CS 511 Formal Methods, Fall 2018	Instructor: Assaf Kfoury

Lecture 2

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(These lecture notes are **not** proofread and proof-checked by the instructor.)

Formal Logic:

- For writing a statement in formal logic, we have to worry about the following:
  - Syntax
  - Semantics
  - Proof Theory
- In case of propositional logic, semantics are given by truth tables. You can use truth tables to build formulas.
- The two kind of formulas are:
  - Disjunctive Normal Form (DNF) : A statement with one or more sequences of OR's, each of which is an AND of one or more variables.
    Eg $(\neg x \wedge y \wedge z) \vee (x \wedge y) \vee (\neg y \wedge z)$
  - Conjuctive Normal Form (CNF) : A statement with one or more sequences of AND's, each of which is an OR of one or more variables.
    Eg $(\neg x \vee y \vee z) \wedge (x \vee y) \wedge (\neg y \vee z)$
- It is extremely easy to go from truth tables to DNF, slightly harder to derive CNF. See lecture slides to see how.
- A more formal way to write the logic is in Backus-Naur Form (BNF). We will talk more about it later in the class.
- Some of the logical operators are associative and some not. For example, $\vee, \wedge$ are associative whereas $\rightarrow$ is not.
- In formal logic, there is also a need to understand where parenthesis go. Having too many parenthesis is confusing, but too few can lead to different interpretations of the formula based on what order you chose to do them in. Hence, there are some precedence rules.
  A way to solve this problem is by using parse trees, but they are harder to store. (See lecture slides for an example of parse tress).
- Proof theory is is a method to establish validity using formal deductions. This is a key step in formal logic. To carry out these proofs there are many rules for assistance. See page 27 of the book to find them.
- See lecture slides for the various examples of natural deduction, which is one of the ways of Proof Theory.