Propositions and Arguments

Logic and argumentation techniques

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What is a proposition?

- A proposition is a predicative sentence that only contains a subject and a predicate

S is P.

Which of these sentences express propositions?

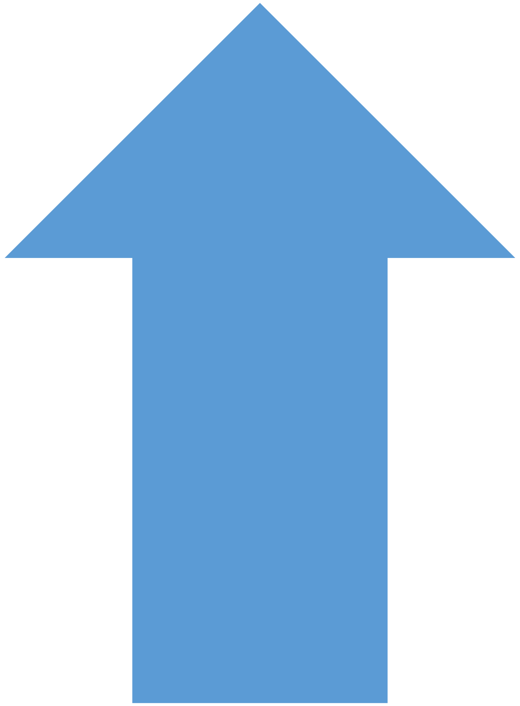
1. Sydney is north of Melbourne.
2. Is Edinburgh in Scotland?
3. The moon is made of swiss cheese.
4. Did you see the eclipse?
5. What an eclipse!
6. Would that I were good at logic.
7. Look at the eclipse.
8. I wish that I were good at logic.
9. 7+12=23

Arguments

- Arguments in everyday situations take place between people.
- Arguments give reasons for believing the truth of a proposition.
- Logic studies the information content of these arguments.

- An argument is a list of propositions, called the
- *premises,*
- followed by a word such as ‘therefore’, or ‘so’, and then another proposition, called the *conclusion*.
- The ***reason for accepting*** the information in the conclusion is based on the premises.
  - If everything is determined, people are not free. Premise
  - People are free. Premise
  - So not everything is determined. Conclusion

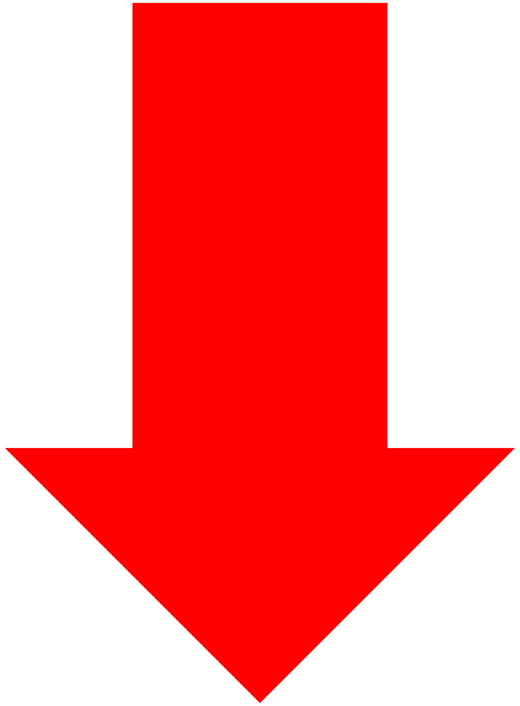
Rule



Individual
instances

INDUCTIVE
Arguments

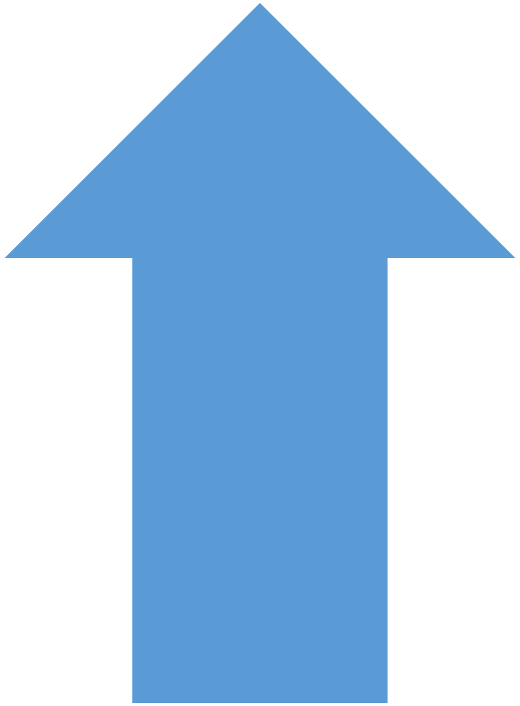
Rule



Individual
instances

DEDUCTIVE
Arguments

Rule



Individual instances

INDUCTIVE

Arguments

Most Hungarians commit tax fraud.
Gábor is Hungarian.
So, Gábor is likely to commit tax fraud.

- The link between the premises weaker.
- The truth of the premises only makes the truth of the conclusion , but does not guarantee it
- The conclusion is only possibly true.
- **These arguments are Inductive arguments.**

$$P(A|B) = \frac{P(A \cap B)}{P(B)}$$

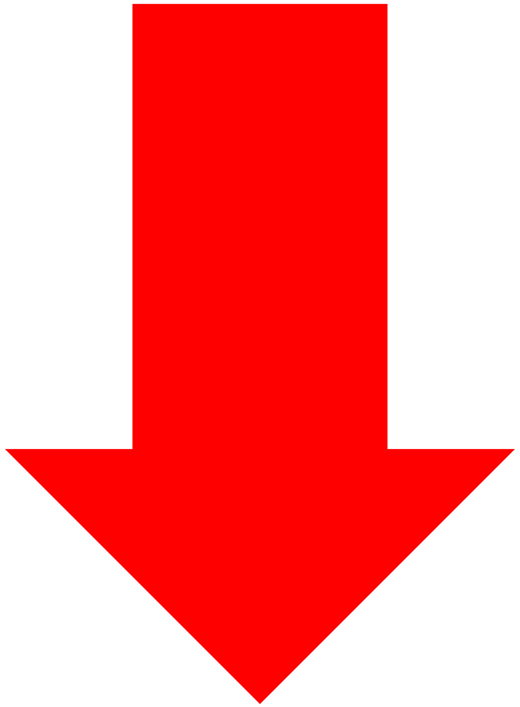
$$P(A|B) = \frac{P(A)P(B|A)}{P(B)}$$

All Hungarians commit tax fraud.
Gábor is Hungarian.
So, Gábor commits tax fraud.

The premises support the truth of the conclusion: it is **impossible for the premises to be true and the conclusion to be false**.

These are called deductive arguments.

Rule



Individual instances

DEDUCTIVE Arguments

Valid arguments

- An argument is valid if and only if whenever the premises are true, so is the conclusion.
- In other words, *it is impossible* for the premises to be true while at the same time the conclusion is false.

Sound arguments

- An argument is sound, just in the case where it is valid, and, in addition, the premises are
- all true. So, the conclusion of a sound argument must also be true.
- soundness appeals to the *truth* of the matter.

Valid Argument Scheme

All bats are birds. F

All birds fly. F Not sound

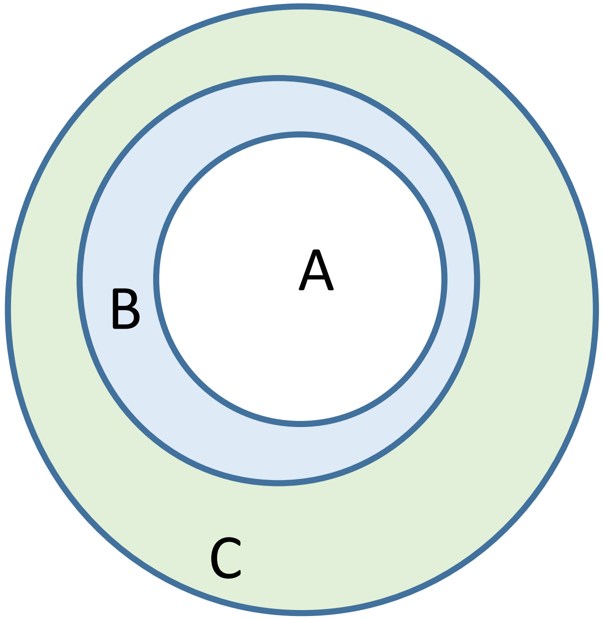
Therefore all bats fly. T

All whales are mammals. T

All mammals have hearts. T Sound

All whales have hearts. T

c



All A's are B's
All B's are C's

So all A's are C's

Logics of different “size”

- Propositional logic
  - Socrates is a man: P
  - WFFs refer to propositions.
- Predicate/First-order logic
  - Socrates is a man: ∀xFx
  - WFFs refer to propositions
  - Quantification over individuals
- Second order logic
  - Socrates is a man: ∀P∀x(x∈P)
  - WFFs refer to propositions
  - Quantification over individuals
  - Quantification over properties (set)

Predicate logic

- Contains names and predicates
  - Names: a proper name is a simple expression that serves to pick out an individual thing – ‘Socrates’
    - a-o
  - a predicate is an expression that results in a sentence when a number of names are inserted in the appropriate places – …is a man.
    - F, G, etc…

Examples of predicate logic

India is big	Bi
John loves Mary	Ljm
John and Mary love each other	$Ljm \wedge Lmj$
John and Mary love themselves	$Ljj \wedge Lmm$
Mary’s love for John is not reciprocated	$Lmj \wedge \neg Ljm$

How to formulate these sentences in propositional and first order logic?

1. Sydney is north of Melbourne.
2. Edinburgh is in Scotland.
3. The moon is made of Swiss cheese.
4. You can see the eclipse.
5. This is a beautiful eclipse.
6. I am good at logic.
7. You are looking at the eclipse.
8. I wish that I were good at logic.
9. 7+12=23

What is the form of the following sentence in predicate logic?

Some male philosophers have beards.

All logic students are intelligent.

Someone have been on the moon.

Not all Swiss live in poverty.

Quantifiers and variables

- When talking about general subjects (e.g. ‘someone’) we need variables.
  - Variables: x, y, z,
  - Someone is a student: Sx
- When talking about a quantity of objects, quantifiers are needed.
  - Existential quantifier: $\exists x(Sx)$ – Someone is a student
  - Universal quantifier: $\forall x\ (Sx)$ – everyone is a student

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Tranlate to english

Dictionary

a=Anthea; b=Brian

Gx=x is a geologist;
Hx=*x* is a hairdresser

Px=*x* is a person;

Lxy=*x* is larger than *y*

1. Ga
2. ¬Hb
3. Ha or Gb
4. Ha and Gb
5. Hb and Gb
6. ¬Gb
7. If Gb then Hb
8. Lab
9. ¬Lba
10. (∀y)(if Gy then Hy)
11. ¬(∀x)(if Gx then Hx)
12. (∀x)(if Gx then ¬Hx)
13. (∃x)(if Hx and Px)
14. (∀x)(if Hx then ¬Lxb)
15. (∀x)(if Px then (∃y)(Py and Lxy))
16. (∀x)(if Px then (∃y)(Gy and Lxy))
17. (∀x)(if Px then (∃y)(If Lxy then ¬ Lyx))
18. (∃y)(Py and ¬Gy)
19. (∃x)(Px and (∀z)(if Pz then Lxz))
20. (∀x) (∀y) (∀z)(If Lxy then (if Lyz then Lxz)).