Logic

Critical Thinking
Logic

• Logic is the study of reasoning
• In particular, logic studies the conditions under which we can say that a piece of reasoning is valid, i.e. the conditions under which the conclusion can be said to follow from the premises.
• Logic thus only studies one of the criteria of what makes something a good argument or good piece of reasoning.
  – In particular, logic does not look at whether the premises themselves are true: logic doesn’t care!
• In sum, logic studies inference.
Normative and Descriptive Theories of Reasoning

- Psychology of reasoning is a scientific study of how humans reason:
  - What do humans infer from what?
  - What is the mechanism behind human reasoning?
- As such, psychologists (and cognitive scientists) come up with descriptive theories of reasoning:
  - These theories are hypotheses as to how humans reason based on empirical studies.
- Logicians, however, try to come up with standard of good inference reasoning:
  - What actually follows from what?
- Logic provides normative theories of reasoning.
Argument Forms and Formal Logic

• “If I win the lottery, then I am poor. I win the lottery. Hence, I am poor.”

• This argument has the following abstract structure or form: “If P then Q. P. Hence, Q”

• Any argument of the above form is valid, including “If flubbers are gook, then trugs are brig. Flubbers are gook. Hence, trugs are brig.”!

• Hence, we can look at the abstract form of an argument, and tell whether it is valid without even knowing what the argument is about!!

• Formal logic studies the validity of arguments by looking at the abstract form of arguments.
Conditional Claims

• Logic often involved conditional claims: If this, then that.
• Many people make mistakes when reasoning using conditional claims.
  – Wason selection task
• Formal logic to the rescue:
  – ‘If this then that’ becomes $P \rightarrow Q$.
  – ‘Not this’ becomes $\neg P$
Some Important Arguments Involving Conditionals

ϕ → ψ

ϕ
ψ
Modus Ponens

Valid!

ϕ → ψ

¬ψ
¬ϕ
Modus Tollens

ϕ → ψ

ψ
ϕ
Modus Ponens

Valid!

ϕ → ψ

ψ
ϕ
Affirming the Consequent

Invalid!

ϕ → ψ

¬ϕ
¬ψ
Denying the Antecedent

Invalid!