Discrete Structures

“Discrete”

1. constituting a separate entity : individually distinct
2.
    a. consisting of distinct or unconnected elements : NONCONTINUOUS
    b. taking on or having a finite or countably infinite number of values

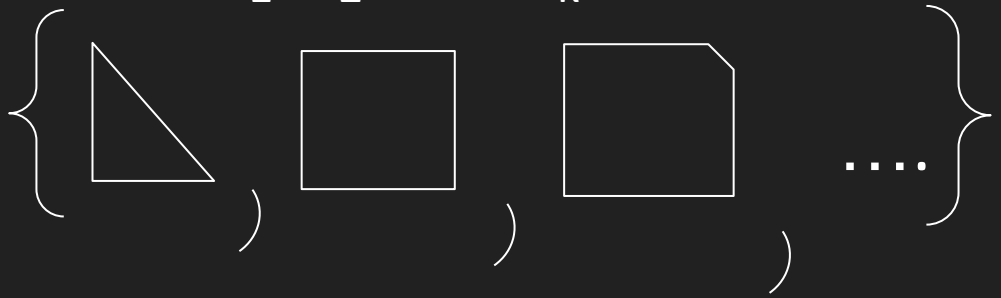
Not to be confused with “discreet” (sneaky)

“Discrete?”

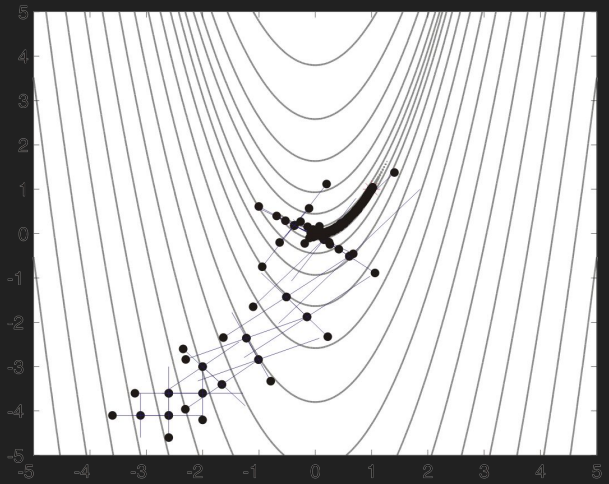
1, 2, 3, 4, …., 100, ….

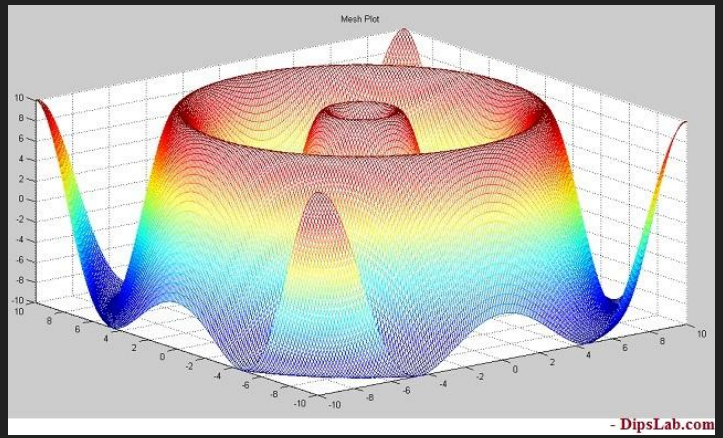
…, -80, -79, …, -1, 0, 1, …., 50, ….

$\{s_1, s_2, \ldots, s_k\}$



… vs “continuous”

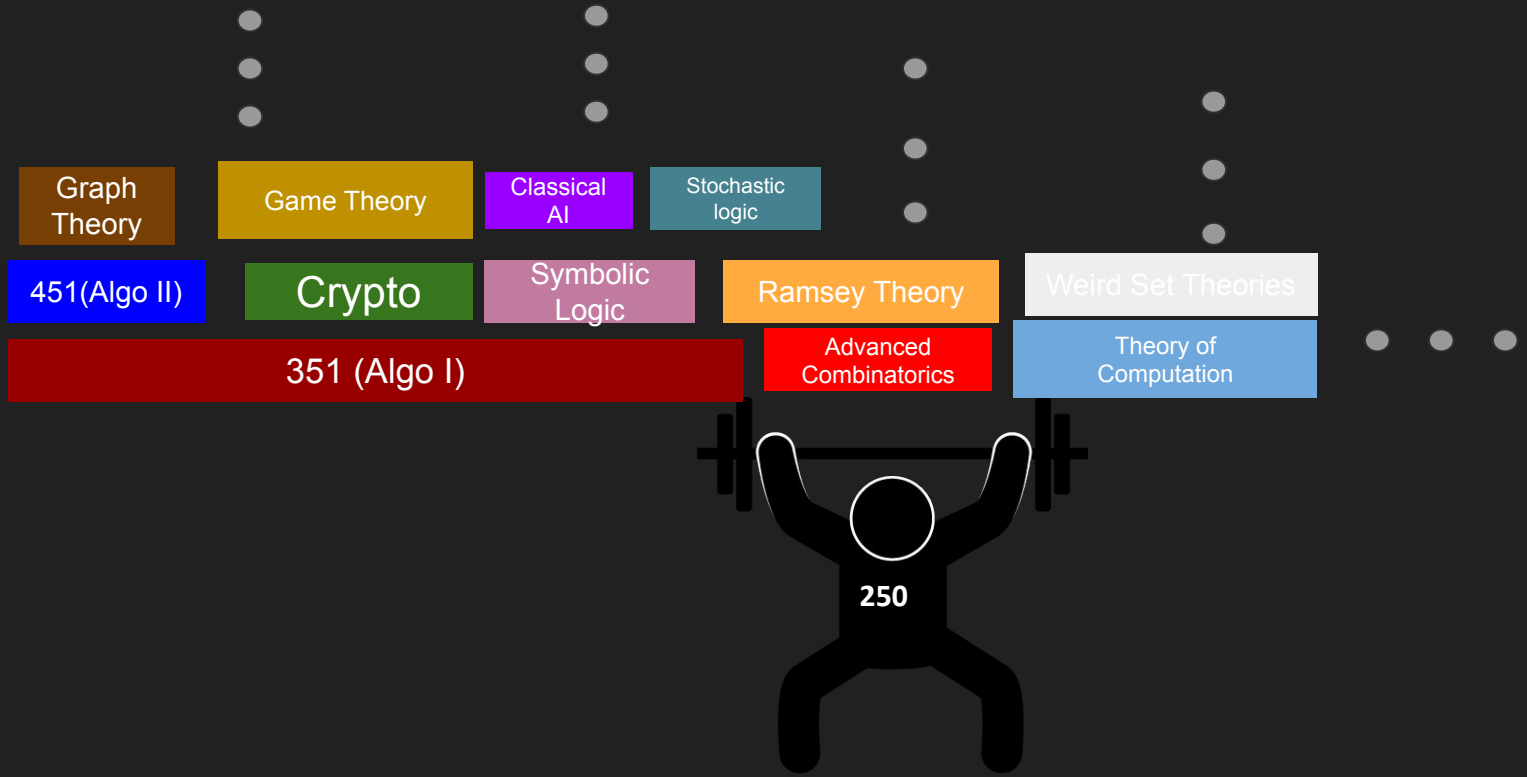




Discrete Math vs Discrete Structures

Slight emphasis towards CS

Goal of 250


Graph Theory
Game Theory
Classical AI
Stochastic logic
451(Algo II)
Crypto
Symbolic Logic
Ramsey Theory
Weird Set Theories
351 (Algo I)
Advanced Combinatorics
Theory of Computation
250

Discrete Structures

- Reasoning/logic
- Counting things
- Proving things

Statement

Statement

a declarative sentence with a truth value

- True OR False (never both)
- Not opinions
- Not meaningless

Statements

- Aristotle's work founded Aristotelian logic
- Discrete Math has no applications to CS
- 2 + 2 = 4
- 1 + 1 = 0

Statement?

x > 30

- Statements must be defined

Examples

Does a statement need to be ‘verifiable’?

There is a teapot that orbits the sun between Earth and Mars.

Variables

- Statement variables are denoted as a lowercase letter

p : Aristotle's work founded Aristotelian logic

q : Discrete Math has no applications to CS

r : 2 + 2 = 4

s : 1 + 1 = 0

Statements can be modified

Negation

- ~, ¬, $\bar{p}$

p : 2 + 2 = 4

¬p : ¬(2 + 2 = 4)

Statements can be combined

- Today is Tuesday *and* French fries are green.
- Today is Tuesday $\wedge$ French fries are green.

p : Today is Tuesday.

q : French fries are green.

p $\wedge$ q

s : *p* $\wedge$ *q*

Is *s* true or false?

Conjunction

Written: ‘∧’

Pronounced: “and”

Example: p ∧ q

Disjunction

Written: ‘$\vee$’

Pronounced: “or”

Example: p $\vee$ q

Disjunction

- Today is Tuesday *or* French fries are green.
- Today is Tuesday $\vee$ French fries are green.

p : Today is Tuesday.

q : French fries are green.

p $\vee$ q

s : *p* $\vee$ *q*

Is *s* true or false?

Exclusive OR

One or the other, but not both

$p \oplus q$

How could we write $p \oplus q$ without using $\oplus$?

How could we write $p \oplus q$ without using $\oplus$?

Review

- Statements
- Can be modified
- Can be combined to make new statements