

Programmazione Dinamica: Serve a trasferire la complessità computazionale a discapito della complessità spaziale. Ricorda le computazioni. Divido il problema in sottoproblemi, ma i sotto problemi hanno una soluzione che è già stata trovata.

Fibonacci $f(n) = f(n-1) + f(n-2)$ mi tengo in memoria $f(n-2)$.

```
1 fib(0,0).
2 fib(1,1).
3
4 fib(N,M):-
5     Nmeno1 is N - 1,
6     Nmeno2 is N - 2,
7     fib(Nmeno1,M1),
8     fib(Nmeno2,M2),
9     M is M1 + M2.
```

≡ ?- fib(5,M).

M = 5

Adesso proviamo a renderlo dinamico in modo da asserire e memorizzare il nuovo fatto.

```
1 :- dynamic fib/2.
2
3 fib(0,0).
4 fib(1,1).
5
6 fib(N,M):-
7     N > 1,
8     Nmeno1 is N - 1,
9     Nmeno2 is N - 2,
10    fib(Nmeno1,M1),
11    fib(Nmeno2,M2),
12    M is M1 + M2,
13    assert(fib(N,M)),
14    listing(fib).
```

Create a

Program

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≡ ?- fib(5,M).

```
:- dynamic fib/2.

fib(0, 0).
fib(1, 1).
fib(N, M) :-
    N>1,
    Nmeno1 is N+ -1,
    Nmeno2 is N+ -2,
    fib(Nmeno1, M1),
    fib(Nmeno2, M2),
    M is M1+M2,
    assert(fib(N, M)),
    listing(fib).
fib(2, 1).
```

```
:- dynamic fib/2.

fib(0, 0).
fib(1, 1).
fib(N, M) :-
    N>1,
    Nmeno1 is N+ -1,
    Nmeno2 is N+ -2,
    fib(Nmeno1, M1),
    fib(Nmeno2, M2),
    M is M1+M2,
    assert(fib(N, M)),
    listing(fib).
fib(2, 1).
fib(3, 2).
```

```
:- dynamic fib/2.

fib(0, 0).
fib(1, 1).
fib(N, M) :-
    N>1,
    Nmeno1 is N+ -1,
    Nmeno2 is N+ -2,
    fib(Nmeno1, M1),
    fib(Nmeno2, M2),
    M is M1+M2,
    assert(fib(N, M)),
    listing(fib).
fib(2, 1).
fib(3, 2).
fib(2, 1).
```

```
:- dynamic fib/2.
```

```
fib(0, 0).
```

```
fib(1, 1).
```

```
fib(N, M) :-
```

```
    N>1,
```

```
    Nmeno1 is N+ -1,
```

```
    Nmeno2 is N+ -2,
```

```
    fib(Nmeno1, M1),
```

```
    fib(Nmeno2, M2),
```

```
    M is M1+M2,
```

```
    assert(fib(N, M)),
```

```
    listing(fib).
```

```
fib(2, 1).
```

```
fib(3, 2).
```

```
fib(2, 1).
```

```
fib(4, 3).
```

```
:- dynamic fib/2.
```

```
fib(0, 0).
```

```
fib(1, 1).
```

```
fib(N, M) :-
```

```
    N>1,
```

```
    Nmeno1 is N+ -1,
```

```
    Nmeno2 is N+ -2,
```

```
    fib(Nmeno1, M1),
```

```
    fib(Nmeno2, M2),
```

```
    M is M1+M2,
```

```
    assert(fib(N, M)),
```

```
    listing(fib).
```

```
fib(2, 1).
```

```
fib(3, 2).
```

```
fib(2, 1).
```

```
fib(4, 3).
```

```
fib(2, 1).
```

```
:- dynamic fib/2.

fib(0, 0).
fib(1, 1).
fib(N, M) :-
    N>1,
    Nmeno1 is N+ -1,
    Nmeno2 is N+ -2,
    fib(Nmeno1, M1),
    fib(Nmeno2, M2),
    M is M1+M2,
    assert(fib(N, M)),
    listing(fib).
fib(2, 1).
fib(3, 2).
fib(2, 1).
fib(4, 3).
fib(2, 1).
fib(3, 2).
```

```
:- dynamic fib/2.

fib(0, 0).
fib(1, 1).
fib(N, M) :-
    N>1,
    Nmeno1 is N+ -1,
    Nmeno2 is N+ -2,
    fib(Nmeno1, M1),
    fib(Nmeno2, M2),
    M is M1+M2,
    assert(fib(N, M)),
    listing(fib).
fib(2, 1).
fib(3, 2).
fib(2, 1).
fib(4, 3).
fib(2, 1).
fib(3, 2).
fib(5, 5).
```

M = 5

Next	10	100	1,000	Stop
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Come possiamo vedere si ripetono alcuni fatti. Ci aspettiamo che una volta calcolato il sottoproblema lo tenga in memoria.

```
1 :- dynamic fib/2.
2
3 fib(0,0).
4 fib(1,1).
5
6 fib(N,M):-
```



```
7      N > 1,  
8      Nmeno1 is N - 1,  
9      Nmeno2 is N - 2,  
10     fib(Nmeno1,M1),  
11     fib(Nmeno2,M2),  
12     M is M1 + M2,  
13     asserta(fib(N,M)), %adesso non si ripetono perchè stiamo asserendo in tes  
14     listing(fib).
```

≡ ?- fib(5,M).



```
:- dynamic fib/2.  
  
fib(2, 1).  
fib(0, 0).  
fib(1, 1).  
fib(N, M) :-  
    N>1,  
    Nmeno1 is N+ -1,  
    Nmeno2 is N+ -2,  
    fib(Nmeno1, M1),  
    fib(Nmeno2, M2),  
    M is M1+M2,  
    asserta(fib(N, M)),  
    listing(fib).
```

```
:- dynamic fib/2.  
  
fib(3, 2).  
fib(2, 1).  
fib(0, 0).  
fib(1, 1).  
fib(N, M) :-  
    N>1,  
    Nmeno1 is N+ -1,  
    Nmeno2 is N+ -2,  
    fib(Nmeno1, M1),  
    fib(Nmeno2, M2),  
    M is M1+M2,  
    asserta(fib(N, M)),  
    listing(fib).
```

```
:- dynamic fib/2.

fib(4, 3).
fib(3, 2).
fib(2, 1).
fib(0, 0).
fib(1, 1).
fib(N, M) :-
    N>1,
    Nmeno1 is N+ -1,
    Nmeno2 is N+ -2,
    fib(Nmeno1, M1),
    fib(Nmeno2, M2),
    M is M1+M2,
    asserta(fib(N, M)),
    listing(fib).
```

```
:- dynamic fib/2.

fib(5, 5).
fib(4, 3).
fib(3, 2).
fib(2, 1).
fib(0, 0).
fib(1, 1).
fib(N, M) :-
    N>1,
    Nmeno1 is N+ -1,
    Nmeno2 is N+ -2,
    fib(Nmeno1, M1),
    fib(Nmeno2, M2),
    M is M1+M2,
    asserta(fib(N, M)),
    listing(fib).
```

M = 5

Se clicchiamo next va in loop allora usiamo il cut.

```
1 :- dynamic fib/2.
2
3 fib(0,0).
4 fib(1,1).
5
6 fib(N,M):-
7     N > 1,
8     Nmeno1 is N - 1,
9     Nmeno2 is N - 2,
10    fib(Nmeno1,M1),
11    fib(Nmeno2,M2),
12    M is M1 + M2,
13    asserta(fib(N,M)):-!),
```

14

listing(fib).

≡ ?- fib(5,M).

