Welcome to ICS 111 Lab

Section 3 and 4

Week 8

****Read through HW7 Assignment****

Tuesday Outline

- Recursion
- Hexadecimal
- HW 7

Recursion:

- A recursion (recursive function) is a function that calls itself.
- To solve a recursive function:
  - 1. Divide the problem into subproblems
  - 2. Specify base case to stop the recursion.

- Structure (for factorial example):

```
function(){

    if(){ //base case (2)
    … return}

    else{... return} //recursive call (1)

}
```

Recursion: Factorial Example

5! = 5 * 4 * 3 * 2 * 1

4!= 4 * 3 * 2 * 1

3!= 3 * 2 * 1

2!= 2 * 1

1!= 1

Recursion: Factorial Pattern Example

5! = 5 * 4 * 3 * 2 * 1

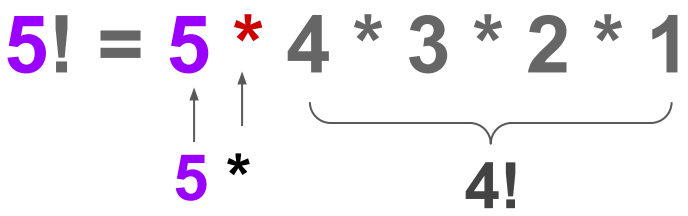
4!= 4 * 3 * 2 * 1

3!= 3 * 2 * 1

2!= 2 * 1

1!= 1

Recursion: Factorial Subproblem



n! = n * (n-1)!

Recursion: Where is the base case?

5! = 5 * 4 * 3 * 2 * 1

4!= 4 * 3 * 2 * 1

3!= 3 * 2 * 1

2!= 2 * 1

1!= 1

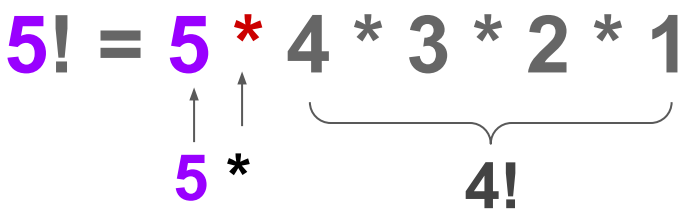
Recursion: base case

$$n! = n * (n-1)!$$

$$1! = 1$$

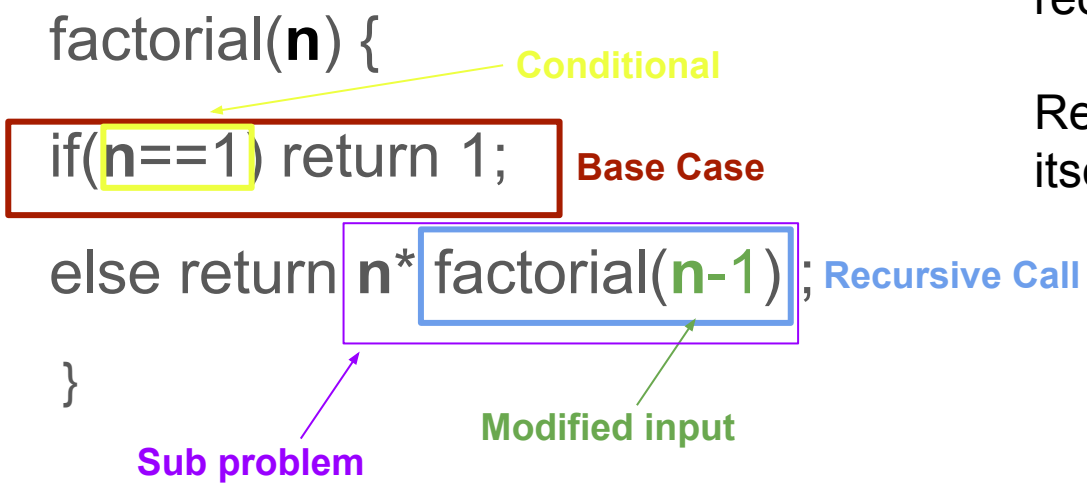
Note: Base case will be evaluated in the if() condition, to end the recursion.

Recursion: Factorial Subproblem



n! = n * (n-1)!

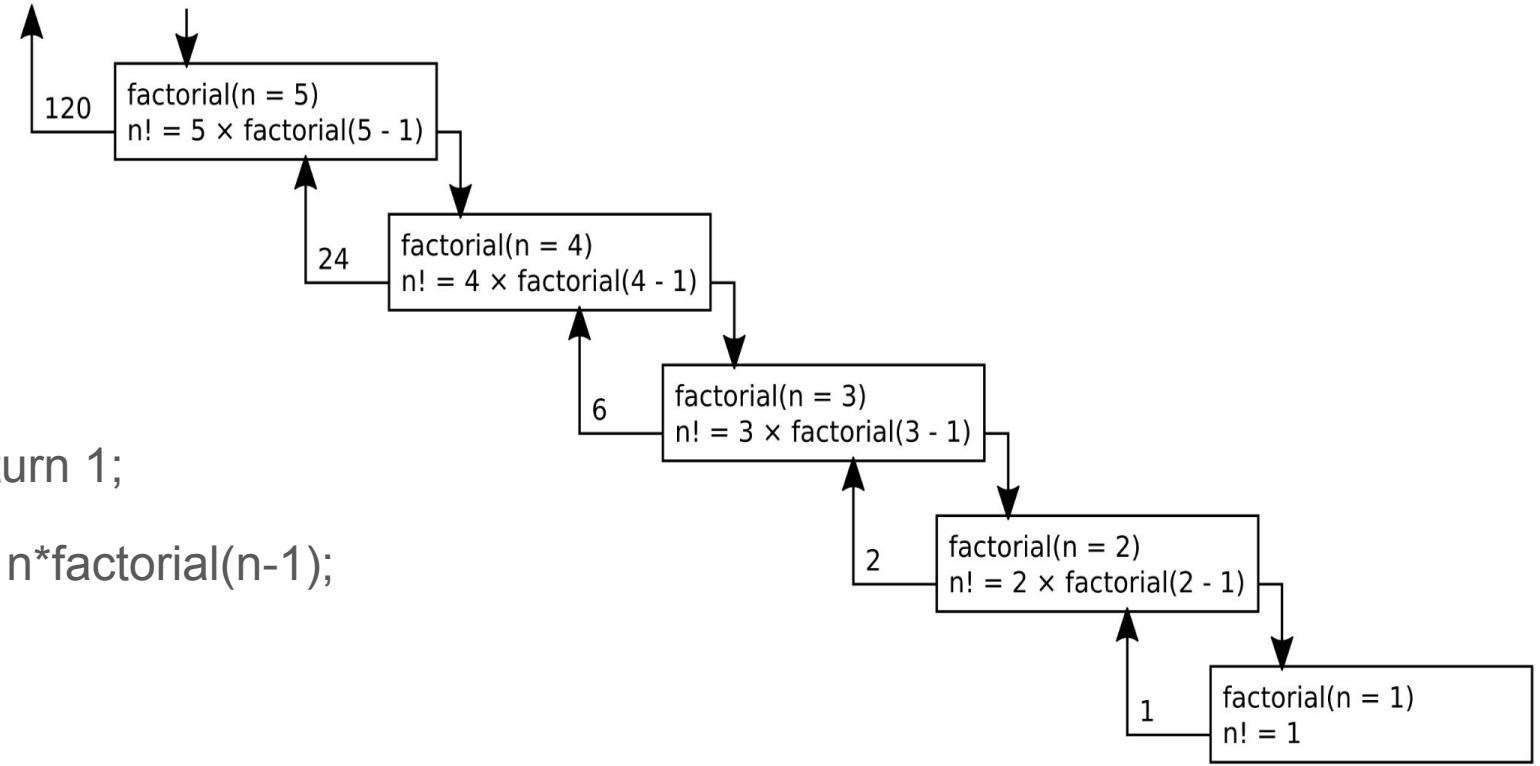
Factorial:



Base Case: Return without making recursive call and stop function.

Recursive Call: Function calls itself.

Factorial:



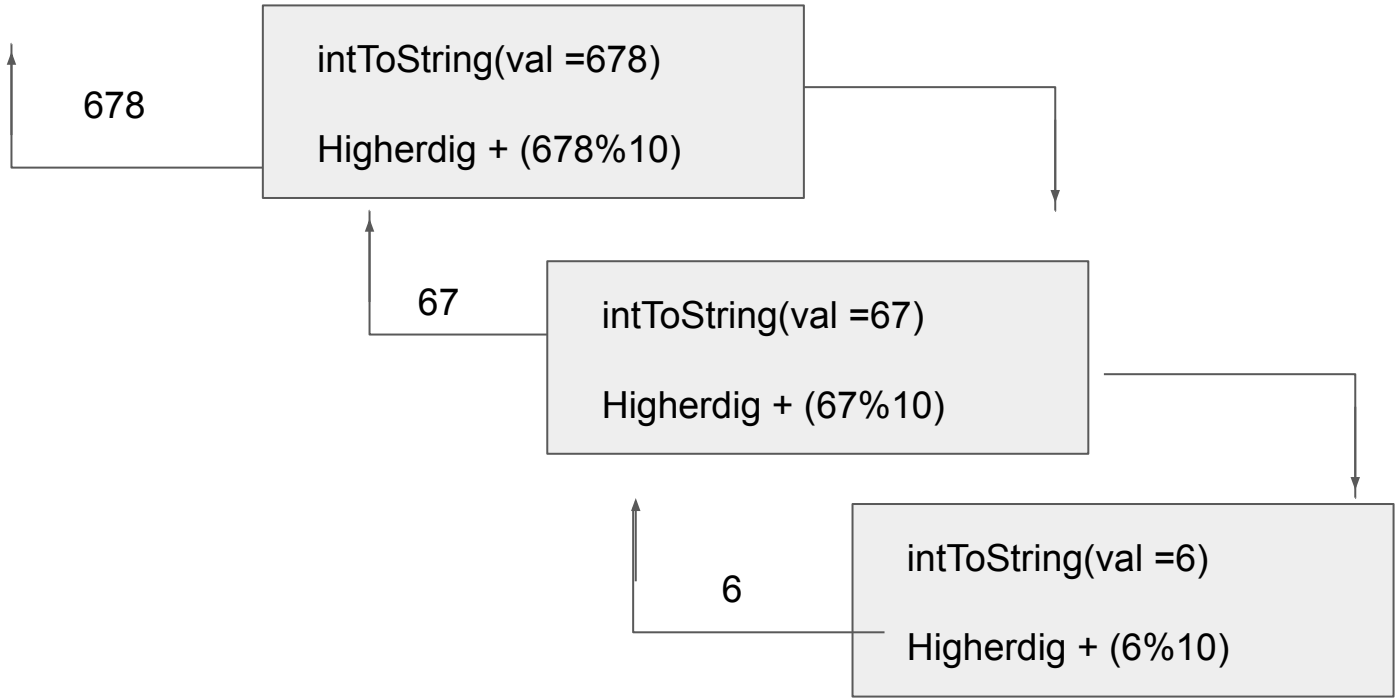

```
factorial(n)

if(n==1) return 1;

else return n*factorial(n-1);
```

Factorial: intToString()

```
intToString(val)
String higherdigits = “”;
if(val>=10) {
higherdigits=intToString(val/10);
}
return higherdigits + (val%10); }
```

Activity: Draw diagram of recursive function/
Describe what is happening.

Factorial: intToString() : Diagram Solution



Hexadecimal:

- 0-9 : Same as decimal (unit)
- 10-15: A-F (unit)
- 16…

16 = 1 0

16 Unit

17 = 1 1

16 Unit

	4 bit	bits
Decimal	**Hexadecimal**	**Binary**
0	0	0000
1	1	0001
2	2	0010
3	3	0011
4	4	0100
5	5	0101
6	6	0110
7	7	0111
8	8	1000
9	9	1001
10	A	1010
11	B	1011
12	C	1100
13	D	1101
14	E	1110
15	F	1111
16	10	0001 0000

Hexadecimal: Resources

See chart: https://kb.iu.edu/d/afdl

Counting in Hex: https://www.electronics-tutorials.ws/binary/bin_3.html

Week 8: Resources

- HW 7: http://www2.hawaii.edu/~esb/2022spring.ics111/hw07.html
- Neso Academy -Recursive Functions: https://www.youtube.com/watch?v=ggk7HbcnLG8
- Geeks for Geeks - Recursive Function types: https://www.geeksforgeeks.org/types-of-recursions/
- Textbook PDF: http://bedford-computing.co.uk/learning/wp-content/uploads/2015/09/Java-for-Everyone-Late-Objects.pdf