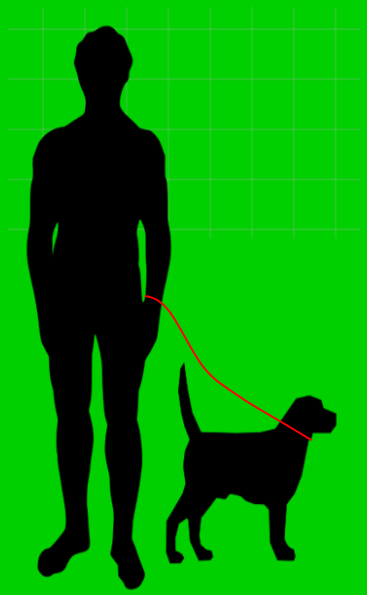
Science Defined



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Color Poster download: www.sjsu.edu/people/lui.lam/scimat

Misunderstandings on Science

- Science = “Natural Science”
- Science = “Natural Science” + Social Science
- Humanities are not part of science (since humans are not part of Nature or are uniquely distinct from other animals).
- Humanities cannot be part of science (since humans are too complicated or a human brain cannot study itself).

These misunderstandings caused all sorts of problem and tragedy in human history.

A major reason: decision making (which determines humans’ well being), a branch of humanities, is not properly treated as part of science.

To overcome these misunderstandings a proper definition of science is needed !

An example of wrong decision making

Cambodia (1975-1979)

Some people mistook a social science hypothesis (Marxism) as a proven theory and decided to apply it in practice.

Casualty: 2 million dead.

AAAS

AAAS' definition of science:

Can't find it on the web!

Possible reasons:

- It is hidden somewhere.
- AAAS can't reach a consensus on any definition.
- They are working on a definition.

Improper and Imprecise Definition

An example

American Physical Society:

Science is the systematic enterprise of gathering knowledge about the world and organizing and condensing that knowledge into testable laws and theories.

Problems:

- According to this definition, Newton's prediction that the world will end in the year 2060 (through careful study of the Bible) is science.
- Systematic: Signature of mature science only; early or initial stages of science will be excluded.
- World: World = Universe? World = Nature?
- Testable laws:

1. possible only in simple cases (deterministic or repeatable experiments.);
2. not so easy for complex systems (e.g., Darwin's evolution theory);
3. impossible in other cases (probability predictions like climate change/global warming).

The Nature of Nature

Does Nature include humans?

Yes, because

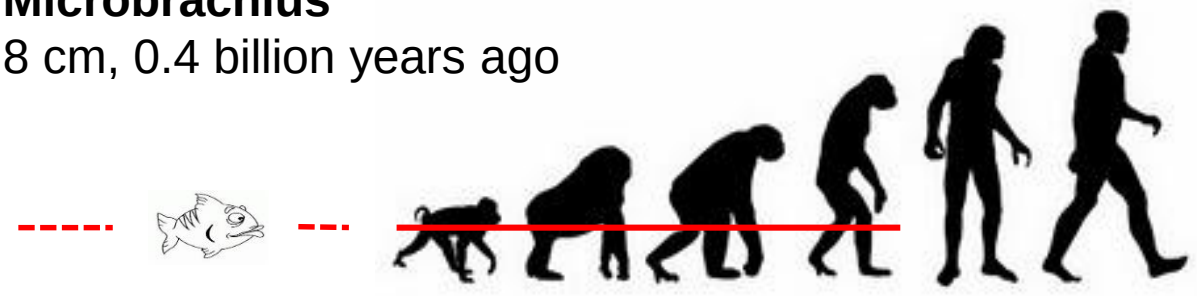
- Nature includes all material systems.
- Humans is a material system made up of atoms.

Moreover,

- Einstein's Brownian motion theory (1905) shows (indirectly) that atoms do exist.
- Darwin's evolution theory (1859): Humans, like other animals, evolved from other more primitive creatures and organisms.

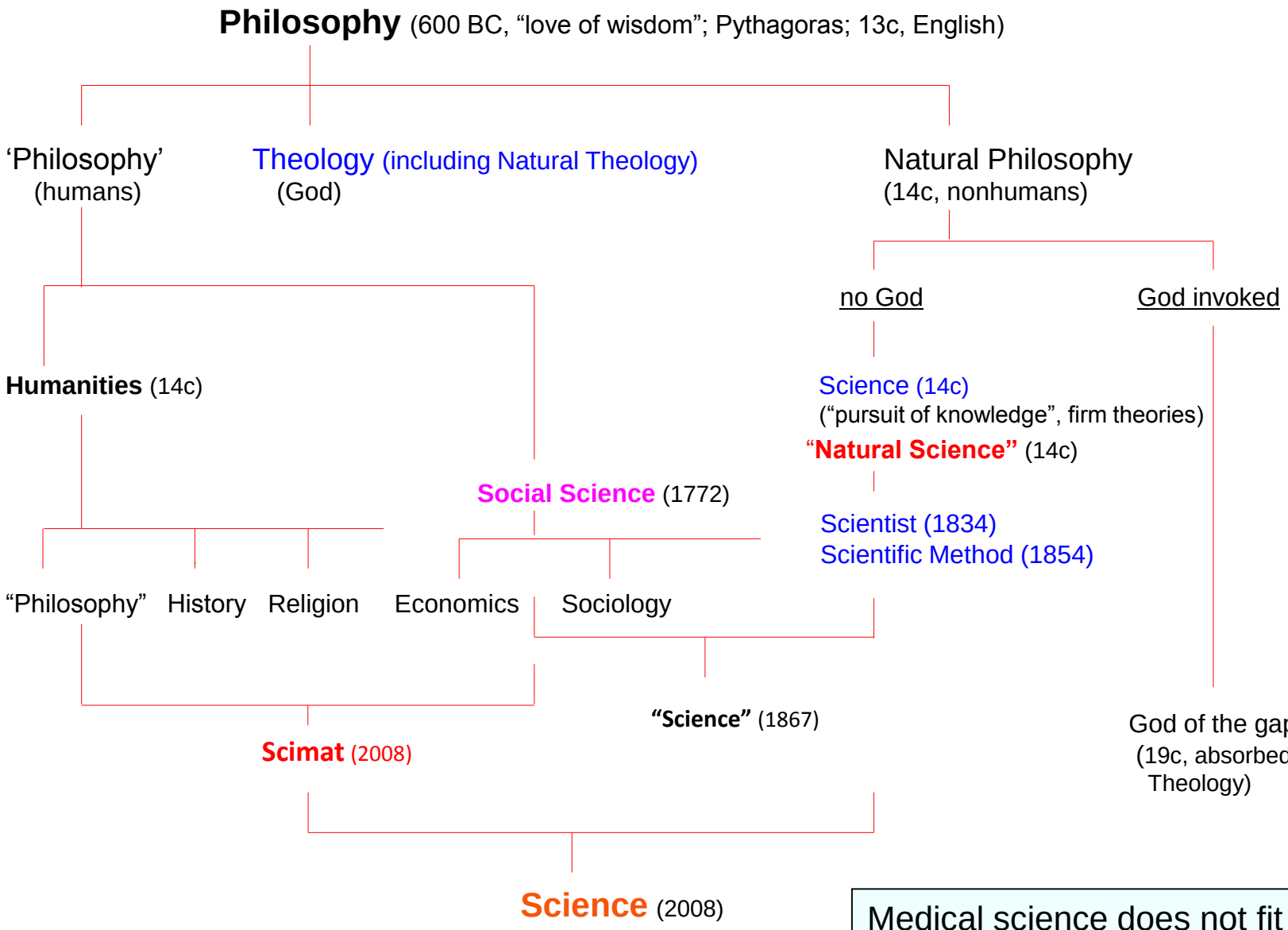
Our ancestor !

Microbrachius
8 cm, 0.4 billion years ago



Consequently, all studies about humans (humanities in particular) are part of science.

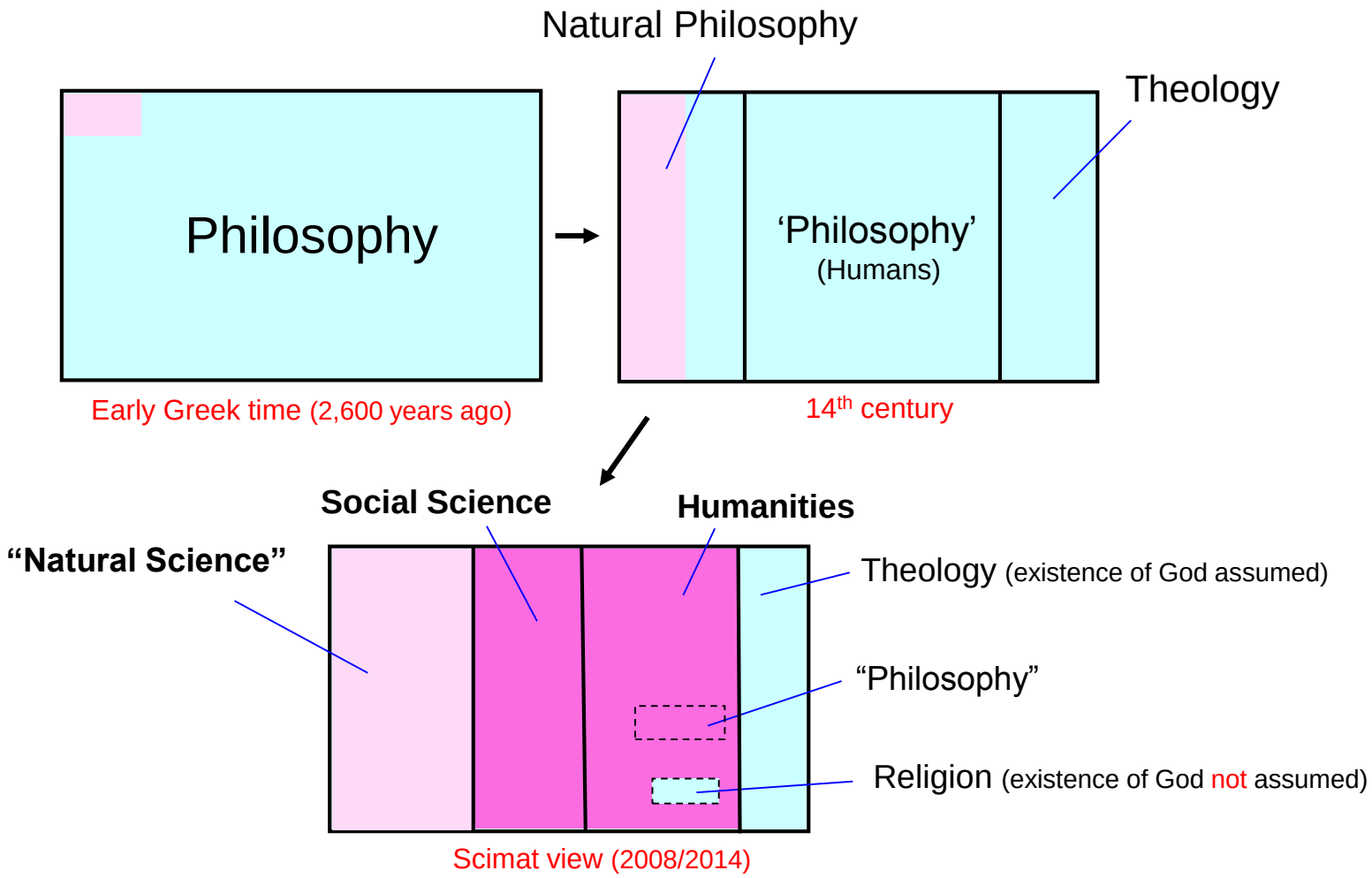
Birth of Disciplines & of Science



Scimat website: www.sjsu.edu/people/lui.lam/scimat

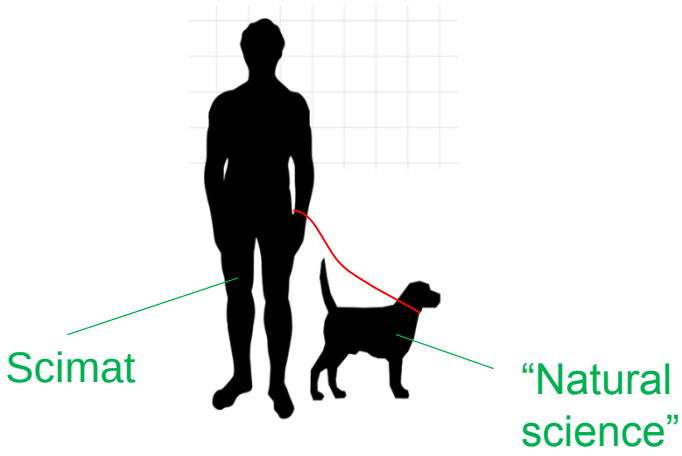
Medical science does not fit into 'Philosophy' or "Natural Science"; it is part of Scimat (Science Matters, 人科) which includes all human matters.

Retreat of God As Science Expands



Science Defined

Science is humans' (earnest and honest) pursuit of knowledge about all things in Nature (which includes all human and nonhuman material systems) without bringing in God or any supernatural.



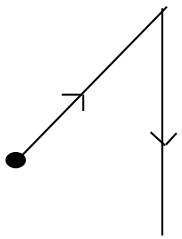
- "Natural science" did enlighten our understanding of Nature (e.g., big bang), make our living easier (cell phone), and help prolonging our life (for good or bad).
- But it is the humanities that determine our quality of life (e.g., to pollute or not to pollute) and bring us genuine happiness (human relationships, arts).
- Also, it is humans (through decision making, a branch of humanities) who controls the use of "natural science".
- And that is why the humanities (itself part of science) are more fundamental and important than "natural science".

Implication 1: Science and Religion

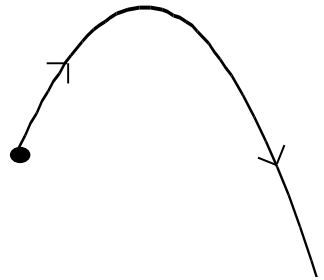
- Science, by definition, has nothing to do with religion.
- But religion has everything to do with science whenever its sayings conflict with "established" scientific facts/theories.
- That is, "conflict" between science and religion occurs not on the science side, but only on the religion side.

Caution

- Scientific "facts/theories" (e.g., projectile path, safety of food/medicine) could change with time (those that pass the Reality Check will be retained).



Before Galileo (Aristotle)



After Galileo (~400 yr ago)

- And religion can easily cope by using "God of the gaps", reinterpreting the Bible (as done successfully by Newton), or making itself viable by retreating fast enough (e.g., Pope, 1992, 1996)

Implication 2: Science and Antiscience

Marriage

Marriage (conventional definition):

1. A legal piece of paper
2. Signed by a woman and a man (who promise to take care of each other).

Anti-Marriage

is usually not against point 1 but is about point 2, which could mean replacing it by:

a legal document signed by a woman and a man, a women and a woman, or
a man and a man.

It is a matter of definition of Marriage.

Science

Similarly, the so-called antiscience is not against science *per se* (except for Plato) but are about

1. application of science,

2. choice of research topics,

3. allocation of government resources.

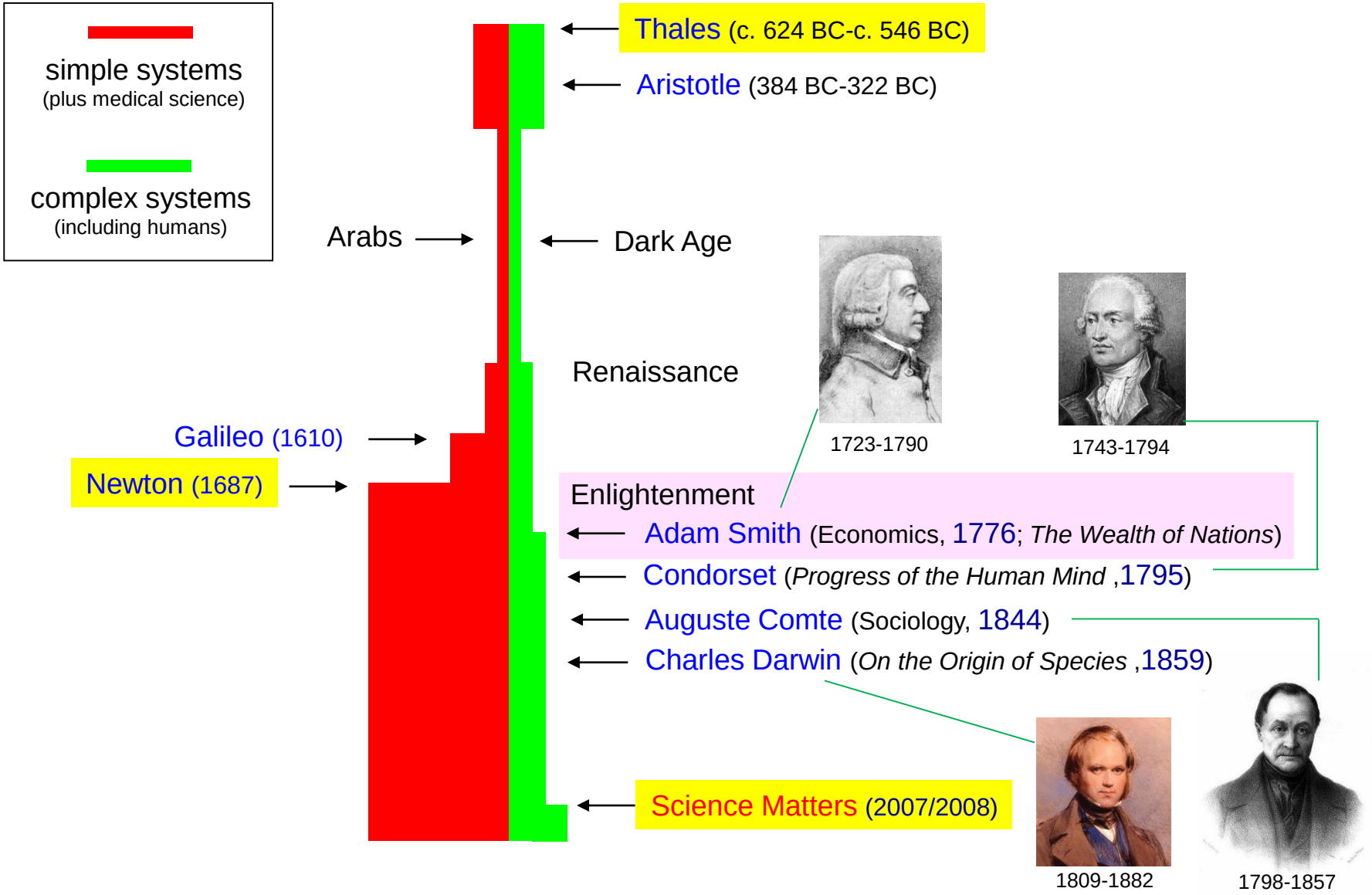
All these disputes are human-dependent matters, part of science (scimat),

There is no such thing called antiscience,
except for those dishonest scientists (including those in humanities) who cheat; they are antiscientists.

Implication 3: Science and Pseudoscience

- The science-pseudoscience demarcation is a complex issue which is less about science *per se* but more about the competition for attention, prestige and resources.
- For example, the debate on intelligent design (ID, a form of creationism) being science or pseudoscience is due to the fuzzy definition of science used (either in the media or in court).
- If God is explicitly excluded from the definition of science, as defined here, this debate would never happen, case closed.
- Other "pseudoscience" claims (e.g., astrology), though unlikely, cannot be ruled out outright by science.
- The fight against pseudoscience should be through education (e.g., on probability knowledge) and persuasion (which depends on the credibility of the educator), but not by science "proofs" which do not really exist (since all science is done through approximations).

Implication 4: Philosophy, History, Sociology & Communication of Science

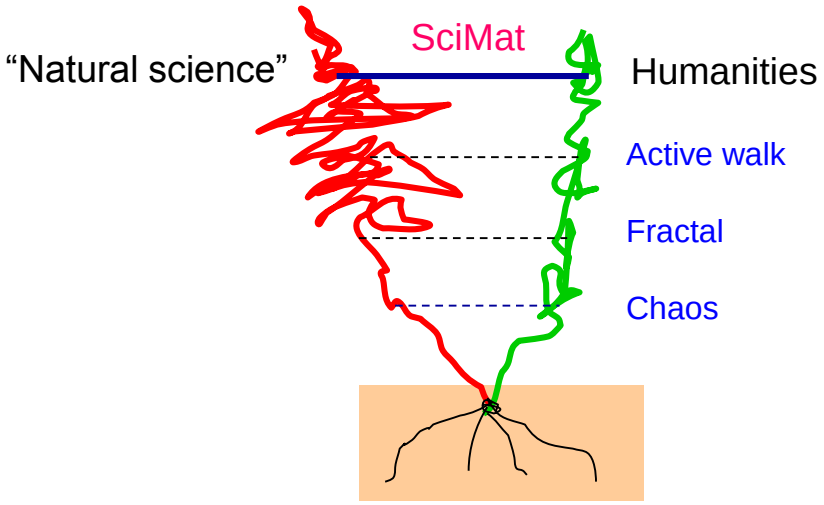


Philosophy, History, Sociolgy and Communication of Science, by focusing on "natural science", are doing only half of the job. The other half concerns complex systems (including the humanities).

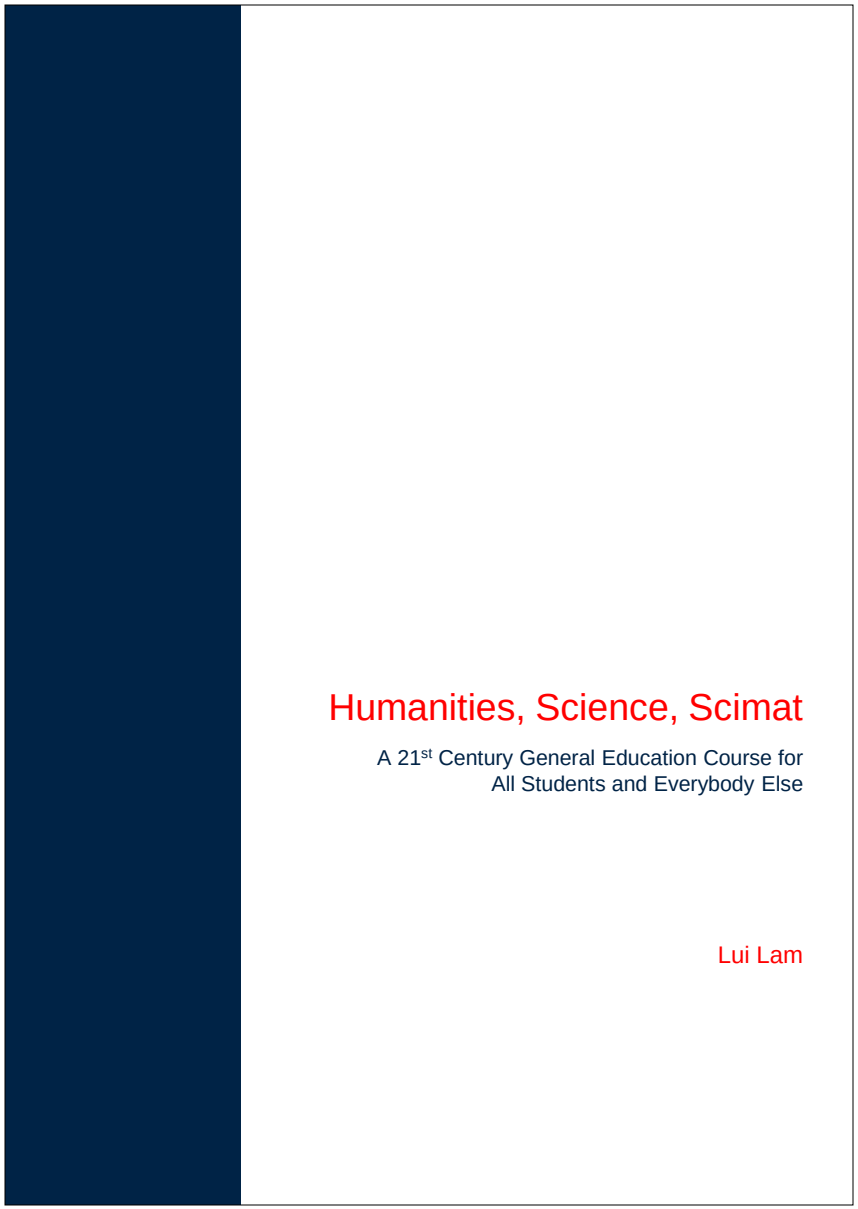
Implication 5: The Two-Culture Problem

- With rapid advance of "natural science" in the last 200 years, humanities were underdeveloped and two cultures were formed (even though both are doing the same thing—to understand Nature; the former about nonhuman systems, the latter humans).
- Literature is stuck with the complicated aspects of humans (a very complex system), such as pride and prejudice.
- The method to bridge the gap advocated by C. P. Snow (1959, adopted in general education) is to ask each side to learn something about the other side.
- This is ineffective and insufficient. The effective step is to educate all students on the common principles governing both sides: chaos, fractals and active walks. Better, teach them the proper definition of science.

C. P. Snow
(1905-1980)



Implication 6: A New General-Education Course Is Needed



Contents Summary

Science: Living with Uncertainty

- Only simple systems in the classical world is certain (e.g., stone falling).
- The quantum world is inherently probabilistic (even though the equation is deterministic).
- The human world, though classical, is inherently stochastic (due to unaccountable factors).

We are thus living with uncertainly, no matter how much science we know or can know.

- Learn basic probability.
- Prepare for the "worse".
- Be humble as scientists !

Physics Nobelist David Gross (2013):

A scientific "frontier" is defined as a state of confusion. … The public generally equates uncertainty with a wild guess. Whereas, for a scientist, a theory like the Standard Model is incredibly precise and probabilistic. In science, it is essential never to be totally certain. … Living with uncertainty is an essential part of science, and it is easily misunderstood.

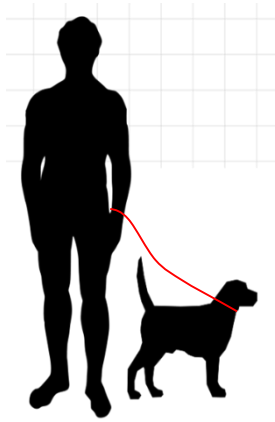
Conclusion

1. Science is humans' pursuit of knowledge about all things in Nature without bringing in God or any supernatural.

2. Humanities are part of science.

3. The proper image of science is:

(not test tubes or nuclear symbol…)



By ignoring the humanities, presently, AAAS is actually AAA**S**S.

(American Association for the Advancement of Selected Science)