

Phil/LPS 31 Introduction to Inductive Logic

Lecture 2

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Topics

- ▶ Sentential Logic: Formulas
- ▶ Sentential Logic: Main connectives
- ▶ Sentential Logic: Paraphrasing English
- ▶ Truth functions and Truth tables
- ▶ Uses of Truth Tables

Sentential Logic: Formulas

Remember that the **formal symbols** of sentential logic are:

1. p , q , r , s and t as symbols for sentences. If we need more than 5 symbols (rarely!), then add the following countably many symbols p_1 , p_2 , p_3 ,
2. \vee for "or", \neg for "not" since the other symbols for "and" and "if..., then..." can be defined from these. (More of this later)
3. (for left bracket and) for right bracket.

The **transformation rules** (also known as "syntactic rules") are:

1. Any sentence p is a formula.
2. If F is a formula, then $\neg F$ is formula.
3. If F is a formula and G is a formula, then $(F \vee G)$ is a formula.

The **closure condition** states that a formula is anything that results from 1 or from a **finite number** of applications of rule 2 or rule 3. Nothing else is a formula of sentential logic.

Sentential Logic: Formulas

Are the following formulas in sentential logic?

1. q
2. t
3. $\neg q$
4. $\neg\neg r$
5. $(\neg\neg\neg p \vee q)$
6. $(p \vee (r \vee \neg q))$
7. $((q \vee (t \vee s)) \vee (r \vee \neg p))$

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Are the following formulas in sentential logic?

1. a

2. b

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- ▶ So using brackets is not just a stipulation of our logic, it turns out that having brackets helps us **parse** the formula correctly in order to identify the **main connective**. In (1) we can identify the main connective but in (2) we cannot. This is why brackets matter.

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- ▶ Since the focus of this class is not sentential logic, we will not spend a lot of time doing these paraphrases in class. But! See **Homework 1**.

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- ▶ Since we are interested in the truth-functional structure of the sentences in natural language, specifying an interpretation of our symbols will involve **truth functions** (also called “truth value assignments”).
- ▶ To understand what truth functions are, remember that we agreed that sentences in sentential logic will be **unambiguously true or false** (not both).
- ▶ So truth functions will take as input **the truth value** (true or false) of the paraphrased sentences in sentential logic and return as output **a unique truth value** (true or false).

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- ▶ But! We shall see that using 0 and 1 will help us see the difference between deductive logic and inductive logic more clearly.

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- ▶ From a truth table, one can see **the unique output** of a truth function for **all** of the possible inputs.
- ▶ Here is the truth table for the simplest truth function. This is the truth function takes the truth value of p and returns its truth value.

p	
1	1
0	0

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- ▶ Here is the truth table for the truth function that takes the truth value of p and returns the truth value of $\neg p$.

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- ▶ Here is the truth table for the truth function that takes the truth value of p and q and returns the truth value of $(p \vee q)$.

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- ▶ The simplicity of the idea of truth tables, understates just how very very powerful truth tables are!

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- ▶ A formula is **contradictory** if its truth function **always** returns the value 0. If a complex formula is a contradictory, then it always has the value 0 under every truth-value assignment to its component sentences.
- ▶ Two formulas are **truth-functionally equivalent** if their truth functions are identical.

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- ▶ See **Homework 2** for more exercises.