Topic 4:

Arguments *

* The Logical Kind, Not The Talk Radio Kind.

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

. . . .

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.

Structure of a Deductive Argument

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

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

Some Rules of Inference (2 / 2)

Learn these, too!

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

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?

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

$$\begin{array}{l} p \to q \\ \overline{p} \to r \\ r \to s \\ \hline \therefore\ \overline{q} \to s \end{array}$$

???

Rules of Inference for Predicates (1 / 3)

Four common rules that you need to know:

1. Universal Instantiation

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

2. Universal Generalization

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

3. Existential Instantiation

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

4. Existential Generalization

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

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?

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)	$\exists x\ C(x)$	(Given)
(2)	$\forall x\ (C(x) \rightarrow P(x))$	(Given)

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

Fallacies (1 / 2)

Definition: Fallacy

. . . .

Three classic types:

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

Fallacies (2 / 2)

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

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

Fallacies for Fun

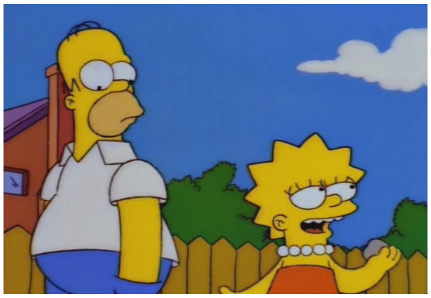
1. Fallacy of Interrogation

2. 'No True Scotsman' Fallacy

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.

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)

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

(1)		w	(Given)
(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)		$\boxed{\neg b \rightarrow w}$	$\leftarrow$ this is what we're trying to show!
(3)	$\therefore$	w	(1, 2, Modus Ponens)

OK, then, how about . . .

(1)		$\neg b$	
(2)		$\boxed{w \rightarrow \neg b}$	$\leftarrow$ might sound good, but . . .
(3)	$\therefore$	w	(1, 2, um . . . Abracadabra?)

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