// \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

// Factorial.java By: Aiman Hanna (C) 1993 - 2021

// This program illustrates the difference between recursion and tail recursion.

// Key Points:

// 1) Tail Recursion

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**import** java.util.Scanner;

**public** **class** Factorial {

// Given a non-negative value n, return factorial n.

// Notice that a large input may result in integer overflow!

// A larger input may result in stack overflow!

// Two methods are included in the class to achieve this functionality;

// one of which resulting in tail recursion

**public** **static** **int** fact(**int** n)

{

**if** (n == 0) **return** 1;

**return** n \* *fact*(n-1);

}

**public** **static** **int** tailFactorial(**int** n)

{

**return** *tfact*(n, 1); // no recursion here

}

**public** **static** **int** tfact(**int** n, **int** res)

{

**if**(n == 0)

**return** res;

**return** *tfact*(n-1, res\*n); // this is where recursion occurs

}

**public** **static** **void** main(String[] args) {

Scanner kb = **new** Scanner(System.***in***);

**int** n;

System.***out***.print("Please enter the value that you wish to calculate its  
 factorial: ");

n = kb.nextInt();

System.***out***.print("The value of " + n +"! using fact("+ n +") is: " +  
 *fact*(n));

System.***out***.print("\n\n");

System.***out***.print("The value of " + n +"! using tailFactorial("+ n +") is: " +  
 *tailFactorial*(n));

System.***out***.print("\n\n");

System.***out***.print("Please enter the value that you wish to calculate its  
 factorial: ");

n = kb.nextInt();

System.***out***.print("The value of " + n +"! using fact("+ n +") is: " +  
 *fact*(n));

System.***out***.print("\n\n");

System.***out***.print("The value of " + n +"! using tailFactorial("+ n +") is: " +  
 *tailFactorial*(n));

kb.close();

}

}

/\*The output

Please enter the value that you wish to calculate its factorial: 6

The value of 6! using fact(6) is: 720

The value of 6! using tailFactorial(6) is: 720

Please enter the value that you wish to calculate its factorial: 10

The value of 10! using fact(10) is: 3628800

The value of 10! using tailFactorial(10) is: 3628800

\*/

/\*Run Again - Notice overflow

Please enter the value that you wish to calculate its factorial: 22

The value of 22! using fact(22) is: -522715136

The value of 22! using tailFactorial(22) is: -522715136

Please enter the value that you wish to calculate its factorial: 3000

The value of 3000! using fact(3000) is: 0

The value of 3000! using tailFactorial(3000) is: 0

\*/

/\*Run Again

Please enter the value that you wish to calculate its factorial: 6500

Exception in thread "main" java.lang.StackOverflowError

at Factorial.fact(Factorial.java:23)

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