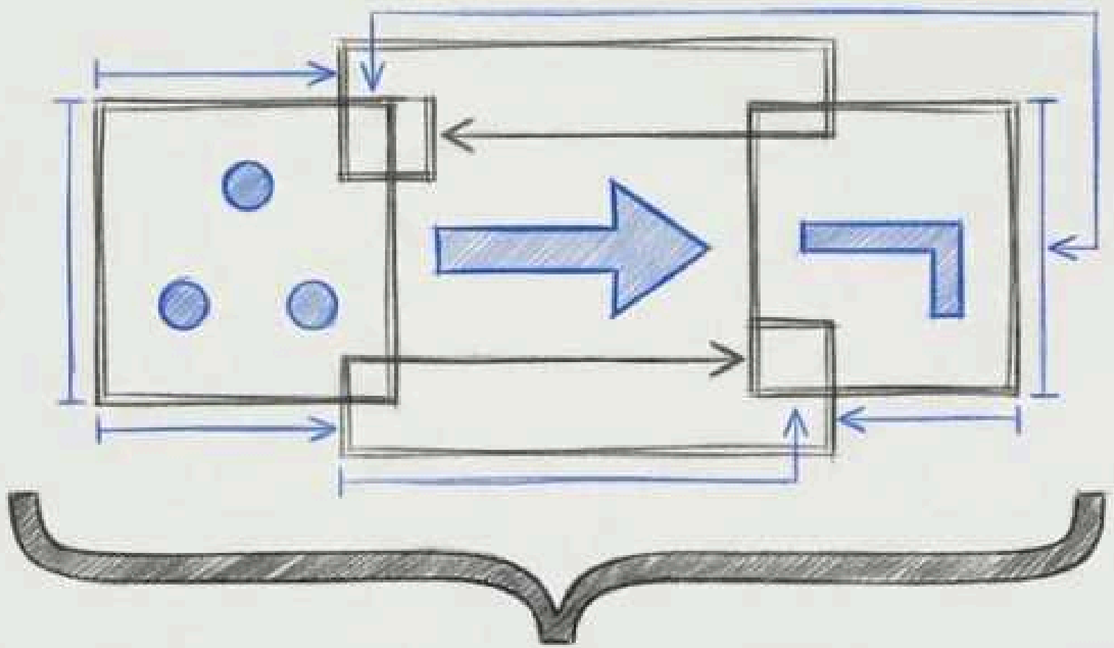
¶ 2.1

Lecture 2: Validity and Soundness



The difference between a valid argument and a sound one, and how to test for each.

Gemini Notebook

Two words sit at the centre of deductive logic

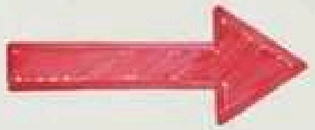
¶ 2.2

Everyday Talk

Valid (True?)

~ ?

Sound (Reasonable?)



Logic

VALID

SOUND



Warning: Mixing these up is the most common beginner mistake. They have exact, mathematical meanings.

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Validity is a matter of structure, not actual truth

¶ 2.3



Premises

Conclusion

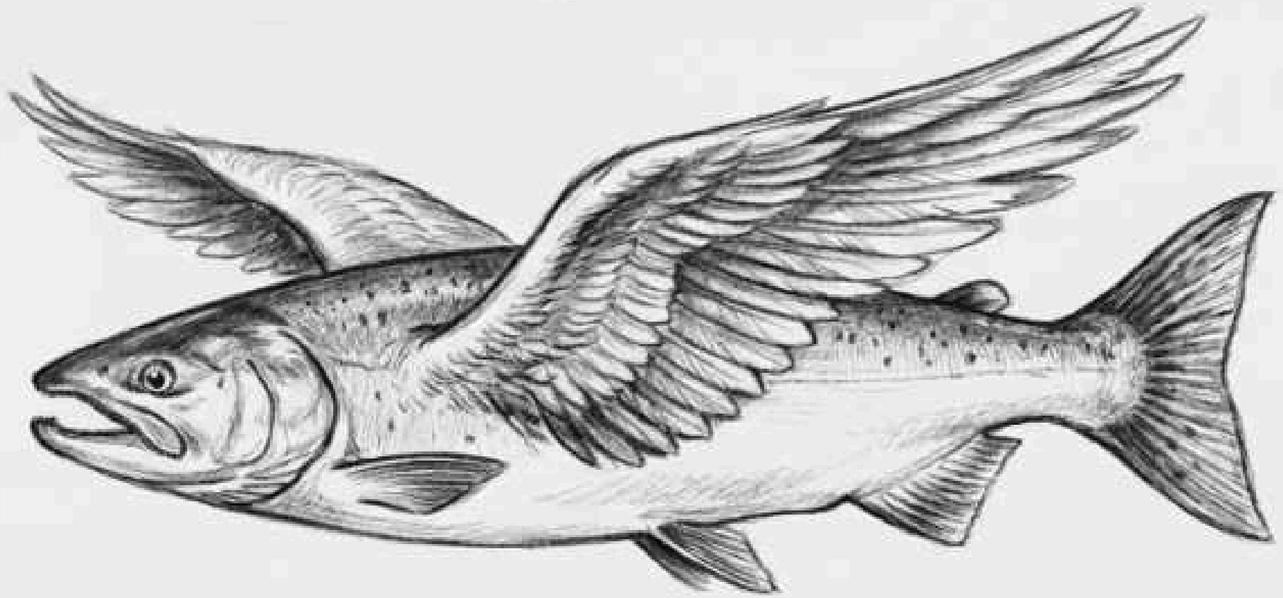
An argument is valid if it is impossible for all premises to be true while the conclusion is false.

~~FACTS~~

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The paradox of perfect reasoning with false facts

¶ 2.4

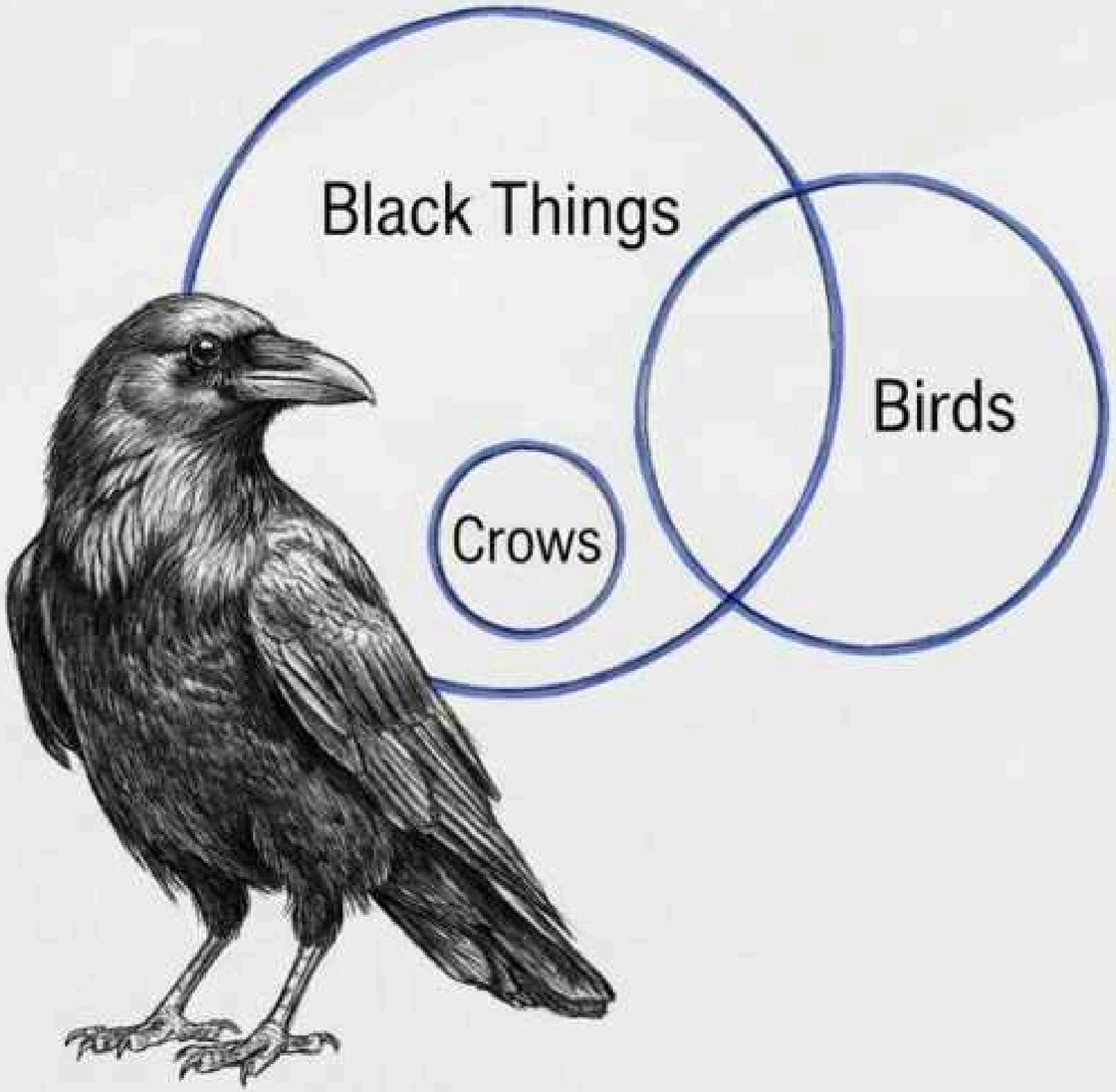


The Argument	The Diagnosis
1. All fish can fly. (F) 2. A salmon is a fish. (T) --- Therefore, a salmon can fly. (F)	✓ **Valid Form** • The reasoning works perfectly: if 1 and 2 were true, 3 must follow. ✗ **Facts** • The premises are false.

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The paradox of true facts with broken logic

¶ 2.5



The Argument

1. Some birds are black. (T)
2. Some black things are crows. (T)

Therefore, some birds are crows. (T)

The Diagnosis

Invalid Form

- The premises do not guarantee the conclusion; the diagram proves the black birds might not be the crows.

Facts

- Statements happen to be true.

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¶2.6

Soundness is the gold standard of deductive logic

[Valid Form] + [All Premises Actually True] = SOUND



A sound argument delivers a guaranteed truth.
Because it is valid, the conclusion must follow.
Because the premises are true, the conclusion is true.

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Every argument falls into exactly one of three bins

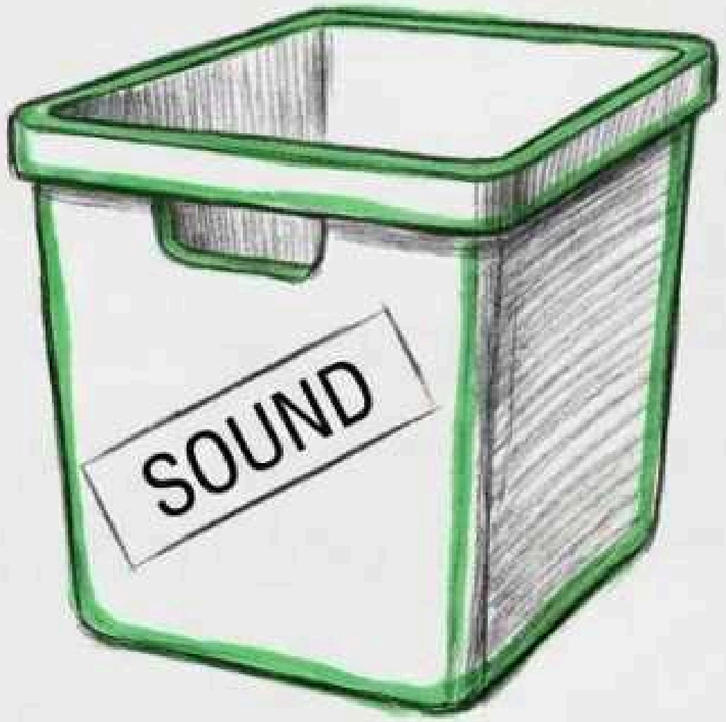
¶ 2.7



Fails, whatever the facts.



Good form, bad facts.

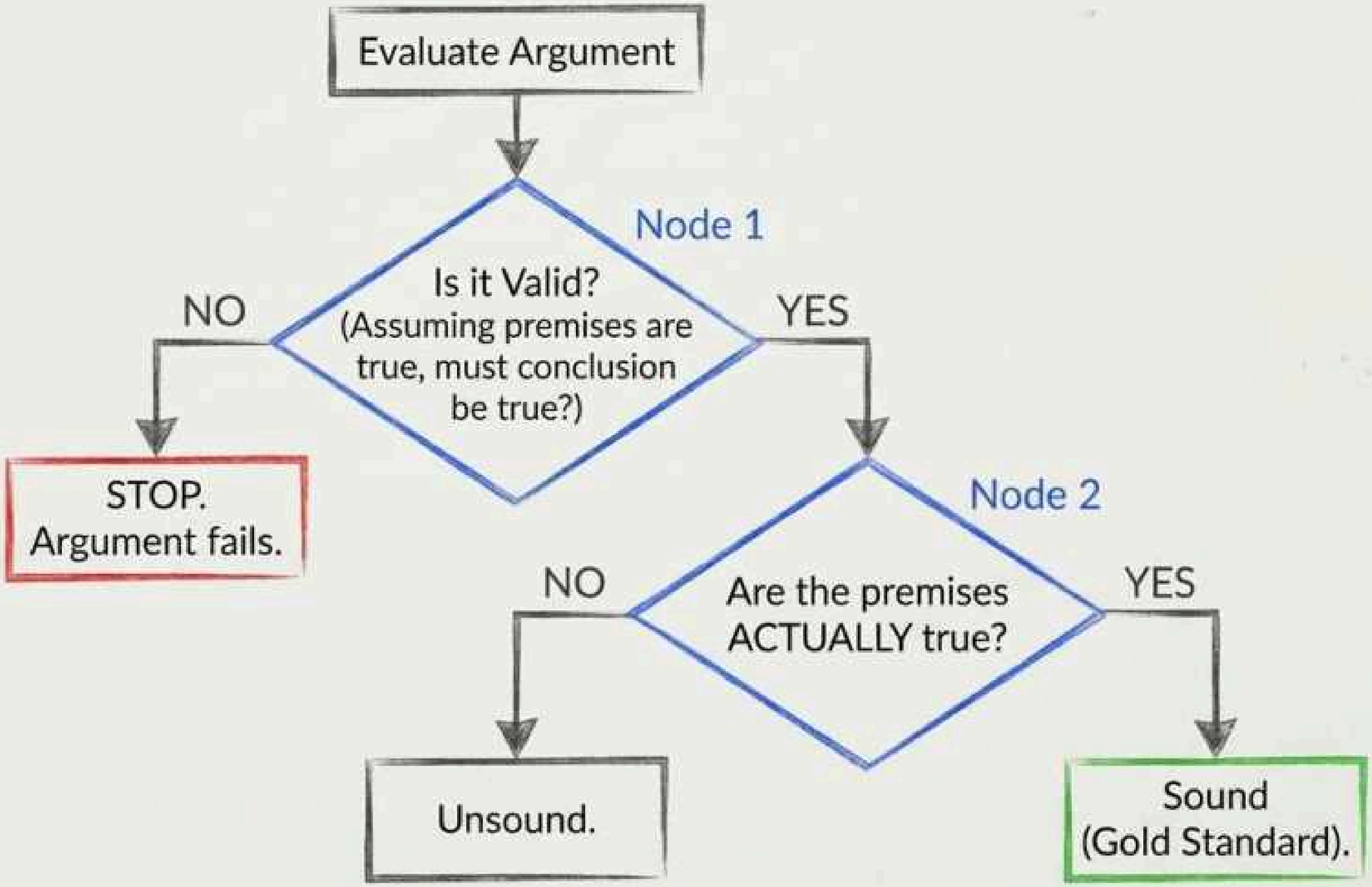


Good form + True premises. You are forced to accept the conclusion.

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The two-step diagnostic method

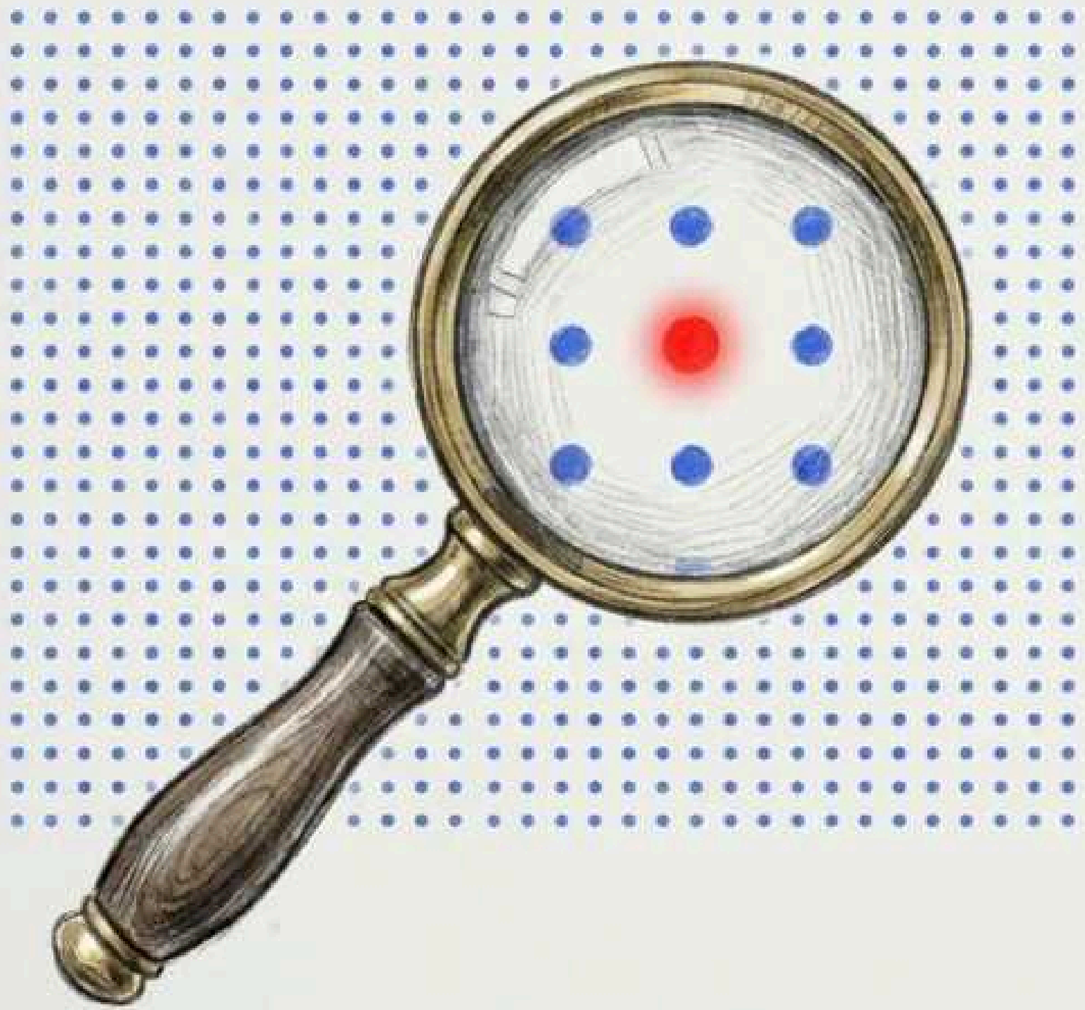
¶ 2.8



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Testing validity by hunting for a counterexample

¶ 2.9



Imagine a situation where:

All premises are TRUE,
but the conclusion is FALSE.

You can describe even ONE such situation → INVALID.

It is strictly impossible to find one → VALID.

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The counterexample in action: Invalid form

¶ 2.10

Premises:

If it is raining (P), the street is wet (Q).

The street is wet (Q).

Conclusion:

It is raining (P).



The Counterexample

A street cleaner washed the street.

Both premises hold true, but the conclusion is false (it is not raining).

Argument is invalid.

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Same ingredients, different arrangement, opposite result

¶ 2.11

Premises:

If it is raining (P), the street is wet (Q).

It is raining (P).

Conclusion:

The street is wet (Q).

The Counterexample Test

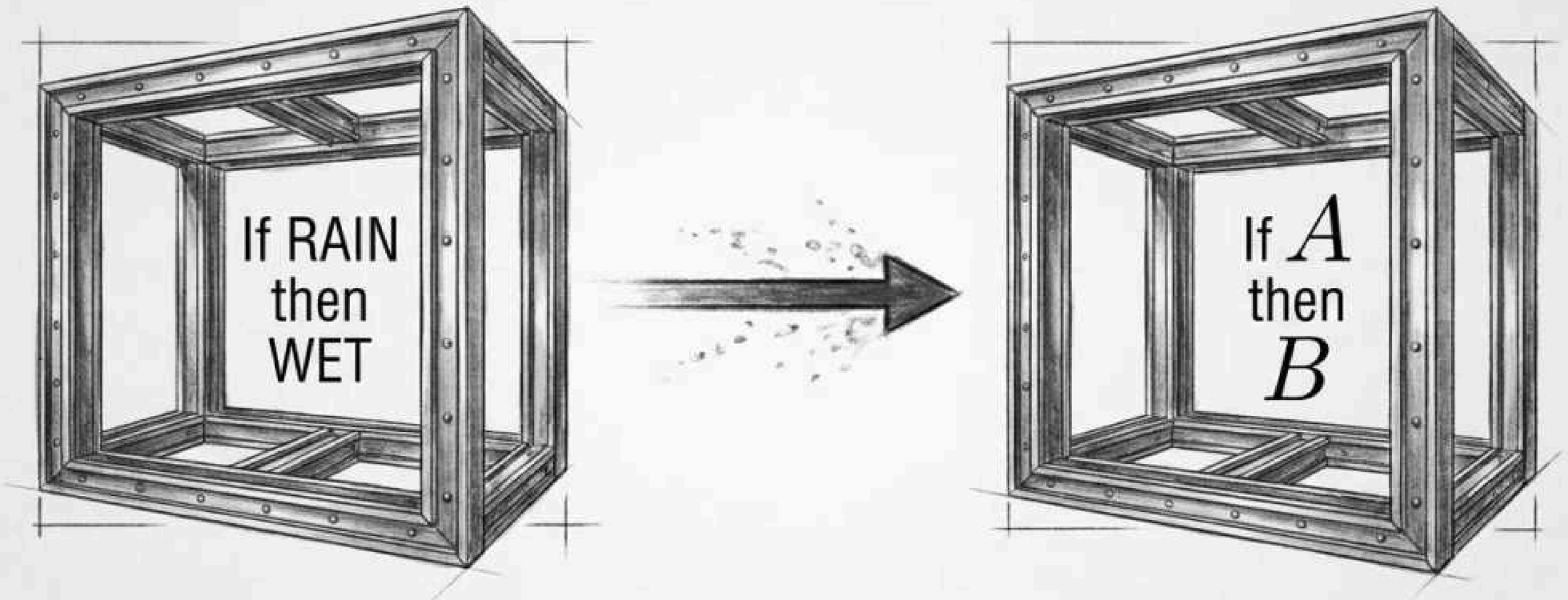
Try to build one. If raining + rain makes street wet = street MUST be wet. No situation can break this. Argument is valid.



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Validity is an unbreakable metal frame

¶ 2.12

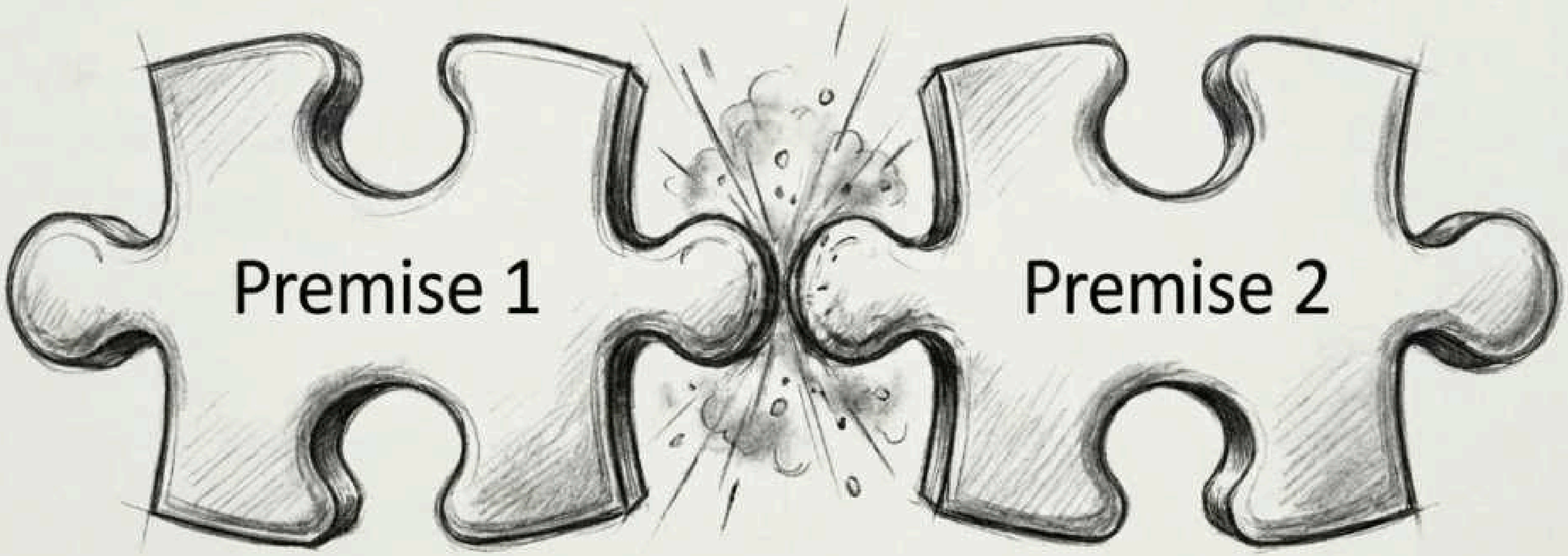


Validity depends on **form.** Two arguments with the same pattern are either both valid or both invalid, whatever they are about. If a pattern is valid, you can use it with confidence on any subject.

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Consistency: When premises can exist together

¶ 2.13



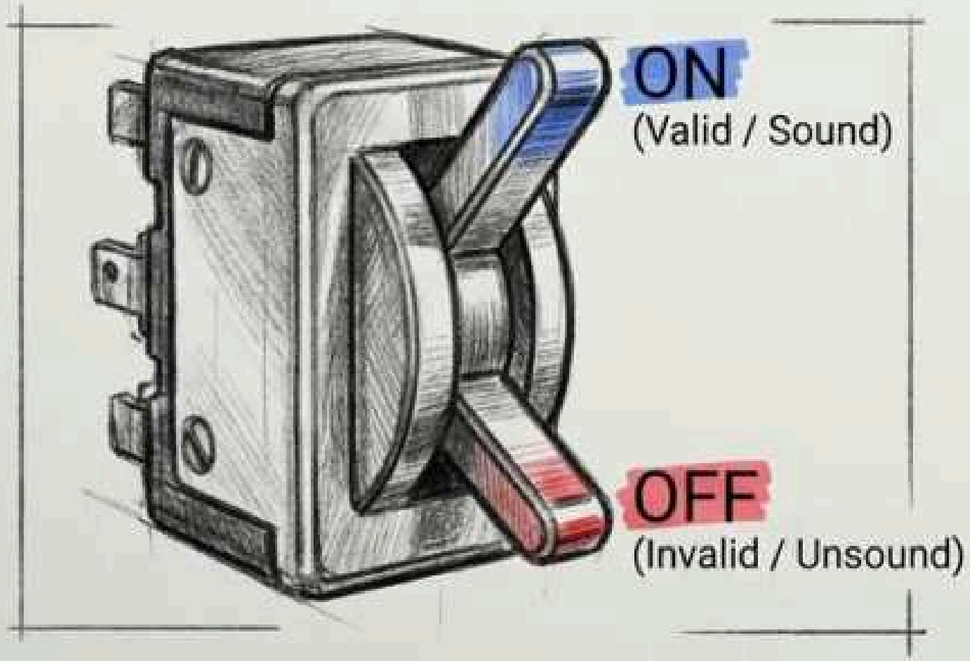
A set of statements is consistent if they can all be true together. A valid argument with contradictory premises is a curious thing: because the premises can never all be true together, the argument can never be sound.

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Deductive validity is absolute; Inductive strength is a gradient

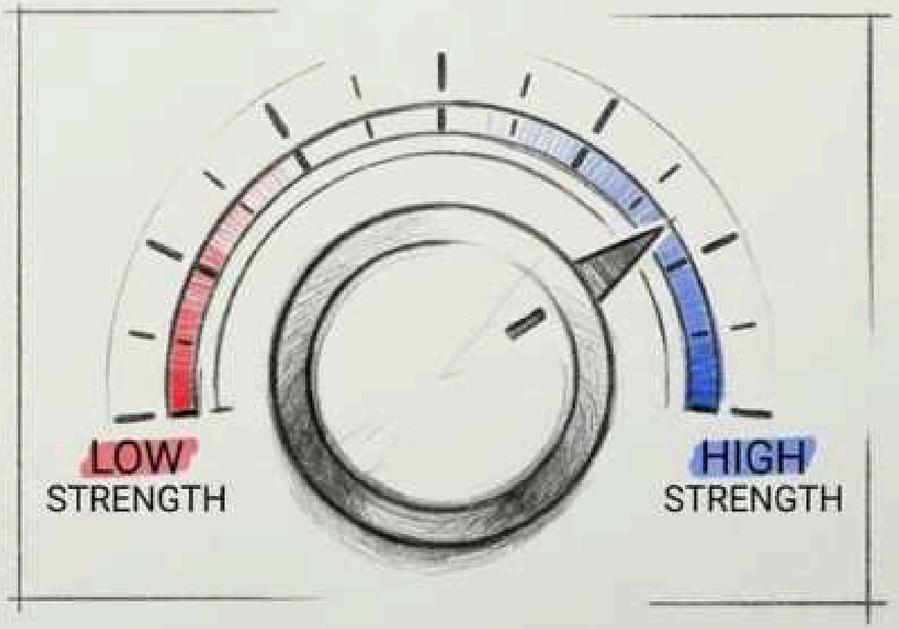
¶ 2.14

Deduction



All or nothing. No degrees.
You cannot have a “fairly valid”
or “very sound” argument.

Induction

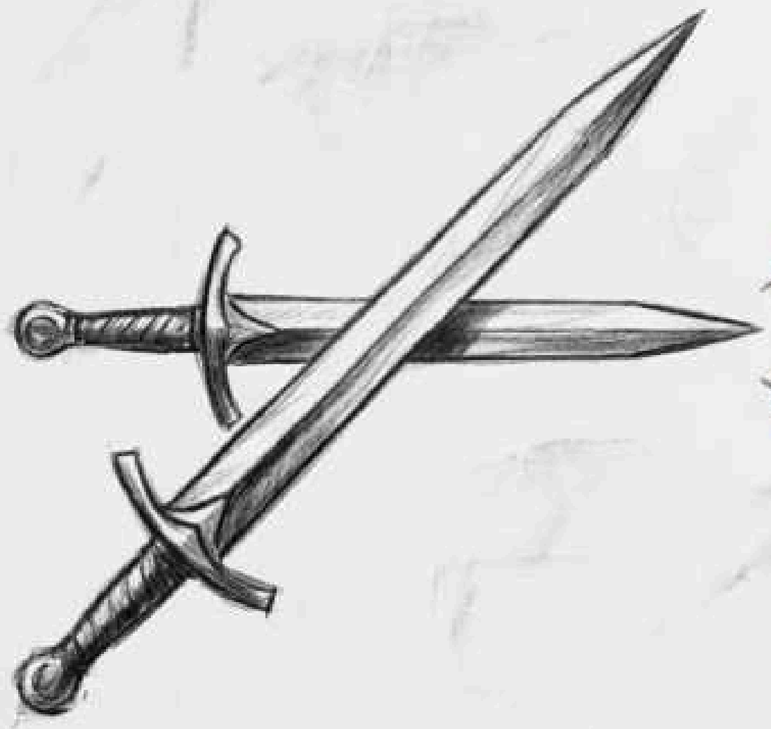


Strength comes in degrees.

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The Debate Battlefield: Two distinct places to push back

¶ 2.15



Target 1 (Attack the Premises)

Accept the reasoning is valid, but prove a premise is FALSE.

Target 2 (Attack the Form)

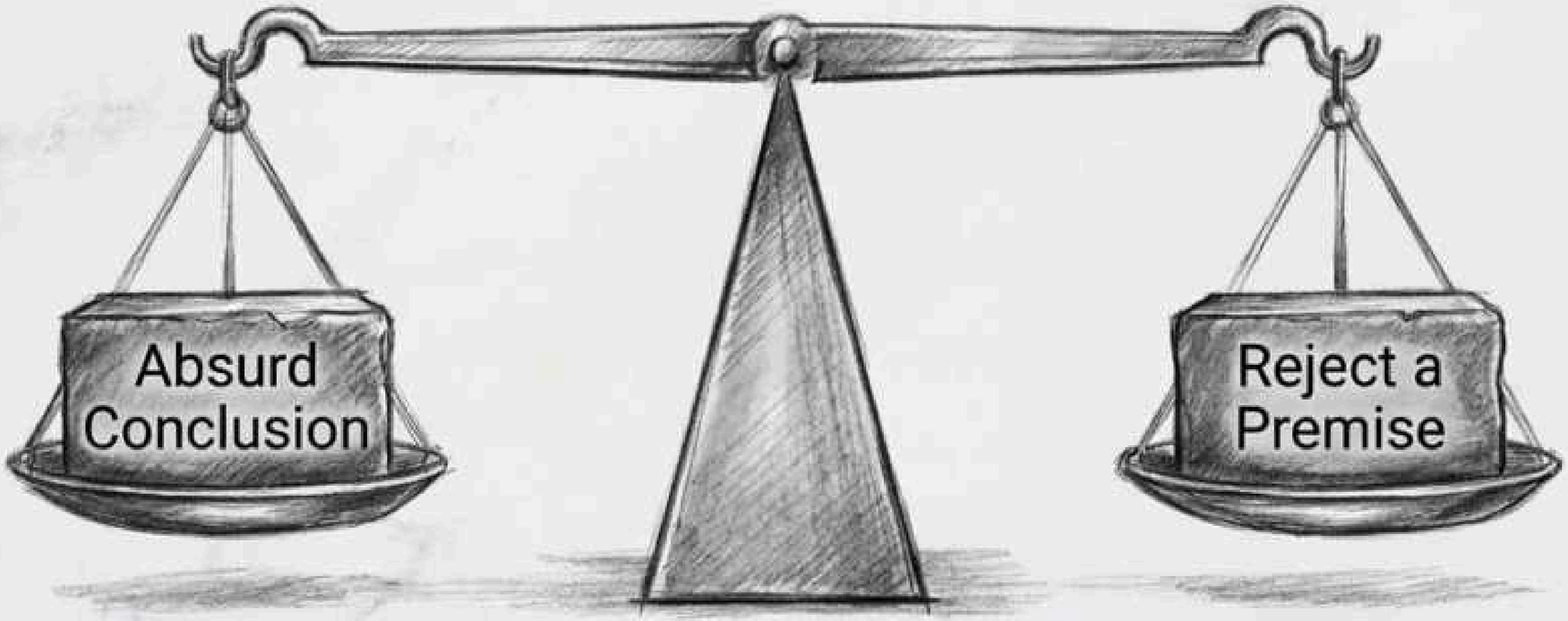
Accept the premises are true, but show the conclusion DOES NOT FOLLOW (Invalid).

Knowing which one you are doing makes disagreements clearer and much more productive.

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Modus Ponens vs. Modus Tollens

¶ 2.16



If presented with a valid argument whose premises you accept, you are logically bound to the conclusion. One person's modus ponens is another's modus tollens: if you find the conclusion absurd, you may logically reject a premise. Either is rational. Ignoring the argument is not.

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The ultimate test of your own reasoning

¶ 2.17

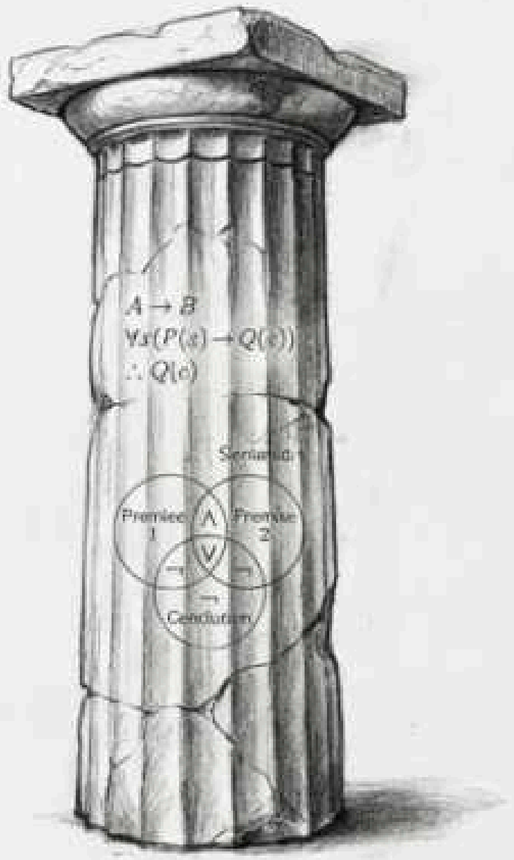
Write an argument you were sure was right here.

- [ ] Was the reasoning valid?
- [ ] Could you have built a counterexample?
- [ ] Were the premises actually true, or only things you wished were true?

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¶ 2.18

Looking ahead to Lecture 3



Next, we meet the oldest formal system of reasoning: The Syllogism.

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