COMP 106
Discrete Mathematics
for Computer Science and Engineering

- **Instructor:**
  - Yücel Yemez, Eng 139, Office hours: Tue/Th 15:00-16:00
- **Lectures:**
  - Tue/Th, 10:00-11:15 @ SNA-A52
  - Problem sessions (Friday afternoons, check course web site)
- **Teaching assistants:**
  - TBA (check course web site)
- **Textbook:**
  - Kenneth H. Rosen, Discrete Mathematics and Its Applications, McGraw-Hill (8^{th} edition)
- **Course webpage:**
  - http://home.ku.edu.tr/~yyemez/comp106/

Grading

- Midterm (%35)
- Final (%45)
- Homeworks and Quizzes (%20)

Expectations

- Attend classes;
- Do your homeworks (on your own!);
- Attend problem sessions;
- Read your textbook;
- Ask when you don't understand; do not get lost!

Warning!

- Doing HWs on your own is important!
- In case of cheating, all HW points will be cancelled!

Course Objectives

- To learn how to reason, in a formal way
- To learn mathematics as a "language"
- To learn basic mathematical tools and discrete structures for problem solving in computer science

Course Objectives
(more specific)

- **Discrete Mathematics**
  - Foundations (Logic, sets and functions)
  - Mathematical reasoning, notation, theorems, proofs...
  - Number Theory
- **Algorithms**
  - Problem solving, algorithm design, complexity analysis
- **Discrete Structures**
  - Tools for problem solving and algorithm design
  - Relations, finite-state machines, Turing machines
- **Applications**

Course Outline

- **Ch. 1–2: Foundations:**
  - Logic, propositional logic, sets, functions.
- **Ch. 3: Algorithms:**
  - Complexity of algorithms, integers,
- **Ch. 4: Number theory:**
  - Cryptography, modular arithmetic, prime numbers.
- **Ch. 5: Induction & Recursion:**
  - Mathematical induction, recursive algorithms.
- **Ch. 8: Advanced counting:**
  - Recurrence relations, divide-and-conquer relations, generating functions.
- **Ch. 9: Relations:**
  - Representing relations, equivalence relations, ordering relations.
- **Ch. 13: Modeling Computation:**
  - Theory of computation, grammars, finite-state machines, Turing machines.

Rules of the Game: A false proof

$$1 = \sqrt{1} = \sqrt{(-1)(-1)} = \sqrt{-1}\sqrt{-1} = -1$$

What's wrong?

Consequences of 1 = -1

$$\frac{1}{2} = -\frac{1}{2} \quad (\text{multiply by } \frac{1}{2})$$

$$2 = 1 \qquad (\text{add } \frac{3}{2})$$

"Since I and the Pope are clearly 2*, we conclude that I and the Pope are* 1*. That is, I am the Pope."*

Bertrand Russell
(1872 - 1970)

Reasoning (Example)

"If you are older than 18 years, then you can have a driving license"

Given this as a fact, can you infer the following?

"If you can have a driving license, then you are older than 18 years"

or

"If you can't have a driving license, then you are not older than 18 years"

Mathematical language (Example)

p: "you are older than 18 years"

q: "you can have a driving license"

"If you are older than 18 years, then you can have a driving license"

$$p \rightarrow q$$

"If you can have a driving license, then you are older than 18 years"

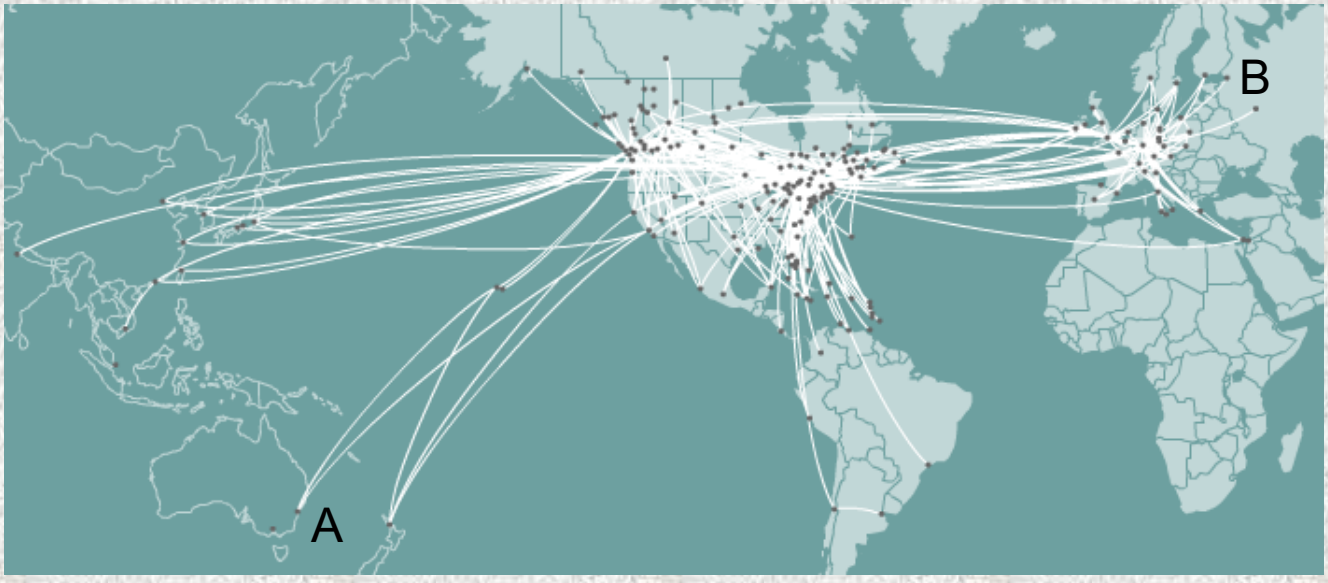
$$q \rightarrow p$$

"If you can't have a driving license, then you are not older than 18 years"

$$\neg q \rightarrow \neg p$$

Tools: Discrete Structures (Example)

Consider the flight network of an airline company



Problem: Which cities are linked? Is there a connection between city A and city B?

Solution: Use a relation (or graph) structure!

Tools: Discrete Structures (Example)

Problem: Given a task (of any kind), can it be done with a computer?

Solution: Use Turing machines!