Homework 3.

- The file name of your homework (in PDF) should be in the format: "學號-作業編號.pdf". For example: 00957999-hw3.pdf
- Please submit your homework to Tronclass **before 23:59, December 15, 2022.**

(可以用 word 檔寫完後轉成 pdf 檔上傳，或是手寫後拍照後存成 pdf 檔上傳)

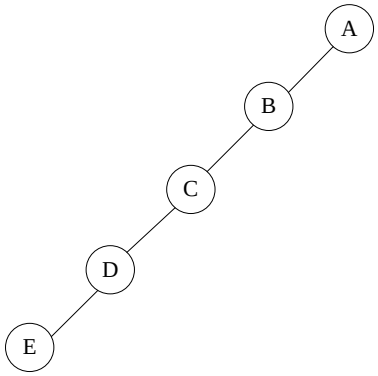
1. (10%) What is the maximum number of nodes in a *k*-ary tree of height *h*? **Prove your answer.**

   Ans = $k^0 + k^1 + k^2 + \dots k^h = (k^{h+1} - 1) / (k - 1)$

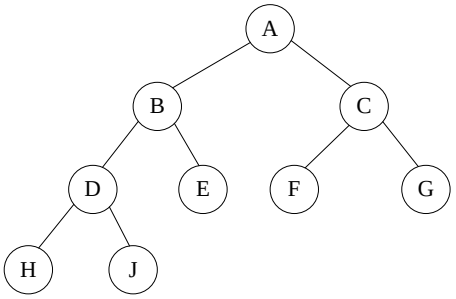
   利用等比級數公式 $(a_0(r^n-1))/(r-1)$

   $a_0 = k^0 = 1$，項數 $n = h + 1(0 \sim h)$，公比 $r = k$

2. (15%) Write out the **inorder**, **preorder**, **postorder**, and **level-order** travels for the binary trees (a) and (b).



(a)



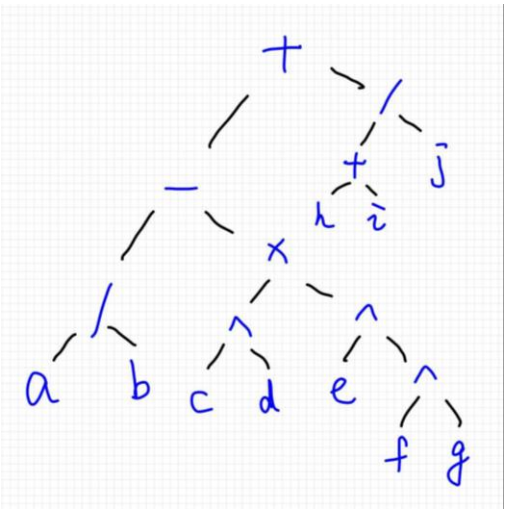
(b)

(a) Inorder: EDCBA
Preorder: ABCDE
Postorder: EDCBA
Level-order: ABCDE

(b) Inorder: HDJBEAFCG
Preorder: ABDHJECFG
Postorder: HJDEBFGCA
Level-order: ABCDEFGHJ

3. (10%) Considering operator precedence, draw the expression tree of the infix expression. . **(^符號表示次方，且^的優先順序大於*)**

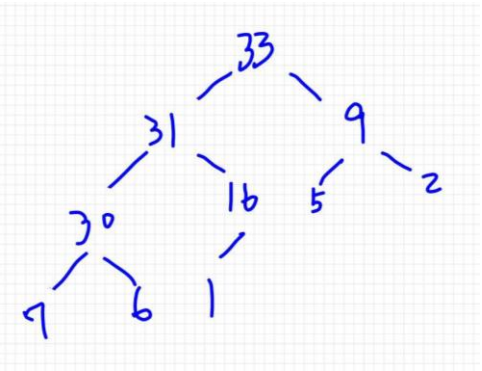
a / b – (c ^ d) * e ^ (f ^g) + (h + i) / j



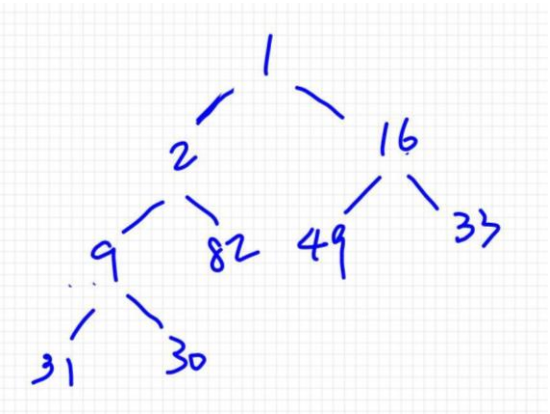
4. (20%) Suppose that we execute the following instructions:

push 7, **push** 9, **push** 16, **push** 30, **push** 49, **pop**, **push** 82, **push** 5, **push** 33, **push** 31, **push** 6, **pop**, **push** 2, **push** 1.

(a) What is the resultant heap if we use a max heap?



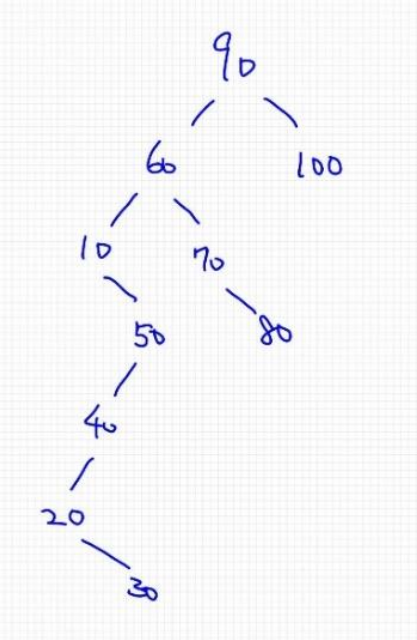
(b)What is the resultant heap if we use a min heap?



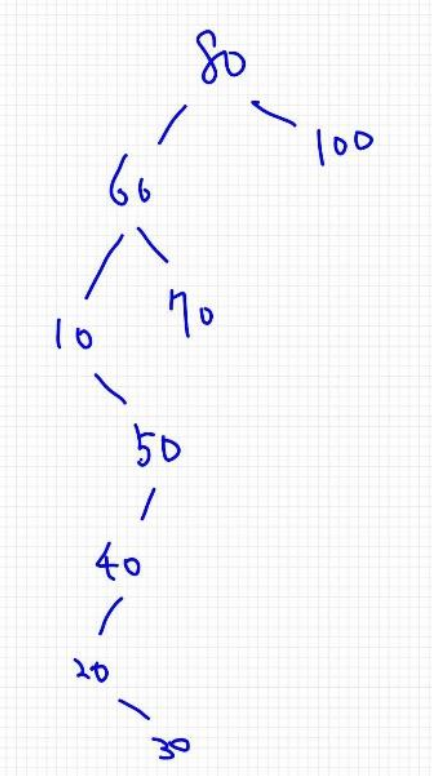
5. (10%) Given the following numbers:

90, 60, 70, 100, 10, 50, 40, 20, 30, 80.

(a) Construct the binary search tree.



(b) From (a), what does the binary search tree become if we delete 90 using the rule "replaced by the largest element in its left subtree"?

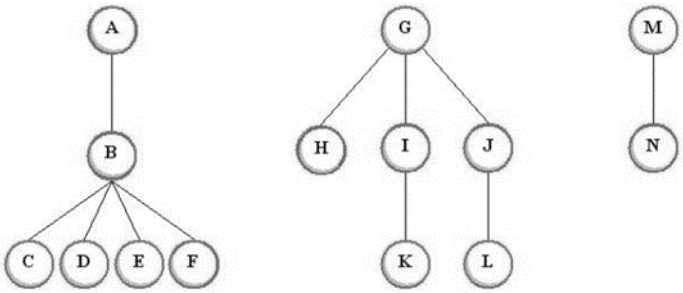


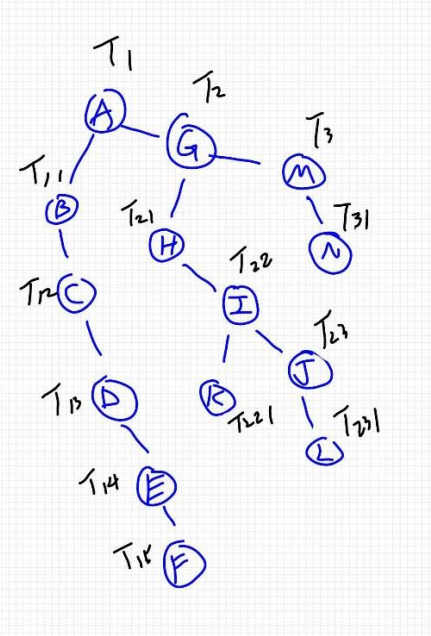
6. (10%) How many distinct 7-node binary tree structures can we create?

Ans: $(1/(7 + 1)) * C_7^{14} * 7! = 2162160$

7. (10%) Transforming the forest into a binary tree using the rule:

> - If $T_1,\ldots, T_n$ is a forest of trees, then the binary tree corresponding to this forest, denoted by $B(T_1,\ldots, T_n)$
> - Root equal to root(T_1)
> - Left subtree equal to $B(T_{11}, T_{12}, \ldots, T_{1m})$, where $T_{11}, \ldots, T_{1m}$ are the subtrees of root (T_1); and has right subtree $B(T_2,\ldots, T_n)$





8. (5%) Do the inorder and postorder sequences of a binary tree uniquely define the binary tree? **Explain your answer.**

   是，postorder 的最後一點為 root，inorder 可以切出左右子樹

9. (5%) Do the inorder and preorder sequences of a binary tree uniquely define the binary tree? **Explain your answer.**

   是，preorder 的第一點為 root，inorder 可以切出左右子樹

10. (5%) Do the inorder and level-order sequences of a binary tree uniquely define the binary tree? **Explain your answer.**

    是，level-order 的第一點為 root，inorder 可以切出左右子樹