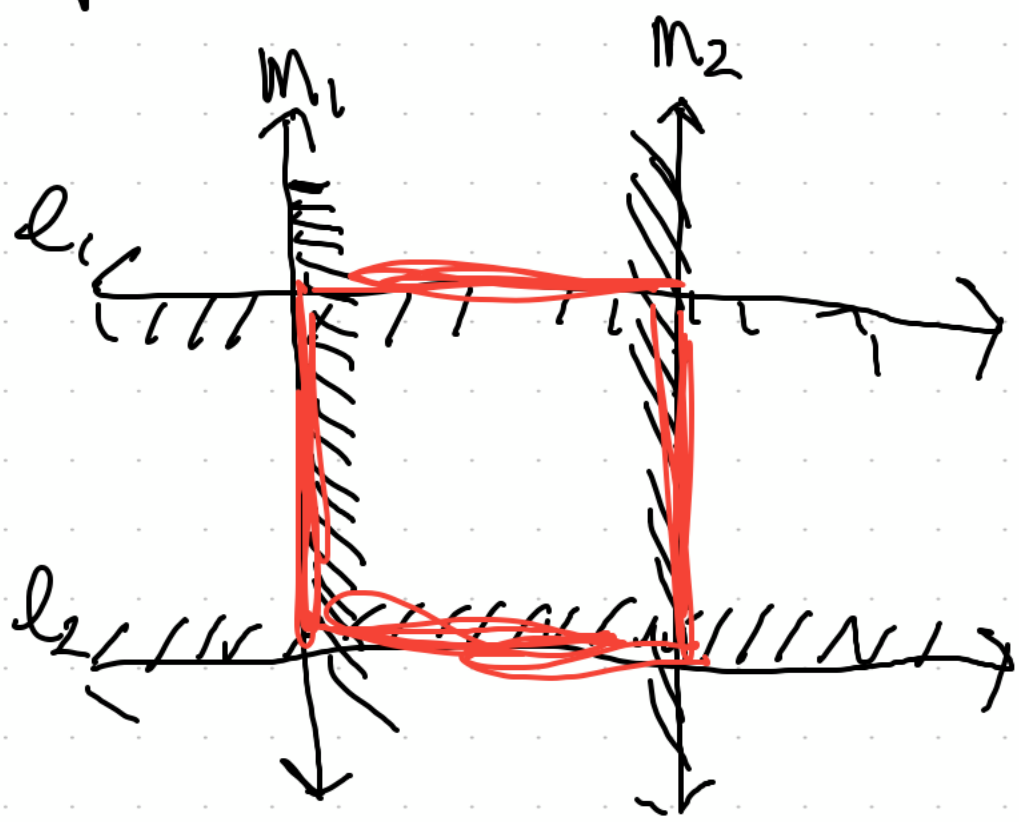
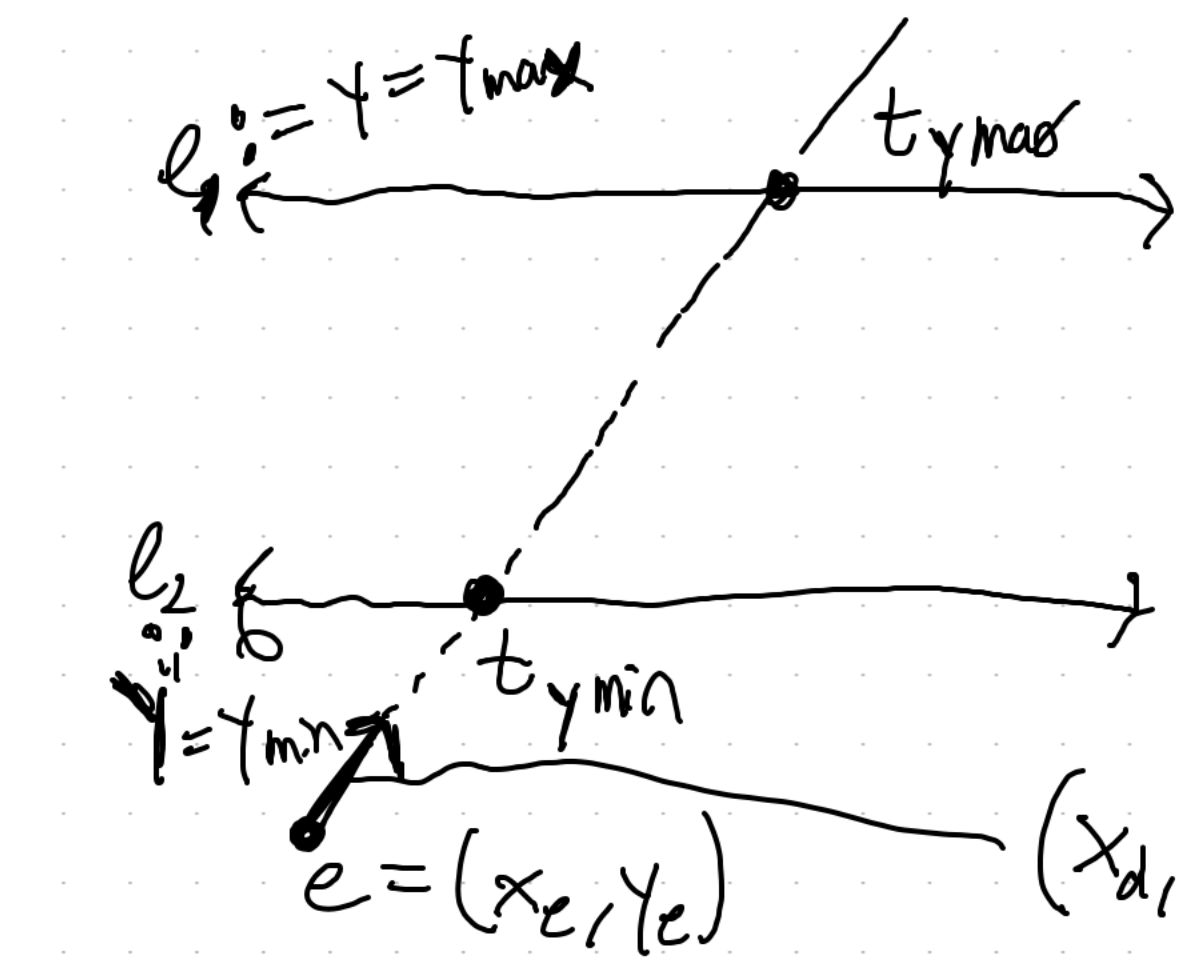
Spatial DS

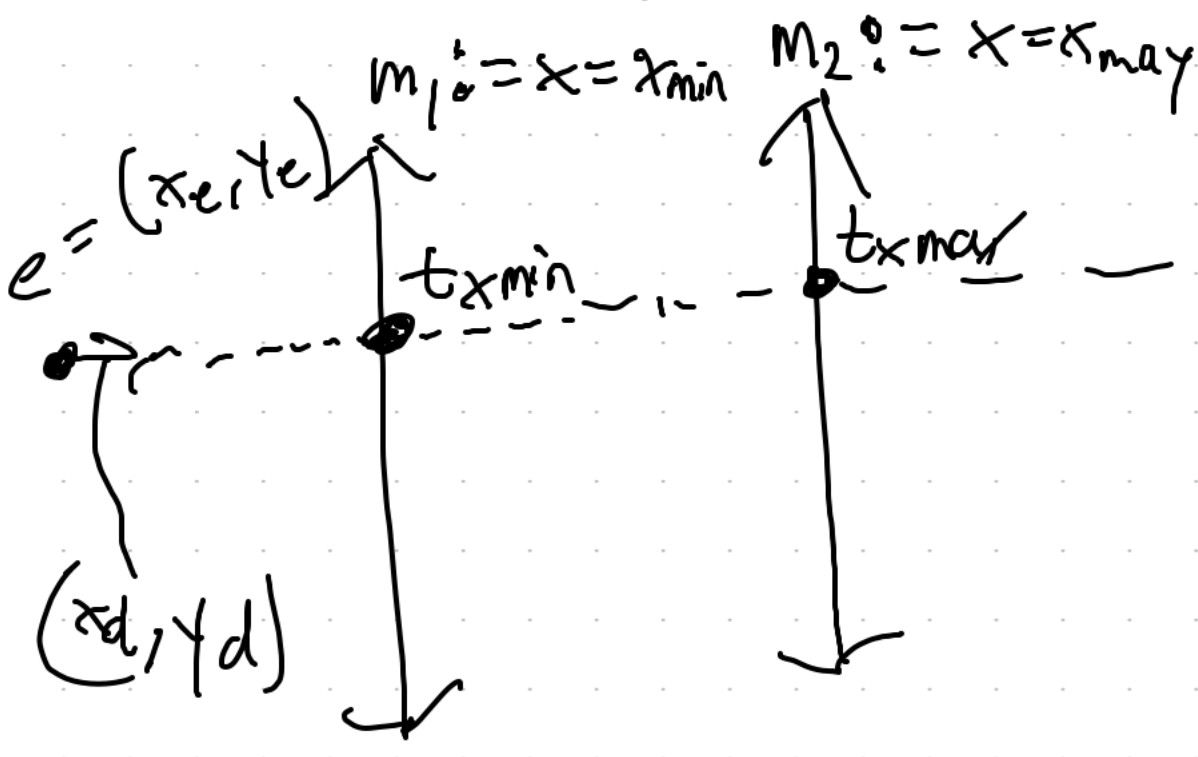
April 14





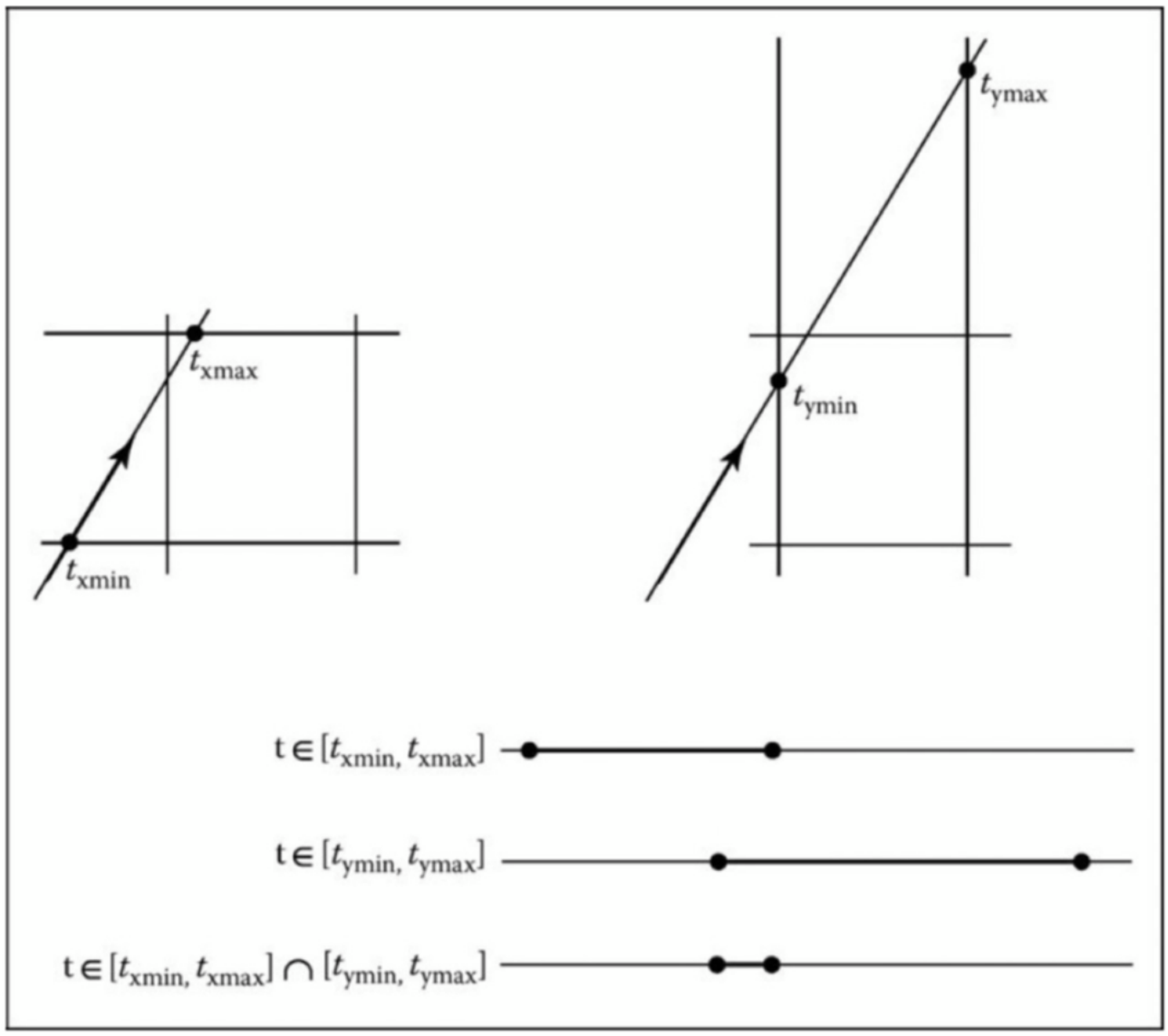
$$t_{ymin} = \frac{y_{min} - y_e}{y_d}$$

$$t_{ymax} = \frac{y_{max} - y_e}{y_d}$$



$$t_{xmin} = \frac{x_{min} - x_e}{x_d}$$

$$t_{xmax} = \frac{x_{max} - x_e}{x_d}$$



Iteration 1

$t_{xmin} = (x_{min} - x_e)/x_d$
$t_{xmax} = (x_{max} - x_e)/x_d$
$t_{ymin} = (y_{min} - y_e)/y_d$
$t_{ymax} = (y_{max} - y_e)/y_d$
if $(t_{xmin} > t_{ymax})$ or $(t_{ymin} > t_{xmax})$ **then**
  return false
else
  return true

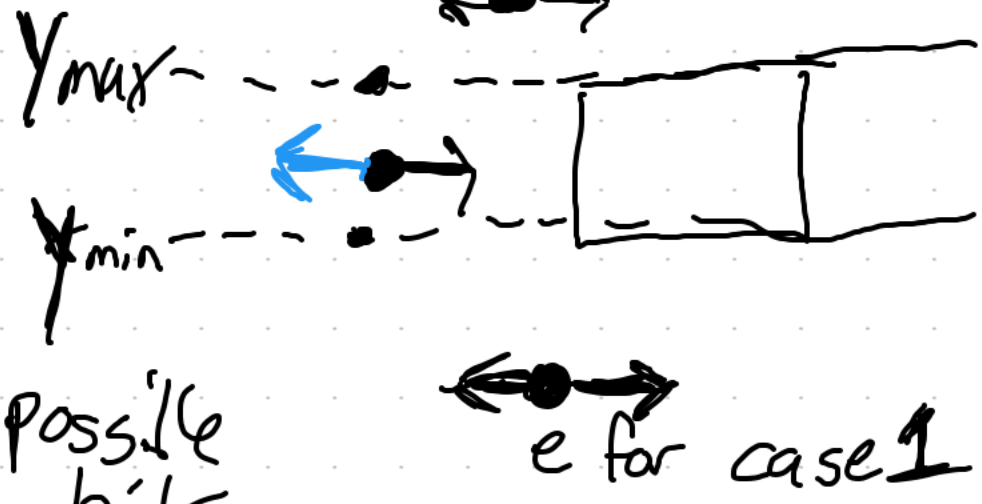
Problem: What if x_d (or y_d) is neg

if $x_d \geq 0$
  $t_{min} = (x_{min} - x_e)/x_d$
  $t_{max} = (x_{max} - x_e)/x_d$
else
  $t_{min} = (x_e - x_{min})/x_d$
  $t_{max} = (x_e - x_{max})/x_d$

} apply to each dim

Problem: Horizontal or vertical rays

eg. $x_d = 0 \Rightarrow (x_{min} - x_e)/x_d = (x_{min} - x_e)/0 = \infty$ (for x_{min})



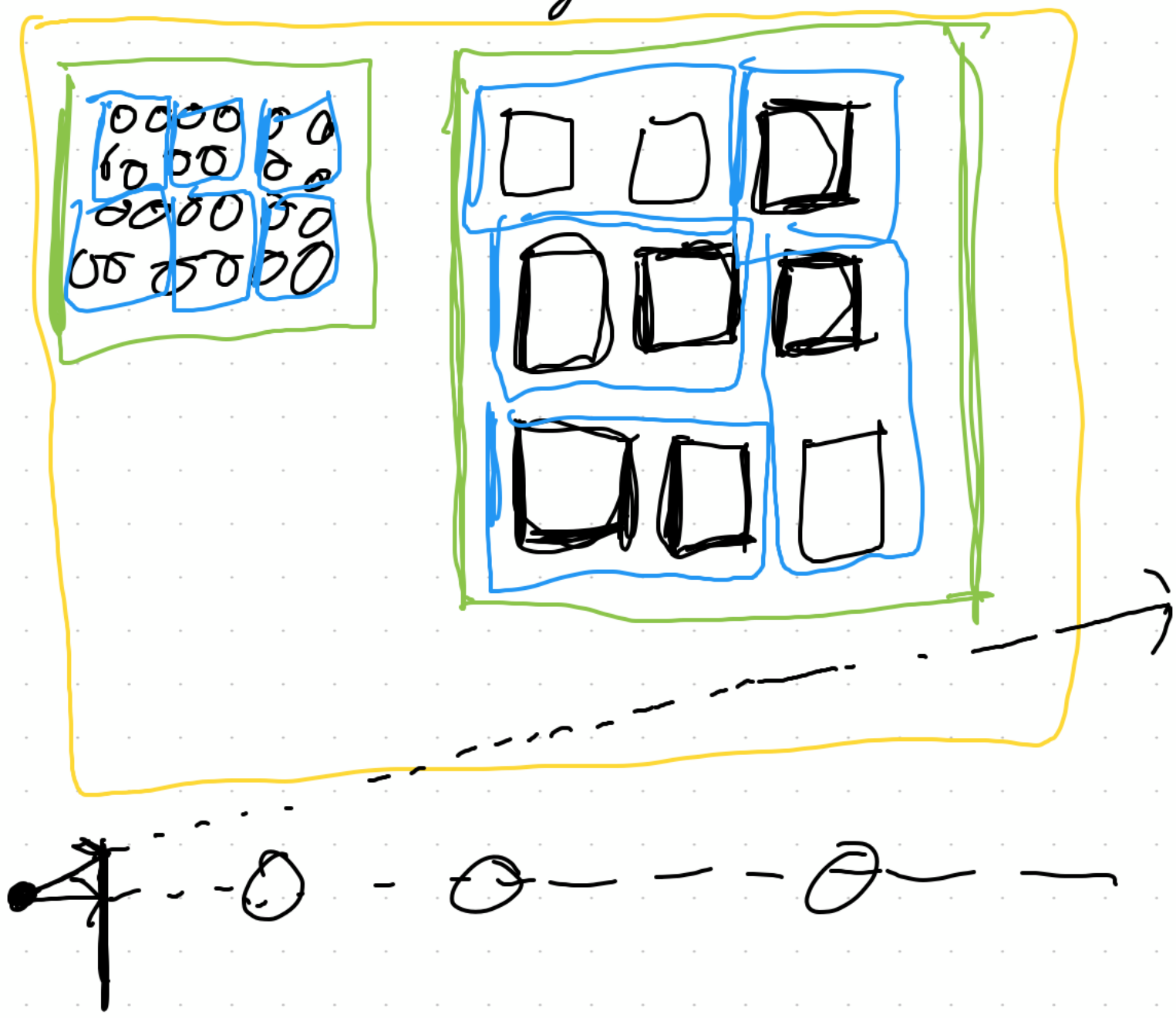
3 possibilities

1. $y_e \leq y_{min} \Rightarrow$ no hit
2. $y_{min} \leq y_e \leq y_{max} \Rightarrow$ possible hit
3. $y_{max} \leq y_e \Rightarrow$ no hit

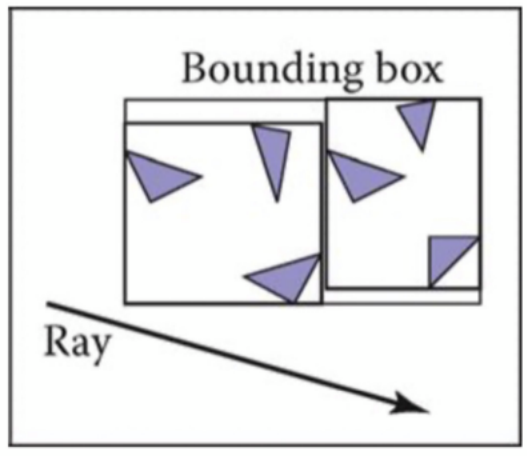
(2005) Williams, Barrus, Morley & Shirley

$a = 1/x_d$
if $(a \geq 0)$ **then**
  $t_{\text{min}} = a(x_{\text{min}} - x_e)$
  $t_{\text{max}} = a(x_{\text{max}} - x_e)$
else
  $t_{\text{min}} = a(x_{\text{max}} - x_e)$
  $t_{\text{max}} = a(x_{\text{min}} - x_e)$

Hierarchical Bounding Boxes



```
if (ray hits root box) then
    if (ray hits left subtree box) then
        check three triangles for intersection
    if (ray intersects right subtree box) then
        check other three triangles for intersection
    if (an intersections returned from each subtree) then
        return the closest of the two hits
    else if (a intersection is returned from exactly one subtree) then
        return that intersection
    else
        return false
else
    return false
```



Observations:

- no order between subtrees
- say may hit both subtrees
- subtrees may overlap
  (all of the children of a node must be completely contained in the node)
- trees can be binary
  (but they don't have to be)
- ideally best if balanced
- ideally w/ low overlap between siblings