As you walk in

Quiz will start at the beginning of lecture

- Have pencil/pen ready
- Don’t use your own scratch paper
  - We have some if you need it
- Silence phones

Hack 112!

https://docs.google.com/presentation/d/1A9BywiD4LPc4AnW9q7FYmk4f_l18MCfo_Zg7hcot6zo/edit?usp=drivesdk

Quiz

Before we start

- Don’t open until we start
- Make sure your name and Andrew ID are on the front
- Read instruction page
- No questions (unless clarification on English)

Additional info

- 20 min

15-112 Lecture 2

Week 9 Tue Recursion

Instructor: Pat Virtue

Announcements

Hack 112!

HW9

OH this weekend

- Heads up! Staff will be split between HW9 and Hack 112

TP ideation meetings

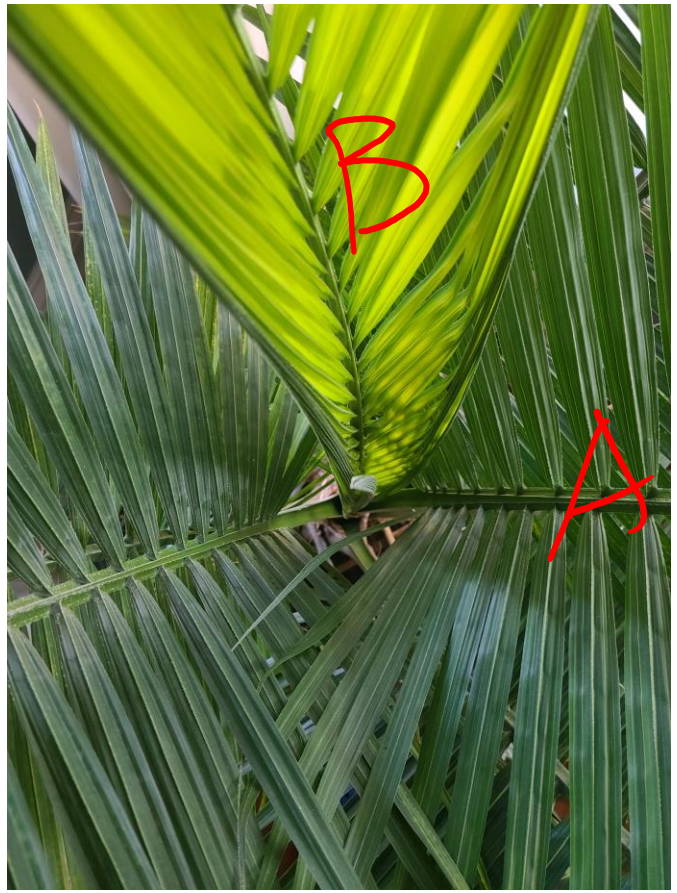
TP Mini-Lectures this week

- Must attend at least one

AIV

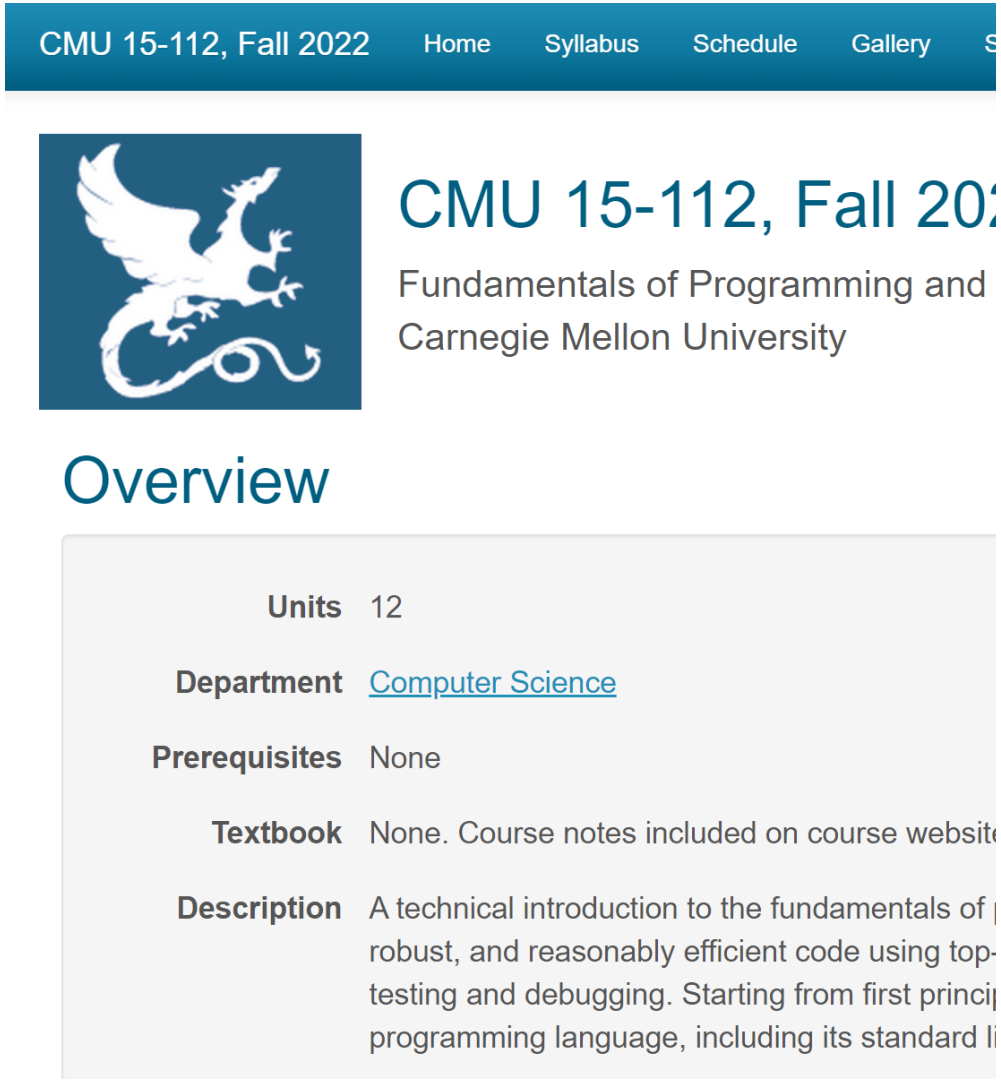
Recursion in the Wild

Recursion in the Wild



Recursion in the Wild

Recursion in the Wild




```
<div class="row col-lg-10 col-lg-offset-1">
  <div id="overview">

    <h1>Overview</h1>

    <div class="well bs-component">
      <form class="form-horizontal">
        <div class="form-group">
          <label class="col-sm-2 control-label">Units</label>
          <div class="col-sm-10">
            <p class="form-control-static">12</p>
          </div>
        </div>
        <div class="form-group">
          <label class="col-sm-2 control-label">Department</label>
          <div class="col-sm-10">
            <p class="form-control-static">
              <a href="http://www.csd.cs.cmu.edu/" target="_blank">Computer Science</a>
            </p>
          </div>
        </div>
        <div class="form-group">
          <label class="col-sm-2 control-label">Prerequisites</label>
          <div class="col-sm-10"><p class="form-control-static">None</p>
          </div>
        </div>
        <div class="form-group">
          <label class="col-sm-2 control-label">Textbook</label>
          <div class="col-sm-10">
            <p class="form-control-static">None. Course notes included on course website.</p>
          </div>
        </div>
        <div class="form-group">
          <label class="col-sm-2 control-label">Description</label>
          <div class="col-sm-10">
            <p class="form-control-static">
              A technical introduction to the fundamentals of programming with an emphasis
              on producing clear, robust, and reasonably efficient code using top-down
              design, informal analysis, and effective testing and debugging. Starting
              from first principles, we will cover a large subset of the Python
              programming language, including its standard libraries and programming
              paradigms.
            </p>
            <p class="form-control-static">
```

Fractals

Mandelbrot set

https://www.youtube.com/watch?v=u1pwtSBTnPU

Fractals

Koch curve

drawKochLine(start, end)

drawKochLine (start, ___)

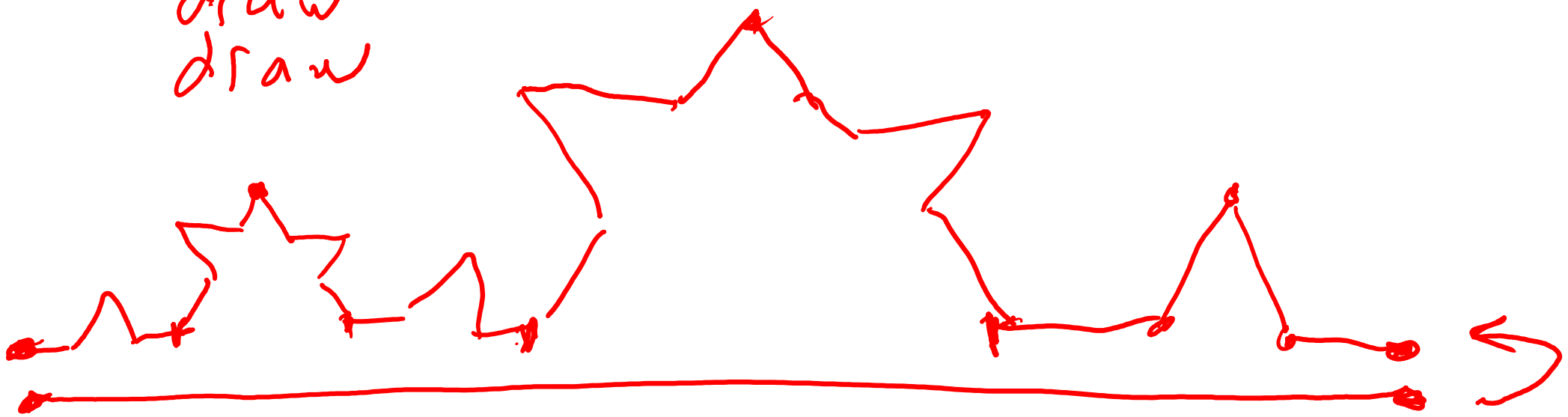
dr . . . . . (___, end)

draw

draw

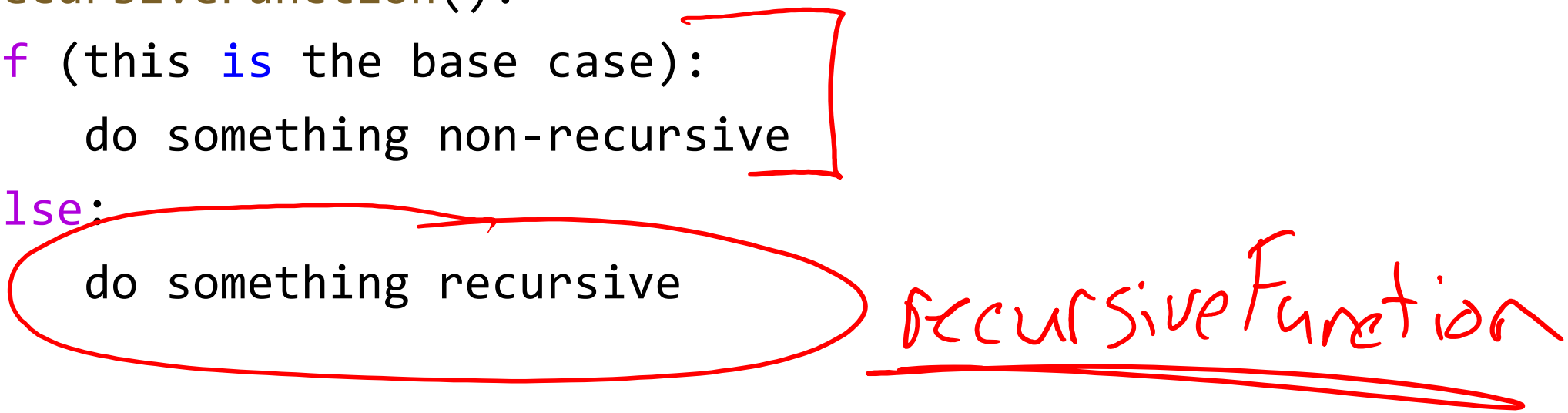
#Left

#Right



General Recursive Form

```
def recursiveFunction():
    if (this is the base case):
        do something non-recursive
    else:
        do something recursive
```



Recursive thinking (and recursive functions)

Recursive thinking (and recursive functions)

Count digits??

```
def countDigits(number):
```

Recursive thinking (and recursive functions)

Word search??

```
def wordSearch(board, word):
    (rows, cols) = (len(board), len(board[0]))
    for row in range(rows):
        for col in range(cols):
            result = wordSearchFromCell(board, word, row, col)
            if (result != None):
                return result
    return None
```

Recursion Example

- Recursive case
- Base case
- Recursion errors
- Call Stack
- Visualizing recursion
- Debugging recursion

Poll 1

Which is the best base case

A.
```
if n == 0
        return 0
```

B.
```
if n == 0
        return 1
```

C.
```
if n == 1
        return 0
```

D.
```
if n == 1
        return 1
```

E.
```
if n == 2
        return 3
```