Introduction to Formal Logic

Arguments

- Arguments are the focal point of logic
- They’re the way we structure our 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 being proved by the premises
- Logical Relation
  - What connects the premises to the conclusion

Example of a “right” 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

Example of a “wrong” argument

- Premise 1: Stephen King is an Author
- Premise 2: The sky is blue
- Conclusion: Therefore, it will rain tomorrow morning

- Notes:
  - There is no direct relation between the premises
  - Even if the conclusion was true, it would not have anything to do with the premises

Statements

- Statements are one example of a premise
- They MUST be declarative
  - It must express a truth or possible truth
- For instance:
  - “What time is it?” – NOT a statement
  - “Close the door!” – NOT a statement
  - “All humans are homo sapiens” – IS a statement
  - “Coffee usually tastes bitter” – IS a statement
- Statements can be combined with operators
  - Ann is home OR Bob is home
  - I made cappuccino this morning AND I got to work on time

Where premises can go wrong

- Not being specific enough
  - Invalid logic:
    - Premise: I made cappuccino this morning AND I got to work on time
    - Conclusion: Therefore, it's going to be a good day
  - Valid logic:
    - Premise 1: I made cappuccino this morning AND I got to work on time
    - Premise 2: If I make cappuccino in the morning or get to work on time, it's a good day.
    - Conclusion: Therefore, it's going to be a good day
- Misunderstanding
  - The epistemic position of the defense side of the litigation lacks justificatory veracity

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 Code

- Original Argument
  - Let X stand for an integer and Y stand for a second integer
  - The values of X and Y will always be given as integers
  - Integers can be added together, resulting in another integer
  - Therefore, X and Y can be added together
  - Return X+Y
- Argument in Java

```
int adder(int x, int y){
    return x+y;
}
```