Análisis de algoritmos iterativos

ANÁLISIS Y DISEÑO DE ALGORITMOS

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Herramientas que vamos a utilizar

- Consideraciones:
  - A todas las divisiones se les aplicará la función "piso". La función `piso(x)` devuelve el entero más pequeño o igual a x. Por ejemplo, piso(3.3) = piso(3.9999) = piso(3.5) = 3.
  - Todas las operaciones como asignaciones, comparaciones, decisiones, operaciones matemáticas básicas (+, -, *, /, <<, >>) se realizan en un tiempo constante.

Herramientas que vamos a utilizar

- $\log_b$ es una función estrictamente creciente y uno a uno:
- $\log_b 1 = 0$
- $\log_b b^a = a$
- $\log_b (XY) = \log_b X + \log_b Y$
- $\log_b X^a = a \log_b X$
- $X^{\log_b Y} = Y^{\log_b X}$

Herramientas que vamos a utilizar

$$\sum_{1}^{n} c = n * c$$

$$\sum_{1}^{n} i = \frac{n * (n+1)}{2}$$

$$\sum_{1}^{n} i^2 = \frac{2n^3 + 3n^2 + n}{6}$$

Ejemplo 1

```
procedure EXAMPLE1(n):
sum ← 0
for i ← 1 until n do
    sum ← sum + 1
return sum
```

$$\sum_{1}^{n} c = n * c$$

$$\sum_{1}^{n} i = \frac{n*(n+1)}{2}$$

$$\sum_{1}^{n} i^2 = \frac{2n^3+3n^2+n}{6}$$

Ejemplo 2

```
procedure EXAMPLE2(n):
sum ← 0
for i ← 1 until n do
    for j ← 1 until n do
        sum ← sum + 1
return sum
```

$$\sum_{1}^{n} c = n * c$$

$$\sum_{1}^{n} i = \frac{n*(n+1)}{2}$$

$$\sum_{1}^{n} i^2 = \frac{2n^3+3n^2+n}{6}$$

Ejemplo 3

```
procedure EXAMPLE3(n):
sum ← 0
for i ← 1 until n do
    for j ← 1 until n do
        for k ← 1 until n do
            sum ← sum + 1
return sum
```

$$\sum_{1}^{n} c = n * c$$

$$\sum_{1}^{n} i = \frac{n * (n+1)}{2}$$

$$\sum_{1}^{n} i^2 = \frac{2n^3 + 3n^2 + n}{6}$$

Ejemplo 4

```
procedure EXAMPLE4(n):
sum ← 0
for i ← 1 until n step +2 do
    sum ← sum + 1
return sum
```

N = 4	N = 8	N = 16

$$\sum_{1}^{n} c = n * c$$

$$\sum_{1}^{n} i = \frac{n*(n+1)}{2}$$

$$\sum_{1}^{n} i^2 = \frac{2n^3+3n^2+n}{6}$$

Ejemplo 5

```
procedure EXAMPLE5(n):
sum ← 0
for i ← 1 until n step *2 do
    sum ← sum + 1
return sum
```

N = 4	N = 8	N = 16

$$\sum_{1}^{n} c = n * c$$

$$\sum_{1}^{n} i = \frac{n * (n+1)}{2}$$

$$\sum_{1}^{n} i^2 = \frac{2n^3 + 3n^2 + n}{6}$$

Ejemplo 6

```
procedure EXAMPLE2(n):
sum ← 0
for i ← 1 until n do
    for j ← 1 until i do
        sum ← sum + 1
return sum
```

$$\sum_{1}^{n} c = n * c$$

$$\sum_{1}^{n} i = \frac{n * (n+1)}{2}$$

$$\sum_{1}^{n} i^2 = \frac{2n^3 + 3n^2 + n}{6}$$

Resumiendo

- ¿Qué sucede cuando tenemos ciclos anidados?
- ¿Qué sucede si el incremento no es +/- 1?
  - Si es (+ ó -) m => ¿?
  - Si es (* ó /) m => ¿?

Ejercicios colaborativos

```
procedure EXERCISE1(n):
sum ← 0
for i ← 1 until n step +2 do
    for j ← 1 until i do
        sum ← sum + 1
return sum
```

```
procedure EXERCISE2(n):
sum ← 0
for i ← 1 until n do
    for j ← 1 until n step *2 do
        sum ← sum + 1
return sum
```

$$\sum_{1}^{n} c = n * c$$

$$\sum_{1}^{n} i = \frac{n*(n+1)}{2}$$

$$\sum_{1}^{n} i^2 = \frac{2n^3+3n^2+n}{6}$$

Algoritmo de burbuja

```
procedure BUBBLE_SORT(A):
for i ← A.length until 2 step -1 do
    for j ← 1 until i - 1 do
        if (A[j] > A[j + 1]) then
            SWAP(A, j, j + 1)
```

$$\sum_{1}^{n} c = n * c$$

$$\sum_{1}^{n} i = \frac{n*(n+1)}{2}$$

$$\sum_{1}^{n} i^2 = \frac{2n^3+3n^2+n}{6}$$

Búsqueda binaria

```
procedure BINARY_SEARCH(A, key):
low ← 1
high ← A.length
while low < high do
begin
    mid ← (high + low) / 2
    if key == A[mid] then
        return mid
    else if key < A[mid] then
        high = mid - 1
    else
        low = mid + 1
end
return low
```

$$\sum_{1}^{n} c = n * c$$

$$\sum_{1}^{n} i = \frac{n*(n+1)}{2}$$

$$\sum_{1}^{n} i^2 = \frac{2n^3+3n^2+n}{6}$$

Ejercicios colaborativos

```
procedure SELECTION_SORT(A):
for i ← A.length until 2 step -1 do
begin
    higher ← 1
    for j ← 2 until i do
        if A[higher] < A[j] then
            higher ← j
    if higher <> j then
        SWAP(A, higher, i)
end
```

```
procedure INSERTION_SORT(A):
for i ← 2 until A.length do
    for j ← i until 2 and A[j] < A[j -1] do
        SWAP(A, j, j – 1)
```

$$\sum_{1}^{n} c = n * c$$

$$\sum_{1}^{n} i = \frac{n * (n+1)}{2}$$

$$\sum_{1}^{n} i^2 = \frac{2n^3 + 3n^2 + n}{6}$$