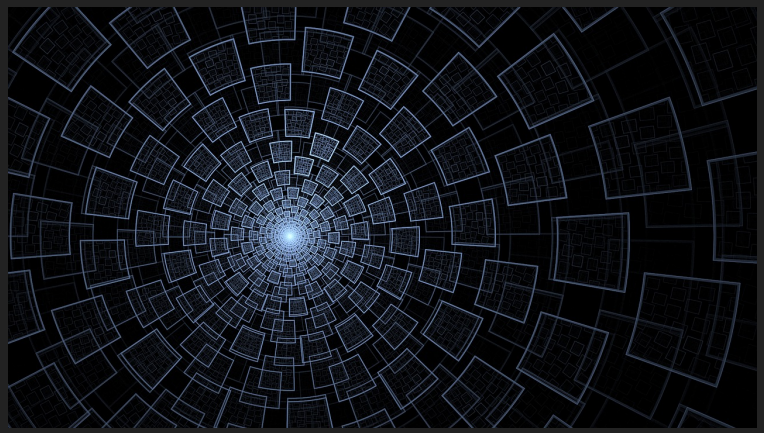
A Little Logic

arguments, reasoning and proof



George Matthews, Pennsylvania College of Technology

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press "h" for help on keyboard controls

What do I know?

Knowledge is

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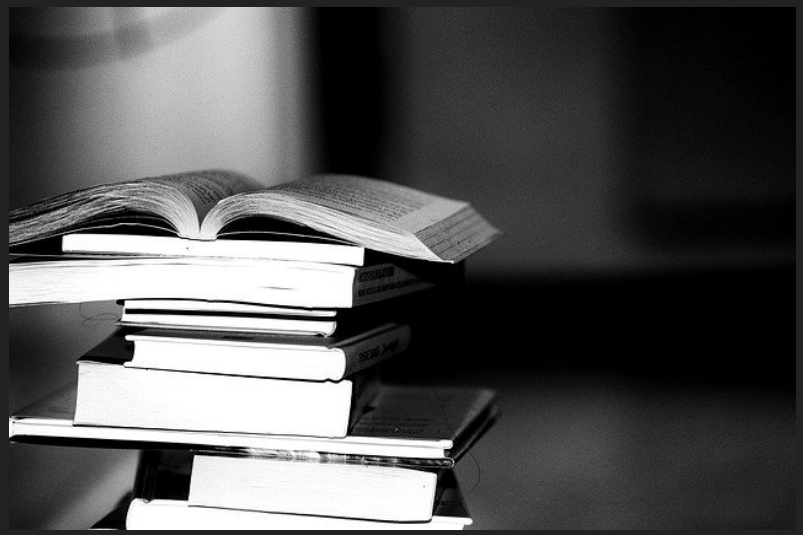
belief.



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- How can we know anything at all? This ancient philosophical question has troubled many people.
- First, note that knowledge is a state of mind, a type of *belief.* But there's more to knowledge than belief.

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- To count as knowledge our beliefs have to be *true.*
- While it may be hard to figure out just what the facts are, simply believing something strongly is not enough to make it true.

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- Finally we need *justification* for anything to really count as knowledge since knowledge is more than just lucky guessing.
- How we can justify our claims is one of the concerns of logic.

Reasoning & logic

deduction

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- It shows what else can we figure out based on what we already know.
- Deductive reasoning demonstrates the necessary consequences of given information.

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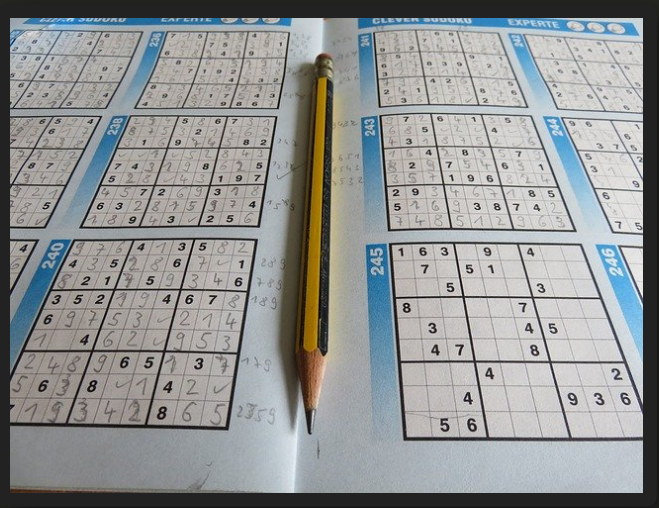

Sudoku puzzles are pure deduction, no guesswork is required.

Reasoning & logic

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- Inductive logic is the logic of *data analysis*.
- It shows what is likely to be true given the data that we have.
- In spite of inductive reasoning being weaker than proof we rely on this kind of reasoning every day.

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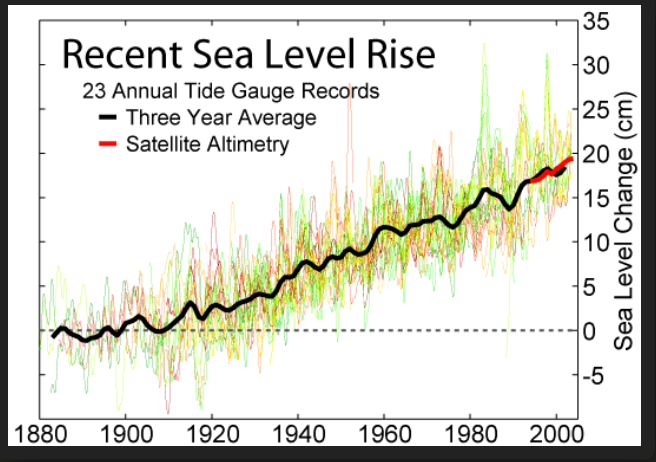

Probability theory and statistics enable us to make reliable guesses with incomplete information.

Reasoning & logic

abduction

- Abductive reasoning is reasoning about the *best explanation* for something.
- It (tries to) show why one way of explaining the facts is better than other ways.
- One explanation is typically better than another when it is simpler and has more predictive power.

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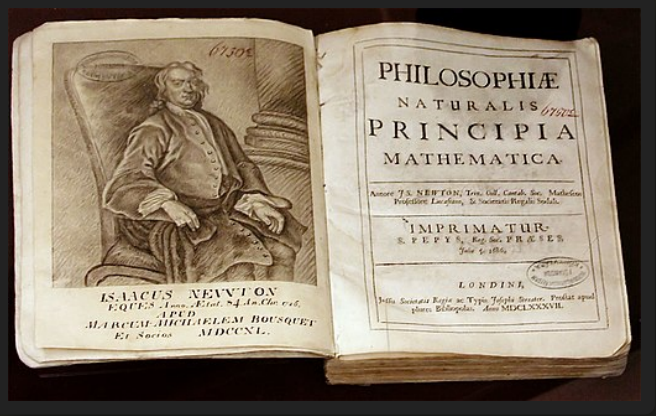

Scientific progress happens when scientists come up with better explanations. Isaac Newton did just that when he showed how all motion in the heavens and on earth followed a few basic laws.

Basic concepts

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Socrates is human.

Thus Socrates is mortal.

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The premises are the information we start out with and the conclusion is what we claim *logically follows from* that information.

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2. And if so is it SOUND? Is the information in the premises true?

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note: I'll write technical terms in all capitals -- it's not shouting, just a reminder that we are using these words in particular ways. See glossary for definitions.

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- To check we *assume* that the premises are **TRUE** (don't worry we'll get rid of that assumption later).
- Is it possible for the premises to be **TRUE** and the conclusion **FALSE**?
- If not, then the argument is VALID, as this one clearly is.

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- So this argument is SOUND!

More examples

All cats are animals.

My brother is an animal.

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- Clearly not, just ask him. Sound it is INVALID and thus alos UNSOUND.

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- Does the conclusion **have to be true** as well?
- Clearly not, just ask him. Sound it is INVALID and thus alos UNSOUND.
- The premises here refer to three *different* categories which are related in some way, but not in the way the conclusion states.

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All fish are made of wood.

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- Yes, so it is VALID.
- If cats were part of the larger class "fish" and fish were themselves part of a larger class "things made of wood" then cats would have to be made of wood. (This is a mini PROOF of validity, more on that later.)

Proving validity

Either Fred or Betty killed Mr. Slate at the quarry.

Either Fred or Wilma were home since somebody let Dino in.

But Wilma was working late.

So Betty killed Mr. Slate.

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note: Even though the argument is VALID it is not SOUND, since it is a *fictional* case.

Counterexamples

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a counterexample

person	age
Barney	35
Betty	40
Fred	45
Wilma	38

Glossary

- **Argument**: a series of statements in which the premises are intended to logically support the conclusion.
- **Valid**: an argument is valid when it is impossible for the premises to be true and the conclusion false.
- **Sound**: an argument is sound when it is valid and has true premises.
- **True**: said only of statements, not of arguments, and surprisingly hard to define.
- **False**: the opposite of true and once again said only of individual statements, not arguments.
- **Proof**: a step by step demonstration of the validity of an argument. In a proof we spell out exactly how we can derive the conclusion from nothing but the information contained in the premises.
- **Counterexample**: a possible case in which the premises of an argument are true and the conclusion is false -- used to show that an argument is invalid.

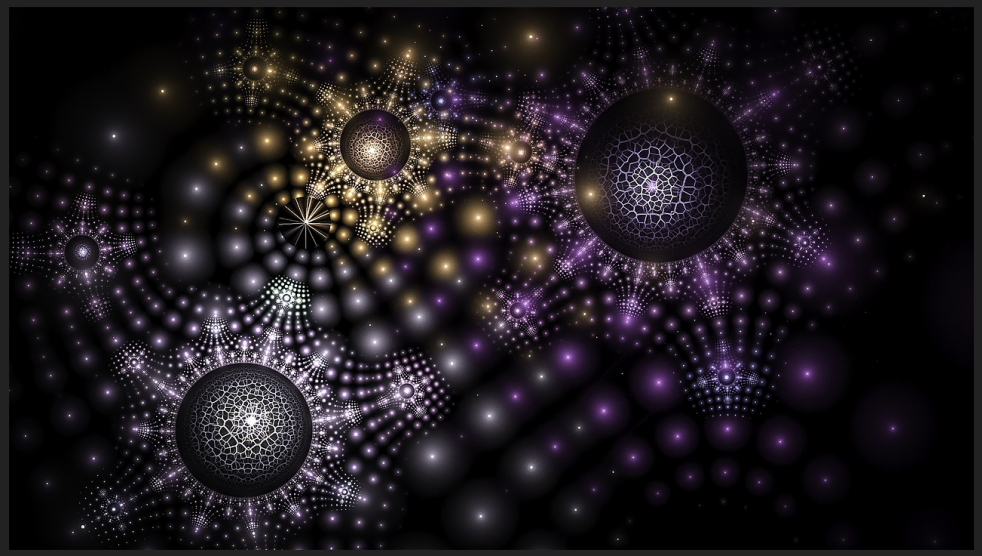
Find out more

Critical Thinking Web: A great site with over 100 free tutorials on many aspects of logic and critical thinking. A nice way to hone your logical thinking skills.

Deductive and Inductive Arguments: An in depth look at the subject at the Internet Encyclopedia of Philosophy.

Abduction: A close look at the logic of scientific explanation. Gets technical, but the introduction is accessible.

The Irrationality of Politics: Michael Huemer is a professor of philosophy at the University of Colorado. This TED Talk by him addresses the question of why we are so irrational when it comes to politics.



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