National Taiwan University of Science and Technology
Department of Electrical Engineering

Software Development for Electronic Design Automation, Spring 2024

Sample Problems

1. Given the following expression, $E = 12V34HVH5$.

   (a) Dose the above expression have the balloting property? Justify your answer.

   (b) Is E a normalized Polish expression? If not, exchange an operator and an operand to transform E into a normalized Polish expression E'.

   (c) Give the slicing tree of E if E is a normalized Polish expression. Otherwise, Give the slicing tree corresponding to the "resulting" normalized Polish expression E'.

   (d) Assume that the modules $1, 2, ..., 5$ have the sizes and shapes indicated in Figure 1. If all modules are rigid (hard) and have free orientations, what will be the size of the smallest bounding rectangle corresponding to the "resulting" normalized Polish expression E'? Show all steps that lead to your answer.

Module No.	Width	Height
1	2	3
2	2	2
3	5	3
4	3	3
5	1	3

Figure 1: Module dimensions for Problem 4(d).

   (e) Give a B*-tree for the floorplan derived in (d).

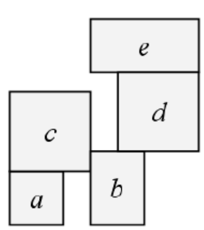
   (f) Show all steps for computing the coordinates of the modules from the resulting B*-tree of (e).

2. Consider the packing of five modules, a, b, c, d, and e shown in Figure 2.

   (a) Derive the sequence pair $S = (\Gamma_+, \Gamma_-)$ for the packing shown in Figure 2. Show your procedure.

   (b) Draw the horizontal and vertical constraint graphs G_H and G_V for S. Label the corresponding weights for G_H and G_V. (Note that you do not need to draw transitive edges.)

   (c) Evaluate the cost (i.e., minimum area required) for the $S = (\Gamma_+, \Gamma_-)$-packing by using its horizontal and vertical constraint graphs. Show your work.



Block	Width	Height
a	2	2
b	2	3
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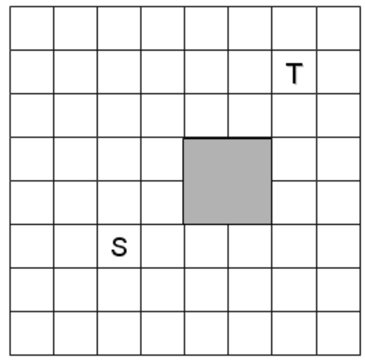
d	3	3
e	4	2

Figure 2: A packing of the five modules for Problem 5.

3. Find the path from S to T by the A*-search routing for the instance shown below by defining $g(x)$ to be the label from the source S to the current node of x and $h(x)$ to be the Manhattan distance between x and the target T, where the cost function is given by $f(x) = g(x) + h(x)$. Break the tie by picking the grid cell on the right of the current position. (Please show you work and labels step by step.)

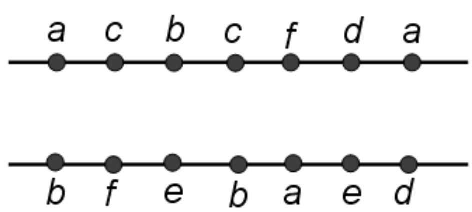


4. Given the instance of the channel routing problem shown below.

   (a) Determine a tight lower bound on the channel width (# tracks).

   (b) Draw the HCG and VCG.

   (c) Can the constrained left-edge algorithm apply to this channel routing instance? Route the instance if this figure gives a feasible routing instance; explain why the algorithm does not apply to this instance, otherwise.



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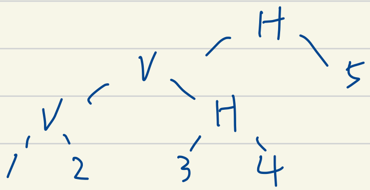
(a) balloting property = # operand > # operator in every subexpression

$\Rightarrow$ not satisfied in subexpression "$12V34HV\underline{H}$".

(b) No, although skewed, but it doesn't fit property above

$\Rightarrow E' = 12V34HV\underline{5}\underline{H}$ (M3)

(c) 1 2 V 3 4 H V 5 H



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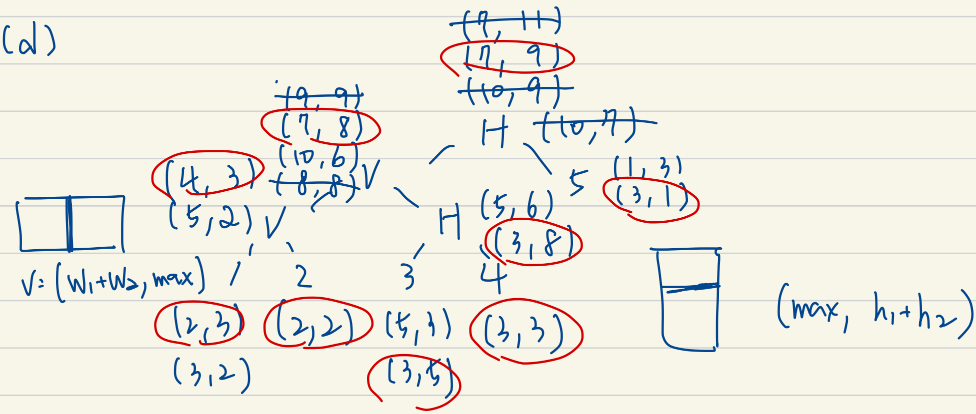
(d)



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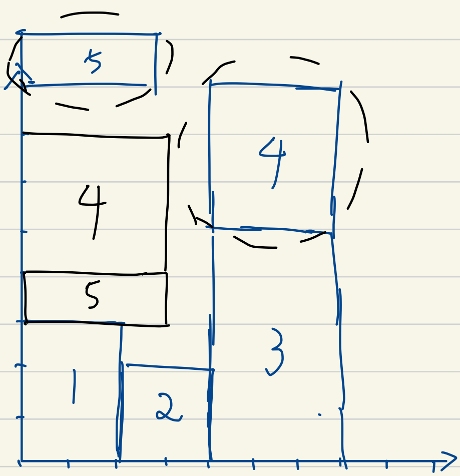
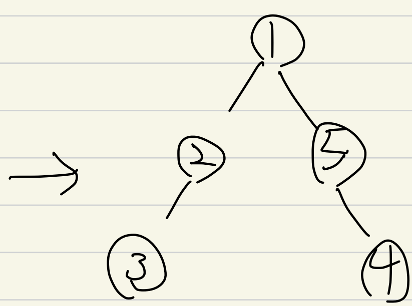
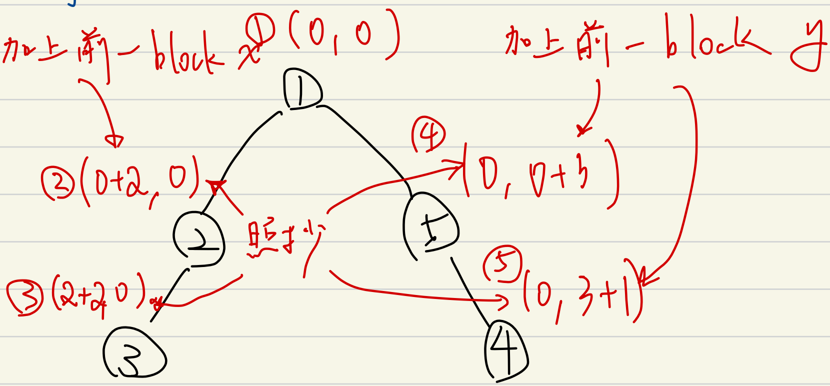




(f) Pre-order traversal



2. Consider the packing of five modules, a, b, c, d, and e shown in Figure 2.

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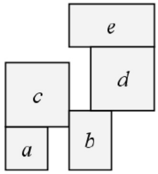

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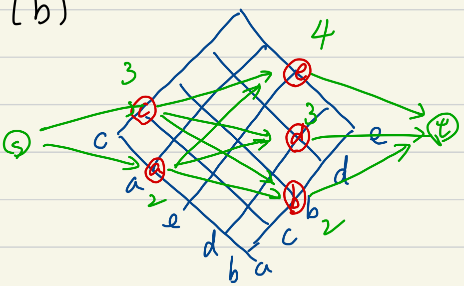
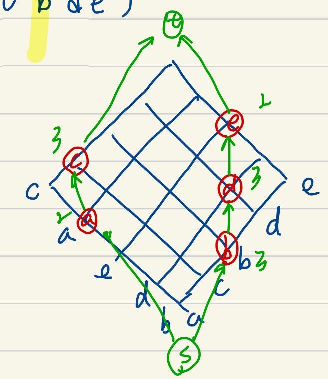
Figure 2: A packing of the five modules for Problem 5.

(a) $(\Gamma^+, \Gamma^-) = (c\,a\,e\,d\,b,\ a\,c\,b\,d\,e)$

(b)



HCG, weight = width



VCG, weight = height

(c) "longest path alg on DAG"

(s→c→e→t) (s→b→d→e→t)

⇒ HCG ⇒ 7, VCG = 8

⇒ cost = 56

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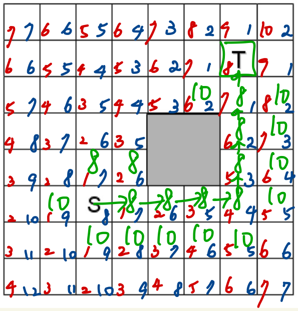
$f(x)$, $g(x)$, $h(x)$



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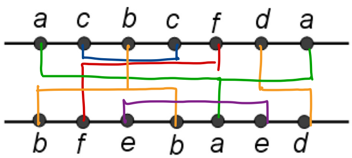
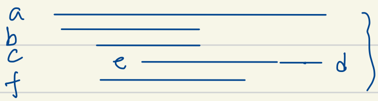
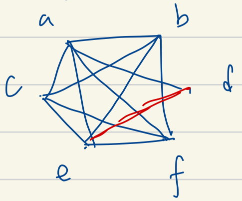
1 : c
2 : f
3 : a
4 : b, d
5 : e



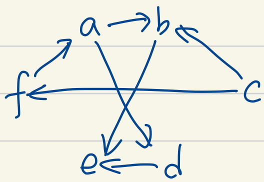


tracks = 5

(b) HCG : undirected graph (重疊)



VCG : directed graph (誰在誰上面)



(c) VCG : 可以，有 "無 In-edge 的 vertex."