PHIL1012 Lecture 9: Functional Completeness, Pt. 1

Welcome!

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Recap

1 Syntax of PL

· Basic propositions A,B,C,..

· Connectives ¬, ∧, ∨, →, ←

@ Semantics of PL

· Racional truth

values T, F

· Connectives are fruth-functional

(truth functions are represented by

truth tables)

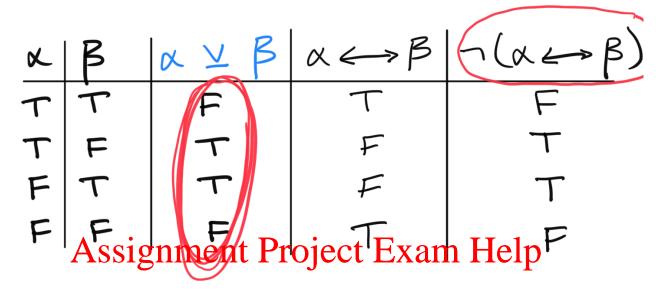
3) Trees for proving facts about

- · Equivalence
- · logical truth
- · validity
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Given any truth table, is there a formula of PL with that truth table?

Example



Question (vZ)

Can we define all possible

connectives using only the connectives in the set $\{7, \vee, \wedge, \rightarrow, \leftrightarrow \}$?

Plan

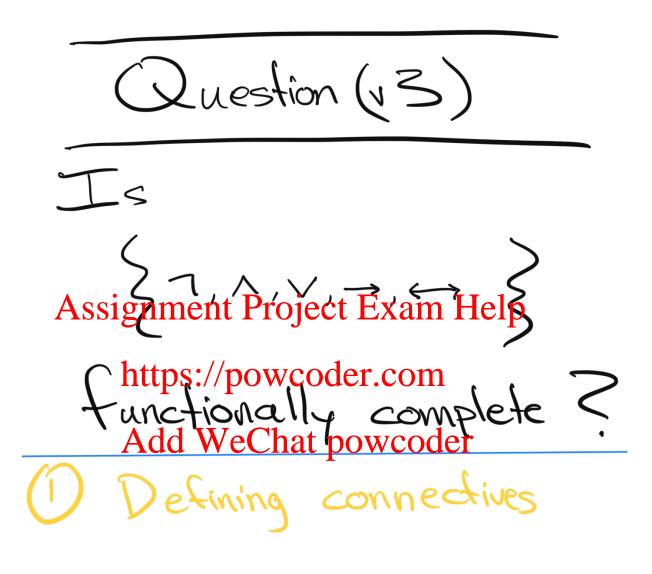
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A set of connectives that can be used to define all possible connectives is called

functionally complete



Simple example

More complex example

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7(7AVB) V (CAD)

In general, for any proposition containing —>, we can find an equivalent proposition that doesn't contain —> and instead contains

So, we can define -> using and v.

Can we define \iff using only $\neg, \wedge, \text{ and } \vee ?$

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(2) All possible connectives

How many I-place connectives are there?

2 rows in the truth table; 2 choices (T or F) in each row.

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How many 2-place connectives are Add WeChat powcoder
there?

×	B	a O, B	K V B	ol 2 ₅ B	a→B	
7	T	7	۲	H	7	
T	F	T	T	T	F	
F		T	T	F	T	
F	F	T	F	T	て	(p.13

22 rows in the truth table;

Z choices in each row (Tor F). So, $2^{2^2} = 2^4 = 16$ Z-place connective

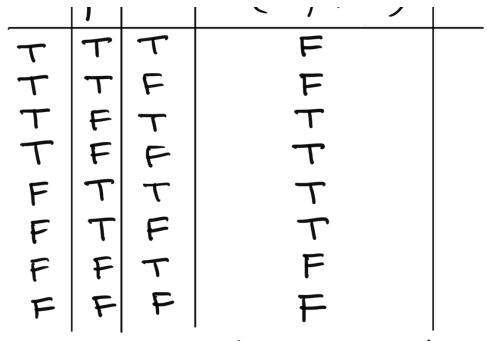
There are also O-place connectives!

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We can also talk about 3-, 4-, and, in general, n-place connectives

For example ... $\alpha \mid \beta \mid \gamma \mid \mathcal{K}(\alpha, \beta, \gamma)$



How many n-place connectives?
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2 rows in the truth table;
2 https://paweader.com (Tor F).
So, 2Add Welchat powerders!

Question

Can we define all possible connectives using only the connectives in the set

Tomorrow we will answer this question ...

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