FACHHOCHSCHULE
WIENER NEUSTADT
Austrian Network for Higher Education

Discrete Mathematics and Algebra
CSCI 2025

Session 1

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Overview

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- Organisational
- Basics
- Logic

Literature

A. Croft & R. Davison
Mathematics for Engineers
5th Edition
Pearson

K. Rosen
Discrete Mathematics and its Applications
8th Edition
McGraw-Hill Education

S. Epp
Discrete Mathematics with Applications
5th Edition
Cengage

Course Structure

- Course division in 14 Lecture and 12 Exercise Sessions
- Lecture Sessions
- Exercise Sessions
- Take place in the lecture hall
- Lecturers: Eirini Kouvela & Arno Kimeswenger

Assignments

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Tests

Final Test

26th of January

60%
60 minutes

Small Tests

30th of September
14th of October
17th of November
15th of December

4*10%
15 minutes

Exercises

Once: Grade 2
Twice: Grade 1

Assignments

Minimum requirements and Resit

- Minimum requirement for a passing grade of the final test: **50% of total points**
- Minimum requirement for a passing grade of the course: **50% of total points**
- If the minimum requirement is not met → **Resit**
- Alternative date: offered only for the final test and one exercise test, e.g. in case you were sick.
- Attendance is strongly recommended!

Grading System

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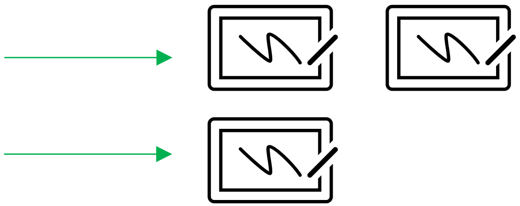
Percentage	Grade
90 to 100	Very good
78 to 89	Good
62 to 77	Satisfactory
50 to 61	Sufficient
0 to 49	Insufficient



It‘s all Greek to me!

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- Study groups
- Take notes
- Textbooks
- Moodle
- Ask us

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Proposition

A proposition is a statement that is either true or false.

For example:

- One plus one is eleven.
- Homer wrote Hamlet.
- Alexander Van der Bellen is the current federal president of Austria.

Some statements are not propositions as it is impossible to assign a truth value to them.

For example:

- Leave us now.
- Quentin Tarantino is the greatest director.
- Maths is interesting.

Logic

Which of the following are propositions?

- Santiago is the capital of Peru.
- What time is it?
- Aristotle had followers and they were called the peripatetics.
- Listen to me please.

Logic

Logic is the study of whether an argument is robust and leads to valid conclusions.

For example:

- m: The moon is made of chocolate.

We use letters to denote **propositional variables** (or **sentential variables**).

Logic

Negation $\neg$

For any proposition, $\boldsymbol{p}$,

$\neg\boldsymbol{p}$ is true whenever p is false.

$\neg\boldsymbol{p}$ is false whenever p is true.

For example:

- $\boldsymbol{m}$: The moon is made of chocolate.
- $\neg\boldsymbol{m}$: The moon is not made of chocolate.

Logic

Conjunction ∧ (and)

If,

$\boldsymbol{w}$: The word is made up of six characters

$\boldsymbol{d}$: The first character is a digit

Then…

$\boldsymbol{w} \wedge \boldsymbol{d}$: The word is made up of six characters **and** the first character is a digit.

Logic

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Disjunction ∨ (or)

If,

$\boldsymbol{w}$: A triangle has three sides

$\boldsymbol{d}$: A circle has four sides

Then…

$\boldsymbol{w} \vee \boldsymbol{d}$: A triangle has three sides **or** a circle has four sides.

Logic

Exclusive or $\oplus$

If,

$\boldsymbol{w}$: A student can have a salad with dinner

$\boldsymbol{d}$: A student can have soup with dinner

Then…

$\boldsymbol{w} \oplus \boldsymbol{d}$: A student can have soup or salad, but not both, with dinner.

Logic

Implication $\rightarrow$

Conditional proposition: "If … then … "

$\boldsymbol{p}$: I pass the maths exam

$\boldsymbol{q}$: I will celebrate at the beach party

'If p then q' is denoted by $\boldsymbol{p} \rightarrow \boldsymbol{q}$

If I pass the maths exam then I will celebrate at the beach party.

Logic

Bi-implication $\leftrightarrow$

Conditional proposition: "If and only if "

$\boldsymbol{p}$: You can take the flight

$\boldsymbol{q}$: You buy a ticket

‘p if and only if q‘ is denoted by $\boldsymbol{p} \leftrightarrow \boldsymbol{q}$

You can take the flight if and only if you buy a ticket.

Logic

Example

Given

w: The word has less than seven characters

c: The program compiles

state in words

- $\neg w$
- $\neg c$
- $w \rightarrow c$
- $w \vee \neg c$
- $c \wedge w$
- $c \oplus w$
- $w \leftrightarrow c$

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Logic

Example

Given

d: The first character is a digit

v: The word has six characters

state symbolically

a) The first character is not a digit.

b) If the word has six characters then the first character is a digit.

c) The word does not have six characters or the first character is a digit.

Quantifiers

- $P(x)$: x is greater than 3
  - x: the subject of the statement
  - greater than 3: a property that the subject of the statement can have
- Quantification expresses the extent to which a predicate is true over a range of elements.
- The notation $\forall x P(x)$ denotes the universal quantification of $P(x)$.
  - Here $\forall$ is called the universal quantifier.
  - We read $\forall x P(x)$ as "for all $x P(x)$" or "for every $x P(x)$."
- We use the notation $\exists x P(x)$ for the existential quantification of $P(x)$.
  - Here $\exists$ is called the existential quantifier.

Quantifiers

Example

- Is the statement "For all natural numbers, $x + 1 > 0$" true or false?
- Is the statement "For all natural numbers x, $x > 3$" true or false?

Quantifiers

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Statement	When True?	When False?
$\forall x P(x)$	$P(x)$ is true for every x.	There is an x for which $P(x)$ is false.
$\exists x P(x)$	There is an x for which $P(x)$ is true.	$P(x)$ is false for every x.

Quantifiers

Negating Quantified Expressions

Every student in your class has taken a course in calculus.

$P(x)$: x has taken a course in calculus

$$\forall x P(x)$$

Negation

It is not the case that every student in your class has taken a course in calculus.

There is a student in your class who has not taken a course in calculus.

$$\exists x \neg P(x)$$

$$\boldsymbol{\neg \forall x P(x) \equiv \exists x \neg P(x)}$$

Quantifiers

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Negating Quantified Expressions

There is a student in this class who has taken a course in calculus.

$Q(x)$: x has taken a course in calculus

$$\exists x Q(x)$$

Negation

It is not the case that there is a student in this class who has taken a course in calculus.

Every student in this class has not taken calculus.

$$\forall x \neg Q(x)$$

$$\boldsymbol{\neg \exists x Q(x) \equiv \forall x \neg Q(x)}$$

Thank you!