CMSC 150
INTRODUCTION TO COMPUTING

LAB – WEEK 3

- STANDARD IO
- FORMATTING OUTPUT
- SCANNER
- REDIRECTING

INPUT AND OUTPUT

- Input devices


Keyboard


Mouse


Hard drive


Network


Digital camera


Microphone

- Output devices.


Display


Speakers


Hard drive


Network


Printer


MP3 Player

- Goal. Java programs that interact with the outside world.
  - Java Libraries support these interactions
  - We use the Operating System (OS) to connect our program to them

WHAT HAVE WE SEEN SO FAR?

- Command-line input. Example: read an integer N as command-line argument.
- Standard output.
  - The OS output stream for text
  - By default, standard output is sent to Terminal.
  - Example: System.out.println() goes to standard output.

```
1.  public class RandomSeq {
2.     public static void main(String[] args) {
3.        int N = Integer.parseInt(args[0]);
4.        int i = 0;
5.        while (i < N) {
6.           System.out.println(Math.random());
7.           i++;
8.        }
9.     }
10. }
```

STANDARD INPUT AND OUTPUT

FORMATTING OUTPUT

- There is too much to cover in one slide, so here is a link to help
- Basics
  - Use System.out.printf() or System.out.format()
  - Their first argument is a string. Each time a % appears in the string, it is a directive to substitute it for a variable value. Attach each value after the string (comma separated) System.out.printf("Hello %s", "World");
  - Use \n in the string to add a new line
- %
  - %s – String
  - %b – Boolean
  - %d – Integer
  - %f – Float/double
  - Etc.
- Examples
  - System.out.printf("My int: %d", a);
  - System.out.printf("My float: %f", d);

FORMATTING OUTPUT

- The power of printf!
- Can control field width – how many characters are used to output item
  - Can right justify text
- Example %5d – always uses 5 characters to output an integer. Beginning would be white space, not zeroes
- Can also do the same on other types. Floats can determine number of decimal places: %5.7f means 5 characters before the decimal and 7 after
- The possibilities become infinite

```
1. public class PlayWithFormat {
2.     public static void main(String args[]) {
3.         System.out.printf("%5.7f\n",
4.             Double.parseDouble(args[0]));
5.     }
6. }
```

COMMAND-LINE INPUT VS. STANDARD INPUT

- Command-line input.
  - Use command-line input to read in a few user values.
  - Not practical for many user inputs.
  - Input entered before program begins execution.

- Standard input.
  - The OS stream for input
  - By default, standard input is received from Terminal window.
  - Input entered while program is executing.

STANDARD INPUT

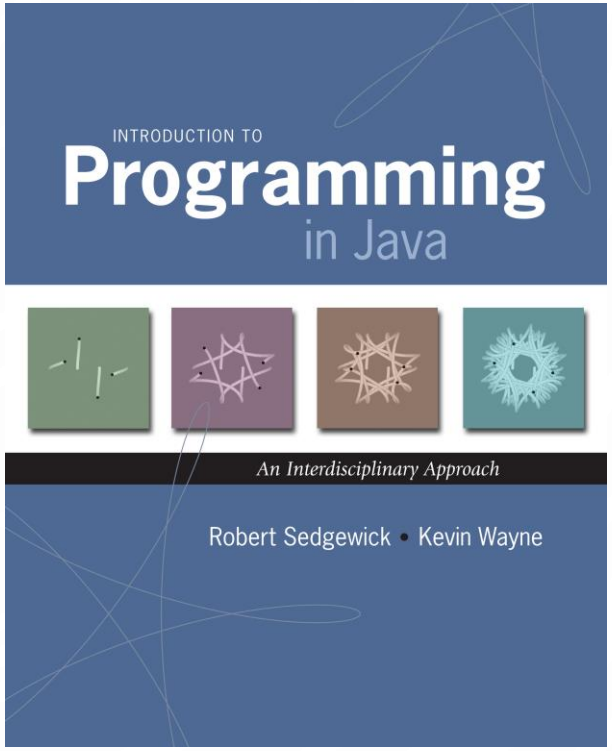
- Use Scanner. Helpful links: API, Tutorial
- Basics:
  - Declare and initialize a scanner like:
    Scanner scanner = new Scanner(System.in);
  - Then use it like in the API:
    double d = scanner.nextDouble();
  - Usually you should prompt the user with System.out.print() to request input

```
1.  import java.util.Scanner;
2.  public class ReadSentence {
3.      public static void main(String[] args) {
4.          System.out.print("Enter sentence: ");
5.          Scanner s = new Scanner(System.in);
6.          String sentence;
7.          while(s.hasNext())
8.              sentence += s.next();
9.          System.out.println("Your sentence: " + s);
10.     }
11. }
```

Note - hasNext() will return true until it sees Control+d.

DECODING YOUR TEXTBOOK

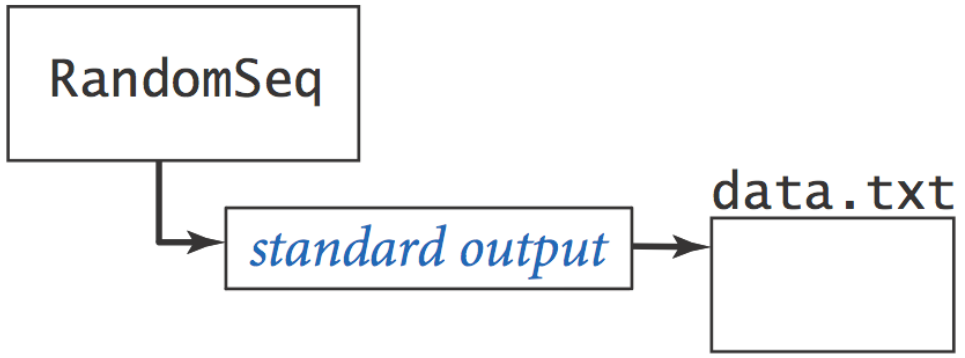
- Your textbook uses their own Java libraries StdIn.java and StdOut.java. These are synonymous (***BUT NOT EXACTLY THE SAME***) as Scanner and System.out respectively
- ***Please do not use StdIn or StdOut! These are not necessary libraries***



REDIRECTION AND PIPING

REDIRECTING STANDARD OUTPUT

- Redirecting standard output. Use OS directive to send standard output to a file for permanent storage (instead of terminal window).

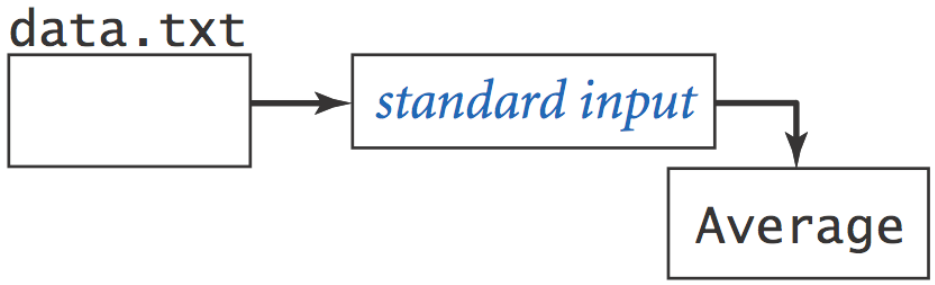



```
% java RandomSeq 1000 > data.txt
```

redirect stdout

REDIRECTING STANDARD INPUT

- Redirecting standard input. Use OS directive to read standard input from a file (instead of terminal window).

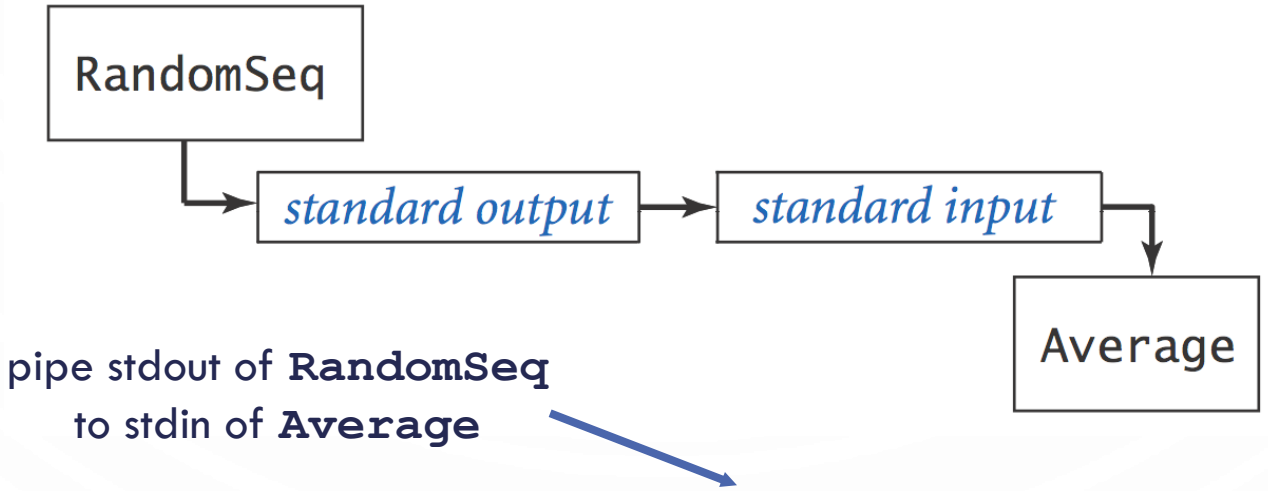


redirect stdin

```
% java Average < data.txt
0.4947655567740991
```

CONNECTING PROGRAMS

- Piping. Use OS directive to make the standard output of one program become the standard input of another.



pipe stdout of **RandomSeq** to stdin of **Average**

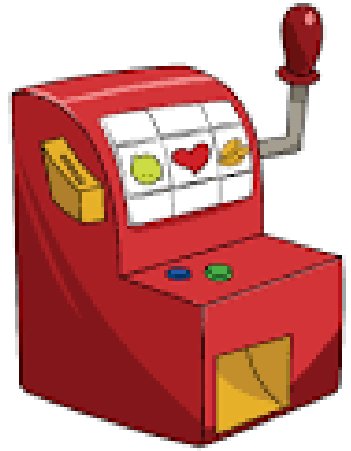
```
% java RandomSeq 1000000 | java Average
0.4997970473016028
```

Another interesting item: Can pipe directly to command line arguments with xargs, e.g.,

```
java RandomSeq 10 |
xargs java AverageCMDLine
```

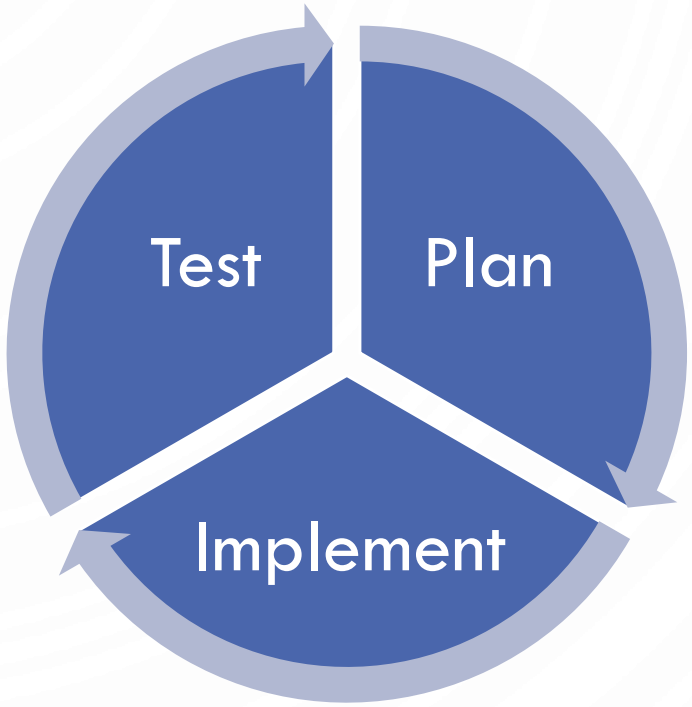
EXERCISE – IN TRIPLETS

- Yes you have to be with someone!
- Starters: You work for JLDiablo Consultants Inc., which specializes in making software for Casino games (Cha-ching! $$$$). A new casino in Reno needs a slot game called Binary Slots 101010.
  - How it works:
    - A player enters a bet of their choice
    - Three Boolean values are randomly generated
    - If they are all true, then the player earns twice their money back!



EXERCISE – WHERE TO BEGIN

- When developing programs
  - Always think first!
  - Sketch out solution, i.e., plan
  - Implement solution
  - Test solution
  - Repeat!
- Called iterative development



EXERCISE – START THE PROGRAM

```
1. public class BinarySlots101010 {
2.     public static void main(String[] args) {
3.         System.out.println("Welcome to Binary Slots 101010!\n\n\n");
4.     }
5. }
```

EXERCISE – GET BET

```
1.  import java.util.Scanner;
2.  public class BinarySlots101010 {
3.      public static void main(String[] args) {
4.          System.out.println("Welcome to Binary Slots 101010!\n\n\n");
5.
6.          System.out.print("Please enter your bet: ");
7.          Scanner scanner = new Scanner(System.in);
8.          double bet = scanner.nextDouble();
9.          System.out.printf("Your bet is $.2f\n\n", bet);
10.     }
11. }
```

Recall, it is good style to name variables descriptively

What happens if you don't enter a double?

EXERCISE – GET BET ROBUSTLY

```
1.  import java.util.Scanner;
2.  public class BinarySlots101010 {
3.      public static void main(String[] args) {
4.          System.out.println("Welcome to Binary Slots 101010!\n\n\n");
5.
6.          System.out.print("Please enter your bet: ");
7.          Scanner scanner = new Scanner(System.in);
8.          while(!scanner.hasNextDouble()) {
9.              System.out.println("Please enter a valid bet: ");
10.             Scanner.next(); //Remember to eat up (read) bad input…
11.         }
12.         double bet = scanner.nextDouble();
13.         System.out.printf("Your bet is $.2f\n\n", bet);
14.     }
15. }
```

EXERCISE – GAME LOGIC

```
1.  import java.util.Scanner;
2.  public class BinarySlots101010 {
3.      public static void main(String[] args) {
4.          System.out.println("Welcome to Binary Slots
        101010!\n\n\n");
5.
6.          System.out.print("Please enter your bet: ");
7.          Scanner scanner = new Scanner(System.in);
8.          while(!scanner.hasNextDouble()) {
9.              System.out.println("Please enter a valid bet: ");
10.             Scanner.next();
                    //Remember to eat up (read) bad input…
11.         }
12.         double bet = scanner.nextDouble();
13.         System.out.printf("Your bet is $.2f\n\n", bet);
13.         System.out.println("Spinning….match all to win!\n");
14.         boolean a = Math.random() < 0.5,
15.             b = Math.random() < 0.5,
16.             c = Math.random() < 0.5;
17.         System.out.println("Binary slots: " +
                a + " " + b + " " + c + "\n");
18.
19.         if(a && b && c)
20.             System.out.printf("You win 2x your bet! You won $%.2f\n",
                    2*bet);
21.         else
22.             System.out.println("Sorry you lose…");
23.     }
24. }
```

EXERCISE

- Until the end of lab work with your team to improve the slots game. Possibilities:
  - Allow multiple bets without restarting the program
  - Track the user's total money amount and allow them to cash out (leave the machine)
  - Modify game to have more Boolean values and allow different winning amount, i.e., if two are matched you get 1.2*bet, 4 matched you get 8*bet, or whatever works for you.
  - Use Unicode characters to allow more than two symbols
  - Make sure to protect all inputs (while and if statements)
- Always start with planning your program modification, then implement, and then test (ensure it works!)
- Save this for program for next week in your Box!