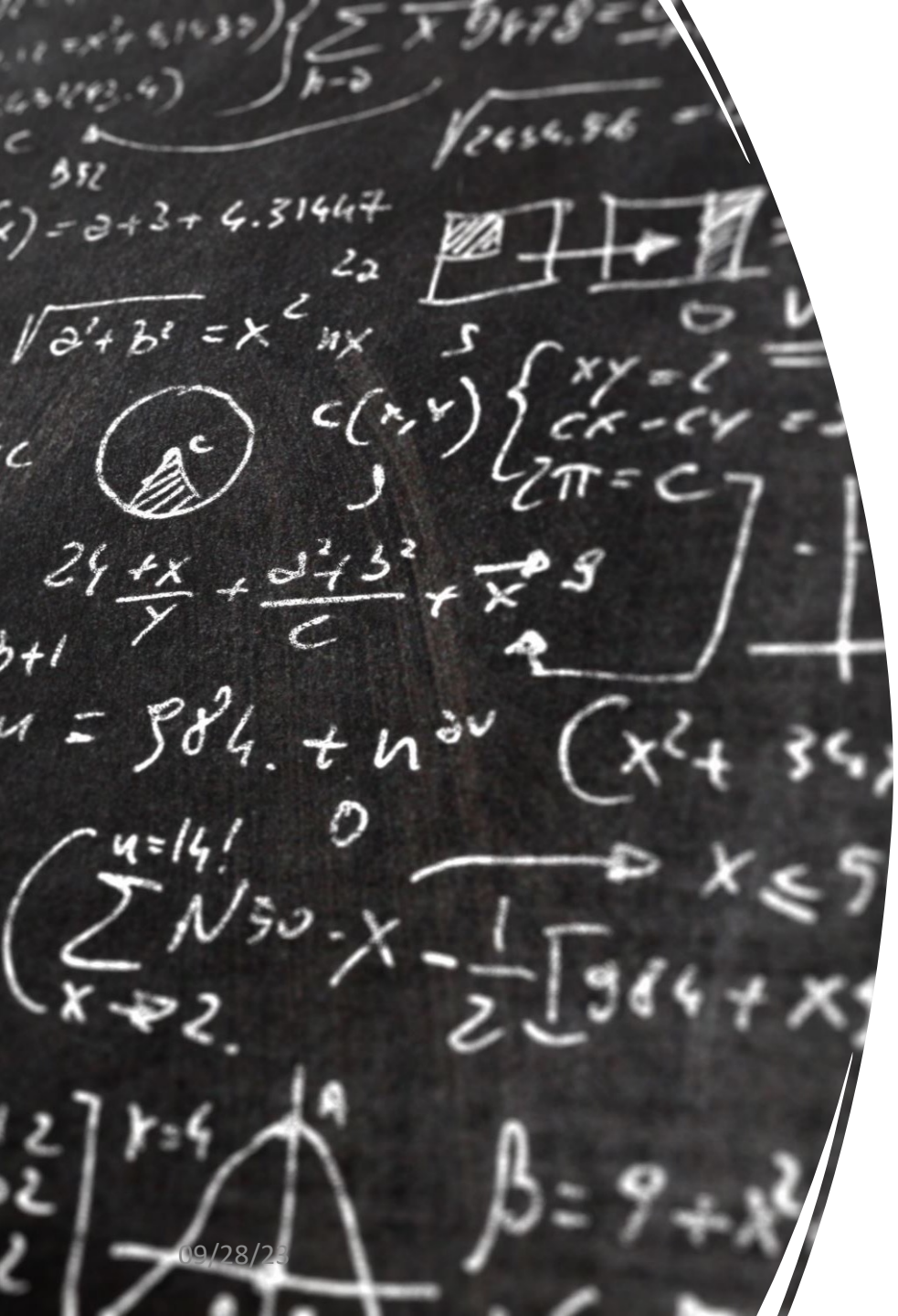


CS 113 – Computer Science I

Lecture 08 – Recursion, Strings, Arrays

Thursday 09/28/2023

Announcements

- HW03 – Due Monday 10/02
  - Shorter side
- Project 01 – Due Monday 10/09
  - Implement Blackjack!
  - Paired assignment – can work with a partner
- **Read & Follow Instructions**
  - Don’t just skim the labs & homework

Agenda

Recursion

Arrays

Recursion

a function that calls itself

“Simple” way to solve “similar” problems

Creating a recursive algorithms

Rule that “does work” then ”calls itself” on a smaller version of the problem

Base case that handles the smallest problem

Prevents “infinite recursion”

Recursion Example – Contains letter

Write a method called “containsLetter” that determines if a String contains a given character

Question: What are the parameters?

1. The String to be looking in
2. The character to look for

Question: What is the return type?

Recursion Example – Contains letter

How can we break this problem down into smaller problems?

contains(“l”, “apple”) =

contains(“l”, “a”) OR

contains(“l”, “p”) OR

contains(“l”, “p”) OR

contains(“l”, “l”) OR

contains(“l”, “e”) OR

Recursion Visualization – Contains letter

contains(“l”, “apple”) =

contains(“l”, “apple”)

contains(“l”, “pple”)

contains(“l”, “ple”)

contains(“l”, “le”)

return true

Recursion Example – IndexOf letter

Write a method called IndexOf.

Arguments: String (haystack), Character (needle)

Return: the index of the character in the String, if the chatacter isnt there, return:

-1.

Recursion Example – printVowels

Write a recursive function that prints just the vowels in a String

Recursion limitations

- Limited number of times we can recurse
  - Stackoverflow – too many frames
- Potentially memory inefficient
  - If we copy data in subproblems – we'll worry about this in a few weeks
- Performance: might duplicate unnecessary work
  - We'll define performance later in the semester

Style

- How we format our programs is **very** important
  - Like rules of etiquette around eating and keep a clean appearance
  - Like punctuation rules, it helps make text more readable
- Variable names should be descriptive
- Indentation is **very** important
  - Every statement inside a pair of braces must be indented
- Braces should be placed consistently

Arrays

Arrays

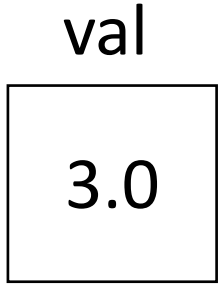
Idea: Store multiple values into a single variable

Values are sequential

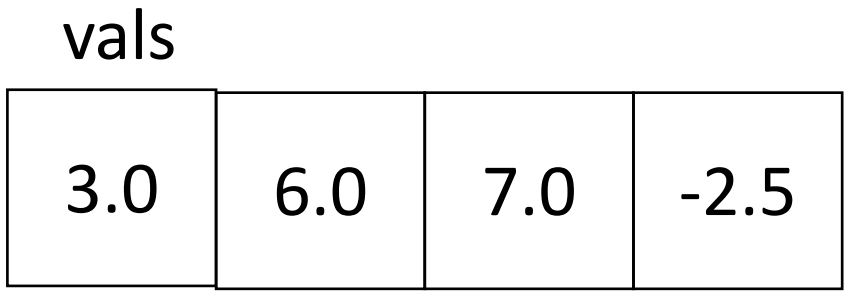
Analogous to a list

Arrays

```
double val = 3.0;
```




```
double[] vals = {3.0, 6.0, 7.0, -2.5};
```



Arrays

Three ways to initialize an array

1. With an initial value

```
int[] numbers = {1, 2, 5};
```

2. With allocated space, but uninitialized

```
int[] numbers = new int[3];
```

3. With an empty array reference

```
int[] numbers = null;
```

Array Indexing

Access individual elements of an array with indexing

array[index]

We use *zero*-based indexing

first element is **0**

last element is **length-1**

Accessing indices out of range results in a **runtime error**!

Exercise: print backwards

Write a program, Backwards.java, that asks the user for 3 integers and then prints the list of numbers in reverse order

Strings

Strings are implemented as *arrays of characters*

Get the length of a string with length()

```
String greeting = “hola”;
int len = greeting.length(); // what is the length?
char c = greeting[2]; // what character is in index 2?
```

char: New built-in type, denoted with single quote, e.g. ‘a’ or ‘{‘

Strings as an array of characters

String str = “hello world”

- How many characters in this String?

  10

- How do we access the first character?

  str.charAt(0)

- How do access the 5th character?

  str.charAt(4)

Exercise: GetCharacters.java

Write a program, GetCharacters.java, that asks the user for a word and then prints the first, last and middle character.

```
Enter a word: hola!
FirstIndex: 0 FirstCharacter: h
MiddleIndex: 2 MiddleCharacter: l
LastIndex: 5 LastCharacter: !
```

Command line arguments

```
public static void main(String[] args)
```

Command line arguments are an *array of String*

Exercise: Write a program called commandLineArgs.java that

1) prints out 3 command line arguments that are passed in.
2) Compute the sum of three command line arguments (assuming they are integers)

Recursion Example – printList

Write a recursive function that prints the contents of an array