Recursion

- Technique to make a function call itself.
- It is a way to break complicated problems into simple problems which are easier to solve

A Mathematical Interpretation

- Let us consider a programmer has to determine the sum of first n natural numbers:

approach(1) – Simply adding one by one

$f(n) = 1 + 2 + 3 + \ldots\ldots + n$

approach(2) – Recursive adding

$f(n) = 1 \qquad n=1$

$f(n) = n + f(n-1) \qquad n>1$

Solving the recursion

- *f(5)=5+f(5-1)----------eq:01*
- *f(5-1)=f(4)=4+f(4-1)----------eq:02*
- *Substitute 02 in 01*
- *f(5)=5+4+f(4-1)----------eq:03*
- *f(4-1)=f(3)=3+f(3-1)----------eq:04*
- *Substitute 04 in 03*
- *f(5)=5+4+3+f(3-1)----------eq:05*
- *f(3-1)=f(2)=2+f(2-1)----------eq:06*
-

Solving the recursion

- *Substitute 06 in 05*
- *f(5)=5+4+3+2+f(2-1)----------eq:07*
- *f(2-1)=f(1)=1----------eq:08*
- *Substitute 08 in 07*
- *f(5)=5+4+3+2+1*
- *f*(5)=15

Solution to add the numbers


```
int fact(int n)
{
    if (n < = 1) // base case
        return 1;
    else
        return n*fact(n-1);
}
```

Factorial

- Try Factorial with Recursion

Solution

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