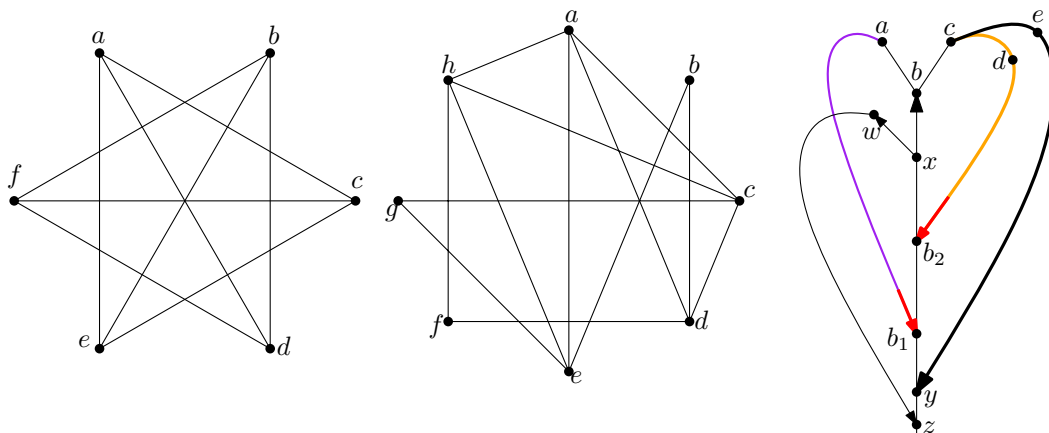


Reading:

- How to Draw a Planar Graph on a Grid, de Fraysseix, Pach, and Pollack, *Combinatorica* 10 (1) 1990, p. 41–51.

You may discuss problems with other people in the class, but you must write up your own solutions. If you do discuss a problem with someone else or you use an outside resource, you must acknowledge them. Do not copy solutions from anyone. A star (★) means that the problem may be somewhat difficult.

1. Determine if the following graphs are planar or not. Find a proof of planarity or non-planarity for each of them. (The last graph should be familiar from class, though I added vertices that were implied by the original figure.)



2. Use Euler's formula to show that any planar graph with n vertices has at most $3n - 6$ edges.
3. (bonus) Use Euler's formula to show that any plane graph with f faces, n vertices, and more than $3n/2$ edges has at least $f/10$ faces with the same number of sides. (A *plane graph* is a planar graph that has a given planar embedding.)
4. What is the coordinate in the grid drawing of de Fraysseix, Pach, and Pollack of the last vertex, v_n , in the canonical ordering? Why?
5. What project are you thinking about for the course? It might be that you have several areas of interest. Look at some papers related to your interests. Write a few sentences about possible project areas.

If you don't have any ideas, come talk with me.