

Teacher Guide for the MIT BLOSSOMS Lesson

Who Do You Know? The Theory behind Social Networking

Learning Objectives:

After this module students will be able to:

- 1) State the basic vocabulary of graph theory --- node, arc, graph, etc
- 2) Identify shortest path problems in several contexts
- 3) Perform a shortest path algorithm on a basic graph

Pre-Requisites:

- 1) Students should be able to think logically and perform very basic arithmetical operations.
- 2) The only tools needed for the activity are paper and pencil, colored pencils may also be helpful, but not necessary.

Activities:

- 1) The module opens with the following question: “On average, in Lebanon with a population of 4million people, how many people does each person need to know in order to ensure that every two randomly selected people share a mutual friend?”

The video should be paused at this question and students should write down their guesses on a piece of paper. The instructor may also make this like a contest to see who is the closest. This process will take **2-5minutes**.

The value of this question is that the answer is rather large, but the opening scene (and general experience in life) reveals that it is often much easier to find a connection, without knowing so many people. The key is the structure of the relationships --- this structure may be modeled using graphs and studied using tools from graph theory.

- 2) The second activity is the largest activity of the module. The activity simulates a party in which party-goers (the students) know only a subset of the people at the party. However, there is one person, whom they do not already know, that they wish to meet. They cannot simply introduce themselves to this person --- they need an introduction from somebody that person knows.

Underlying the set of people each student knows and the person each student would like to meet is a graph. A set of graphs for different class sizes (10, 15, and 20 students) have been prepared to facilitate this exercise. These graphs are included in Excel files where the instructor need only to insert the student roster into a column. The list of students that each student “knows” and the student that each student must “meet” will appear automatically. Also included in this file is a graphical depiction of the graph (this should not be revealed to the students at this point!).

In order to administer this activity, each student should be given a slip of paper with the list of students s/he “knows” and the students “target” person --- this slip may simply be cut from a print out of the excel sheet. Note, if the class is larger than 20 students, it should be divided into smaller groups of 10 or 15. The students should then be allowed **15-20 minutes** to seek introductions from those that they know. With each introduction they receive, they may be introduced to more people, until they reach their goal. As they receive introductions, they should write these down. The goal is to meet their target as quickly (with as few introductions) as possible.

The value of this activity is that the students experience the feeling of moving through a graph --- following edges and pausing at nodes.

- 3) The third activity requires the students to draw the graph that they experienced when seeking introductions. There are several ways that this could be administered, here are a few suggestions:
 - a. The students can work individually for **5minutes**, drawing the portion of the graph that they experienced. After working individually, the class or the subgroups (if the class was partitioned) can come together to patch together the individually drawn graphs, **~10 minutes**.
 - b. The teacher can facilitate the drawing of the graph at the board with each student naming the people on the list of those they know. (**~15 minutes**).

To facilitate this activity, the teacher may consider printing a sheet with only the nodes shown and have the students fill in their names and the arcs.

The value of this exercise is that they must translate what they experienced into a graph-based model.

- 4) The fourth activity requires the students to use the graph that they constructed of the relationships in their classroom in order to determine if they actually achieved the least number of introductions possible. To facilitate this activity, the teacher should distribute printouts of the full graph structure and key to student – node assignments (as included in the Graph sheet of the Excel workbook).

This activity should be done individually and should take **~5minutes**.

NOTE: If this module must be administered over two class periods, stopping the first day after activity 3 or 4 is recommended.

- 5) The fifth activity is the activity in which the students get to practice Dijkstra’s algorithm. As the algorithm is a bit detailed, this activity might frustrate students. To minimize their frustration it is recommended that the students are provided with clean copies of the graph which represents their class or subgroup. The students should spend **~10-15 minutes** writing on the graph and working out the steps of the algorithm.

Following this activity, the students should be able to find the least number of introductions that was required for them to meet their target. To make this result a bit more interesting, prizes or recognition could be given to (a) students that

correctly applied the algorithm and found that lowest number and/or (b) students who actually achieved their lowest number during the party game of activity 2.