



# Critical thinking


Deductive reasoning




# Deduction



- **Deductive reasoning:** spelling out whatever conclusion follows logically from your premises, without references to any external information
- **Deductive proof:** demonstrating that a particular conclusion logically follows from certain premises, and that this conclusion must be true if these premises are true
- **Truth-preserving:** when used correctly, deductive



Spell out the logical conclusion that the information leads to:

- 
1. I can't stand any kind of physical activity. Sailing is a physical activity, so...
  2. There is no such thing as a magnetic plastic. My plate is plastic, so...
  3. Anyone ignoring me while speaking on their phone is irritating. You are ignoring me while speaking on your phone, so...



# What conclusion can be drawn deductively?

- A combination of poor diet and inactivity in elderly patients leads to memory loss. George (not his real name) is inactive and eats a poor diet. Barbara (not her real name) is inactive but eats well. Thus, we predict that...

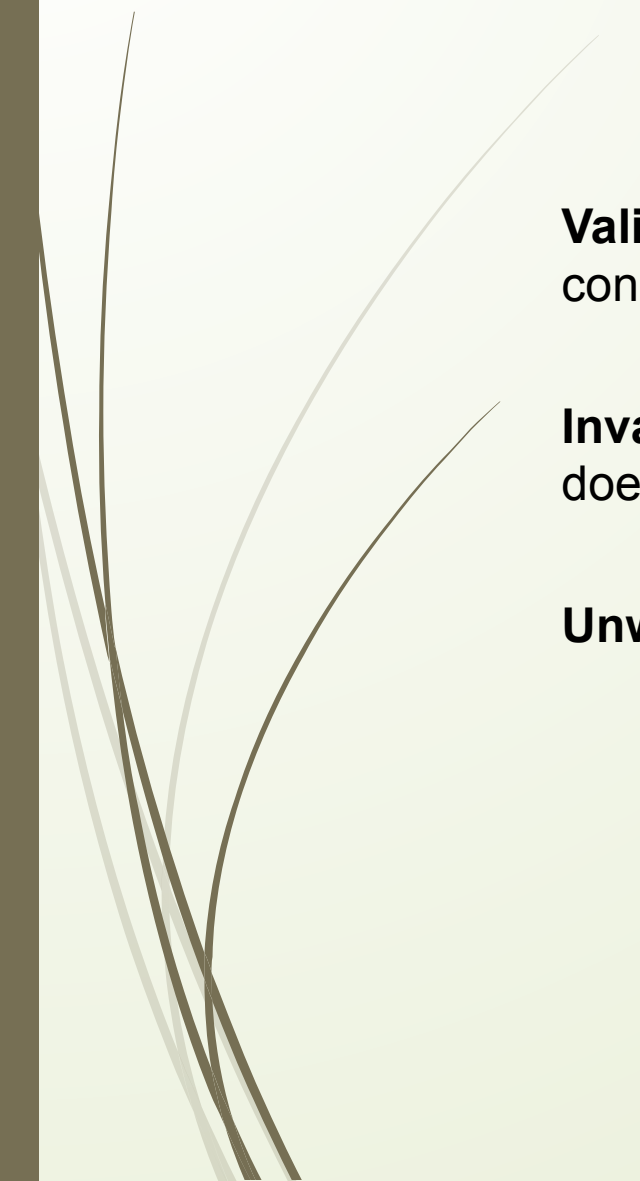



# What is valid?

**Valid reasoning:** correctly applying deductive reasoning in drawing out the logical conclusion of your premises

**Invalid reasoning:** incorrectly applying deductive reasoning so that your conclusion does not logically follow from your premises

**Unwarranted:** a conclusion that is not supported by the argument





# Valid or invalid? Work in groups

1. All students must register if they wish to attend the workshop. I wish to attend the workshop. Therefore, I must register.
2. There is no such thing as a purple monkey. This creature is purple, so it can't be a monkey.
3. Purple monkeys are difficult to spot. This creature is difficult to spot, so it must be a purple monkey.
4. We always need the permission of human volunteers if our experiments on them are to be ethical. We do not yet have permission from these subjects, so we cannot yet experiment on them in an ethical manner.
5. We always need the permission of human volunteers if our experiments on them are to be ethical. We do not yet have permission from these subjects, so we can only experiment on them if they don't know what we are doing



# Answers



☐ 1. Valid

☐ 2. Valid

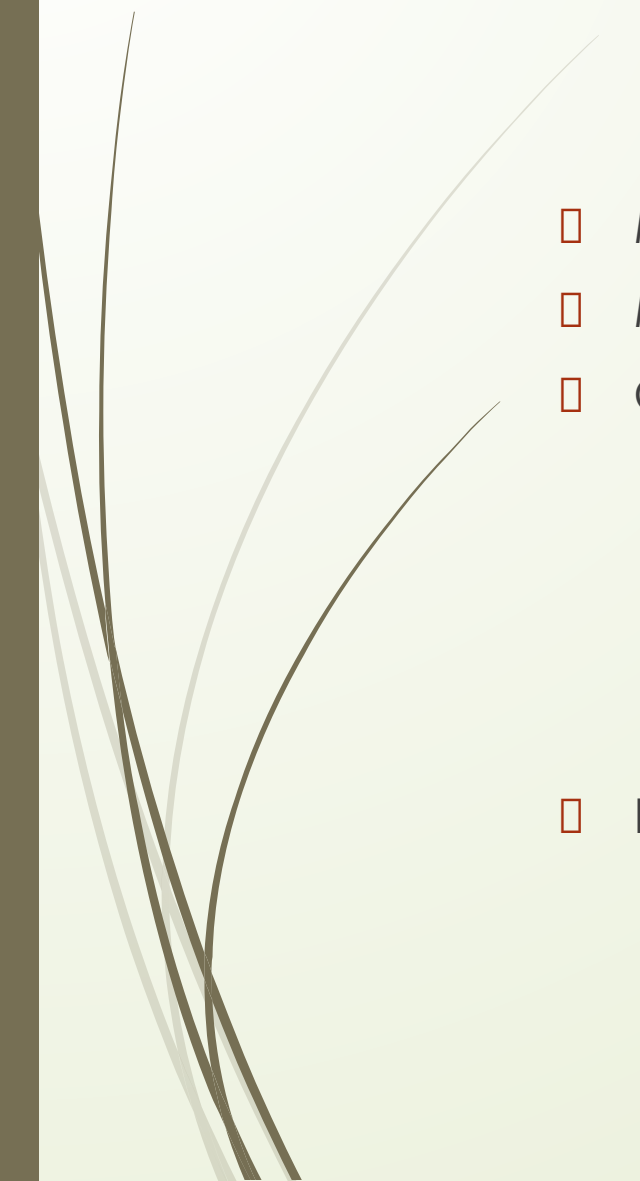
☐ 3. Invalid

☐ 4. Valid

☐ 5. Invalid



# Structure of a syllogism

- 
- Major premise
  - Minor premise
  - Conclusion
- 
- Enthymeme – a syllogism with one hidden premise

# Valid deductive reasoning

- Affirming the antecedent

- If A, then B.

- A.

- Therefore, B.

- Denying the consequent

- If A, then B.

- Not B.

- Therefore, not A.

- Affirming the antecedent

- All sailors drink heavily.

- He is a sailor.

- Therefore, he drinks heavily.

- Denying the consequent

- All politicians lie.

- She doesn't lie.

- Therefore, she is not a politician.

Create examples!



# Invalid deductive reasoning



- ❑ Denying the antecedent
  - ❑ If A, then B.
  - ❑ Not A.
  - ❑ Therefore, not B. (Wrong!)
- ❑ Affirming the consequent
  - ❑ If A, then B.
  - ❑ B.
  - ❑ Therefore, A. (Wrong!)

Create examples!

- ❑ Denying the antecedent
  - ❑ All sailors drink heavily.
  - ❑ He is not a sailor.
  - ❑ Therefore, he does not drink heavily.
- ❑ Affirming the consequent
  - ❑ All politicians lie.
  - ❑ She lies.
  - ❑ Therefore, she is a politician.



# Valid vs true



1. Argument valid, conclusion not true
  1. All poets are English.
  2. Mayakovsky is a poet.
  3. Conclusion: Mayakovsky is English.
2. Argument invalid, conclusion true
  1. All poets are English.
  2. Mayakovsky is English.
  3. Conclusion: Mayakovsky is a poet.
3. Validity + truth: a sound argument.



# Necessary vs sufficient condition



# Sound argument

**Sound:** a deductive argument that is both valid and has true premises, meaning its conclusion must also be true

**Unsound:** an argument that does not meet the standard of soundness, either because it is invalid or because one or more of its premises is untrue, or both

## THINK ABOUT THIS

Can you think of a deductive argument in common use that is valid but unsound? What kind of premises can we be certain are true? What kinds of deductive argument may never be sound, because their premises can't be proven as true?



# Analyse an argument

- The following appeared as a letter to the editor from a Central Plaza store owner.
  - "Over the past two years, the number of shoppers in Central Plaza has been steadily decreasing while the popularity of skateboarding has increased dramatically. Many Central Plaza store owners believe that the decrease in their business is due to the number of skateboard users in the plaza. There has also been a dramatic increase in the amount of litter and vandalism throughout the plaza. Thus, we recommend that the city prohibit skateboarding in Central Plaza. If skateboarding is prohibited here, we predict that business in Central Plaza will return to its previously high levels."
- *Write a response in which you discuss what questions would need to be answered in order to decide whether the recommendation is likely to have the predicted result. Be sure to explain how the answers to these questions would help to evaluate the recommendation.*