LEC 05

CSE 121

Nested Loops, Random, Math

BEFORE WE START

Talk to your neighbors:

What's your favorite dessert?

Music: CSE 121 25au Lecture Tunes

Instructors: Brett Wortzman & James Weichert

TAs:

Trey	Ava	Caleb	Elden	Anya
Amogh	Reese	Anum	Suyash	Minh
Samrutha	Hayden	Abdul	Sthiti	TJ
Dalton	Aki	Janvi	Paul	Zach
Ailsa	Spencer	Navya	Shayna	Cayden
Ryan	Savannah	Sam	Jesse	Johnathan
Anant	Tamsyn	Jessica	Nhan	

Questions during Class?

Raise hand or send here

sli.do #cse121

Agenda

- **Announcements, Reminders**
- String Traversal Review
- Nested for Loop Practice
- Random, Math Practice

Announcements, Reminders

- **C1** is out, due Tuesday October 14th
- **Resubmission Cycle 0 (R0)** released, due Thursday October 16th
  - Eligible for resubmission: C0 & P0
- **Quiz 0** is on Thursday, October 16th (in your registered quiz section)
  - Read the quiz logistics post on Ed!
  - can't make it? email cse121-instructors@cs.uw.edu ASAP
- Observation: the course picks up pace a bit in this next week!
  - Go to section!
- Support reminders:
  - Instructor OH
    - James: W 1-2 and F 2-3; Coffee Chats 11-12:30 on Mondays!
    - Brett: Tu 2:30 -3:30 and Thu 11-12
  - IPL: Mon-Thu 12:30 – 9:30, Fri 12:30 – 5:30
  - Async via Ed & email!

Agenda

- Announcements, Reminders
- **String Traversal Review**
- Nested for Loops
- Random, Math

Wed PCM: String Traversals

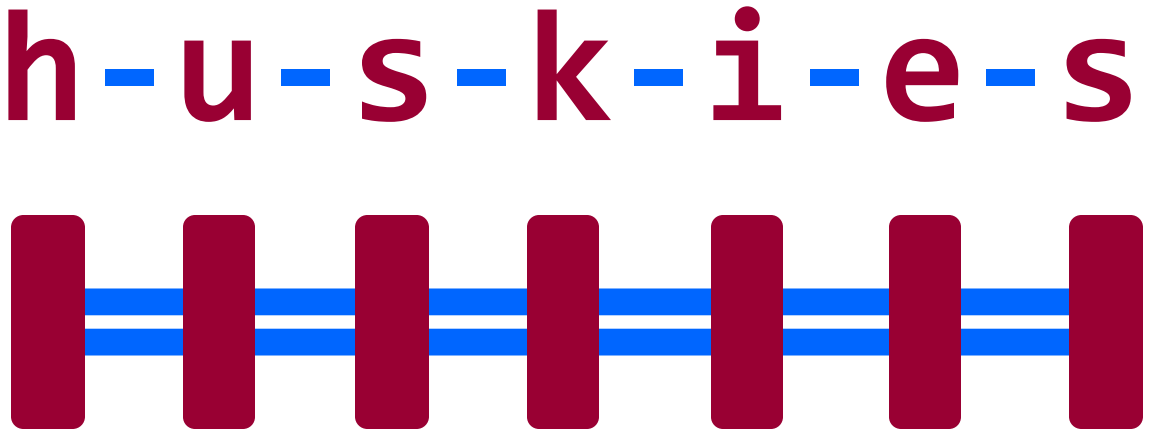
```
// For some String s
for (int i = 0; i < s.length(); i++) {
    // do something with s.charAt(i)
}
```

Go Huskies?

```
h-u-s-k-i-e-s
```

The Fencepost Pattern

Some task where one piece is repeated *n* times, and another piece is repeated *n-1* times and they alternate



Agenda

- Announcements, Reminders
- String Traversal Review
- **Nested for Loops**
- Random, Math

Wed PCM: for Loops!

For loops are our first **control structure**: a syntax *structure* that *controls* the execution of other statements.

```
for ( initialization ; test ; update ) {
    body (statements to be repeated)
}
```

PCM: Nested for Loops

```
for (int outerLoop = 1; outerLoop <= 5; outerLoop++) {
    System.out.println("outer loop iteration #" + outerLoop);
    for (int innerLoop = 1; innerLoop <= 3; innerLoop++) {
        System.out.println("    inner loop iteration #" + innerLoop);
    }
    System.out.println(outerLoop);
}
```

PCM: Nested for Loops, "Outer Loop"

```
for (int outerLoop = 1; outerLoop <= 5; outerLoop++) {
    System.out.println("outer loop iteration #" + outerLoop);
    for (int innerLoop = 1; innerLoop <= 3; innerLoop++) {
        System.out.println("    inner loop iteration #" + innerLoop);
    }
    System.out.println(outerLoop);
}
```

PCM: Nested for Loops, "Inner Loop"

```
for (int outerLoop = 1; outerLoop <= 5; outerLoop++) {
    System.out.println("outer loop iteration #" + outerLoop);
    for (int innerLoop = 1; innerLoop <= 3; innerLoop++) {
        System.out.println("    inner loop iteration #" + innerLoop);
    }
    System.out.println(outerLoop);
}
```

Practice: Think

sli.do #cse121

What output is produced by the following code?

```
for (int i = 1; i <= 5; i++) {
  for (int j = 1; j <= i; j++) {
    System.out.print(i);
  }
  System.out.println();
}
```

A.
```
1
12
123
1234
12345
```

B.
```
i
ii
iii
iiii
iiiii
```

C.
```
1
22
333
4444
55555
```

D.
```
1
11
111
1111
11111
```

Practice: Pair

sli.do #cse121

What output is produced by the following code?

```
for (int i = 1; i <= 5; i++) {
  for (int j = 1; j <= i; j++) {
    System.out.print(i);
  }
  System.out.println();
}
```

A.
```
1
12
123
1234
12345
```

B.
```
i
ii
iii
iiii
iiiii
```

C.
```
1
22
333
4444
55555
```

D.
```
1
11
111
1111
11111
```

Practice: Think

sli.do #cse121

What code produces the following output?

A.

```
for (int i = 1; i <= 5; i++) {
  for (int j = 1; j <= i; j++) {
    System.out.print(i);
  }
  System.out.println();
}
```

B.

```
for (int i = 1; i <= 5; i++) {
  for (int j = 1; j <= i; j++) {
    System.out.print(j);
  }
  System.out.println();
}
```

C.

```
for (int i = 1; i <= 5; i++) {
  for (int j = 1; i <= j; j++) {
    System.out.print(j);
  }
  System.out.println();
}
```

D.

```
for (int i = 1; i <= 5; i++) {
  for (int j = 1; j <= i; i++) {
    System.out.print(j);
  }
  System.out.println();
}
```

```
1
12
123
1234
12345
```

Practice: Pair

sli.do #cse121

What code produces the following output?

A.

```
for (int i = 1; i <= 5; i++) {
  for (int j = 1; j <= i; j++) {
    System.out.print(i);
  }
  System.out.println();
}
```

B.

```
for (int i = 1; i <= 5; i++) {
  for (int j = 1; j <= i; j++) {
    System.out.print(j);
  }
  System.out.println();
}
```

C.

```
for (int i = 1; i <= 5; i++) {
  for (int j = 1; i <= j; j++) {
    System.out.print(j);
  }
  System.out.println();
}
```

D.

```
for (int i = 1; i <= 5; i++) {
  for (int j = 1; j <= i; i++) {
    System.out.print(j);
  }
  System.out.println();
}
```

```
1
12
123
1234
12345
```

New: Scope

Scope: the part of a program where a variable exists (and can thus be referenced, modified, or used).

- General Rule: a variable 'exists' from its **declaration** to the **closing brace of that indentation level }**

innerloop's scope

```
for (int outerLoop = 1; outerLoop <= 5; outerLoop++) {
    System.out.println("outer loop iteration #" + outerLoop);
    for (int innerLoop = 1; innerLoop <= 3; innerLoop++) {
        System.out.println("    inner loop iteration #" + innerLoop);
    }
    System.out.println(outerLoop);
}
```

outerloop's scope

Agenda

- Announcements, Reminders
- String Traversal Review
- Nested for Loops
- **Random, Math**

Randomness

Having a computer generate truly random numbers is hard!

Instead, computers generate numbers that “look random” in a predictable way, using mathematical formulas

Pseudo-Randomness

Having a computer generate truly random numbers is hard!

Instead, computers generate numbers that "look random" in a predictable way, using mathematical formulas

- can use "external" variables like time, mouse position, etc.
- if we "fix" these variables, we can reproduce the same behavior
  - very important for testing!

Aside: Why Randomness?

Randomness is core to computer science. It powers (among others):

- cryptography
- computer security
- machine learning (LLMs!)

True randomness is important: if we just use math, someone can "reverse" the formula.

LavaRand: CloudFlare's Wall of Lava Lamps

PCM: Random

The Random class helps us generate pseudo-random numbers.

- We create a new Random number generator by calling `new Random()`
- First, we need to **import** the Random class with `import java.util.*;`
- We can "seed" the generator to make it behave *deterministically*

Method	Description
`nextInt()`	Returns a random integer
`nextInt(`*max*`)`	**Returns a random integer in the range [0, *max*), or in other words, 0 to *max*-1 inclusive**
`nextDouble()`	Returns a random double in the range [0.0, 1.0)

Practice: Think

sli.do #cse121

Assuming you've declared: `Random randy = new Random();`

Which of these best models picking a random card? (number between 1 and 13 inclusive)

A. `randy.nextInt()`

B. `randy.nextInt(13)`

C. `randy.nextInt(13) + 1`

D. `randy.nextInt(13 + 1)`

Practice: Pair

sli.do #cse121

Assuming you've declared: `Random randy = new Random();`

Which of these best models picking a random card? (number between 1 and 13 inclusive)

A. `randy.nextInt()`

B. `randy.nextInt(13)`

C. `randy.nextInt(13) + 1`

D. `randy.nextInt(13 + 1)`

PCM: Math

`Math.<method>(…)`

Method	Description
`Math.abs(`*value*`)`	Returns the absolute value of *value*
`Math.ceil(`*value*`)`	Returns *value* rounded up
`Math.floor(`*value*`)`	Returns *value* rounded down
`Math.max(`*value1*`, `*value2*`)`	Returns the larger of the two values
`Math.min(`*value1*`, `*value2*`)`	Returns the smaller of the two values
`Math.round(`*value*`)`	Returns *value* rounded to the nearest whole number* note: need to cast result to int (it's complicated!)
`Math.sqrt(`*value*`)`	Returns the square root of *value*
`Math.pow(`*base*`, `*exp*`)`	Returns *base* raised to the *exp* power