

CS 200 - Programming I: Additional Topics

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Fall 2019

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RECURSION

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Recursive Method

- A method that calls itself.
- *Indirect* recursion – a method that calls another method (and possibly others) that eventually calls the original method.

MAIN COMPONENTS

Base Case

- One or more cases that return a value with making a recursive call.

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Reduction

- Break the problem into one (or more) recursive calls.
- The sequence of calls must *converge* to a base.

TOPHAT QUESTION 1

What is the output when `f(5)` is called?

```
public static void f(int i) {  
    if(i <= 0) return;  
    f(i-1);  
    System.out.print(i + " ");  
}
```

TOPHAT QUESTION 2

What is the output when `f(5)` is called?

```
public static void f(int i) {  
    if(i <= 0) return;  
    System.out.print(i + " ");  
    f(i-1);  
}
```

RECURSION VS ITERATION

Recursive:

```
public static long factorial(int n) {
    if(n == 0)
        return 1;
    return n * factorial(n-1);
}
```

Iterative:

```
public static long factorialIter(int n) {
    long retVal = 1;
    for(int i = 1; i <= n; i++)
        retVal *= i;
    return retVal;
}
```


RECURSION

Benefits

- Simple, clean code.
- Natural solution to many problems.
- Recursion and iteration are equally powerful.

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Potential Pitfalls

- *Stack Overflow* – too many recursions.
- *Inefficient* – exponential number of method calls.

LOOPY EXERCISE

Write 3 methods that calculate $\sum_{i=0}^n i2^i$ in a:

- 1 recursive manner
- 2 iterative manner
- 3 direct with the formula $\sum_{i=0}^n i2^i = 2 + (n - 1)2^{n+1}$

SORTING

SORTING EXERCISE

Given an array of integers, sort the array from smallest to largest.

MERGE SORT

A RECURSIVE SORT

Algorithm MERGESORT

- 1 If array has length more than 1, split array into two sub-arrays.
- 2 Merge sub-arrays into a combined sorted array until there is only 1 array left.

FURTHER READING



COMP SCI 200: Programming I
zyBooks.com, 2015.
zyBook code:
WISCCOMPSCI200Fall2019

- Chapter 14. Additional Topics

APPENDIX

REFERENCES

IMAGE SOURCES I



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<https://brand.wisc.edu/web/logos/>



<http://www.zybooks.com/>