

National University of Singapore  
School of Computing  
CS1101S: Programming Methodology (JavaScript)  
Semester I, 2012/2013

**Mission Sidequest 3-1**  
**Force Efficiency**

Start date: 23 August 2012

**Due: 1 September 2012, 23:59**

Readings:

- Textbook Sections 1.1 to 1.2

Upon completion of your third mission, your instructor mused about whether you know more than just the usage of the force but also the various levels of efficiency in its usage. Seeing an opportunity, you offered to take up an additional challenge.

Upon completion of this challenge, your proven knowledge about force efficiency will grant you the "Insightful" achievement, and bring you that much closer to becoming a Legend of the Academy.

This side quest consists of **three** tasks.

**Task 1:**

Which one has faster-growing order of growth? (And give order notations for **all eight** of them!)  
(Note: you may express  $x^y$  in the format  $x^y$ )

(i)  $4^n n^2$  or  $n 3^n$ ?

(ii)  $1000000000n^2$  or  $2^n / 1000000000$ ?

(iii)  $n^n + n^2 + 1$  or  $4^n + 2^n$ ?

(iv)  $1^n$  or  $n^2$ ?

**Task Files**

- **sidequest\_3-1\_1.js**

## Task 2:

Consider the following function `foo`:

```
function foo(n){
  function bar(n){
    if(n === 0){
      return 0;
    }else{
      return 1 + bar(n - 1);
    }
  }
  return n * bar(n);
}
```

What is the order of growth for the running time of `foo` in terms of its input  $n$ ? What about its memory requirement?

## Task Files

- `sidequest_3-1.2.js`

## Task 3:

Consider the following two functions:

```
function bar(n){
  if(n === 0){
    return 0;
  }else{
    return n + bar(n - 1);
  }
}
function foo(n){
  if(n === 0){
    return 0;
  }else{
    return bar(n) + foo(n - 1);
  }
}
```

- What is the order of growth of `bar`? What about `foo`?
- What is the memory requirement of `bar`? What about `foo`?
- Implement `improved_foo` a tail-recursive solution such that it computes the same value as `foo`, but with slower-growing order of growth in time. Also, state the order of growths for your new function clearly in order notations.

## **Task Files**

- sidequest\_3-1\_3.html
- **sidequest\_3-1\_3.js**

## **Submission**

To submit your work to the Academy, copy the contents from the template file(s) into the box that says "Your submission" on the mission page, click "Save Code", then click "Finalize Submission". Note that submission is final and that any mistakes in submission requires extra effort from a tutor or the lecturer himself to fix.