What next?

Week 5 . Topic introduction.

Summarizing: What have we done so far?

Truth table method	Proof method
Advantages:	**Advantages:**
Simple procedure to make Always gives an answer to validity questions	Displays our reasoning Easy to check for correctness Can handle arguments with many propositional letters
Disadvantages:	**Disadvantages:**
Sometimes too big to write down Don’t show our reasoning	Hard to generate a proof Doesn’t always give an answer to validity questions

Summarizing: What have we done so far?

So how do we know which method to use?

The **Soundness and Completeness Theorems for Sentential Logic**: For any argument in SL, that argument is *valid by the truth table method* if and only if that argument is *valid by the proof method.*

Summarizing: What have we done so far?

So how do we know which method to use?

Recall:

One final note before we dive into the rules:

For sentential logic (which is everything we've done up to this point) proofs and truth tables are equivalent methods. In other words, whenever an argument is valid by a truth table, there is a proof for its validity, and vice versa. As noted in your book, "...[I]f a form can be shown to be valid by the [truth table method of the previous lessons], then it is also provable by the rules of the calculus [i.e., through a proof.] We can also express this fact by saying that the calculus is complete. In addition, the calculus is valid, i.e., it does not allow one to generate an argument which is not valid" (81). For more on this, check out the soundness and completeness of sentential logic.

Summarizing: What have we done so far?

Recall:

Consider the following argument and translation manual:

If it's Saturday, the movie theatre plays both *No Time to Die* and *Black Widow*. They're not playing *No Time to Die*. So, it must not be Saturday.

S: It's Saturday.

N: The movie theater is playing *No Time to Die*.

B: The movie theater is playing *Black Widow*.

1. Using this translation manual, provide a truth table (you may use shortcuts if you'd like). Then, use our test for semantic validity to check if the argument is semantically valid. (Please circle or box the rows of the truth table you are checking in order to determine semantic validity.)

2. Now provide a complete proof for the above argument.

Summarizing: Sentential logic?

Consider this argument

1. All squares are rectangles.
2. Every rectangle has four sides.
3. Therefore, every square has four sides.

There are no connective like “and” or “or.”
How you you translate this? : P, Q, ∴ R?
We can’t show the validity of the translated form of that argument, but the argument seems to make sense?

Summarizing: Sentential logic?

Consider this argument

1. All squares are rectangles.
2. Every rectangle has four sides.
3. Therefore, every square has four sides.

What about:

1. All poodles are dogs
2. Every dog is a mammal
3. Therefore, every poodle is a mammal

Hmm…seems like we want to be able to talk about *properties* of objects.

What's next: Quantified logic

Sentential logic can only talk about sentences and their relations.

SL, aka 0^{th}-order logic, propositional calculus.

Quantified logic allows us to talk about sentences, their relations, as well as *objects and their properties*.

QL, aka 1^{st}-order logic, predicate logic.

What’s next: Quantified logic

Quantified logic allows us to talk about sentences, their relations, as well as *objects and their properties*.

We’ll follow the same general format as the past 4 weeks:

- first: translations
- second: models
    - We won’t have truth tables for quantified logic. Instead, we’ll have models.
- third: proofs

What's next: Quantified logic

The vocabulary of QL builds on the vocabulary of SL, which is what gives QL a lot more expressive power!

We will have:

- Connectives: ∧, ∨, →, ¬, ↔
- Parentheses: (,)
- Predicate/relation terms: capital letters like A, B …
- A special, logical relation: =
- Constants: lower case letters like a, b …
- Variables: x, y, z…
- *Quantifiers*: ∀, ∃

New pieces of vocab are indicated in purple!