Objects

Create a class called “Phone”
- Phone number (string)
- Type of phone (string)
- Contact list (array of Contacts)

Methods
- Send text message (Contact Bob)
- Send multiple text messages (Array of contacts[])
- Call (contact Bob)

Create a class called Contact
- Name
- Phone number

Strings

Problem 2

Ask the user for a sentence (one string). Take each word and reverse the order of its letters, keeping the order of the words unchanged. Output the modified sentence (one string). Assume that the sentence is properly capitalized and ends with a period, and do the same to the output. You may assume that the input does not contain digits, punctuation, or extraneous spaces.

Example:

java ReverseWords

The quick brown fox jumps over the lazy dog.

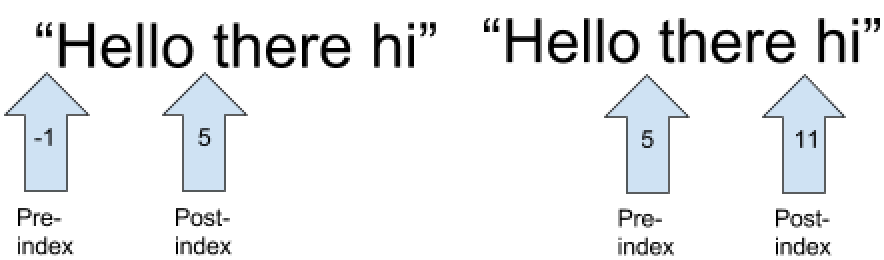
RESULT: "Eht kciuq nworb xof spmuj revo eht yzal god."

Code: See Problem2.java

Explanation

Option 1

Keep track of all of the spaces with a pre- and post- Index tracker. Keep moving both indexes up as we go through each word.



Option 2

Use String.split() to return an array of Strings that are split by the parameter

Example:

“Hello there hi” with parameter of “ “ (line 28) becomes an array containing:

Hello	there	hi

Recursion

Problem 4
Write a method that takes a string and produces a backwards version of it. (for example, "good gravy" backwards is "yvarg doog").

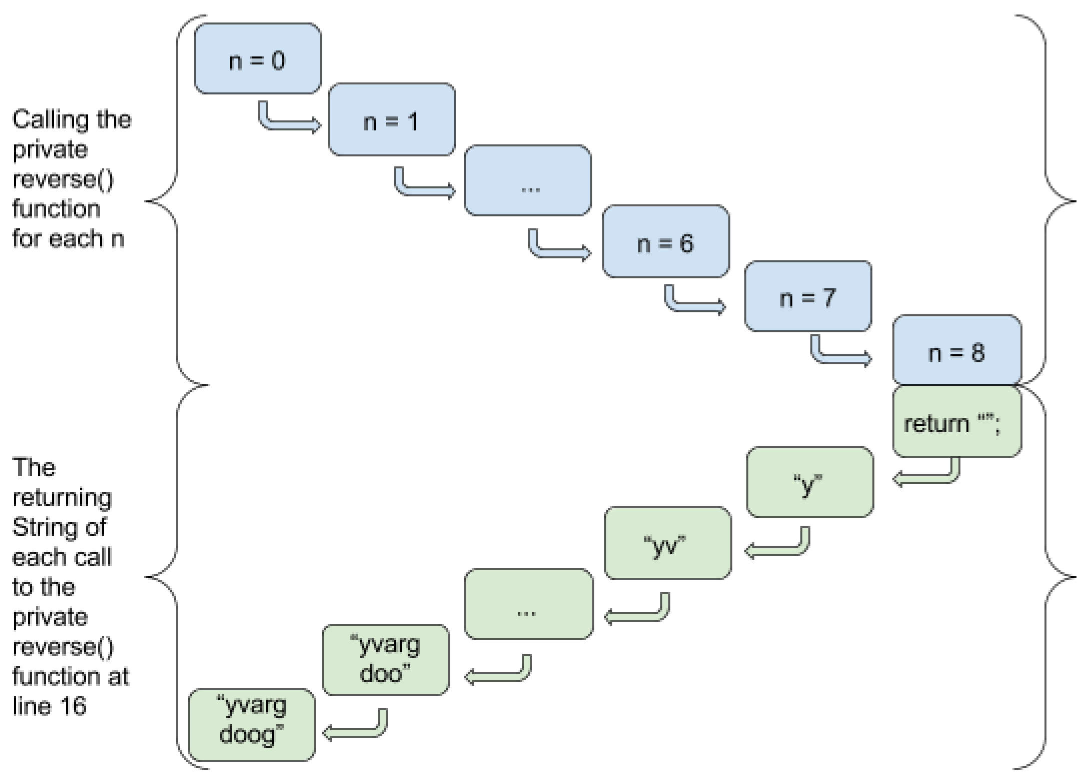
Code See Problem4.java

Explanation

Variables:

- str → the string to reverse
- n → the index of the character

Go through each index of the string and print out each letter at index n, starting from the back of the string to the front (aka go from index str.length()-1 to index 0). Take each character and append it to the end of the resulting string.



Efficiency Analysis

Some Notes

Multiplying vs Adding Runtimes

- O(A + B) → if your code/algo is in the form of: *“do this, then when you’re all done, do that”*
- O(A * B) → if your code/algo is in the form of: *“do this for each time you do that”*

Worst Case vs Best Case

- Worst Case → be really pessimistic and think what is the case that would make you do the *most* amount of work.
- Best Case → be really optimistic and think what is the case that you make you do the *least* amount of work
- For example, think to a time when you were looking for a sheet of paper in a stack of papers.
  - Worst case: it’s the sheet that you last look at (at the bottom of the stack)
  - Best case: it’s the first sheet you look at

Problem 8.a

```
double[] combine(double[] array1, double[] array2){
        double[] result = new double[array1.length +
                                        array2.length];
        int r = 0;

        for (int i = 0 ; i < array1.length ; i++){
                result[r] = array1[i];
                r++;
        }
        for (int i = 0 ; i < array2.length ; i++){
                result[r] = array2[i];
                r++;
        }
        return result;
}
```

Variables

- n = array1.length
- m = array2.length

Operations

1. (1 work) Each for-loop iteration, which includes
   a. Reading from array1 or array2
   b. Writing to result
   c. Increasing i and r
   d. For-loop conditional check
2. (1 work) Creating an array

Work Count

- 1 → creating an array once
- n → doing operation 1 for array1.length many times
- m → doing operation 1 for array2.length many times

Big-O

O(1) + O(n) + O(m) = O(1 + n + m) = O(n + m)

** O(1) is dropped because it’s insignificant in the long run (and because constants are dropped)

Searching/Sorting

Problem 9

1. Trace selection sort on the following array of letters (sort into alphabetical order):
   a. 10, 23, 21, 4, 20, 1, 17, 5, 16, 4

	# comparisons	
10 23 21 4 20 1 17 5 16 4		
1 | 23 21 4 20 10 17 5 16 4	9	Smallest = ~~10~~ ~~4~~ 1
1 4 | 21 23 20 10 17 5 16 4	8	smallest = ~~23~~ 4
1 4 4 | 23 20 10 17 5 16 21	7	smallest = ~~21~~ ~~20~~ ~~10~~ ~~5~~ 4
1 4 4 5 | 20 10 17 23 16 21	6	smallest = ~~23~~ ~~20~~ ~~10~~ 5
1 4 4 5 10 | 20 17 23 16 21	5	smallest = ~~20~~ 10
1 4 4 5 10 16 | 17 23 20 21	4	smallest = ~~20~~ ~~17~~ 16
1 4 4 5 10 16 17 | 23 20 21	3	smallest = 17
1 4 4 5 10 16 17 20 | 23 21	2	smallest = ~~23~~ 20
1 4 4 5 10 16 17 20 21 | 23	1	smallest = ~~23~~ 21

Total # of comparisons = 1 + 2 + 3 + … + 8 + 9 = $\frac{n(n+1)}{2}$

2. Trace insertion sort on the following array of letters (sort into alphabetical order):
   a. 10, 23, 21, 4, 20, 1, 17, 5, 16, 4

10 23 21 4 20 1 17 5 16 4	# comps	target #	Compare with
10 23 | 21 4 20 1 17 5 16 4	1	23	10
10 21 23 | 4 20 1 17 5 16 4	2	21	23, 10
4 10 21 23 | 20 1 17 5 16 4	3	4	23, 21, 10
4 10 20 21 23 | 1 17 5 16 4	3	20	23, 21, 10
1 4 10 20 21 23 | 17 5 16 4	5	1	23, 21, 20, 10, 4
1 4 10 17 20 21 23 | 5 16 4	5	17	23, 21, 23, 20, 10
1 4 5 10 17 20 21 23 | 16 4	6	5	23, 21, 20, 17, 10, 4
1 4 5 10 16 17 20 21 23 | 4	5	16	23, 21, 20, 17, 10
1 4 4 5 10 16 17 20 21 23 |	8	4	23, 21, 20, 17, 16, 10, 5, 4
	= 38		

** SORRY. The second #5 of comps (target #17) should be ***4*** comparisons. So the total is 37 comparisons

3. Trace binary search for the **number 2** on the following array of letters:
    a. 1, 4, 4, 5, 10, 16, 17, 20, 21, 23

$\left(\frac{l+r}{2}\right)$

0 1 2 3 4 5 6 7 8 9

1 4 4 5 $\boxed{10}$ 16 17 20 21 23 $l = 0$ $r = 9$ mid $= 4$

$10 \neq 2$ and $10 > 2$, go left

1 $\boxed{4}$ 4 5 | $\underbrace{10\ 16\ 17\ 20\ 21\ 23}_{\text{disregard}}$ $l = 0$ $r = 3$ mid $= 1$

$4 \neq 2$ and $4 > 2$, go left

$\boxed{1}$ | $\underbrace{4\ 4\ 5\ 10\ 16\ 17\ 20\ 21\ 23}_{\text{disregard}}$ $l = 0$ $r = 0$ mid $= 0$

$1 \neq 2$ and $1 < 2$, go right

$l = 1$ $r = 0$

↓

stop because $l > r$