3134 APPLIED COMBINATORICS PROJECT

1. Assignment Description

The goal of this assignment (45 points worth 8% of total grade) is to write a method that solves one of the following questions about graphs using the programming language of your choice. Your code should be written from scratch; use of built-in functions for graph theory will not be accepted. Sample inputs for the assignment options are given below. Note that the algorithm you use need not be efficient. For example, a brute force algorithm is acceptable, where applicable.

2. Questions about graphs

(1) **Given** a graph G, **determine** if G is bipartite (§1.2).
(2) **Given** a graph G, **find** an Euler cycle, if present (§2.1).
(3) **Given** a tree G, **find** the number of leaves of G (§3.1).
(4) **Given** a graph G, **find** a spanning tree of the graph (depth-first vs. breadth-first? §3.2).
(5) **Given** a graph G, **determine** if G is connected (by finding spanning tree? §3.2).
(6) Topic of your choice? Run it by me before 7/24/14.

3. Result

You will need to turn in an electronic copy of your code (10 points) and a printout of the results of your code (35 points) when run on the following sample inputs. Your code may be submitted through Scholar, email, Dropbox, or Google Drive.

4. Sample Results

Please run your code on the following graphs and include the result in a printout. Each graph is given in the form $\{V(G), E(G)\}$. For example, the second graph has three vertices (labeled 1, 2, and 3) with two edges (one between 1 and 2, and one between 2 and 3). You are welcome to change input formatting (e.g. you might prefer '[' instead of '{'). Each successful result will be worth 5 points. **NOTE**: If you have chosen problem 3 you need only address inputs a, b, c, and f, each for 8.75 points. Figures of the graphs are at the end of this document.

- a. **input:** $\{\{1\},\{\}\}$
- b. **input:** $\{\{1,2,3\},\{\{1,2\},\{2,3\}\}\}$

- c. **input:** $\{\{R,S,T,U,V,W\},\{\{R,S\},\{S,T\},\{S,V\},\{S,W\},\{U,V\}\}\}$
- d. **input:** $\{\{A,B,C,D,E,F,G,H,I\},$
  $\{\{A,E\},\{B,C\},\{B,D\},\{C,E\},\{D,F\},\{E,G\},\{E,H\},\{F,G\},\{G,I\},\{H,I\}\}\}$
- e. **input:** $\{\{A,B,C,D,E,F,G,H,I\},\{\{A,C\},\{A,E\},\{B,C\},\{B,D\},$
  $\{C,E\},\{C,G\},\{D,F\},\{E,G\},\{E,H\},\{F,G\},\{G,I\},\{H,I\}\}\}$
- f. **input:** $\{\{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16\},\{\{1,2\},\{2,3\},\{2,4\},$
  $\{2,5\},\{3,6\},\{4,7\},\{4,8\},\{5,9\},\{7,10\},\{7,11\},\{7,12\},\{9,13\},\{13,14\},\{13,15\},\{13,16\}\}\}$
- g. **input:** $\{\{A,B,C,D,E,F,G,H,I,J,K,L,M,N\},\{\{A,B\},\{B,L\},\{C,G\},\{C,M\},\{D,E\},$
  $\{D,G\},\{D,M\},\{E,F\},\{E,G\},\{E,N\},\{F,G\},\{F,N\},\{I,J\},\{J,K\},\{K,L\},\{M,N\}\}\}$

5. Figures

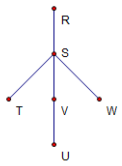

Figure 5.1. Graph c.

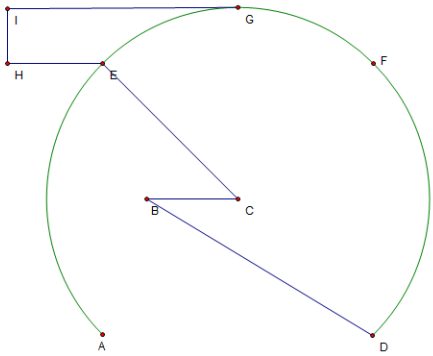

Figure 5.2. Graph d.

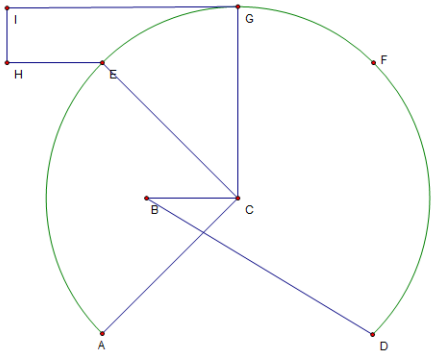

FIGURE 5.3. Graph e.

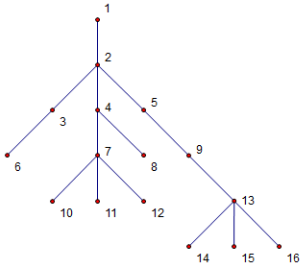

FIGURE 5.4. Graph f.

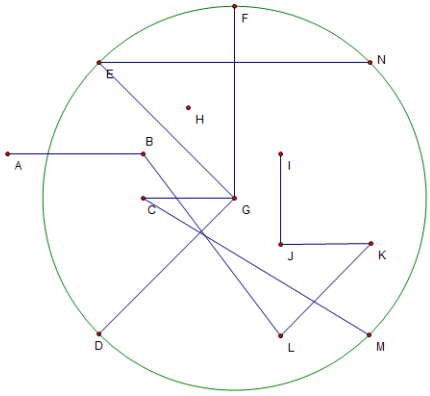

FIGURE 5.5. Graph f.