

# & Computation

CS 205

Formal Languages, Automata  
Theory & Computation

(I) Course Web Page = link from

my home page

Text : - Hopcroft, Motwani & Ullman  
2007

- Hopcroft & Ullman 1999

Grading Policy : 60% Quizzes  
40% HW

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Interactions: Teams (preferred)

- Email responses will

take more time

## Doubts / Queries

Q: What is the course about?

A: Fundamental capabilities & limitations of computers.

- Models of computation

Automata: computers with constrained

memories

Finite Automata  $\rightarrow$  Pushdown automata  $\rightarrow$  Turing Machines

Language acceptance

$\hookrightarrow$  Set of strings / words / finite sequences of symbols

Complexity theory: Computations with bounded space & time

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Cardinality of Sets

Q: When do two sets A and B have

are same sigle ;

A: When there is a bijection between them

$$f: A \rightarrow B$$

injective (one-to-one)

surjective (onto)

$$\forall x, y \in A$$

$$\text{injective: } f(x) = f(y) \Rightarrow x = y$$



$$x \neq y \Rightarrow f(x) \neq f(y)$$

Surjective

$$\forall y \in B, \exists x \in A$$

$$f(x) = y$$

$$\text{Q1 } A = \{0, 1, 2, \dots\}$$

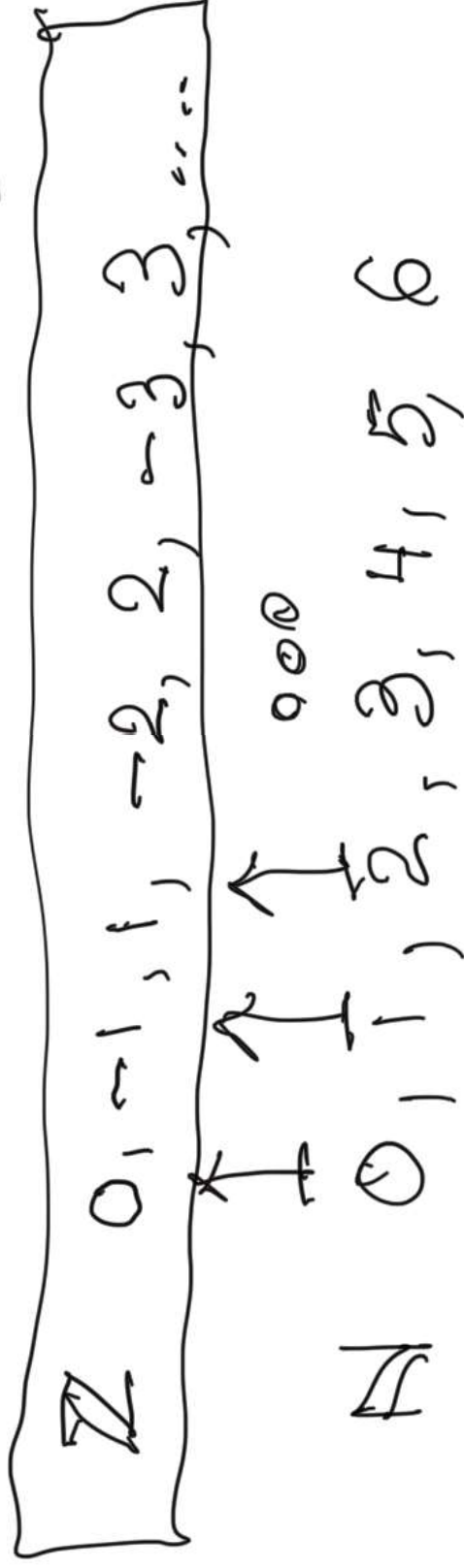
$$B = \{0, 1, 2, \dots\}$$

$$\mathbb{N} = \{0, 2, 4, \dots\}$$

Same size?

$$f: \mathbb{N} \rightarrow \mathbb{E} \quad f(x) = 2x$$

$$(2) \quad \mathbb{N} \text{ and } \mathbb{Z} = \{\dots, -3, -2, -1, 0, 1, 2, 3, \dots\}$$



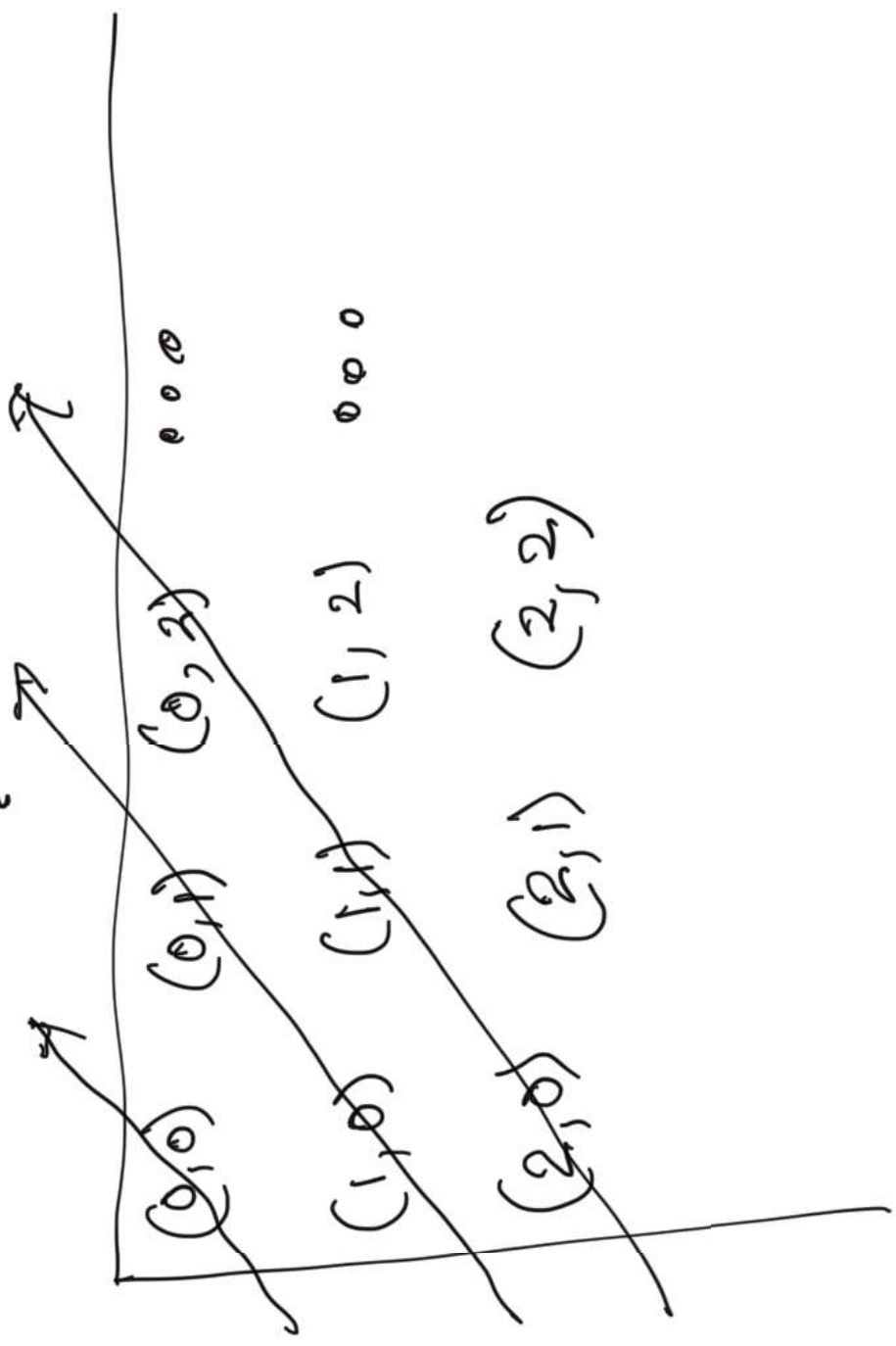
- Denumerable / Countably infinite
- Countable : finite or countable

Q

infinite

$$Q = \mathbb{Z} \times \mathbb{Z} = \{(i, j) \mid i, j \in \mathbb{Z}\}$$

Denumerable?



$$A = \underbrace{(0,0), (1,0)}_{100}, \underbrace{(0,1), (2,0), (1,1)}_{100}, \underbrace{(0,2)}_{100}$$



$\mathbb{R}$  = set of real nos

real no — of the form  $\frac{p}{q}$   $p, q$  integers  
 $q \neq 0$

~~$\frac{0}{1}$   $\frac{1}{1}$   $\frac{2}{1}$   $\frac{3}{1}$  ...~~  
 ~~$\frac{0}{2}$   $\frac{1}{2}$   $\frac{2}{2}$   $\frac{3}{2}$  ...~~  
 $\frac{0}{3}$   $\frac{1}{3}$   $\frac{2}{3}$

Real nos.  $\mathbb{R}$

Denumerable?

No.

Cantor: Diagonalization Technique

(0,1) : set of all reals  $x$

~~set~~  $0 < x < 1$

not countable

Proof by contradiction