Graphs exercises

Agnese Barbensi

(1) (a) Generate the complete graph on 7 vertices. Visualize this graph in $2D$ and $3D$. Print the list of vertices and edges of this graph.
(b) Generate the 3-dimensional cube graph. Visualize this graph in $2D$ and $3D$. Find the shortest path (with length) between the vertices 000 and 110.
(c) Generate the 4-dimensional cube graph. Visualize this graph in $2D$ and $3D$.

- Find the shortest path (with lenght) between the vertices 0000 and 1101.
- Add an edge between 0000 and 1101, and visualize the graph again.
- Add a new vertex labelled 'new', and add edges between 'new' and the vertieces 0001, 0010, 0100, 1000. Visualize the graph again.

(2) Compute the Laplacian of the Petersen graph G.

- Compute the number of spanning trees using the appropriate function and check Kirchoff's Theorem (the number of spanning trees of a graph is $\lambda_1 \cdots \lambda_{n-1} n^{-1}$, where λ_is are the non-zero eigenvalues of the Laplacian.)
- Find the edges of a minimal spanning tree of G.

(3) Initialize the graph in Figure 0.1 in at least two different ways.

- Find all the bridges.
- Add subgraph having 3 vertices.
- Compute the number of connected components.
- Remove all the cycles and compute the number of connected components again.

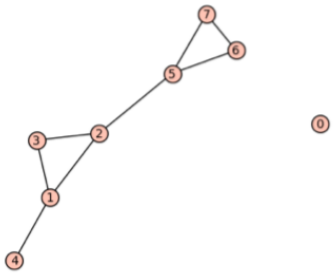

FIGURE 0.1

(4) Generate a random graph on 10 vertices, with edges probability 0.1, 0.4 and 0.8.

- Check whether they are planar.
- If non planar, check whether they contain a K5 minor.

(5) Generate a random graph on 100 vertices, with edges probability 0.02.

- Find the number of connected components.
- If connected, search for a bridge and remove it.
- Look for spanning trees in each connected component.
- In the biggest connected component, look for bridges.