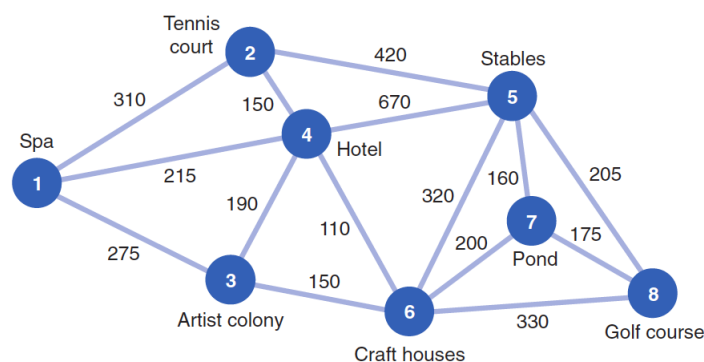


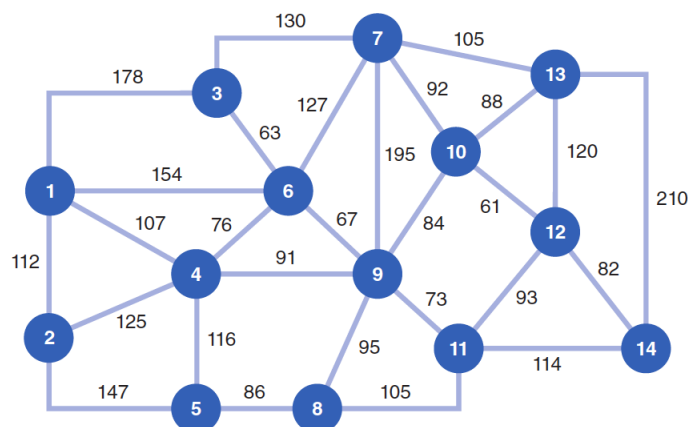
## Assignment #8 – due Friday, March 20th, 2020

1. A major hotel chain is constructing a new resort hotel complex in Greenbranch Springs, West Virginia. The resort is in a heavily wooded area, and the developers want to preserve as much of the natural beauty as possible. To do so, the developers want to connect all the various facilities in the complex with a combination walking/riding path that will minimize the amount of pathway that will have to be cut through the woods. The following network shows possible connecting paths and corresponding distances (in yards) between the facilities:



Determine the path that will connect all the facilities with the minimum amount of construction and indicate the total length of the pathway.

2. State University has decided to reconstruct the sidewalks throughout the east side of its campus to provide wheelchair access. However, upgrading sidewalks is a very expensive undertaking, so for the first phase of this project, university administrators want to make sure they connect all buildings with wheelchair access with the minimum number of refurbished sidewalks possible. Following is a network of the existing sidewalks on the east side of campus, with the feet between each building shown on the branches:



Determine a minimal spanning tree network that will connect all the buildings on campus with wheelchair access sidewalks and indicate the number of feet of sidewalk.

3. A manufacturing company produces products 1, 2, and 3. The three products have the following resource requirements and produce the following profit:

Product	Labor (hr./unit)	Material (lb./unit)	Profit (\$/unit)
1	5	4	\$3
2	2	6	5
3	4	3	2

At present, the firm has a daily labor capacity of 240 available hours and a daily supply of 400 pounds of material. The general linear programming formulation for this problem is as follows:

$$\begin{aligned}
 &\text{maximize} && 3x_1 + 5x_2 + 2x_3 \\
 &\text{subject to} && 5x_1 + 2x_2 + 4x_3 \leq 240 \\
 &&& 4x_1 + 6x_2 + 3x_3 \leq 400 \\
 &&& x_1, x_2, x_3 \geq 0
 \end{aligned}$$

Management has developed the following set of goals, arranged in order of their importance to the firm:

- (1) Because of recent labor relations difficulties, management wants to avoid underutilization of normal production capacity.
- (2) Management has established a satisfactory profit level of \$500 per day.
- (3) Overtime is to be minimized as much as possible.
- (4) Management wants to minimize the purchase of additional materials to avoid handling and storage problems.

Formulate a goal programming model to determine the number of each product to produce to best satisfy the goals.

4. A rural clinic hires its staff from nearby cities and towns on a part-time basis. The clinic attempts to have a general practitioner (GP), a nurse, and an internist on duty during at least a portion of each week. The clinic has a weekly budget of \$1,200. A GP charges the clinic \$40 per hour, a nurse charges \$20 per hour, and an internist charges \$150 per hour. The clinic has established the following goals, in order of priority:

- (1) A nurse should be available at least 30 hours per week.
  - (2) The weekly budget of \$1,200 should not be exceeded.
  - (3) A GP or an internist should be available at least 20 hours per week.
  - (4) An internist should be available at least 6 hours per week.
- (a) Formulate a goal programming model to determine the number of hours to hire each staff member to satisfy the various goals.

(b) Solve the model by using the computer.

5. Infocomp Systems Lab is a research and development (R&D) company that develops computer systems and software primarily for the medical industry. The lab has proposals from its own researchers for eight new projects. Each of the proposed research projects requires limited resources, and it is not possible to undertake all of them. The following table shows the developmental budget, the number of researchers, and the expected annual sales from each project if successfully developed and implemented:

<b>Project</b>	<b>Developmental Budget (\$1,000,000s)</b>	<b>Number of Research Personnel</b>	<b>Expected Annual Sales (\$1,000,000s)</b>
1	\$0.675	6	\$0.82
2	1.050	5	1.75
3	0.725	7	1.60
4	0.430	8	1.90
5	1.240	10	0.93
6	0.890	6	1.70
7	1.620	7	1.30
8	1.200	6	1.80

The lab has developed the following set of prioritized goals for selecting which projects to initiate:

- (1) The company would like to remain within a total developmental budget of \$5,000,000.
  - (2) The number of available research personnel is 27, and Infocomp would like to avoid obtaining extra researchers.
  - (3) The company would like the expected future annual sales from the implemented projects to be at least \$6,500,000.
  - (4) Projects 1, 3, 4, and 6 are considered offensive in that they represent new product initiatives, while projects 2, 5, 7, and 8 are existing product upgrades and thus defensive in nature. The lab would like to select at least two projects from each group.
  - (5) Projects 2, 3, 5, 6, and 7 are considered the most risky of the projects, and the company would prefer not to select any more than three of these projects.
  - (6) The labs owner has indicated that she would like to see projects 5 and 6 initiated if doing so would not interfere with the achievement of any of the more important goals determined by the labs top management.
- (a) Formulate a goal programming model to determine which projects Infocomp Systems Lab should select to best achieve its goals.
  - (b) Solve this model by using the computer. (Note that the solution requires 0-1 integer values for the variables in the model.)