

Visportals and BSP trees

- consider this map
 - the walls are in red

chisel/maps/spiral.txt

```
define 1 room 1
define 2 room 2
define 3 room 3
define 4 room 4
define 0 monster monster_demon_imp
define H monster monster_demon_hellknight
define S worldspawn
```

Visportals and BSP trees

chisel/maps/spiral.txt

```
#####
#1          #2          #
#           .           #
#           .           #
#           #           #
#...#####...#####
#3          #4          #
#           #  O O O  #
#   S       #           #
#           #  O O O  #
#           #           #
#####
```

Visportals and BSP trees

- we can see that we are spawned in room 3
 - the imps are in room 4
- let us build this map with chisel

```
$ cd
$ cd Sandpit/chisel/python
$ ./developer-txt2map ../maps/spiral.txt
txt2pen: pass
Total rooms = 4
Total cuboids = 769
Total cuboids expanded (optimised) = 0
Total entities used = 89 entities unused = 4007
Total brushes used = 769
pen2map: pass
```

Visportals and BSP trees

- now compile the map within dhewm3
 - and play it!
- notice when you are spawned at the beginning of the game
 - turn and if you face room 4
 - watch the fps drop !
 - why is this the case?

Visportals and BSP trees

- now we can implement visportals for open doors
 - compile the map and play the game
- notice after the player is spawned you can face room 4
 - and what happens?
 - why?

Algorithm for splitting an area into a BSP tree

```

PROCEDURE makeTree (polyList: polygon) : tree;
VAR
  root: polygon ;
  backList, frontList: polygonP ;
  p, backPart, frontPart: polygon ;
BEGIN
  IF polyList = NIL
  THEN
    RETURN NIL
  ELSE

```

Algorithm for splitting an area into a BSP tree

```

root := selectAndRemovePolygon (polyList) ;
backList := NIL ;
frontList := NIL ;
FOR p in polyList DO
  IF p is in front of root
  THEN
    frontList := addToList (frontList, p)
  ELSIF p is behind root
  THEN
    backList := addToList (backList, p)
  ELSE
    (* polygon, p, must be split as it spans across, root.
    splitPolygon (p, root, frontPart, backPart) ;
    frontList := addToList (frontList, frontPart) ;
    backList := addToList (backList, backPart) ;
  END
END ;
RETURN combineTree (makeTree (frontList),
                   root,
                   makeTree (backList))
END
END makeTree;

```

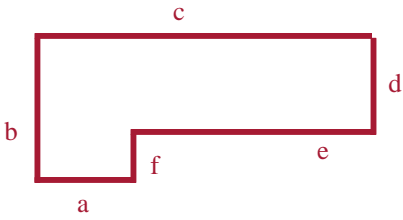
BSP trees

- consider the following walls in a map



BSP trees

- we will label each line



BSP trees

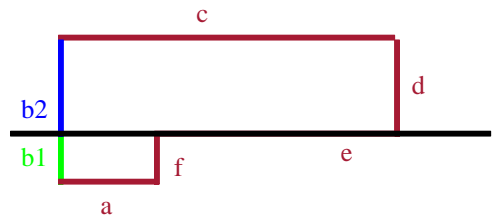
- we initialise our `polyList` to the labeled lines
- and the tree to empty
 - the tree will be a binary tree, built by a number of 3 item lists
 - in the list, element 0, is the left, which represents behind,
 - middle, element 1, is the node label
 - right, element 2, means forward
 - forward means right for a vertical line
 - forward means above a horizontal line
 - the algorithm will create a binary tree of ordered lines
 - the algorithm keeps recursing until each node is a label (rather than a list)
 - and each leaf contains a label (rather than a list)

BSP trees

```
polyList = [a, b, c, d, e, f]
tree     = []
```

BSP trees

- we will choose an existing line to perform the split (marked in black)



BSP trees

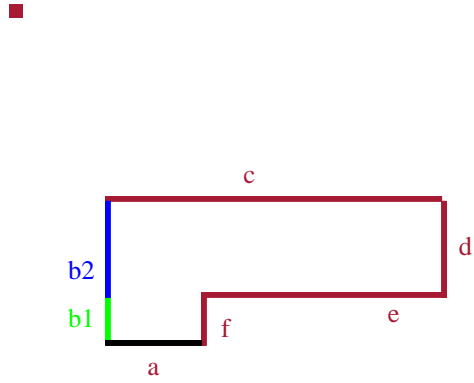
```

polyList = [a, b1, b2, c, d, e, f]
tree = [makeTree ([b1, a, f]),
        e,
        makeTree ([b2, c, d])]

```

we will call makeTree ([b1, a, f])

makeTree ([b1, a, f])



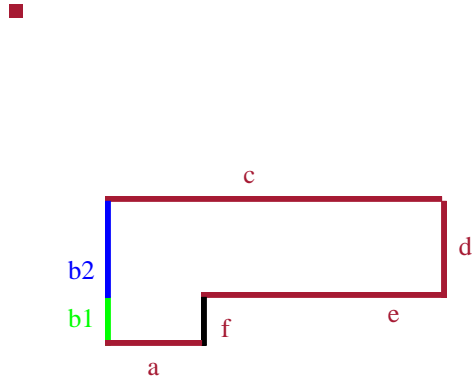
makeTree ([b1, a, f])

```

polyList = [b1, a, f]
tree = [combineTree ([], a, makeTree ([b1, f])]

```

makeTree ([b1, f])



makeTree ([b1, f])

```
tree = [b1, f, []]
```

therefore the caller to makeTree now creates the tree as:

```
tree = [combineTree ([], a, makeTree ([b1, f])]
tree = [a, b1, f]
```

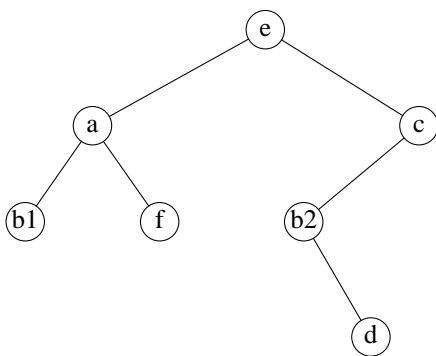
makeTree ([b1, f])

and the caller to this makeTree

```
tree = [makeTree ([a, b1, f]),
        e,
        makeTree ([b2, c, d])]
```

```
tree = [[a, b1, f],
        e,
        makeTree ([b2, c, d])]
```

BSP tree

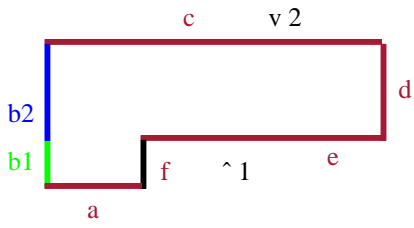


Display BSP Tree algorithm

```

PROCEDURE displayTree (tree)
BEGIN
  IF tree # NIL
  THEN
    IF Viewer is in front of tree->line
    THEN
      (* display back child, root, front child. *)
      displayTree (tree->left) ; (* back. *)
      displayLine (tree->line) ;
      displayTree (tree->right) (* front. *)
    ELSE
      (* display front child, root and back child. *)
      displayTree (tree->right) ; (* front. *)
      displayLine (tree->line) ;
      displayTree (tree->left) (* back. *)
    END
  END
END displayTree ;
  
```

Display BSP Tree algorithm



Line (polygon) display order using the bsp tree and display algorithm

- given position 1 (facing upwards)
 - c, b2, d, e, b1, a, f

- given position 2 (facing downwards)
 - b1, a, f, e, b2, d, c