What is a logical argument? What is deductive reasoning?

Fundamentals of Academic Writing

Logical relations

- Deductive logic
  - Claims to provide conclusive support for the truth of a conclusion
- Inductive logic
  - Arguments support a conclusion, but do not claim to show that it is necessarily true

Deductive logic

- Categorical propositions
  - Deductive arguments are either valid or invalid.
  - Premises are either true or not true.

  - If the argument is valid and the premises are true, then the conclusion is true.

Deductive logic

- Categorical propositions
  - All *S* is *P*.
  - No *S* is *P*.
  - Some *S* is *P*.
  - Some *S* is not *P*.

- Quantity: Some or All
- Quality: Positive or Negative (*no, not*)

Deductive logic

- Categorical propositions
  - All dogs are mammals.
  - No dogs are fish.
  - Some mammals are carnivores.
  - Some mammals are not carnivores.

- The truth of a proposition is determined by its "fit" with the world.
  - "Some mammals are carnivores" is true if and only if there are some mammals that eat meat.

Deductive logic

- Categorical propositions
  - "**Physicians licensed to practice in Japan must pass the National Medical Licensing Board Exam.**"
  - All licensed physicians in Japan are people who passed the Licensing Board Exam.
  - All *S* is *P*.

Exercise

- Create one or more categorical statements of the following types. Compare your statements with your group members'.
  - All *S* is *P*.
  - No *S* is *P*. (= All *S* is *not-P*.)
  - Some *S* is *P*.
  - Some *S* is not *P*.

Syllogisms

- Syllogism: A conclusion inferred from two premises

  All Cretans are liars.

  All liars are dishonest.

  ∴ All Cretans are dishonest.

Syllogisms

All Cretans are liars.

All liars are dishonest.

∴ All Cretans are dishonest.

- Major term: Predicate ("is *P*") of the conclusion
- Minor term: Subject (e.g. "All *S*") of the conclusion
- Middle term: Term in both premises that is not in the conclusion

Syllogisms

All Cretans are liars.

All liars are dishonest.

∴ All Cretans are dishonest.

- Major term
- Minor term
- Middle term
- ∴ “Ergo”, Latin for “therefore”

Syllogisms

All enzymes are proteins.

All proteins are organic compounds.

∴ All enzymes are organic compounds.

Syllogisms

Some plankton is algae.

All algae consume CO_2.

Therefore, some plankton consume CO_2.

"Plankton helps reduce levels of CO_2, since the algae in plankton consume CO_2 from the environment."

Deductive logic

- If the argument is valid and the premises are true, then the conclusion is true.
  - Valid: The argument (relation of the premises) *necessarily entails* the conclusion.
  - True: The premises accurately reflect the world.
- Deductive logic is used to prove that the conclusion must be true (if the premises are true).

Deductive logic

- If the argument is valid and the premises are true, then the conclusion is true.
  - Valid (but not true)

    Humans are animals.

    All animals live under water.

    Therefore, humans live under water.

Deductive logic

- If the argument is valid and the premises are true, then the conclusion is true.
  - True (but not valid)

    Humans are animals.

    Some animals live under water.

    Therefore, humans sometimes live under water.

Deductive logic

- If the argument is valid and the premises are true, then the conclusion is true.

  Humans are animals.

  All animals breathe.

  Therefore, humans breathe.

- Deductive logic is used to prove that the conclusion must be true (if the premises are true).

Exercise

- Work with your group members. Try to create one or more valid (preferably true) syllogisms.

All **S** are **M**.	**Carbon atoms are atoms.**
All **M** are **P**.	**All atoms have mass.**
∴ **All S** are **P**.	**Therefore, carbon atoms have mass**

(No S are M; Some S are M; Some S are not M; etc.)

Deductive logic

- There are other deductive arguments, but syllogism is probably the most commonly used in most types of academic writing.

- Let’s look at how to turn a syllogism into an academic paper.

Logic in writing

Our business has a reputation for poor service.

Premise

Businesses with a reputation for poor service have few customers.

Premise

Therefore, our business has few customers.

Conclusion

- If the argument is valid and the premises are true, then the conclusion is true.

Logic in writing

✔ Valid

Our business has a reputation for poor service.

Businesses with a reputation for poor service have few customers.

Therefore, our business has few customers.

– If the argument is valid and the premises are true, then the conclusion is true.

Logic in writing

- The paper will need one section showing that “Our business has a bad reputation” is true.
- The next section will show “Businesses with bad reputations have few customers” is true.
- The conclusion section needs to show how the true premises and the valid argument prove the author’s conclusion. (It will probably also recommend changing the reputation.)

Logic in reading

- When you read, ask yourself:
  - What is the conclusion?
  - What is the argument? (In other words, what premises lead to the conclusion?)
  - Is the argument valid?
  - Are the premises true?

Logic in reading

"I do not believe that we can have any freedom in the philosophical sense, for we act not only under external compulsion but also by inner necessity."

– Albert Einstein

Logic in reading

"I do not believe that we can have any freedom in the philosophical sense, for we act not only under external compulsion but also by inner necessity."

– Albert Einstein

- What is the conclusion?
  - People are not free. (All people are not free.)

Logic in reading

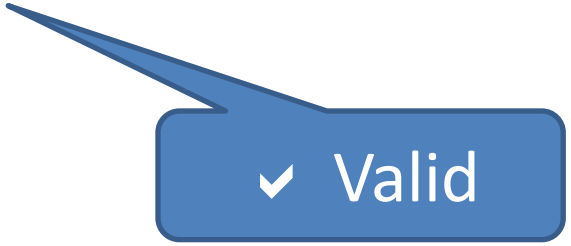
"I do not believe that we can have any freedom in the philosophical sense, for we act not only under external compulsion but also by inner necessity."

– Albert Einstein

- What are the premises?
  - People act under compulsion and necessity.
  - (The other premise is not stated, but implied.) Things acting under compulsion are not free.

Logic in reading

- Is the logic valid?
  - All people are under compulsion and necessity.
  - All things under compulsion and necessity are not free.
  - Therefore, all people are not free.



Logic in reading

"I do not believe that we can have any freedom in the philosophical sense, for we act not only under external compulsion but also by inner necessity."

– Albert Einstein

- Are the premises true?
  - I'm not sure. It's more a matter of "belief" than "fit with the world".

Logic in reading

"To those who scare peace-loving people with phantoms of lost liberty, my message is this: Your tactics only aid terrorists, for they erode our national unity."

– John Ashcroft (US politician)

Logic in reading

"To those who scare peace-loving people with phantoms of lost liberty, my message is this: Your tactics only aid terrorists, for they erode our national unity."

– John Ashcroft (US politician)

- What is the conclusion?
  - People who 'scare with phantoms of lost liberty' aid terrorists.
    (All people who argue for liberty are aids to terrorists.)

Logic in reading

"To those who scare peace-loving people with phantoms of lost liberty, my message is this: Your tactics only aid terrorists, for they erode our national unity."

– John Ashcroft (US politician)

- What are the premises?
  - People who argue for liberty 'erode our national unity' (disagree with the US government).
  - Terrorists disagree with the US government.

Logic in reading

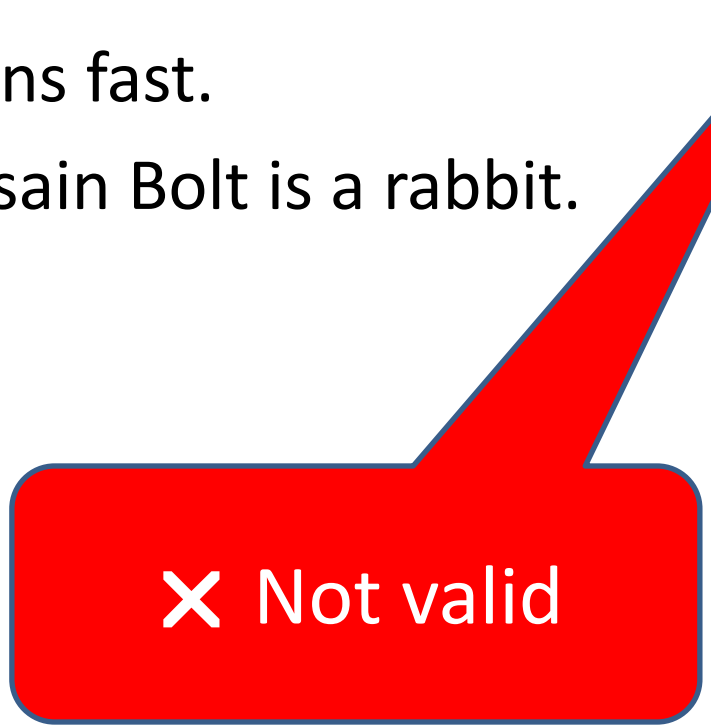
All P is M.
Q is M.
∴ All P is Q.

- Is the argument valid?
  - All people who argue for liberty dis[illegible]e US government.
  - Terrorists disagree with the US government.
  - Therefore, all people who argue for liberty are aids to terrorists.

Logic in reading

- Is the argument valid?
  - All rabbits run fast.
  - Usain Bolt runs fast.
  - Therefore, Usain Bolt is a rabbit.

All P is M.
Q is M.
∴ All P is Q.



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