CSE 121 Lesson 5: Nested for loops, Random, Math

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sli.do #cse121

TAs:

Abby	Afifah	Ailsa	Alice	Aliyan	Arohan
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Hanna	Hannah	Heather	Hibbah	Janvi	Jasmine
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Maitreyi	Maria	Merav	Minh	Neha	Ronald
Ruslana	Sahej	Sam	Samrutha	Sushma	Vivian
Yijia	Zachary				

Today's playlist:
121 24au lecture tunes

Announcements, Reminders

- Creative Project 1 is out, due Tue Oct 15th
- Resubmission Cycle 0 released, due Thu Oct 17th
  - Eligible for submission: C0 & P0
- Course logistics reminders:
  - “Extra Resources” on course website
  - Post-section work must be done by 11:59 that day
  - Brett’s office hours out now!

Last time: for loops!

For loops are our first *control structure*

A syntactic structure that *controls* the execution of other statements.

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

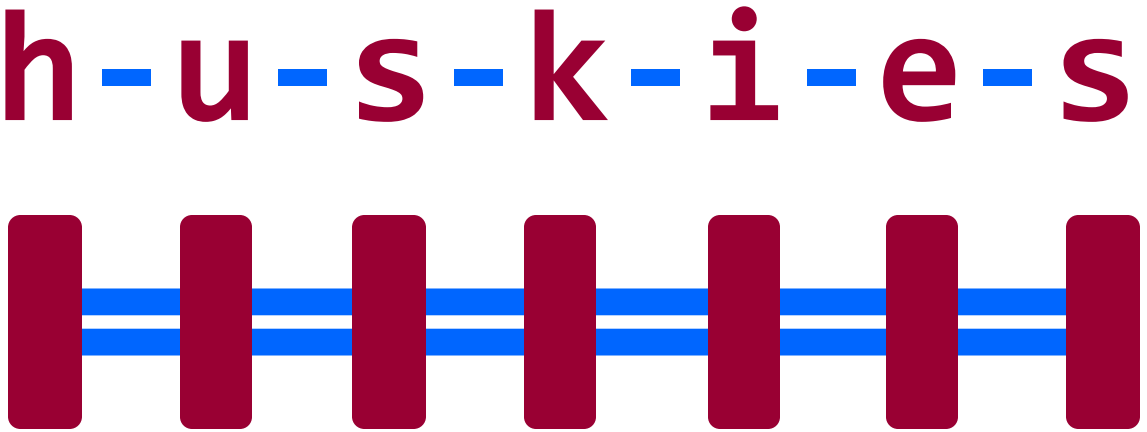
Fencepost Pattern 1

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

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

Fencepost Pattern 2

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



(PCM) Nested for loops (1/3)

```
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 (2/3)

```
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 (3/3)

```
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);
}
```

Poll in with your answer!

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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
```

Poll in with your answer!

What code produces the following output?

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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
```

Pseudo-Randomness

Computers generate numbers that “look random” in a predictable way using mathematical formulas.

- can use “external” variables like time, mouse position, etc.

True randomness is hard – we rely on natural processes

- e.g., atmospheric noise, lava lamps

Why randomness?

Randomness is a core part of computer science! It powers:

- cryptography
- security
- machine learning!

But true randomness is really hard. If we just use math, someone could "reverse" the formula.

So … lava lamps.

LavaRand: CloudFlare's Wall of Lava Lamps

(PCM) Random

A Random object generates *pseudo*-random numbers.

- The `Random` class is found in the `java.util` package

```
import java.util.*;
```

- We can "seed" the generator to make it behave deterministically (helpful for testing!)

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 real number in the range [0.0, 1.0)

Poll in with your answer!

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

Which of these best models picking a random card? (1-13 inclusive)

A. `randy.nextInt()`

B. `randy.nextInt(13)`

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

D. `randy.nextInt(14)`

(PCM) Math

Calling:

`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
`Math.sqrt(`*value*`)`	Returns the square root of *value*
`Math.pow(`*base*`, `*exp*`)`	Returns *base* raised to the *exp* power

Reminders

- Creative Project 1 is out, due Tue Oct 15th
- Resubmission Cycle 0 released, due Thu Oct 17th
- Getting help today?
  - Matt's office hours: 12:30-1:20 (in-person/Zoom)
  - Brett's office hours: 1:30-2:30 (Zoom)
  - IPL (until 6:30)