$f(n) = 2n^2$ $O(n^2)$ lim. as sup.
$\Omega(n^2)$ lim as. inf.
$\Theta(n^2)$ lim as. sia inf che sup.

$\log(n) = \Theta(n)$ no perché non é inferiormente limitato da n

- $\log(n) = \Omega(n)$ si
- $n^2\log(n) = O(n^2\log n)$ non devo trascurare $\log n$

$\lim_{n \to \infty} \frac{n^2 \log n}{n^2} = \infty$ non hanno stessa velocitá

$n^2\log n = \Omega(n\log n)$

$\log(n^{10}) = 10\log n = \Theta(\log n)$

$4n^2 + 2n\log n = \Theta(n^2)$

$(n+a)^6 = \Theta(n^6)$

$f(n) = 700 - 25 \cdot 2 = \Theta(1)$

2 valori binari in array LSB in pos n, MSB in 1
calcolare somma bit a bit.

```
somma ( A[n], B[n], C[n+1] ){
  c·1   riporto =0
  c·n   for(i=n downto 1 ){
  c·n       C[i+1]=A[i]+B[i]+ riporto
  c·n       if( C[i+1]≤1 ){
  c·Tif         riporto=0
            }
            else{
  c·Fif         C[i+1]= C[i+1]-2
  c·Fif         riporto=1
            }
        }
  c·1   C[1]=riporto
}
```

$$T(n) = (2c)+(3c\cdot n)+(c\cdot T_{if})+(2cF_{if})$$

caso migliore   if sempre vero $t_{if}=n$

$$\forall i \quad (A[i] \text{ AND } B[i]) = 0$$

$$t_m(n) = 2c+3cn+cn+0=\Omega(n)$$

caso peggiore   if sempre falso $F_{if}=n$
c'é sempre riporto

$A[n]=B[n]=1$ unico caso per il primo bit
$A[i]$ OR $B[i]=1 \ \forall i \quad 1\leq i\leq n-1$

$$T_p(n) = 2c+3cn+2cn=O(n)$$

$$\tilde{T}_m(n) = \Theta(n)$$

```
int f_y(int n){
c·1   z=n        ← la dimensione vera è la quantità di bit necessaria
c·1   t=0
c·tw  while(z>0){
   c·tw   x= z mod 2
   c·tw   z = z div 2
   c·tw   if(x==0){
   c·tif·n   for(i=1 to n){      } t=t+n
      c·tif n   t++            } modo complicato per farlo
            }
         }
   }
c·1   return (t)
```

$$T(n) = 3c + 4c\,t_w + 2cn \cdot t_{if}$$

Peggiore

$t_w = \log n$

$t_{if} = \log n$

$n = 10000\ldots0$

$T_p(n) = 3c + 4c\log n + 2cn\log n = O(n\log n)$

migliore

$n = 11111\ldots11$ $\quad T_m = 3c + 4c\log n + 0 = \Omega(\log n)$

Tmedio

```
int f_y(int V[n]){
c·1        r=0
c(n-1)     for(i=1 to n-1){
               for(j= i+1 to n){
                   for(K= 1 to j){
                       r++
                   }
               }
           }
c·1        return r
```

$c \cdot \sum_{j=i+1}^{n} j$

$\sum_{i=1}^{n-1} \sum_{j=i+1}^{n} j$

$T(n) = \ldots + \sum_{i=1}^{n-1}\left(\sum_{j=i+1}^{n} j\right) = \sum_{i=1}^{n-1}\left(\frac{n(n+1)}{2} - \frac{i(i+1)}{2}\right)$

$\cong \square + \left(n^3 - \frac{n^3}{6}\right) \cong \square + \frac{n^3}{5} = O(n^3)$

$\frac{n(n+1)}{2} - \left(\sum_{j=1}^{i} j\right)$

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

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

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

$= \frac{n(n+1)}{2} \cdot (n-1) - \frac{1}{2}\left(\sum_{i=1}^{n-1} i^2 + \sum_{i=1}^{n-1} i\right)$

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

$\frac{1}{2}\left(\sum_{i=1}^{n-1} i^2 + \frac{(n-1)(n)}{2}\right) =$

$= \frac{1}{2}\left(\frac{(n-1)n \; 2(n-1)+1}{6}\right) + \frac{1}{2} \frac{(n-1)(n)}{2}$

$M[n,n]$ controllare se é simmetrica e valutare $(M[a,b] = M[b,a] \ \forall a,b)$

```
boolean simmetrica (int M[n,n]){          B righe
 2C       simm=true                       A colonne
          b=1
c·tw1 while (simm==true AND b<n){

     c·tw1  a=b+1
      c·tw2 while(a<=n) AND  M[a,b]==M[b,a] {

            c·tw2 a++
            }
     c·tw1  if(a>n){
             ctif  b++
            }
            else{
                 simm= false  CFif
            }
      }
  c·1 return (simm)
 }
```

$T(n,n) = 3C + 3Ctw_1 + 3Ctw_2 + Ctif + CF_{if}$

<u>caso migliore</u> $tw_1 = 1$ $\quad tw_2 = 0 \rightarrow tif = 0$ $\quad F_{if} = 1$

il primo controllo non é simmetrica

$$M[2,1] \neq M[1,2]$$

$tm(n,n) = 3C + 3C + 2C + 0C + 0C + 1 = \Omega(1)$ tempo cost.

<u>caso peggiore</u> é simmetrica

$tw_1 = n-1$ $\quad tw_2 = \sum_{i=1}^{n-1} i$ $\quad t_{if} = n-1$ $\quad f_{if} = 0$

$$T_p(n,n) = 3 + +3c(n-1) + 2c\sum_{i=1}^{n-1} i + c(n-1) + c \cdot 0 =$$

$$= 3c + 4c(n-1) + 2c\,\frac{(n-1)n}{2} = O(n^2)$$

Tmedio dell'ordine di grandezza di n^2

algo. ord.

$$\left.\begin{array}{l}\text{Sel}\\ \text{Ins}\\ \text{Bubble}\end{array}\right\} \Theta(n^2)\ T_m$$