

Topic 4:

Arguments *

* The Logical Kind, **Not** The Talk Radio Kind.

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Monty Python’s “The Argument Clinic”

Featuring:

Michael Palin as “Man”
Rita Davies as “Receptionist”
Graham Chapman as “Mr. Barnard”
John Cleese as “Mr. Vibrating”
Eric Idle as “Complainer”
Terry Jones as “Spreaders”



Definition: Argument

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Inductive and Deductive Reasoning (1 / 3)

Definition: Inductive Argument

.....

Definition: Deductive Argument

.....

Inductive and Deductive Reasoning (2 / 3)

Example(s):

Inductive and Deductive Reasoning (3 / 3)

What type of argument is this?

3 is a prime number, 5 is a prime number, and 7 is a prime number.

Therefore, all positive odd integers above 1 are prime numbers.

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Structure of a Deductive Argument

$$(p_1 \wedge p_2 \wedge \dots \wedge p_n) \rightarrow q$$

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Valid and Sound Arguments (1 / 2)

Definition: Valid Argument

.....

.....

Example(s):

Valid and Sound Arguments (2 / 2)

Example(s):

Definition: Sound Argument

.....

Some Rules of Inference (1 / 2)

Learn these!

1. Addition
2. Simplification
3. Conjunction
4. Modus Ponens

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Some Rules of Inference (2 / 2)

Learn these, too!

5. Modus Tollens
6. Hypothetical Syllogism
7. Disjunctive Syllogism
8. Resolution

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Examples of Valid Arguments (1 / 4)

#1: You accidently drop a pen. You know that the pen will fall if it is dropped. How do you know that the pen will fall?

Examples of Valid Arguments (2 / 4)

#2: If 191 is divisible by 7, then 191^2 is divisible by 49.
191 is divisible by 7, so 191^2 is divisible by 49.
Is this argument valid?

Examples of Valid Arguments (3 / 4)

#3: If you email me a love note, I'll send you flowers. If you don't, I'll study Discrete Math. If I study Discrete Math, I'll do well on the quiz.
Can we conclude that, if I don't send you flowers, I'll do well on the quiz?

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Examples of Valid Arguments (4 / 4)

#3: (cont.)

p : You email me a love note

q : I send you flowers

r : I study Discrete Math

s : I do well on the quiz

$p \rightarrow q$

$\bar{p} \rightarrow r$

$r \rightarrow s$

$\therefore \bar{q} \rightarrow s$???

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Rules of Inference for Predicates (1 / 3)

Four common rules that you need to know:

1. **Universal Instantiation**

$$\forall x P(x), x \in D / \therefore P(d) \text{ if } d \in D$$

2. **Universal Generalization**

$$P(d) \text{ for any } d \in D / \therefore \forall x P(x), x \in D$$

3. **Existential Instantiation**

$$\exists x P(x), x \in D / \therefore P(d) \text{ for some } d \in D$$

4. **Existential Generalization**

$$P(d) \text{ for some } d \in D / \therefore \exists x P(x), x \in D$$

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Rules of Inference for Predicates (2 / 3)

Example(s):

Everyone taking CSc 144 has had a programming class.
Hugo is in CSc 144. **Has he had a programming class?**

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Rules of Inference for Predicates (3 / 3)

Here's a more general example using the same setup:

Someone's taking CSc 144. Everyone in CSc 144 has had a programming class. **Does there exist someone who both had a programming class and is taking CSc 144?**

$$(1) \quad \exists x C(x) \quad (\text{Given})$$

$$(2) \quad \forall x (C(x) \rightarrow P(x)) \quad (\text{Given})$$

$$(7) \quad \therefore \exists x (P(x) \wedge C(x))$$

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Fallacies (1 / 2)

Definition: Fallacy

Three classic types:

1. **Affirming the Conclusion (or ... Consequent)**

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Fallacies (2 / 2)

2. Denying the Hypothesis (or ... Antecedent)

3. Begging the Question (a.k.a. Circular Reasoning)

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Fallacies for Fun

1. Fallacy of Interrogation

2. 'No True Scotsman' Fallacy

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Extra Slides

The remaining slides in this topic are some that I no longer cover in class. I won't ask about them on a quiz or an exam, but they could be referenced on a homework or in SIs.

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Specious Reasoning: The Bear Patrol (1 / 3)

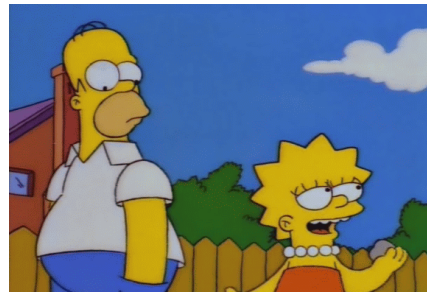
Homer: Ah, not a bear in sight. The Bear Patrol must be working like a charm!

Lisa: That's **specious reasoning**, Dad. [...] By your logic, I could claim that this rock keeps tigers away!

Homer: Oh . . . and how does it work?

Lisa: It doesn't work. [...] It's just a stupid rock. [...] But I don't see any tigers around here, do you?

Homer: Lisa, I want to buy your rock.



From: **The Simpsons, “Much Apu About Nothing”**

(Season 7, Episode 151, Production Code 3F20)

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Specious Reasoning: The Bear Patrol (2 / 3)

Definition: Specious Reasoning

An unsupported or improperly constructed argument.
(That is, an unsound or invalid argument.)

Question: Where is the error in Homer's logic?

b : There are bears in Springfield

w : The Bear Patrol is working

First issue: Which of these is Homer's argument?

(1) $\neg b$ (Given)

(1) w (Given)

(2) $\therefore w$ (???)

(2) $\therefore \neg b$ (???)

The first seems most reasonable in context.

Specious Reasoning: The Bear Patrol (3 / 3)

Question: Where is the error in Homer's logic? (cont.)

Next, what is the missing piece of Homer's argument?

(1) $\neg b$

(2) $\boxed{\neg b \rightarrow w}$ ← this is what we're trying to show!

(3) $\therefore w$ (1, 2, Modus Ponens)

OK, then, how about ...

(1) $\neg b$

(2) $\boxed{w \rightarrow \neg b}$ ← might sound good, but ...

(3) $\therefore w$ (1, 2, um ... Abracadabra?)

(The second form of Homer's argument fails similarly.)