CSC148 fall 2013

recursive structures

week 5

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Outline

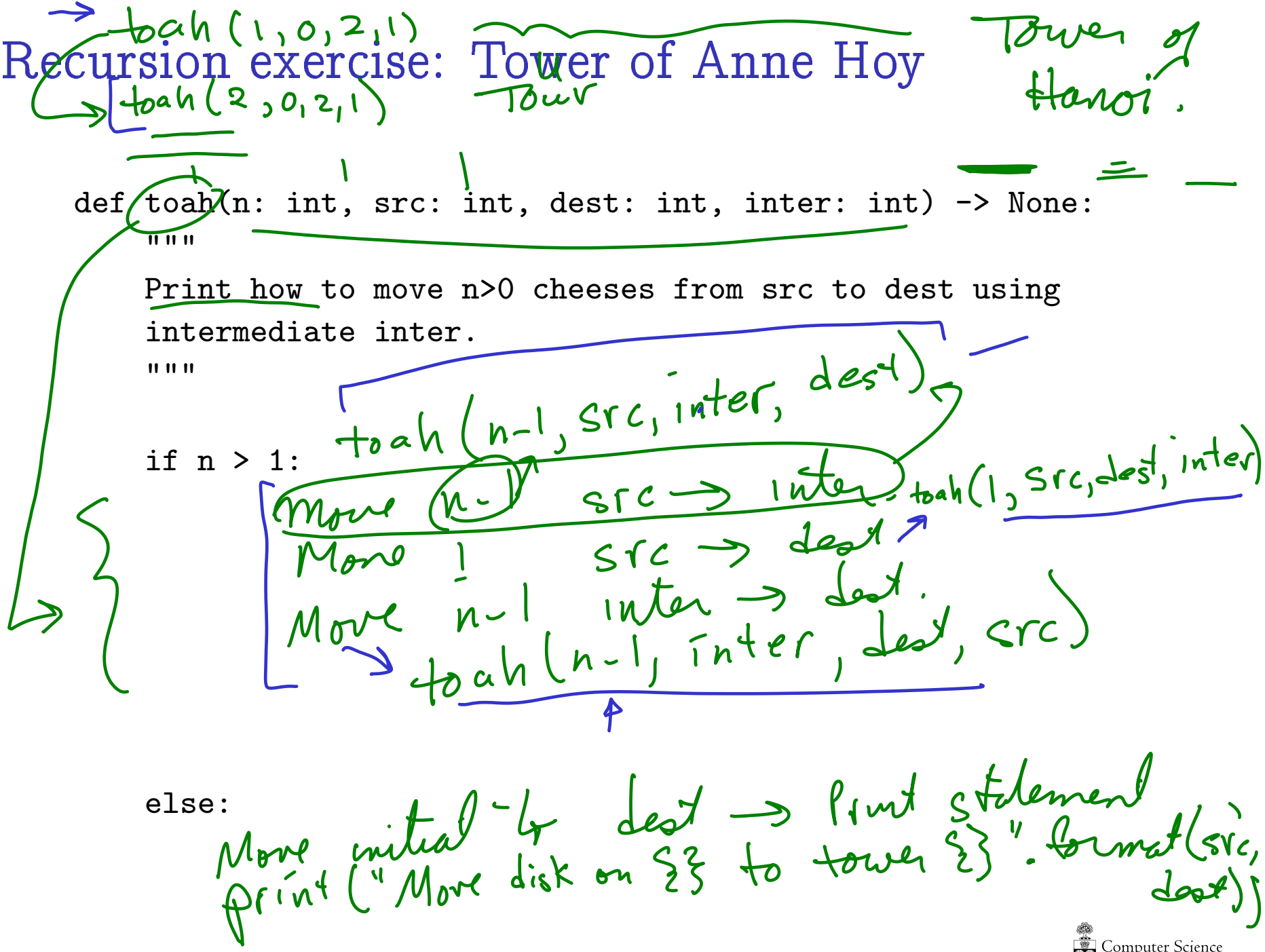
place, add, move

read Manual Controller!

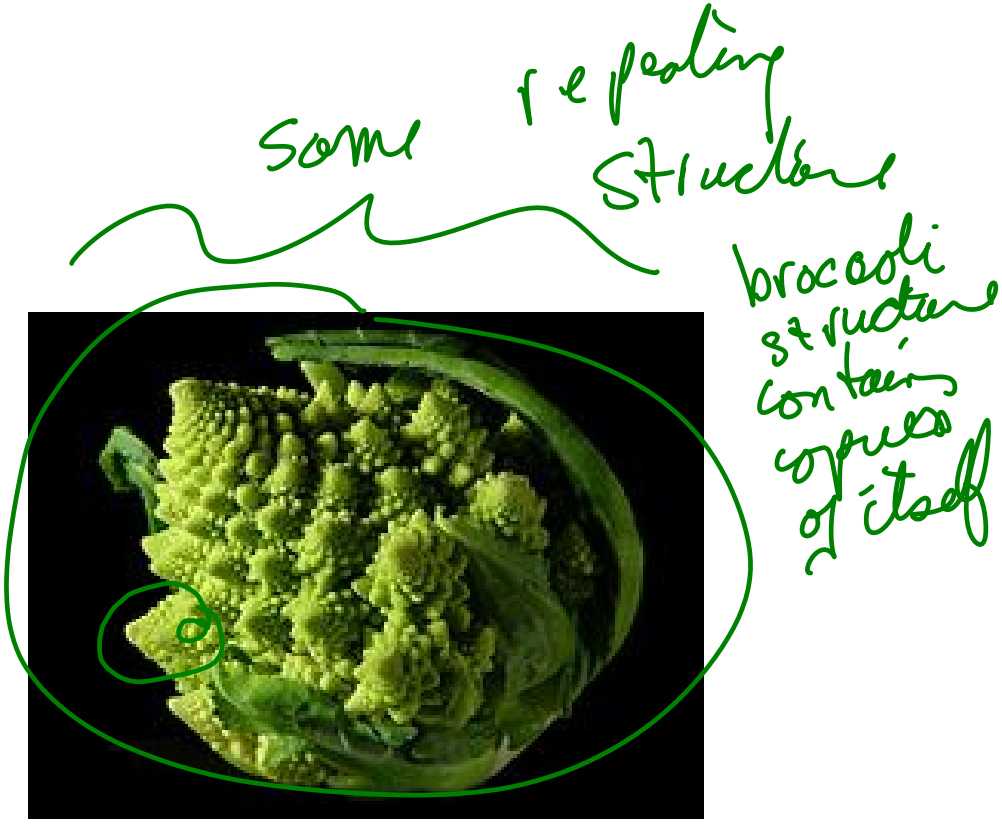
What can we figure out from what's given?

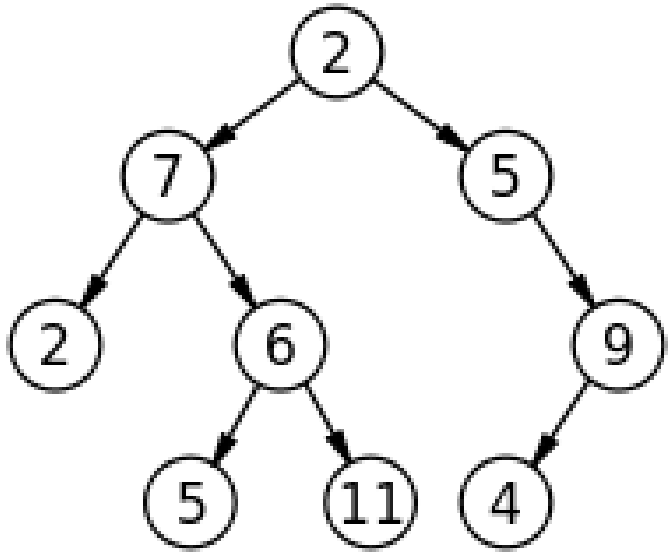
Recursion exercise: Tower of Anne Hoy

```
def toah(n: int, src: int, dest: int, inter: int) -> None:
    """
    Print how to move n>0 cheeses from src to dest using
    intermediate inter.
    """

    if n > 1:

    else:
```



recursion, natural and otherwise





terminology

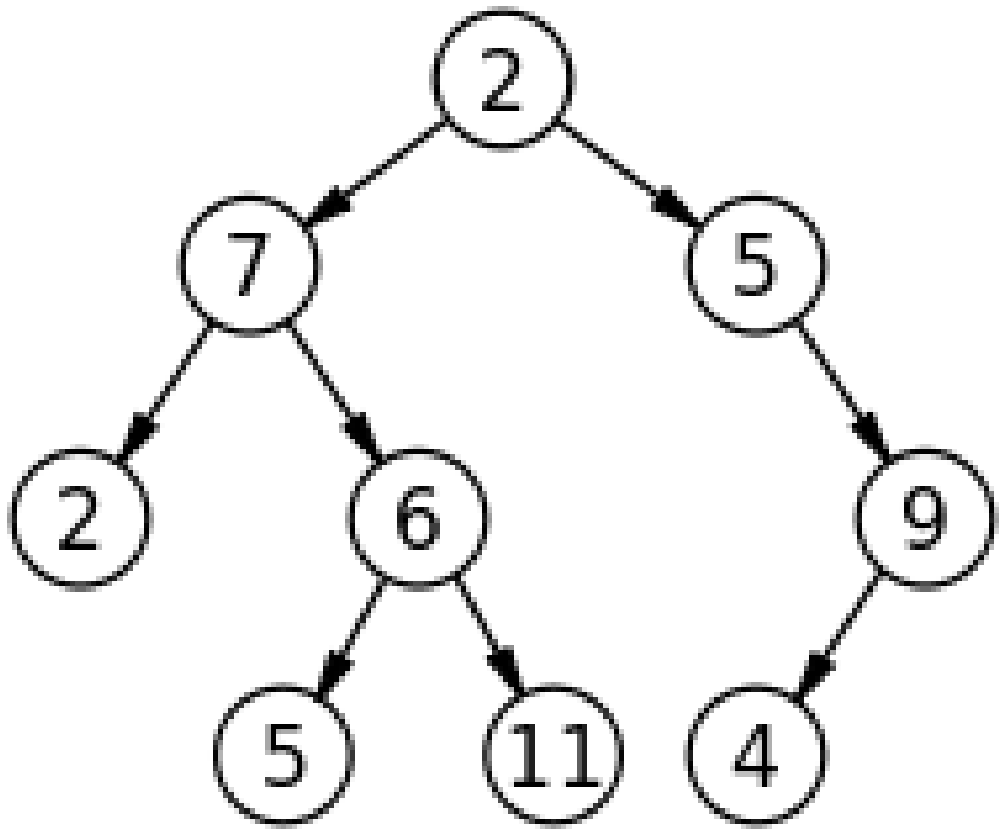
- set of **nodes** (possibly with values or labels), with directed **edges** between some pairs of nodes
- One node is distinguished as **root**
- Each non-root node has exactly one parent.
- A **path** is a sequence of nodes $n_1, n_2, \ldots, n_k$, where there is an edge from n_i to n_{i+1}.
- There is a unique path from the root to each node. In the case of the root itself this is just n_1, if the root is node n_1.
- There are no **cycles** — no paths that form loops.

more terminology

- **leaf**: node with no children
- **internal node**: node with one or more children
- **subtree**: tree formed by any tree node together with its descendants and the edges leading to them.
- **height**: Maximum path length in a tree, where the length of a path is the number of edges in it. **nb**: The length of a path is sometimes defined by the number of **nodes** in it, which makes it taller by 1.
- **arity, branching factor**: maximum number of children for any node.

pre-order traversal

Visit root, then pre-order left subtree, then pre-order right subtree

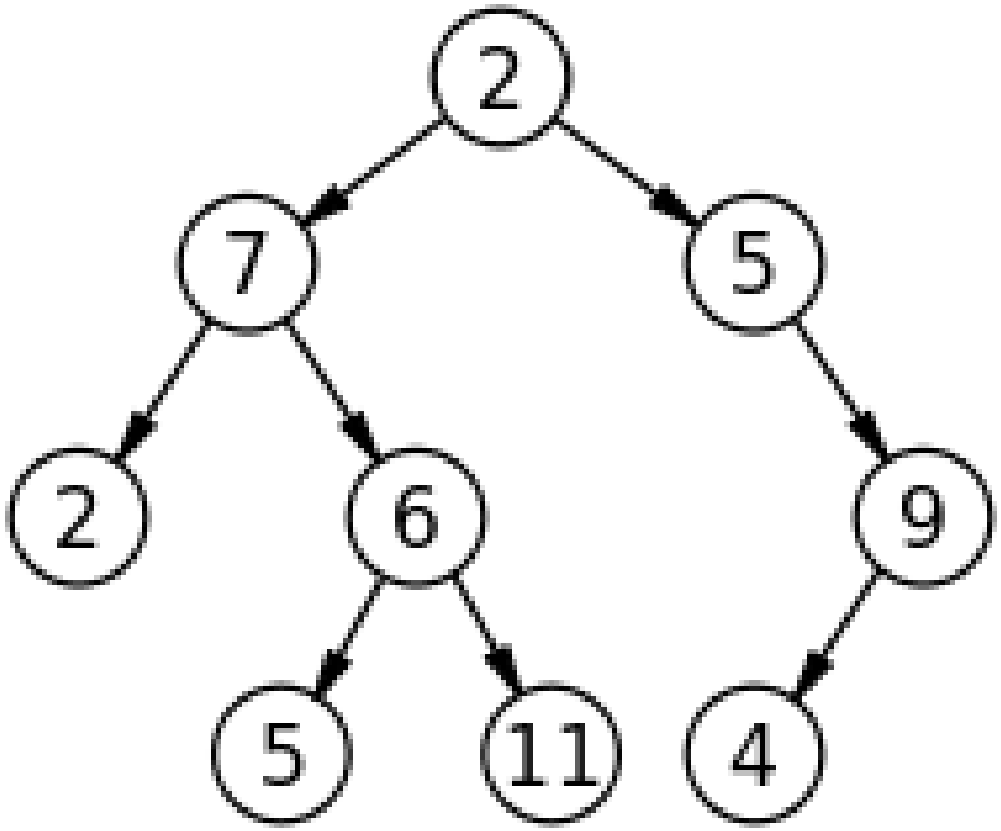


exercise: code for preorder traversal

```
"""
A TreeList is a Python list with 3 elements
  --- element 0 is a value
  --- element 1 is either a TreeList or None
  --- element 2 is either a TreeList or None
"""

def preorder(tl: 'TreeList') -> list:
    """
    Return list of values in tl in preorder

    >>> T = [5, [4, None, None], [3, [2, None, None], [1, None, None]]]
    >>> preorder(T)
    [5, 4, 3, 2, 1]
    """
```

in-order traversal

Visit in-order left subtree, then root, then in-order right subtree



post-order traversal

Visit post-order left subtree, then post-order right subtree, then root