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 “Spreadsers”

Definition: Argument
Inductive and Deductive Reasoning (1 / 3)

Definition: Inductive Argument

Example(s):

Inductive and Deductive Reasoning (2 / 3)

Definition: Deductive Argument

Example(s):
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

\[(p_1 \land p_2 \land \ldots \land p_n) \rightarrow q\]
Valid and Sound Arguments (1 / 2)

**Definition: Valid Argument**


**Example(s):**


Valid and Sound Arguments (2 / 2)

**Example(s):**


**Definition: Sound Argument**


Arguments – CSc 245 v1.1 (McCann) – p. 7

Arguments – CSc 245 v1.1 (McCann) – p. 8
Some Rules of Inference (1 / 2)

Learn these!

1. Addition

2. Simplification

3. Conjunction

4. Modus Ponens

Arguments – CSc 245 v1.1 (McCann) – p. 9

Some Rules of Inference (2 / 2)

Learn these, too!

5. Modus Tollens

6. Hypothetical Syllogism

7. Disjunctive Syllogism

8. Resolution

Arguments – CSc 245 v1.1 (McCann) – p. 10
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.)

\[
\begin{align*}
p &: \text{You email me a love note} \\
q &: \text{I send you flowers} \\
r &: \text{I study Discrete Math} \\
s &: \text{I do well on the quiz}
\end{align*}
\]

\[
\begin{align*}
p &\rightarrow q \\
\overline{p} &\rightarrow r \\
r &\rightarrow s \\
\therefore \quad \overline{q} &\rightarrow s
\end{align*}
\]

???
Four common rules:

1. **Universal Instantiation**
   \[ \forall x \ P(x), \ x \in D \ / \ : \ P(d) \text{ if } d \in D \]

2. **Universal Generalization**
   \[ P(d) \text{ for any } d \in D \ / \ : \ \forall x \ P(x), \ x \in D \]

3. **Existential Instantiation**
   \[ \exists x \ P(x), \ x \in D \ / \ : \ P(d) \text{ for some } d \in D \]

4. **Existential Generalization**
   \[ P(d) \text{ for some } d \in D \ / \ : \ \exists x \ P(x), \ x \in D \]

Example(s):
Definition: Fallacy

Three classic types:

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

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 section.
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?**

\begin{align*}
\text{b:} & \quad \text{There are bears in Springfield} \\
\text{w:} & \quad \text{The Bear Patrol is working}
\end{align*}

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

\begin{align*}
(1) & \quad \neg b \quad \text{(Given)} \\
(2) & \quad \therefore w \quad (???)
\end{align*}

\begin{align*}
(1) & \quad w \quad \text{(Given)} \\
(2) & \quad \therefore \neg b \quad (???)
\end{align*}

The first seems most reasonable in context.
**Question:** Where is the error in Homer’s logic? (cont.)

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

<table>
<thead>
<tr>
<th>(1)</th>
<th>¬b</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2)</td>
<td>¬b → w</td>
</tr>
<tr>
<td>(3)</td>
<td>∴ w</td>
</tr>
</tbody>
</table>

OK, then, how about . . .

<table>
<thead>
<tr>
<th>(1)</th>
<th>¬b</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2)</td>
<td>w → ¬b</td>
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</table>

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