

# Topic 4:

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## Arguments \*

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

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## Monty Python's "The Argument Clinic"

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### 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)

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## Definition: Inductive Argument

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## Definition: Deductive Argument

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# Inductive and Deductive Reasoning (2 / 3)

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## Example(s):

# Inductive and Deductive Reasoning (3 / 3)

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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

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

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# Valid and Sound Arguments (1 / 2)

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## Definition: Valid Argument

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## Example(s):

# Valid and Sound Arguments (2 / 2)

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## Example(s):

## Definition: Sound Argument

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# Some Rules of Inference (1 / 2)

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Learn these!

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

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# Some Rules of Inference (2 / 2)

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Learn these, too!

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

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## Examples of Valid Arguments (1 / 4)

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#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)

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#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)

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#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)

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#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

$p \rightarrow q$

$\bar{p} \rightarrow r$

$r \rightarrow s$

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

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# Rules of Inference for Predicates (1 / 3)

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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)

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**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)

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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?**

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

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

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

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## Fallacies (1 / 2)

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### Definition: Fallacy

Three classic types:

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

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# Fallacies (2 / 2)

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

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

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# Fallacies for Fun

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1. Fallacy of Interrogation

2. 'No True Scotsman' Fallacy

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# Extra Slides

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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)

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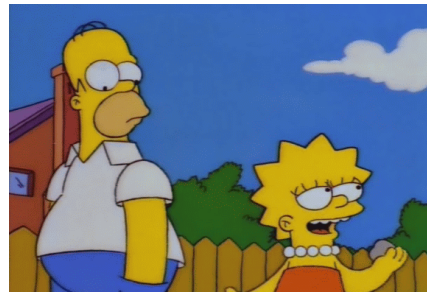
Homer: Ah, not a bear in sight. The Bear Patrol must be working like a charm!

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.)