Tutrial 3

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Design and Analysis of Algorithms (CSC311) – Spring 2017
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Tutorial 3 (Performance analysis of non-recursive algorithms)
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1. For each of the following algorithms, indicate (i) an input size metric; (ii) its basic operation; (iii) whether the basic operation count can be different for inputs of the same size:
   (a) Computing the sum of n numbers.
   (b) Computing $n!$.
   (c) Finding the largest element in a list of n numbers.
   (d) Euclids algorithm.

2. Consider the following algorithm.

Algorithm 1 unknown(n) ▷ Input: A nonnegative integer n

```
1: S ← 0
2: for i ← 1, n do
3:     S ← S + i * i
4: end for
5: return S
```

   (a) What does this algorithm compute?
   (b) What is its basic operation?
   (c) How many times is the basic operation executed?
   (d) What is the efficiency class of this algorithm?
   (e) Suggest an improvement or a better algorithm altogether and indicate its efficiency class. If you cannot do it, try to prove that, in fact, it cannot be done.

3. Consider the following algorithm.

Algorithm 2 unknown($A[0..n-1, 0..n-1]$) ▷ Input: A matrix $A[0..n-1, 0..n-1]$ of real numbers

```
for i ← 0, n − 2 do
    for j ← i + 1, n − 1 do
        if A[i, j] ≠ A[j, i] then
            return false
        end if
    end for
end for
return true
```

Answer the questions (a)–(e) of the previous problem about this algorithm.

4. Consider the following algorithm.

Algorithm 3 GE($A[0..n-1, 0..n]$) ▷ Input: An n-by-$n+1$ matrix $A[0..n-1, 0..n]$ of real numbers

```
for i ← 0, n − 2 do
    for j ← i + 1, n − 1 do
        for k ← i, n do
            A[j, k] ← A[j, k] − A[i, k] ∗ A[j, i]/A[i, i]
        end for
    end for
end for
```

(a) Find the time efficiency class of this algorithm.

(b) What glaring inefficiency does this pseudocode contain and how can it be eliminated to speed the algorithm up?