

Introduction to Logic

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In this section we will learn:

- What is the difference between Deduction and Induction?
- Why use different types of logic?
- What is a valid argument? Invalid? Sound?
- What is a strong argument?

Deduction and Induction

Arguments

- Factual claim: The claim that there is evidence.
- Inferential claim: The claim that something follows from this evidence.
- When we analyze arguments, we look at the inferential claim first, and the factual claim second. That is, we look at the argument structure first and the argument content second.

All arguments

```
graph TD; A[All arguments] --> B[Deductive Arguments claim to guarantee the truth of the conclusion.]; A --> C[Inductive Arguments claim that the conclusion probably follows.];
```

Deductive Arguments claim to guarantee the truth of the conclusion.

Inductive Arguments claim that the conclusion probably follows.

All arguments

```
graph TD; A[All arguments] --> B[Deductive Arguments claim to guarantee the truth of the conclusion.]; A --> C[Inductive Arguments claim that the conclusion probably follows.]; B --> D[Valid]; B --> E[Invalid];
```

Deductive Arguments claim to guarantee the truth of the conclusion.

Inductive Arguments claim that the conclusion probably follows.

Valid

Invalid

Valid Arguments

- An argument in which it is impossible for the conclusion to be false given that the premises are true.
- The conclusion follows with strict necessity from the premises.

Invalid Arguments

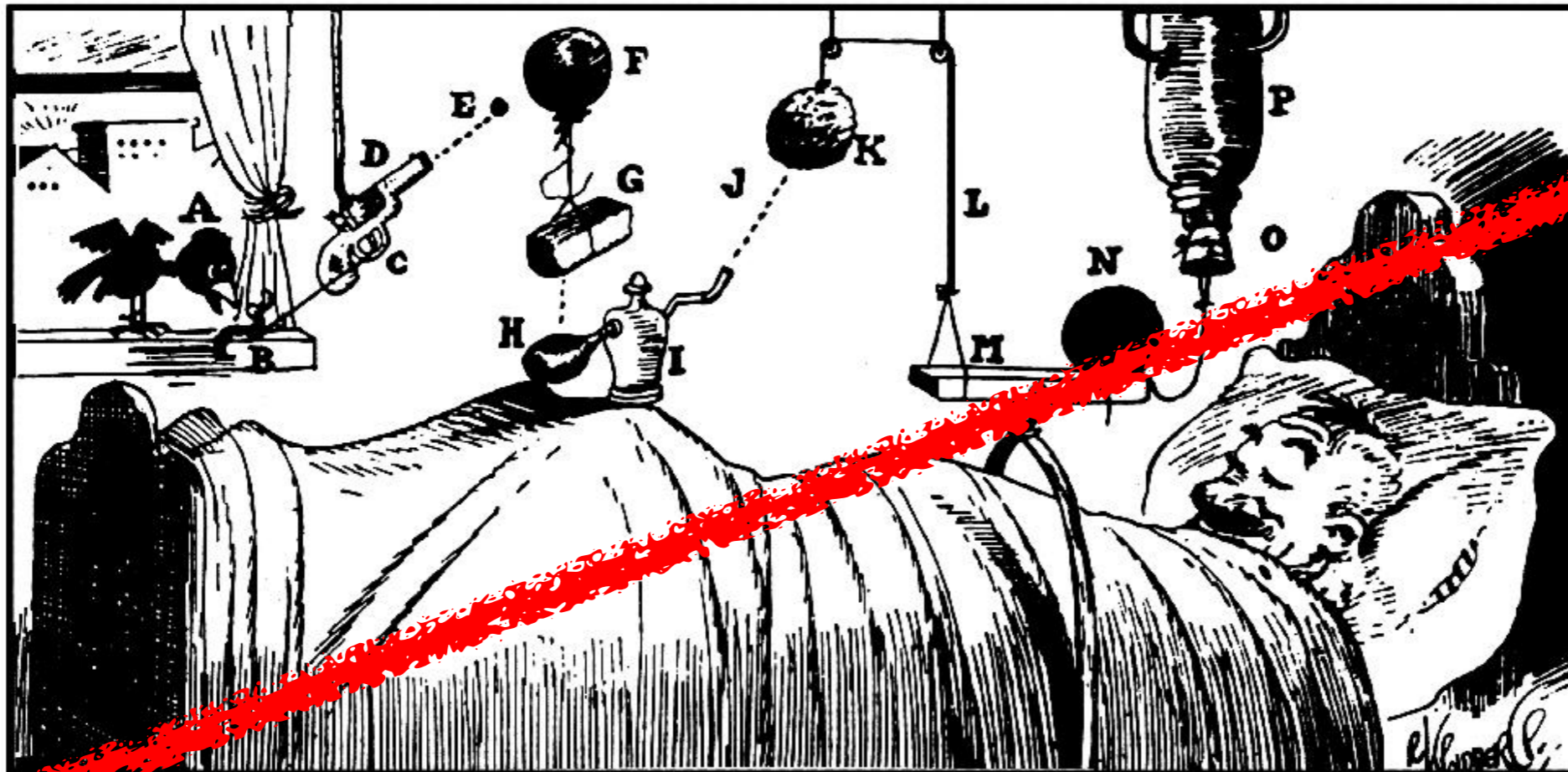
- An argument in which it is possible for the conclusion to be false given that the premises are true.
- The conclusion does not follow with strict necessity from the premises.

Testing for validity

- 1. Assume that the premises are true (even when you know they are not).
- 2. Ask whether the conclusion could be false given 1.

Machine analogy: invalidity

Simple Alarm Clock



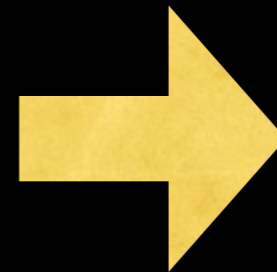
The early bird (A) arrives and catches worm (B), pulling string (C) and shooting off pistol (D). Bullet (E) busts balloon (F), dropping brick (G) on bulb (H) of atomizer (I) and shooting perfume (J) on sponge (K)—As sponge gains in weight, it lowers itself and pulls string (L), raising end of board

(M)—Cannon ball (N) drops on nose of sleeping gentleman—String tied to cannon ball releases cork (O) of vacuum bottle (P) and ice water falls on sleeper's face to assist the cannon ball in its good work.

Fountain analogy: invalidity



“Buckets of truth”



Valid

“Buckets of truth”



Invalid

Testing for validity

- P1: All television networks are media companies.
- P2: NBC is a television network.
- C: Therefore, NBC is a media company.

Valid

Testing for validity

- P1: All automakers are computer manufacturers.
- P2: United Airlines is an automaker.
- C: Therefore, United Airlines is a computer manufacturer.

Valid

Testing for validity

- P1: All banks are financial institutions.
- P2: Wells Fargo is a financial institution.
- C: Therefore, Wells Fargo is a bank.

Invalid

Testing for validity

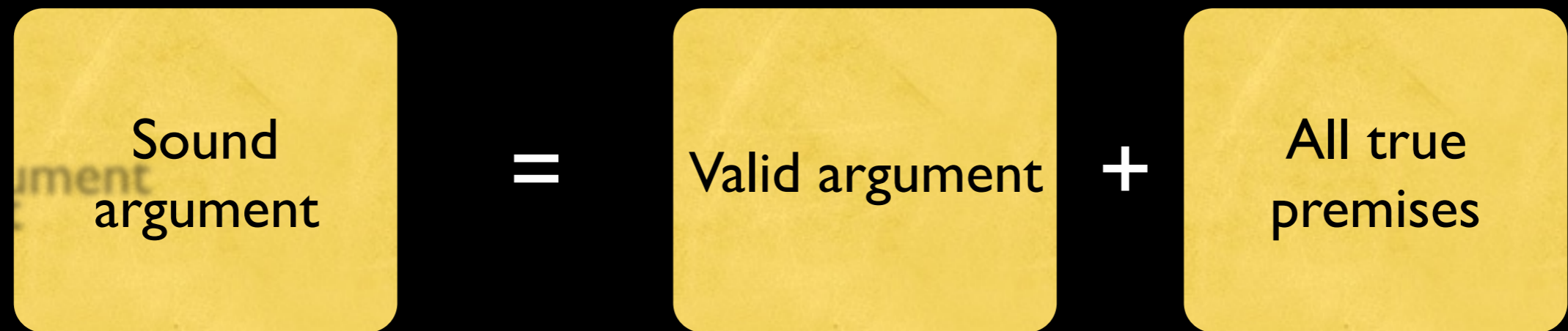
- P1: All wines are whiskeys.
- P2: Ginger ale is a wine.
- C: Therefore, ginger ale is a whiskey.

Valid

TABLE 1.1 DEDUCTIVE ARGUMENTS

	Valid	Invalid
True premises True conclusion	All wines are beverages. Chardonnay is a wine. Therefore, chardonnay is a beverage. [sound]	All wines are beverages. Chardonnay is a beverage. Therefore, chardonnay is a wine. [unsound]
True premises False conclusion	None exist.	All wines are beverages. Ginger ale is a beverage. Therefore, ginger ale is a wine. [unsound]
False premises True conclusion	All wines are soft drinks. Ginger ale is a wine. Therefore, ginger ale is a soft drink. [unsound]	All wines are whiskeys. Chardonnay is a whiskey. Therefore, chardonnay is a wine. [unsound]
False premises False conclusion	All wines are whiskeys. Ginger ale is a wine. Therefore, ginger ale is a whiskey. [unsound]	All wines are whiskeys. Ginger ale is a whiskey. Therefore, ginger ale is a wine. [unsound]

Sound Arguments



Note: In this class, testing for validity is the hard part. But once you're sure you've got a valid argument, you just need to determine if the premises are true or false -- that gives you soundness.

All arguments

```
graph TD; A[All arguments] --> B[Deductive Arguments claim to guarantee the truth of the conclusion.]; A --> C[Inductive Arguments claim that the conclusion probably follows.];
```

Deductive Arguments claim to guarantee the truth of the conclusion.

Inductive Arguments claim that the conclusion probably follows.

Inductive arguments

```
graph TD; A[Inductive arguments] --> B[Strong Inductive argument: It is improbable that the conclusion is false given that the premises are true.]; A --> C[Weak Inductive argument: The conclusion probably does not follow from the premises, even though it is claimed to.];
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Strong Inductive argument:
It is improbable that the conclusion is false given that the premises are true.

Weak Inductive argument:
The conclusion probably does not follow from the premises, even though it is claimed to.

Testing for strength

- 1. Assume that the premises are true (even when you know they are not).
- 2. Ask whether the conclusion is probably true.

Testing for strength

- P1: All dinosaur bones to this day have been at least 50 million years old.
- C: Therefore, probably the next dinosaur bone to be found will be at least 50 million years old.

Strong

Testing for strength

- P1: When a lighted match is slowly dunked into water, the flame is snuffed out.
- P2: Gasoline is a liquid, just like water.
- C: Therefore, when a lighted match is slowly dunked into gasoline, the flame will be snuffed out.

Weak

TABLE 1.2 **INDUCTIVE ARGUMENTS**

	Strong	Weak
<p>True premise</p> <p>Probably true conclusion</p>	<p>All previous U.S. presidents were older than 40. Therefore, probably the next U.S. president will be older than 40. [cogent]</p>	<p>A few U.S. presidents were lawyers. Therefore, probably the next U.S. president will be older than 40. [uncogent]</p>
<p>True premise</p> <p>Probably false conclusion</p>	<p>None exist</p>	<p>A few U.S. presidents were unmarried. Therefore, probably the next U.S. president will be unmarried. [uncogent]</p>
<p>False premise</p> <p>Probably true conclusion</p>	<p>All previous U.S. presidents were TV debaters. Therefore, probably the next U.S. president will be a TV debater. [uncogent]</p>	<p>A few U.S. presidents were dentists. Therefore, probably the next U.S. president will be a TV debater. [uncogent]</p>
<p>False premise</p> <p>Probably false conclusion</p>	<p>All previous U.S. presidents died in office. Therefore, probably the next U.S. president will die in office. [uncogent]</p>	<p>A few U.S. presidents were dentists. Therefore, probably the next U.S. president will be a dentist. [uncogent]</p>

Cogent
argument

=

Strong
argument

+

All true and relevant
premises

Valid or invalid? Sound?

- Since London is north of Paris and south of Edinburgh, it follows that Paris is south of Edinburgh.

Valid. Sound.

Valid or invalid? Sound?

- If George Washington was beheaded, then George Washington died. George Washington died. Therefore, George Washington was beheaded.

Invalid; true premises, false conclusion.

Valid or invalid? Sound?

- All leopards with lungs are carnivores.
Therefore, all leopards are carnivores.

Invalid; true premise, true conclusion.

Valid or invalid? Sound?

- If Senator Hillary Clinton represents California, then she represents a western state. Hillary Clinton does not represent a western state. Therefore, she does not represent California.

Sound.

Valid or invalid? Sound?

- Since some fruits are green and some fruits are apples, it follows that some fruits are green apples.

Invalid.

Quick Quiz

- Give an example of a statement.
- Give an example of sentence that is not a statement.
- Give an example of an argument