



第6章 函数

——尾递归



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普通递归与尾递归 (Tail Recursion)

$$n! = \begin{cases} 1 & n = 0, 1 \\ n \times (n-1)! & n \end{cases}$$

$$F(n, a) = \begin{cases} a & n = 0, 1 \\ F(n-1, n \times a) & n > 1 \end{cases}$$

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

```
unsigned long Fact(unsigned int n,
                    unsigned int a)
{
    if (n==0 || n==1)
        return a;
    else
        return Fact(n-1, n*a);
}
```

普通递归与尾递归 (Tail Recursion)

$\text{Fact}(3) = 3 * \text{Fact}(2)$

递推阶段

$\text{Fact}(2) = 2 * \text{Fact}(1)$

$\text{Fact}(1) = 1$ 终止条件

$\text{Fact}(2) = 2 * 1$

回归阶段

$\text{Fact}(3) = 3 * 2$

6

$3! = 1 * 2 * 3$

递推阶段
递进
↓
 $\text{Fact}(3) = 3 * \text{Fact}(2) = 3 * 2 = 6$
 $\text{Fact}(2) = 2 * \text{Fact}(1) = 2 * 1 = 2$
 $\text{Fact}(1) = 1$

回归阶段
返回
↑

$\text{Fact}(3, 1) = \text{Fact}(2, 3)$

递推阶段

$\text{Fact}(2, 3) = \text{Fact}(1, 6)$

$\text{Fact}(1, 6) = 6$ 终止条件

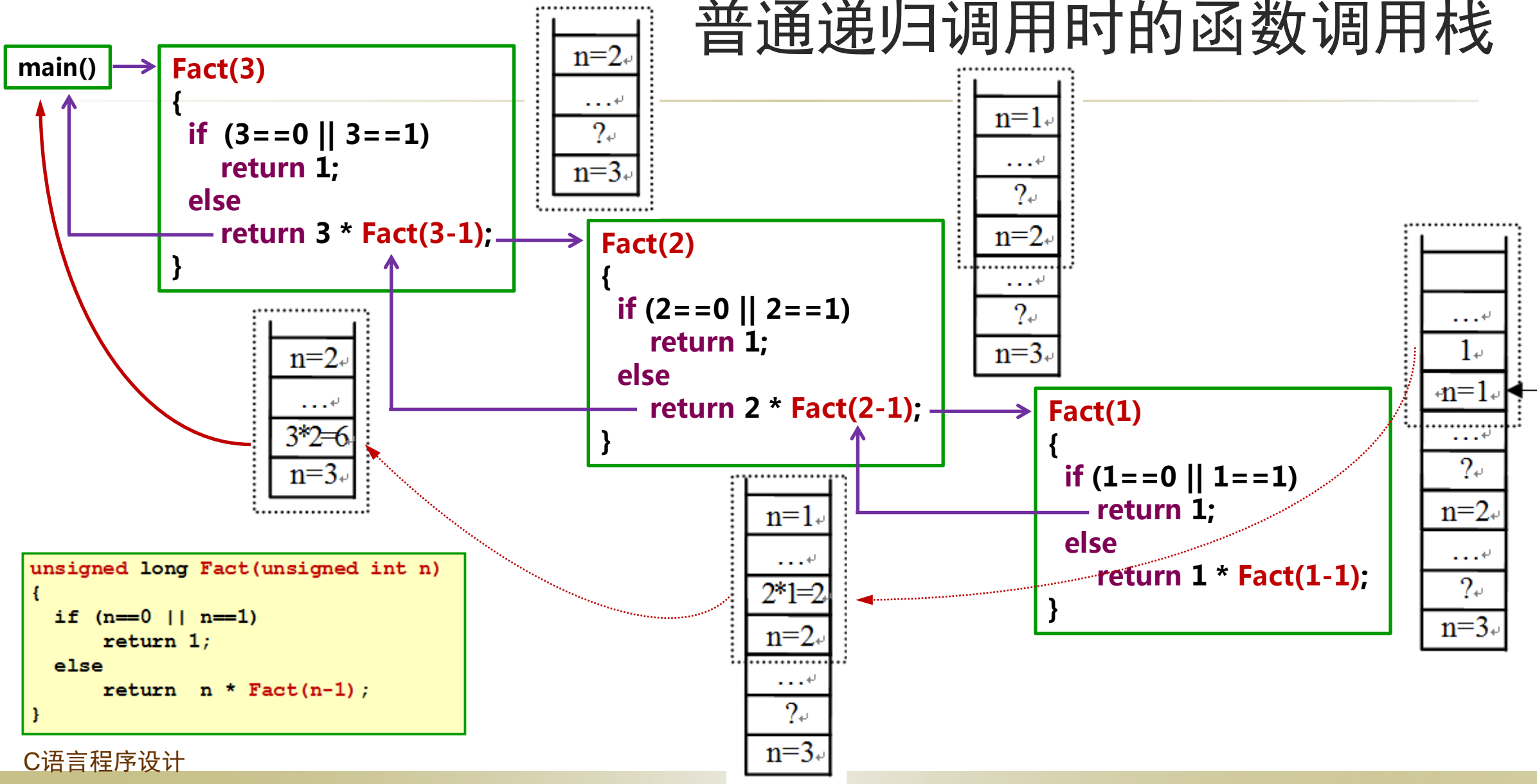
```
unsigned long Fact(unsigned int n,
                   unsigned int a)
{
    if (n==0 || n==1)
        return a;
    else
        return Fact(n-1, n*a);
}
```

6 回归阶段
递归完成

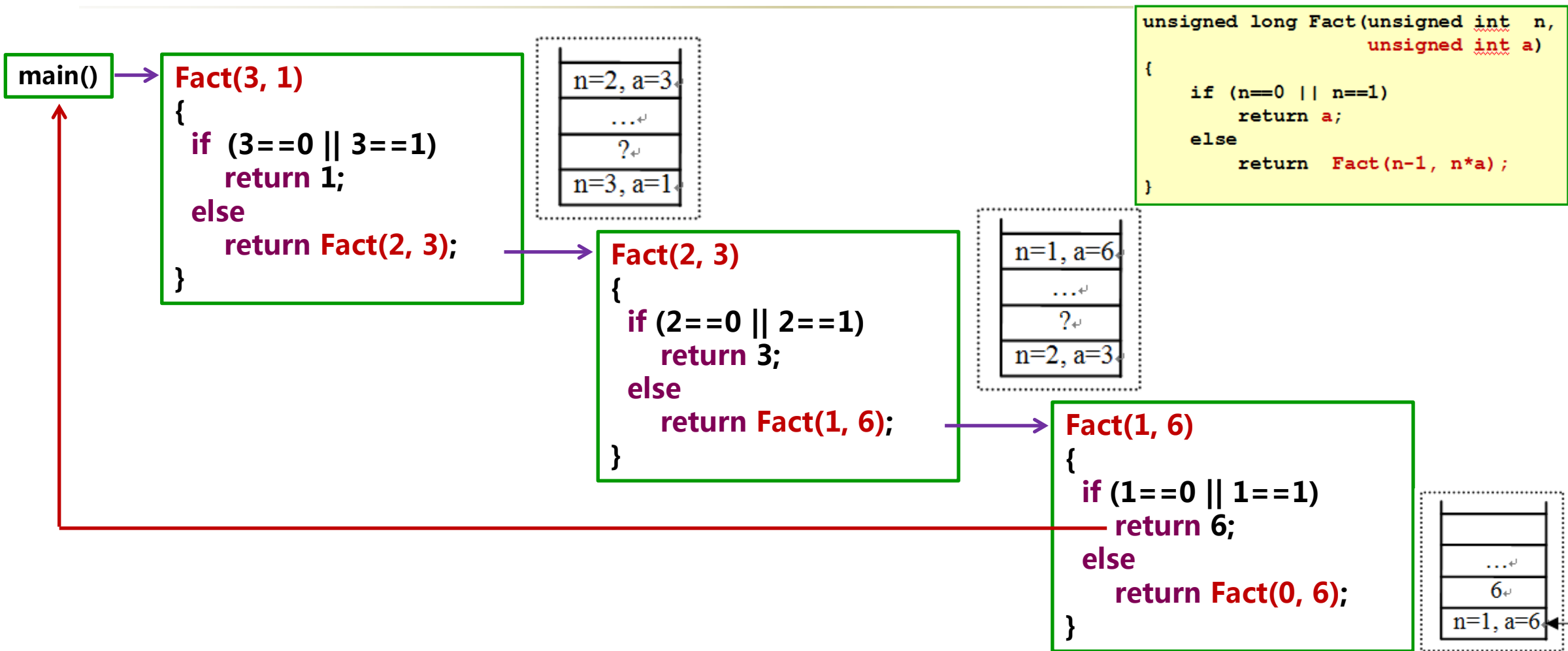
$3! = 3 * 2 * 1$

递推阶段
↓
 $\text{Fact}(3, 1) \leftarrow a = 3 * 1 = 3$
 $\text{Fact}(2, 3) \leftarrow a = 2 * 3 = 6$
 $\text{Fact}(1, 6) \leftarrow$ (终止条件)

普通递归调用时的函数调用栈



尾递归调用时的函数调用栈



讨论

- 普通递归和尾递归，哪种递归方式更容易转换为与其等价的迭代控制结构？



