Competitive Algorithm Design and Practice
Dynamic Programming
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http://myweb.ncku.edu.tw/~f74991073/20140319_DP.zip

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Recall Divide & Conquer

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Recall Divide & Conquer

- Do you remember……

```c
/* file name: fibonacci.c */
#include <stdio.h>
int fib(int n)
{
    if(n<=1)return n;
    else return fib(n-1)+fib(n-2);
}
int main()
{
    int i;
    for(i=0;i<10;i++)
        printf("F%d is: %d\n",i,fib(i));

    return 0;
}
```

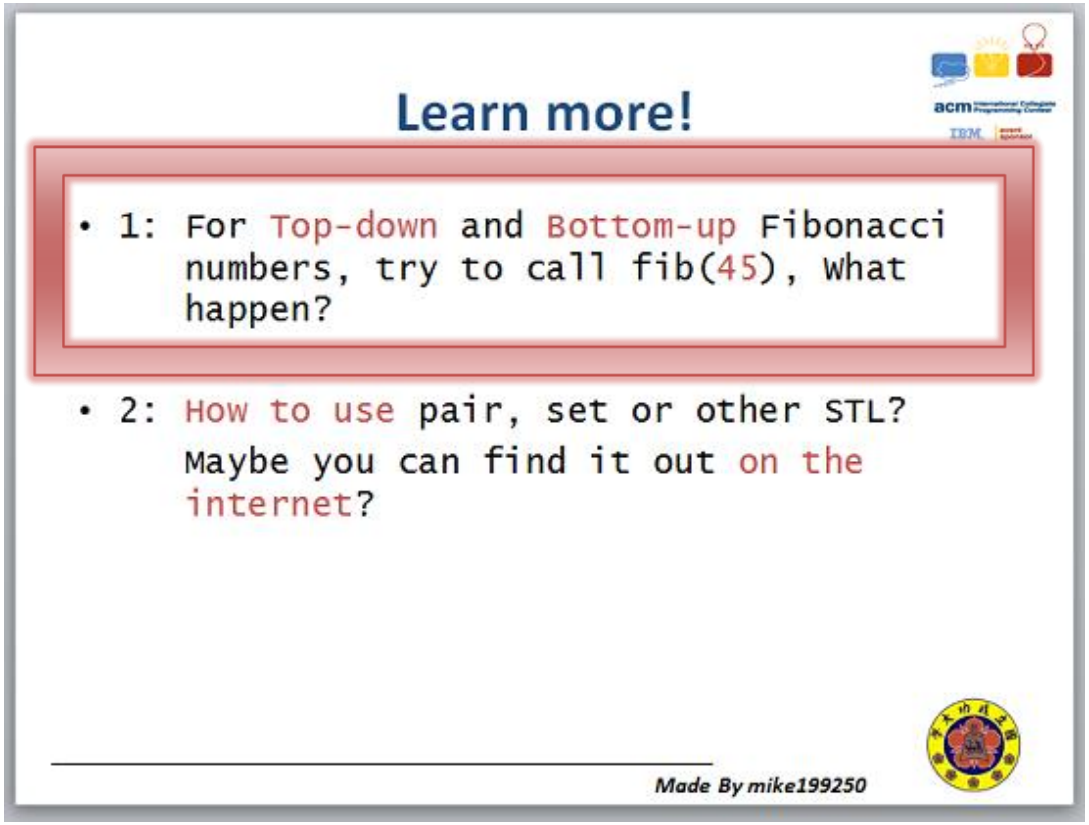
```c
/* file name: fibonacci_bottom_up.c */
#include <stdio.h>
int fib(int n)
{
    int i,f0=0,f1=1,f2;
    if(n<=1)return n;
    for(i=2;i<=n;i++)
    {
        f2=f0+f1;

        f0=f1;
        f1=f2;
    }
    return f2;
}
int main()
{
    int i;
    for(i=0;i<10;i++)
        printf("F%d is: %d\n",i,fib(i));

    return 0;
}
```

Recall Divide & Conquer

- Have you tried……

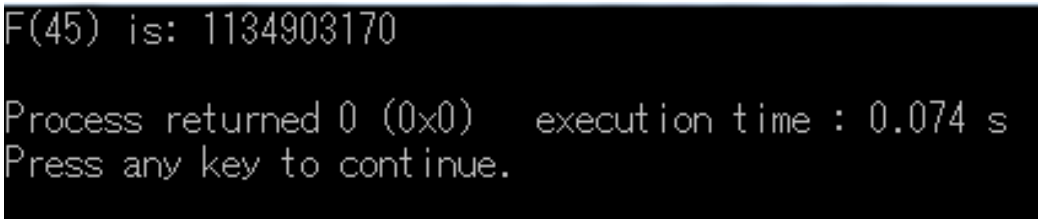


Recall Divide & Conquer

- If you tried……
  - Top-down:

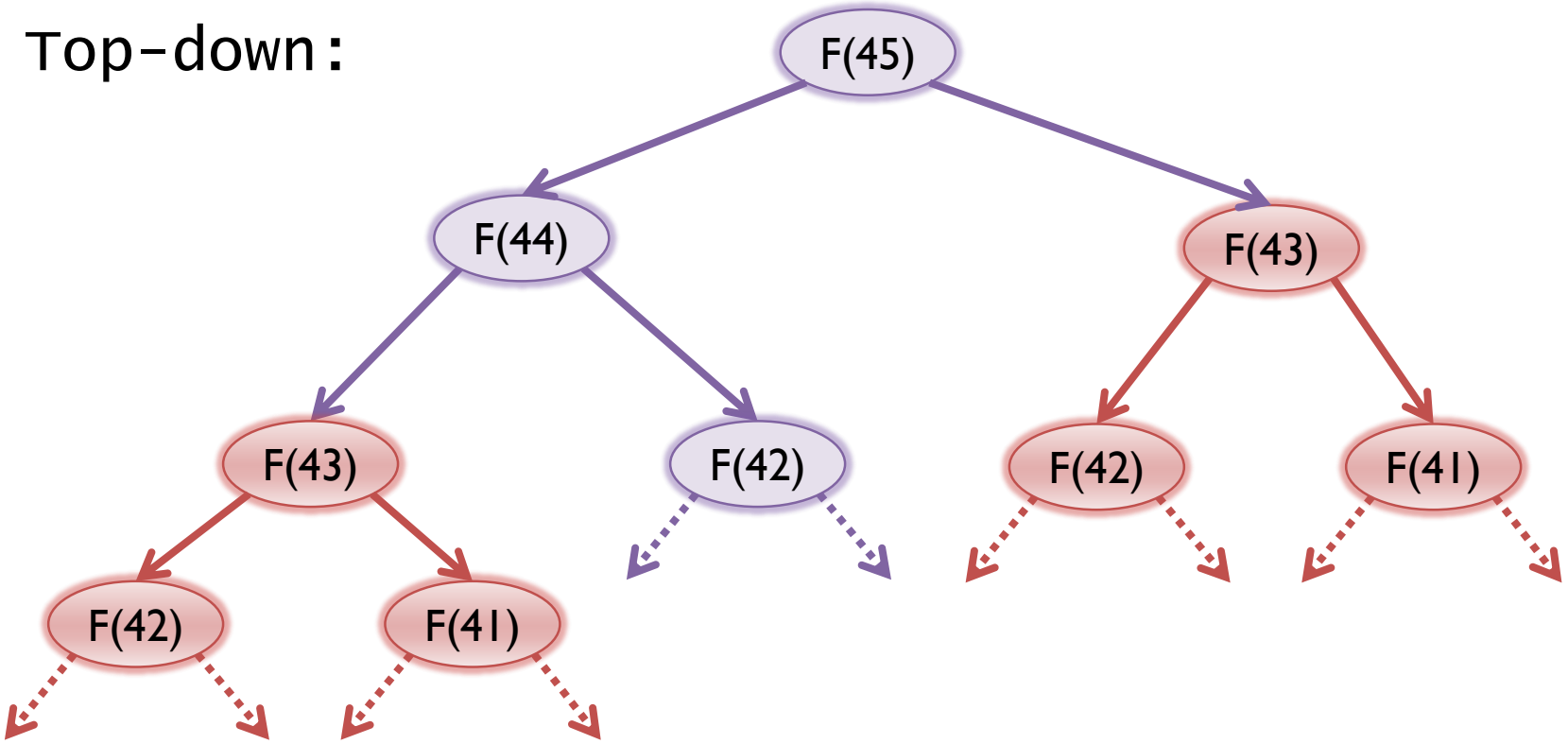
→

  - Bottom-up:



Recall Divide & Conquer

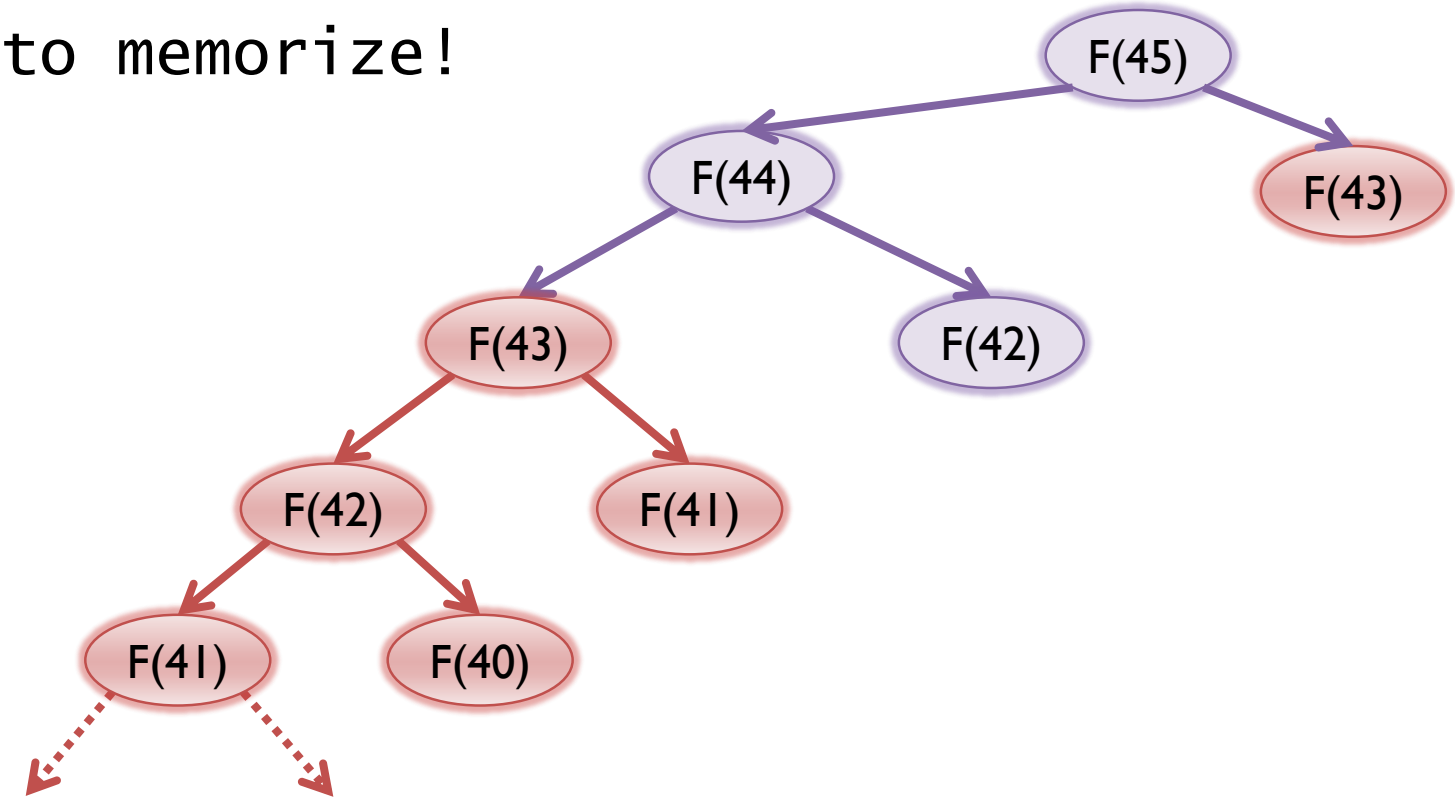
- Top-down:



- It calculate F(43),F(42),… many times!

Recall Divide & Conquer

- Try to memorize!



Recall Divide & Conquer

```c
/* file name: fibonacci_dp_top_down.c */
#include <stdio.h>
#include <string.h>
int num[46];
int fib(int n)
{
    if(n<=1)return n;
    else if(num[n]!=-1)return num[n];
    else return num[n]=fib(n-1)+fib(n-2);
}
int main()
{
    memset(num,-1,sizeof(num));
    printf("F(45) is: %d\n",fib(45));
    return 0;
}
```

```
F(45) is: 1134903170

Process returned 0 (0x0)   execution time : 0.056 s
Press any key to continue.
```

Dynamic Programming

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Dynamic Programming

- What is DP?
- Optimal substructure.
- Overlapping sub-problems.
- bla……bla……bla……

- Just focus on two questions:
  - What do we want to know?
  - How can we get that?
- And remember not to recalculate.

Dynamic Programming

- What do we want to know?
  - The Fibonacci number F_n
- How can we get that?
  - $F_n = F_{n-1} + F_{n-2}$
- And remember not to recalculate.