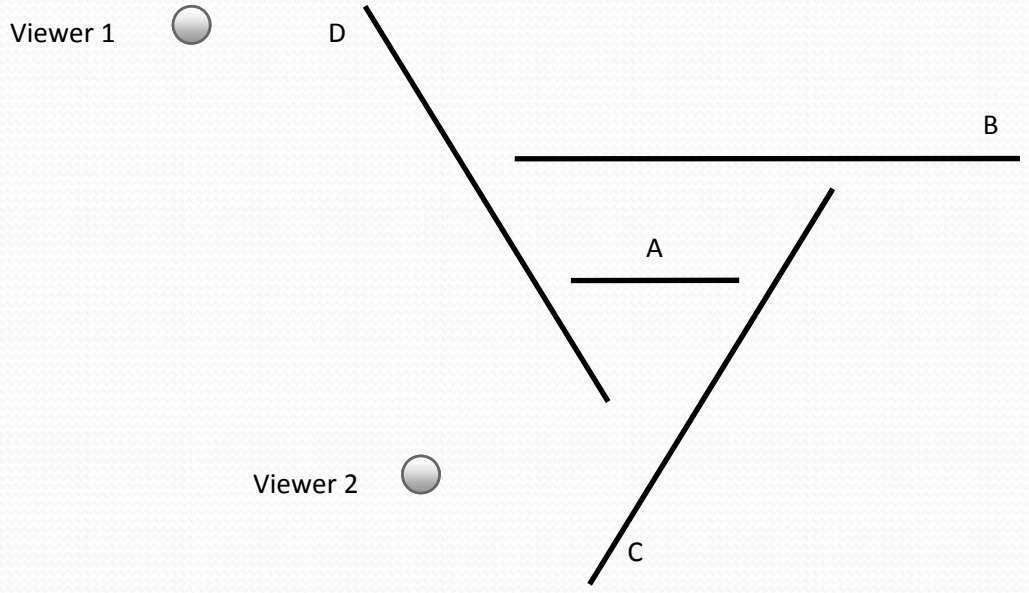
CS3241 Computer Graphics

Tutorial 4

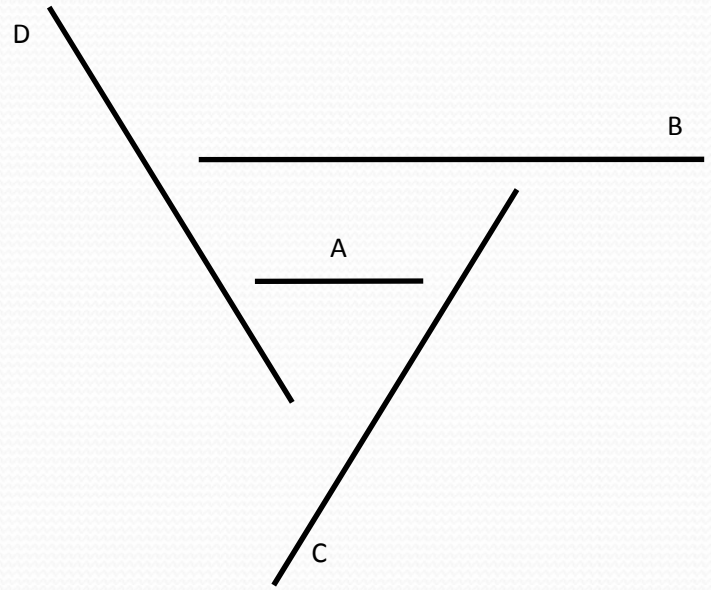
Question

- The following diagram is the cross section (bird's eye view) of a set of polygons in 3D space.



Part (A)

- Construct their BSP tree, in the priority of A > B > C > D. Draw construction lines to help you in the diagram.



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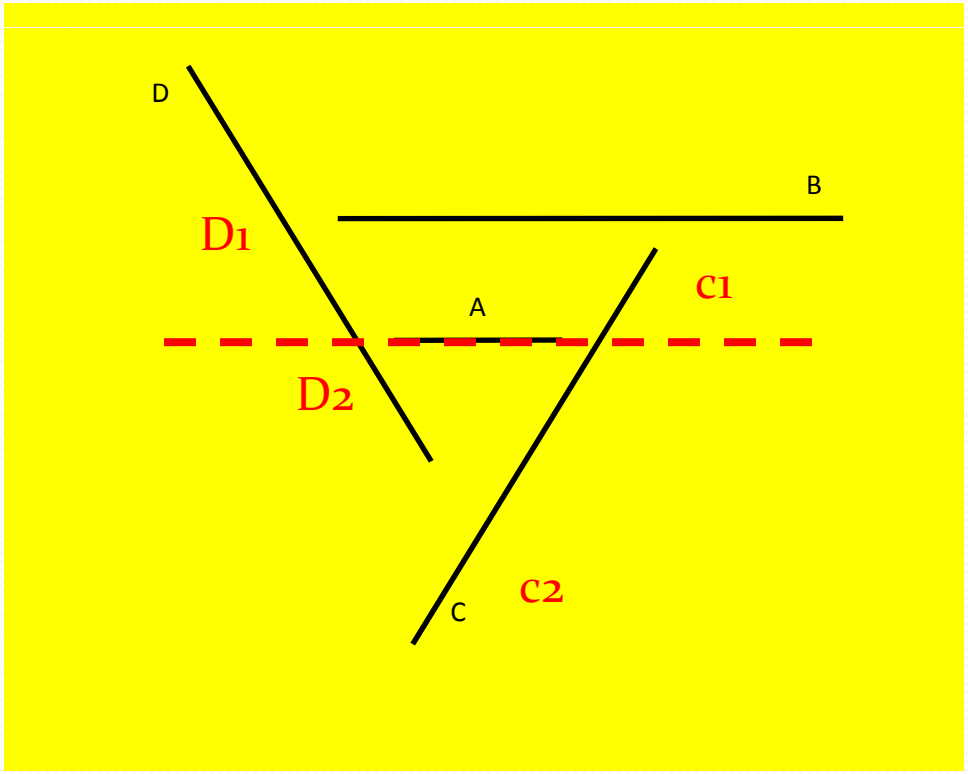

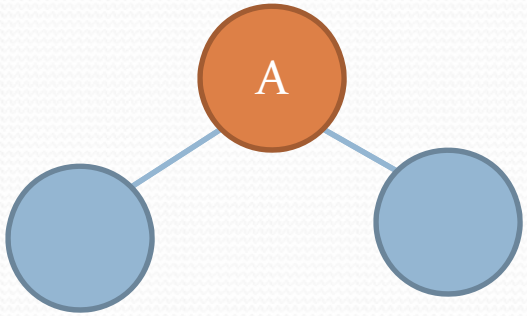

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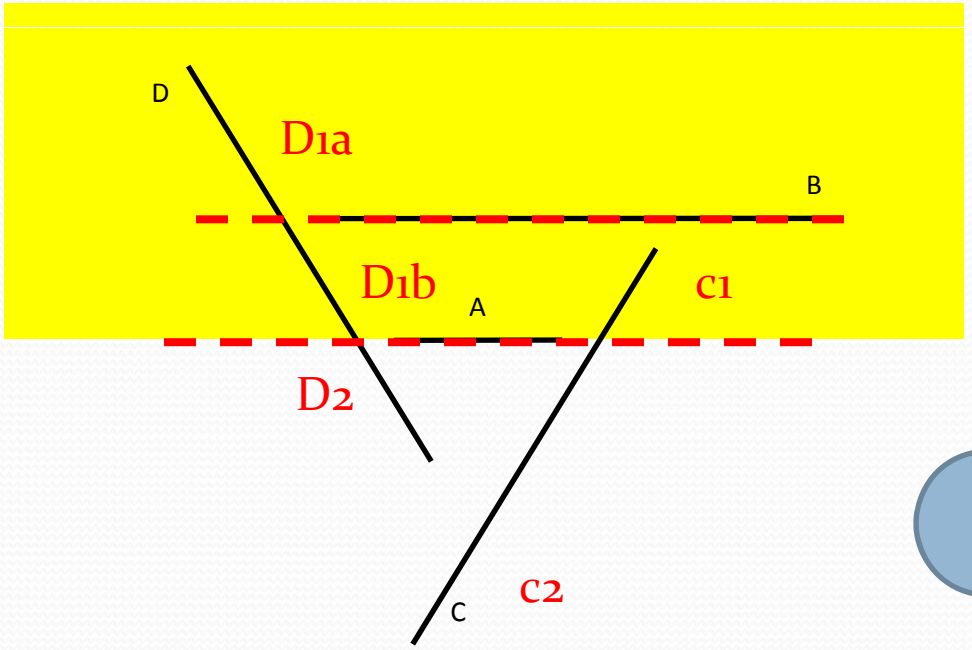

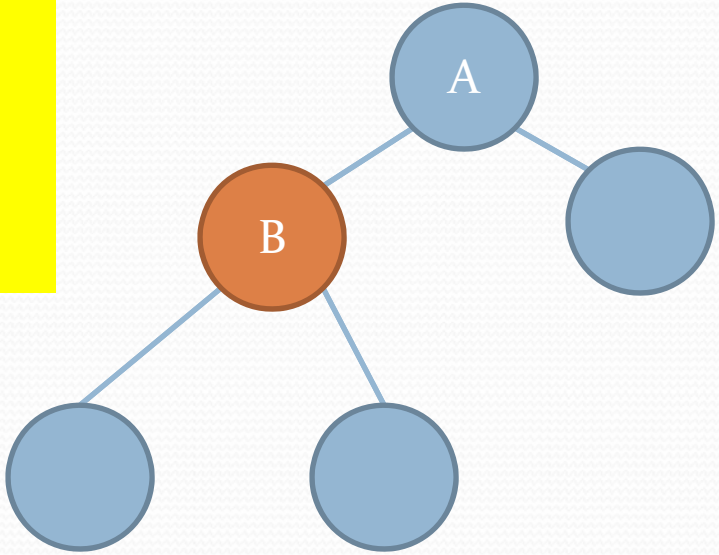

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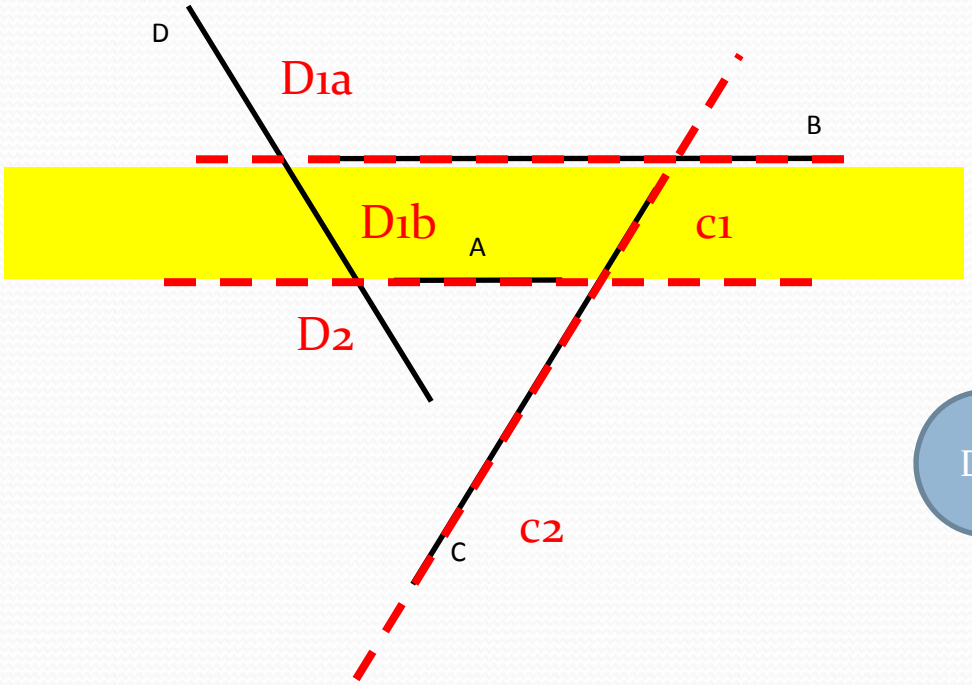

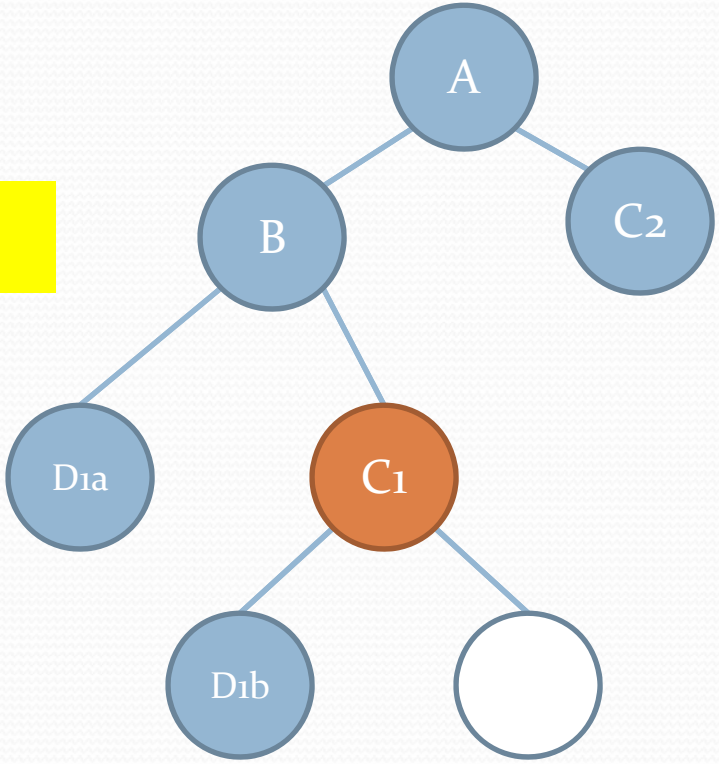

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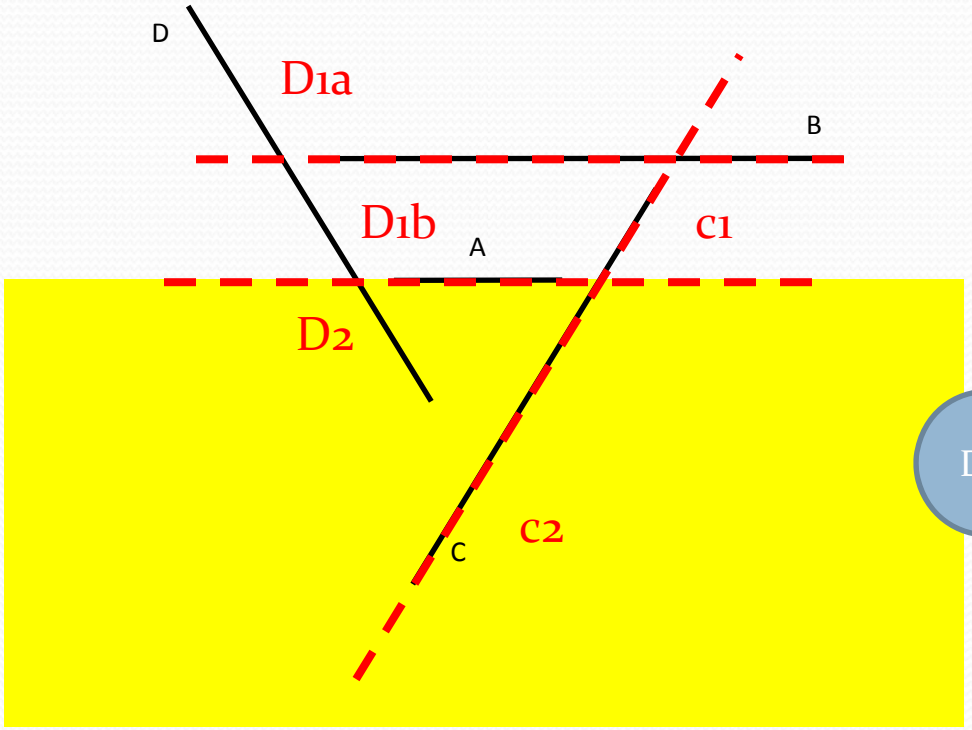
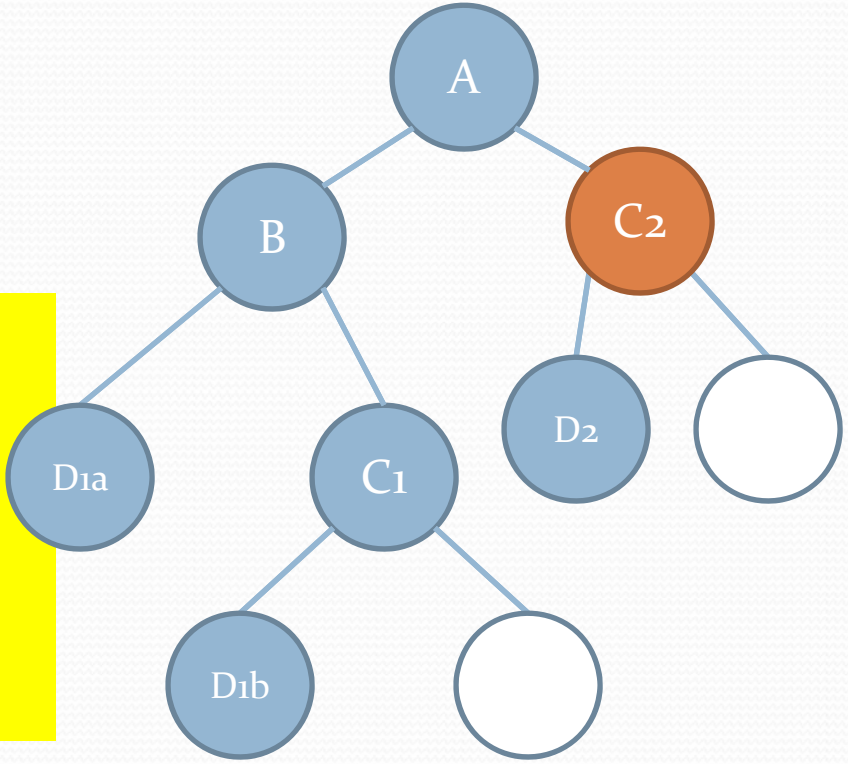
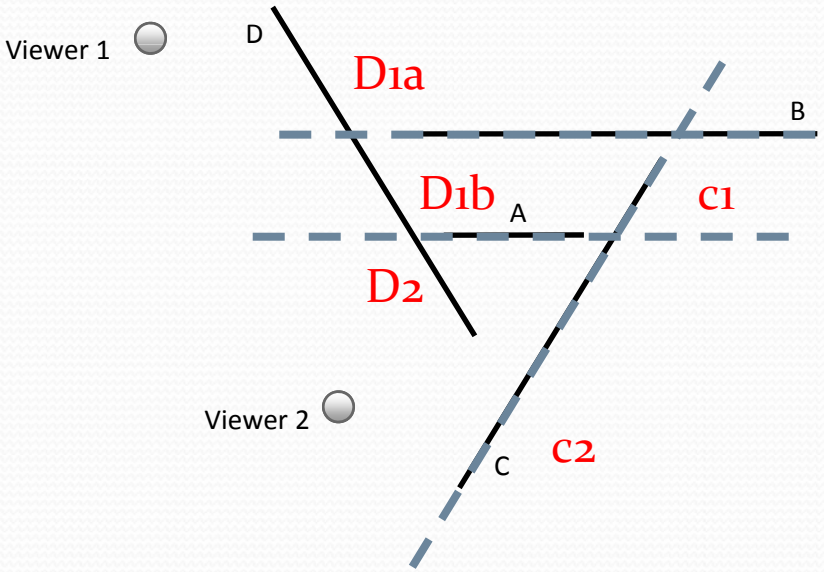
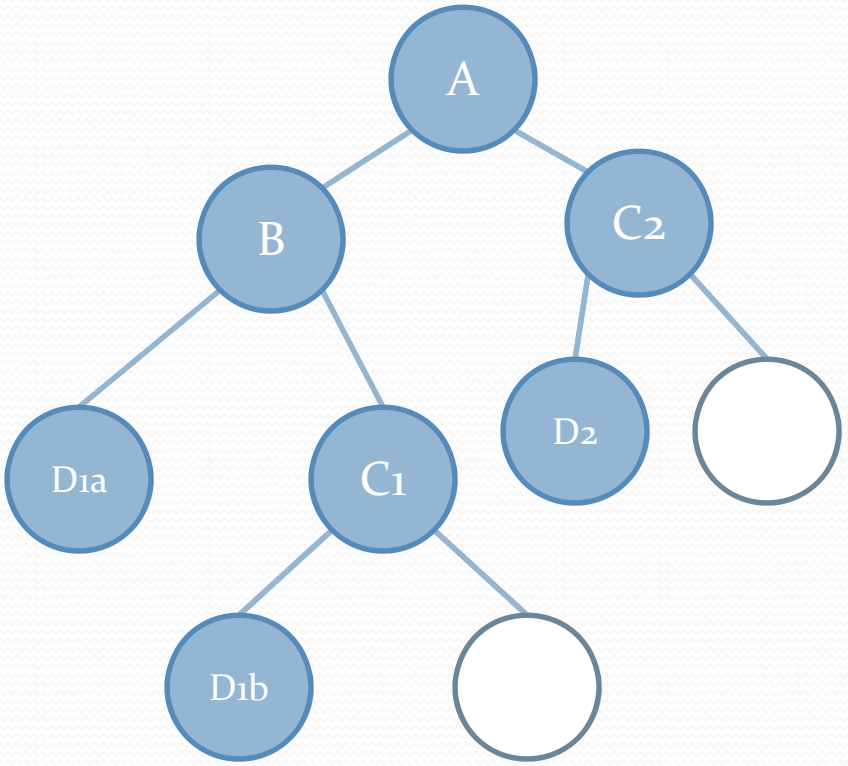




Part (B)

- The two dots are the positions of Viewers 1 and 2. Give the order of polygons drawn in the BSP tree when you view from the two positions.

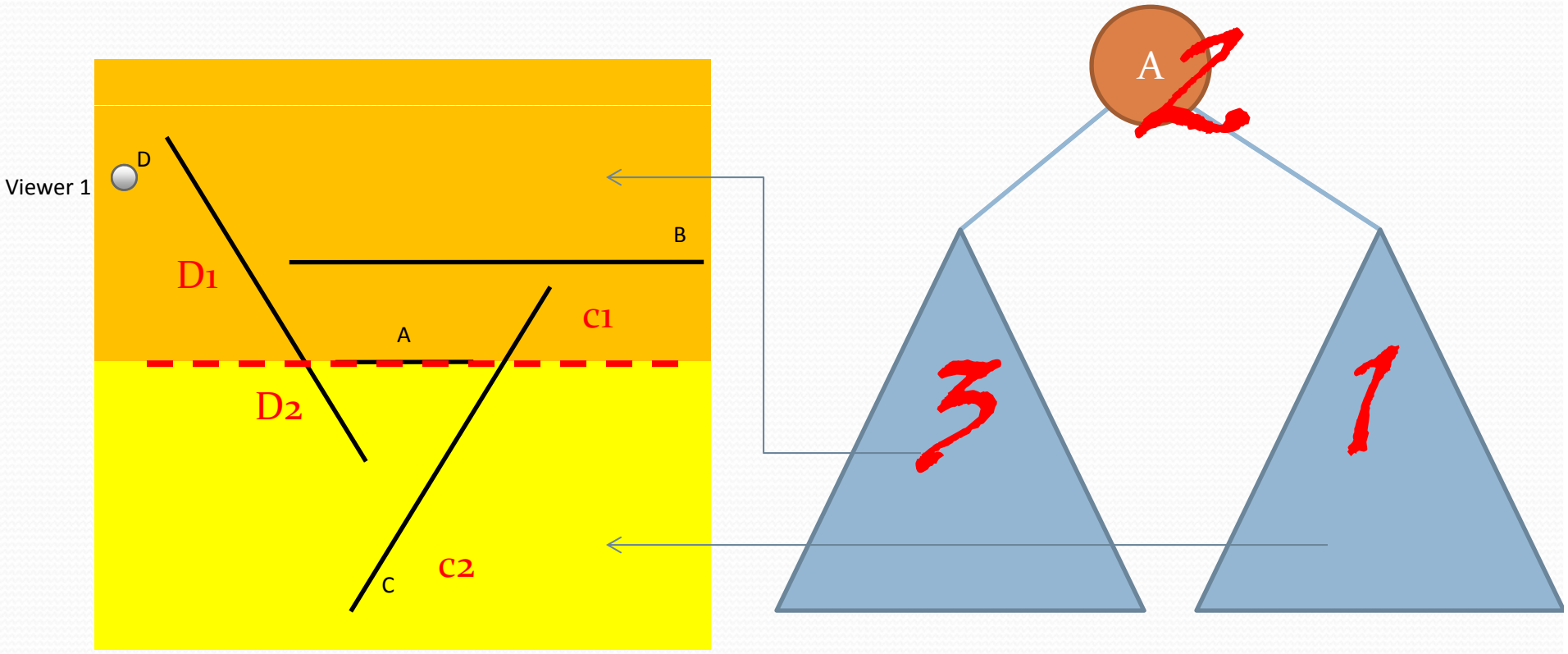




Type 1b: BSP-tree **Rendering**

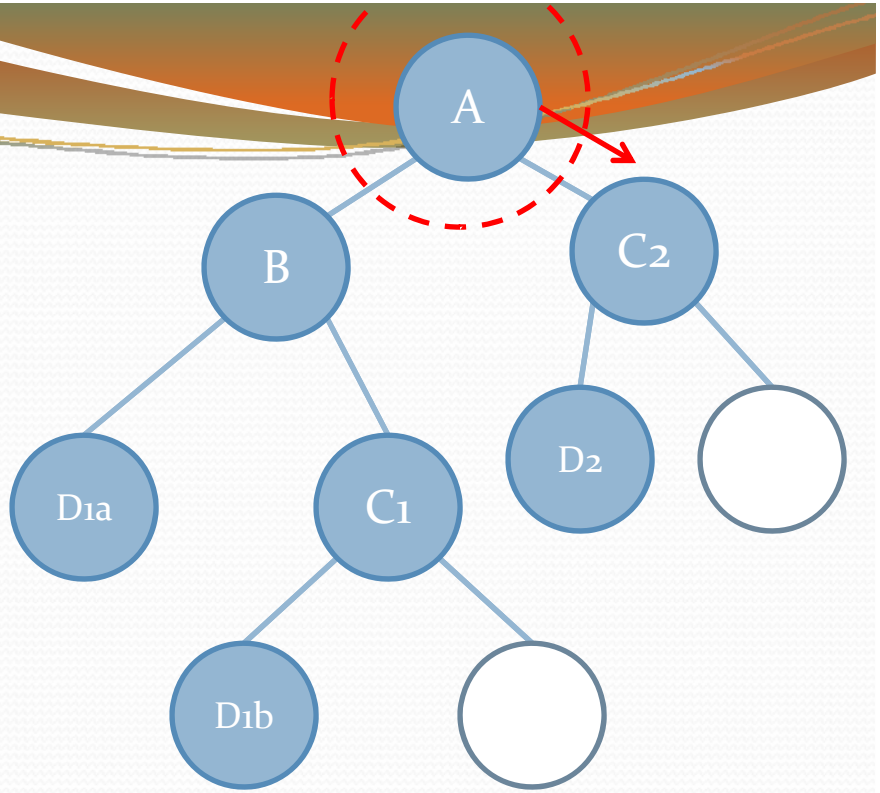
- Depending on the viewpoint *p*
- Start from the root
  - For each node there is one polygon and two sub-spaces in the two children
    1. Recursively draw the sub-tree behind the polygon from the view point *p*
    2. Draw the polygon of the node
    3. Recursively, draw the sub-tree in front of the polygon from the view point *p*

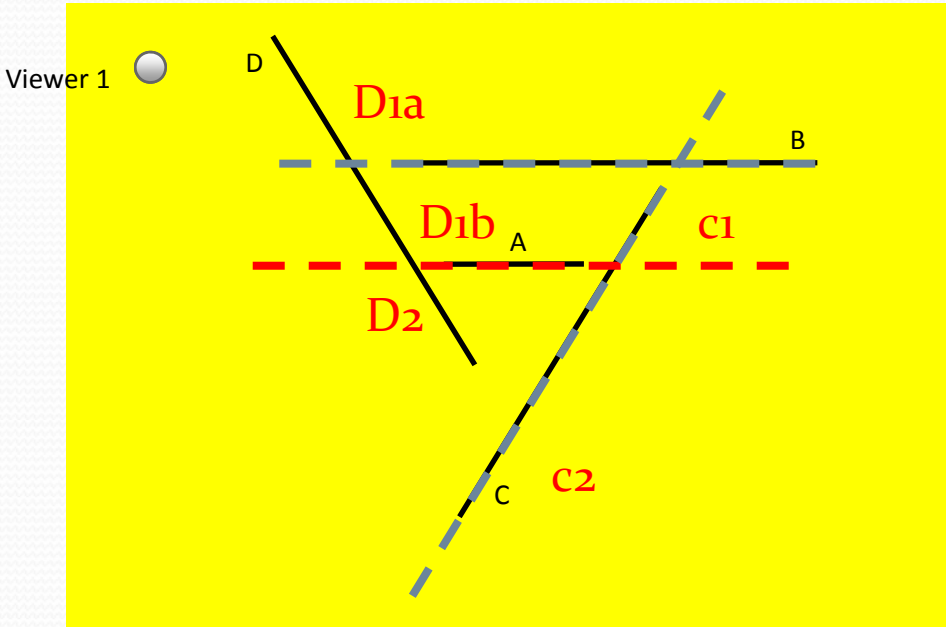
Type 1b: BSP-tree **Rendering**



Part (B)

- Viewer 1
- Starting Node: A
- Draw the sub-tree behind the polygon from the view point
  - C2

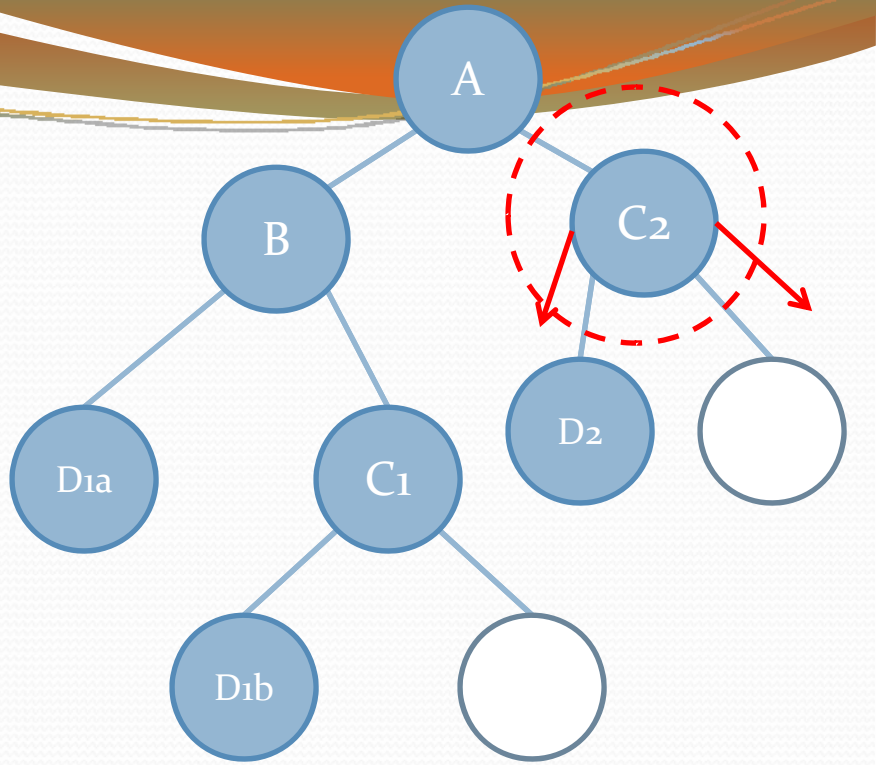


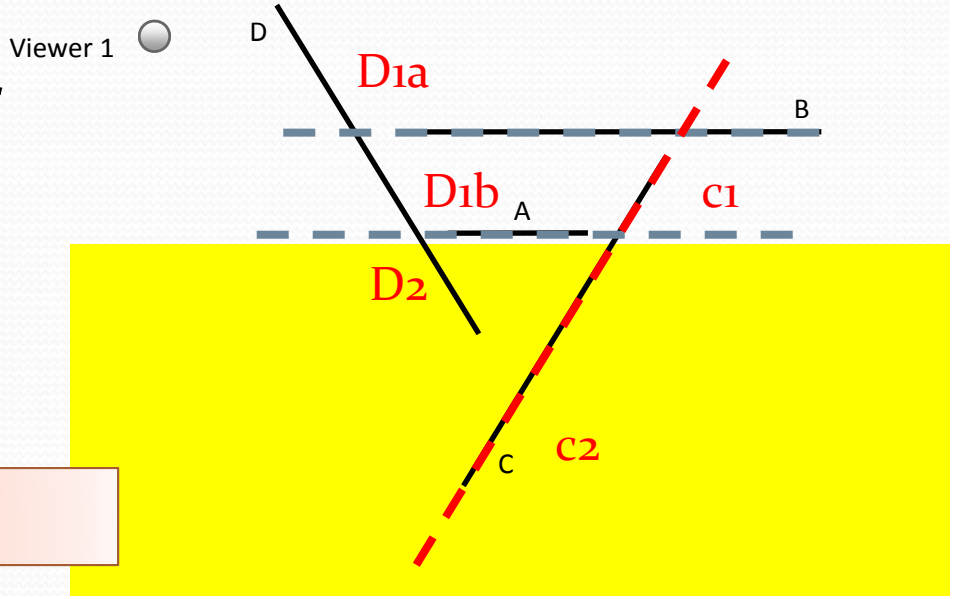


Part (B)

- Viewer 1
- Inside C2
- Draw the sub-tree behind the polygon from the view point
  - Nothing
- Back to the node you were in
  - C2 (+ C2)
- Draw the sub-tree in front of the polygon from the view point
  - D2 (+ D2)
- C2 finished, back to A

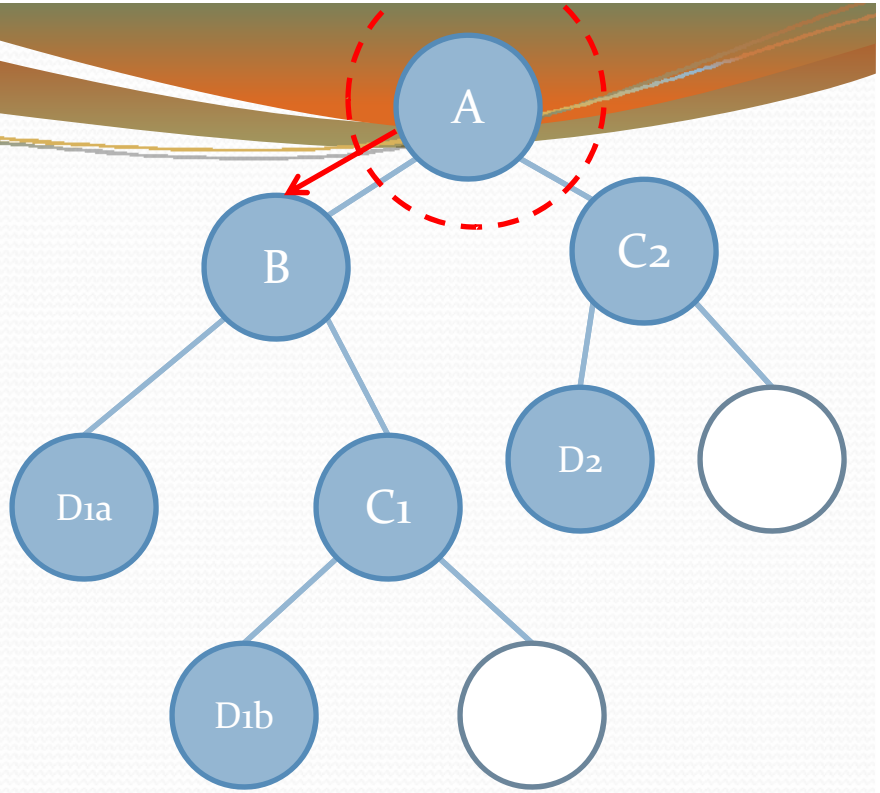
Drawing sequence: C2, D2 ....

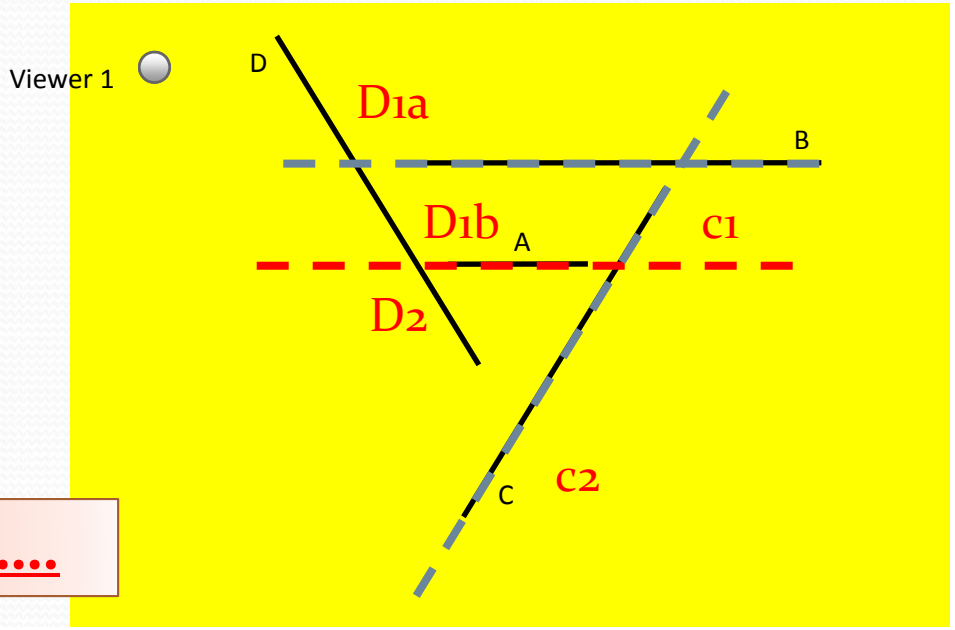




Part (B)

- Viewer 1
  - Inside A
  - You had finished one subtree
  - Draw the polygon of the node
    - A (+ A)
  - Draw the sub-tree in front of the polygon from the view point
    - B

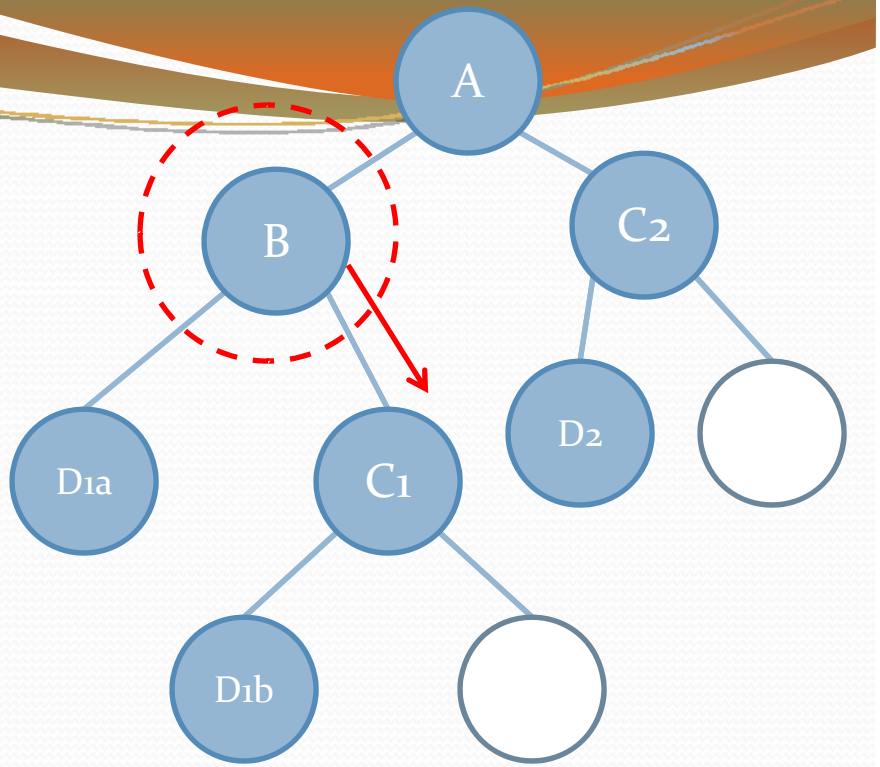


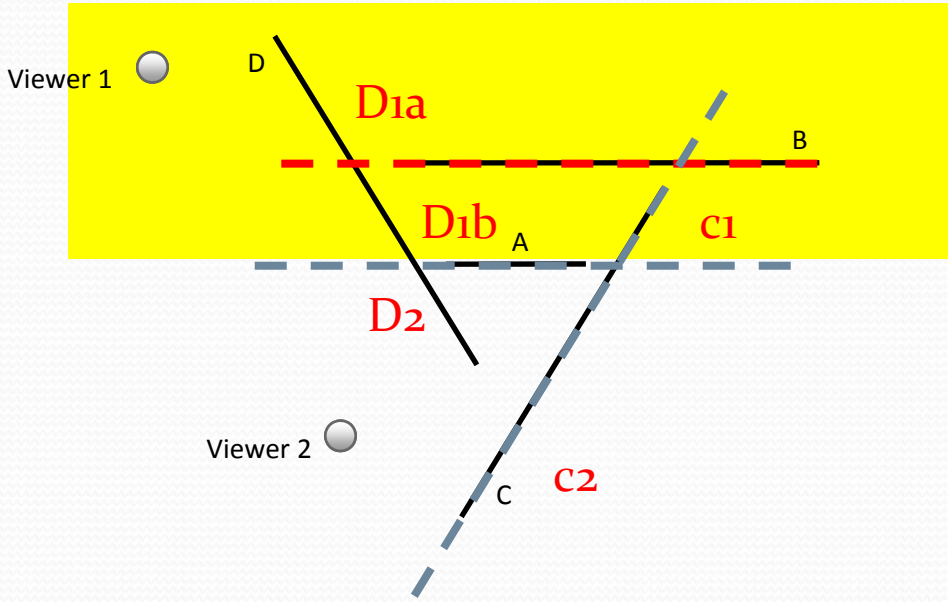


Drawing sequence: C2, D2 , A ....

Part (B)

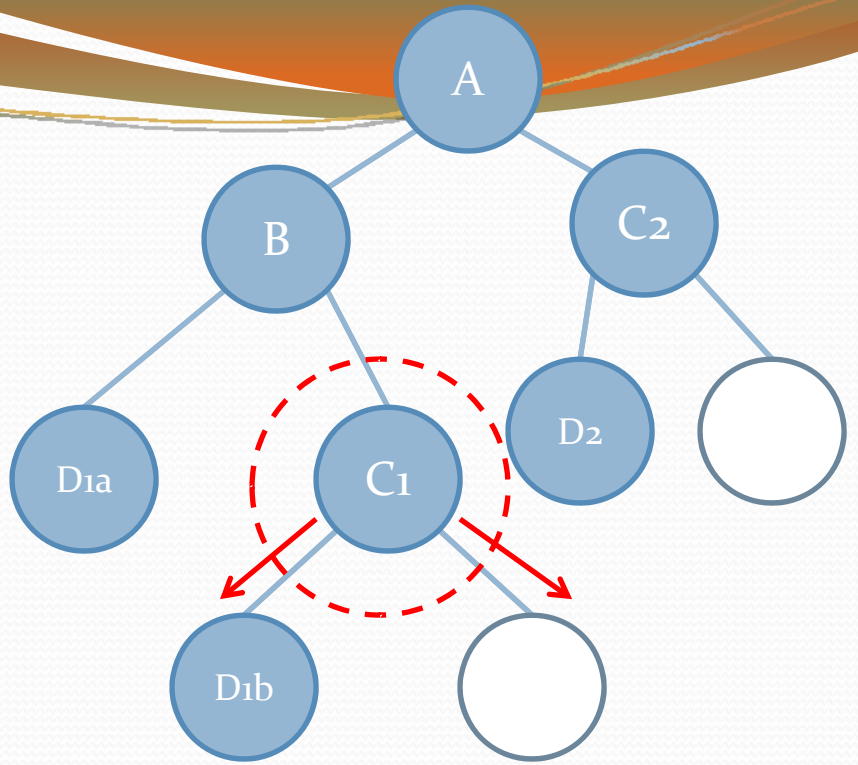
- Viewer 1
- Inside B
- Draw the sub-tree behind the polygon from the view point
  - C1

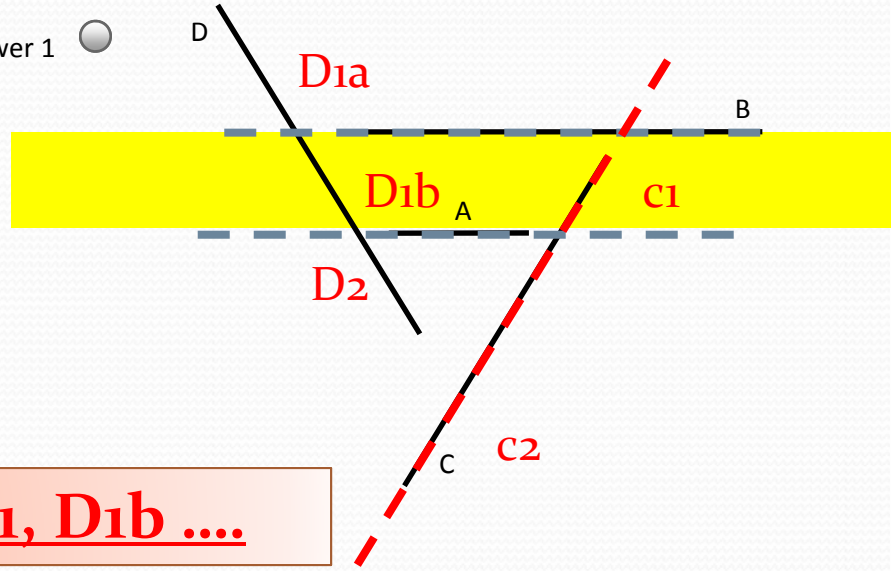




Part (B)

- Viewer 1
- Inside C1
- Draw the sub-tree behind the polygon from the view point
  - Nothing
- Back to the node you were in
  - C1 (+ C1)
- Draw the sub-tree in front of the polygon from the view point
  - D1b (+ D1b)
- C1 finished, back to B

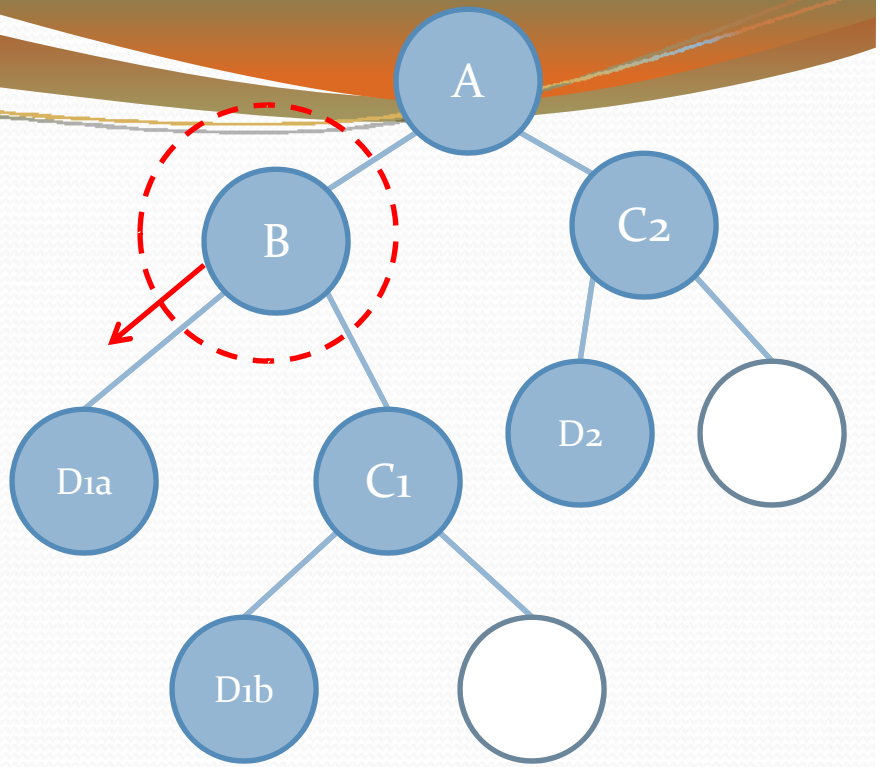


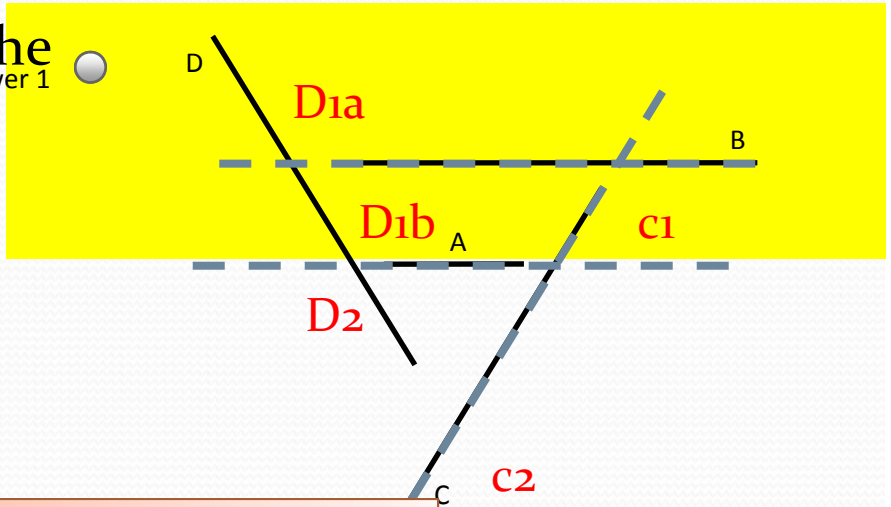


Drawing sequence: C2, D2 , A, C1, D1b ....

Part (B)

- Viewer 1
  - Inside B
  - You had finished one subtree
  - Draw the polygon of the node
    - B (+ B)
  - Draw the sub-tree in front of the polygon from the view point
    - D1a (+ D1a)

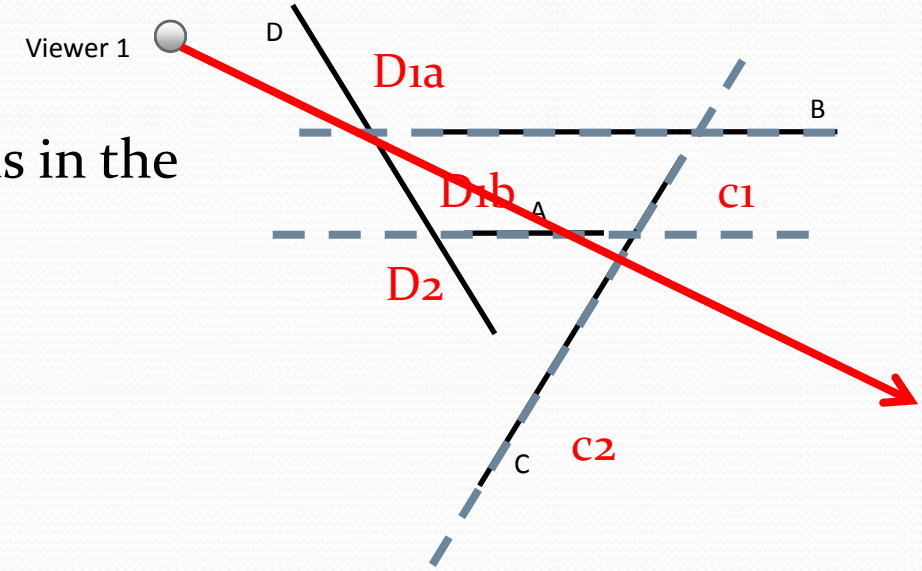




Drawing sequence: C2, D2 , A, C1, D1b, B, D1a

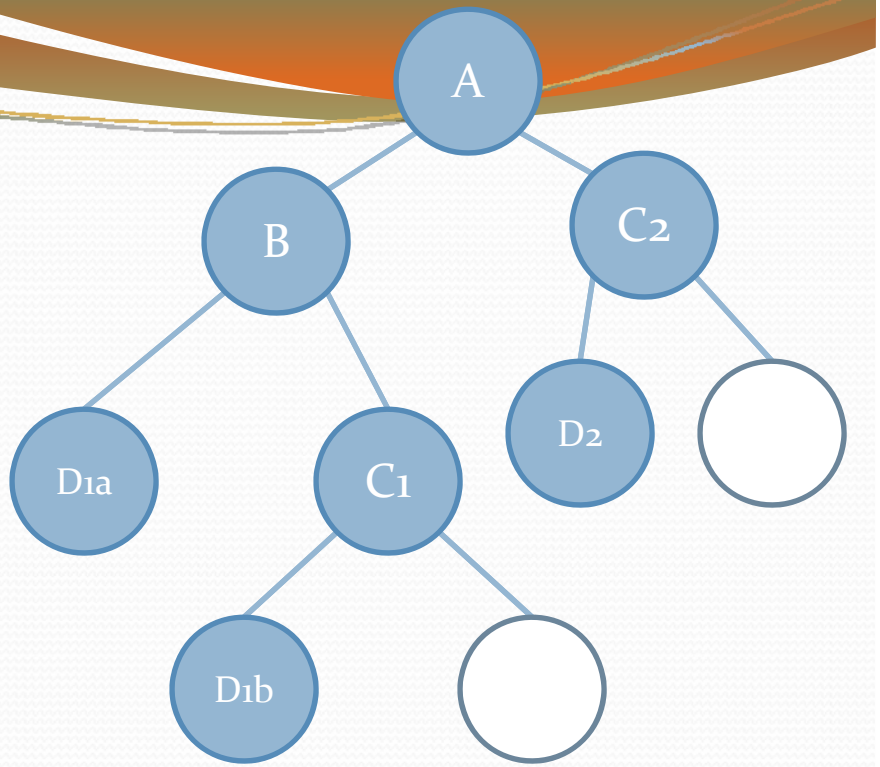
Part (B)

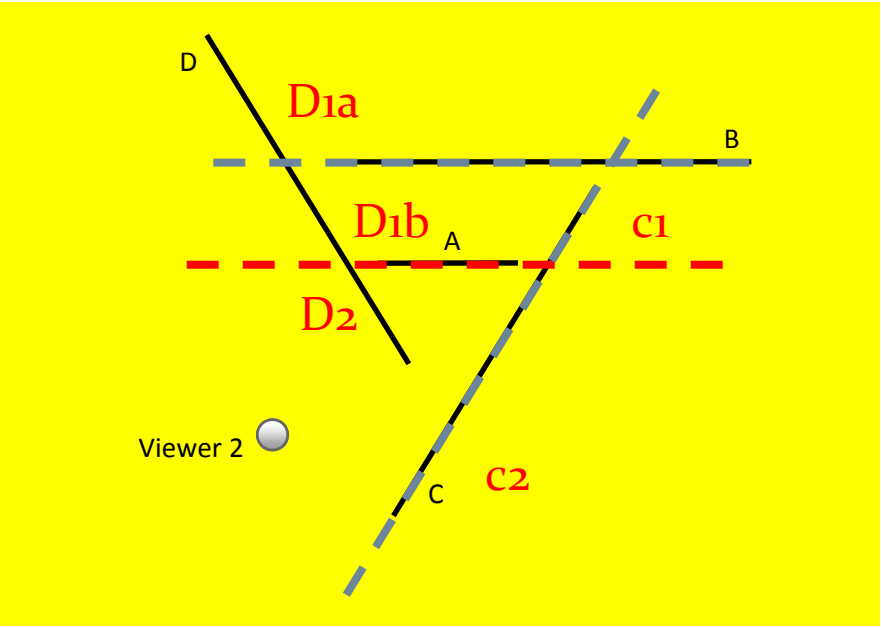
- Viewer 1: C2, D2, A, C1, D1b, B, D1a
  - A simple way to check the answer
  - Draw any line and find the intersecting sequence
    - From far to near:
      - C2, A, D1b
  - Should be the same order as in the answer



Part (B)

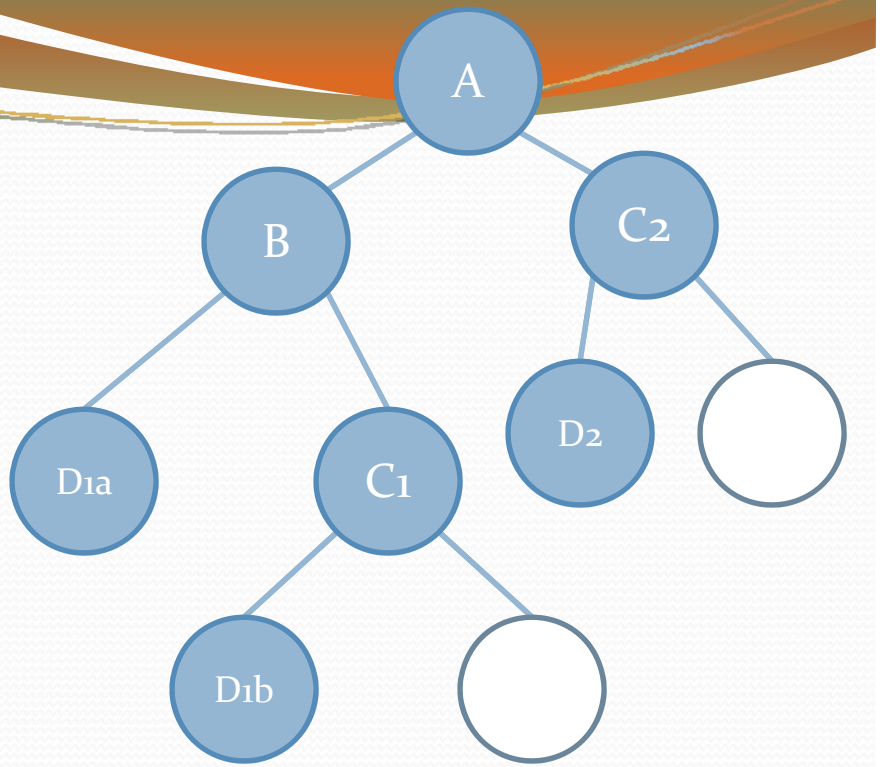
- Viewer 1
- Starting Node: A
- Draw the sub-tree behind the polygon from the view point
  - B

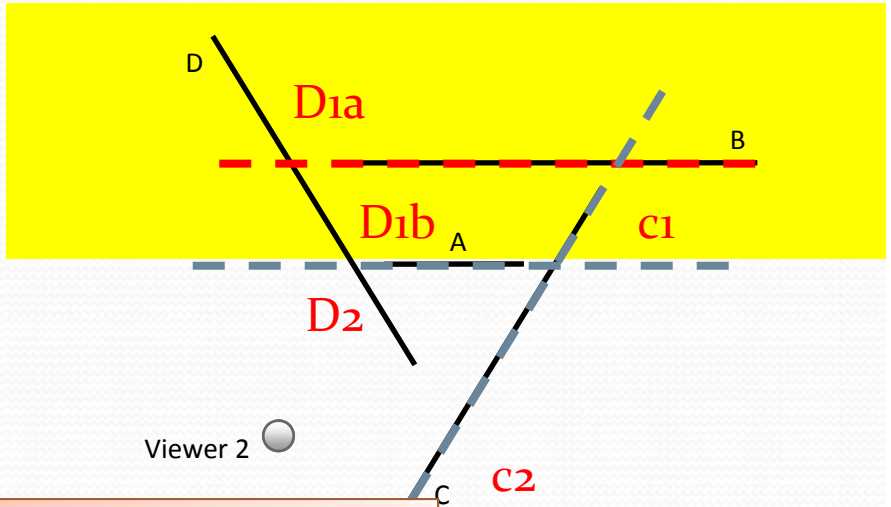




Part (B)

- Viewer 2
- Inside B
- Draw the sub-tree behind the polygon from the view point
  - D1a (+ D1a)
- Back to the node you were in
  - B (+ B)
- Draw the sub-tree in front of the polygon from the view point
  - C1

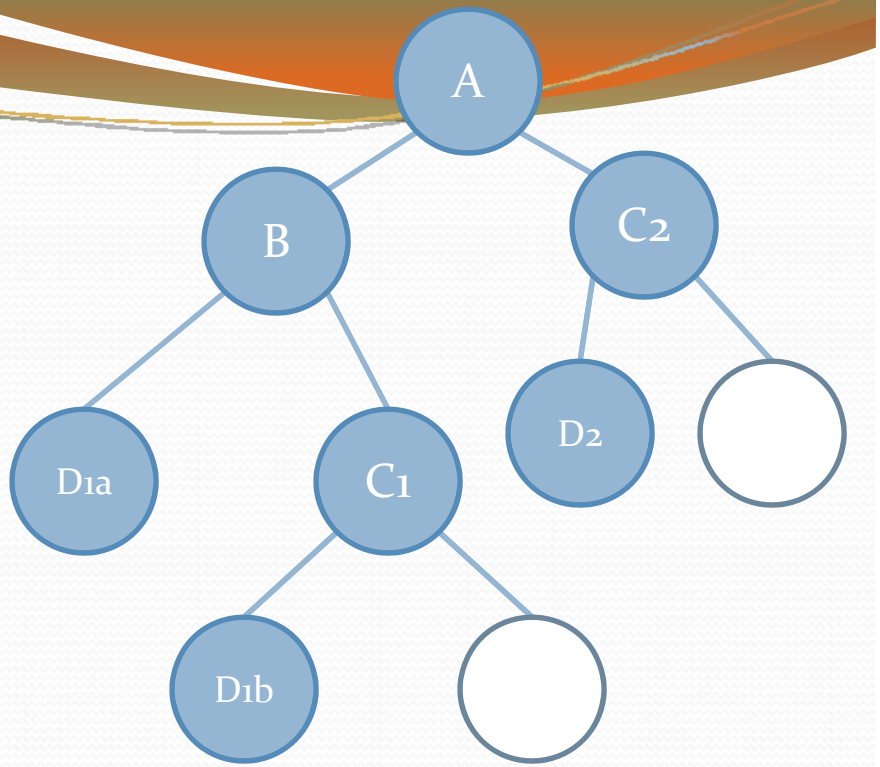


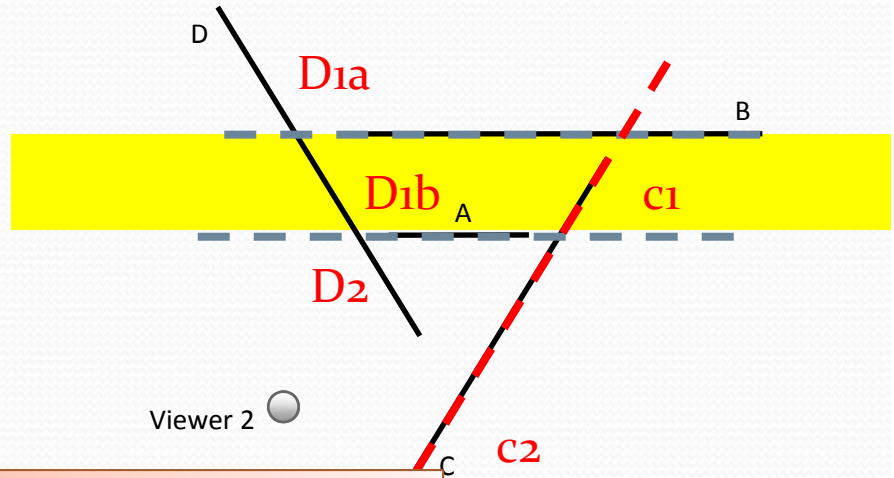


Drawing sequence: D1a, B, ...

Part (B)

- Viewer 2
- Inside C1
- Draw the sub-tree behind the polygon from the view point
  - Nothing
- Back to the node you were in
  - C1 (+ C1)
- Draw the sub-tree in front of the polygon from the view point
  - D1b (+ D1b)
- C1 finished, back to B
- B finished, back to A

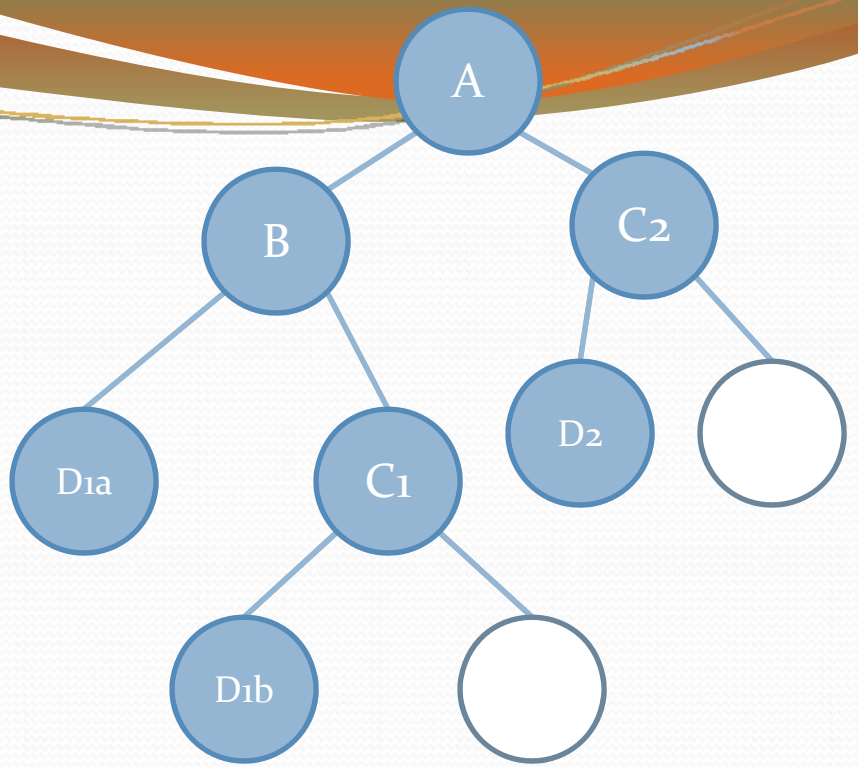


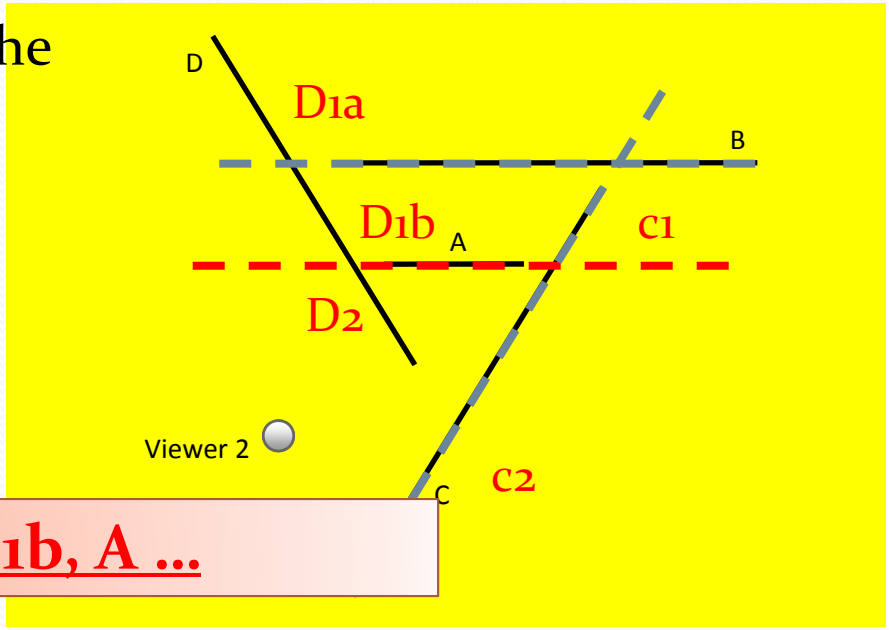


Drawing sequence: D1a, B, C1, D1b ...

Part (B)

- Viewer 2
  - Inside A
  - You had finished one subtree
  - Draw the polygon of the node
    - A (+ A)
  - Draw the sub-tree in front of the polygon from the view point
    - C2

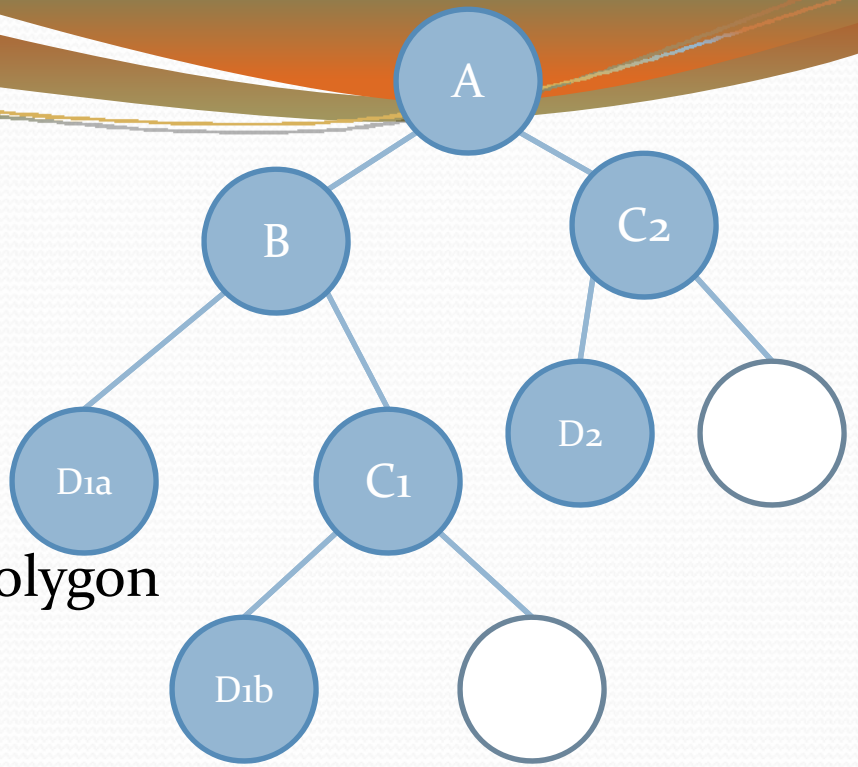


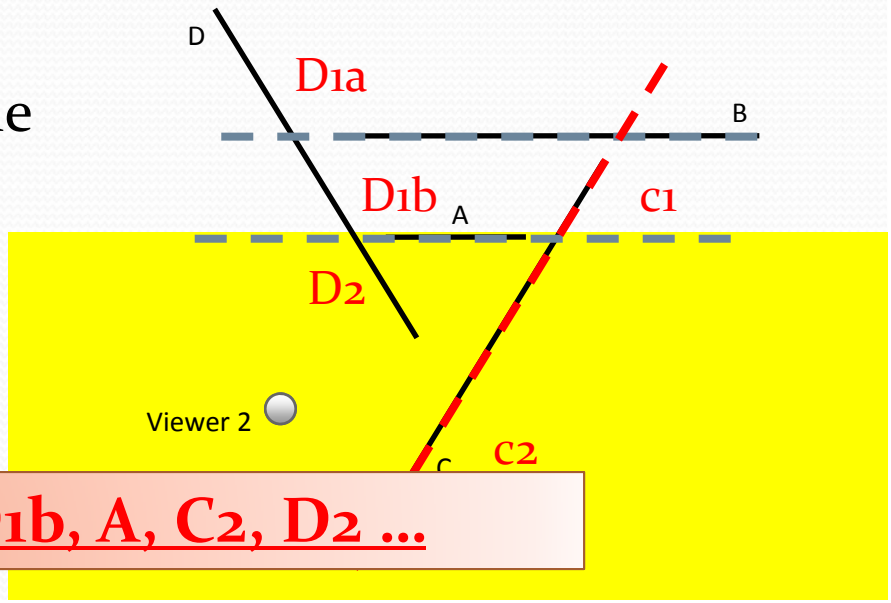


Drawing sequence: D1a, B, C1, D1b, A ...

Part (B)

- Viewer 1
- Inside C2
- Draw the sub-tree behind the polygon from the view point
  - Nothing
- Back to the node you were in
  - C2 (+ C2)
- Draw the sub-tree in front of the polygon from the view point
  - D2 (+ D2)
- C2 finish, back to A

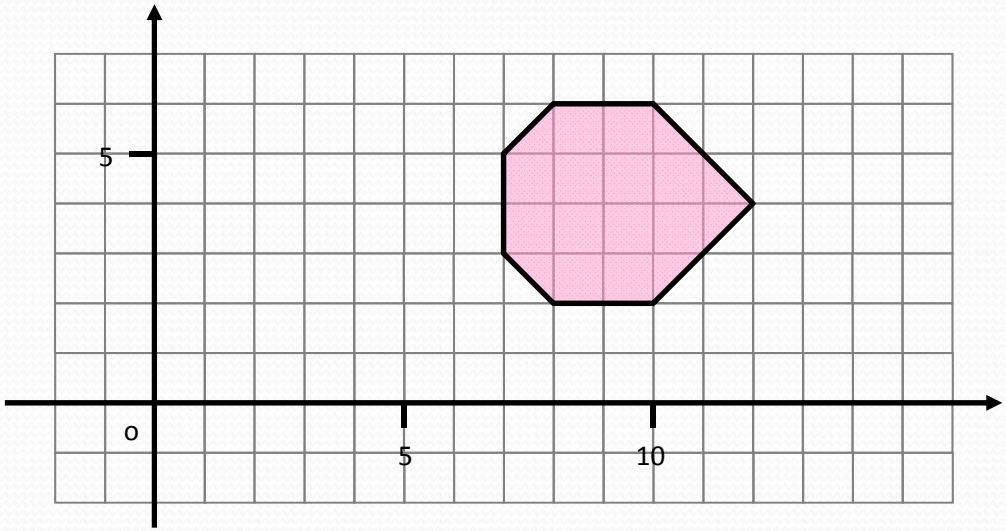




Drawing sequence: D1a, B, C1, D1b, A, C2, D2 ...

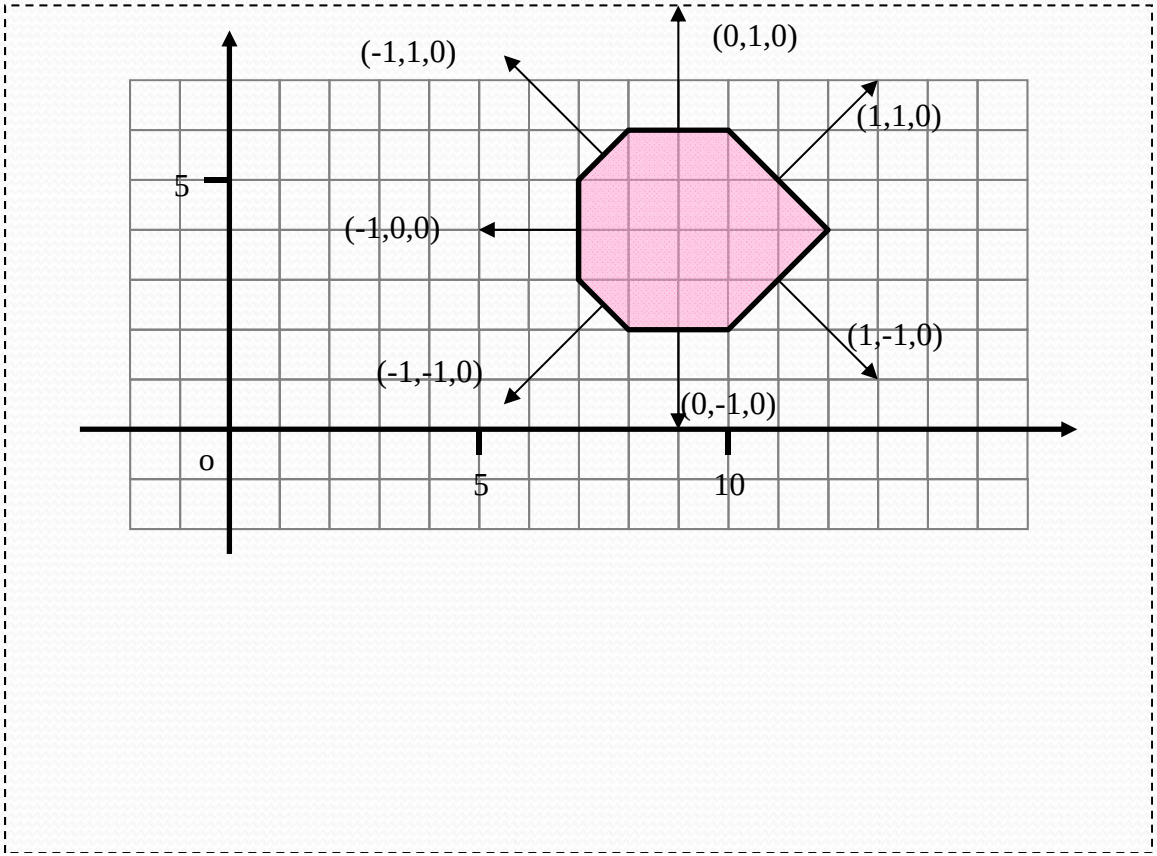
Question 2

- An object (the cross section) is placed at the space like the figure below, with the camera positioned at the **origin**.

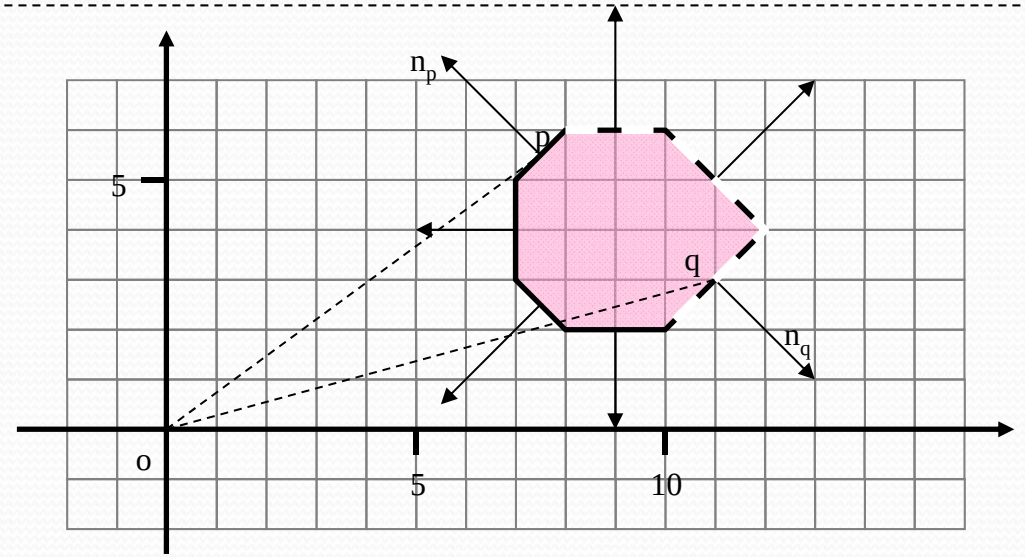


Question 2a

- What is the normal vector for each polygon?



Question 2



For example:

$n_p = (-1,1,0)$
$po = o - p = (-7.5,-5.5,0)$
dot product:
$< n_p, po > = 7.5 - 5.5 = 2 > 0$

$n_q = (1,-1,0)$
$qo = o - q = (-11,-3,0)$
dot product:
$< n_p, qo > = -11+3 = -8 < 0$