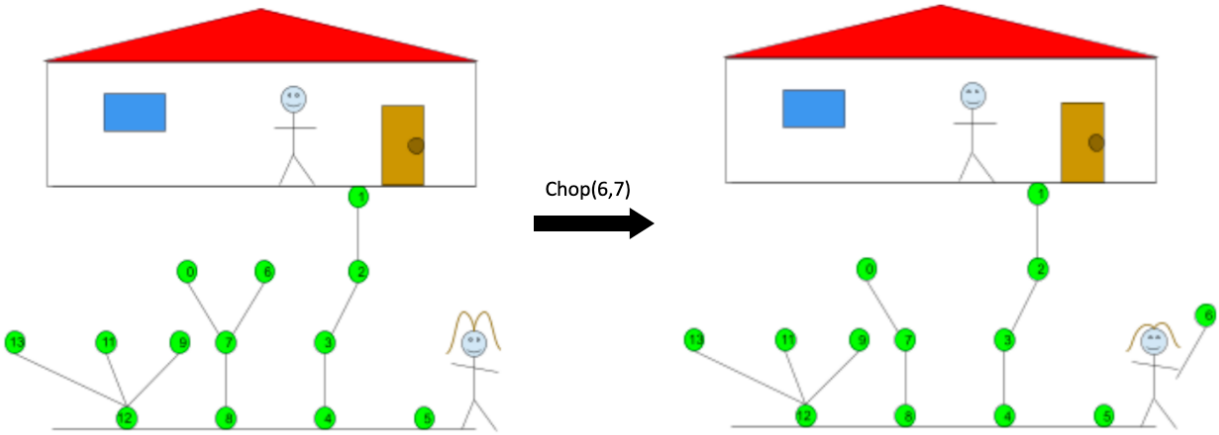
Information Technology Research - Take Home Assignment 1
Spring 2023

This assignment requires you to write code for the following goals.

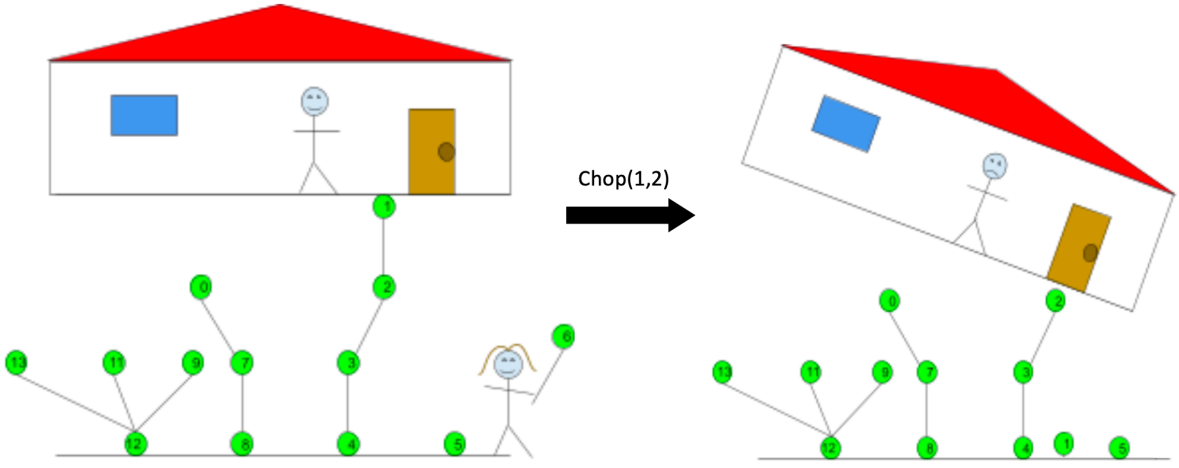
Jack's house is built on top of a set of magic trees (see illustration below). The tallest magic tree (or trees) supports Jack's house. Because of this construction, if only one tree is left supporting the house, the height of this tree under Jack's house can only increase or remain the same height for his house to be safely supported. If this tree's height decreases, the house will collapse. When the house collapses, the magic trees will also be crushed.

For a living, Jack also sells parts of the magic trees. He lets customers to specify which branch of a tree to chop to separate parts of the tree for sell. After chopping, Jack needs to tell the size of the tree (by nodes) that is separated for sell or whether the house will collapse.

For example, in the following figure, the third tree from the left is supporting the house. When the customer, Rose, chopped off branch (6,7), node 6 fell off as the part of the tree for sell.



However, when Rose chopped off branch (1,2), the height of the supporting tree reduced and resulted in the callapse of the house. Luckily, Rose ran away before the callapse.



Due Date:

- 2022/03/22 (Wed) 9 pm

Requirements:

- Modify HW1.java which is posted in the online assignment of the course website.
- If only one tree is left supporting the house, the height of this tree under Jack's house can only increase or remain the same height for his house to be safely supported. If this tree's height decreases, the house will collapse.
- Write the *chop* method to return the number of nodes that will fall when chopping the branch between two tree nodes. e.g., chop(1,2) means we chop the edge between node 1 and node 2. There are also two special cases:
    - If there is no such edge before the house collapsed, return 0.
    - If the house collapses after the chop or has already collapsed, return -1.
- Any tree node that falls from the tree after chopping can no longer to be connected.
- If the house collapsed, all nodes from all trees are considered destroyed and can no longer be connected or chopped.
- The maximum number of magic tree nodes is 1000.
- Modify the *union* method to add nodes to the tree.
    - If adding a new node to a node that do not exist on the tree, return false.
    - Otherwise, return true.
- Some expected outputs are commented in the main function of HW1.java.
- We will also test your code's correctness and robustness with other input and parameters that satisfy our requirement but are not provided in the main function.
- Write a comment for each key operation.

Deliverables:

- HW1.java
    - The java file needs to be uploaded to the course website.

Rules:

- THE ASSIGNMENT HAS TO BE WRITTEN INDEPENDENTLY BY YOU.
- You can discuss ideas with classmates and the TA if you cannot do it on your own, but make sure to credit the person who helped you in the comments.
- If you referenced an online source, also cite it in the comments.
- Late policy: this assignment will be docked 10% for every day late and will not be accepted 5 days after the due date.