

CIS 122

Recursion Homework

Anagram Algorithm

- Recursive Step
 - Select a letter in one string
 - Remove letter from both words
 - See if remaining letters are anagrams
- Base Cases
 - X - Strings have different lengths
 - X - A letter in one string isn't in the other
 - O - Both strings are empty

Assignment 2

- Four recursion themed problems
 - Triangle warmup
 - Puzzling Palindromes
 - Collatz Quandary
 - A Shifty Problem (part 2)

Part 0 - Triangle Warmup

- How many dots does it take to draw a triangle?
 - 1 dot on the first row
 - 2 dots on the second row
 - 3 dots on the third row
 - ...



Part 0 - Triangle Warmup

- How many dots does it take to draw a triangle?
 - 1 dot on the first row
 - 2 dots on the second row
 - 3 dots on the third row
 - ...



- How many dots in a triangle of size 1?
 - 1

Part 0 - Triangle Warmup

- How many dots does it take to draw a triangle?
 - 1 dot on the first row
 - 2 dots on the second row
 - 3 dots on the third row
 - ...



- How many dots in a triangle of size 2?
 - $1 + 2 = 3$

Part 0 - Triangle Warmup

- How many dots does it take to draw a triangle?
 - 1 dot on the first row
 - 2 dots on the second row
 - 3 dots on the third row
 - ...



- How many dots in a triangle of size 3?
 - $1 + 2 + 3 = 6$

Part 0 - Triangle Warmup

- How many dots does it take to draw a triangle?
 - 1 dot on the first row
 - 2 dots on the second row
 - 3 dots on the third row
 - ...



- How many dots in a triangle of size n ?
 - $1 + 2 + 3 + \dots + n$

Part 0 - Triangle Warmup

- Write a function **triangle(n)**
 - Calculate the nth triangle number
 - $1 + 2 + 3 + \dots + n$
- What's our base case?
- What's our recursive step?

Part 0 - Triangle Warmup

- Write a function **triangle(n)**
 - Calculate the nth triangle number
 - $1 + 2 + 3 + \dots + n$
- What's our base case?
 - $\text{triangle}(0) = 0$
- What's our recursive step?

Part 0 - Triangle Warmup

- Write a function **triangle(n)**
 - Calculate the nth triangle number
 - $1 + 2 + 3 + \dots + n$
- What's our base case?
 - $\text{triangle}(0) = 0$
- What's our recursive step?
 - $\text{triangle}(n) = n + \text{triangle}(n-1)$

Part 0 - Triangle Warmup

- Write a function **triangle(n)**
 - Calculate the nth triangle number
 - $1 + 2 + 3 + \dots + n$
- What's our base case?
 - $\text{triangle}(0) = 0$
- What's our recursive step?
 - $\text{triangle}(n) = n + \text{triangle}(n-1)$
- Very similar to factorial...

Part 1 - Puzzling Palindromes

- A **palindrome** reads the same forwards and backwards
 - pop
 - madam
 - racecar
- Write a function **isPalindrome(word)**
 - Return **True** if word is a palindrome
 - Return **False** otherwise

Part 1 - Puzzling Palindromes

- How do we tell if a word is a palindrome?

RACECAR

Part 1 - Puzzling Palindromes

- How do we tell if a word is a palindrome?
 - First and last letters must match

RACECAR

Part 1 - Puzzling Palindromes

- How do we tell if a word is a palindrome?
 - First and last letters must match
 - Rest of word must be a palindrome

RACECAR

Part 1 - Puzzling Palindromes

- How do we tell if a word is a palindrome?
- Base Cases
- Recursive Step

Part 1 - Puzzling Palindromes

- How do we tell if a word is a palindrome?
- Base Cases
 - O - The empty string is a palindrome
 - X - First and last letters don't match
- Recursive Step

Part 1 - Puzzling Palindromes

- How do we tell if a word is a palindrome?
- Base Cases
 - O - The empty string is a palindrome
 - X - First and last letters don't match
- Recursive Step
 - If first and last letters match...
 - The rest of the word must be a palindrome

Part 2 - Collatz Quandary

- **HOTPO - Half Or Triple Plus One**
 - If number is even, divide it by two
 - If number is odd, multiply by three and add one
- **Collatz Conjecture**
 - Pick any number
 - Repeatedly apply HOTPO
 - Eventually, it will reach 1
- You don't need to prove the Collatz Conjecture
 - It's still an open problem

Part 2 - Collatz Quandary

- Write a function **collatz(n)**
 - How many steps does it take to get from n to 1?

Part 2 - Collatz Quandary

- Write a function **collatz(n)**
 - How many steps does it take to get from n to 1?
- We know what the next number in the sequence is
 - If n is even, it's $n/2$
 - If n is odd, it's $3*n+1$
- What if we knew how long it took that number to get to 1?
 - Clearly, it takes n one step more!

Part 2 - Collatz Quandary

- Write a function **collatz(n)**
 - How many steps does it take to get from n to 1?
- Base Case
- Recursive Step

Part 2 - Collatz Quandary

- Write a function **collatz(n)**
 - How many steps does it take to get from n to 1?
- Base Case
 - $\text{collatz}(1) = 0$
 - It's already there!
- Recursive Step

Part 2 - Collatz Quandary

- Write a function **collatz(n)**
 - How many steps does it take to get from n to 1?
- Base Case
 - $\text{collatz}(1) = 0$
 - It's already there!
- Recursive Step
 - Find how many steps the number after n takes
 - n takes one step more