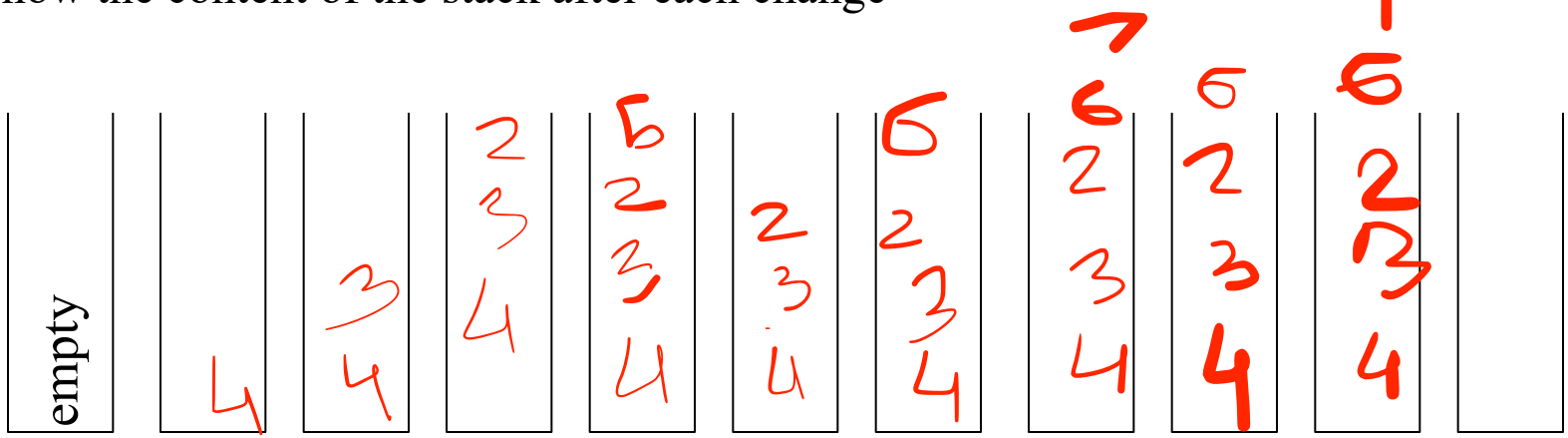
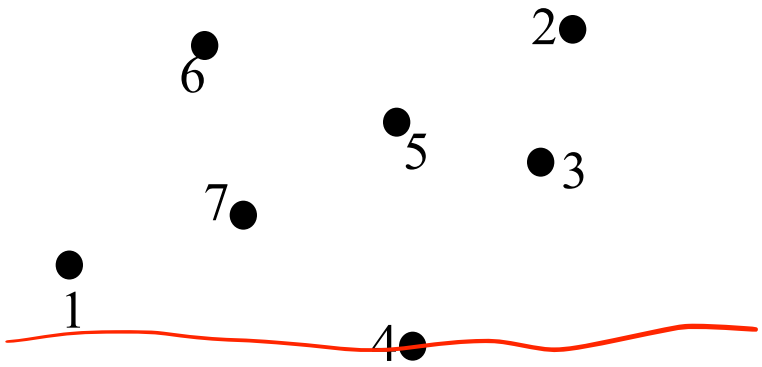
1. For Graham's scan finding convex hull of the point set given below:

- Give the sorted sequence of points for Graham scan 4 3 2 5 6 7 1

- Show the content of the stack after each change



- Give the convex hull of this point set 4 3 2 6 1

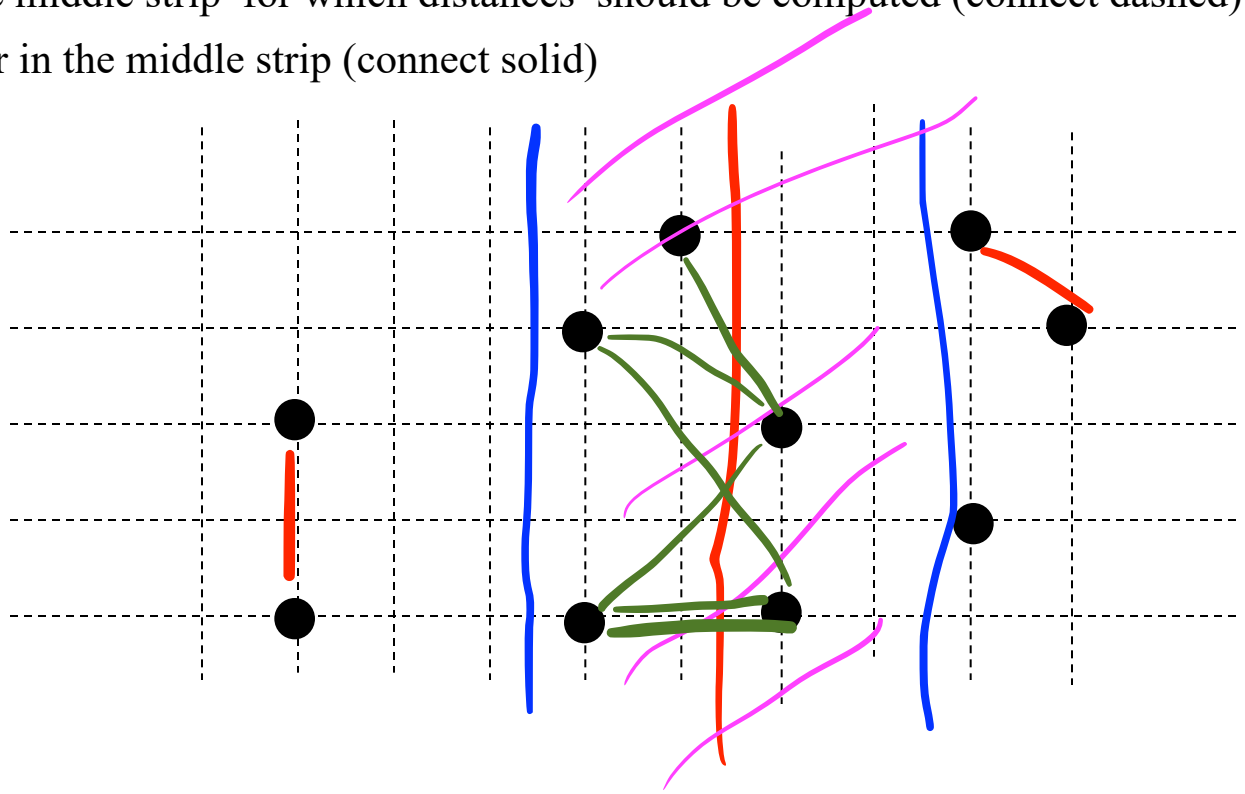


2. Below given a point set in the **rectilinear** metric (the height/width of any cell=1) where the closest pair of points should be found using divide and conquer. Show

- the first partition of the point set (draw a line)
- the closest pair in the left part (connect solid), δ_{left} = 2 ,
  and the right part (connect solid), δ_{right} = 2

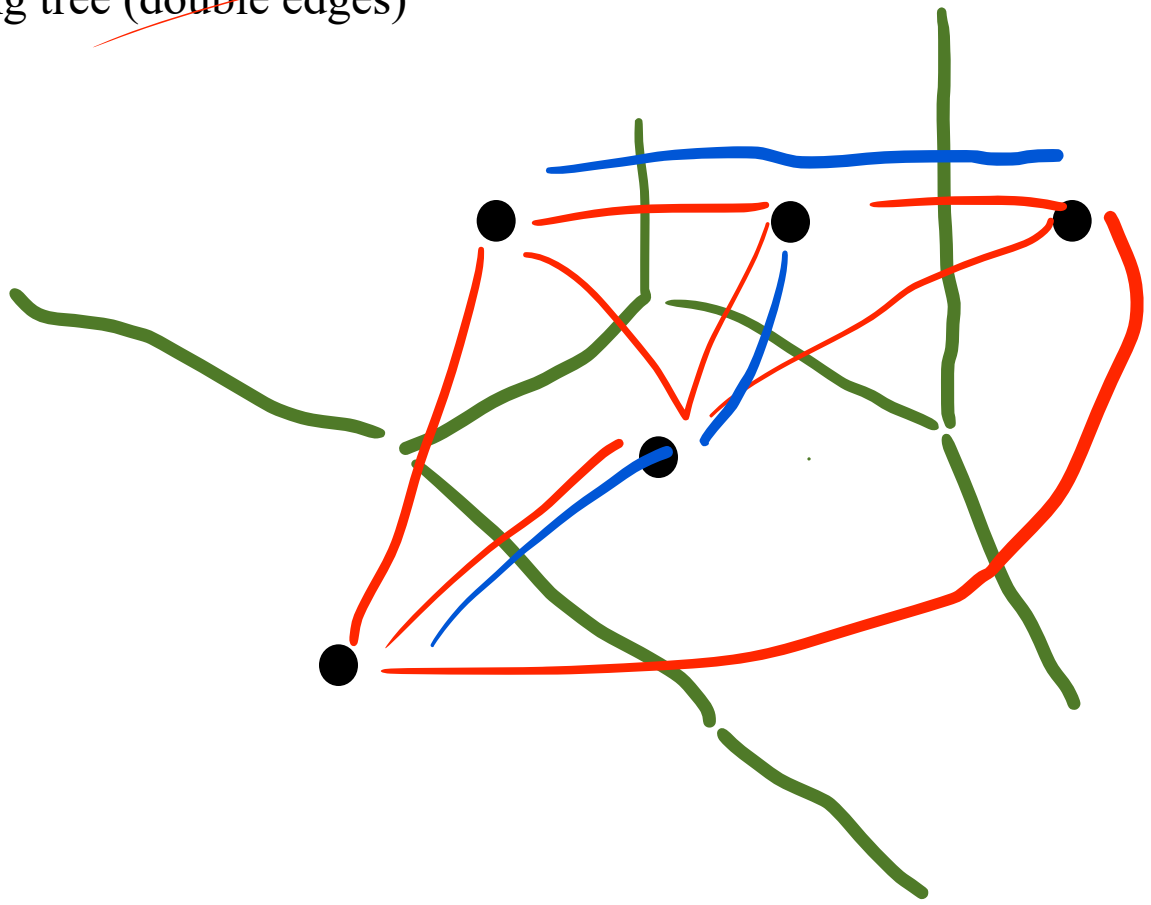
$\delta = 2$

- the middle strip (shade)
- pairs in the middle strip for which distances should be computed (connect dashed)
- closest pair in the middle strip (connect solid)



3. Below given a point set in the **Euclidean** metric. Draw

- Voronoi regions (dashed edges)
- Voronoi graph / Delanau triangulation (solid edges)
- minimum spanning tree (double edges)



4. Prove, that the Maximum Independent set problem (finding maximum number of vertices pairwise non-adjacent) is in class NP

a) Optimization formulation

Given: A graph G=(V,E),
Find: a subset X of V w/o edges b/w them such that |X| is maximized

b) Decision formulation

Given: A graph G=(V,E), a number A
Does it exist a subset X of V w/o edges b/w them such that |X| => A?

c) Polynomial-size certificate

an independent (subset X) of V of size at most A

d) Polynomial time verification algorithm

Check that |X|<=A and that no edges b/w vertices in X

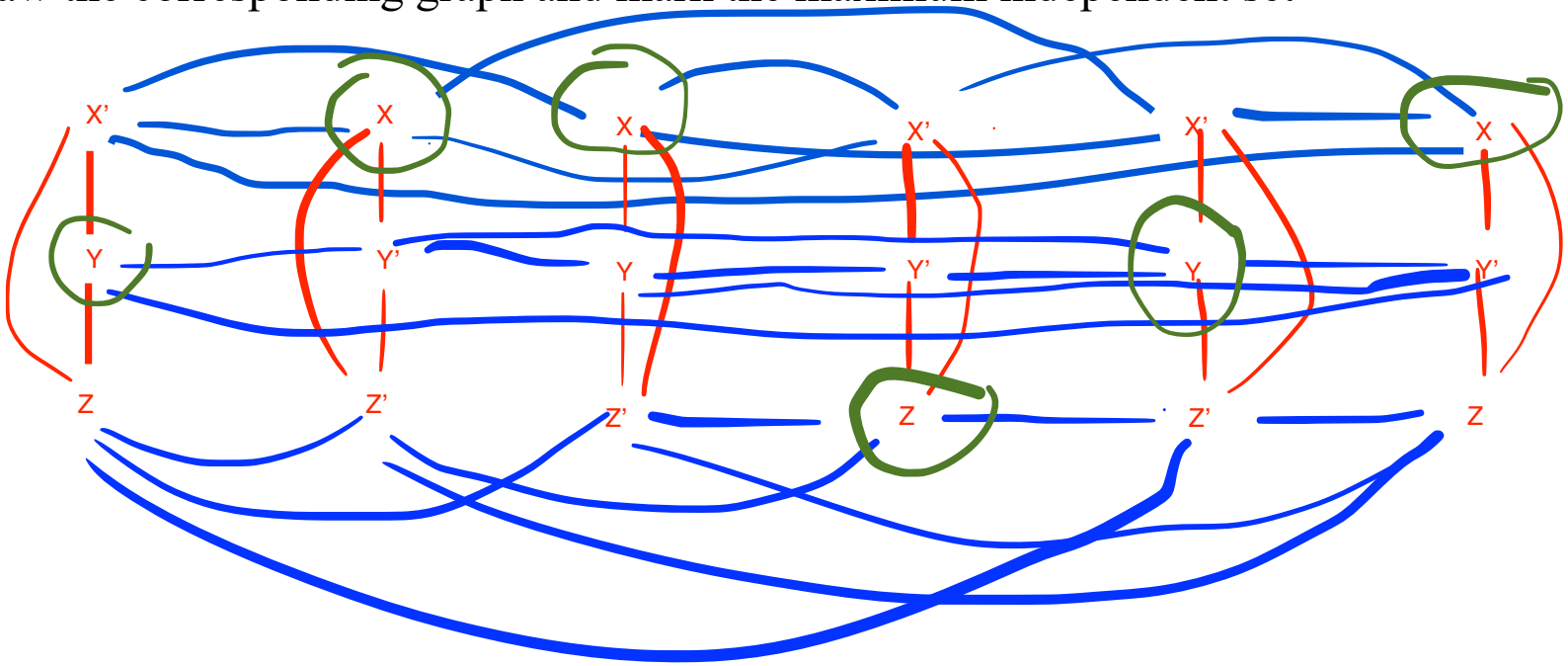
5. For the 3-CNF

f = (x' +y +z)& (x+y'+z')&(x+y+z')& (x'+y'+z)&(x'+y+z') &(x+y'+z)

- give 0-1 assignment to variables such that f=1 x =y=z=1, i.e. x=1, y=1, z=1

- give 0-1 assignment to variables such that f=0 x' =y=z=0, i.e. x=1, y=0, z=0

-Draw the corresponding graph and mark the maximum independent set



6. In the following graph find

- Maximum Independent Set 2 4 6
- Minimum Vertex Cover 1 3 5 7 8 9
- Maximum Clique 1 4 5 8 9