Discrete Structures for Computer Science

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MW 2:15 – 3:00pm

Spring 2010

rm MSB115

Course Material

- Textbook: Discrete Mathematics and Its Applications
- Kenneth H. Rosen, McGraw Hill

Course Requirements

- Homework, 20%
- Quiz, 20%
- Three Intermediate Exams: 10%
- Final Exam, 30%
- Bonus Questions 5-10%

Why Discrete Math?

Design efficient computer systems.

- How did Google manage to build a fast search engine?
- What is the foundation of internet security?

algorithms, data structures, database,
parallel computing, distributed systems,
cryptography, computer networks…

Logic, sets/functions, counting, graph theory…

What is discrete mathematics?

Logic: artificial intelligence (AI), database, circuit design

Counting: probability, analysis of algorithm

Graph theory: computer network, data structures

Number theory: cryptography, coding theory

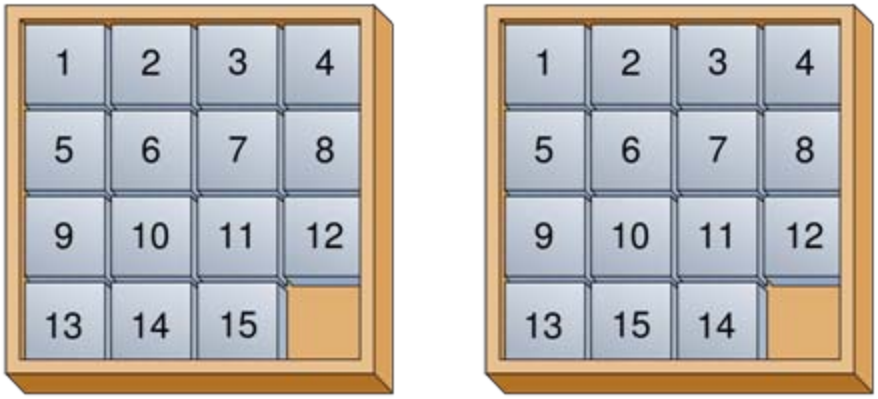
logic, sets, functions, relations, etc

Topic 1: Logic and Proofs

How do computers think?

Logic: propositional logic, first order logic

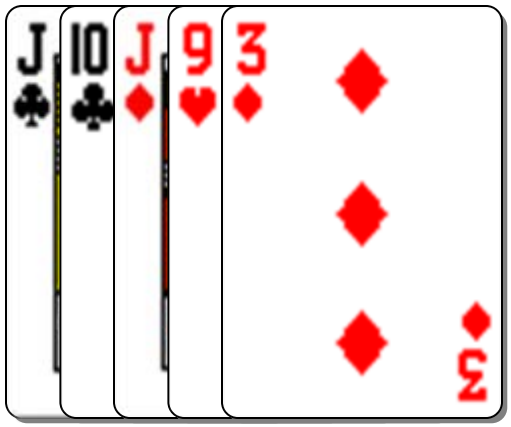
Proof: induction, contradiction



Artificial intelligence, database, circuit, algorithms

Topic 2: Counting

- Sets
- Combinations, Permutations, Binomial theorem
- Functions
- Counting by mapping, pigeonhole principle
- Recursions, generating functions



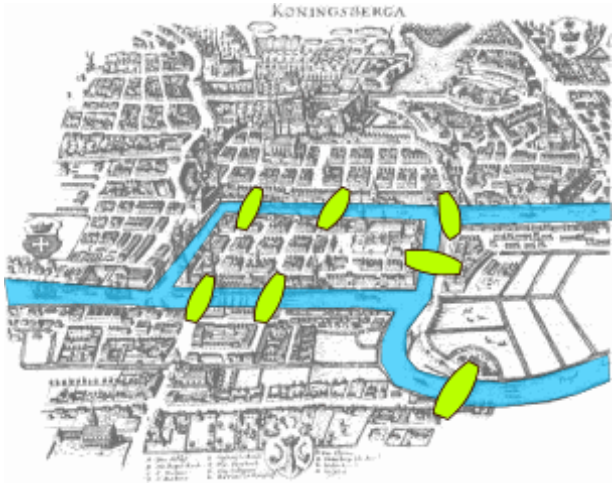
Probability, algorithms, data structures

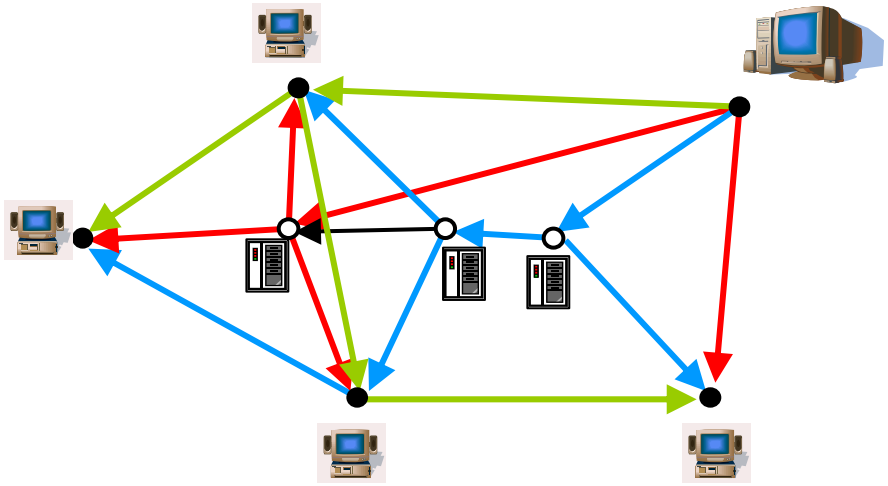
Topic 2: Counting

How many steps are needed to sort n numbers?

Topic 3: Graph Theory

- Relations, graphs
- Degree sequence, isomorphism, Eulerian graphs
- Trees





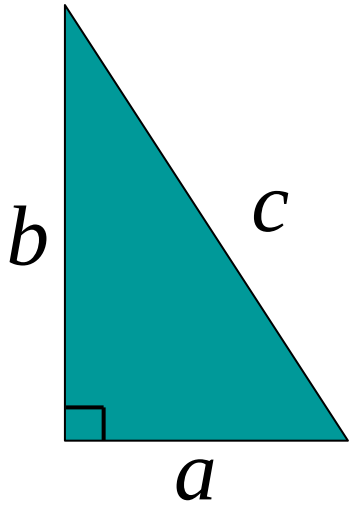
Computer networks, circuit design, data structures

Topic 4: Number Theory

- Number sequence
- Euclidean algorithm
- Prime number
- Modular arithmetic

Cryptography, coding theory, data structures

Pythagorean theorem

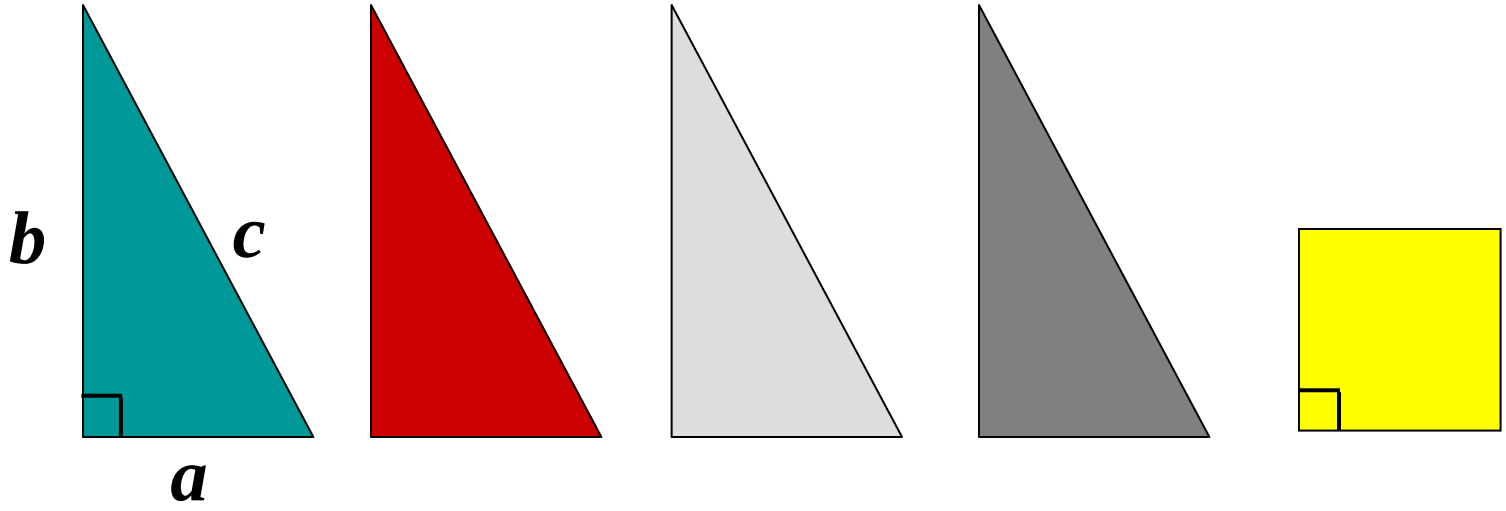


$$a^2 + b^2 = c^2$$

Familiar?

Obvious?

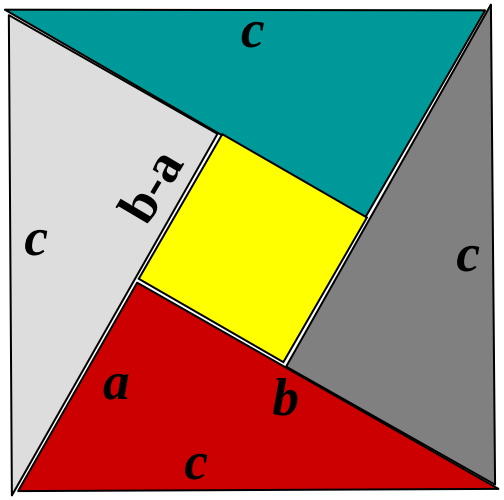
Good Proof



Rearrange into: (i) a c×c square, and then

(ii) an a×a & a b×b square

Good Proof



81 proofs in http://www.cut-the-knot.org/pythagoras/index.shtml