

Module 14: Floorplans

An adjacency graph is a graph in which each room in a house is represented by a vertex and two vertices are connected if the rooms share at least part of a wall (see Section 4.17 of the graph theory supplement to the Notes). An access graph is a graph in which two rooms are connected by an edge if there is access from one to the other via a door or a window.

The floorplan is the dual of the adjacency or access graph.

1. This relationship is illustrated in Fig. 4.52 by a design of Frank Lloyd Wright's. *(an reproduced on the next page).*

2. On the page following, a map and its dual are illustrated in Fig. 1 of part A.

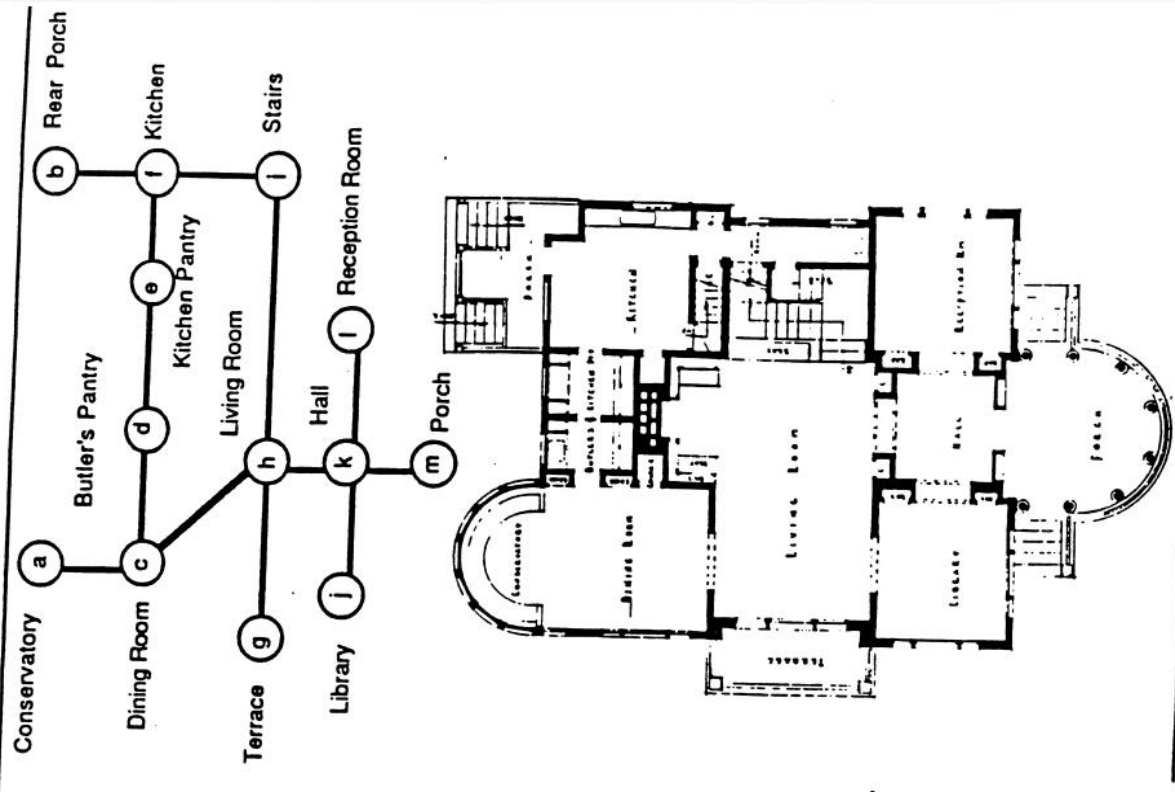
3. In B the dual is redrawn in Fig. 2 so that it looks more like a floorplan by using the idea that a vertex can be duplicated and new edges inserted between the duplicated vertices so long as no doors or windows are placed in the added edges. In this way the connectivity is not altered. For example, vertex 5 of the dual is duplicated twice in Fig. 2.

4. In C face f is interchanged with the outside face of Fig. 1. The result is shown in Fig. 3. In this figure, the dual is redrawn so that the vertices 1,2,3,4 of face f are now the vertices of the outside face and all other faces of the dual are redrawn in such a way that the connectivity of the dual map is preserved.

5. In Figure 4 of D) the interchanged dual is "squared off" so that it looks more like a floorplan. Notice how the vertices have been duplicated but the connectivity is not changed.

Problem: For the access graph in Figure 5:

- a) Draw the dual
- b) Redraw the dual so that it looks more like a floorplan (you may duplicate vertices if necessary).
- c) Interchange face "e" of the dual with face "o".
- d) Redraw the interchanged dual so that it looks more like a floorplan.



	Graph	Adjacency Graph
V	17	14
E	29	29
F	14	17

Table 2.1. The number of vertices, edges and faces in the graph and adjacency graphs of the Blossom house.

Figure 2.14. A floor plan and access graph of Frank Lloyd Wright's Blossom house.

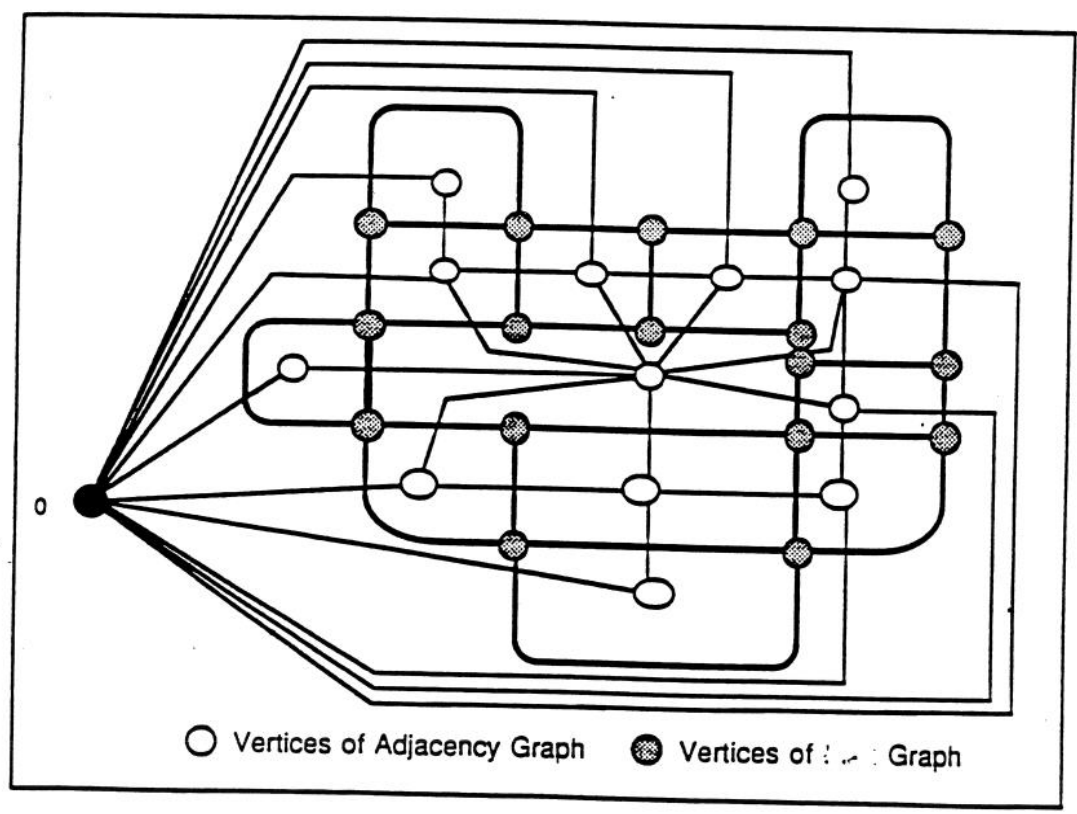


Figure 2.18. Adjacency and planar graphs of the Blossom house.

A) Map and Dual

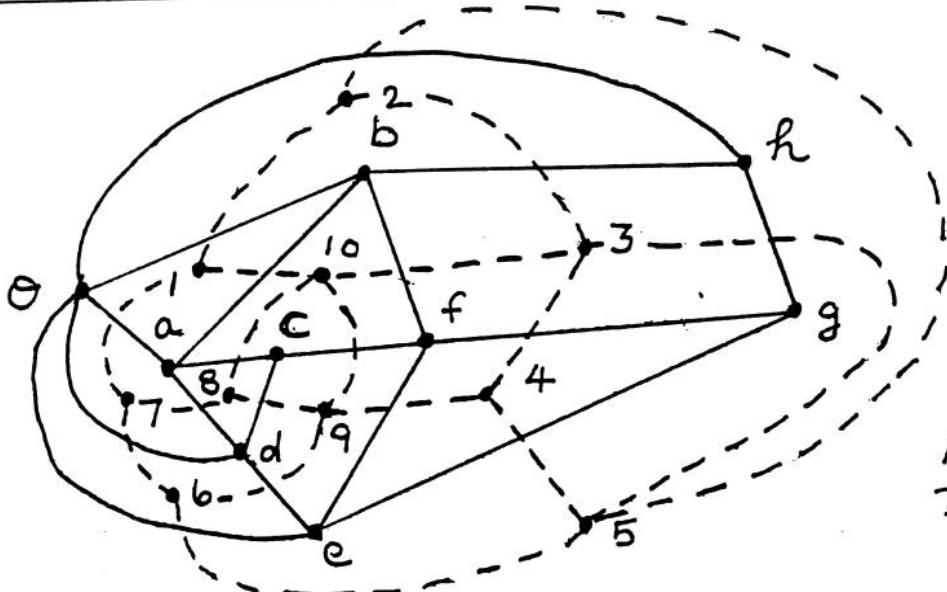


FIG. 1

Access graph ---
Dual Map —

B) DUAL Redrawn

{ Note that vertex 5 has been split. No opening to the exterior is placed between 5 and

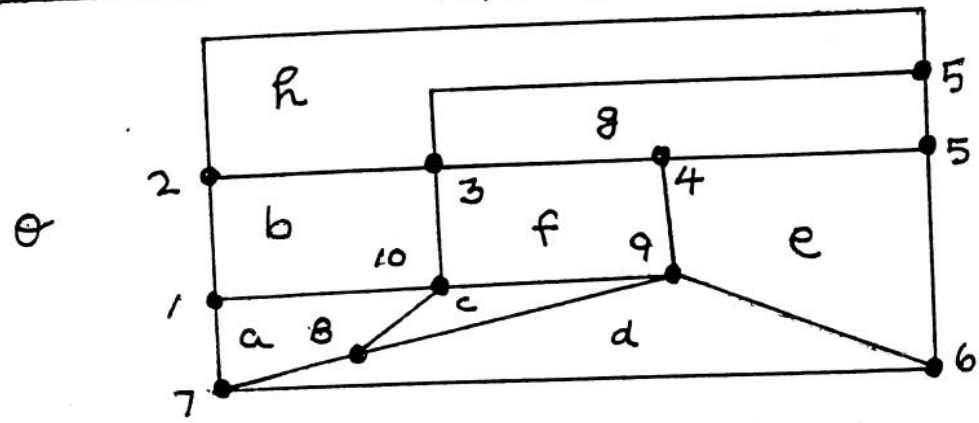


FIG. 2

C) DUAL REDRAWN SO THAT theta AND f ARE INTERCHANGED:

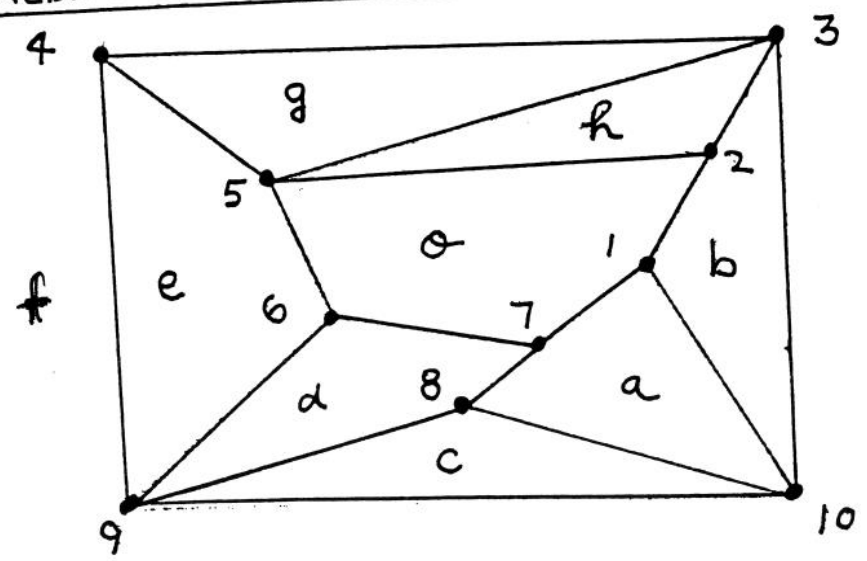


FIG. 3

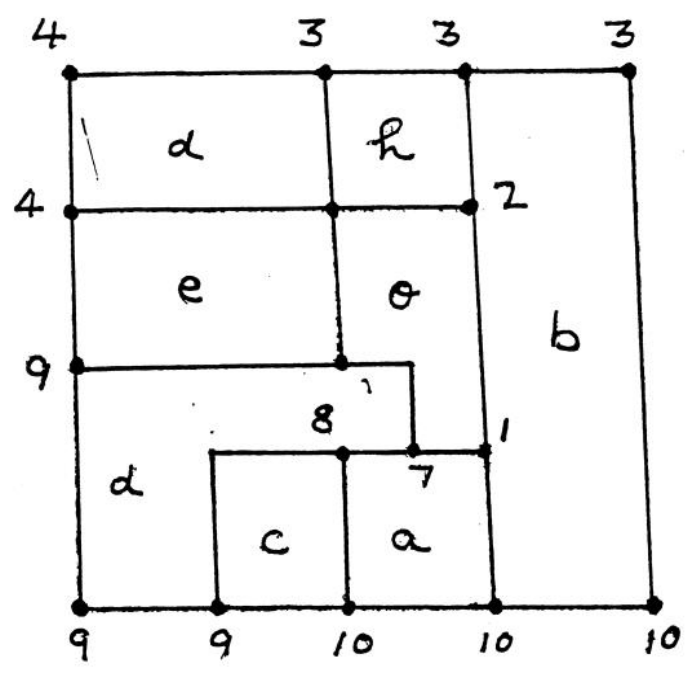


FIG. 4

THE REDRAWN DUAL IS "SQUARED OFF".

PROBLEM: FOR THE FOLLOWING ACCESSY GRAPH, DRAW THE DUAL, DUAL FLOORPLAN ("SQUARED OFF" DUAL). THEN INTERCHANGE FACE @ OF THE DUAL WITH FACE o.

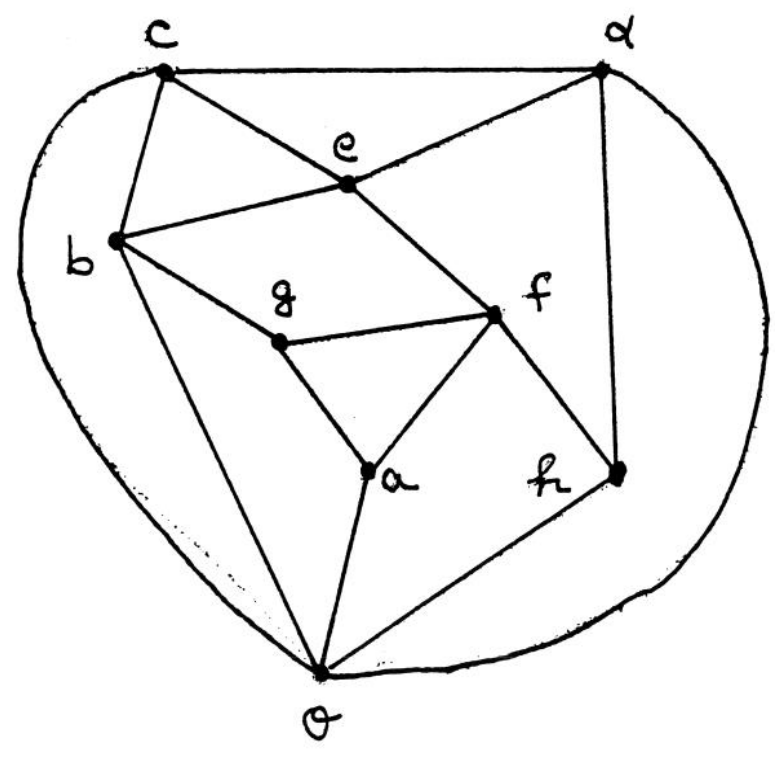


FIG. 5

W

PROJECT - FLOORPLANS

1. Define the adjacency requirements for a home, office or other building. You may select any type of building you want, but:

- There must be a minimum of 10 different areas (plus exterior).
- At least 8 of the areas must have at least 2 adjacencies.
- At least 3 of the areas must have at least 3 adjacencies.
- At least 2 of the areas must have at least 4 adjacencies.

As long as you meet these minimums you can have as many adjacencies as you want: complexity will be considered in the grading.

2. Show the adjacency matrix for the building: be sure it exactly reflects the requirements (And don't forget to include the exterior).

3. Draw the adjacency graph which has the connections specified in the matrix.

4. Redraw the adjacency graph as a planar graph.

5. Draw the dual graph.

6. Rearrange the dual graph to give a floor plan for the building. Make sure that all of the adjacencies listed in your original specifications are actually present and that there are no adjacencies not specified in the original requirements. Remember, rooms connected to the exterior have access to the outside via a window or a door.

7. Choose one area to be interchanged with the exterior. (When you do this, label the former exterior region as a new room - it doesn't have to have the same function as in (5) - and relabel the space now outside as the exterior).

8. Rearrange the graph in (7) to give a new floor plan - you can relabel the rooms and change the function of the building if you want.

9. Arrange this material in an attractive fashion with an explanation of the process; you may use large or small format, single sheet or booklet form.

10. Write an essay on your thoughts about the project. Does it give you ideas on manipulating connections? Arranging spaces? etc. The essay should be about two pages in length.

Grading will be based on mathematical accuracy (are the specifications complete and are they properly carried out?)

6
Complexity (Is the design simplistic or did it require careful manipulation to carry out?) Workmanship (Carefully drawn and labeled?) Overall impression (Does it give the viewer a feel for what is going on?) and the essay.

You may (or may not use, as you wish) the program MATGEN to prepare a listing of vertices, edges, and to establish the matrix. You can also use it to arrive at a planar map, but you should draw both the maps and the duals carefully as part of your presentation.