CS 149

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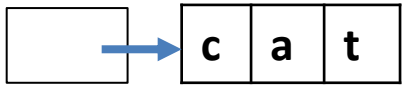
(adapted from slides originally developed by Alvin Chao)

Model 1 Character Arrays

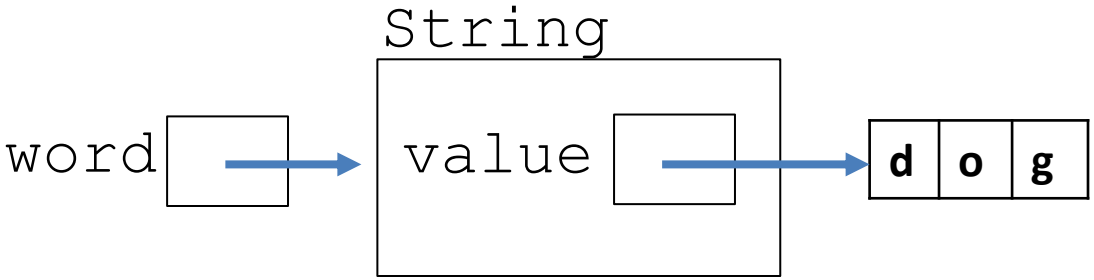
The primitive type **char** is used to store a single character, which can be a letter, a number, or a symbol. In contrast, the reference type **String** encapsulates an array of characters.

```
char letter;
letter = 'A';
```


```
char [] array;
array =  new char[]{'c','a','t'};
```

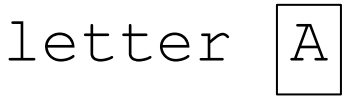



```
String word;
word = "dog";
```

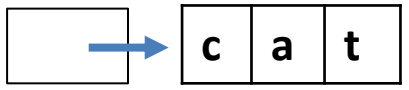


Questions 1-3

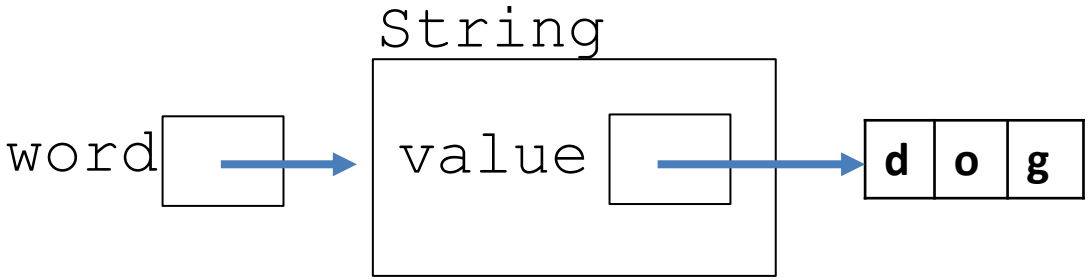
```
char letter;
letter = 'A';
```




```
char [] array;
array = new char[]{'c','a', 't'};
```




```
String word;
word = "dog";
```



1. How is the syntax of character literals and string literals different?

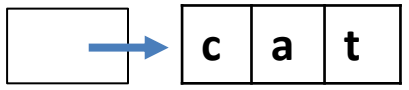
2. What is the index of 'd' in the string above? What is the index of 'g'? In general, what is the index of the last character of a string?

3. Based on the diagram, what does it mean for a class to encapsulate data? How do you access data inside of a class?

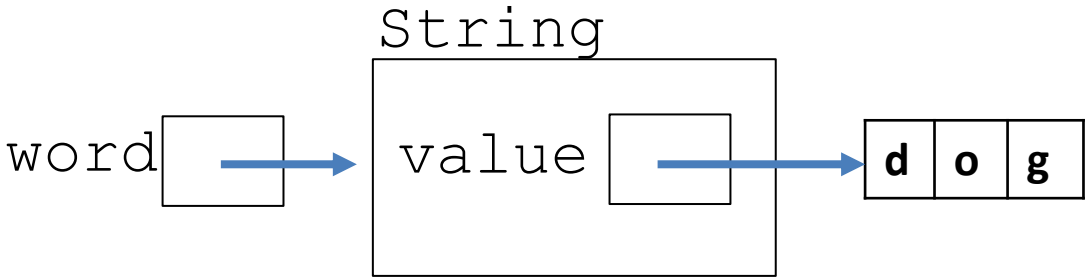
Questions 4-6

```
char letter;
letter = 'A';
```


```
char [] array;
array = new char[]{'c','a', 't'};
```




```
String word;
word = "dog";
```



4. Why can you use the String class in Java programs without having to import it first?

5. What is the value of a char variable? What is the value of an array variable? What is the value of a String variable?

Question 6

Draw a memory diagram for the given code. Each variable should be a name next to a box containing its value.

```
String str;
str = "Hi!";

char let;
let = 'X';

int num;
num = -1;

double foo;
foo = num;

String hmm;
hmm = str;
```

Questions 7-8

7. Recall that the == operator compares the value of two variables. What does it mean for two char variables to be ==? What does it mean for two String variables to be ==?

8. How could you determine whether two character arrays have the same contents? In other words, how does the Arrays.equals method work internally?

Model 2 String Methods

Method	Returns	Description
`charAt(int)`	`char`	Returns the char value at the specified index of `this` string.
`indexOf(String)`	`int`	Returns the index within `this` string of the first occurrence of the specified substring.
`length()`	`int`	Returns the length of `this` string.
`substring(int, int)`	`String`	Returns a new string that is a substring of `this` string (from `beginIndex` to `endIndex - 1`).
`toUpperCase()`	`String`	Returns a copy of `this` string with all the characters converted to upper case.

9. If str references the string "hello world", then what is the return value of the following method calls?

a) str.charAt(6)

b) str.indexOf("ll")

c) str.length()

d) str.substring(4, 7)

e) str.toUpperCase()

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`indexOf(String)`	`int`	Returns the index within `this` string of the first occurrence of the specified substring.
`length()`	`int`	Returns the length of `this` string.
`substring(int, int)`	`String`	Returns a new string that is a substring of `this` string (from `beginIndex` to `endIndex - 1`).
`toUpperCase()`	`String`	Returns a copy of `this` string with all the characters converted to upper case.

10. In the expression **str.charAt(6)** what precedes the . (dot) operator in the expressions above. What does it have to do with the keyword **this** in the model?

11. How many arguments does each method call use? (Hint: None of them really have zero.)

.equals and ==

12. To compare strings, you must use either the String.equals method or the == operator.
Predict the output of the following code.

```
String name1 = "Mark";
String name2 = "Ma" + "rk";
String name3 = "Mary";

// compare name1 and name2
if (name1 == name2) {
    System.out.println("name1 and name2 are identical");
} else {
    System.out.println("name1 and name2 are NOT identical");
}

// compare "Mark" and "Mark"
if (name1.equals(name2)) {
    System.out.println("name1 and name2 are equal");
} else {
    System.out.println("name1 and name2 are NOT equal");
}

// compare "Mark" and "Mary"
if (name1.equals(name3)) {
    System.out.println("name1 and name3 are equal");
} else {
    System.out.println("name1 and name3 are NOT equal");
}
```

Model 3 Common Mistakes

Program A	Program B

`String greeting = "hello world";`
`greeting.toUpperCase();`
`System.out.println(greeting);`
	`Scanner in = new Scanner(System.in);`
	`String line = in.nextLine();`
	`char letter = line.charAt(1);`
	`System.out.println(letter);`

16. Write the output of each program. What is the logic error you see when you run Program A?

17. In Program A, what is returned by the string method toUpperCase()?

18. Describe two different ways you can fix the logic error in #17.

19. What happens to this string when calling the methods in Model 2?

20. In what cases will Program B crash? What is the error message displayed? How can we fix this problem (describe 2 ways).

Characteristics of Strings

Program A	Program B

`String greeting = "hello world";`
`greeting.toUpperCase();`
`System.out.println(greeting);`
	`Scanner in = new Scanner(System.in);`
	`String line = in.nextLine();`
	`char letter = line.charAt(1);`
	`System.out.println(letter);`

21. Looking at program A as an example, do any of the String operators modify the string on which they are invoked? If so, which ones?

Strings are Immutable

Strings are immutable, meaning that once created, by design, they can not be changed.

This greatly simplifies argument/parameter passing.

As we have also seen, 2 (or more) references can point to the same string without worry that it might be changed.

- **Acknowledgements**

Parts of this activity are based on materials developed by Chris Mayfield and Nathan Sprague.

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