Homework 1. revise

Algorithm - the instruction to follow the task
Turing Machine - a rule to do step by step and how to update value
Correctness - make sure that the algorithm is give the correct answer
Running time - the elementary operation that the algorithm takes

2. • Algorithm Linear_mul
Input: array a[0... m-1]

```
begin
    s ← 1
    for i ← 0 step i ← i+1 until m-1 do
        s ← s * a[i]
    end for
    return s
end
```

size n = m
T(n) = n

• Algorithm Quad_mul
Input: array a[0...2m-1]

```
begin
    s ← 1
    for i ← 0 step i ← i+1 until m do
        for j ← 0 step j ← j+1 until m-1 do
            s ← s * a[i+j]
        end for
    end for
    return s
end
```

size n = 2m
$T(n) = m+1(m) = m^2 + m$
$= \frac{n^2}{4} + \frac{n}{2}$

• Algorithm Cube_runnigtime
Input: array a[0...2m-1]

```
begin
    s ← 1
    for i ← 0 step i ← i+1 until m-1 do
        for j ← 0 step j ← j+1 until m-1 do
            s ← s * a[i+j]
            for k ← 1 step k ← k+1 until m do
                s ← s + a[k]
            end for
        end for
    end for
    return s
end
```

size n = 2m
$T(n) = m \times m \times m = m^3$
$= \frac{n^3}{8}$

3.

```
algorithm fastSums
    Input: array a[0..2m − 1]
begin
    array s[0..m]
    s[0] ← 0
    for j ← 0 to m − 1 do
        s[0] ← s[0] + a[j]
    end for
    for i ← 1 to m do
        s[i] ← s[i − 1] + a[i + m − 1] − a[i − 1]
    end for
    return s;
end
```

the size of input is $2m$

start with $s[0] = 0$

1st loop : then $s[0] = a[0] + a[1] + a[2] + \dots a[m-1]$

2nd loop : $s[1] = s[0] + a[m] - a[0]$ $(s[1] = a[1] + a[2] \dots + a[m])$

$s[2] = s[1] + a[m+1] - a[1]$ $(s[2] = a[2] + a[3] \dots + a[m+1])$

:

$s[i] = s[i-1] + a[i+m-1] - a[i-1]$

then $s[i+1] = s[i] + a[i+m] - a[i]$ ※