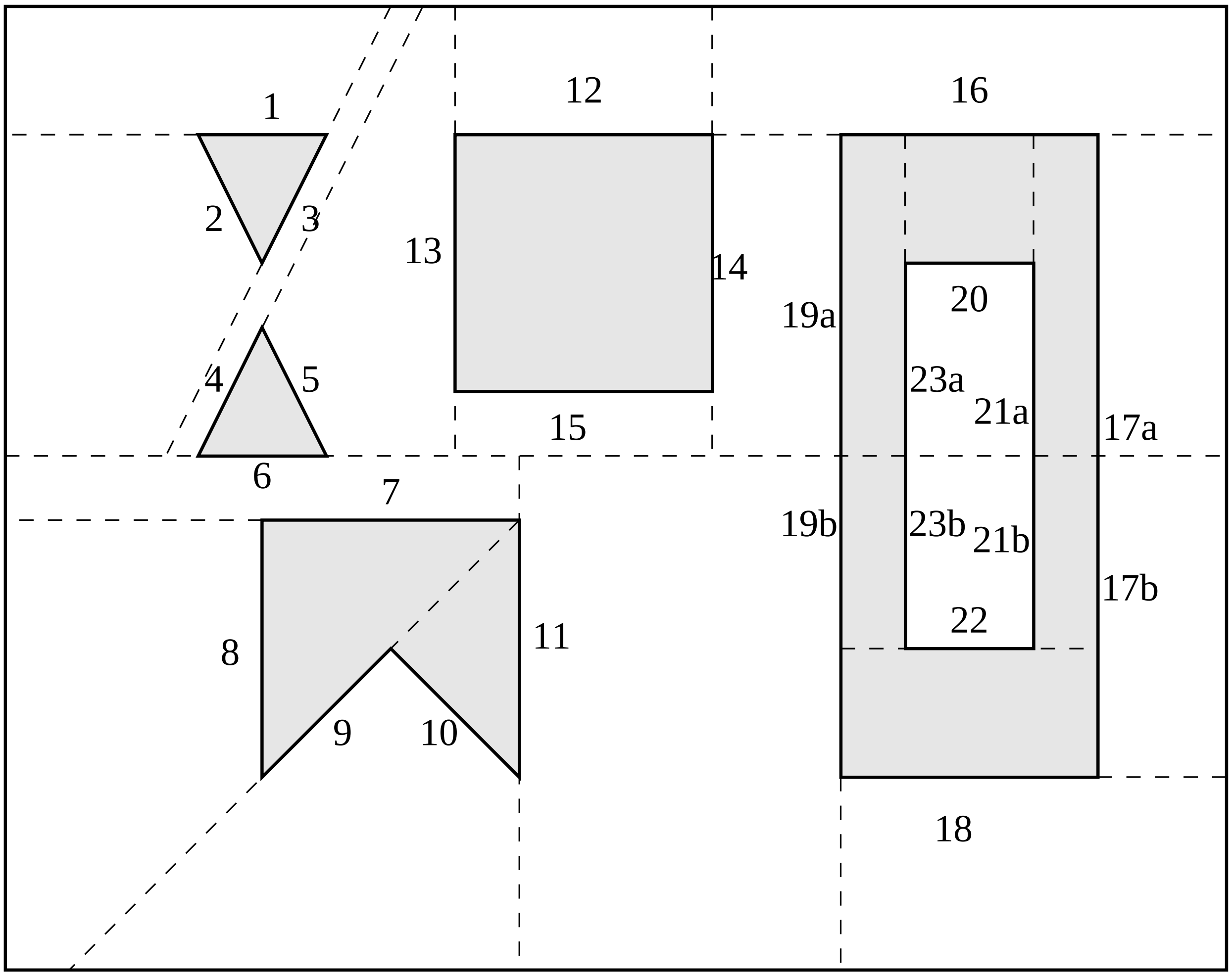
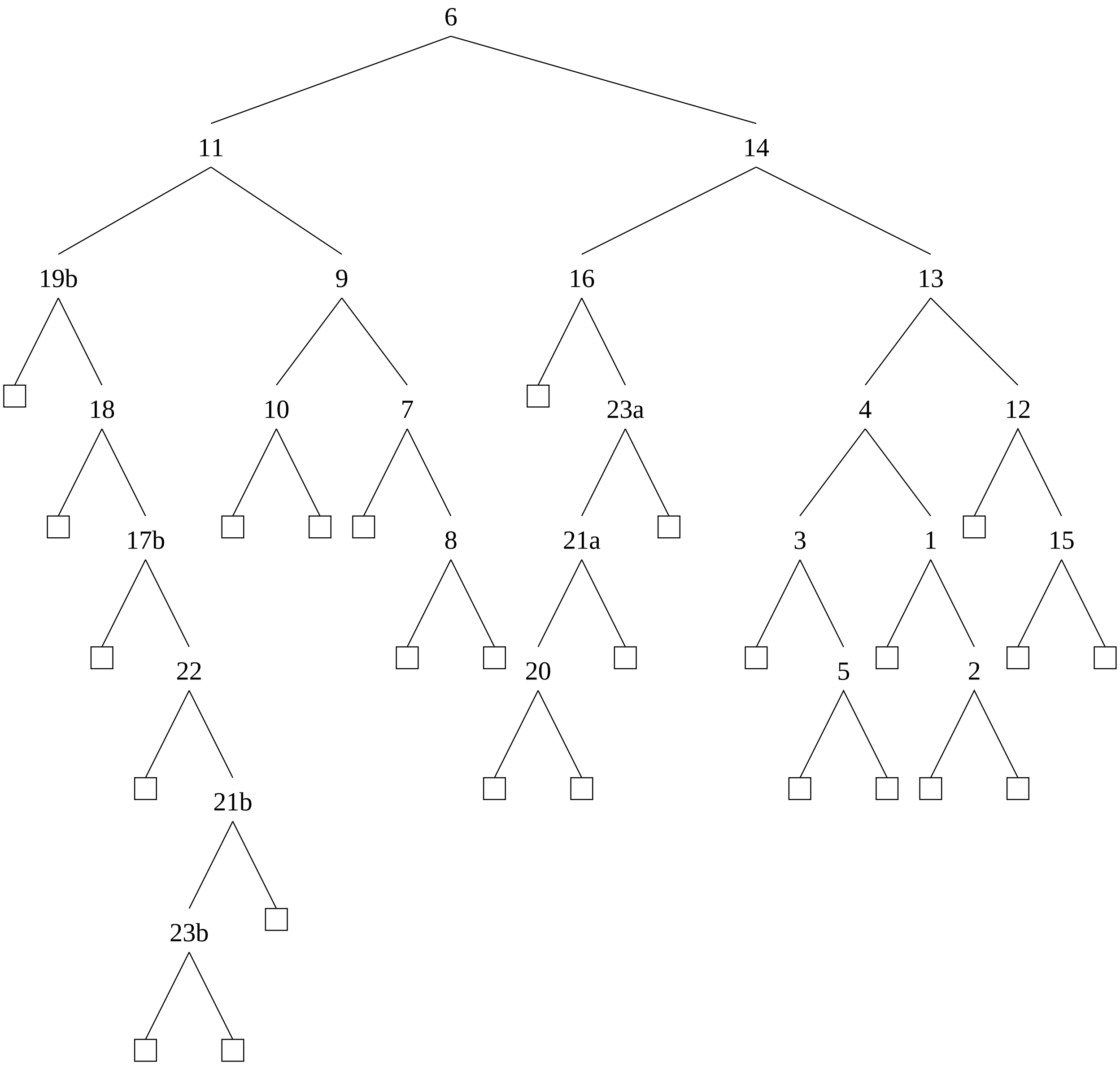
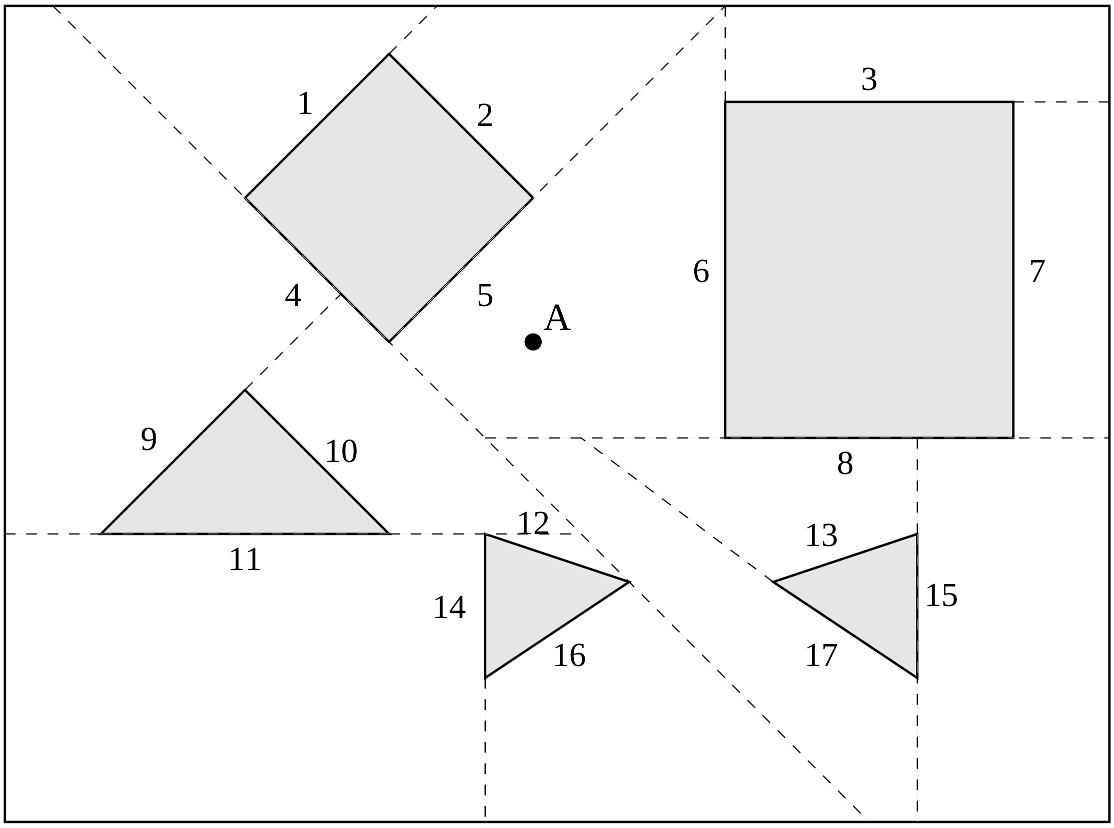
CS450/550 — Written Homework 6 — Due March 5, 1996

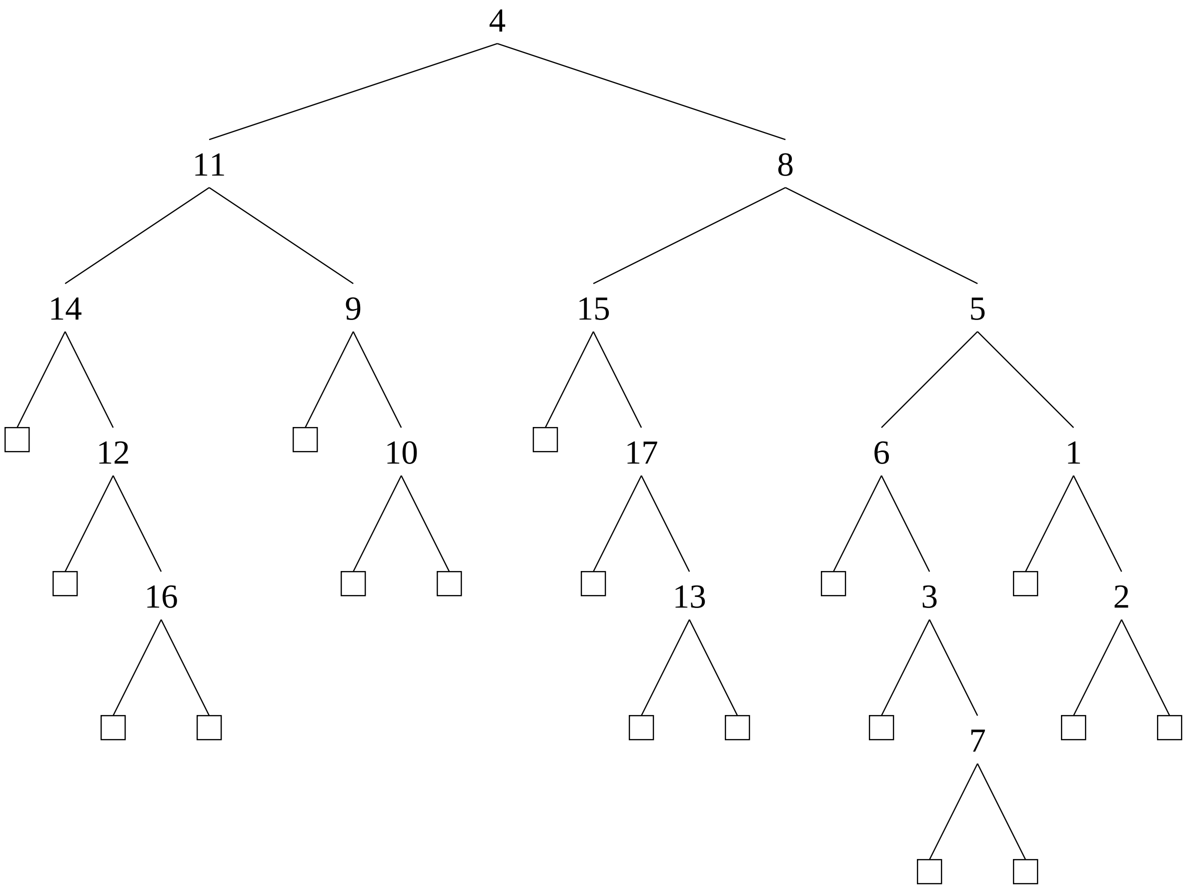
1. Construct a 2-dimensional BSP tree for the 2-d scene shown below. The root of your tree should be the line segment 6. If you split a segment into subsegments, label them on the figure as 8a, 8b, etc. Try to make your binary tree balanced while avoiding splitting too many segments into subsegments.





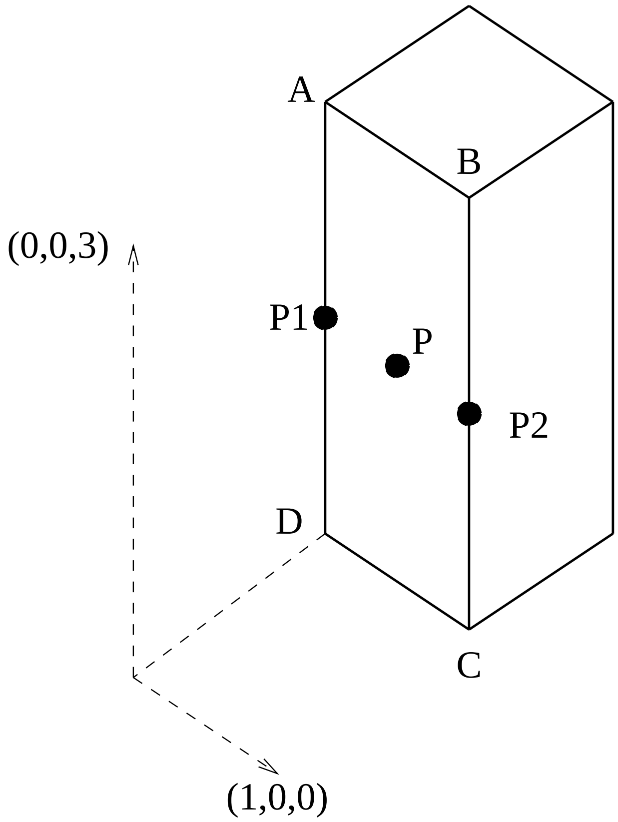
2. Consider the 2-d scene and BSP tree shown below. Suppose the camera is at point A. Fill out the following table showing the nodes in the order that they are “drawn” on the screen. Indicate for each node whether it is a front face (obviously, only the front faces would actually be drawn, but enter all faces in the table in the proper order).


1
2
3
4
5
A
6
7
8
9
10
11
12
13
14
15
16
17


4
11
8
14
9
15
5
12
10
17
6
1
16
13
3
2
7

Node number	Frontface?
14	Backface
16	Backface
12	Frontface
11	Backface
9	Backface
10	Frontface
4	Backface
15	Backface
17	Backface
13	Frontface
8	Backface
1	Backface
2	Backface
5	Frontface
3	Backface
7	Backface
6	Frontface

3. Consider the object shown below. Suppose we want to render this using Phong interpolative shading to get the effect of a cylinder.



(a) For the purposes of Phong shading the quadrilateral ABCD, what should be the vertex normals at points A, B, C, and D?

We want the vertex normals to be parallel to the XZ plane and point out at 45 degree angles.
A: $(\frac{1}{-\sqrt{2}}, 0, \frac{1}{-\sqrt{2}})$
B: $(\frac{1}{\sqrt{2}}, 0, \frac{1}{-\sqrt{2}})$
C: $(\frac{1}{\sqrt{2}}, 0, \frac{1}{-\sqrt{2}})$
D: $(\frac{1}{-\sqrt{2}}, 0, \frac{1}{-\sqrt{2}})$

(b) What would be the interpolated normals at P1 and P2 (the y coordinates of P1 and P2 are 1.5).

The vertex normals at A and D are identical, so interpolating them is trivial; we just get the same value. B and C are analogous.
P1: $(\frac{1}{-\sqrt{2}}, 0, \frac{1}{-\sqrt{2}})$
P2: $(\frac{1}{\sqrt{2}}, 0, \frac{1}{-\sqrt{2}})$

(c) What would be the interpolated normal at P (the coordinates of P are (0.5,1.5,1.0).

We will be half way between the normals, so the surface normal will have the value $(0, 0, -1)$.

For Students Enrolled in CS550:

4. The file `~tgd/public_html/hw6.tar` contains updated versions of the Pokorny code for everything we have discussed so far. Install this code. Then `cd` to the `Phong` subdirectory and issue the command `make demo` to compile the "demo" program. This program takes one command line argument: the name of a file containing a `pmesh`.

Construct a `pmesh` file that represents a hemisphere and use the `demo` program to render it with Phong shading. Turn in a hardcopy of your `pmesh` file. Also turn in a printed copy of your picture. You can use `xv` to "Grab" your output and save it as a postscript file that can be printed (in black and white). Make sure that the flat side of the hemisphere is flat and properly shaded. You may also want to use the `demo` program to render some of the files in the `Data` subdirectory. The file `saucer.dat` is particularly nice.

Here is my pmesh file:

```
1.0 1.0 1.0
75
 0 -1 0
 0.0000 -1.000 0.0000
 -.5000 -.8660 0.0000
 0.0000 -.8660 0.5000
 0.0000 -.8660 -.5000
 0.5000 -.8660 0.0000
 -.4330 -.7500 0.5000
 -.4330 -.7500 -.5000
 0.4330 -.7500 0.5000
 0.4330 -.7500 -.5000
 -.8660 -.5000 0.0000
 0.0000 -.5000 0.8660
 0.0000 -.5000 -.8660
 0.8660 -.5000 0.0000
```

```
-.7500 -.4330 0.5000
-.7500 -.4330 -.5000
-.2500 -.4330 0.8660
-.2500 -.4330 -.8660
0.2500 -.4330 0.8660
0.2500 -.4330 -.8660
0.7500 -.4330 0.5000
0.7500 -.4330 -.5000
-.4330 -.2500 0.8660
-.4330 -.2500 -.8660
0.4330 -.2500 0.8660
0.4330 -.2500 -.8660
-1.000 0.0000 0.0000
-.8660 0.0000 0.5000
-.8660 0.0000 -.5000
-.5000 0.0000 0.8660
-.5000 0.0000 -.8660
0.0000 0.0000 -1.000
0.0000 0.0000 1.0000
0.5000 0.0000 0.8660
0.5000 0.0000 -.8660
0.8660 0.0000 0.5000
0.8660 0.0000 -.5000
1.0000 0.0000 0.0000
-.4330 0.2500 0.8660
-.4330 0.2500 -.8660
0.4330 0.2500 0.8660
0.4330 0.2500 -.8660
-.7500 0.4330 0.5000
-.7500 0.4330 -.5000
-.2500 0.4330 0.8660
-.2500 0.4330 -.8660
0.2500 0.4330 0.8660
0.2500 0.4330 -.8660
0.7500 0.4330 0.5000
0.7500 0.4330 -.5000
-.8660 0.5000 0.0000
0.0000 0.5000 0.8660
0.0000 0.5000 -.8660
0.8660 0.5000 0.0000
-.4330 0.7500 0.5000
-.4330 0.7500 -.5000
0.4330 0.7500 0.5000
0.4330 0.7500 -.5000
-.5000 0.8660 0.0000
0.0000 0.8660 0.5000
0.0000 0.8660 -.5000
0.5000 0.8660 0.0000
0.0000 1.0000 0.0000
0.0000 -1.000 0.0000
```

```
 -.5000 -.8660 0.0000
 0.5000 -.8660 0.0000
 -.8660 -.5000 0.0000
 0.8660 -.5000 0.0000
 -1.000 0.0000 0.0000
 1.0000 0.0000 0.0000
 -.8660 0.5000 0.0000
 0.8660 0.5000 0.0000
 -.5000 0.8660 0.0000
 0.5000 0.8660 0.0000
 0.0000 1.0000 0.0000
42
31 19 12 12
31 25 19 19
31 34 25 25
31 41 34 34
31 47 41 41
31 52 47 47
31 45 52 52
31 39 45 45
31 30 39 39
31 23 30 30
31 17 23 23
31 12 17 17
12 19 9 4
19 25 21 9
25 34 36 21
34 41 49 36
41 47 57 49
47 52 60 57
52 45 55 60
45 39 43 55
39 30 28 43
30 23 15 28
23 17 7 15
17 12 4 7
4 9 5 1
9 21 13 5
21 36 37 13
36 49 53 37
49 57 61 53
57 60 62 61
60 55 58 62
55 43 50 58
43 28 26 50
28 15 10 26
15  7  2 10
 7  4  1 2

72 73 74 74
```

70 71 73 72
68 69 71 70
66 67 69 68
64 65 67 66
65 64 63 63

Here is my picture: