Review of Lab04, Hw04, Lab05

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Lab04p2: Preorder

```
def preorder(t):
    Return a list of the entries in this tree in the order that they would be
visited by a preorder traversal.
```

Lab04p2: Preorder

```
def preorder(t):
    if is_leaf(t):
        return [label(t)]
```

Lab04p2: Preorder

```
def preorder(t):
    if is_leaf(t):
        return [label(t)]
    else:
        result = [label(t)]
        for b in branches(t):
            result.extend(preorder(b))
        return result
```

They are equivalent!

Lab04p2: Preorder

```
def preorder(t):
    result = [label(t)]
    for b in branches(t):
        result.extend(preorder(b))
    return result
```

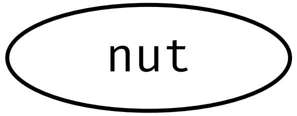
```
def preorder(t):
    return sum([preorder(b) for b in branches(t)], [label(t)])
```

Hw04p3.1: Nut Finder

```
def nut_finder(t):
    Returns True if T contains a node with the value 'nut' and False otherwise.
```

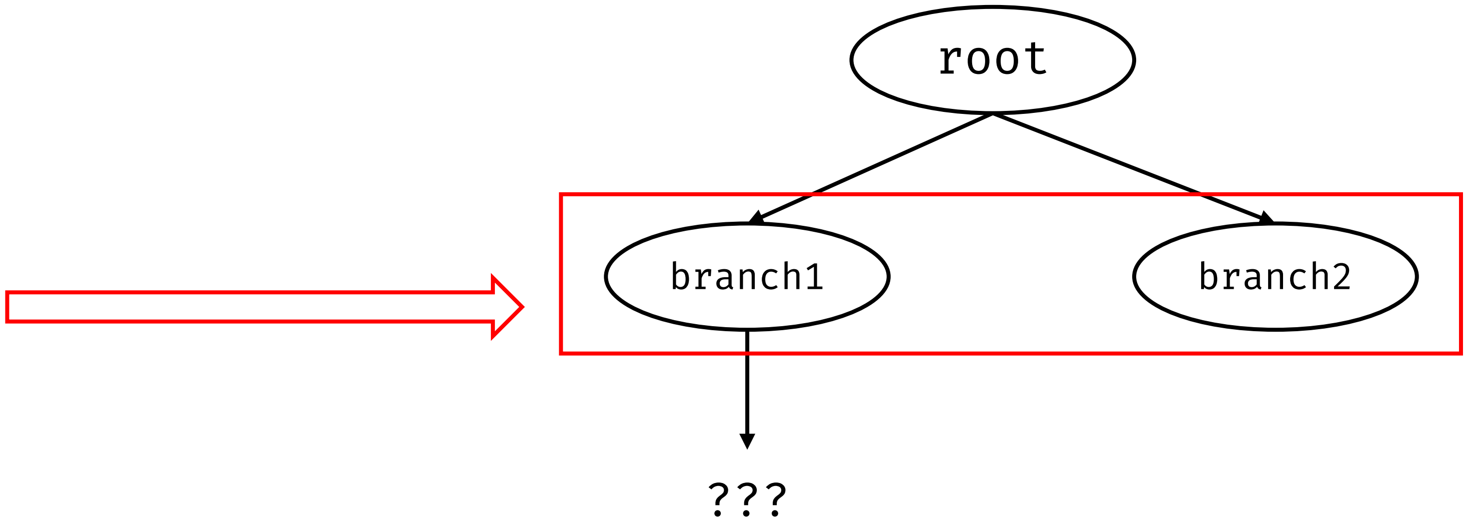
Hw04p3.1: Nut Finder

```
def nut_finder(t):
    if label(t) == ‘nut’:
        return True
```



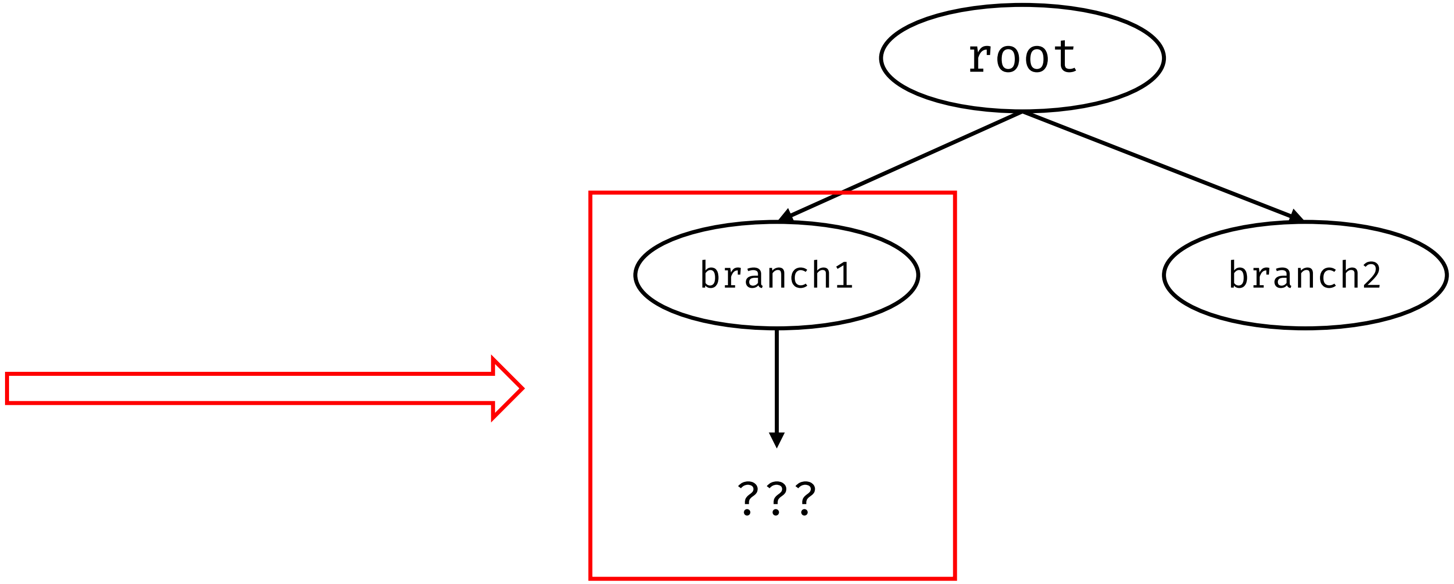
Hw04p3.1: Nut Finder

```
def nut_finder(t):
    if label(t) == 'nut':
        return True
    for b in branches(t):
        if nut_finder(b):
            return True
```



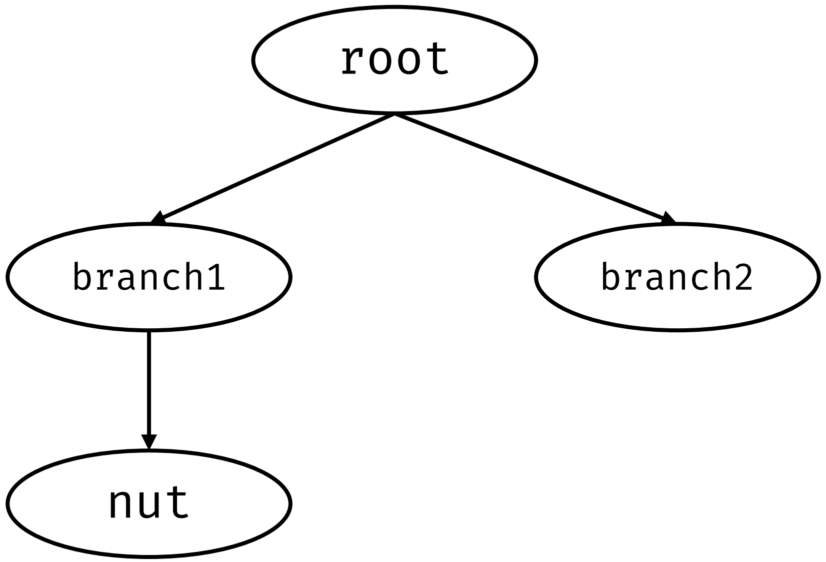
Hw04p3.1: Nut Finder

```
def nut_finder(t):
    if label(t) == 'nut':
        return True
    for b in branches(t):
        if nut_finder(b):
            return True
```



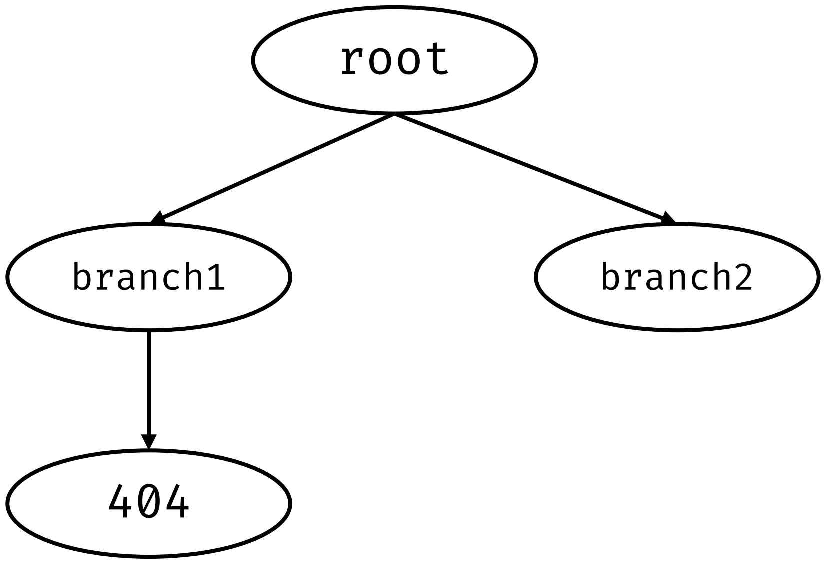
Hw04p3.1: Nut Finder

```
def nut_finder(t):
    if label(t) == ‘nut’:
        return True
    for b in branches(t):
        if nut_finder(b):
            return True
```



Hw04p3.1: Nut Finder

```
def nut_finder(t):
    if label(t) == 'nut':
        return True
    for b in branches(t):
        if nut_finder(b):
            return True
    return False
```



Hw04p3.1: Nut Finder

```
def nut_finder(t):
    if label(t) == 'nut':
        return True
    for b in branches(t):
        if nut_finder(b):
            return True
    return False
```

Base case

Recursion

```
def nut_finder(t):
    return label(t) == 'nut' or any([nut_finder(b) for b in branches(t)])
```

Hw04p3.1: Nut Finder

```
def nut_finder(t):
    return label(t) == ‘nut’ or any([nut_finder(b) for b in branches(t)])
```

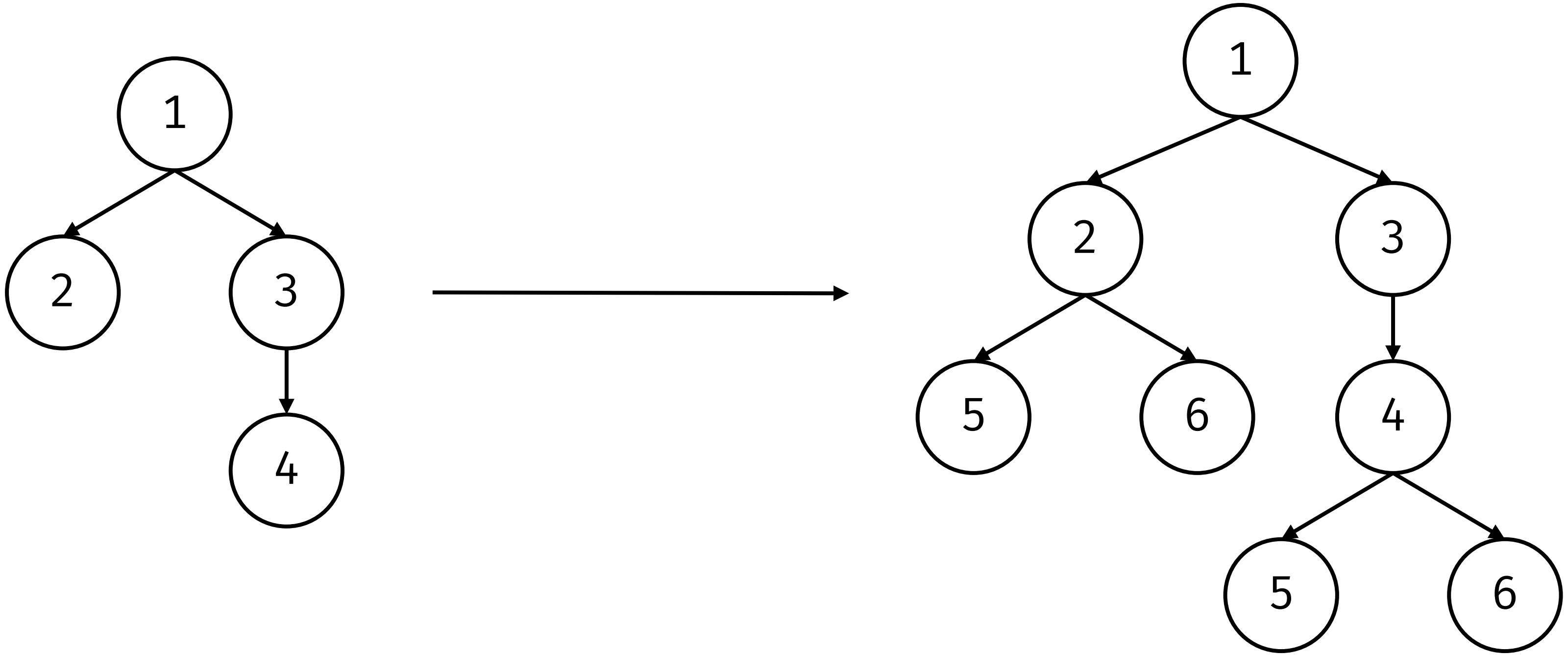
List comprehension
v.s.
Generator comprehension

```
def nut_finder(t):
    return label(t) == ‘nut’ or any(nut_finder(b) for b in branches(t))
```

Maybe Faster

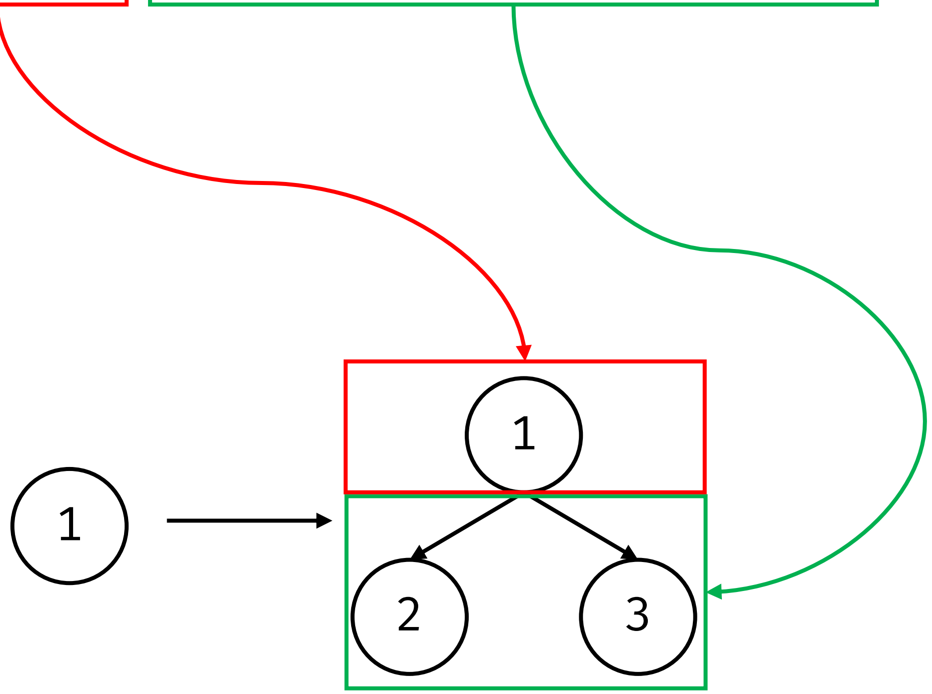
Hw04p3.2: Sprout Leaves

```
def sprout_leaves(t, values):
    Sprout new leaves containing the data in VALUES at each leaf in the
original tree T and return the resulting tree.
```



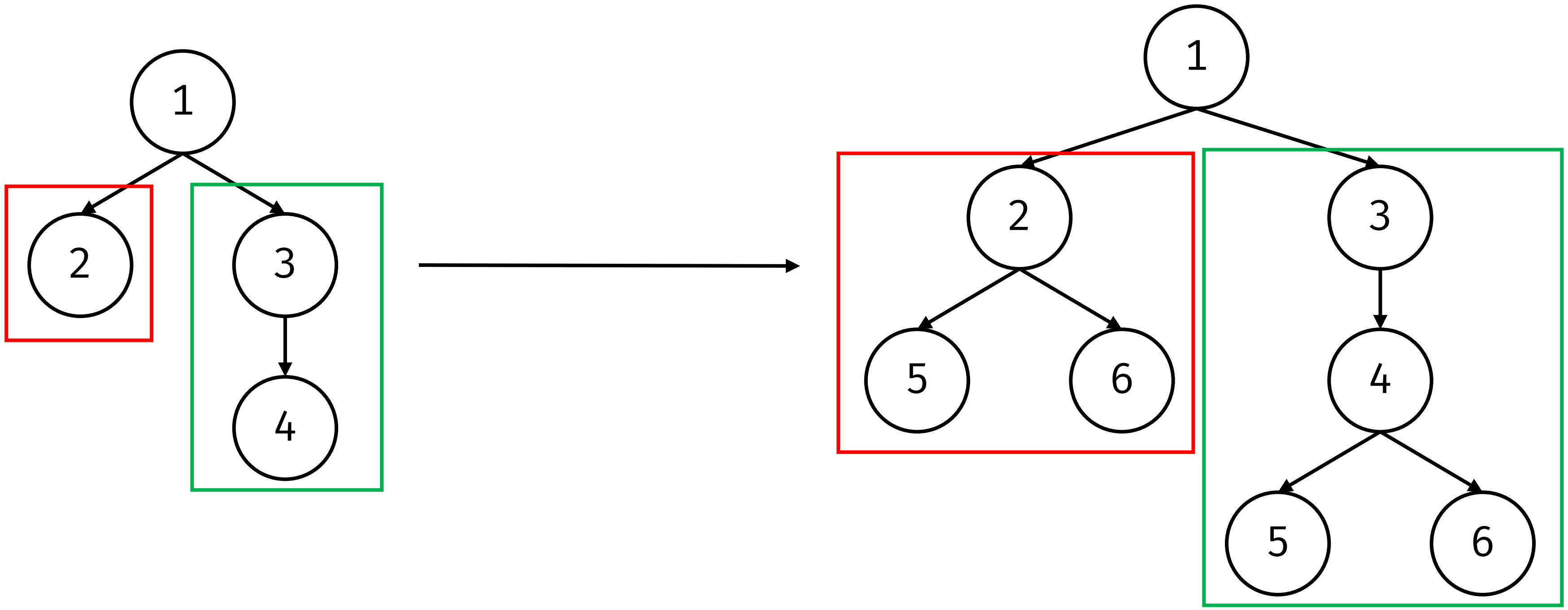
Hw04p3.2: Sprout Leaves

```
def sprout_leaves(t, values):
    if is_leaf(t):
        return tree(label(t), [tree(v) for v in values])
```



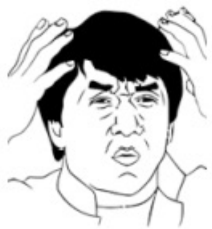
Hw04p3.2: Sprout Leaves

```
def sprout_leaves(t, values):
    if is_leaf(t):
        return tree(label(t), [tree(v) for v in values])
    return tree(label(t), [sprout_leaves(b, values) for b in branches])
```

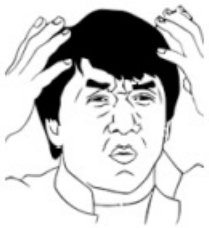


Hw04p3.2: Sprout Leaves

```
def sprout_leaves(t, values):
    if is_leaf(t):
        new = list(values)
        for x in new:
            t.append([x])
        return t
    else:
        i = 0
        while i < len(branches(t)):
            branches(t)[i] = sprout_leaves(branches(t)[i],values)
            i = i + 1
        return t
```



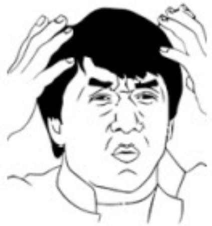
Hw04p3.2: Sprout Leaves



```
def sprout_leaves(t, values):
    def helper(t):
        if is_leaf(t):
            return tree(label(t),[[i] for i in values])
        else:
            return tree(label(t),[helper(i) for i in branches(t)])
    return helper(t)
```

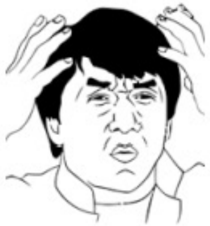
Hw04p3.2: Sprout Leaves

```
def sprout_leaves(t, values):
    c=[]
    for d in values:
      c=c+[tree(d)]
    if branches(t)==[]:
      return tree(label(t),c)
    else:
      a=label(t)
      e=[]
      for b in branches(t):
        e=e+tree(sprout_leaves(b,values))
      a=tree(a,e)
      return a
```



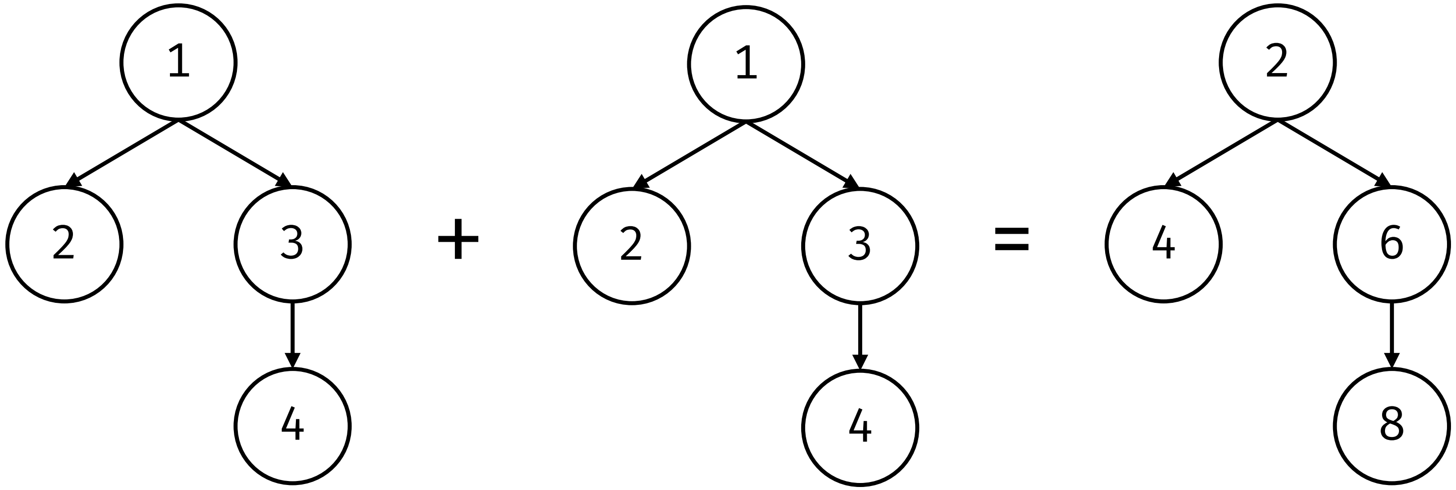
Hw04p3.2: Sprout Leaves

```
def sprout_leaves(t, values):
    if is_leaf(t):
        for x in values:
            t.append(tree(x))
    else:
        for b in branches(t):
            sprout_leaves(b, values)
    return t
```



Hw04p3.3: Add Trees

```
def add_trees(t1, t2):
    Returns a new tree where each corresponding node from T1 is added with the
node from T2.
```



Hw04p3.3: Add Trees

```
def add_trees(t1, t2):
    def merge_branches(branches1, branches2):
        merged_branches = []
        for i in range(max(len(branches1, branches2)):
            if i < len(branches1) and i < len(branches2):
                merged_branches.append(add_trees(branches1[i], branches2[i]))
            elif i < len(branches1):
                merged_branches.append(branches1[i])
            else:
                merged_branches.append(branches2[i])
        return merged_branches
    return tree(label(t1) + label(t2), merge_branches(branches(t1), branches(t2)))
```

Hw04p3.3: Add Trees

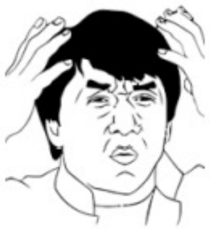
```
def add_trees(t1, t2):
    def merge_branches(branches1, branches2):
        merged_branches = []
        for i in range(max(len(branches1, branches2)):
            if i < len(branches1) and i < len(branches2):
                merged_branches.append(add_trees(branches1[i], branches2[i]))
            elif i < len(branches1):
                merged_branches.append(branches1[i])
            else:
                merged_branches.append(branches2[i])
        return merged_branches
    return tree(label(t1) + label(t2), merge_branches(branches(t1), branches(t2))
```

Hw04p3.3: Add Trees

```
def add_trees(t1, t2):
    def merge_branches(branches1, branches2):
        merged_branches = []
        for i in range(max(len(branches1, branches2)):
            if i < len(branches1) and i < len(branches2):
                merged_branches.append(add_trees(branches1[i], branches2[i]))
            elif i < len(branches1):
                merged_branches.append(branches1[i])
            else:
                merged_branches.append(branches2[i])
        return merged_branches
    return tree(label(t1) + label(t2), merge_branches(branches(t1), branches(t2))
```

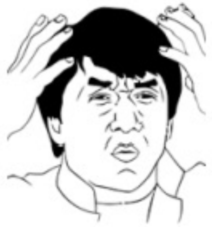
Hw04p3.3: Add Trees

```
def add_trees(t1, t2):
    if is_leaf(t1) or is_leaf(t2):
        return tree(label(t1)+label(t2),branches(t1)+branches(t2))
    lst=[]
    n=1
    l=min(len(t1),len(t2))
    while l>n:
        lst+=[(t1[n],t2[n])]
        n+=1
    left=t1[n:]+t2[n:]
    return tree(label(t1)+label(t2),[add_trees(x,y) for x,y in lst]+left)
```



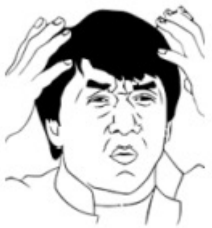
Hw04p3.3: Add Trees

```
def add_trees(t1, t2):
    len_1, len_2 = len(branches(t1)), len(branches(t2))
    if len_1 == len_2:
        return tree(label(t1) + label(t2), \
                   [add_trees(b1, b2) for b1, b2 in zip(branches(t1), branches(t2))])
    elif len_1 < len_2:
        branches_t1 = branches(t1) + [tree(0) for _ in range(len_2 - len_1)]
        new_t1 = tree(label(t1), branches_t1)
        return add_trees(new_t1, t2)
    else:
        return add_trees(t2, t1)
```



Hw04p3.3: Add Trees

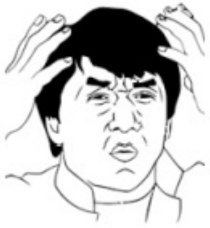
```
def add_trees(t1, t2):
    new_label = label(t1) + label(t2)
    if is_leaf(t2):
        return tree(new_label,branches(t1))
    if is_leaf(t1):
        return tree(new_label,branches(t2))
    else:
        new_branch = []
        for i in range(0,max(len(branches(t1)),len(branches(t2)))):
            if i >= len(branches(t1)):
                new_branch += [branches(t2)[i]]
            if i >= len(branches(t2)):
                new_branch += [branches(t1)[i]]
            else:
                new_branch +=[add_trees(branches(t1)[i],branches(t2)[i])]
        return tree(new_label,new_branch)
```



Hw04p3.3: Add Trees

```
def add_trees(t1, t2):
    if is_leaf(t1) and is_leaf(t2):
        return tree(label(t1) + label(t2))
    if is_leaf(t1) and not is_leaf(t2):
        return tree(label(t1) + label(t2), branches(t2))
    if is_leaf(t2) and not is_leaf(t1):
        return tree(label(t1) + label(t2), branches(t1))
    b1, b2 = branches(t1), branches(t2)
    if len(b1) > len(b2):
        t1, t2 = t2, t1
        b1, b2 = b2, b1
    nb = []
    for i in range(len(b1)):
        nb.append(add_trees(b1[i], b2[i]))
    nb += b2[len(b1):]
    return tree(label(t1) + label(t2), nb)
```

没想到吧，加法可
以不满足交换律！



Hw04p3.4: Big Path

```
def big_path(t, n):
    Return the number of paths in T that have a sum larger or equal to N.
    The path starts from root of T.


def bigger_path(t, n):
    Return the number of paths in T that have a sum larger or equal to N.
    The path might not start from root of T.
```

Hw04p3.4: Big Path

```
def big_path(t, n):
    return (1 if label(t) >= n else 0) + \
            sum([big_path(b, n - label(t)) for b in branches(t)])


def bigger_path(t, n):
    return big_path(t, n) + sum([bigger_path(b, n) for b in branches(t)])
```

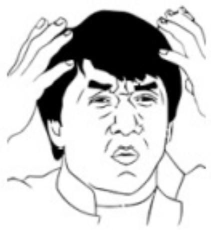
Lab05p3: Scale

```
def scale(it, multiplier):
    Yield elements of the iterable IT scaled by a number MULTIPLIER.
    for value in it:
        yield it * multiplier
```

Lab05p3: Scale

```
def scale(it, multiplier):
    iter_it=iter(it)
    a=next(iter_it)
    while True:
        yield a*multiplier
        a=next(iter_it)
```

StopIteration



Lab05p3: Scale

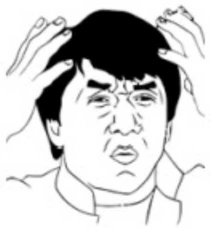
```
def scale(it, multiplier):
    Yield elements of the iterable IT scaled by a number MULTIPLIER.
    yield from [value * multiplier for value in it]
```

Lab05p3: Scale

```
def scale(it, multiplier):
    Yield elements of the iterable IT scaled by a number MULTIPLIER.
    yield from [value * multiplier for value in it]
```

List comprehension must be evaluated first!

`[1, 2, 3, 4, 5, 6, 7, 8, ...] ->` infinite loop



Lab05p3: Scale

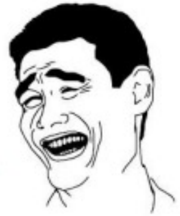
```
def scale(it, multiplier):
    Yield elements of the iterable IT scaled by a number MULTIPLIER.
    yield from (value * multiplier for value in it)
```

Lab05p3: Scale

```
def scale(it, multiplier):
    Yield elements of the iterable IT scaled by a number MULTIPLIER.
    yield from (value * multiplier for value in it)
```

Generator comprehension must be evaluated first!

A generator!



Lab05p3: Scale

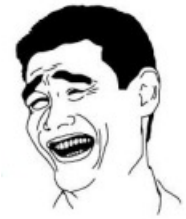
```
def scale(it, multiplier):
    Yield elements of the iterable IT scaled by a number MULTIPLIER.
    yield from map(lambda value: multipler * value, it)
```

Lab05p3: Scale

```
def scale(it, multiplier):
    Yield elements of the iterable IT scaled by a number MULTIPLIER.
    yield from map(lambda value: multipler * value, it)
```

Function call must be evaluated first!

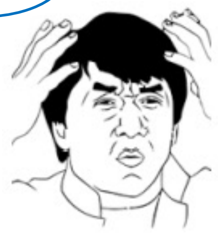
map returns an iterable class!



Lab05p3: Scale

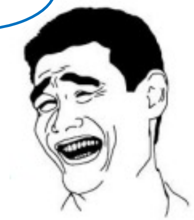
```
def scale(it, multiplier):
    yield from [value * multiplier for value in it]
```

List comprehension



```
def scale(it, multiplier):
    yield from (value * multiplier for value in it)
```

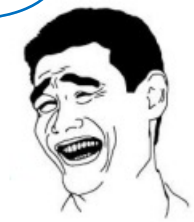
Generator comprehension



"Lazy Evaluation"

```
def scale(it, multiplier):
    yield from map(lambda value: multipler * value, it)
```

Iterable class

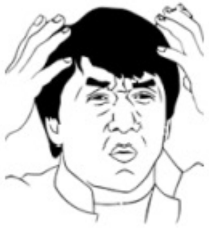


Lab05p5: Hailstone

```
def hailstone(n):
    Return a generator that outputs the hailstone sequence.
    yield n
    if n == 1:
        return
    elif n % 2 == 0:
        yield from hailstone(n // 2)
    else:
        yield from hailstone(n * 3 + 1)
```

Lab05p5: Hailstone

```
def hailstone(n):
    while n!=1 :
        yield n
        if n%2==0:
            n = n//2
            if (n==1):
                yield 1
        else:
            n = 3*n + 1
```



```
def hailstone(n):
    while n!=1 :
        yield n
        if n%2==0:
            n = n//2
        else:
            n = 3*n + 1
    yield 1
```

Something about yield

```
def func():
    a = [1, 2]
    yield a        ──►  1, 2
    a = [2, 1]
    yield a        ──►  2, 1
```

Something about yield

```
def func():
    a = [1, 2]
    yield a          # -> 1, 2
    a = [2, 1]
    yield a          # -> 2, 1
```

```
def func():
    a = [1, 2]
    yield a          # -> 1, 2
    a[0], a[1] = a[1], a[0]
    yield a
```

Something about `yield`

```
def func():
    a = [1, 2]
    yield a
    a = [2, 1]
    yield a
```

```
1, 2
2, 1
```

```
def func():
    a = [1, 2]
    yield a
    a[0], a[1] = a[1], a[0]
    yield a
```

```
2, 1
```

Something about yield

```
def func():
    a = [1, 2]
    yield a
    a[0], a[1] = a[1], a[0]
    yield a
```

1, 2

```
>>> it = func()
>>> next(it)
[1, 2]
```

Something about yield

```
def func():
    a = [1, 2]
    yield a
    a[0], a[1] = a[1], a[0]
    yield a
```

2, 1

```
>>> it = func()
>>> next(it)
[1, 2]
>>> next(it)
[2, 1]
```

Something about yield

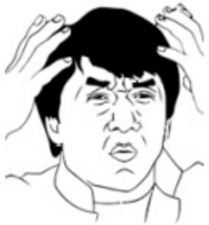
```python
def func():
    a = [1, 2]
    yield a
    a[0], a[1] = a[1], a[0]
    yield a
```

2, 1

```python
>>> it = func()
>>> next(it)
[1, 2]
>>> next(it)
[2, 1]
>>> sorted(list(it))
[[2, 1], [2, 1]]
```

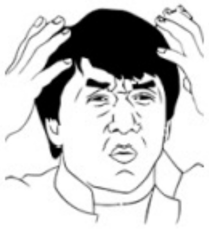
Something about `lambda`

```
i = 0
def helper(x):
    print(i)
while i < n:
    yield helper
    i += 1
```



Something about `lambda`

```
i = 0
def helper(x):
    print(i)
while i < n:
    yield helper
    i += 1
```



```
i = 0
def helper(x, i):
    print(i)
while i < n:
    yield helper(bar, i)
    i += 1
```

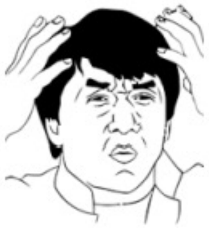
Function call must be evaluated

Parameter i must be evaluated

But we don't want to call the function right now!

Something about `lambda`

```
i = 0
def helper(x):
    print(i)
while i < n:
    yield helper
    i += 1
```



```
i = 0
def helper(x, i):
    print(i)
while i < n:
    yield helper(bar, i)
    i += 1
```

Function call must be evaluated

Parameter i must be evaluated

```
i = 0
def helper(x, i):
    print(i)
while i < n:
    yield (lambda i: lambda x: helper(x, i))(i)
    i += 1
```

Function call must be evaluated

Questions?

恭喜你又变的更强了👍