

# Discrete MATH

## Logic of Statements

### Statements & Logical Connectives

A **statement** is a sentence that is either true or false, but not both.

**EC:** This moon orbits this Earth is a true statement.

**EC:** One plus one equals three is a false statement.

A **compound statement** is a statement that is made up of one or more simple statements using **logical connectives**.

For statements  $p$  and  $q$ , the table summarizes the logical connectives that can be used to create compound statements.

Logical Connectives		
Expression	How it is read	Type of connective
$\neg p$	"not $p$ "	negation
$p \wedge q$	" $p$ and $q$ "	conjunction
$p \vee q$	" $p$ or $q$ "	disjunction

Compound statements may contain multiple logical connectives. For compound statements that contain a negation and another logical connective, the negation ( $\neg$ ) is performed first.

**EC:**  $\neg p \vee q$  is equivalent to  $[\neg p] \vee q$ .

**EC:**  $\neg p \wedge \neg q$  is equivalent to  $[\neg p] \wedge [\neg q]$ .

You can express compound statements symbolically using  $\neg$ ,  $\wedge$ , and  $\vee$ .

**EC:** Let  $p$  represent the statement "It is cloudy." Let  $q$  represent the statement "It is raining." Represent each compound statement below symbolically.

It is not raining.  $\neg q$

It is cloudy and it is raining.  $p \wedge q$

It is cloudy but it is not raining.  $p \wedge \neg q$  or  $p \wedge [\neg q]$

It is not cloudy and it is not raining.  $\neg p \wedge \neg q$  or  $[\neg p] \wedge [\neg q]$

### Truth Tables

A **statement** is either true or false and has a well-defined **truth value**. Compound statements also have well-defined truth values that are determined by the truth values of the simple statements that comprise them. **Truth tables** can be used to show the truth value of a compound statement based on the truth values of its components.

**EC:** Negation of a statement

For a statement  $p$ , the negation of  $p$  is written  $\neg p$  and means "not  $p$ ." The truth value of  $\neg p$  is the opposite of the truth value of  $p$ . If  $p$  is true, then  $\neg p$  is false. If  $p$  is false, then  $\neg p$  is true.

$p$	$\neg p$
T	F
F	T

**EC:** Conjunction of a statement

For statements  $p$  and  $q$ , the **conjunction** of  $p$  and  $q$  is written  $p \wedge q$  and means " $p$  and  $q$ ." The truth value of a conjunction is true when, and only when, both  $p$  and  $q$  are true. If either  $p$  or  $q$  is false, or if both  $p$  and  $q$  are false, the conjunction is false.

$p$	$q$	$p \wedge q$
T	T	T
T	F	F
F	T	F
F	F	F

**EC:** Disjunction of a statement

For statements  $p$  and  $q$ , the **disjunction** of  $p$  and  $q$  is written  $p \vee q$  and means " $p$  or  $q$ ." The truth value of a disjunction is true when at least one of  $p$  or  $q$  is true. If both  $p$  and  $q$  are false, then the disjunction is false.

$p$	$q$	$p \vee q$
T	T	T
T	F	T
F	T	T
F	F	F

Truth tables can also be used to determine the truth values of more complicated compound statements.

## Logic, Graphs & Trees, Sets, Probability

**EC:** Construct a truth table for the compound statement  $\neg p \vee (q \wedge r)$ .

$p$	$q$	$r$	$\neg p$	$q \wedge r$	$\neg p \vee (q \wedge r)$
T	T	T	F	T	T
T	T	F	F	F	F
T	F	T	F	F	F
T	F	F	F	F	F
F	T	T	T	T	T
F	T	F	T	F	T
F	F	T	T	F	T
F	F	F	T	F	T

### Logical Equivalence & De Morgan's Laws

Two statements are **logically equivalent** if and only if they have identical truth values. The symbol  $\equiv$  is used to denote logical equivalence.

**Steps to Determine Logical Equivalence**

For compound statements  $P$  and  $Q$ :

1. Construct a truth table for  $P$ .
2. Construct a truth table for  $Q$  using the same statement variables as step 1.
3. Compare the truth values of the tables. If the truth values in each row are the same, the statements are logically equivalent. If the tables have a different truth value in any row, the statements are not logically equivalent.

**De Morgan's laws** are used to determine the negation of a conjunction and the negation of a disjunction.

The negation of a conjunction is logically equivalent to a disjunction in which each component is negated.

$\neg(p \wedge q) \equiv \neg p \vee \neg q$

**EC:** Find the negation of the statement *Justine is a sophomore and has blonde hair*.

The negation of this statement is *Justine is not a sophomore or does not have blonde hair*.

The negation of a disjunction is logically equivalent to a conjunction in which each component is negated.

$\neg(p \vee q) \equiv \neg p \wedge \neg q$

**EC:** Find the negation of the statement *Luis was sick on Monday or he missed the school bus*.

The negation of this statement is *Luis was not sick on Monday and he did not miss the school bus*.

As with other compound statements, a truth table can be used to demonstrate the logical equivalence of De Morgan's laws.

**EC:** Construct a truth table to show that  $\neg(p \vee q) \equiv \neg p \wedge \neg q$ .

$p$	$q$	$\neg p$	$\neg q$	$\neg(p \vee q)$	$\neg p \wedge \neg q$	$\neg p \vee \neg q$
T	T	F	F	F	F	F
T	F	F	T	T	F	T
F	T	T	F	T	F	T
F	F	T	T	T	T	T

### Conditional Statements

A **conditional statement** is an if-then statement of the form "if  $p$ , then  $q$ ," where  $p$  is the **hypothesis** and  $q$  is the **conclusion**. This is symbolized by  $p \rightarrow q$  or read as " $p$  implies  $q$ ."

**EC:** If 12 is divided by 4, then the quotient is 3.

If Nathan makes the soccer team, then he will play fullback.

If Christy does not earn at least a B on her final, then she will earn a C for the class.

A conditional statement is false when, and only when, the hypothesis  $p$  is true and the conclusion  $q$  is false. Otherwise, the conditional statement is true.

$p$	$q$	$p \rightarrow q$
T	T	T
T	F	F
F	T	T
F	F	T

Truth tables can be used to analyze compound conditional statements.

# Guide For Discrete Mathematics

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## **Guide For Discrete Mathematics:**

**Guide to Discrete Mathematics** Gerard O'Regan, 2016-09-16 This stimulating textbook presents a broad and accessible guide to the fundamentals of discrete mathematics highlighting how the techniques may be applied to various exciting areas in computing The text is designed to motivate and inspire the reader encouraging further study in this important skill Features provides an introduction to the building blocks of discrete mathematics including sets relations and functions describes the basics of number theory the techniques of induction and recursion and the applications of mathematical sequences series permutations and combinations presents the essentials of algebra explains the fundamentals of automata theory matrices graph theory cryptography coding theory language theory and the concepts of computability and decidability reviews the history of logic discussing propositional and predicate logic as well as advanced topics examines the field of software engineering describing formal methods investigates probability and statistics

**A Beginner's Guide to Discrete Mathematics** W.D. Wallis, 2013-03-14 This text is a basic introduction to those areas of discrete mathematics used by students of mathematics and computer science Introductory courses on this material are now standard at many colleges and universities Usually these courses are of one semester's duration and usually they are offered at the sophomore level Very often this will be the first course where the students see several real proofs The preparation of the students is very mixed and one cannot assume a strong background In particular the instructor should not assume that the students have seen a linear algebra course or any introduction to number systems that goes beyond college algebra In view of this I have tried to avoid too much sophistication while still retaining rigor I hope I have included enough problems so that the student can reinforce the concepts Most of the problems are quite easy with just a few difficult exercises scattered through the text If the class is weak a small number of sections will be too hard while the instructor who has a strong class will need to include some supplementary material I think this is preferable to a book at a higher mathematical level which will scare away weaker students

**Discrete Mathematics and Graph Theory** K. Erciyes, 2021-01-28 This textbook can serve as a comprehensive manual of discrete mathematics and graph theory for non Computer Science majors as a reference and study aid for professionals and researchers who have not taken any discrete math course before It can also be used as a reference book for a course on Discrete Mathematics in Computer Science or Mathematics curricula The study of discrete mathematics is one of the first courses on curricula in various disciplines such as Computer Science Mathematics and Engineering education practices Graphs are key data structures used to represent networks chemical structures games etc and are increasingly used more in various applications such as bioinformatics and the Internet Graph theory has gone through an unprecedented growth in the last few decades both in terms of theory and implementations hence it deserves a thorough treatment which is not adequately found in any other contemporary books on discrete mathematics whereas about 40% of this textbook is devoted to graph theory The text follows an algorithmic approach for discrete mathematics and graph problems where

applicable to reinforce learning and to show how to implement the concepts in real world applications *A Beginner's Guide to Discrete Mathematics*, 2011-10-08 [A Beginner's Guide to Discrete Mathematics](#), 2014 **Student's Solutions Guide for Discrete Mathematics and Its Applications** Kenneth H. Rosen, 2018-07-23 Rosen's *Discrete Mathematics and Its Applications* presents a precise relevant comprehensive approach to mathematical concepts This world renowned best selling text was written to accommodate the needs across a variety of majors and departments including mathematics computer science and engineering As the market leader the book is highly flexible comprehensive and a proven pedagogical teaching tool for instructors Digital is becoming increasingly important and gaining popularity crowning Connect as the digital leader for this discipline McGraw Hill Education's Connect available as an optional add on item Connect is the only integrated learning system that empowers students by continuously adapting to deliver precisely what they need when they need it how they need it so that class time is more effective Connect allows the professor to assign homework quizzes and tests easily and automatically grades and records the scores of the student's work Problems are randomized to prevent sharing of answers and may also have a multi step solution which helps move the students learning along if they experience difficulty **A Comprehensive Guide to Discrete Mathematics** Christopher Rhoades, 2025-08-25 Discrete mathematics is the study of mathematical structures that are fundamentally non continuous including concepts such as integers logical statements and graphs Number theory logic probability graph theory algebra set theory information theory combinatorics geometry game theory and topology among others are the key topics explored under this discipline The topics included in this book on discrete mathematics are of utmost significance and bound to provide incredible insights to readers It explores all the important aspects of the discipline in the present day scenario Coherent flow of topics student friendly language and extensive use of examples make this book an invaluable source of knowledge *Student Solutions Guide for Discrete Mathematics and Its Applications* Kenneth H. Rosen, 2002-09-01 This text is designed for students preparing for future coursework in areas such as math computer science and engineering *Discrete Mathematics and Its Applications* has become a best seller largely due to how effectively it addresses the main portion of the discrete market which is typically characterized as the mid to upper level in rigor The strength of Rosen's approach has been the effective balance of theory with relevant applications as well as the overall comprehensive nature of the topic coverage **Student's Solutions Guide for Discrete Mathematics and Its Applications** Jerrold W. Grossman, Professor, Kenneth H. Rosen, 2011-07-26 Answers to ODD numbered problems are in the back of the book WORKED OUT SOLUTIONS for these ODD numbered problems are in the PRINTED Student's Solutions Guide 0 07 7353501 Complete SOLUTIONS for the EVEN NUMBERED PROBLEMS are available for the Instructor ONLY in the Instructor's Resource Guide link under the Instructor Resources **Student Solutions Guide for Discrete Mathematics and Its Applications** Kenneth H. Rosen, 1995 This text provides a balanced survey of major sub fields within discrete mathematics It demonstrates the utility of discrete mathematics in the solutions of

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**Discrete Mathematics with Proof Second Edition** is an excellent book for mathematics and computer science courses at the undergraduate level It is also a valuable resource for professionals in various technical fields who would like an introduction to discrete mathematics

*The Discrete Math Workbook* Sergei Kurgalin, Sergei Borzunov, 2018-07-31 This practically oriented textbook presents an accessible introduction to discrete mathematics through a substantial collection of classroom tested exercises Each chapter opens with concise coverage of the theory underlying the topic reviewing the basic concepts and establishing the terminology as well as providing the key formulae and instructions on their use This is then followed by a detailed account of the most common problems in the area before the reader is invited to practice solving such problems for themselves through a varied series of questions and assignments Topics and features provides an extensive set of exercises and examples of varying levels of complexity suitable for both laboratory practical training and self study offers detailed solutions to many problems applying commonly used methods and computational schemes introduces the fundamentals of mathematical logic the theory of algorithms Boolean algebra graph theory sets relations functions and combinatorics presents more advanced material on the design and analysis of algorithms including asymptotic analysis and parallel algorithms includes reference lists of trigonometric and finite summation formulae in an appendix together with basic rules for differential and integral calculus This hands on study guide is designed to address the core needs of undergraduate students training in computer science informatics and electronic engineering emphasizing the skills required to develop and implement an algorithm in a specific programming language

*Schaum's Outline of Theory and Problems of Discrete Mathematics* Seymour Lipschutz, 1997 Offers explanations and step by step guidance on solving the kinds of problems students find in exams This guide features the applications of discrete mathematics to computer science and is useful for independent study or to supplement reinforce and strengthen work in class

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**Student Solutions Manual and Study Guide, Discrete Mathematics with Applications** Susanna S. Epp, 2011-04 A solutions manual designed to accompany the fourth edition of the text Discrete mathematics with applications by Susanna S Epp It contains complete solutions to every third exercise in the text that is not fully answered in the appendix of the text itself Additional review material is also provided

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