Below you can find some hints on what subjects you should focus on when preparing for the examination. Note that I only highlight the most important of these, i.e., the ones for which the chances of appearing during the examination are the greatest. Still, however, the subjects **not listed below may occur**, but with a **much lower probability**. The test will consist of two types of questions:

- Theoretical – they intend to verify that you understand "what is going on". For instance, "What is the main purpose of introducing artificial variables to the LP model?" or "Does the simplex algorithm guarantee finding the optimum for the LP problems? Justify your answer." So these can be called "practical/theoretical" questions. Their total impact on the final grade will be between 20% and 30%.
- Practical – mostly solving some problems using some algorithms. They will have a major impact on the final grade 😊.

There will be **no** "A, B, C, D" questions or "Yes/No" ones. However, the latter **can appear** in the "Yes/no + justify your answer" format. During the test, you will be allowed to use **simple/scientific calculators, but not graphical ones (so for only e.g., +, -, /, *, power, sqrt, log, or displaying simple fractions).** But you **will not** be allowed to use your notes. You will have 90 minutes to finish the assignments. It is recommended to take a ruler 😊. Note that a blank page for calculations will be given (**you cannot use your own blank pages**). Generally, the exercises provided to you during the laboratories **cover most of the material** that may appear during the examination. Therefore, they can be helpful when it comes to revising.

Hints

Topic 1 – Introduction to LP: Solving LP problems using the graphical method. The problems will already be provided in the "mathematical form," like in Ex. 1 for Lab 1. Hence, you **will not** be asked to formulate a problem based on the provided description, like in Ex. 3 for Lab 1 (to avoid misunderstandings).

Topic 2 – The Simplex Method: You should get acquainted with this topic well. You should know how to transform a problem from a (non) standard form to the augmented one and how to solve it using the simplex method. It includes dealing with, e.g., an objective function to be minimized; or inclusion of "≥" and "=" constraints (the Big M method). You need to understand how the simplex tableau is organized and what is **degeneracy** and its implications. Also, it is recommended to learn the two-phase method (but not needed). Generally, having a well understanding of this topic is essential 😊. For your convenience, the possible tasks to solve during the examination **will not** concern problems of considerable size. You can expect that only two iterations will be required (three simplex tableaus) to solve the problem. The tableaus **will not** be provided in the examination sheets. However, for your convenience, the **gridlines will be provided** to allow you to align the numbers better. When organizing the data, you can follow the **format of a simplex tableau given in exercises for Lab 2** (but the tableau borders and edges will not be required to be drawn).

Topic 3 – The Matrix Form and the Duality Theory: The set of equations for reconstructing a simplex tableau (the fundamental insight) **will be provided**, as in the exercises for Lab 3, so you do not need to memorize these. You should know how to:

- recalculate the simplex tableau using the fundamental insight;
- formulate a dual problem to the primal one;
- understand the relationships between primal and dual complementary solutions;

- know how to derive a complementary dual solution to a primal one either from the simplex tableau (where the dual solution is hidden in a simplex tableau for a primal problem) or "from scratch" (Ex. 3 for Lab 3).

Topic 4 – Sensitivity Analysis: Get acquainted with the general procedure for performing the sensitivity analysis. Focus also on the following "cases":

- changing the limits in constraints + identifying the allowable ranges + 100% rule (Ex. 1 for Lab 4);
- identifying the shadow prices in the simplex tableau + how to interpret these (Ex. 1 for Lab 4);
- adding new constraints + the dual simplex method (Ex. 2 for Lab 4)
- changing coefficients of non-basic variables + using the duality theory to identify whether the current solution will preserve its optimality (Ex. 3 for Lab 4).

Topic 5 – The Transportation and the Assignment Problem: You need to know how to transform a given problem (transportation/assignment) into its proper form (only "=" for supplies/demands, adding dummy sources or destinations, etc.). See, e.g., Ex. 1 for Lab 5 and the lecture slides concerning the Hungarian Algorithm ("example problem & some tricks"). For your convenience, the possible tasks to solve during the examination will be of small size. One/two iterations to reach the optimum will be required (hence, two tables for the transportation problem or two/three matrices for the assignment problem will be sufficient).

Topic 6 – Network Optimization Models: There will be **no** practical task to solve because some of the problems/algorithms introduced have already been presented to you during other courses (but do not forget about possible theoretical questions).

Topic 7 – Dynamic programming: No practical tasks. Potentially, only some theoretical questions may appear (but very general ones).

Topic 8 – Integer programming: No practical tasks. Potentially, only some theoretical questions may appear (but very general ones).

Topic 9 – Nonlinear programming: There **will be no** task involving using either Bi-section or Newton's algorithm. Also, there **will not** be any practical exercise related to quadratic programming. However, you may expect to be asked to prove the convexity/concavity of some function that involves 1 or 2 variables (see Ex. 1 and 3 in Lab9.pdf). Furthermore, you may be asked to prove that a given solution can be optimal for a given problem using the KKT conditions (see Ex. 4 in Lab9.pdf). Note that the equations representing these conditions **will be provided**, so you do not have to memorize these.

Topic 10 – Metaheuristics: No practical tasks. Potentially, only some theoretical questions may appear (but very general ones).

Topic 11 – Job Scheduling: You should have some general knowledge of the main properties of the introduced Job Scheduling problems (e.g., flow-shop, open-shop, etc.) and of the three-symbol notation used in this field ($\alpha|\beta|\gamma$). When it comes to practical tasks, you may expect that any of the exercises given you in the Lab11.pdf may appear during the examination (i.e., calculating performance indicators, LPT and SPT algorithms, Coffman-Graham algorithm, Johnson algorithm, Gonzalez and Sahni algorithm).

Topic 12 – Queuing theory: Exercises provided in Lab12.pdf represent what may appear as a practical task during the examination. Note that all the equations will be provided (except for calculating waiting and servicing costs), as well as the complete model for M|M|s, so you do not need to memorize these.