Modeling Situations in Urban Mathematics

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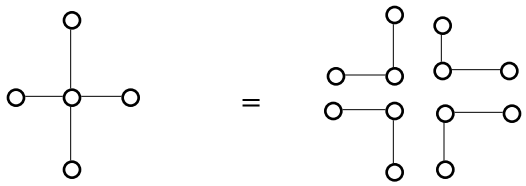
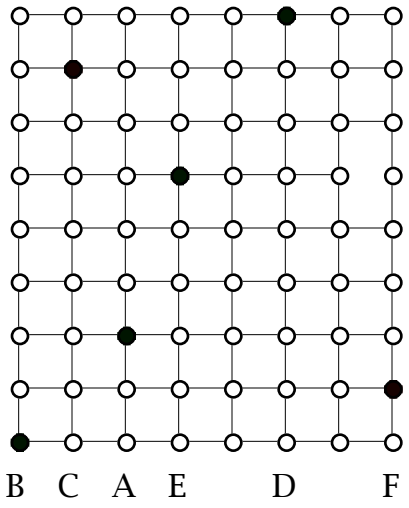


In the graph below, dots with 4 edges are designed to represent street corners as suggested by the schematic diagram above.



The names associated with the black dots in the grid are shown at the bottom of the grid.

Let us consider several situations, all of which will use as "input data" the diagram above. List any assumptions beyond the information you are given that you feel are necessary to "solve" the problems (questions) that are posed.

a. Solve the problem which emerges from the situation given.

b. For the situation described list as many examples of "real world situations" as you can which seem to you to be similar to (have the same "flavor as") the situation you have been working on. For each example you list, what about the situation seems similar and what seems different from the problem you solved?

c. Make up a new problem based on the diagram and information implicit in the diagram given at the start. Perhaps you may want to ask that more information be added to the diagram to make up your problem. For example, you might want to know if there are traffic lights at any of the corners, or in what directions the automobile traffic can move on the streets shown.

Situation 1:

A contractor located at B has been hired to check the streets in the urban area shown above for pot holes. All the street segments shown will take the same time to traverse. The contractor wishes to traverse (walk) each segment of street at least once and return to B, following a route which will minimize the total amount of time for the inspection. What is this minimum amount of time?

(As part of your solution, explain why it is not possible to traverse each section of street once and only once on a tour that starts and ends at B.)

Situation 2:

You live at A and must run errands by foot that take you to the sites B, C, D, E, and F in any order you might want, and then return to A. What route makes the most sense? How far do you have to walk to achieve your "best" result? Are there different routes that are "best," and if so how many are there?

Situation 3:

A company must lay cable to connect up the sites A, ..., F so that messages can be sent between any pair of sites by relay if necessary. Thus, if cable is laid from A to B and B to C, cable does not have to be laid between A and C because one can relay a signal from A to C via B. If the cost of laying cable is proportional to the "distance" between two sites, what site pairs should be joined to minimize the cost of providing the cable service among the sites?

Situation 4:

Students live at sites A, ..., F. A teacher wishes to group the students in pairs for the purposes of working on projects. If X and Y are paired it is assumed that X will walk to Y's house or the other way around to work together. What pairing will minimize the "average" distance that must be walked to have the students work together?

Situation 5:

There are apartment blocks (or single family homes) at A,...,F. What would be an optimal location for a mobile medical facility which would:

a. Minimize the maximum distance that it would take to reach the mobile facility.

b. Minimize the total distance from all of the locations (A-F) to reach the mobile medical facility.