DISCRETE MATHEMATICS

Meeting 2

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Definition of Logic

Logic is the science that systematically studies the rules of valid reasoning.

- There are two types of reasoning: deductive reasoning and inductive reasoning.

Deductive Reasoning

Deductive reasoning is based on premises assumed to be true to draw a conclusion following a specific reasoning pattern.

Example:

- Premise 1: All new students attend the orientation.
- Premise 2: Wulandari is a new student.
- Conclusion: Wulandari attends the orientation.

Inductive Reasoning

Inductive reasoning is based on factual premises to draw a general conclusion.

Example:

- Premise 1: Chicken-1 lays eggs.
- Premise 2: Chicken-2 lays eggs.
- Premise 3: Chicken-3 lays eggs.
- ...
- Premise 50: Chicken-50 lays eggs.
- Conclusion: All chickens lay eggs.

Mathematical Logic

Mathematical Logic or Symbolic Logic is logic that uses the language of mathematics, specifically using symbols.

The advantages/strengths of symbolic language are: concise, unambiguous, and universal.

Mathematical Logic (cont.)

Logic studies human reasoning, while someone's reasoning is expressed in the form of sentences. Thus, logic studies the sentences that express or formulate human reasoning.

Propositions

A proposition is a declarative sentence that is either true or false, but not both. The truth value of a proposition is called the *truth value* of that statement, depending on reality.

Examples of Propositions:

1. $2 + 2 = 4$.
2. The moon is a celestial body.
3. All humans are rational beings.
4. Jakarta is the capital of Indonesia.
5. The number 5 is odd.
6. A triangle has three sides.
7. It rained today.
8. 10 is greater than 7.
9. No planet is closer to the Sun than Mercury.
10. Every prime number is greater than 1.

Open Sentences

An open sentence is a sentence that contains a variable, making its truth value indeterminate. Such a sentence remains "open" to being true or false.

Examples of Open Sentences:

1. x is an integer.
2. $x + 2 \geq 10$
3. $3x + 5 = 0$
4. $y = 2x + 1$

We can transform an open sentence into a proposition by substituting all variables within it with constants from its domain. The resulting statement can be either true or false.

Negation

The negation of a statement is another statement formed by adding the word "not" or inserting "not" into the original statement. The negation of a statement p is denoted by the symbol $\sim p$ and read as "not p".

p	$\sim p$
T	F
F	T

Examples of Negation:

1. The moon is a celestial body.
   Negation: The moon is not a celestial body.
2. $2 + 2 = 4$
   Negation: $2 + 2 \neq 4$
3. All humans are rational beings.
   Negation: There are humans who are not rational beings.
4. Jakarta is the capital of Indonesia.
   Negation: Jakarta is not the capital of Indonesia.
5. 10 is greater than 7.
   Negation: 10 is not greater than 7.

Compound Statements

A compound statement is a statement that consists of multiple simple statements connected by conjunctions or disjunctions.

Types of Compound Statements:

- **Conjunction (And)**:
  The compound statement "A and B" is true if and only if both statements A and B are true. If either is false, the statement is false.
  Example: "Today is sunny and hot."
- **Disjunction (Or)**:
  The compound statement "A or B" is true if at least one of the statements A or B is true, or both are true. It is false only if both are false.
  Example: "I will go to the beach or the park today."

- **Negation (Not)**:
  The compound statement "Not A" is true if statement A is false.
  This is the negation of a single statement.
  Example: "I will not eat pizza."
- **Combination of Logical Operators**:
  Compound statements can combine logical operators. For instance, "A and (B or C)" is true if A is true and B or C is true.

Importance of Compound Statements

Compound statements are important in mathematical logic because they allow us to describe and analyze more complex situations by leveraging the logical relationships between simpler statements. This is particularly useful in problem-solving and proofs in mathematics and computer science.

THANK YOU!!

See you in the next meeting!!