Mathematical and **Logic**al Aspects of Computing (CS304/CS310)

Lecture 23: More examples of logical consequences

Friday, 22$^{\text{nd}}$ of November 2013

This is the last "proper" lecture of the course. The aim to is show how to reason with arguments/logical consequences as posed in natural language.

. . . .

Recall: Universe of discourse

We think of a predicate as a function that maps elements from some set to the truth values $\{F, T\}$. The domain of this predicate is often called the *universe of discourse*.

Translating natural language to 1st order logic

There is no one right way to do this (but many wrong ways!). To be correct we must:

1. state clearly the universe of discourse;
2. define any functions we need (or better...)
3. define any predicates we need
4. apply quantifiers appropriately.

Consider the following argument, taken from CS304 Summer Exam 2011/2012:

All roses smell nice. This flower is a rose. Therefore this flower smells nice.

Show how to apply the Tableau approach to testing the validity of the following
argument:

No natural number is both a perfect square, and a prime number.
There is an even number that is prime. The number m is even, but is
not a perfect square. Therefore, m is a prime number.

If the following argument valid?

> *No fish can breathe outside of the water. Anyone who can breathe under water and cannot breathe outside of the water has gills. The fish which just swam down the Corrib can breathe under water. Therefore, that fish has gills.*

Thank you for participating in CS304/CS310 ("Logic"). The final exam is (currently) scheduled for the 3rd of December at 9.30 a.m. at Leisureland, Salthill (but please check your own exam schedule... this might change).
The paper has **5** questions; you have **2 hours**(!) to answer any **4** of them.
Topics that you can be expected to be examined on include:

- logic tables and standard logical connectives. You need to know the tables for $\land$, $\lor$, $\neg$, $\rightarrow$, $\oplus$, $\uparrow$, $\downarrow$, *IFF*. They will not be provided.
- identities, especially de Morgan's Laws; also distributive laws.
- functional completeness, disjunctive normal form (DNF); Venn diagrams.
- interpretations and models; valid/invalid and satisfiable/unsatisfiable;
- decision procedures and semantic tableaux;
- Consistency of sets, and logical consequences.
- Conjunctive normal form; Clause Form; Resolution.
- Natural deduction.
- predicates; universal and existential quantifiers; quantifier equivalences;
- bound and free variables; parse trees
- semantic tableaux for predicate logic;
- reasoning with arguments in predicate logic.