Hangman

Thursday, February 14, 7:30 – 9:00PM

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Overview

- Review Lecture Material
  - Characters
  - Strings
- Assignment Overview
  - Milestones/breakdown of tasks
  - Some useful upcoming topics
  - General suggestions and reminders
- Q&A

Lecture Review

Characters

```
char ch = 'a';
// need to store return value
ch = Character.toUpperCase(ch);
// converting a char to a string
String str = "" + ch;
```

Useful methods in the Character Class

`static boolean isDigit(char ch)` Determines if the specified character is a digit.
`static boolean isLetter(char ch)` Determines if the specified character is a letter.
`static boolean isLetterOrDigit(char ch)` Determines if the specified character is a letter or a digit.
`static boolean isLowerCase(char ch)` Determines if the specified character is a lowercase letter.
`static boolean isUpperCase(char ch)` Determines if the specified character is an uppercase letter.
`static boolean isWhitespace(char ch)` Determines if the specified character is **whitespace** (spaces and tabs).
`static char toLowerCase(char ch)` Converts **`ch`** to its lowercase equivalent, if any. If not, **`ch`** is returned unchanged.
`static char toUpperCase(char ch)` Converts **`ch`** to its uppercase equivalent, if any. If not, **`ch`** is returned unchanged.

Using portions of slides by Eric Roberts

Comparing Characters

- Write a program that…
  - …prompts the user for 2 words
  - …prints out "The first letters match!" if the first letters of the two words are the same and "The first letters differ" if the first letters are not the same
    - Case-insensitive (so "CS106A" and "cs106a" should match)

Comparing Characters - Solution

```
String first = readLine("Enter a word: ");
String second = readLine("Enter a word: ");
```

Comparing Characters - Solution

```
String first = readLine("Enter a word: ");
String second = readLine("Enter a word: ");
if (Character.toLowerCase(first.charAt(0)) ==
     Character.toLowerCase(second.charAt(0))) {
    println("The first letters match!");
} else {
    println("The first letters differ.");
}
```

Comparing Characters - Solution

```
String first = readLine("Enter a word: ");
String second = readLine("Enter a word: ");
if (Character.toLowerCase(first.charAt(0)) ==
     Character.toLowerCase(second.charAt(0))) {
    println("The first letters match!");
} else {
    println("The first letters differ.");
}
```

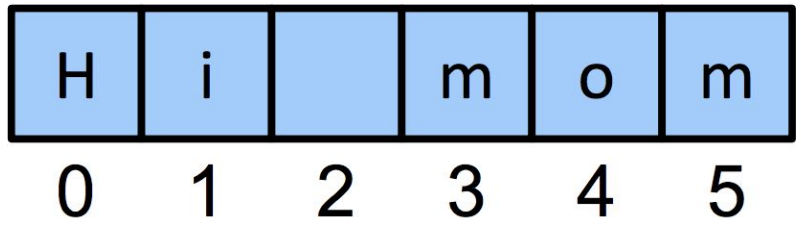
What if the user enters an empty string?

Comparing Characters - Solution

```
String first = readLine("Enter a word: ");
String second = readLine("Enter a word: ");
if (first.length() == 0 || second.length() == 0) {
    println("Empty string");
} else if (Character.toLowerCase(first.charAt(0)) ==
           Character.toLowerCase(second.charAt(0))) {
    println("The first letters match!");
} else {
    println("The first letters differ.");
}
```

Strings

```
String s = "Hi mom";   // ordered characters
```




```
// need to store value of s.toUpperCase()
s = s.toUpperCase();
println(s);              // prints "HI MOM"
```

Useful methods in the String Class

`int length()` Returns the length of the string
`char charAt(int index)` Returns the character at the specified index. Note: Strings indexed starting at 0.
`String substring(int p1, int p2)` Returns the substring beginning at **`p1`** and extending up to but not including **`p2`**
`String substring(int p1)` Returns substring beginning at **`p1`** and extending through end of string.
`boolean equals(String s2)` Returns true if string **`s2`** is equal to the receiver string. This is case sensitive.
`int compareTo(String s2)` Returns integer whose sign indicates how strings compare in lexicographic order
`int indexOf(char ch)` *or* **`int indexOf(String s)`** Returns index of first occurrence of the character or the string, or -1 if not found
`String toLowerCase()` *or* **`String toUpperCase()`** Returns a lowercase or uppercase version of the receiver string

Looping over a String

Canonical “loop over the characters in a string” loop

```
for (int i = 0; i < string.length(); i++) {
    char ch = string.charAt(i);
    /* … process ch … */
}
```

*string.length() returns length not final index

Comparing Strings

```
String s1 = “racecar”;
String s2 = reverseString(s1);

// How do we check equality?
```

Comparing Strings

```
String s1 = "racecar";
String s2 = reverseString(s1);

// How do we check equality?
```

```
if (s1 == s2) {
    …
}
```

OR

```
if (s2.equals(s1)) {
    …
}
```

Comparing Strings

```
String s1 = "racecar";
String s2 = reverseString(s1);

// How do we check equality?
if (s1 == s2) {
    …
}
```

DON'T DO THIS

String References vs. Literals

```
String s1 = "racecar";
String s2 = reverseString(s1);

// How do we check equality?
if (s1 == s2) {
    …  // Compares reference address
}
```

Stack	reference address
s1	memory.com/42
s2	memory.com/79

Heap	string literal
memory.com/49	"racecar"
memory.com/79	"racecar"

```
if (s2.equals(s1)) {
    … // Compares string literal
}
```

String References vs. Literals

```
String school = "Harvard";
println(school + " is a top university..")
fix(school);
println(school + " is not as good as Stanford!")

// What is printed?
private void fix(String str) {
    str = "Stanford of the East";
}
```

String References vs. Literals

Stack (run)	reference address
school	memory.com/36

Heap	string literal
memory.com/36	"Harvard"
memory.com/99	"Stanford of the East"

```
String school = "Harvard";
println(school + " is a top university..") // Harvard is a top university..
fix(school);
println(school + " is not as good as Stanford!") // Harvard is not as good as
                                                 // Stanford!
// Because strings are immutable they behave like primitives in methods!
private void fix(String str) {
    str = "Stanford of the East";
}
```

Stack (fix)	reference address
str	memory.com/99

String References vs. Literals

Stack (run)	reference address
school	memory.com/99

Heap	string literal
memory.com/36	"Harvard"
memory.com/99	"Stanford of the East"

```
String school = "Harvard";
println(school + " is a top university..") // Harvard is a top university..
school = fix(school);
println(school + " is not as good as Stanford!") // Stanford of the East is
                                                 // not as good as Stanford!
// Because strings are immutable they behave like primitives in methods!
private String fix(String str) {
    str = "Stanford of the East";
    return str;
}
```

Stack (fix)	reference address
str	memory.com/99

Searching Strings

- You can use the `indexOf` method to search a string:

```
int index = str.indexOf(pattern);
```

- `indexOf` returns the start index of the first occurrence of the pattern if the pattern exists in the string. Otherwise, if returns -1
- Overloaded so that `pattern` can be either a **`String`** or a **`char`**!

```
int index = "hello".indexOf("el");          // 1
int index = "hello".indexOf('e');       // 1 (overloaded to work with chars!)
int notFound = "cs106a".indexOf("b");       // -1
```

Building Strings

- 1. Use substrings – smaller pieces of strings

  OR

- 2. Make new string and build over time

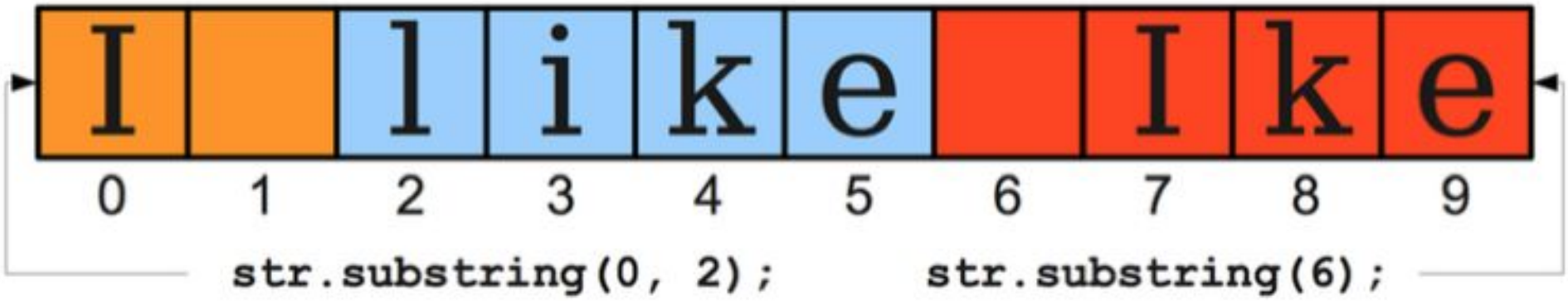
1. Substrings

- To get all of the characters in the range [start, stop), use

```
str.substring(start, stop);
```

- To get all of the characters from some specified point forward, use

```
str.substring(start);
```



Building a New String

- Start with an empty string and build up a new string
- Iterate through the old string
- Use Character methods at each position to decide what to concatenate to the new string
- See this week's section handout for examples

String Summary: Strings are...

- objects that have methods (`length()`, `charAt()`, `equals()`, `indexOf()...`)
- zero-indexed list of `chars`
- **immutable!**
    - but you can concatenate them, get substrings from them, search them, compare them
    - ...using **methods** and the canonical **new string + reassignment to old** pattern

Assignment 4 - Hangman!

Assignment 4 - Hangman

- Due Wednesday, February 20th
- String processing
- Pair assignment (optional)
- We suggest approaching this assignment in stages

Part I: Playing a Console-Based Game

Part I: Console Game

- Choose a **random word** (using HangmanLexicon)
- Display a "**hint**" (initially "- - - - - - - - - -")
- Get **guesses** from the user
- Figure out if a guess is **correct** (letter in the secret word) or **incorrect** (not in secret word)
- **Update** hint
- Keep track of the **number of guesses** the user has left
- Determine when the game has **ended** (no guesses left or they guessed the word)
- **...Repeat**

Game Flow

`String secretWord`	P R O G R A M M E R
`String wordState`	- - - - - - - - - -
`char guess`	r

`String newWordState`	-R--R----R

Hangman Lexicon

- Stub class you can use until you are able to implement part 3
- Beginning of run: create a new **HangmanLexicon** and store it in an **instance variable**
- If you extend the program to allow the user to play multiple games, create HangmanLexicon outside the loop that plays the game repeatedly

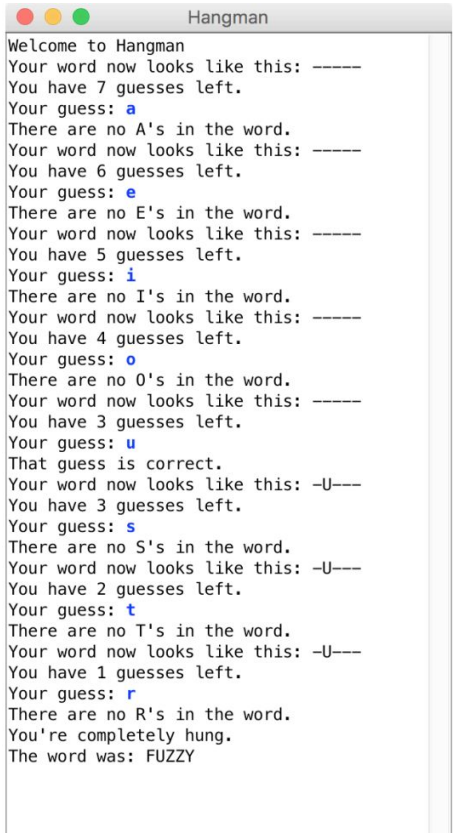
Part I: Console Game - Tips

- Keep track of the user's partially-guessed word (dashes and letters)
- Your program should be **case-insensitive** (**R** and **r** should be the same guess)
  - Guessed letters string should be all upper-case, even when a guess is lower case
- You will have some **fencepost** issues – look at lecture slides for techniques to deal with this
- Watch out for edge case input! (single letter, empty string, etc)

Part I: Console Game - Error Checking

- You'll need to prompt the user to enter guesses
- The user may enter a letter in upper or lower case (hint: the secret words are all upper-case)
- If the user guesses anything other than a single letter, print out an error message and reprompt
- If the user enters the same correct letter more than once, do nothing.
- If the user enters the same *incorrect* letter more than once, it's incorrect again.

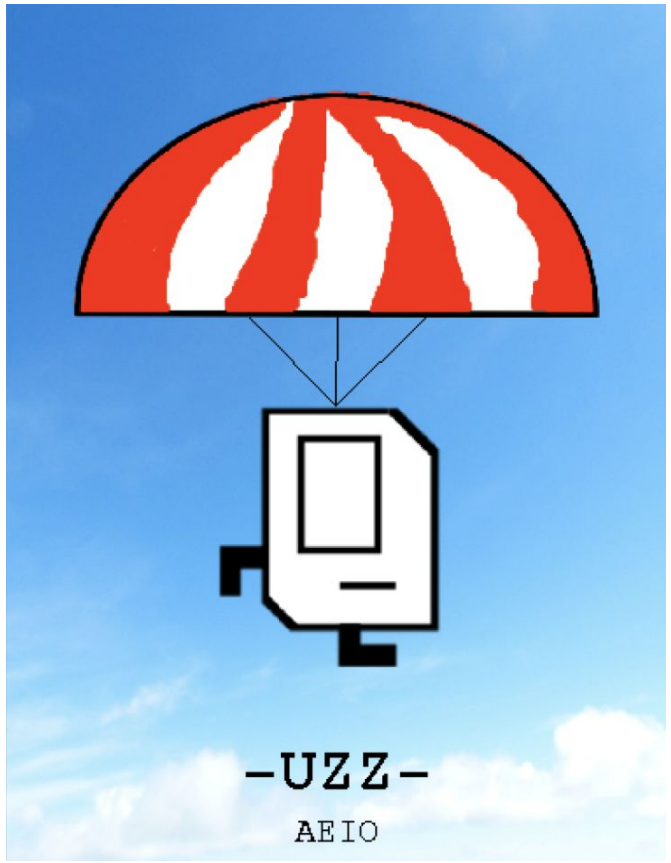
Part I: Console Game – Sample Output



Follow the screenshots to know what your output should look like!

Part II: Adding Graphics

Part II: Hangman Graphics



Drawing

- Add the canvas instance variable to the window using `init()`
  - Call graphics methods on the canvas object, since console programs don't know how to do graphics tasks! i.e.: `canvas.add(object, x, y);`
    - The `canvas` will behave *exactly* like your `GraphicsPrograms`, besides the fact that you have to put `canvas.` at the start
- If the user inputs a wrong guess, remove one of the strings holding Karel's parachute
- If all the guesses are up, display flipped Karel :'(

Drawing the Guess

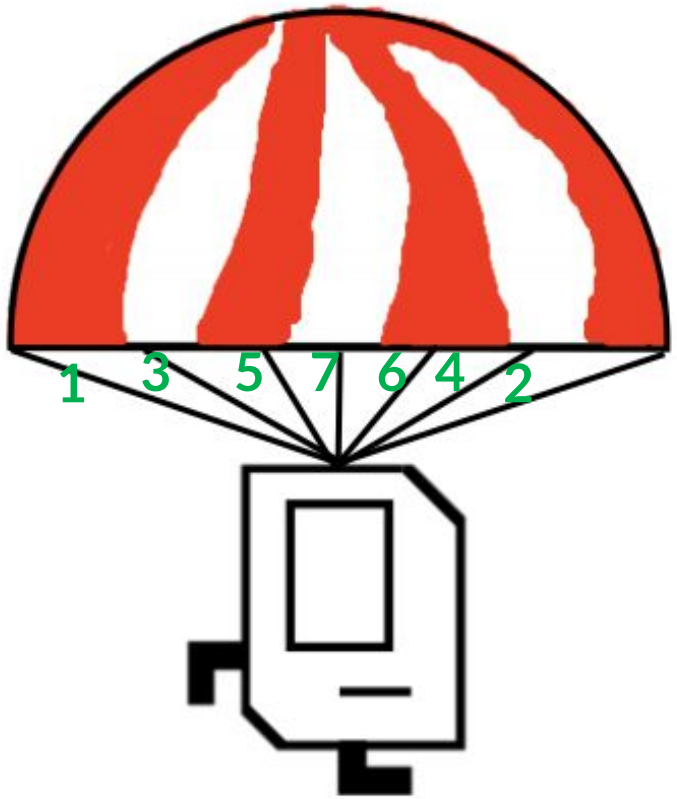
- Should update any time the user enters a *valid* guess (i.e. one character)
- If it is correct, update the partially guessed dashed word
- If it is incorrect, update the set of incorrect guesses
- Setting the font of a `GLabel` (e.g. `label`): `label.setFont("MyCoolFont-42");`

Drawing an Image

```
GImage img = new GImage("mycoolpicture.png");
img.setSize(400,300); //optional, if you want to resize
canvas.add(img, 20, 50); //Just like GRects!
```

Drawing the strings (strings, not Strings)

- Should initially draw as many strings as N_GUESSES constant that are equally spaced across the base of the parachute
- Special order for removing the strings! Basically outside in.
- What's the best way to represent these strings in your code?



Part III: Reading The Lexicon From a Data File

Part III: Random Word from File

```
private String getRandomWord()
```

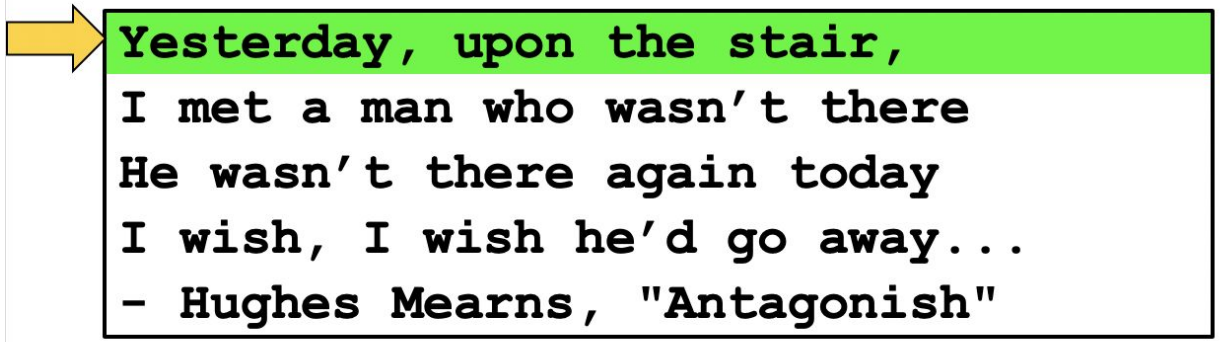
- Before starting this milestone, just use the provided “stub” implementation to get one of 10 random words.
- 1. Open the data file **`HangmanLexicon.txt`** using a Scanner (at start of program)
- 2. Read the lines from the file into an **`ArrayList`** (at start of program)
- 3. Reimplement **`getRandomWord`** so it uses this ArrayList as the source of the words.

There is also a **`ShorterLexicon.txt`** file you can use for testing/debugging.

Useful Topics

Scanner

- Use a `Scanner` to read from a file




```
Scanner input = new Scanner(new File("mydata.txt"));

// Yesterday, upon the stair
String line1 = input.nextLine();
```

Canonical File Reading Loop

```
Scanner input = new Scanner(new File("poem.txt"));
while (input.hasNextLine()) {
   String line = input.nextLine();
   //more awesome code here
}
input.close();
```

Try/Catch

```
try {
   Scanner input = new Scanner(new File("poem.txt"));
   while (input.hasNextLine()) {
      String line = input.nextLine();
      //more awesome code here
   }
} catch (IOException ex) {
   println("I couldn't open poem.txt :(");
}
```

Why try/catch?

- Opening a file is “dangerous” (what if it doesn’t exist?)
- By using a try/catch, we’re promising Java that we have a plan if things go horribly wrong
- Things often go horribly wrong

ArrayLists

- Class representing an ordered, variable size list of data
- Homogeneous (each entry is of the same data type)
- Can store any object!

ArrayList Example

```
ArrayList<String> ourFirstArrayList = new ArrayList<String>();
// Add elements to the right (the 'back')
ourFirstArrayList.add("hello");
ourFirstArrayList.add("world");
// Elements 0-indexed left ('front') to right ('back')
println(ourFirstArrayList.get(0) + " " + ourFirstArrayList.get(1);
// Will get an IndexOutOfBoundsException since size is 2, but we 0-index!
String tmp = ourFirstArrayList.get(ourFirstArrayList.size());
```

Helpful ArrayList Methods

`boolean add(<T> element)` Adds a new element to the end of the **`ArrayList`**; the return value is always **`true`**.
`void add(int index, <T> element)` Inserts a new element into the **`ArrayList`** before the position specified by **`index`**.
`<T> remove(int index)` Removes the element at the specified position and returns that value.
`boolean remove(<T> element)` Removes the first instance of **`element`**, if it appears; returns **`true`** if a match is found.
`void clear()` Removes all elements from the **`ArrayList`**.
`int size()` Returns the number of elements in the **`ArrayList`**.
`<T> get(int index)` Returns the object at the specified index.
`<T> set(int index, <T> value)` Sets the element at the specified index to the new value and returns the old value.
`int indexOf(<T> value)` Returns the index of the first occurrence of the specified value, or −1 if it does not appear.
`boolean contains(<T> value)` Returns **`true`** if the **`ArrayList`** contains the specified value.
`boolean isEmpty()` Returns **`true`** if the **`ArrayList`** contains no elements.

Wrapping Up

Extensions

- Extensions are optional, and you will get a small amount of extra credit if you do them
  - Focus on the main program first, though – extensions won't make up for a broken Hangman!
- If you do extensions, submit two different .java files for the assignment
  - The basic Hangman.java that meets all of the assignment requirements
  - HangmanExtra.java that has your extensions. *In Eclipse, right click on Hangman.java, click Copy, then ctrl+v (paste). In the Name Conflict window that appears, write HangmanExtra and click OK, then make extension edits in the new file. Both files will submit together.*
- In HangmanExtra.java, be sure to comment all of your extensions in the header comment so your SL knows what to look for.
- See the spec for ideas or come up with your own!

Final Tips

- Make sure your program compiles without any errors or warnings
- Follow the spec carefully and make sure your output matches the spec and expected output
- Make sure you properly handle all user input, including faulty/unexpected input
- Use instance variables only where absolutely necessary
- Don't have a method that calls itself
- Go to the LaIR if you get stuck, and incorporate IG feedback!

questions?

fin.