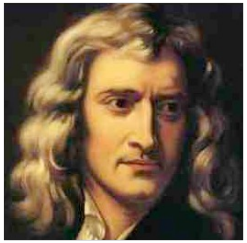
01. Introduction

Central topic: Nature of space(time).

1. Three approaches:

(a) Metaphysics: *What kind of thing is space?*

Sample responses



Issac Newton
(1643-1727)

Space is an absolute substance existing independently of physical objects. If you take all physical objects out of the world, space would be left.

G. W. Leibniz
(1646-1716)

Space consists merely in the relations between physical objects. If you take all physical objects out of the world, nothing would be left.

(b) Epistemology: *How is knowledge of space possible?*

Sample responses:

Immanuel Kant
(1724-1804)

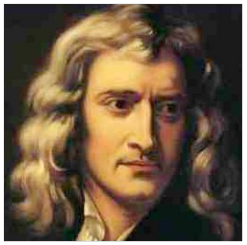
Knowledge of space is based entirely on pure reason alone, and reason says it's geometry is necessarily Euclidean.

Henri Poincaré
(1854-1912)

Knowledge of space is based entirely on experience, and experience indicates that the geometry of space is a matter of convention.

(c) Physics: *What role does space play in theories of motion?*

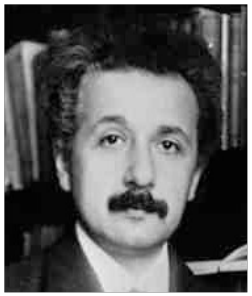
- What is the role of space in Newtonian mechanics?



Issac Newton
(1643-1727)

Absolute space and absolute time are necessary to provide the unique fixed frame of reference by means of which motion can be unambiguously defined.

- What is the role of space in relativistic mechanics?



Albert Einstein
(1879-1955)

Measurements of space and time are relative to inertial reference frames: inertial observers will disagree on the spatial distance and time interval separating two events (but they will all agree on the spatiotemporal distance between two events).

- What does general relativity tell us about the nature of space?
- How does what we take to be the nature of space influence our approach to quantum gravity?

2. Two Preliminary Topics

(i) Logic

- Study of deductive arguments:

Argument = a set of sentences consisting of
- conclusion (the claim being argued for)
- premises (reasons given for the claim)

Valid-deductive argument = an argument in which, *if* the premises are true, the conclusion must be true.

1. Joe is British.
2. No British citizens are president.

∴ Joe is not president.

1. Some people are nuns.
2. I'm a person.

∴ I am a nun.

INVALID!

1. All pigs can fly.
2. Wilbur is a pig.

∴ Wilbur can fly.

If the conclusion of a *valid-deductive* argument is false, then one or more premises must be false.

Indirect Proof (reductio ad absurdum):

To argue that claim p is false:

(a) Assume p is true.

(b) *Derive* an *unacceptable* conclusion q.

Which means: Construct a *valid-deductive* argument with q as conclusion, where q is known to be false, self-contradictory, or inconsistent with p.

(c) Conclude that p must be false.

Ex. p = Zeno missed class.

1. Zeno missed class.
2. If Zeno missed class, he would not have signed the roster.

$\therefore$ Zeno did not sign the roster. (q)

- *Now*: Suppose q is false.
- Since we have a valid-deductive argument with a false conclusion, one or more of its premises must also be false.
- Premise 2 seems acceptable.
- *So*: Premise 1 (our claim p) must be false.

(ii) Scientific Theories

Theory = a set of basic principles (laws and definitions) from which further claims can be *derived*.

Possible world = a world in which a theory and all the claims that can be derived from it are true.

Two ways in which a theory can be good

(1) *Applied aspect*: A theory is good if it matches the facts (*i.e.*, if its claims are true in the actual world).

(2) *Logical aspect*: A theory is good if it is consistent (*i.e.*, if there is at least one possible world it describes).

Analogy:

- A *sound* argument is a valid-deductive argument with true premises.
- A *valid-deductive* argument has premises that need not be true, but *if* they are, then the conclusion must be true.

- *Goal of theorist*: construct a theory that is *both* consistent (has at least one possible world) *and* matches the facts (is true of the actual world).