

Discrete Mathematics Projects (Spring 2007)

March 5, 2007

1 General Guidelines

Choose one project and submit an outline (one per group) of your project report by March 23, 2007. You can work in groups of up to 2 students except on the programming project, which should be done individually.

- Your outline should be at most one page long and should contain the name of your other group member if applicable.
- Your outline should be a summary with brief descriptions of what you are planning to do on your project. It should not be reduced a simple list of the topics you plan to cover.
- If applicable, your outline should clearly show your choices among those specified in the project you are planning to do. Refer to the individual projects for further details.

The final report must be well presented and typed. It should also include appropriate references. The general expectations for the outcome of the final report on a given topic are:

- To understand the historical context and the development of the topic.
- To understand the mathematical and practical relevance of the topic.
- To outline the basic principles of the topic.
- To understand a special view of the topic (if applicable).

Your project will be evaluated as follows.

- Outline (Due by March 23, 2007): 10%
- Final Report (Due by May 4, 2007): 75%
- Oral Presentation and Attendance (Done during last two weeks of class): 15%

2 Projects

2.1 Project 1: Traveling Salesperson Trip (Cycles and Circuits)

A salesperson who wants to expand his business to other locations. He decides to visit 30 international cities (starting from a specific city) as a feasibility study for his future business. He does not mind visiting a city more than once but he does not want to travel between two given cities more than once. You are the travel agent for the salesperson and your goals are as follows:

1. Select the 30 cities for the salesperson to visit.
2. Do an on-line search and find at least 40 different routes connecting (corresponding to edges) the 30 cities to be visited by the salesperson.
3. Find the prices of those routes. The prices must be “real” and you should attach to your report printouts of the web pages confirming at least 10 of the prices you are claiming.
4. Outline to the salesperson a potential schedule of a for his trip with a small enough total cost.

Example of things to do in your outline:

- Specify at least 20 of the 30 cities (including the starting city) that you are considering for this project.
- Outline how you are planning to complete the project.

Note: If you are two doing this project, you need at least 50 different routes instead of 40.

2.2 Project 2: Assignment Problem (Matchings)

Define an *assignment problem* of your choice and use graph coloring to model and analyze it. One such example is the problem of assigning dormitory rooms to the maximum number of incoming ISU freshmen; given that each of them can postulate for 5 dormitory rooms.

Example of things to do in your outline:

- Define the actual assignment problem you will be working on.
- Discuss your approach for analyzing the problem.

2.3 Project 3: Scheduling Problem (Coloring)

Define a *scheduling problem* of your choice and use graph coloring to model and analyze it. One such example is the problem of scheduling final exams (at ISU for instance) using the least number of exam periods.

Example of things to do in your outline:

- Define the actual scheduling problem you will be working on.
- Discuss your approach for analyzing the problem.

2.4 Project 4: Computer Program Implementation

Using a computer language of your choice, write a computer program to implement the Maximum-size Matching Algorithm for bipartite graphs or the Nearest-neighbor Heuristic for the Traveling Salesperson Problem.

Example of things to do in your outline:

- Specify the Algorithm you are planning to implement, the programming language you are planning to use, and a basic design for your program.
- Outline how you are planning to complete the project (e.g. what data structures will you use to implement a graph).

2.5 Project 5: Your own project

Choose a project involving Graph Theory that you would like to do. Construction of Phylogenetic Trees (application to Biology), Counting Isomers (application to chemistry), etc. To minimize problems that could result from the selection of over ambitious or unsuitable topics, you will need to have your project approved by me in advance.

Example of things to do in your outline:

- Define the actual problem you plan to work on.
- Discuss your approach for solving the problem.