

ECE 332:202, Discrete Mathematics
Computer Project 2
Spring 2007
Due Date: April 26, 2007

In this assignment, you and your team are to implement a program that will find the shortest path (according to several different metrics, such as distance or ‘danger’) in a graph.

The Story: The young Scarlet lives in the Kingdom of Rutgers (a magical place filled with handsome knights, evil professors, an old Queen, and several large cities with exciting night life). A map of the Kingdom can be found on the course website.

Scarlet lives in a little Hamlet in the southern region of the kingdom. As an independent young woman, Scarlet wants to escape from her sleepy town and explore the rest of the kingdom.

In this project, you are to help Scarlet find her way through the kingdom using the information provided in the map. In particular, the kingdom has several roads that go between different towns and locations. These roads are labeled Rt. 1 through Rt. 21. Some of these roads are longer than others. Some of them are less treacherous than others (in an kingdom populated with evil professors, there is a distinct probability that a traveler will be subjected to an “exam” while traveling that road). Some roads may be more expensive than others as the Old Queen likes to tax the citizens that use her fancier roads. A list of the roads and their properties is provided at the end of the assignment.

Using the map and data provided, you are to implement a program that will help Scarlet find the best way to achieve several objectives:

1. Scarlet met Bob the Knight at a recent sporting event (involving an orange leather ball). She was enamored with the elder knight’s handsome squire (Squire Bill) and has arranged a clandestine meeting with the squire at Bob’s Castle. Find the shortest path (in distance) from her Hamlet to Bob’s Castle.
2. Unfortunately, the shortest path takes Scarlet through the territory of the Professor’s Tower. An evil wizard lives in the tower and threatens trespassers with painful discrete mathematics exams. The “danger” for this path is therefore very high (as measured by the high probability of being given an exam on these roads). Instead, find a path to Bob’s Castle that involves the least danger.
3. Squire Bill decides to take Scarlet to NYC for an evening of opera. Bill is, unfortunately, cheap and can’t afford to spend more than 10 dollars on tolls. Develop a scheme that allows Bill to get to NYC as cheaply as possible while traveling as little distance as possible.
4. After a horrible evening in NYC, where Scarlet discovered that her date was a cheapskate and that she preferred sports events (like the leveling of the rivals of Cardinal City), Scarlet decides to visit her Grandmother for encouragement and to deliver a basket of baked goods. If she travels at a constant rate of 10 miles/hour, what should her path be in order to minimize the time it takes her to get from NYC to Grandma’s House?
5. Her Grandmother advises Scarlet to escape from the cruelty of a patriarchal society and recommends that Scarlet join the kingdom’s nunnery (“Get thyself to a nunnery!” her grandmother insisted). If Scarlet wants to visit every location in the kingdom one last time before committing herself to the nunnery (even the evil Professor but not the Big Hole), how should she do this so that she travels the least distance possible? (Note: She may or may not have to visit the same place twice. Also, there may be many different solutions possible.)

The details of the project are as follows:

- **Team:** Your team may consist of no more than 3 students. Please be advised that it is up to you to make certain that all team members contribute– I will not make teams or resolve team ‘disputes’.
- **What you turn in:** You are to turn in a well-written report describing the details behind your project. Specifically, your report should include a description of your methodology, how you tested to make certain your code worked, any challenges you faced in the project, and how you overcame these challenges (perhaps some example code will help explain things). Please make certain to spend sufficient time to writing the report. A large part of your grade is based on the appearance of a well-done project (i.e. perfect code with a very poorly written report is bad). Lastly, please attach a printout of your code.
- **The scoring of the task:** Each of the objectives above is worth three points (out of a possible 30 points). The remaining 15 points will be split, with 5 points devoted to the technical soundness and merit of your approach, 5 points devoted to the clarity of your writeup (make certain to explain your algorithms, what you had to do, etc.), and 5 points devoted to whatever the evil professor feels like doing.

- **Final Comments:** Please be aware that you are not to copy another group's code. You may discuss with other groups for general assistance but keep this discussion to reasonable levels. Additionally, be aware of 'leaving your code on the lab computer.' If you find another group's code left on a computer, just ignore it! Dean Bernath and I have had to expel students who stole another group's code this way.

The details for the kingdom's roads is provided in the table below:

Road	Distance (miles)	Danger (probability of an exam)	Tolls (dollars)
Rt. 1	50	0.05	0
Rt. 2	70	0.20	10
Rt. 3	25	0.10	0
Rt. 4	100	0.05	0
Rt. 5	61	0.10	10
Rt. 6	51	0.10	0
Rt. 7	41	0.05	10
Rt. 8	59	0.10	0
Rt. 9	54	0.10	10
Rt. 10	63	0.25	0
Rt. 11	35	0.01	0
Rt. 12	50	0.95	0
Rt. 13	50	0.95	0
Rt. 14	80	0.2	0
Rt. 15	35	0.10	0
Rt. 16	135	0.00	0
Rt. 17	40	0.05	0
Rt. 18	35	0.02	0
Rt. 19	15	0.05	0
Rt. 20	30	0.03	0
Rt. 21	34	0.10	0