

1 Project – submit your solution to petr.kovar@vsb.cz

Combinatorics

- 1.1. In the land "Of Seven bridges" the mighty king *Leonhard II* gave the order, that every coat of arms in his land must look like the one shown in the picture 1 with these options of colouring. The regions of the shield may be coloured with these colours: *red, blue, pink, orange, white, green* and *black*. The colours can be repeated, but two neighbouring fields must not be dyed by the same colour. Helmet could be *rusty bronze* or *grey*. The wreath (the crown) must be *silver*. The crest could be *dark yellow, brown, orange*. The strip with three stars (and the stars themselves) is the same colour on the crest as on the shield. The strip cannot have same colour as crest. What is the maximum possible number of different coat of arms in the land "Of Seven bridges"?



Obrázek 1: Every coat of arms must look like this.

(2 b)

- 1.2. There is a standard deck of 52 cards. (2, 3, 4 up to *A* each of four suits). We shall call *BLACK JACK* every of these two cards combinations $A + J, A + Q, A + K$ or $A + 10$ order or the suits ($\clubsuit, \spadesuit, \heartsuit, \diamondsuit$) does not matter. For example pair of $Q\clubsuit$ and $A\spadesuit$ is *BLACK JACK*. What is the probability that the random selection of two cards from the deck form *BLACK JACK* if these cards: $2\spadesuit, 4\clubsuit, 4\spadesuit, 6\spadesuit, 9\clubsuit, 10\clubsuit, K\spadesuit$, have been removed from the deck before selecting?

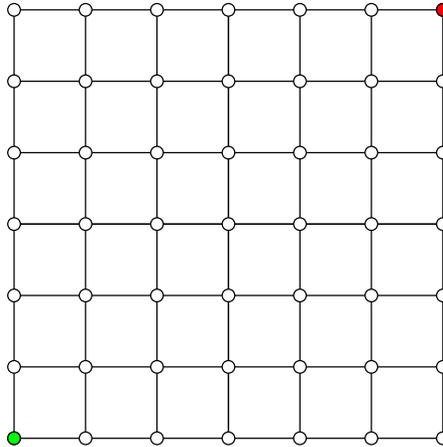


(3 b)

Graph Theory

- 1.3. Assume that you are playing the game with these rules. You play the game in the given maze (pic. 2). You start at the green spot. In the k -th round ($-st, -nd$) you have to make k moves, where move means going from one vertex to its neighbour. What is the first possible round, that allows you to finishing the round by moving to the red spot?

(2 b)



Obrázek 2: The maze.

- 1.4. *Atlanta, Boston, Chicago, Detroit* and *El Paso* are cities in USA. Assume there is a single road between each possible pair of cities. No other roads will be considered. The supply of alcohol doses is provided by two gangs at the hard time of the prohibition. Unfortunately, there is such hatred between those gangs that anytime they meet they try to kill each other. Therefore, every gang has own road network connecting all 5 cities, without a single common road with the other gang. What is the smallest number of police patrols we must deploy on the roads (one patrol covers one road) to make absolutely sure we catch at least one gang? Explain carefully why less is not enough.

(3 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. 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 petr.kovar@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 8.12.2014 at 23:59**.