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Practising and reinforcing skills using puzzles

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Abstract

At faculties preparing students in the area of computer science subjects dealing with graph theory and algorithms belong to essential parts. Students studying this field of study are also expected to have good English language skills. Engagement of students in the learning process and carefully prepared study materials seem to be crucial elements of a successful teaching/learning process. If students deal with a task in an interesting and enjoyable way, they can recall the explained subject matter much more easily and, even more, their engagement is supported and keeps progressing. To get students engaged in the subjects dealing with graph theory and algorithms a particular problem with a real life example or a puzzle is introduced as a prototype of the explained concept or algorithm and a suitable graph-representation of a problem is discussed. Practising and reinforcing language skills play a very important role in foreign language education. With regard to the fact that our students of computer science specialization study both graph theory and algorithms together with English language, we innovated study materials testing their skills in both subjects combining graph theory tasks with English language tasks. Some examples using puzzles will be introduced in the paper. The aim of the paper is to introduce our approach to other pedagogues as a good inspiration for their teaching.

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1. Introduction

Engagement of students in the learning process seems to be a crucial element of a successful teaching/learning process. Practising and reinforcing gained knowledge and skills belong to the most essential and important parts in education. Carefully prepared study materials play a very important role in the teaching/learning process.

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In the paper we devote attention to students studying at faculties specialized in computer science where subjects dealing with the graph theory and algorithms belong to essential parts of their study program, as well as good English language skills are expected and required. We show and discuss a possible approach how to get students engaged in the learning process. Even more, we introduce and present examples of study materials for students´ self-study which combine and include both areas mentioned above.

2. Graph theory and combinatorial optimization

The main aim of the subjects dealing with the graph theory and combinatorial optimization is to develop and deepen students' capacity for logical and algorithmic thinking. After learning basic graph concepts students are usually introduced to more complex algorithms with, at first a polynomial time complexity. At this point we must not forget to mention that although there are usually more methods which can be used to solve the same graph-problem, by using effective modifications of one algorithm other methods of solving various other tasks can be devised. Well-prepared students should be able to describe various practical situations with the aid of graphs, solve the given problem expressed by the graph, and translate the solution back into the initial situation, cf. Milkova (2014).

To get students engaged in the subject, it is advisable to introduce first a particular problem with a real life example or a puzzle as a prototype of the explained concept or algorithm, and then to discuss a suitable graph-representation of a problem. (Remark: Various puzzles can be found on the Internet, in recreation mathematics books and journals, e.g. Loyd (1959), Vejmola (1986). In the area of graph theory the history can also serves as a good source of practical examples and puzzles. There is a very valuable book written by Biggs, Lloyd & Wilson (1976). The most important problems from 1736 until 1936 are introduced there.) Students are provided more complex tasks aimed to repeating the subject matter for their self-study. Solutions to the tasks are introduced later in lessons.

Let us illustrate such a task on the following puzzle chosen from the Czech semi-monthly magazine Křižovka a Hadanka (Crossword puzzle and Riddle in English).

2.1. Example 1:

Try to place the names of towns Atlanta, Berlin, Caracas, Dallas, Lima, London, Metz, Nairobi, New York, Paris, Quito, Riga, Rome, Oslo, Tokyo into the frames of the given map (Fig. 1) so that no town shares any letter in its name with any towns in adjacent frames (neither horizontal nor vertical).

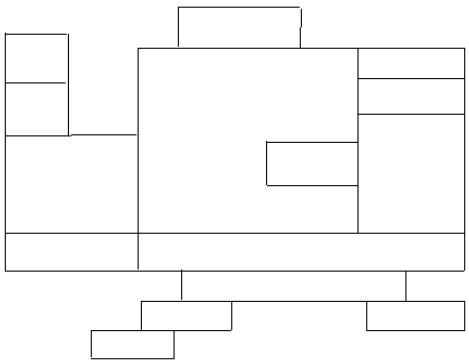

Fig. 1 – Given map

Remark: Readers interested in the result can find the whole process of solution in appendix A.

Considering this puzzle statement we can modify it and apply it not only in lessons dealing with the appropriate part of the graph theory, but also in English lessons: instead of towns we can use English words and students fill the words in the frames according to the rule, e.g.: insert the words in the frames so that verbs and nouns do not