CISC-204*
Logic for Computer Scientists

- Today:
  - Administrivia
  - Outline
  - Fundamentals

Administrivia:

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Marking scheme: five tests –
lowest mark worth 10%
other four are worth 22.5% each
- no marked assignments, no “midterm”, no “final”
- no make-up tests for missed tests
- tests will be held in class on Fridays
- first test will be on February 1, 2013

Course URL: http://sites.cs.queensu.ca/courses/cisc204/

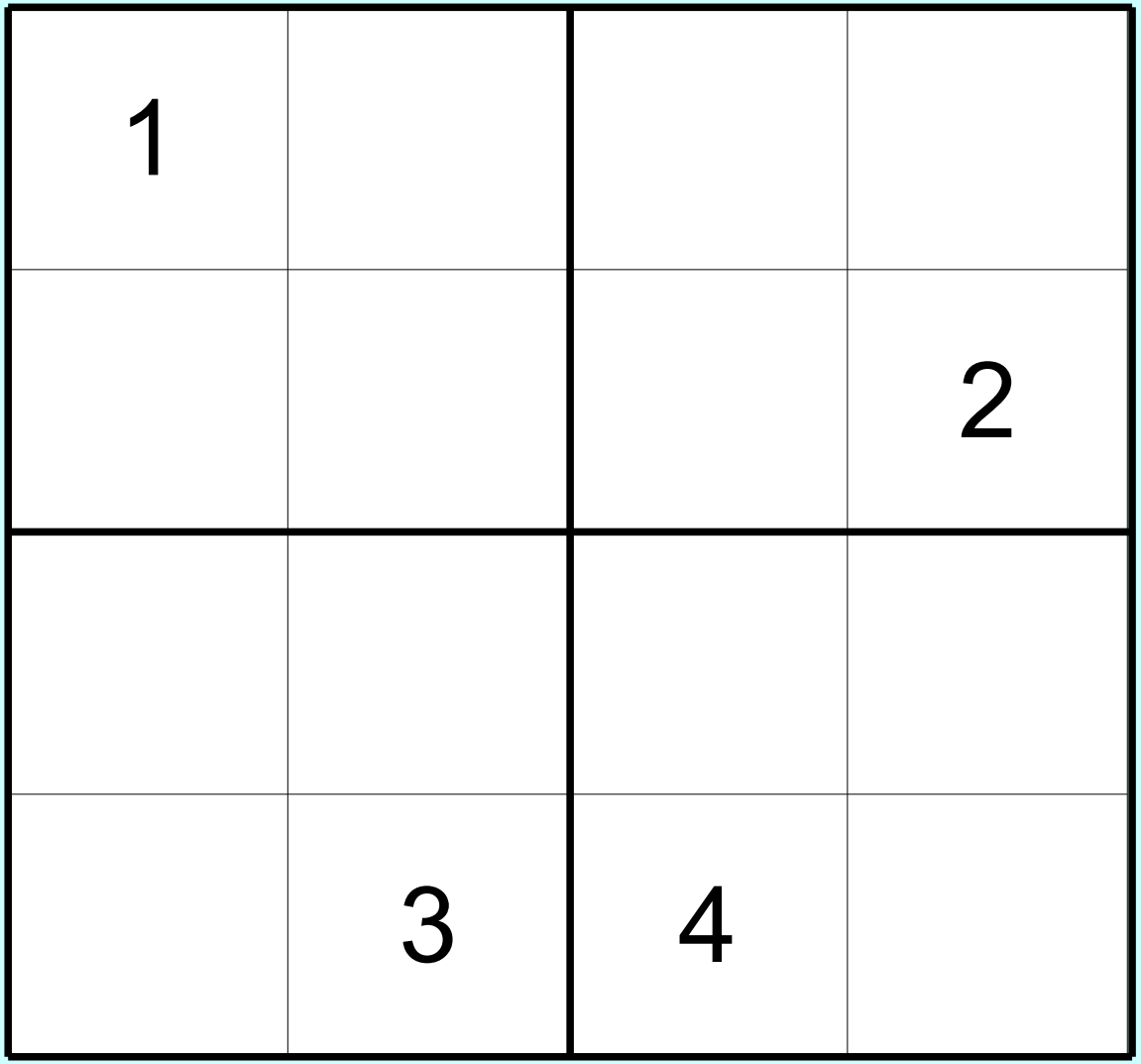
Outline:

The calendar says ...

Elements of mathematical logic with computing applications. Formal proof systems for propositional and predicate logic. Interpretations, validity, and satisfiability. Introduction to soundness, completeness and decidability.

I say …

An exploration of the centrality of formal logic in computer science. Fundamental systems of logic (propositional, predicate, temporal and fuzzy) will be developed and applied to computing issues.
Oh, and that stuff in the calendar too.



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Each box contains {1,2,3,4}

Fundamental Questions:

What is logic?

Who invented it?

Why?

Why should computer scientists study logic?

The science of thinking based on laws that determine the validity of a conclusion.

The sequence of functions performed by hardware or software.

Sound reasoning and the formal laws of reasoning.

The rules whereby valid conclusions may be derived from a given set of axioms.

The principles of right reasoning.

A formal and powerful method of explaining why my program doesn't work.

Logic is sometimes criticised on the grounds that it does not generate any new information: the information in the conclusion is already contained (implicitly) in the premises.

This is like saying that gold mining does not generate any new wealth, because the gold is already present in the ground.

Logic also has the critically important power to reveal faulty reasoning and conclusions which are *not* supported by the premises.

Aristotle (384 - 322 BC) is widely regarded as the founder of formal logic … but was he?

Plato and other earlier Greek philosophers presented logical arguments.

Aristotle seems to have been the first Western scholar to have written down rules for determining when a chain of reasoning is valid.

Indian philosophers, possibly as much as 200 years earlier, had created related systems for verifying statements.

Aristotle defined the *syllogism*: A pattern of three statements (two premises and a conclusion), relating three terms in such a way that each pair of terms appears in exactly one of the statements.

Aristotle's example:

Every Greek is a person.
Every person is mortal.

Therefore

Every Greek is mortal.

There are 256 possible forms of the classical syllogism. Only 15 of them are valid (although some people accept some others as well).

Some valid syllogisms:

No P are M.
All S are M.
Therefore, no S are P.

Some M are not P.
All M are S.
Therefore, some S are not P.

Some P are M.
All M are S.
Therefore, some S are P.

Some invalid syllogisms:

All P are M.
Some S are M.
Therefore, some S are P.

Some M are not P.
Some M are S.
Therefore, all S are not P.

A semi-valid syllogism:

All M are P.
All S are M.
Therefore, some S are P.

However, Bertrand Russell (1872 - 1970, Nobel Prize 1950) said …

"In most universities, the beginner in logic is still taught the doctrine of the syllogism, which is **useless** and **complicated**, and an obstacle to a sound understanding of logic.

If you wish to become a logician … **Do NOT** learn the traditional formal logic.

To teach [the doctrine of the syllogism] in the present day is a **ridiculous piece of antiquarianism**."