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Subject : ALGORITHM AND PROGRAMMING
Year : 2022

Recursion (T)

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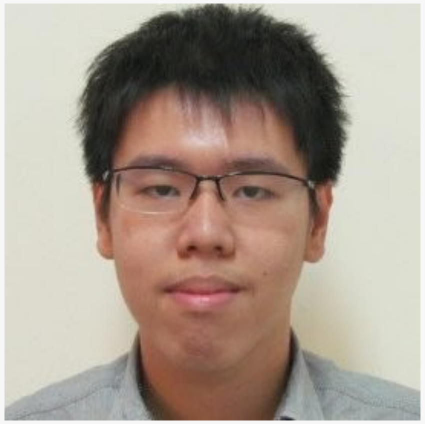
Introduction



- **Alexander, S.Kom., M.T.I**
  - **S1 Binus University (2010-2014)**
    - Teknik Informatika
  - **S2 Binus University (2014-2016)**
    - Magister Teknik Informatika
  - **Professional Experience**
    - **IT Automation Consultant (2016-2021)**
      - Telco, Bank, F&B
    - **Engineering Manager (2021-current)**
      - Data Engineering & Data Science

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Recursive Definition

- **Recursive** is a function call inside a certain function calling itself
- Recursive Function, suitable for recursive problem
- Example :

  Factorial (n) or n! defined as follows :

  n! = 1, for n = 0;

  *n! = n * (n-1)!, for n > 0*

  4! = 4 * 3!

  3! = 3 * 2!

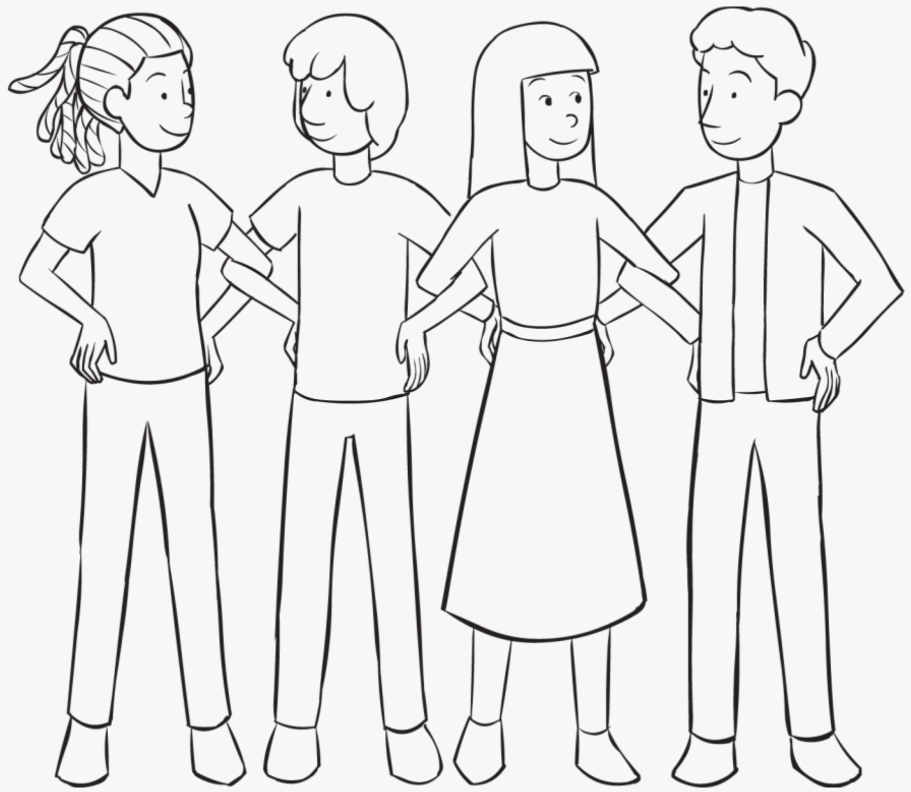
  2! = 2 * 1!

  1! = 1* 0!

  0! = 1

  Trace back : 4! = 1*2*3*4 = 24

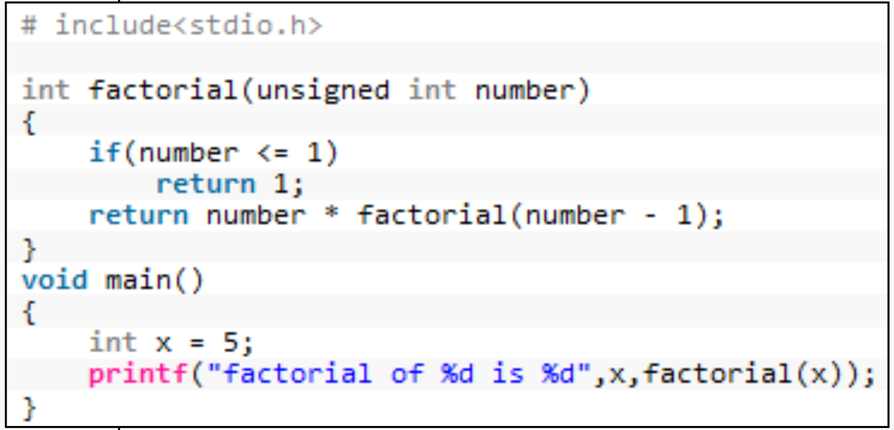
How Recursive Works?



Recursive Definition

Example: (5 factorial)

5!
(5 * 4!)
(5 * (4 *3!))
(5 * (4 * (3 * 2!)))
(5 * (4 * (3 * (2 * 1!))))
(5 * (4 * (3 * (2 * (1 * 0!)))))
(5 * (4 * (3 * (2 * (1 * 1)))))
(5 * (4 * (3 * (2 * 1))))
(5 * (4 * (3 * 2)))
(5 * (4 * 6))
(5 * 24)
120



```c
# include<stdio.h>

int factorial(unsigned int number)
{
    if(number <= 1)
        return 1;
    return number * factorial(number - 1);
}
void main()
{
    int x = 5;
    printf("factorial of %d is %d",x,factorial(x));
}
```

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Recursive Function

Recursive Function has two components:

- **Base case**:
  return value(constant) without calling next recursive call.
- **Reduction step**:
  sequence of input value converging to the base case.

Example: (Factorial function)

- **Base case :** n = 0
- **Reduction step:** f(n) = n * f(n-1)

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Iterative vs Recursive

Example: (Iterative vs Recursive)

- **Factorial - Recursive**

```
long factor (int n)
{
     if(n==0) return (1);
      else return(n * factor(n-1));
}
```

- **Factorial - Iterative**

```
long factor(int n) {
     long i, fac = 1;
     for(i=1; i<=n; i++)  fac *= i;
     return (fac);
}
```

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Recursive

Recursive Drawback

Although recursive code more concise it needs:

- More memory consumption – as stack memory is needed
- Takes longer time, should traverse through all recursive call using stack

Recursive Best Practice

Generally, use recursive solution if:

- Difficult to solve iteratively.
- Efficiency using recursive has been reached
- Efficiency is less important in comparison with readability
- Memory efficiency and execution time are not the main concern

Consider carefully speed and efficiency using iterative approach, rather than nice logical design using recursive

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Program Example Using Recursive

Fibonacci Number

sequence: 0, 1, 1, 2, 3, 5, 8, 13 ...

Relation between the number define recursively as follows:

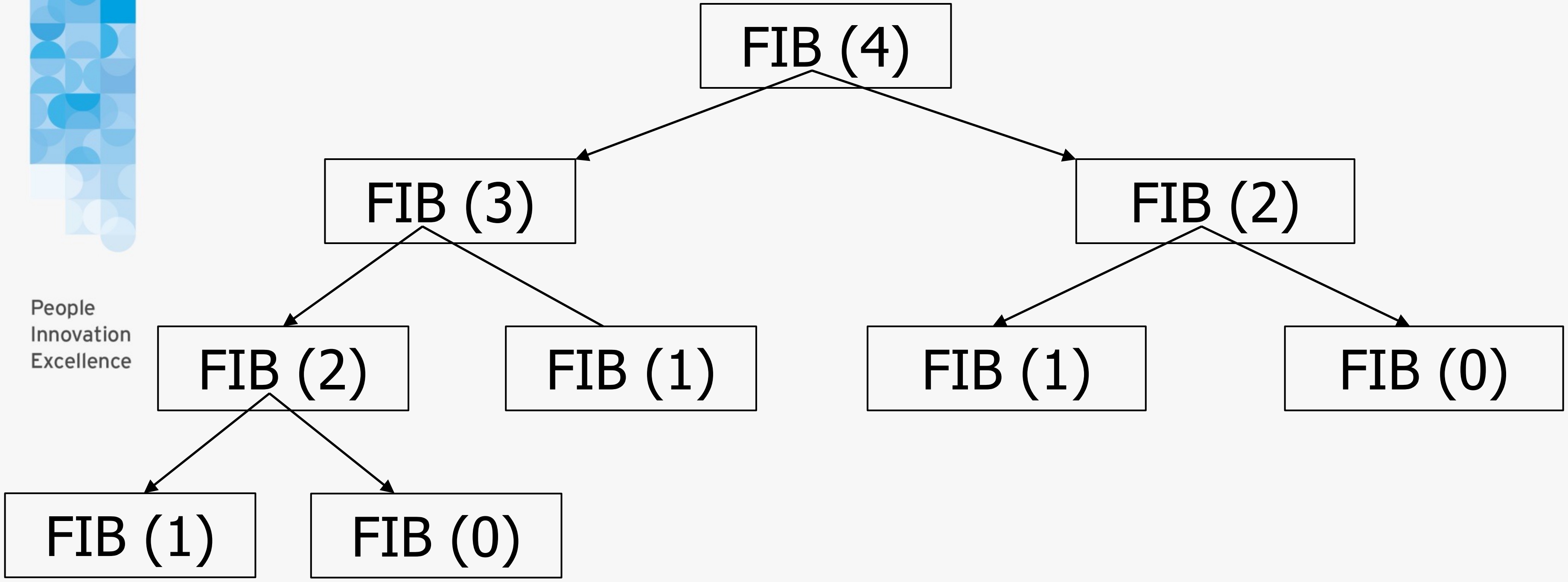
Fib(N) = N	if N = 0 or 1
Fib(N) = Fib(N-2) + Fib(N-1)	if N >= 2

```
int Fib(int n) {
    int f;
    if(n==0) f = 0;
        else if(n==1) f = 1;
            else f = Fib(n-2) + Fib(n-1);
    return f;
}
```

Program Example Using Recursive

Fibonacci Number

Fibonacci illustration N=4



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References

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- Functions in C: http://aelinik.free.fr/c/ch15.htm

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END