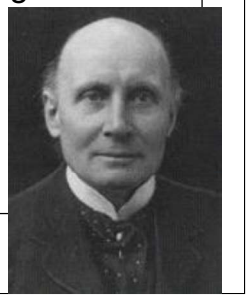
Topic 15
boolean methods
and random numbers

"It is a profoundly erroneous truism, repeated by all the copybooks, and by eminent people when they are making speeches, that we should cultivate the habit of thinking of what we are doing. The precise opposite is the case. **Civilization advances by extending the number of operations which we can perform without thinking about them.** Operations of thought are like cavalry charges in a battle:
-they are strictly limited in number,
they require fresh horses, and
must only be made at decisive moments."

-**Alfred North Whitehead**



Programming Terminology

- Bit, Binary digit, 1 or 0
- Byte, 8 bits
  - Nibble, half a byte, 4 bits
- kilobyte, 1024 bytes (2^{10} = 1024)
- megabyte, 2^{20} bytes, 1,048,576
  - 1,000,000 bytes in some contexts
- gigabyte, 2^{30} bytes, 1,073,741,824
  - 1,000,000,000 bytes in some contexts

Programming Terminology

- compile
- syntax error, compile error, runtime error, logic error
- high level language
- class
- object

Clicker 1

- What is the base 2 representation of 67_{10}?

A. 100011
B. 111111
C. 1000000
D. 2111
E. None of A-D are correct

- Write a method to convert a base 10 int to a base 2 String

The keyword list thus far:

- Complete list of Java keywords:

```
abstract    default     if          private     this
boolean     do          implements  protected   throw
break       double      import      public      throws
byte        else        instanceof  return      transient
case        extends     int         short       try
catch       final       interface   static      void
char        finally     long        strictfp    volatile
class       float       native      super       while
const       for         new         switch
continue    goto        package     synchronized
assert      enum
```


Methods that are tests

- Some methods return logical values (`true` or `false`).
  - A call to such a method is used as a ***<test>*** in a loop or `if`.

```
Scanner console = new Scanner(System.in);
System.out.print("Type your first name: ");
String name = console.next();

if (name.startsWith("Dr.")) {
  System.out.println("Med school or PhD?");
} else if (name.endsWith("Esq.")) {
   System.out.println("And I am Ted 'Theodore' Logan!");
}
```


`String` test methods

Method	Description
`equals(`***<str>***`)`	whether two strings contain the same characters
`equalsIgnoreCase(`***<str>***`)`	whether two strings contain the same characters, ignoring upper vs. lower case
`startsWith(`***<str>***`)`	whether one contains other's characters at start
`endsWith(`***<str>***`)`	whether one contains other's characters at end
`contains(`***<str>***`)`	whether the given string is found within this one

```
String name = console.next();
if (name.contains("Prof")) {
    System.out.println("When are your office hours?");
} else if (name.equalsIgnoreCase(""mavEriCk")) {
    System.out.println("You're grounded, young man!");
}
```


Strings question

- Prompt the user for two words and report whether they:
  - *"rhyme"* (end with the same last two letters)
  - *alliterate* (begin with the same letter)
  - Example output: (run #1)

```
Type two words: car STAR
They rhyme!
```

(run #2)

```
Type two words: bare bear
They alliterate!
```

(run #3)

```
Type two words: sell shell
They alliterate!
They rhyme!
```

(run #4)

```
Type two words: extra strawberry
```

Strings answer

```
// Determines whether two words rhyme and/or alliterate.
import java.util.*;

public class Rhyme {
    public static void main(String[] args) {
        Scanner console = new Scanner(System.in);
        System.out.print("Type two words: ");
        String word1 = console.next().toLowerCase();
        String word2 = console.next().toLowerCase();

        // check whether they end with the same two letters
        if (word2.length() >= 2 &&
            word1.endsWith(word2.substring(word2.length() - 2))) {
            System.out.println("They rhyme!");
        }

        // check whether they alliterate
        if (word1.startsWith(word2.substring(0, 1))) {
            System.out.println("They alliterate!");
        }
    }
}
```


Random numbers

reading: 5.1

The `Random` class

- A `Random` object generates pseudo-random numbers.
  - Class `Random` is found in the `java.util` package.

```
import java.util.Random;
```

Method name	Description
`nextInt()`	returns a random integer
`nextInt(`***<max>***`)`	returns a random integer in the range [0, *max*) in other words, 0 to *max*-1 inclusive
`nextDouble()`	returns a random real number in the range [0.0, 1.0)

  - Example:

```
Random rand = new Random();
int randomNumber = rand.nextInt(10);// 0-9
```


Generating random numbers

- Common usage: to get a random number from 1 to *N*

```
int n = rand.nextInt(20) + 1;
// 1-20 inclusive
```

- To get a number in arbitrary range [*min*, *max*] inclusive:

  <name>`.nextInt(`***<size of range>***`) + `***<min>***

  - Where ***<size of range>*** is (***<max>*** `-` ***<min>*** `+ 1`)
  - Example: A random integer between 4 and 10 inclusive:

```
int n = rand.nextInt(7) + 4;
```

Random questions

- Given the following declaration, how would you get:

```
Random rand = new Random();
```

  - A random number between 1 and 47 inclusive?

```
int random1 = rand.nextInt(47) + 1;
```

  - A random number between 23 and 30 inclusive?

```
int random2 = rand.nextInt(8) + 23;
```

  - A random even number between 4 and 12 inclusive?

```
int random3 = rand.nextInt(5) * 2 + 4;
```


Random and other types

- nextDouble method returns a double between [0.0 - 1.0)
  - Example: Get a random GPA value between 1.5 and 4.0:

```
double randomGpa
                = rand.nextDouble() * 2.5 + 1.5;
```

- Any set of possible values can be mapped to integers
  - code to randomly play Rock-Paper-Scissors:

```
int r = rand.nextInt(3);
if (r == 0) {
    System.out.println("Rock");
} else if (r == 1) {
    System.out.println("Paper");
} else {  // r == 2
    System.out.println("Scissors");
}
```


Random question

- Write a program that simulates rolling of two 6-sided dice until their combined result comes up as 7.

```
2 + 4 = 6
3 + 5 = 8
5 + 6 = 11
1 + 1 = 2
4 + 3 = 7
You won after 5 tries!
```


Random answer

```
// Rolls two dice until a sum of 7 is reached.
import java.util.*;

public class Dice {
    public static void main(String[] args) {
        Random rand = new Random();
        int tries = 0;

        int sum = 0;
        while (sum != 7) {
            // roll the dice once
            int roll1 = rand.nextInt(6) + 1;
            int roll2 = rand.nextInt(6) + 1;
            sum = roll1 + roll2;
            System.out.println(roll1 + " + " + roll2 + " = " + sum);
            tries++;
        }

        System.out.println("You won after " + tries + " tries!");
    }
}
```

Random question

- Write a program that plays an adding game.
  - Ask user to solve random adding problems with 2-5 numbers.
  - The user gets 1 point for a correct answer, 0 for incorrect.
  - The program stops after 3 incorrect answers.

```
4 + 10 + 3 + 10 = 27
9 + 2 = 11
8 + 6 + 7 + 9 = 25
Wrong! The answer was 30
5 + 9 = 13
Wrong! The answer was 14
4 + 9 + 9 = 22
3 + 1 + 7 + 2 = 13
4 + 2 + 10 + 9 + 7 = 42
Wrong! The answer was 32
You earned 4 total points.
```


Random answer

```
// Asks the user to do adding problems and scores them.
import java.util.*;

public class AddingGame {
    public static void main(String[] args) {
        Scanner console = new Scanner(System.in);
        Random rand = new Random();

        // play until user gets 3 wrong
        int points = 0;
        int wrong = 0;
        while (wrong < 3) {
            int result = play(console, rand);   // play one game
            if (result == 0) {
                wrong++;
            } else {
                points++;
            }
        }

        System.out.println("You earned " + points + " total points.");
    }
```


Random answer 2

```
    ...
    // Builds one addition problem and presents it to the user.
    // Returns 1 point if you get it right, 0 if wrong.
    public static int play(Scanner console, Random rand) {
        // print the operands being added, and sum them
        int operands = rand.nextInt(4) + 2;
        int sum = rand.nextInt(10) + 1;
        System.out.print(sum);

        for (int i = 2; i <= operands; i++) {
            int n = rand.nextInt(10) + 1;
            sum += n;
            System.out.print(" + " + n);
        }
        System.out.print(" = ");

        // read user's guess and report whether it was correct
        int guess = console.nextInt();
        if (guess == sum) {
            return 1;
        } else {
            System.out.println("Wrong! The answer was " + total);
            return 0;
        }
    }
}
```