

8 Project – submit your solution to tereza.kovarova@vsb.cz

Combinatorics

- 8.1. The choreographer of the Moravian-Silesian National Theater is in trouble. The theater is rehearsing a new ballet interpretation of Swan lake and the problem of assigning roles in the famous mansion scene is at hand. In this scene there are acting 3 female aristocrats and 3 male aristocrats. In how many ways can the choreographer assign roles to the actors if he can choose among 11 female ballet dancers and 10 male ballet dancers, provided William Light and George Feather, both being very subtle, can represent a male as well as a female aristocrat? (3 b)
- 8.2. We have a deck of 52 cards (values are 2 up to aces in four suits). We shuffle the deck, split it in halves and take off the top two cards. What is the probability that one of these cards is an *ace* and the other are *J*, *Q*, *K* or *10*? Disregard the suits. (2 b)

Graph Theory

- 8.3. Spaceship H08 is traveling along hypergalactic corridors between orbital beacons. Some of the beacons are joined by intergalactic corridors, some not. Representing the beacons as vertices and the corridors as edges we obtain a graph of a hypercube of order 18 which the spaceship H08 can travel along. Traversing each corridor is expensive. If H08 flies empty, it burns one fuel cell for each corridor (one edge). However, the mass of each fuel cells is enormous. For each fuel cell on board, H08 burns another fuel cell for the transport. For example transporting 3 fuel cells traversing one corridor costs 4 fuel cells. How many fuel cells are needed to travel without refueling among two most distant beacons?
- A hypercube of order k is a graph whose vertices are binary k -tuples of zeros and ones, while two vertices are joined by an edge if and only if the corresponding k -tuples differ in one coordinate only. An animation on hypercubes can be found here: <http://homel.vsb.cz/~kov16/animations/hyperkrychle.pdf> (3 b)
- 8.4. We have an ordered rooted tree of $n > 2$ characters. An error in transmission occurred and there is a problem in reading two characters of the code. Suppose trees are encoded by 0 and 1 only. The code always starts with a 0 and now in our code the next two characters are missing. Under which conditions we will be able to repair the code and under which conditions we can't tell for sure what the two missing character were? Explain carefully. (2 b)

Guidelines

Write the project using a computer, include the title with your name, student ID, number of the project, year and a grading table (see the sample project). The project will contain a detailed description of your solution for each problem. Show your work by explaining the steps carefully. If you skip a problem, mark it clearly in the text by saying „*I did not solve the problem number X*“.

Submit your project to tereza.kovarova@vsb.cz as an uncompressed PDF file, use your student ID in the name of your submitted file.

You will be awarded 0 upto 2 or 0 upto 3 points for each of the problems.

Submit your project no later than on **Monday December 5th 2016 at 23:59**.