Welcome back to MAT137- Section L5101

- Class begins at 8:10pm ET Mon, Wed, Thursdays
- I am still Sourav (Hi!!)
- Your TAs are Stephen Zhang and Haolin (Lucy) Liu
- Course website: http://uoft.me/MAT137

- **Before next class:**
  - **Watch videos 1.4, 1.5, 1.6**
  - Download next class slides.
    No need to look at them.

How to work?

- Open today's slides alongside Zoom.

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- **Mute your mic and camera to avoid lag**. Please, without exception!

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- You can also raise your hand and the TA will get back to you.

Let's get started!!

Today's videos: 1.1, 1.2, 1.3

Today's topic: Sets

Any question from previous class?

Sets

Describe the following sets in the simplest terms you can.

1. $[2, 4] \cup (3, 10)$
2. $[2, 4] \cap (3, 10)$
3. $(\pi, 3)$
4. $[7, 7]$
5. $(7, 7)$

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3. $(\pi, 3)$
4. $[7, 7]$
5. $(7, 7)$
6. $A = \{ x \in \mathbb{R} : x^2 < 7 \}$
7. $B = \{ x \in \mathbb{Z} : x^2 < 7 \}$
8. $C = \{ x \in \mathbb{N} : x^2 < 7 \}$

Sets defined with quantifiers

Problem 1. Describe the following sets in the simplest terms you can.

1. $A = \{ x \in \mathbb{R} : \forall y \in [5, 7], x < y \}$.
2. $B = \{ x \in \mathbb{R} : \exists y \in [5, 7] \text{ such that } x < y \}$
3. $C = \{ x \in [5, 7] : \forall y \in [5, 7], x < y \}$.
4. $D = \{ x \in [5, 7] : \exists y \in [5, 7] \text{ such that } x < y \}$
5. $E = \{ x \in [5, 7] : \exists y \in \mathbb{R} \text{ such that } x < y \}$
6. $F = \{ x \in [5, 7] : y \in \mathbb{R}, x < y \}$

Set difference

Given two sets A and B, we define

- $A \setminus B = \{x \in A \ : \ x \notin B\}$. This set is called "A minus B".

What are the following sets?

- $[0, 1] \setminus (0.5, \infty)$
- $\mathbb{R} \setminus [0, 1]$
- $[0, 1] \setminus \mathbb{R}$

Raise your hand if...

- A:= {Students whose name starts with A,E, I, O or U}
- B:={Male students}

Raise your hand if you are in $(A \setminus B) \cup (B \setminus A)$. Can you describe the set in English?
This set is called the symmetric difference set of A and B (written as $A \Delta B$).

Rational numbers

Let $\mathbb{Q}$ be the set of rational numbers. Write $\mathbb{Q}$ in set-building notation.

Describing a new set

An irrational number is a number that is real but not rational.

B is the set of positive, rational numbers and negative, irrational numbers.

Write a definition for B using only mathematical notation.

(You may use the words "and", "or", and "such that".
You may define B with set-builder notation in one piece, or you may use unions and/or intersections, or something else.)

Functions and quantifiers

Let f be a function with domain $\mathbb{R}$. Rewrite the following statements using $\forall$ or $\exists$:

1. The graph of f intersects the x-axis.
2. f is the zero function.
3. f is not the zero function.
4. The equation $f(x) = 0$ has a solution.
5. The equation $f(x) = 0$ has no solutions.
6. f takes both positive and negative values.
7. f is never negative.