Chapter 2
Sets and Propositions

ABSTRACT

This chapter is devoted to an elementary introduction to sets theory and propositions. We define some fundamental concepts of sets and introduce several types of sets. We study the algebra of sets and define the cardinal number, which is the number of elements of a finite set and its applications. We presented some results related to the cardinality of a finite set by the principle of inclusion and exclusion. We will also consider a related subject to the theory of sets, namely the theory of propositions. After an introduction to propositions and predicate logic, we discuss operations on propositions by using truth tables and their applications on mathematical problems through different mathematical proofs.

2.1 INTRODUCTION

The basis of all fields of mathematics in the present era is the concept of the set, which provides for the concise formulation of topics that are examined in mathematics. Trying to define a work set is difficult, but we can have an intuitive understanding of it. For example, in mathematics, the concept of "numbers" is not defined, but despite this, they all understand about numbers. Here, we present an intuitive definition of the set that was first presented by Georges Cantor in 1895, and then relying on it, we will achieve several algebraic relations by defining some other terms related to the sets.

In many daily tasks, data can be defined as a set, and if the data types are different, several sets can be used to distinguish them. An applied example of set theory is in the field of computer science, particularly in database management. For example, in the database of students, a set can be used to represent the collection of students who are enrolled in a particular course. Some instructive examples of sets application in management are project, inventory, and risk management.

DOI: 10.4018/979-8-3693-3657-1.ch002

In this chapter, in addition to explaining the basic concepts of sets, we will examine some applications, and the rules related to sets by including some different examples.

2.2 FUNDAMENTAL CONCEPTS OF SETS

A set is a collection of distinct objects with the condition that each object in question belongs to this set or is not a member of it. The meaning of being specific is to be able to specify its members exactly. For example, effective management is not a set because its members are not clear. The big factories are not also a set, but even if we just say natural numbers or English alphabets, both represent a set. The objects that make up a set are called the *members* or *elements* of that set, and we use the symbol $\in$ to show the membership, and the uppercase letters A, B, C,… and members of a set by lowercase letters. For example, $x \in A$ is interpreted to mean x is a member of A, or $x \notin B$ means x is not a member of B.

Likewise, we use the following three methods to display each set.

1. Using the Symbol {}

For example, a set of positive integer numbers which we used in the previous chapter is an example of a set. This set is known as *Natural Numbers* denoted by $\mathbb{N}$ such that,

$$\mathbb{N} = \{1, 2, 3, \ldots\}.$$

We remind you of sets that will be used throughout the whole book given by:

(i) $\mathbb{N}^* = \{0, 1, 2, 3, \ldots\}$;*Arithmetic numbers*

This set contains all positive integer numbers, and it also has the element '0'. We beware that the set of natural numbers does not contain this element.

(ii) $\mathbb{Z} = \{0, \pm 1, \pm 2, \pm 3, \ldots\}$;*Integer numbers*

This set contains all positive and negative integer numbers, and it is denoted by $\mathbb{Z}$.

(iii) $\mathbb{Q} = \left\{\frac{p}{q}, p, q \in \mathbb{Z}; q \neq 0\right\}$;*Rational numbers*

This set is a collection of numbers which can be written as the ratio of two integer numbers. We denote it by $\mathbb{Q}$.

Related Content

The Products of Molecules and Clusters on Polytopes of Higher Dimension
(2021). *Normal Partitions and Hierarchical Fillings of N-Dimensional Spaces (pp. 144-181).*
www.irma-international.org/chapter/the-products-of-molecules-and-clusters-on-polytopes-of-higher-dimension/267845

A Survey on Fake News Detection Using Word Embedding Using the Linguistic Features
Puspita Dashand Sakthiyavathi K. (2023). *Stochastic Processes and Their Applications in Artificial Intelligence (pp. 1-9).*
www.irma-international.org/chapter/a-survey-on-fake-news-detection-using-word-embedding-using-the-linguistic-features/326226

Graph Indices
V. R. Kulli (2020). *Handbook of Research on Advanced Applications of Graph Theory in Modern Society (pp. 66-91).*
www.irma-international.org/chapter/graph-indices/235532

Neutro Ordered Ring
Ahmed Hatipand Necati Olgun (2022). *Theory and Applications of NeutroAlgebras as Generalizations of Classical Algebras (pp. 219-233).*
www.irma-international.org/chapter/neutro-ordered-ring/302860

Using of Fuzzy SWARA and Fuzzy ARAS Methods to Solve Supplier Selection Problem
Alptekin Ulutas (2020). *Theoretical and Applied Mathematics in International Business (pp. 136-148).*
www.irma-international.org/chapter/using-of-fuzzy-swara-and-fuzzy-aras-methods-to-solve-supplier-selection-problem/231036