Introduction to Formal Logic

PER SCHOLAS

Topics Covered

- Logic and Arguments
- Premises and Conclusions
- Correct and Incorrect Arguments
  - False Premises
  - Obfuscation
- Statements
- Logical Operators
- Propositions
- Symbolism
- Symbols and Computer Code

Arguments

- Arguments are the focal point of logic
- They're the way we structure our analytical thinking
- They have a formal structure
- They consist of reasons in support of a claim

Structure of an argument

- Premises
  - The evidence used in the argument
- Conclusion
  - The statement proven by the premises
- Logical Relation
  - What connects the premises to the conclusion

A Logical Argument

- Premise 1: All vegetables are plants
- Premise 2: This tomato is a vegetable
- Conclusion: This tomato must be a plant

A Logical Argument

- Premise 1: All vegetables are plants
- Premise 2: This tomato is a vegetable
- Conclusion: This tomato must be a plant

- Notes:
  - There is a direct relation between the premises
  - The conclusion is a result of that relation

A Logical Argument

- Premise 1: Stephen King is an author of horror stories
- Premise 2: Most horror stories include a thunderstorm.
- Conclusion: Therefore, it will rain tomorrow morning

An Incorrect Argument

- Premise 1: Stephen King is an author of horror stories
- Premise 2: Most horror stories include a thunderstorm.
- Conclusion: Therefore, it will rain tomorrow morning

- Notes:
  - There is a direct relation between the premises, though it is qualified (“most”, not “all”).
  - Even without the qualifier, the premises cannot support the conclusion. Horror stories are fictions; tomorrow is not.

A Logical Argument

- Premise 1: The pavement is black.
- Premise 2: Obsidian is black.
- Conclusion: The pavement is made from obsidian.

Another Incorrect Argument

- Premise 1: The pavement is black.
- Premise 2: Obsidian is black.
- Conclusion: The pavement is made from obsidian.

- Notes:
  - There is a direct relation between the premises.
  - The relationship is coincidental.
  - The conclusions is incorrect because it fails to consider the many other materials with which to create black pavement.

Statements

- Statements are one example of a premise.
- Statements must be declarative.
- Statements express a truth or probable truth:
  - What time is it? – not a statement
  - Close the door! – not a statement
  - All humans are homo sapiens – a statement
  - Coffee often tastes bitter – a statement
- Statements can be combined with **logical operators**:
  - Ann is home **OR** Bob is home.
  - I made capuccino this morning **AND** I got to work on time.

Where Premises Go Wrong

- Premise: It rained yesterday AND rain causes roses to bloom.
- Conclusion: The roses are blooming today.

Where Premises Go Wrong

- Missing Detail
  - Premise: It rained yesterday AND rain causes the roses to bloom.
  - Conclusion: The roses are blooming today.
- Problem: The premise is missing a detail: how long does it take for the rain to cause the roses to bloom?

Where Premises Go Wrong

- Premise: The epistemic position of the defense side of the litigation lacks justificatory veracity.

Where Premises Go Wrong

- Obfuscation
  - Premise: The epistemic position of the defense side of the litigation lacks justificatory veracity.
- The wording of the premise makes it hard to understand, misleading.

Propositions

- A Proposition is the meaning behind the statement
- Statements can be reworded while still meaning the same thing
- For instance:
  - The epistemic position of the defense side of the litigation lacks justificatory veracity
  - The defendant failed to make their case
- Propositions can remain the same even when changing languages
  - The moon has craters
  - La luna tiene cráteres
- The important thing is to make sure people understand your propositions

Truth Value

- In logic, a proposition can only be true or false
- Some propositions can be true or false depending on circumstances, while others are always true or always false
- For instance, compare these:
  - New York City is located in New York State
  - It's raining in Chicago

Introducing Symbolism

- In mathematics, we can use symbols in equations and formulas
- We can replace those symbols with a variety of numbers and the equations still work
- For example, we could create an addition formula using symbols:
  - x + 1 = y

Example of Symbolism

- Original Argument:
  - All humans are rational
  - All rational things are conscious
  - Therefore, all humans are conscious
- Symbolized Argument:
  - Let H stand for human, R stand for rational, and C stand for conscious and write our argument as:
  - All H are R
  - All R are C
  - Therefore All H are C

Linking Symbolism to Computer Code

Original Argument:
Let X represent an integer and Y represent another integer.
Any two integers can be added together to generate a third integer called the Sum.
Therefore, X and Y can be added together to return a sum.

Equivalent Code in C#:

```
int Sum(int X, int Y)
{
   return X + Y;
}
```

Questions?

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