Iterations

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What is iteration? Why is it important?

From CollegeBoard 4.1-4.4: "Iteration is a way to simplify code that would otherwise be repeated many times in succession. Using loops, we can finally implement complex algorithms and solutions to common problems that we weren't able to before. In this unit, we will learn two types of loops: the while loop and the for loop."

TLDR: Iteration are repeated sequences to simplify code of advanced algorithms.

Operators

- Increment & Decrement Operator: ++ & --
  - Postfix and Prefix mode

    x = 2;

    System.out.println(--x);

    //Prefix mode (x = 1)

    _____

    x = 2;

    System.out.println(x++);

    //Postfix mode (x= 2)

Operators

Operator Type	Category	Precedence
Unary	postfix	*expr*++ *expr*--
	prefix	++*expr* --*expr* +*expr* -*expr* ~ !
Arithmetic	multiplicative	* / %
	additive	+ -
Shift	shift	<< >> >>>
Relational	comparison	< > <= >= instanceof
	equality	== !=
Bitwise	bitwise AND	&
	bitwise exclusive OR	^
	bitwise inclusive OR	|
Logical	logical AND	&&
	logical OR	||
Ternary	ternary	? :
Assignment	assignment	= += -= *= /= %= &= ^= |= <<= >>= >>>=

What are some examples?

- While Loop - 4.1

- For Loop - 4.2

- Recursion Loop - 4.3

- Nested Iteration - 4.4

What's a 'While Loop'?

A sequence of code that loops itself **while** a specified condition is met. If the condition is no longer true then the loop will stop. Can be used for input validation as well.

```java
int i = 1;

while (i <= 5) {

    System.out.println(i);

    i++;

}
```
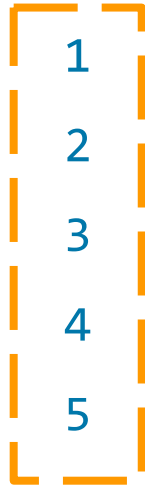
Output:

1

2

3

4

5

What's a 'For Loop'?

A sequence of code that loops itself **for** as long as a condition is met. If the condition is no longer true the loop will stop.

```java
int n = 5;

for (int i = 1; i <= n; ++i) {

    System.out.println(i);

}
```

Output:

1

2

3

4

5

What's a 'Recursion Loop'?

Similar to *For Loop* and *While Loop*, recursion also repeats itself over and over again. The difference is that for recursion, a function calls itself to repeat (**recurses**).

```java
int result = sum(5, 10);
System.out.println(result);


public static int sum(int first, int last) {
    if (last > first) {
        return last + sum(first, last- 1);
    } else {
        return last;
    }
}                       Output: 45
```

What's a 'Nested Iteration'?

Nested iterations is when you put a loop inside of another loop. Any of the 3 loops mentioned earlier are usable. It's less of a java method and more of a technique coders know and utilize.

```java
int weeks = 3;
int days = 7;

for (int i = 1; i <= weeks; ++i) {
    System.out.println("Week: " + i);

    for (int j = 1; j <= days; ++j) {
        System.out.println("  Day: " + j);
    }
}
------------------------------------------
Week: 1
    Day: 1
    Day: 2…
Week: 2…
```

Jupyter Notebook

https://tigran7.github.io/fastpages/2022/10/18/Recursion.html

Pop Quiz

Simplify the code to the right using iteration:

//Hint for syntax

while (condition) {

}

for (condition) {

}

* Challenge: Use recursion

```java
int i = 0;
System.out.println(i);
i++;
System.out.println(i);
i++;
System.out.println(i);
i++;
System.out.println(i);
i++;
System.out.println(i);
i++;
System.out.println(i);
i++;
```

Quiz Answers

Simplify the code to the right using iteration:

//Hint for syntax

while (condition) {

}

for (condition) {

}

* Challenge: Use recursion

```java
int i = 0;

while (i < 5) {
System.out.println(i);

i++;

}
```

Homework

Part 1: Find on the bottom of the Jupyter Notebook linked on slide 2

Part 2: Complete this Homework Quiz:
https://docs.google.com/forms/d/e/1FAIpQLSdkf05-dGNIOtyf1KW52mh5Tj25HhHwOMouHuHMfGQOyD0tbA/viewform

Create a Jupyter Notebook with your answer to Part 1 and a screenshot of you completing the Quiz for Part 2