it can be in fact."

–Aristotle, *Metaphysics* 4.4, W.D. Ross (trans.), GBWW 8, 525–526)

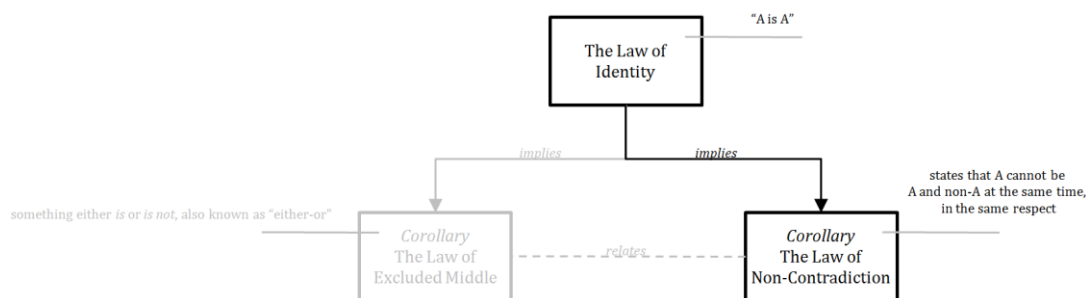
Aristotle's assertion that "it will not be possible to be and not to be the same thing", which would be written in propositional logic as $\sim(P \wedge \sim P)$, is a statement modern logicians could call the law of excluded middle ($P \vee \sim P$), as distribution of the negation of Aristotle's assertion makes them equivalent, regardless of the fact that the former claims that no statement is *both* true and false, while the latter requires that any statement is *either* true or false.

But Aristotle also writes, "since it is impossible that contradictories should be at the same time true of the same thing, obviously contraries also cannot belong at the same time to the same thing" (Book IV, CH 6, p. 531). He then proposes that "there cannot be an intermediate between contradictories, but of one subject we must either affirm or deny any one predicate" (Book IV, CH 7, p. 531). In the context of Aristotelian logic, this is a precise statement of the law of excluded middle, $P \vee \sim P$.

3. The Law of Non-Contradiction

"**A contradiction cannot exist.** An atom is itself, and so is the universe; neither can contradict its own identity; nor can a part contradict the whole. No concept man forms is valid unless he integrates it without contradiction into the total sum of his knowledge. To arrive at a contradiction is to confess an error in one's thinking; to maintain a contradiction is to abdicate one's mind and to evict oneself from the realm of reality."

– Ayn Rand, "Atlas Shrugged", Galt's Speech [accent mine]



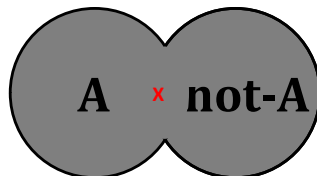
The traditional source of the law of non-contradiction is Aristotle's *Metaphysics* where he gives three different versions:

- Ontological: "It is impossible that the same thing belong and not belong to the same thing at the same time and in the same respect." (1005b19-20)
- Psychological: "No one can believe that the same thing can (at the same time) be and not be." (1005b23–24)
- Logical (aka the medieval *Lex Contradictoriarum*): "The most certain of all basic principles is that contradictory propositions are not true simultaneously." (1011b13-14)

Ayn Rand: "Objectivism agrees with Aristotle's formulation of the Law of Non-Contradiction:

"These truths hold good for everything that is, and not for some special genus apart from others. And all men use them, because they are true of being *qua* being For a principle which everyone must have who understands anything that is, is not a hypothesis Evidently then such a principle is the most certain of all; which principle this is, let us proceed to say. It is, that the same attribute cannot at the same time belong and not belong to the same subject and in the same respect." "

– Aristotle, *Metaphysics*, IV, 3 (W. D. Ross, trans.)



"The Law of Identity (A is A) is a rational man's paramount consideration in the process of determining his interests. He knows that the contradictory is the impossible, that a contradiction cannot be achieved in reality and that the attempt to achieve it can lead only to disaster and destruction. Therefore, he does not permit himself to hold contradictory values, to pursue contradictory goals, or to imagine that the pursuit of a contradiction can ever be to his interest."

– Ayn Rand, *The Virtue of Selfishness, The 'Conflicts' of Men's Interests*

It is The Law of Non-Contradiction that is the basis for the requirement that the entire knowledge structure of a human being must be formed and formulated *without contradictions*. The corollary to this is: identifying a contradiction is equivalent to identifying a knowledge error. ("To arrive at a contradiction is to confess an error in one's thinking" – John Galt)

Logic in action: Logical inference: induction and deduction

Induction

An Aristotelian definition of induction is: the process of reasoning from the observation of concretes or individuals to a general or universal conclusion.

Alternatively: Inference of a generalized conclusion from particular instances.

(For the refutation of the 'problem' of induction, see *The Logical Leap* by Peikoff/Harriman)

Induction vs. the law of non-contradiction:

Induction is a conclusion following necessarily from a) perceptually observed concretes and causal relations, plus b) one's existing, total valid conceptual structure. You cannot contradict the perceptually witnessed concretes or causal relationships, nor the sum, i.e. the total of the validated conceptual structure attained *up to that point* – otherwise contradicting either a) the witnessed percept(s), or b) one's existing body of knowledge (which amounts to contradicting the process of concept-formation as such). Induction is the conceptualization-process in action. Philosophy is primarily an *inductive science*. Many scientific truths and theories are also attained by the inferencing method of induction (see for instance the lecture "The Inductive Origins of Darwin's Origin" by James Lennox).

Deduction

Deduction is the process of applying a universal or general proposition to a particular case. It is the process of reasoning from a universal premise to a conclusion which is no wider in extent than the premises.

Alternatively: Inference of a specific conclusion that necessarily follows from general or universal premises, e.g. a syllogism in which the major and minor premises are true.

A syllogism (Greek: συλλογισμός, syllogismos, 'conclusion, inference') is a kind of logical argument that applies deductive reasoning to arrive at a conclusion based on two propositions that are asserted or assumed to be true. In its earliest form (defined by Aristotle in his 350 BCE book *Prior Analytics*): "a syllogism arises when two true premises (propositions or statements) validly imply a conclusion".

The classical example of a syllogism is:

Major premise: "All men are mortal."

Minor premise: "Socrates is a Man."

Conclusion: "Socrates is mortal."

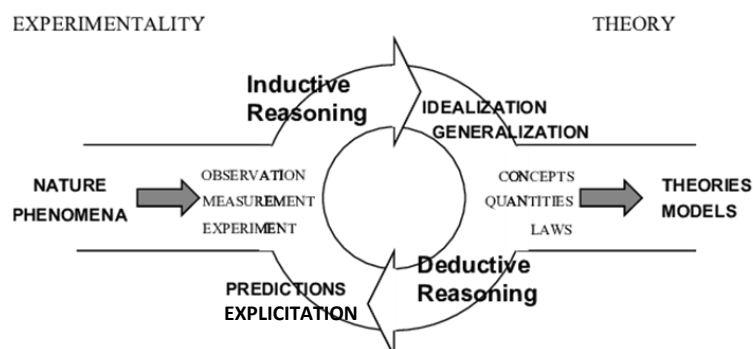
As one can observe, the conclusion consists of knowledge already contained within the sum of knowledge available, and is made explicit by the application of the fact described in the major premise, to the fact described in the minor premise.

"Deduction is making explicit what was already implicitly known."

– Harry Binswanger, Lectures on Logic

Deduction vs. the law of non-contradiction:

Deduction is explicitizing a conclusion already implicit in the premises, therefore following *necessarily* from the premises – otherwise contradicting one of the premises (contradicting "A is A").



Cycle of concept formation (amended from Kurki-Suonio, K. & R.)

"The process is directed from phenomena to theory. Inductive and deductive processes are identified as semicircles of the complete cyclic and perpetuate process."

– Kurki-Suonio, K. & R. 1994, 149; Hämäläinen, A. 1998, 7.

The interaction between experimentality and theory is that these parts of concept-formation complete each other: while experimentality (direct perception, measurement, experiment) *represents* the natural phenomena, the aim of theory is to *explain* them.

NB: Deduction *presupposes* induction: one cannot apply what one does not know or cannot conceive (or has not yet conceived). The *primary process* of gaining knowledge that goes beyond perceptual data is *induction*. Concept-formation is primarily an inductive process.

Philosophy is primarily an inductive science. When one has grasped these last two statements, one may grasp the profound destructiveness of such theories as "the problem of induction".

NB2: there exist no 'multiple logics' (the fallacy of "Polylogism"), and logic is not subjective, neither intrinsic, *nor optional*.

Logic is *objective*, it is based on how a human being cognitively relates to reality.

The various areas logic is operant

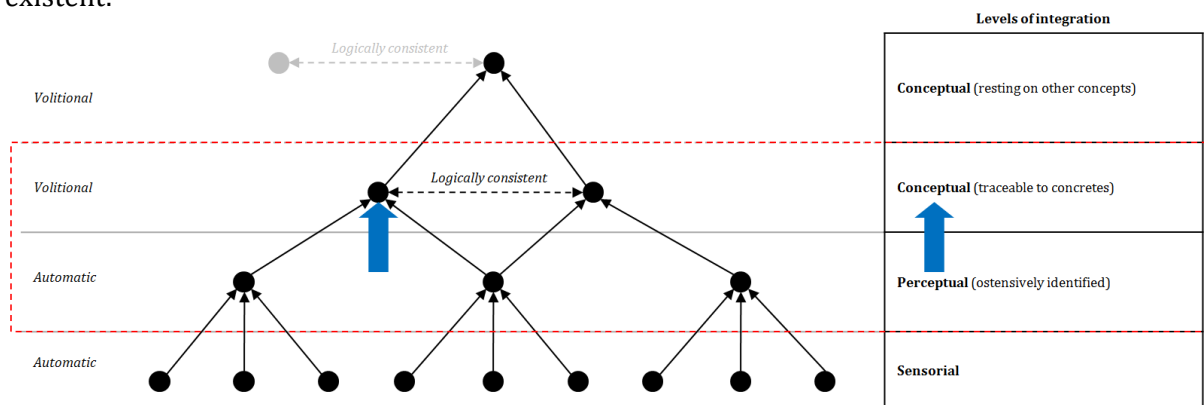
Aristotle describes three areas where logic is operant: inference, propositions and concepts. Their logical order can be derived as follows: propositions consist of concepts; and (first-level) concepts are formed by inductions of percepts. Concepts therefore *precede* propositions. Logic is also operant as an essential element in the process of "the scientific method".

We've covered inference and propositions (syllogisms).

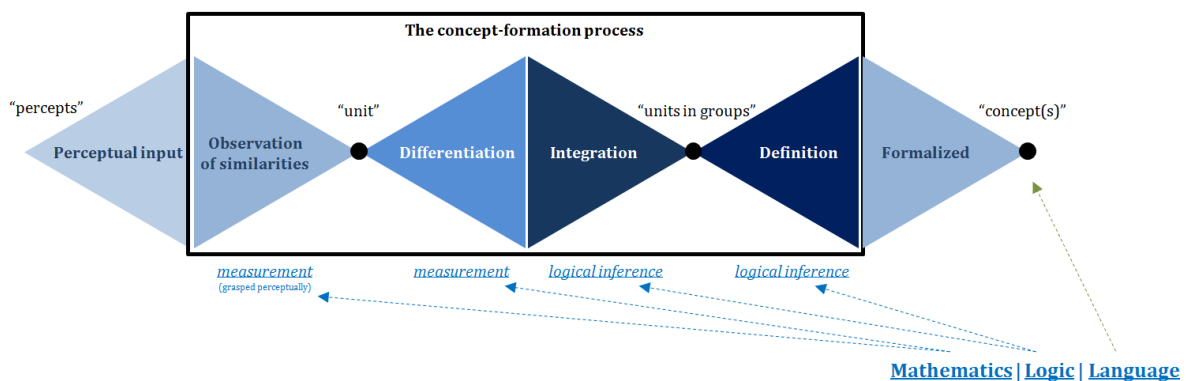
We will next analyze how logic operates specifically within the process of concept-formation and within the process of the scientific method.

Logic as operant in the process of concept-formation

In concept-formation, logic is applied to achieve correct, non-contradictory definitions. Each concept designates genus and species, and then defines a particular conceptualized existent:



As we 'zoom-in' to look at the specific steps within the concept-formation process, we can make clear in which way logic is operant in the process of 'refining' percepts into concepts:



This process represents the essence of a human being's specific, conceptual mode of cognition. (for the role of Mathematics in this process, see *Ayn Rand's* theory of "measurement omission" in "Introduction to Objectivist Epistemology") (ITOE)

Every concept essentially consists of two elements: 1) a term to designate the concept and 2) a definition to identify the concept. A definition consists of assigning the "genus" and "species" and indicating the essential differentiae (in Rand's terms: the "Common Conceptual Denominator"), meaning by what characteristics, attributes or (type of) relationships the concept in question is distinguished from every other concept.

The rules of definition *logically derive* from the process of concept-formation.

When designating "genus" and "species" of a specific concept, it may not be in contradiction with already existing, validated concepts (the rule of reference and rule of scope: all definitions are contextual). It demands any definition must be formulated in terms of *essentials* (the rule of unit-economy and rule of fundamentality) and the formalized definition of a concept itself may also not contain any contradictions (such as propositions perpetrating the fallacy of "self-exclusion", covered by the rule of genus and differentia). The rules of correct definition were already formulated by *Aristotle*. An objective theory of the process of concept-formation was first formulated by *Ayn Rand* (in *ITOE*).

Here we conclude the introduction to how logic is operant specifically in the process of concept-formation.

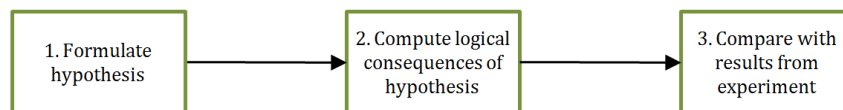
Logic as operant in the scientific method

"If it [an hypothesis] disagrees with experiment... it's wrong!"
 "In that simple statement is the key to science."

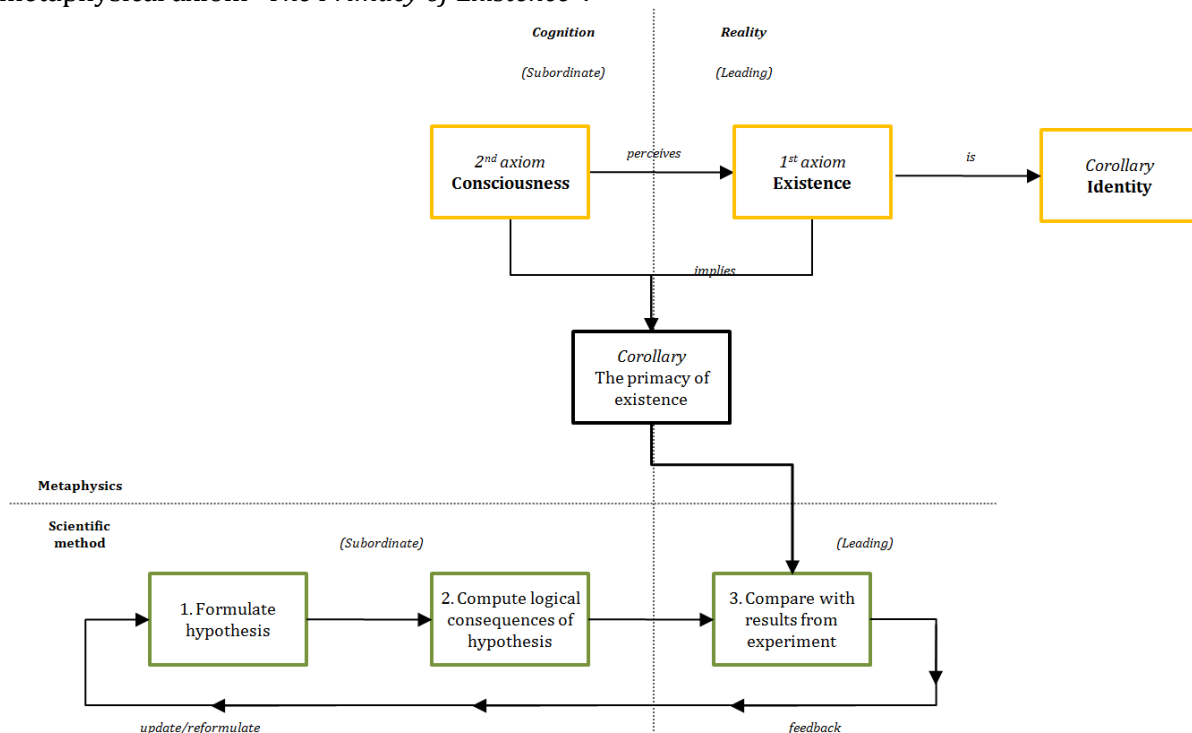
- Richard Feynman, Cornell Lecture Series (1964)

The scientific method, in terms of steps of a process, can be summarized as follows:

1. Formulate a hypothesis ('guess') → 2. What are the **logical** implications? → 3. Compare to nature via observation or experiment.



In order to demonstrate why *in experiment in reality* lies the "key to science", we have to again return to the fundamental science of Metaphysics: The base of the scientific method is the metaphysical axiom "*The Primacy of Existence*":



Reality is the *standard* of all knowledge. The scientific method rests on this axiom. Experiment (with reality as its standard) is the *touchstone* of any and all hypotheses.

Induction in the scientific method

The process of observing the facts of reality and of integrating them into concepts is, in essence, a process of induction. This is one of the patterns discovered by *Ayn Rand*. (see "*Introduction to Objectivist Epistemology*")

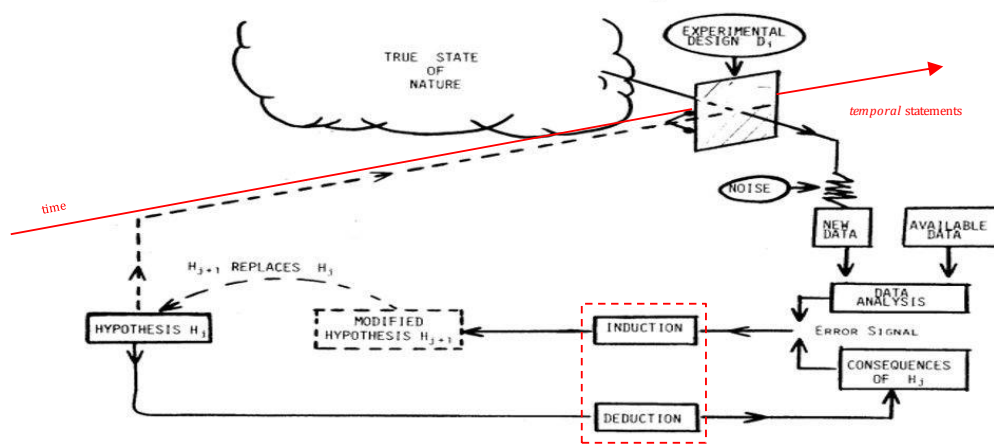
The process of observing the facts of reality and of integrating them into base-level propositions is, in essence, also a process of induction. This is one of the pattern discovered by *Leonard Peikoff*. (see "*The Logical Leap*" or Peikoff's lecture series on induction)

The process of analyzing the observed facts of an experiment to modify a preceding hypothesis is, in essence, also a process of induction. This is described by prof. *Kaarle Kurki-Suonio*. (see *Principles Supporting the Perceptual Teaching of Physics - A Practical Teaching Philosophy*)

Deduction in the scientific method

The process of computing the logical consequences of a hypothesis is, in essence, a process of deduction.

The process of subsuming new instances under a known concept is, in essence, a process of deduction.



The requirements of performing scientific experiments:

- A hypothesis must be defined in concrete, (com)mensurable terms (a physical quantity) and formulated in valid concepts.
- A hypothesis must be falsifiable
- The computed consequences must adhere to the Laws of Logic (an analysis of these consequences will reveal whether any contradictions or logical errors were made in the computation).
- An experiment needs to be described accurately and be executed- and measured methodically and procedurally, as well as be reproducible.

If these conditions are met, then experimental results are the decisive test for reaching a conclusion(s) about the stated hypothesis.

(It is the specific task of *Meta-Science* to check the validity and consistency of Man's entire 'body' of scientific knowledge, as a continuous underlying process supporting the progress of Science.)

This invalidates many scientific theories that exist as purely theoretical works, at which no established facts in reality are at its base. (including e.g. the '11+ dimensions' models of the Universe as posited by proponents of "string theory" in Physics.)

Not contradicting *any* metaphysical axiom, also means the theories that posit that "space" is not merely the absence of entities, meaning a space *between entities*, but 'an entity in and of itself', are invalid. Space is not 'full', it is not a thing – it is only the space between *things* – meaning it is *relative*: it pertains to the identity of its *relating* entities. (the same applies to "time")

It also means not contradicting the axiom of Causality, which, in many of the 'non-Feynman interpretations' of quantum mechanics, is incessantly being contradicted.

Richard Feynman stated his position (relating to the validity of the Standard Model) explicitly:

"We will never experience this kind of thing again"

(referring back to the historic process of unraveling the universe on this fundamental level, puzzling in the 'dark unknown' looking for answers to the big questions in physics)

"All questions in physics, from now on, will be of a fundamentally different kind, as its fundamental building blocks and their mechanics have now become known to us."

– *Richard Feynman, Introduction to Quantum Mechanics*

The *Rand-Feynman demarcation* distances itself from people that refuse to accept this fact.

Here one needs to stand with *Aristotle*, *Ayn Rand* and *Richard Feynman* in stating:

- Existence *exists*.
- *Reality* is the *standard* of knowledge.
- The Laws of Logic are *absolutes*.
- *No contradiction* of these facts can exist in any part, nor at any point in, nor in any area of one's entire conceptual structure.
- The Universe is *finite*. ("infinity" is strictly a mathematical potentiality of iteration)
- Time is a *relational* concept, relating to entities – as entities are the primary constituents of reality, there is nothing else to observe. (time is not an independent "dimension")
- Space is a *relational* concept, relating to entities – as entities are the primary constituents of reality, there is nothing else to observe. (space is not an "entity")
- Metaphysical axioms, including The Primacy of Existence and Causality, are *absolutes*.

By designating the *Rand-Feynman demarcation*, one designates the consistent application of these facts all the way to quantum mechanics, meaning: that Causality does not 'break down', this is a fallacy in physics equivalent to "mixing categories" in linguistics. Feynman explains that the non-deterministic mechanics that experiments demonstrate to exist on the quantum level, do in fact behave as a "unit" when viewed from a different *order of magnitude*. This is the key to the proper understanding of quantum mechanics (and Physics as such more generally).

The universe is a complex of cooperative and simultaneously operating principles:

- Gravitational forces are dominant on a *planetary* scale;
- Electromagnetic forces are dominant on the *human* (experience) scale;
- Atomic forces are dominant on the *subatomic* scale;

Given that atoms, objects and planets are *all* composed of subatomic particles, there can exist no contradiction between the orders of magnitudes. Just as gravitational forces do not dissolve the electromagnetic forces that hold atoms together and their electrons in orbit – so do the atomic forces that hold the nuclei of atoms together not dissolve the gravitational forces that holds solar systems together and their planets in orbit. Cause and effect do not break down. This error perpetrated by the 'non-Feynman' quantum physicists is akin to the error of mixing categories, where in this case, it pertains to a mixing of orders of magnitude.

Proof

“Proof,” in the full sense, is the process of deriving a conclusion step by step from the evidence of the senses, each step being taken in accordance with the laws of logic.

– Leonard Peikoff, *Introduction to Logic*, Lecture 1

Proof presupposes existence, consciousness and a complex chain of knowledge:

- the existence of something to know,
- of a consciousness able to know it, and
- of a knowledge that has learned to distinguish between such concepts as the proved and the unproved.

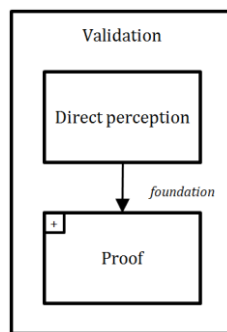
Proof is a concept that belongs to the wider concept "validation":

Validation

“Validation” in the broad sense includes any process of relating mental contents to the facts of reality. Direct perception, the method of validating axioms, is one such process.

“Proof” designates another type of validation.

– Leonard Peikoff, *The Philosophy of Objectivism* lecture series, Lecture 3



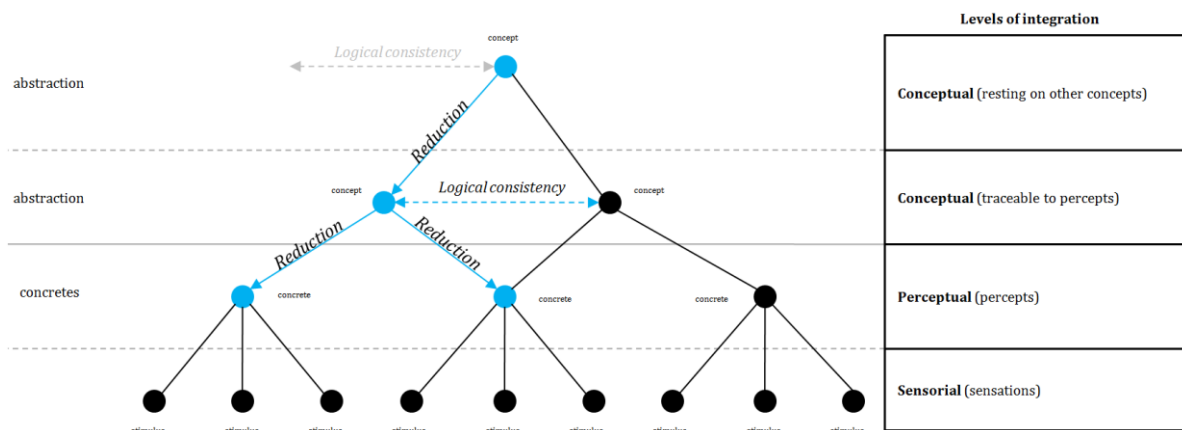
At the base of all types of proof is *direct perception*, meaning observation and measurements.

Logically reducing a concept back to its perceptual concretes is one such method of validation.

Logically reducing a scientific theory back to its experimental facts/data is another.

In essence, their pattern is *the same*: it consists of retracing logical steps of inference back to perceptual level concretes. (remember: all theories are composed of concepts, the difference lies merely in their *level of abstraction/integration*)

Logical reduction



Truth

Truth is correct identification, specifically: *correctly identified reality*.

"Truth is the recognition of reality;
reason, man's only means of knowledge, is his only standard of truth."

– Ayn Rand, *Atlas Shrugged*, Galt's Speech

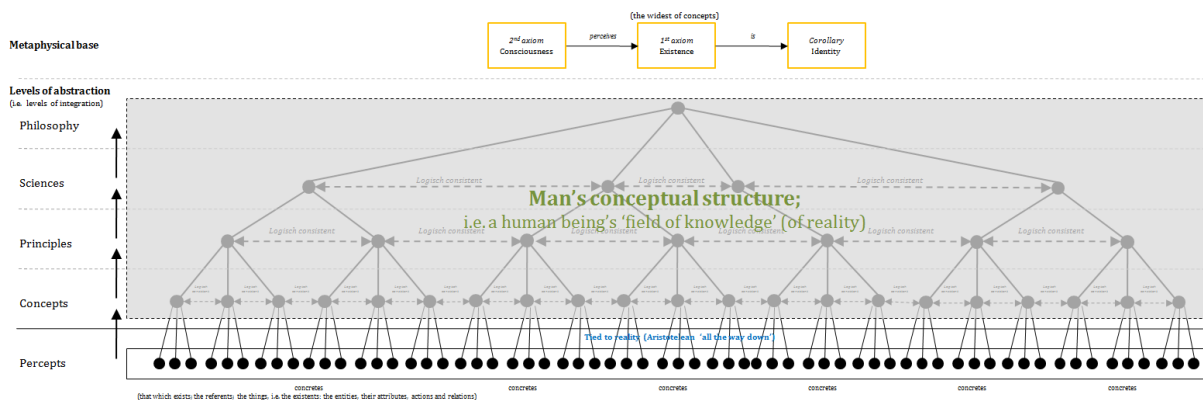
"Truth is the product of the recognition (i.e., identification) of the facts of reality. Man identifies and integrates the facts of reality by means of concepts. He retains concepts in his mind by means of definitions. He organizes concepts into propositions—and the truth or falsehood of his propositions rests, not only on their relation to the facts he asserts, but also on the truth or falsehood of the definitions of the concepts he uses to assert them, which rests on the truth or falsehood of his designations of *essential* characteristics."

– Ayn Rand, "Introduction to Objectivist Epistemology", Definitions

Facts of reality and logical validation also form the base of the *Philosophy of Law* – and all *legal propositions*, including the base of the "burden of proof" and its corollary principle of "innocent until proven guilty" are derived from the same philosophical base.

Logic is also at the base of e.g. the concepts of *Aesthetics*, for instance in literary "plot structure" and "plot construction". An artist projects what processes his artwork will induce cognitively, i.e. how it will be processed, meaning via which *logical steps*, in the minds of his audience.

Man's entire conceptual structure is founded on, emerges from and is bounded by the axiomatic (metaphysical) concepts of "existence", "identity" and "consciousness" – and for each and every concept that he will ever conceive, *logic* is his *essential guiding method* to achieving correct identifications of the facts of reality, incl. for all of the Natural- and Humanistic Sciences.



Logic is the art of non-contradictory identification. The result of consistently applying the laws of logic while forming one's 'body of knowledge' is: "*logical consistency*".

Logic is a method which pertains to and results from the specific identity, and relation of a human consciousness to reality, i.e. the specific relationship of the human *conceptual* faculty of cognition ("reason") to the natural world in which it exists ("nature").

It is the fundamental method by which a human being validates the truth/falsehood of his conclusions – and should be accepted as such, and then held as an absolute. It is the conceptual structure that is *dynamic*. The axioms of Metaphysics, and the methods of Epistemology are *static* – they do not change, nor are they ever subject to change – they are only to be *identified*. They may be viewed as forming Man's cognitive *constants*.

As an addendum, the next pages contain a summary of many well-known *logical fallacies*. Use your knowledge of logical fallacies to analyse your own reasoning, and the reasoning of others – and don't use nor sanction the use of logical fallacies yourself.

Logical Fallacies

Formal Fallacies

A "formal fallacy" is an argument that contains a *logical error*.

Affirming the Consequent - Asserting that the converse of a true conditional statement is also true:

$$P \rightarrow Q \therefore Q \rightarrow P$$

Argumentum ad Ignorantiam - Arguing that a proposition is true because it has not yet been proved false, or that a proposition is false because it has not yet been proved true.

Argumentum ad Temperantiam (False Compromise) - Assuming the compromise between two opposing positions solves the problem or must be true.

Cum Hoc ergo Propter Hoc - Assuming causation because of correlation or association.

Denying the Antecedent - Asserting that the inverse of a true conditional statement is also true:

$$P \rightarrow Q \therefore \neg P \rightarrow \neg Q$$

False Dilemma - Asserting that among a number of alternatives only one can be true.

Post Hoc ergo Propter Hoc - Arguing that a phenomenon causes an event because the phenomenon took place earlier.

Retrorsum Causa et Effectus (Reverse Causality) - Reversing the cause and effect.

Secundum Quid - Not recognizing that a generalisation does not apply to specific situation (i.e. an acceptable exception is ignored), or that a specific case does not justify a generalisation (e.g. an acceptable exception is eliminated or simplified).

Polylogism - The doctrine that there is not one correct logic, one correct method of reasoning necessarily binding on all men, but that there are many 'logics', each valid for some men and invalid for the others. (Polylogism is not a theory of logic – it is a *denial* of logic.)

Informal Fallacies

An "informal fallacy" is an argument that is based on *wrong* or *irrelevant premises*.

Argumentum ad Antiquitatem (Appeal to Tradition) - Arguing that something is better because it already exists for some time.

Argumentum ad Consequentiam (Appeal to Consequences) - Arguing that something is true or not, based on the desirability of the consequences.

Argumentum ad Hominem (Attack the Person) - Discrediting a person rather than countering their arguments.

Argumentum ad Nauseam (Repetition) - Repeating an argument to let it appear to be more true or certain.

Argumentum ad Novitatem (Appeal to Novelty) - Arguing that something is better because it is newer.

Argumentum ad Numeram (Appeal to Common Practice) - Arguing that something is better because many people do it.

Argumentum ad Passiones (Appeal to Emotion) - Using an argument based on emotion rather than facts.

Argumentum ad Populum (Appeal to Common Belief) - Arguing that something is true because most people believe it.

Argumentum ad Verecundiam (Appeal to Authority) - Using the opinion of an authority as evidence to support an argument.

Association Fallacy - Drawing conclusions based on an existing but irrelevant association.

Continuum Fallacy - Rejecting a claim because it is not specific.

Dicto Simpliciter (Accident) - Using a general rule to explain a specific case that does not fall under its rule.

Ignoratio Elenchi (Irrelevant Conclusion or Missing the Point) - Using an argument proving an irrelevant point to prove the point at issue.

Locus Lubricus (Slippery Slope Argument) - Using assumed significant consequences of a small step as an argument against.

Petito Principii (Begging the Question) - An argument's premises assumes the truth of the conclusion, instead of supporting it independently.

Plurium Interrogationum (Loaded Question) - Using a question with presupposed facts that cannot be denied by answering the question.

Strawman - Refuting an argument by not addressing the actual subject but instead a false one.

Tu Quoque (Personal Inconsistency) - Bringing up a person's previous behaviour that is inconsistent with their argument rather than to counter their arguments.

Wishful Thinking - Making an argument based on beliefs or desires, rather than on evidence, rationality or reality.

Argument from Intimidation - A method of *bypassing* logic by means of *psychological pressure*. It consists of threatening to impeach an opponent's character by means of his argument, thus impeaching the argument without debate. It conveys nothing clearly except a moral threat. Example: "Only the immoral can fail to see that Candidate X's argument is false." The falsehood of his argument is asserted arbitrarily and offered as proof of his immorality.

Recommended reading for those interested in further, in-depth study:

- *Ayn Rand*: "Galt's Speech" (from *Atlas Shrugged*), "Introduction to Objectivist Epistemology".
- *Dr. Leonard Peikoff's* and *Dr. Harry Binswanger's* lectures on Logic.
- *Peikoff/Harriman's* and *Michael Saylor's* works on the *History of Science*.
- *The Walter Lewin Lectures* for an exposition of the experiments of classical mechanics.
- *The Feynman Lectures* for an exposition of the experiments of quantum mechanics.
- For a 'non-Genesis' view on astronomy: e.g. "Frontiers of Astronomy" by *Fred Hoyle*.

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