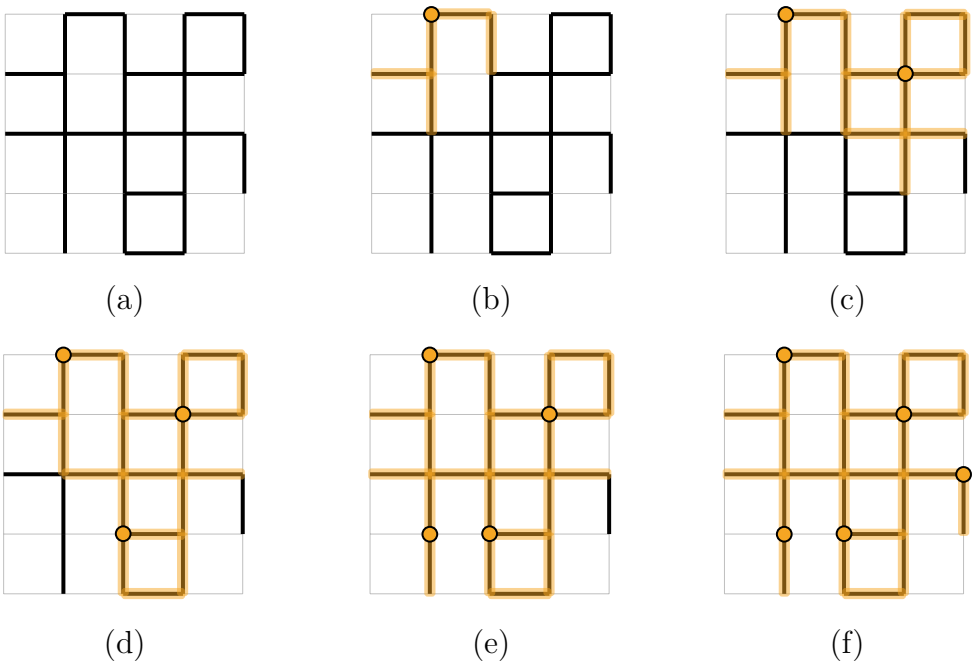
Elektra Bikes
A Hands-On Game about Optimization

Elektra Bikes Inc. wants to install electric bike stations around the city for their ad to claim *"Wherever you are, a bike is never too far!"* This means you are never more than two street segments, that is, the length of two blocks, away from a bike station. Stations can be installed on any city corner. On the map in figure (a), each square is a city block and street segments are the thick black lines. When you install a bike station on a corner, shown as the orange circle in (b), it takes care of (i.e. covers) all street segments within two block lengths of that corner, shown as the orange shading. By installing more stations as in figures (c), (d), (e), and (f), eventually all street segments will be covered. To minimize cost, what is the fewest number of bike stations needed, and where to place them, in order to cover all street segments?



(a) (b) (c)

(d) (e) (f)

In the example above, 5 bike stations were used to cover all streets. Is it possible to use fewer than 5? If so, how? If not, is this the only placement of 5 stations that covers the entire city area?

The next page has a larger city map (green areas are public parks). Cut out the orange circles with a pair of scissors and place them on street corners to cover all the streets (thick black lines) with the fewest possible number of bike stations. What if the ad wanted to claim one is never farther than 3 street segments from a bike station, rather than 2? How would you change your solution? When you are finished playing with that map, draw you own maps to keep playing, or use a portion of your hometown's downtown area map.

Additional Questions for Discussion:

How do you know for sure that your solution is the best possible?
What assumptions or simplifications from a real-life situation were made while solving this problem?

Variations of the game: note that there is some overlap in coverage because some street segments are close enough to more than one bike station. This is a desirable property because certain street segments have heavier pedestrian traffic. Choose a few street segments to be "busy" and require them to have either double or triple coverage. Then try to solve the problem again. What changes in your solution?

This game is about covering an area with "facilities." Another example would be a surveillance context in which you want to install cameras to monitor a region. Can you think of other examples of this sort?

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