Miguel Alcón Doganoc
Algorithms for VLSI
October 25, 2019

Exercises on physical design

1 Quadratic placement

Show the two linear system of equations for the x and y coordinates.

Our system of equations is

$$AX - b_x = 0, \text{ and } AY - b_y = 0$$

where

$$A = \begin{bmatrix} 3 & 0 & -1 & -1 \\ 0 & 5 & -1 & 1 \\ -1 & -1 & 4 & 0 \\ -1 & -1 & 0 & 4 \end{bmatrix} \quad X = \begin{bmatrix} X_a \\ X_b \\ X_c \\ X_d \end{bmatrix} \quad b_x = \begin{bmatrix} 5 & 6 & 5 & 10 \end{bmatrix} \quad Y = \begin{bmatrix} Y_a \\ Y_b \\ Y_c \\ Y_d \end{bmatrix} \quad b_y = \begin{bmatrix} 0 & 12 & 2 & 5 \end{bmatrix}$$

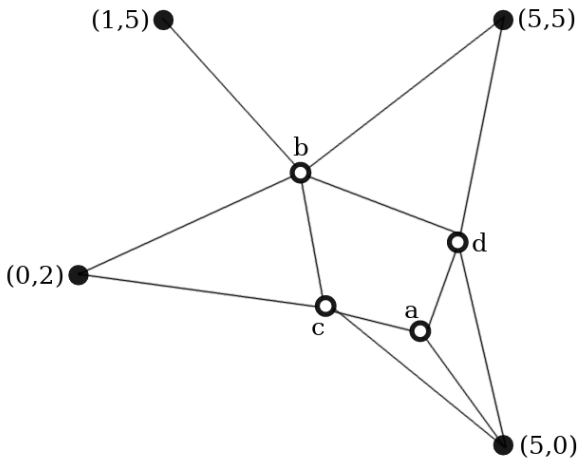
So, the final systems are

$$\begin{cases} 3X_a - X_c - X_d - 5 = 0 \\ 5X_b - X_c - X_d - 6 = 0 \\ -X_a - X_b + 4X_c - 5 = 0 \\ -X_a - X_b + 4X_d - 10 = 0 \end{cases} \qquad \begin{cases} 3Y_a - Y_c - Y_d = 0 \\ 5Y_b - Y_c - Y_d - 12 = 0 \\ -Y_a - Y_b + 4Y_c - 2 = 0 \\ -Y_a - Y_b + 4Y_d - 5 = 0 \end{cases}$$

Solve the systems of equations and draw the final solution in a 2D plot.

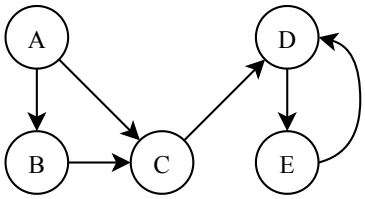
The final solution is

$$a = (\frac{177}{44}, \frac{59}{44}) \qquad b = (\frac{115}{44}, \frac{141}{44}) \qquad c = (\frac{32}{11}, \frac{18}{11}) \qquad d = (\frac{183}{41}, \frac{105}{44})$$

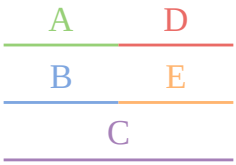


2 Channel Routing

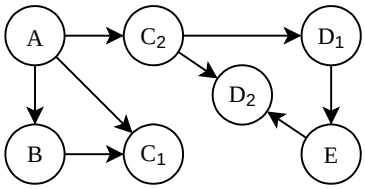
Draw the vertical constraint graph without splitting the nets.



Determine the zone representation for the nets.



Draw the vertical constraint graph with net splitting.

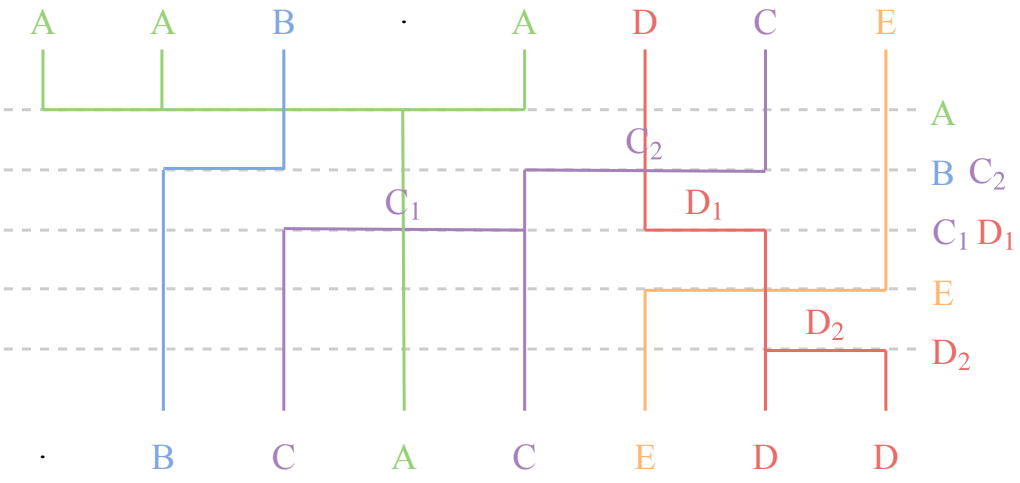


Find the minimum number of required tracks with net splitting and without net splitting.

Since without net splitting nodes D and E creates a loop in the VCG, it is impossible to route this channel. With net splitting, I found the number of tracks after applying the Dogleg Left-Edge algorithm, which is 5.

Use the Dogleg Left-Edge algorithm to route this channel. For each track, state which nets are assigned. Draw the final routed channel.

The assignment of nets to tracks is specified at the right of the route diagram.



3 Sequence pairs