

Discrete Mathematics Cheat Sheet

Set Theory

Definitions

Set Definition: A set is a collection of objects called elements



Visual Representation:

List Notation: $\{1, 2, 3\}$

Characteristics

Sets can be finite or infinite.

Finite: $A = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$

Infinite: $\mathbb{Z}^+ = \{1, 2, 3, 4, \dots\}$

Dots represent an implied pattern that continues infinitely

Repeated Elements are only listed once: $\{a, b, a, c, b, a\} = \{a, b, c\}$



Sets are Unordered:

$$\{3, 2, 1\} = \{1, 2, 3\} = \{2, 1, 3\}$$

Common Sets

Natural Numbers: $\mathbb{N} = \{0, 1, 2, 3, \dots\}$

Positive Integers: $\mathbb{Z}^+ = \{1, 2, 3, \dots\}$

Integers: $\mathbb{Z} = \{\dots, -2, -1, 0, 1, 2, \dots\}$

Rational Numbers: $\mathbb{Q} = \{\dots, \frac{1}{2}, \frac{1}{3}, \frac{2}{3}, \frac{3}{2}, \dots\}$

Elements and Cardinality

Elements are the things contained in the set.

Let $C = \{\text{Yellow, Blue, Red}\}$

$\text{Yellow} \in C$: Yellow is an element of C .

$\text{Green} \notin C$: Green is not an element of C .

Cardinality refers to the number of elements in the set.

$|C| = 3$: The **Cardinality (size)** of C is 3.

The Empty Set

$\emptyset = \{\}$: The empty set is a set with no elements.

$|\emptyset| = |\{\emptyset\}| = 0$: The cardinality of the empty set is 0.

$\{\emptyset\} \neq \emptyset$.

$\{\emptyset\} = \{\{\}\}$

$|\{\emptyset\}| = 1$: The set contains the empty set.

Set Builder Notation

Elements in the list are defined as variables.

$X = \{\text{expression} \mid \text{rule}\}$

If $\text{Desk} = \{\text{drink, laptop, microphone}\}$

Set Builder Notation defines the set as:

$\text{Desk} = \{x \mid x \text{ is on the desk}\}$

Let $E = \{2n \mid n \in \mathbb{Z}\}$

Reads as: The set of all things with form $2n$ such that n is an element of \mathbb{Z} .

$2n$ is an expression that defines the **form** of the elements.

$n \in \mathbb{Z}$ defines a rule for elements appearing in the set.

\mid is read "such that" and separates the expression from the rule.

Examples:

$E = \{2n \mid n \in \mathbb{Z}\}$: A set containing even integers.

$\mathbb{Q} = \{\frac{m}{n} \mid m, n \in \mathbb{Z}, n \neq 0\}$: A set containing rational numbers (m and n are integers and n is not zero).

Ordered Pairs

An **Ordered Pair** is any list of things enclosed in parentheses: (x, y) .

$(1, 2) \neq (2, 1)$

Cartesian Products

AKA Cross Product

Given 2 sets, A and B , a Cartesian Product is denoted by $A \times B$.

The Cartesian Product is a set of Ordered Pairs where the first element comes from A and the second element comes from B .

$$A \times B = \{(a, b) \mid a \in A, b \in B\}$$

Let $X = \{0, 1, 2\}$ and $Y = \{0, 1\}$

$$X \times Y = \{(0, 0), (0, 1), (1, 0), (1, 1), (2, 0), (2, 1)\}$$

$$Y \times X = \{(0, 0), (0, 1), (0, 2), (1, 0), (1, 1), (1, 2)\}$$

3-tuple: $A \times B \times C = \{(a, b, c) \mid a \in A, b \in B, c \in C\}$

n-tuple:

$$A_1 \times A_2 \times \dots \times A_n = \{(a_1, a_2, \dots, a_n) \mid a_1 \in A_1, a_2 \in A_2, \dots, a_n \in A_n\}$$

$$\emptyset \times A = \emptyset$$

Cartesian Product Cardinality

The cardinality of a cross product is the product of the cardinalities of each set.

If $|A| = m$ and $|B| = n$, then $|A \times B| = m \times n$

Let $|X| = 3$ and $|Y| = 2$.

$$|X \times Y| = 3 \times 2 = 6$$

$$|\emptyset| \times |A| = 0$$

Subsets

A is a subset of B if every element in A is also in B .



$A \subseteq B$: A is a subset of B .

$$\{a, b\} \subseteq \{a, b, c\}$$

$$\{c, d\} \subseteq \{c, d\}$$

$\{a\} \not\subseteq \{\{a\}\}$: The element a is not an element of the second set.

$\emptyset \subseteq \{x, y, z\}$: The empty set is a subset of every set.

Proper Subsets

A is a **proper subset** of B if every element in A is also in B and A is smaller than B .



$A \subset B$: A is a proper subset of B .

$$\{a, b\} \subset \{a, b, c\}$$

$$\{c, d\} \not\subset \{c, d\}$$

$$\emptyset \subset \{x, y, z\}$$

Power Sets

A **Power Set** of a set A is the set containing all possible subsets of A .

Let $A = \{a, b\}$

$$\mathcal{P}(A) = \{\emptyset, \{a\}, \{b\}, \{a, b\}\}$$

$\mathcal{P}(\emptyset) = \emptyset$

Power Sets Cardinality

If $|A| = n$, then $|\mathcal{P}(A)| = 2^n$

Let $|A| = 2$

$$|\mathcal{P}(A)| = 2^2 = 4$$

Set Operations

Universes

Every set A exists within some universe U .



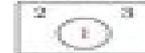
Complement

The complement of a set A is everything outside of A that is in the Universe.

$$A^c \text{ (or } \bar{A}) = \{a \in U \text{ and } a \notin A\}$$

Let $A = \{1\}$ and $U = \{1, 2, 3\}$.

$$A^c = \{2, 3\}$$



Discrete Mathematics Chartrand Answers

Richard Bailey



Discrete Mathematics Chartrand Answers:

Algorithms and Computation Sudebkumar Prasant Pal, Kuniyuki Sadakane, 2014-01-18 This book constitutes the revised selected papers of the 8th International Workshop on Algorithms and Computation WALCOM 2014 held in Chennai India in February 2014 The 29 full papers presented together with 3 invited talks were carefully reviewed and selected from 62 submissions The papers are organized in topical sections on computational geometry algorithms and approximations distributed computing and networks graph algorithms complexity and bounds and graph embeddings and drawings

Synergies in Analysis, Discrete Mathematics, Soft Computing and Modelling P. V. Subrahmanyam, V. Antony Vijesh, Balasubramaniam Jayaram, Prakash Veeraraghavan, 2023-02-02 This book contains select papers on mathematical analysis and modeling discrete mathematics fuzzy sets and soft computing All the papers were presented at the international conference on FIM28 SCMSPS20 virtually held at Sri Sivasubramaniya Nadar SSN College of Engineering Chennai India and Stella Maris College Autonomous Chennai from November 23-27 2020 The conference was jointly held with the support of the Forum for Interdisciplinary Mathematics Both the invited articles and submitted papers were broadly grouped under three heads Part 1 on analysis and modeling six chapters Part 2 on discrete mathematics and applications six chapters and Part 3 on fuzzy sets and soft computing three chapters

Discrete Mathematics Gary Chartrand, Ping Zhang, 2011-03-31 Chartrand and Zhang's *Discrete Mathematics* presents a clearly written student friendly introduction to discrete mathematics The authors draw from their background as researchers and educators to offer lucid discussions and descriptions fundamental to the subject of discrete mathematics Unique among discrete mathematics textbooks for its treatment of proof techniques and graph theory topics discussed also include logic relations and functions especially equivalence relations and bijective functions algorithms and analysis of algorithms introduction to number theory combinatorics counting the Pascal triangle and the binomial theorem discrete probability partially ordered sets lattices and Boolean algebras cryptography and finite state machines This highly versatile text provides mathematical background used in a wide variety of disciplines including mathematics and mathematics education computer science biology chemistry engineering communications and business Some of the major features and strengths of this textbook Numerous carefully explained examples and applications facilitate learning More than 1 600 exercises ranging from elementary to challenging are included with hints answers to all odd numbered exercises Descriptions of proof techniques are accessible and lively Students benefit from the historical discussions throughout the textbook

Foundations of Discrete Mathematics Albert D. Polimeni, H. Joseph Straight, 1985

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Selected Topics in Graph Theory Lowell W. Beineke,Robin J. Wilson,1978 **Graph Coloring Problems** Tommy R. Jensen,Bjarne Toft,2011-10-24 Contains a wealth of information previously scattered in research journals conference proceedings and technical reports Identifies more than 200 unsolved problems Every problem is stated in a self contained extremely accessible format followed by comments on its history related results and literature The book will stimulate research and help avoid efforts on solving already settled problems Each chapter concludes with a comprehensive list of references which will lead readers to original sources important contributions and other surveys *Martin Kneser Collected Works* Ulf Rehmann,Yuri Tschinkel,2021-11-15 This volume presents the collection of mathematical articles by Martin Kneser reprinted in the original language mostly German including one yet unpublished Moreover also included is an article by Raman Parimala discussing Kneser s work concerning algebraic groups and the Hasse principle which has been written especially for this volume as well as an article by Rudolf Scharlau about Kneser s work on quadratic forms published elsewhere before Another commentary article written by G nter M Ziegler especially for this volume describes the astounding influence on the field of combinatorics of what was published as Aufgabe 360 and its subsequent solution in 1955 resp 1957 in the Jahresbericht der Deutschen Mathematiker Vereinigung However as the titles of the articles show Kneser s mathematical interests were much broader which is beautifully discussed in an obituary by Ulrich Stuhler included as well in this volume [Applied and Algorithmic Graph Theory](#) Gary Chartrand,Ortrud R. Oellermann,1993 Designed as a bridge to cross the gap between mathematics and computer science and planned as the mathematics base for computer science students this maths text is designed to help the student develop an understanding of the concept of an efficient algorithm

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Rose Arny, 2002-04 **Dissertation Abstracts International** ,2004

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