YEAH!

Meta Academy

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Adapted from SLs Rishi Bedi & Audrey Ho

Create a Teaching Tool For Recursion

1. Demo Recursion By Definition
2. Demo Recursion By Fractals
3. Demo Recursion For Exploration
4. Personal Curriculum
5. Generate Question

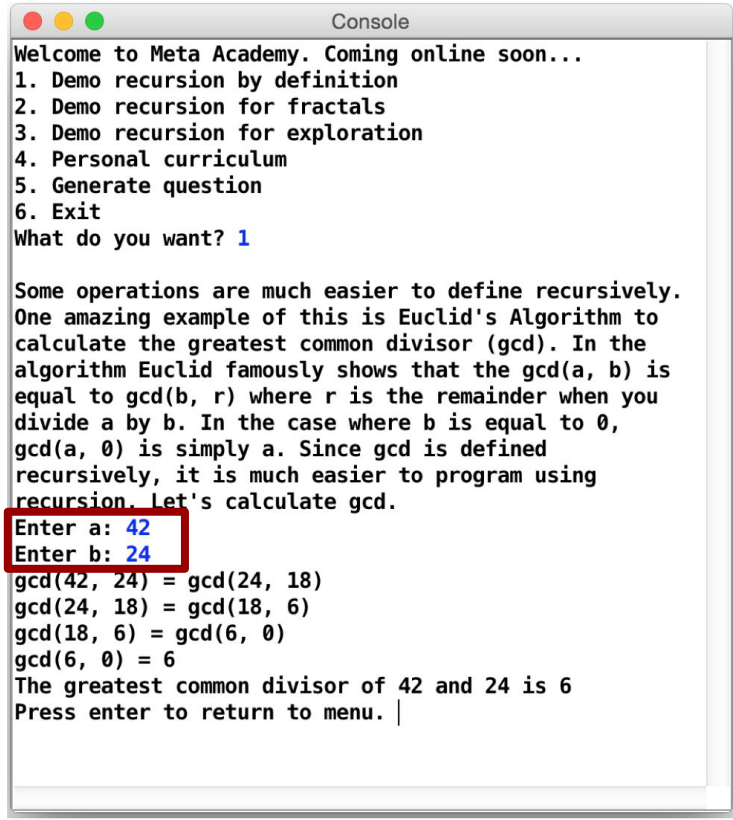
Milestone 1: GCD (Recursive By Definition)

```
int gcd (int a, int b):

    // RECURSIVE ALGORITHM

    ifx b = 0 gcd(a, b) = a

    else      gcd(a, b) = gcd(b,a%b)
```

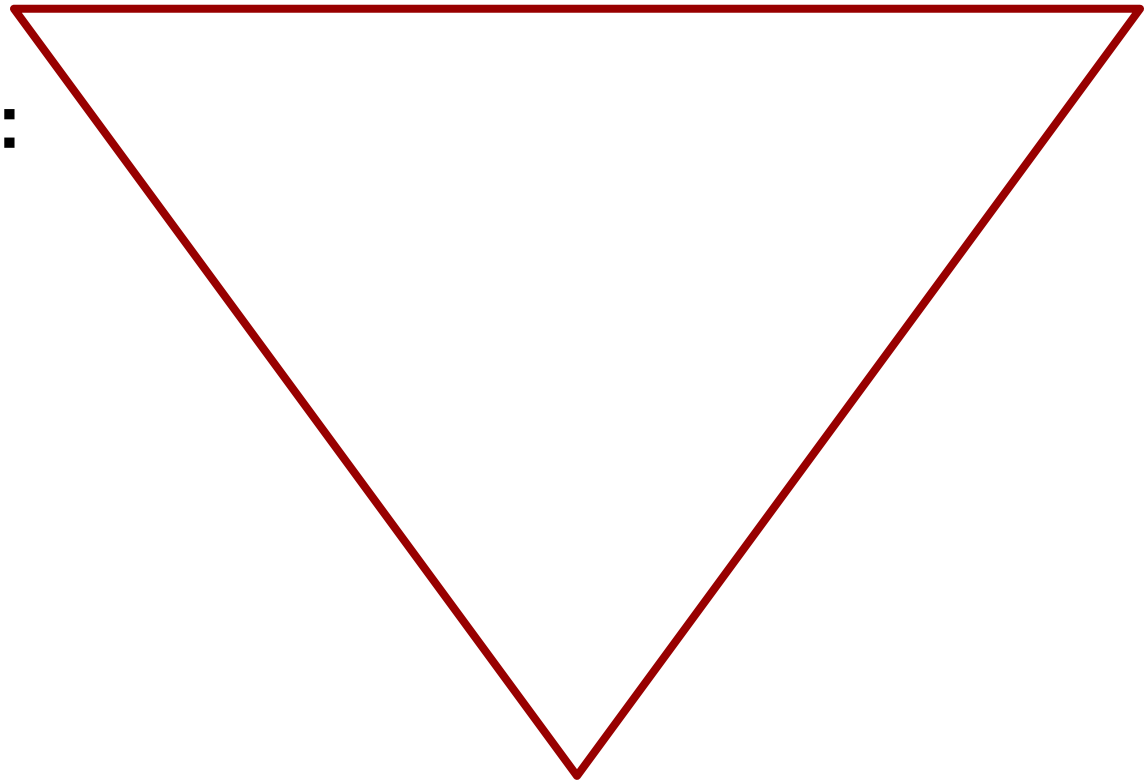


Milestone 1: GCD (Recursive By Definition)

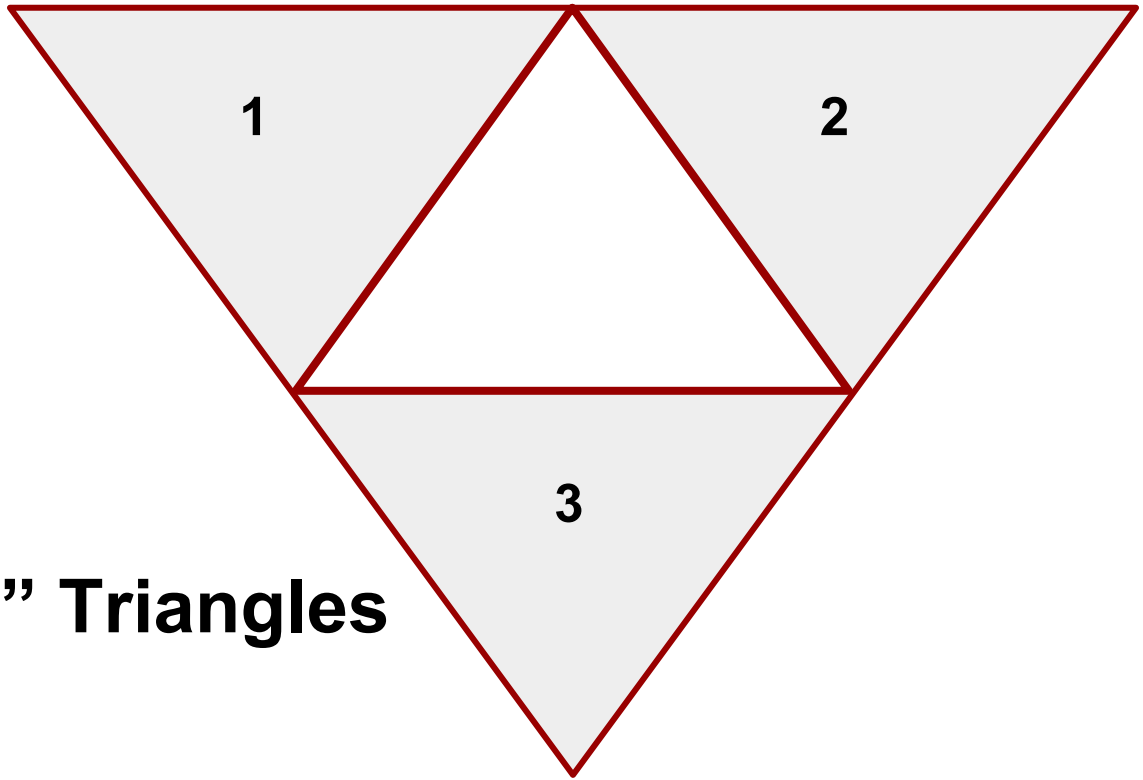
```
1)  gcd(42,24) // Apply gcd(a, b) = gcd(b,a%b) since b!= 0
2)  gcd(24, 18)// Apply gcd(a, b) = gcd(b,a%b) since b!= 0
3)  gcd(18, 6) // Apply gcd(a, b) = gcd(b,a%b) since b!= 0
4)  gcd(6, 0) // Apply gcd(a, b) = a (Base Case)
```

Milestone 2: Serpinski (Recursion by Fractals)

Order 1:

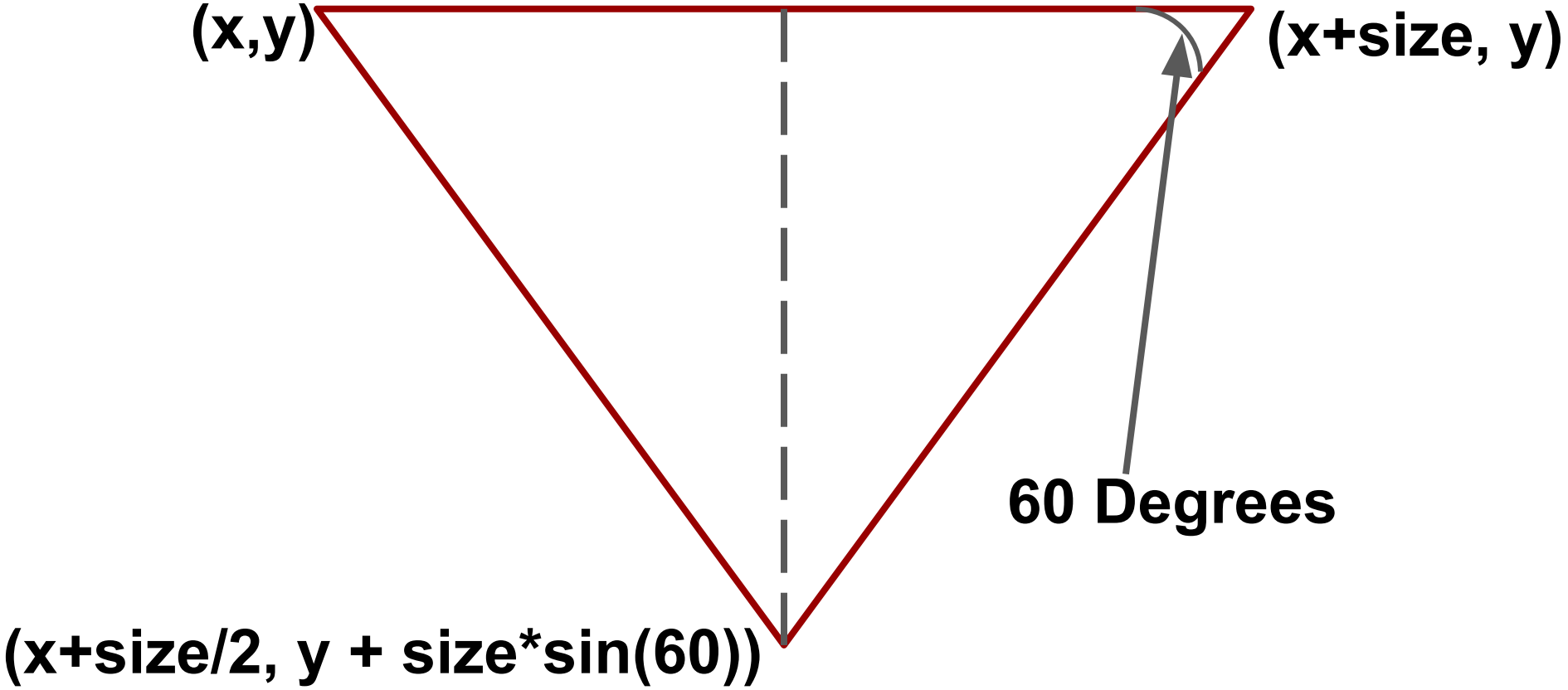


Milestone 2: Serpinski (Recursion by Fractals)



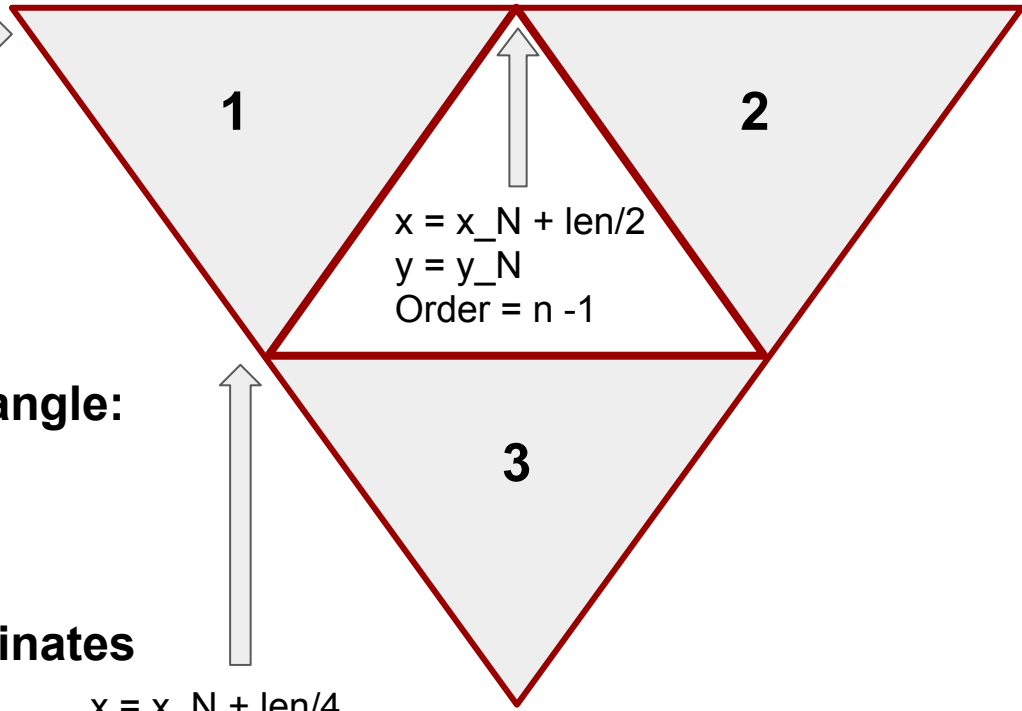
Order 2 =
3 “Order-1” Triangles

Milestone 2: Serpinski (Recursion by Fractals)



Milestone 2: Serpinski (Recursion by Fractals)

x = x_N
y = y_N
Order = n -1



Recursive Step: Drawing Order-N Triangle:

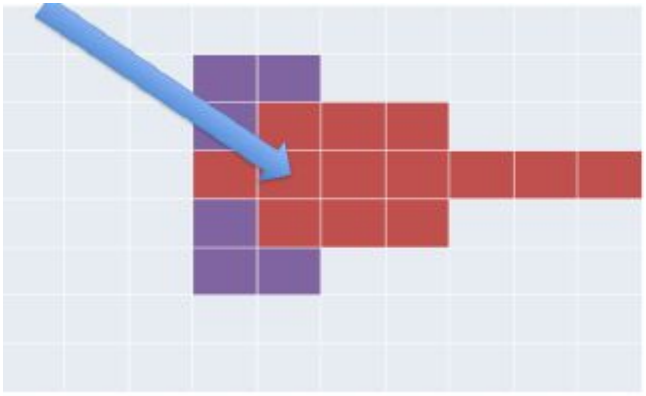
- **3 Triangles of Order N-1**
- **Each Tri. Has ½ a Side Length**
- **(x_N, y_N) are (x,y) anchor coordinates**

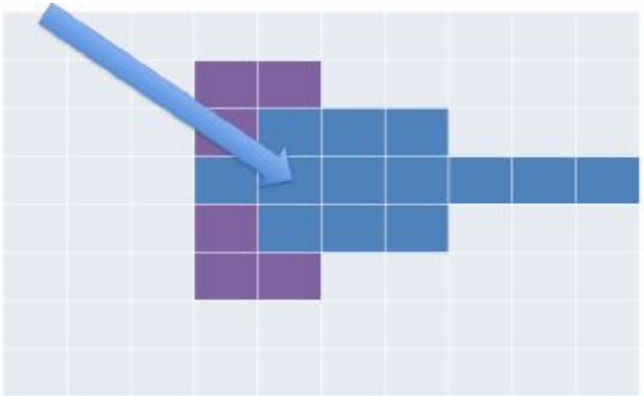
for Order-N Tri.

Milestone 3: Flood Fill (Recursion by Exploration)

```
int floodFill(GBufferedImage& image, int x, int y, int color)

// e.g. floodFill(image, 4, 3, blue)
```





Milestone 3: Flood Fill (Recursion by Exploration)

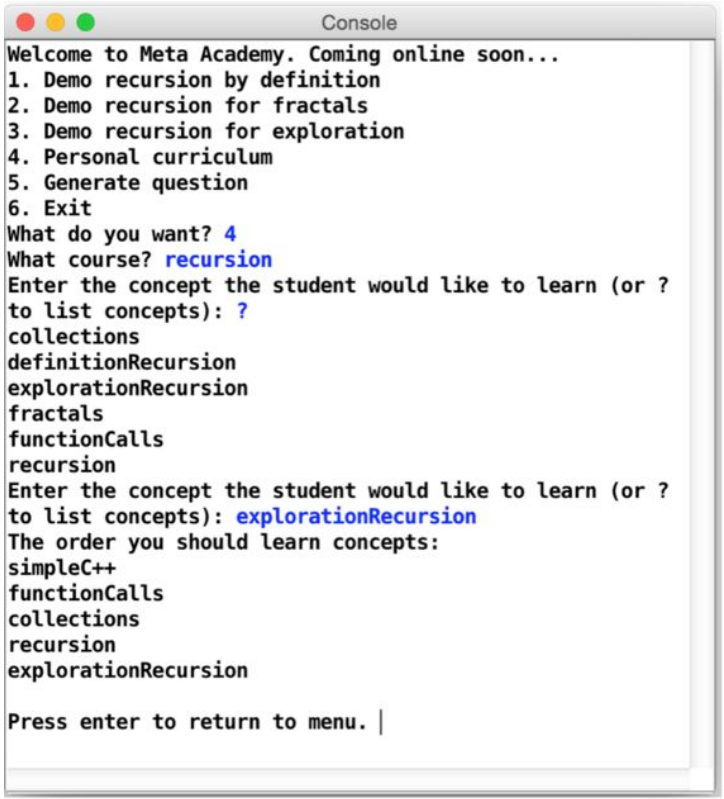
- Only fill boxes of old color that we clicked on ...

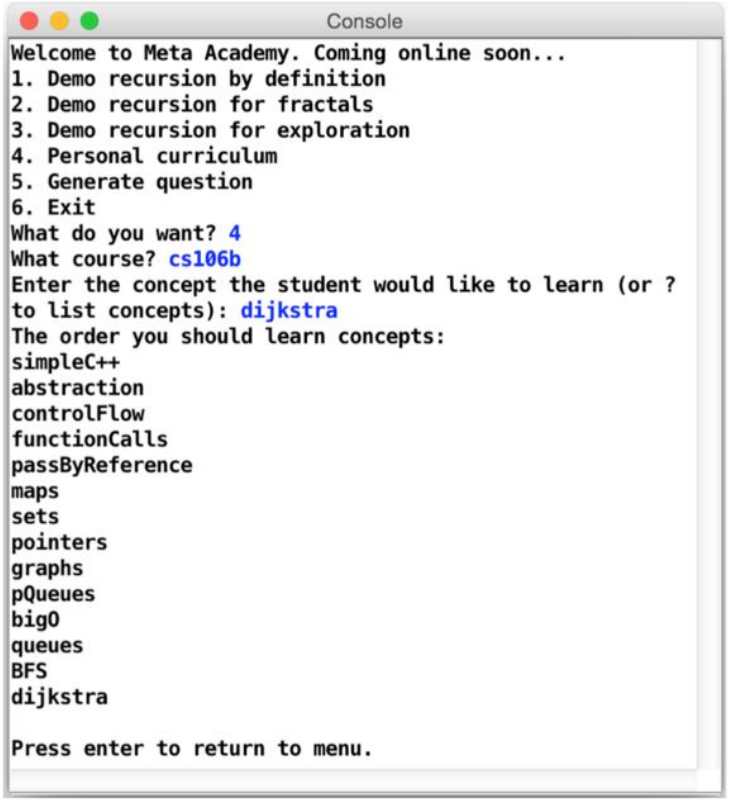
- How do we keep track of the old color?
  - Helper function lets us keep track of more variables

```
int floodFillHelper(image, x, y, newColor, oldColor)
```

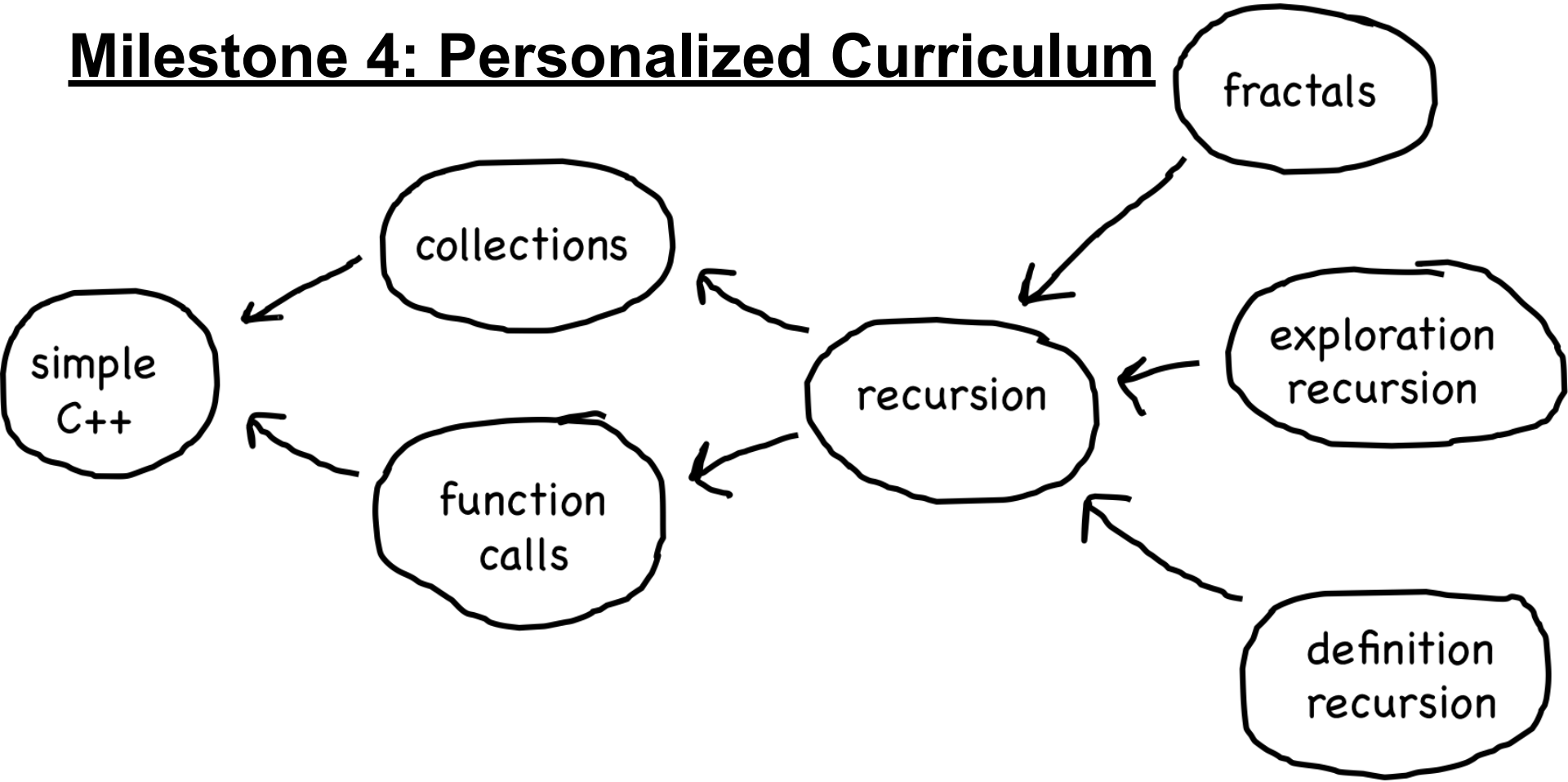
- Recursion: What options can we explore for each pixel?

Milestone 4: Personalized Curriculum





Milestone 4: Personalized Curriculum



Milestone 4: Personalized Curriculum

```
allPrereqsOfConcept(prereqMap, concept){

    it's direct prerequisites and

    for (childConcept : direct prerequisites){

    allPrereqsOfConcept(prereqMap, childConcept)

    }

}
```

Q: Make sure to avoid repeating the same prerequisite multiple times in your list. How we can store prerequisites that we have already listed?

Q: Where should cout << statements go, in order to print the curriculum in the correct order?

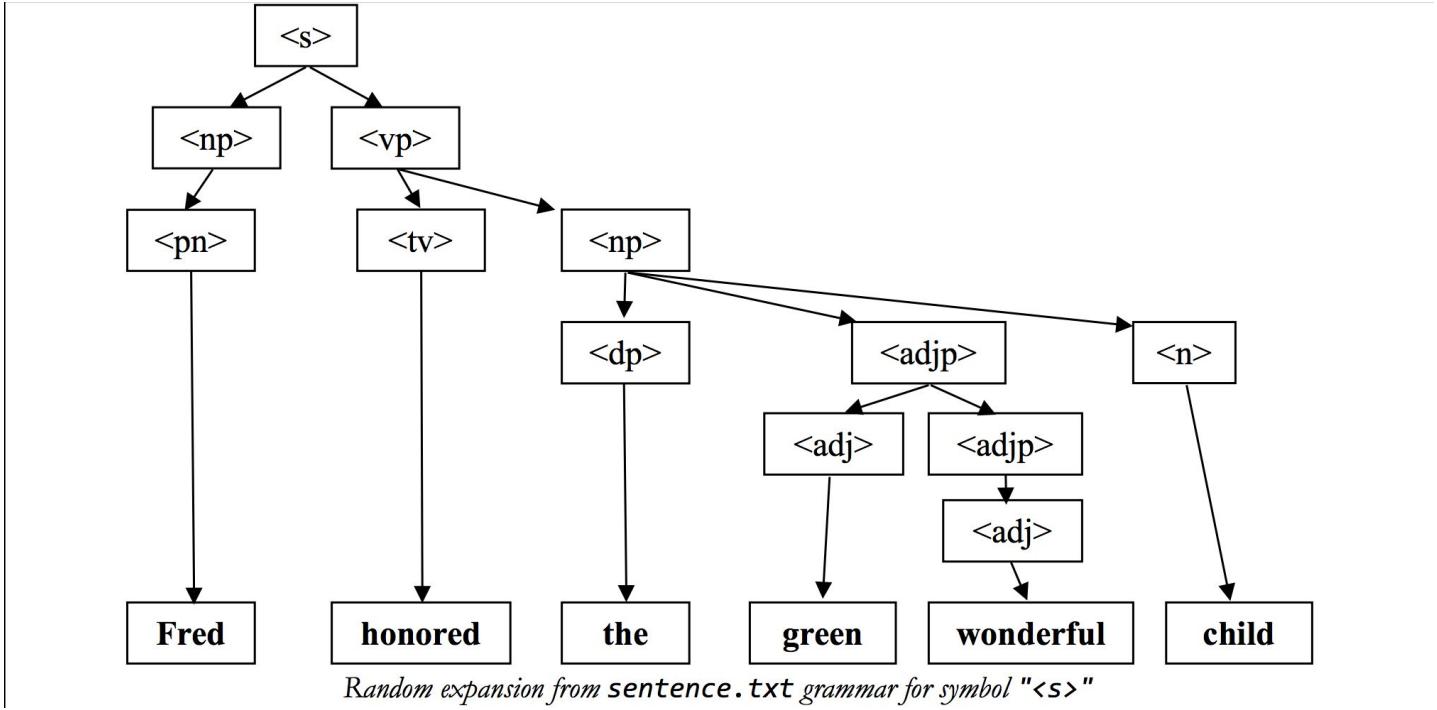
```
"fractals"              → ["recursion"]
"explorationRecursion" → ["recursion"]
"definitionRecursion"  → ["recursion"]
"recursion"             → ["collections", "functionCalls"]
```

Milestone 5: Generate Question

```
<s>:<np> <vp>                                                    // Non Terminal
<np>:<dp> <adjp> <n>|<pn>                                        // Non Terminal
<dp>:the|a                                                       // Non Terminal
<adjp>:<adj>|<adj> <adjp>                                        // Non Terminal
<adj>:big|fat|green|wonderful|faulty|subliminal|pretentious      // Terminal
<n>:dog|cat|man|university|father|mother|child|television        // Terminal
<pn>:John|Jane|Sally|Spot|Fred|Elmo                              // Terminal
<vp>:<tv> <np>|<iv>                                              // Non Terminal
<tv>:hit|honored|kissed|helped                                   // Terminal
<iv>:died|collapsed|laughed|wept                                 // Terminal
```

Milestone 5: Generate Question

- Can Recursively Expand Non-Terminals Until Terminal Reached



Random expansion from `sentence.txt` *grammar for symbol* `"<s>"`

Milestone 5: Generate Question

- **Base Case: Terminal Reached**
- **Recursive Step:**
  - **Get the rules from the map for your current symbol**
  - **Get a random rule from those rules**
  - **For each symbol in that rule, recurse adding the result to an output string separated by a space**

Milestone 5: Generate Question

- Question grammars will have a non-terminal <QUESTION>
- To loop over a string expansion you will need to process the string one "token" at a time where a token could be a non-terminal or a terminal.

```
TokenScanner scanner(production);
while (scanner.hasMoreTokens()) {
   string token = scanner.nextToken();
   // do something with token
}
```