

Discrete Structures

COURSE No.:	PBM 763
PROGRAM:	BITL, BBA (elective)
INSTRUCTOR:	Kalvis Apsītis, Jānis Lazovskis Spring 2021 Semester: Mondays, Tuesdays, Wednesdays, Fridays. January 4 till April 9, 2021. (Consultation Week: April 12-16, 2021).
CLASS DAYS & TIME:	
OFFICE LOCATION & HOURS:	Near Room 423 by appointment
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TEXTBOOK

The Textbook: Kenneth H. Rosen. Discrete Mathematics and Its Applications, 8th Edition. McGraw-Hill Education. 2019.

Class Website: <http://linen-tracer-682.appspot.com/discrete/index.html> (hosting may change – the permanent URL will be announced to the students).

It contains presentations and descriptions of assignments.

Reading Assignments: Class Website also links to some math papers and other supplementary material.

COURSE OBJECTIVES

At the end of this course, students will be able to prove statements about the mathematical properties of sets, numbers and discrete structures (various data models typically stored in the memory of a computer). They will communicate the rules to manipulate this discrete data. This course prepares for advanced algorithms used in computer networks, data encryption, financial transactions, Internet search and social media. The course can strengthen creative thinking and general problem solving capabilities.

COURSE OVERVIEW

The course provides foundational material for further studies in computer science. It covers large number of interrelated topics – Boolean and predicate logic, proofs, set theory, integer arithmetic (in particular, number theory and divisibility), recurrence relations, counting methods, discrete probabilities, graphs and trees.

In order to achieve the course objectives, we will use these methods and tools:

- (1) **Class Participation: 4*14 sessions, 90 minutes each.** The scope of this course requires regular work and diligent practice. It is not easy to catch up after missing a few classes. Due to the epidemic we expect that some class sessions are hybrid and/or remote. Two out of four class sessions are for all participants (same meeting room or remote session). During another two sessions the class is split into two parts; both instructors will teach them in parallel and will switch places.

Attendance is not graded, but we expect active participation in the following activities:

- a. Work with examples provided in the class. Every concept in mathematics is taught by looking at the “typical representatives” of this concept; examples in this course are as important as the theory itself.
- b. Complete multiple-choice or short answer tests. They are not graded just like other classroom activity, but can provide instant feedback and give early indication about the difficulties.
- c. Read some theory topics before the class session itself (flipped classroom).
- d. Participate in problem solving when working in groups; contribute the knowledge that other people in the team might not have (e.g. because of different reading assignments).

- (2) **Solving mathematical problems (12 Homeworks):** The key ability developed in this class is reasoning in written English. In this class we suggest that you typeset your homework in LaTeX using APA style guidelines. You should expect about one homework per week. A homework consists of 3 types of problems:

- a. 2-3 problems ask you to solve a typical example (for example, apply a procedure covered in a class to a particular case).
- b. 1-2 problems ask you to prove general statements or solve cases where there is no single obvious method. Instructors try to assist by giving hints and encouraging creative problem solving techniques.

- (3) **Solving mathematical problems (Midterm and Final Exam):** Problems in midterm and final exams are similar (regarding their style and scope) to the homeworks.

- (4) **Individual Assignment:** Discrete structure results are not found just in textbooks; they may appear as academic papers and some technology solutions. You can study some topic, to prepare slides and give a 10-minute technical talk for your half of the class. We can negotiate that everybody can prepare a different topic matching his/her interests and abilities.

Topics may include an important application area for a discrete math topic, some important algorithm, doing math with proof assistants (such as Coq) or processing data (interactive environments such as Python/Jupyter or R/RStudio).

COURSE REQUIREMENTS

In order to get a satisfactory grade, you need to get the total evaluation that matches the minimum grade requirements defined for your study program.

- (1) **Class Participation** should match the expectations of your study program. If you expect to miss more 1 class per week and there are difficulties following the material, we should resolve the situation as early as possible (since it is easy to miss material that is crucial for understanding the next topics).

(2) **Homeworks** should be submitted electronically (typically, on the day preceding the class, where they are discussed). class on the due date and should be submitted electronically. These will include several sets of math problems - mostly proofs or applying your theory knowledge in specific contexts.

Late homework submissions are not allowed and they earn no credit.

(3) **Midterm and Final Exams.** Both exams are “closed book, closed notes” – you rely on your memory and understanding. Relevant definitions and notation will be included in the problems themselves, if necessary.

Make-up exams for the mid-term and the final are generally not given. If there are extenuating circumstances and you must miss an exam the instructor must be notified ahead of the exam time. The only time a make-up exam can be taken is during the week following the date of the exam. If a student does not notify the instructor of an absence or misses the make-up exam deadline, the exam will not be included in the final grade.

(4) **Individual Assignments** should be presented on the day they were scheduled.

GRADING

Grading for the course is as follows:

<i>Assignments</i>	<i>Points</i>
Homeworks	600
Midterm	150
Final	200
Individual Assignment	50
TOTAL	1000

Final grades are calculated on the following basis.

> 949 = 10

850-949 = 9

750-849 = 8

650-749 = 7

550-649 = 6

450-549 = 5

350-449 = 4

< 350 = failing

Your grades will be updated regularly in ORTUS (E-studijas RTU). Please check to see that your grades are recorded correctly.

ACADEMIC INTEGRITY

To strengthen ethics within Riga Business School and the business community the RBS policy is to take steps to avoid cases of academic fraud. Be aware that any student who turns in written work that is not original with incorrectly referenced sources (i.e. plagiarized) will be subject to the RBS sanctions policy on Academic Fraud (see the policy on the online assistant). The same consequences apply to academic dishonesty on tests and quizzes.

To find information on what plagiarism is and how to avoid it please visit the links at:

<http://www.uottawa.ca/plagiarism.pdf>

<http://www.socialsciences.uottawa.ca/pdf/plagiarism2.pdf>

<http://www.sass.uottawa.ca/writing/plagiarism.pdf>

This short presentation on research and plagiarism will also help learn to correctly reference sources and provides good advice on research:

<http://library.acadiau.ca/tutorials/plagiarism/>

During the Discrete Structures class, you should be aware of the following integrity guidelines in particular:

- **Homeworks:** Discussing your assignments is encouraged as long as you do not take any notes or copies of the work of other people. At the moment when you write your proofs, you should not interact with others and use only your notes and any other notes and papers. Results from external sources can be referred to in your solution, if they are properly quoted (APA guidelines tell how to do citations).
- **Problems completely solved online:** We try to give you problems that are variations of the textbook stuff. But occasionally you may find that the homework problem is completely solved in some online resource. Please do NOT copy the solution (even if properly quoted and referenced), since you will not learn from such practice. Instead, please inform the instructor(s) that a homework problem might be compromised, and then we can try to find a fix together.
- **Exams:** Both exams will be proctored and are closed book and closed notes. You can use only paper and pen.
If exams are done remotely they can be open book and open notes (no collaboration of any kind is allowed). To save your time we suggest that you write your exam solutions on grid paper (size A4) and send us photographs of your handwriting.

CLASS SCHEDULE

A schedule of topics is listed below. Specific readings and assignments will be defined later.

Spring 2020	Topic	Pre-class preparation	Deliverables and Activities
Week1 04.01-08.01	Propositional logic, proofs, predicates and quantifiers.	Chapter 1 from the textbook.	Learning to typeset with LaTeX. (Submitting a “dummy LaTeX” file to test the procedure.)
Week 2 11.01 - 15.01	Theory of sets, functions, relations, comparing set cardinalities.	Chapter 2 from the textbook.	HW01
Week 3 18.01 - 22.01	Revisit Propositional Logic, First Order Logic, and Sets.	Chapters 1 and 2 from the textbook.	HW02
Week 4 25.01 - 29.01	Revisit Propositional Logic, First Order Logic, and Sets.	Chapters 1 and 2 from the textbook.	HW03
Week 5 01.02 - 05.02	The theory of algorithms, unsolvable problems, complexity of algorithms	Chapter 3 from the textbook.	HW04 Individual Assignments Part 1: presentations on proofs, logic, math creativity.
Week 6 08.02 - 12.02	Number theory, Modular arithmetic, primes, cryptography.	Chapter 4 from the textbook.	HW05
Week 7 15.02 - 19.02	Mathematical induction, recursion, invariants.	Chapter 5 from the textbook.	HW06
Week 8 22.02 - 26.02	Counting. The rule of multiplication. Permutations.	Chapter 6 from the textbook. Reviewing for the midterm.	HW07 Midterm Exam
Week 9 01.03 – 05.03	Discrete Probability. Assigning probabilities. Bayes theorem. Descriptive statistics	Chapter 7 from the textbook.	HW08 Individual Assignments Part 2: presentations on number theory, cryptography etc.
Week 10 08.03 - 12.03	More counting. Recurrences. Generating functions. Inclusion-exclusion.	Chapters 6 and 7 from the textbook	HW09

Spring 2020	Topic	Pre-class preparation	Deliverables and Activities
Week 11 15.03 - 19.03	Relations. Types of relations. Orderings.	Chapter 8 from the textbook.	HW10 Individual Assignments Part 3: presentations on counting and probabilities.
Week 12 22.03 - 26.03	Graphs. Representing graphs. Cycles. Shortest paths.	Chapter 9 from the textbook.	HW11
Week 13 29.03 - 02.04	Trees. Tree traversal.	Chapter 11 from the textbook.	HW12
Week 14 05.04 - 09.04	More graphs and trees. Minimum spanning trees.	Chapters 10 and 11 from the textbook.	Individual Assignments Part 4: presentations on graphs.
Consultation Week 12.04 - 16.04	Reviewing all the topics. Feedback on the individual assignments and presentations.	N/A	N/A
Exam Session 19.04 - 23.04	Final Exam not scheduled yet.	N/A	Final Exam