Recursion

“To understand recursion, you’ll have to understand recursion.”

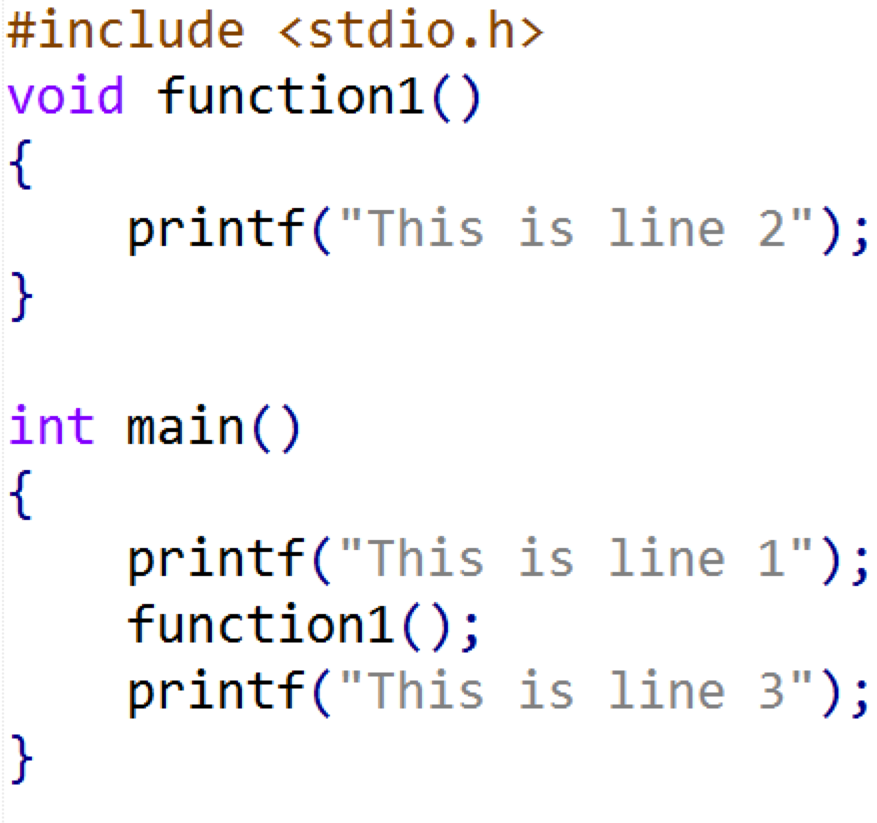
Prerequisite: Function

Find more contents at
https://sites.google.com/view/cse105june18/home

Md. Saidul Hoque Anik
onix.hoque.mist@gmail.com

Let’s take another look at function

What is the output of this program?

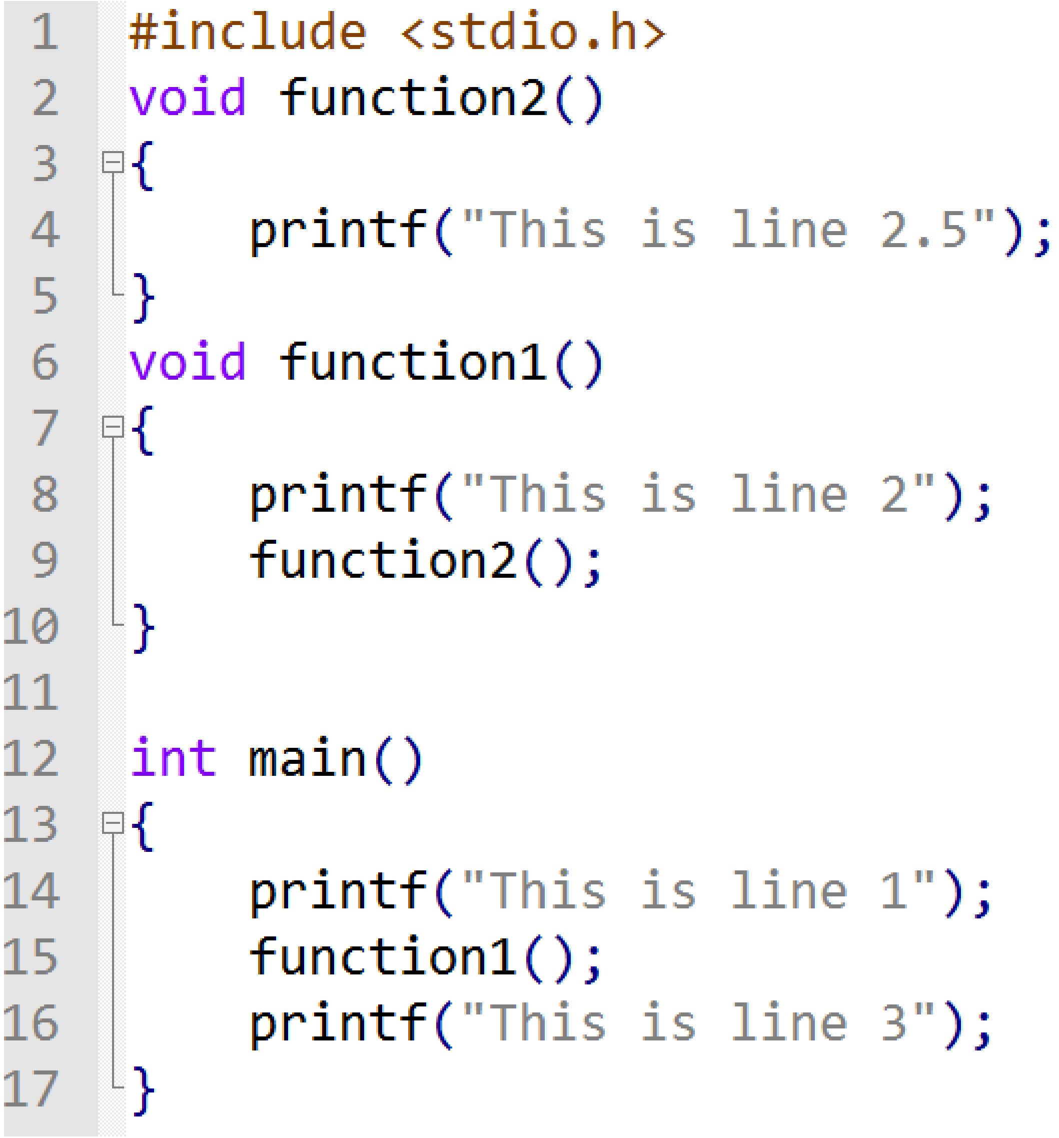


```c
#include <stdio.h>
void function1()
{
    printf("This is line 2");
}

int main()
{
    printf("This is line 1");
    function1();
    printf("This is line 3");
}
```

Let’s take another look at function

We can call one function from another function



```c
#include <stdio.h>
void function2()
{
    printf("This is line 2.5");
}
void function1()
{
    printf("This is line 2");
    function2();
}

int main()
{
    printf("This is line 1");
    function1();
    printf("This is line 3");
}
```

Let’s take another look at function

Call sequence

```
int main()
{
printf("This is line 1");
function1();
printf("This is line 3");
}
```

```
Output:
```

Let’s take another look at function

Call sequence

```
int main()
{
printf("This is line 1");
function1();
printf("This is line 3");
}
```

```
Output:
This is line 1
```

Let’s take another look at function

Call sequence

```
int main()
{
printf("This is line 1");
function1();
printf("This is line 3");
}
```

```
void function1()
{
printf("This is line 2");
function2();
}
```

```
Output:
This is line 1
```

Let’s take another look at function

Call sequence

```
int main()
{
printf("This is line 1");
function1();
printf("This is line 3");
}
```

```
void function1()
{
printf("This is line 2");
function2();
}
```

```
Output:
This is line 1
This is line 2
```

Let’s take another look at function

Call sequence

```
int main()
{
printf("This is line 1");
function1();
printf("This is line 3");
}
```

```
void function1()
{
printf("This is line 2");
function2();
}
```

```
Output:
This is line 1
This is line 2
```

```
void function2()
{
printf("This is line 2.5");
}
```

Let’s take another look at function

Call sequence

```
int main()
{
printf("This is line 1");
function1();
printf("This is line 3");
}
```

```
void function1()
{
printf("This is line 2");
function2();
}
```

```
void function2()
{
printf("This is line 2.5");
}
```

```
Output:
This is line 1
This is line 2
This is line 2.5
```

Let’s take another look at function

Call sequence

```
int main()
{
printf("This is line 1");
function1();
printf("This is line 3");
}
```

```
void function1()
{
printf("This is line 2");
function2();
}
```

```
Output:
This is line 1
This is line 2
This is line 2.5
```

Let’s take another look at function

Call sequence

```
int main()
{
printf("This is line 1");
function1();
printf("This is line 3");
}
```

```
Output:
This is line 1
This is line 2
This is line 2.5
This is line 3
```

Let’s take another look at function

Call sequence

```
int main()
{
printf("This is line 1");
function1();
printf("This is line 3");
}
```

```
Output:
This is line 1
This is line 2
This is line 2.5
This is line 3
```

Let’s take another look at function

Call sequence

```
int main()
{
printf("This is line 1");
function1();
printf("This is line 3");
}
```

```
Output:
This is line 1
This is line 2
This is line 2.5
This is line 3

<Program terminated>
```

Recursion

Write a function that sums from 1 to n

Recursion

Write a function that sums from 1 to n

>> f(n) = 1 + 2 + 3 + … … … + n

Recursion

Write a function that sums from 1 to n

>> f(n) = 1 + 2 + 3 + … … … + n

For n = 5,

f(5) =

Recursion

Write a function that sums from 1 to n

>> f(n) = 1 + 2 + 3 + … … … + n

For n = 5,

f(5) = 5 + f(4)

Recursion

Write a function that sums from 1 to n

>> f(n) = 1 + 2 + 3 + … … … + n

For n = 5,

f(5) = 5 + 4 + f(3)

Because f(4) = 4 + f(3)

Recursion

Write a function that sums from 1 to n

>> f(n) = 1 + 2 + 3 + … … … + n

For n = 5,

f(5) = 5 + 4 + 3 + f(2)

Because f(3) = 3 + f(2)

Recursion

Write a function that sums from 1 to n

>> f(n) = 1 + 2 + 3 + … … … + n

For n = 5,

f(5) = 5 + 4 + 3 + 2 + f(1)

Because f(2) = 2 + f(1)

Recursion

Write a function that sums from 1 to n

>> f(n) = 1 + 2 + 3 + … … … + n

For n = 5,

f(5) = 5 + 4 + 3 + 2 + 1

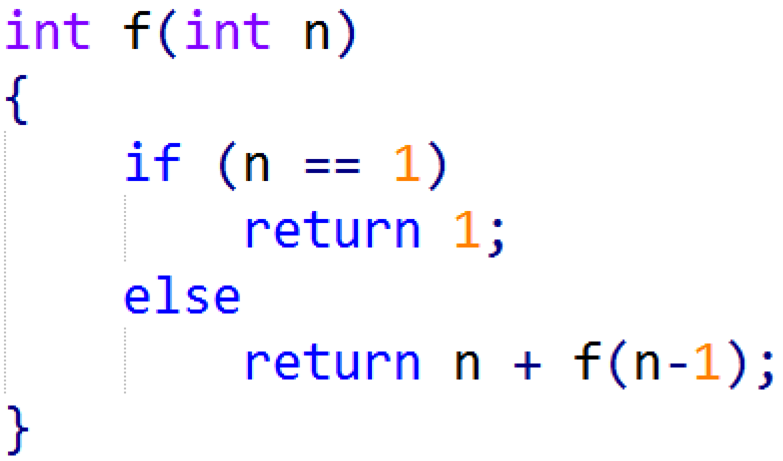
Recursion

Write a function that sums from 1 to n

>> f(n) = 1 + 2 + 3 + … … … + n

For n = 5,

f(5) = 5 + 4 + 3 + 2 + 1

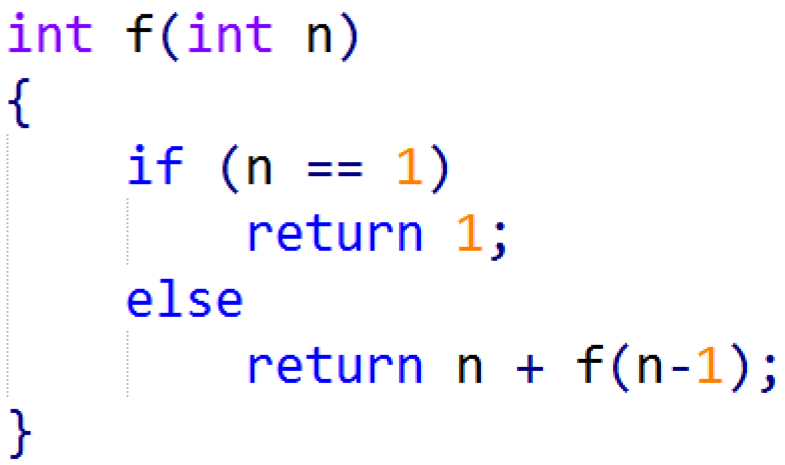


```
int f(int n)
{
    if (n == 1)
        return 1;
    else
        return n + f(n-1);
}
```

Recursion

Call sequence for n = 3

```
int main()
{
int sum = f(3);
Printf("%d", sum);
}
```



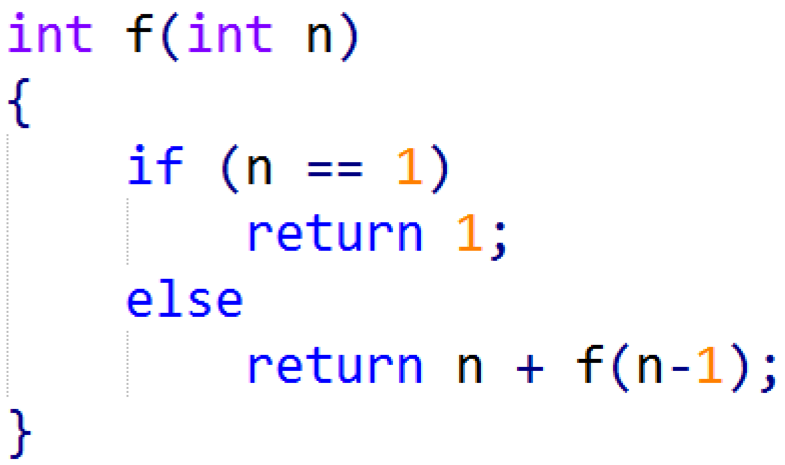
```
int f(int n)
{
    if (n == 1)
        return 1;
    else
        return n + f(n-1);
}
```

Recursion

Call sequence for n = 3

```
int main()
{
int sum = f(3);
Printf("%d", sum);
}
```

```
int f(3) //n=3
{
if (n==1) return 1;
else return n + f(n-1)
}
```



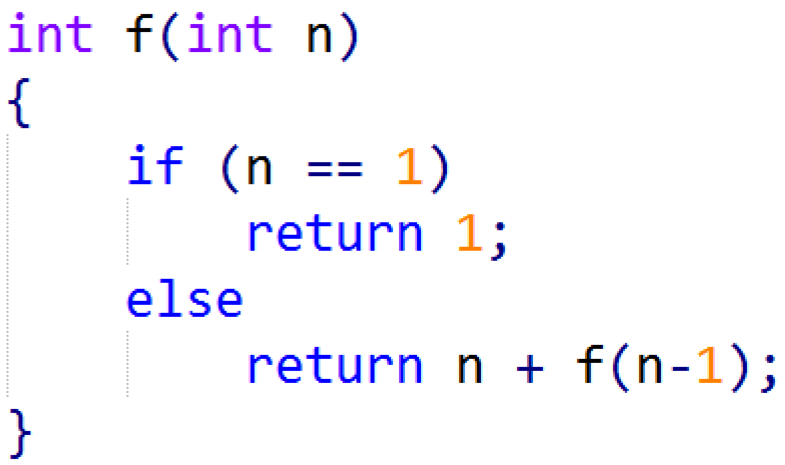
```
int f(int n)
{
    if (n == 1)
        return 1;
    else
        return n + f(n-1);
}
```

Recursion

Call sequence for n = 3

```
int main()
{
int sum = f(3);
Printf("%d", sum);
}
```

```
int f(3) //n=3
{
if (n==1) return 1;
else return n + f(n-1)
}
```



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

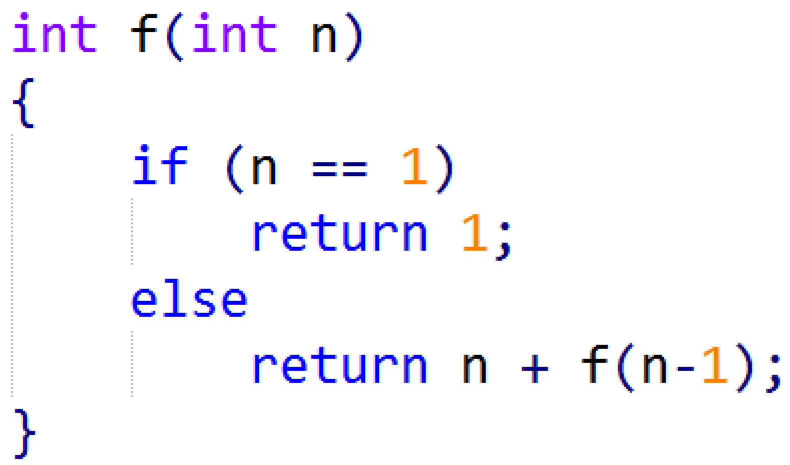
Recursion

Call sequence for n = 3

```
int main()
{
int sum = f(3);
Printf("%d", sum);
}
```

```
int f(3) //n=3
{
if (n==1) return 1;
else return n + f(n-1)
}
```

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



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

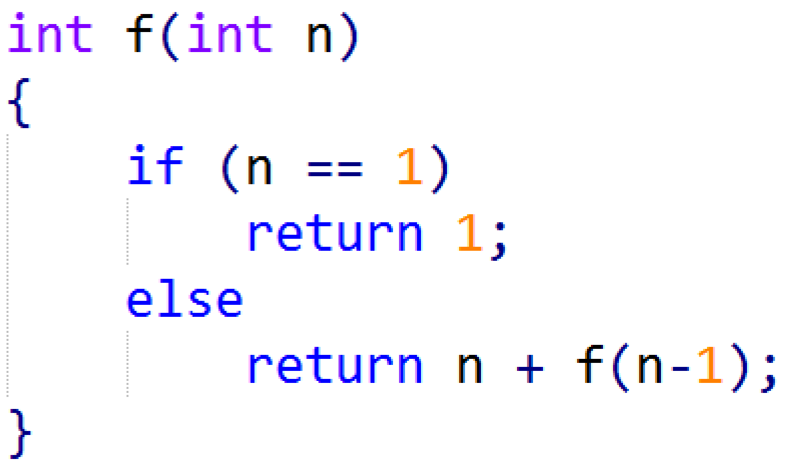
Recursion

Call sequence for n = 3

```
int main()
{
int sum = f(3);
Printf("%d", sum);
}
```

```
int f(3) //n=3
{
if (n==1) return 1;
else return n + f(n-1)
}
```

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



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

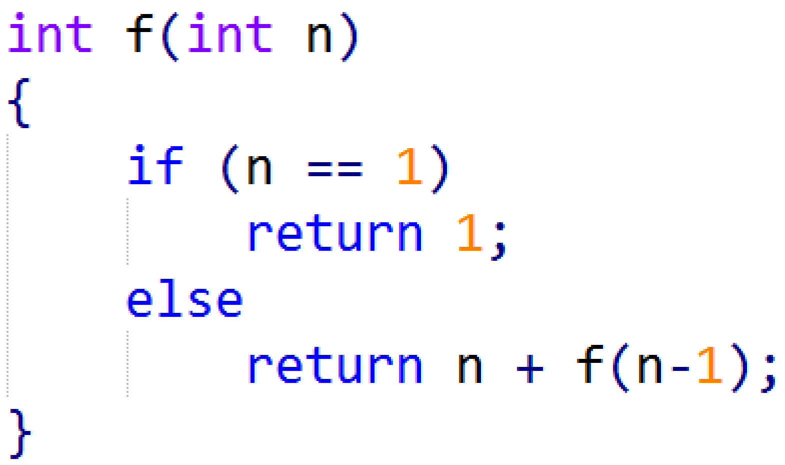
Recursion

Call sequence for n = 3

```
int main()
{
int sum = f(3);
Printf("%d", sum);
}
```

```
int f(3) //n=3
{
if (n==1) return 1;
else return n + f(n-1)
}
```

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



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

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

Recursion

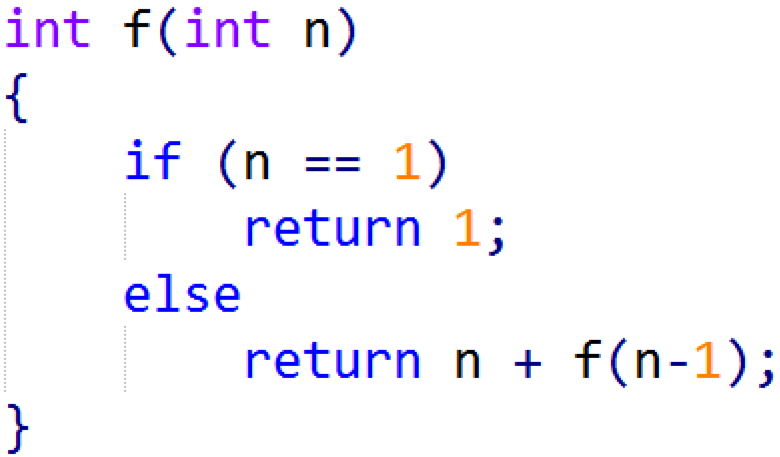
Call sequence for n = 3

```
int main()
{
int sum = f(3);
Printf("%d", sum);
}
```

```
int f(3) //n=3
{
if (n==1) return 1;
else return n + f(n-1)
}
```

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

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



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

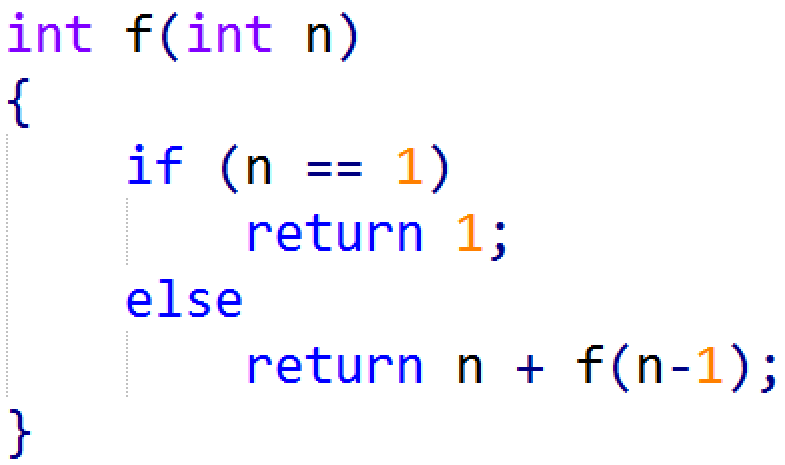
Recursion

Call sequence for n = 3

```
int main()
{
int sum = f(3);
Printf("%d", sum);
}
```

```
int f(3) //n=3
{
if (n==1) return 1;
else return n + f(n-1)
}
```

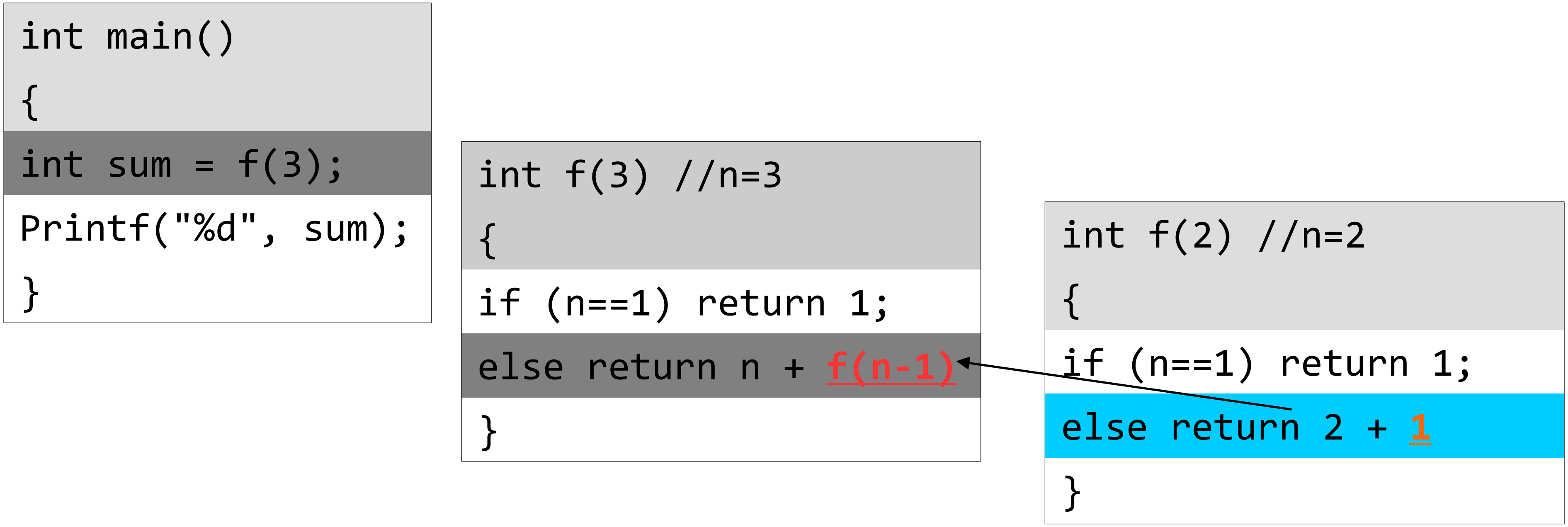
```
int f(2) //n=2
{
if (n==1) return 1;
else return 2 + 1
}
```



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

Recursion

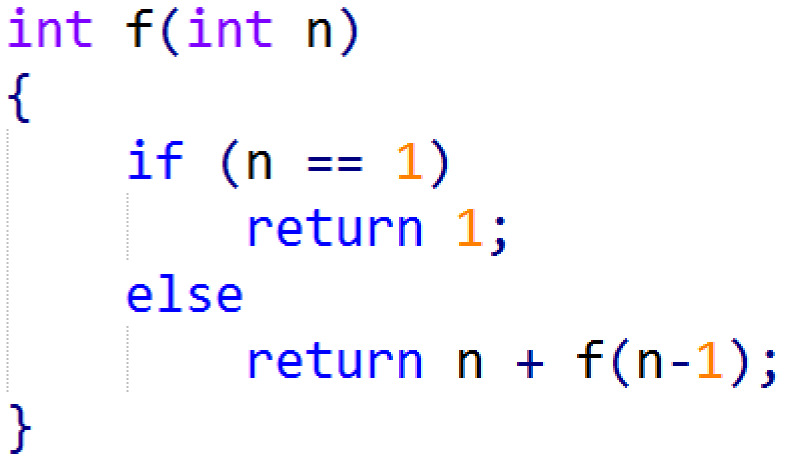
Call sequence for n = 3



```
int main()
{
int sum = f(3);
Printf("%d", sum);
}
```

```
int f(3) //n=3
{
if (n==1) return 1;
else return n + f(n-1)
}
```

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



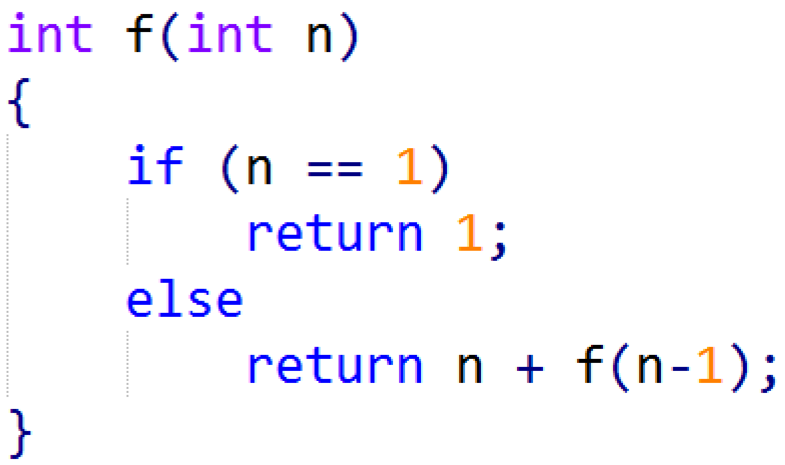
```
int f(int n)
{
    if (n == 1)
        return 1;
    else
        return n + f(n-1);
}
```

Recursion

Call sequence for n = 3

```
int main()
{
int sum = f(3);
Printf("%d", sum);
}
```

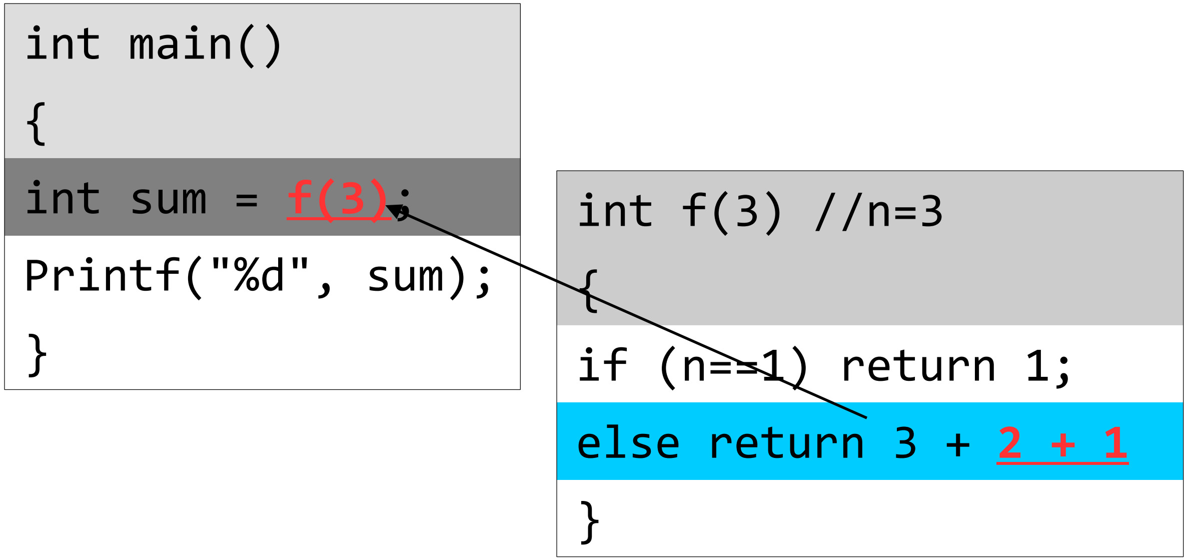
```
int f(3) //n=3
{
if (n==1) return 1;
else return 3 + 2 + 1
}
```



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

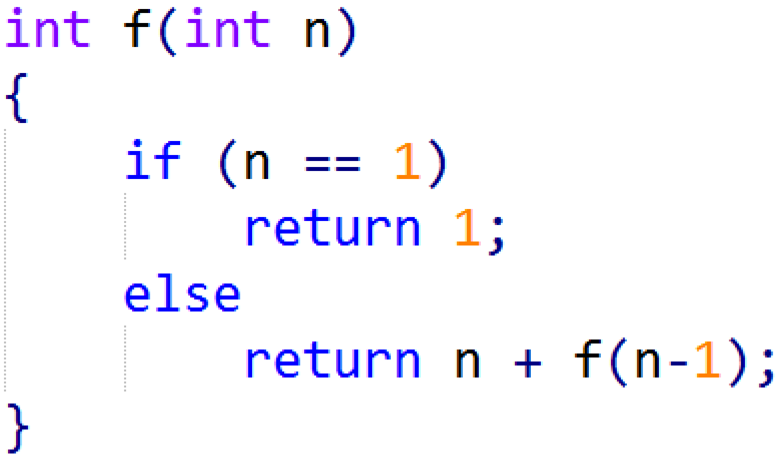
Recursion

Call sequence for n = 3



```
int main()
{
int sum = f(3);
Printf("%d", sum);
}
```

```
int f(3) //n=3
{
if (n==1) return 1;
else return 3 + 2 + 1
}
```



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

Recursion

Call sequence for n = 3

```
int main()
{
int sum = 3 + 2 + 1;
Printf("%d", sum);
}
```

Recursion

Call sequence for n = 3

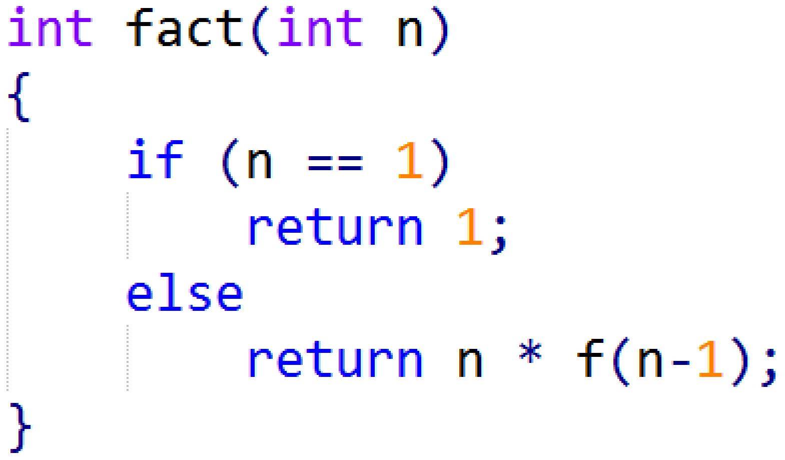
```
int main()
{
int sum = 3 + 2 + 1;
Printf("%d", sum); //6
}
```

Recursion

Write a factorial function `fact(n)` = 1 x 2 x 3 x … … … x n

Recursion

Write a factorial function fact(n) = 1 x 2 x 3 x … … … x n



```
int fact(int n)
{
    if (n == 1)
        return 1;
    else
        return n * f(n-1);
}
```

Recursion

- Write a factorial function `fact(n)` = 1 x 2 x 3 x … … … x n
  - Write down the call sequence for `fact(3)`, show the output in each step

```
int main()
{
int prod = fact(3);
Printf("%d", prod);
}
```

Recursion Practice

Find the sum of the following series using recursive function

a) 1^2 + 2^2 + 3^2 + 4^2 + … … … + n^2

b) 1 – 2 + 3 – 4 + … … … ± n

c) Fibonacci series