Tail calls

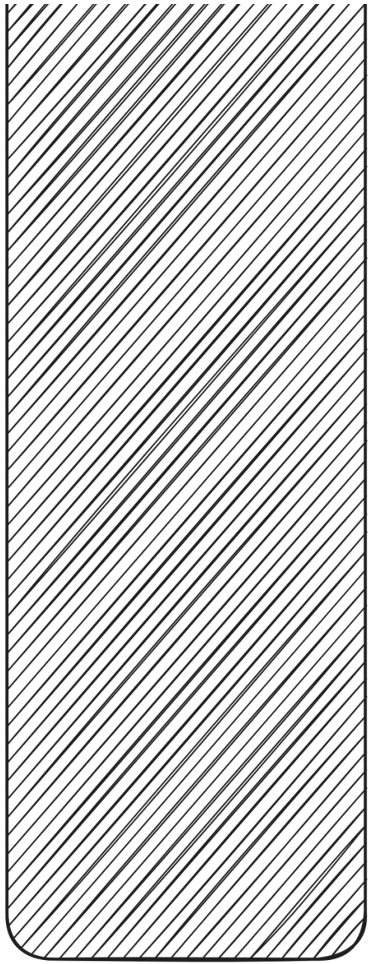
```
function fact(n, acc) {
    if (n == 0) {
        return acc
    }
    return fact(n - 1, n * acc)
}
```

```
function fact(n, acc) {
    if (n == 0) {
        return acc
    }
    return fact(n - 1, n * acc)
}
```

```
function fact(n, acc) {
    if (n == 0) {
        return acc
    }
    return fact(n - 1, n * acc)
}
```

20:

Execution:

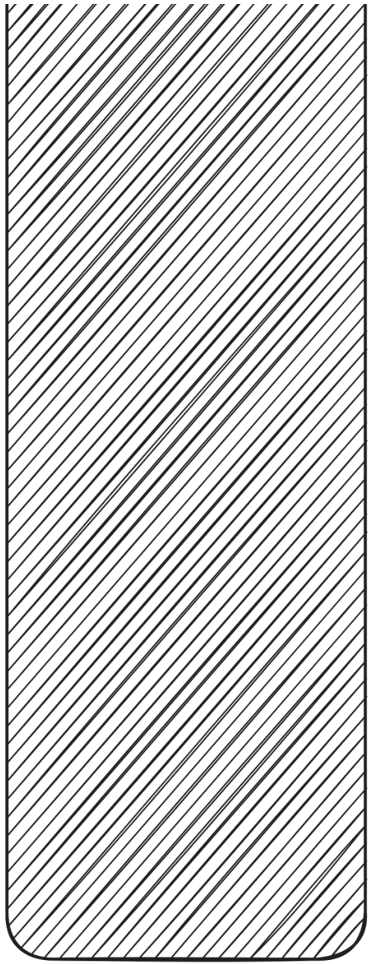


```
function fact(n, acc) {
    if (n == 0) {
        return acc
    }
20:  return fact(n - 1, n * acc)
}
```

Execution:

Address 10

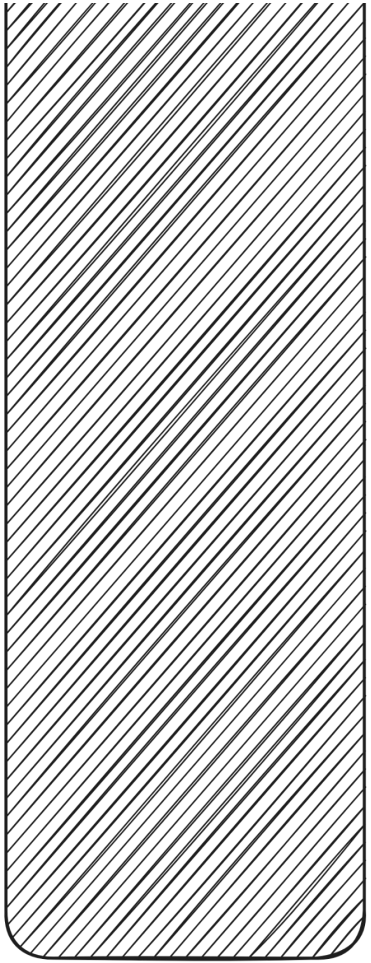
```
fact(4, 1)
```



```
function fact(n, acc) {
    if (n == 0) {
        return acc
    }
20:  return fact(n - 1, n * acc)
}
```

Execution:

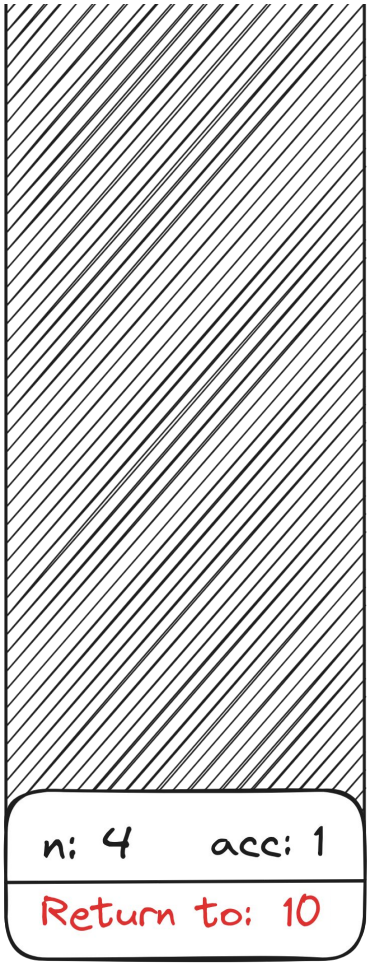
10: fact(4, 1)



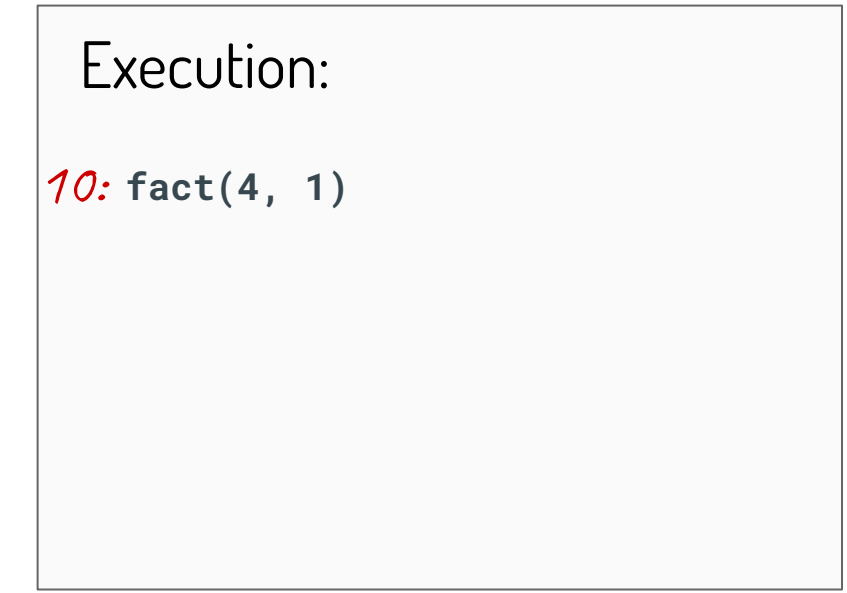
```
function fact(n, acc) {
    if (n == 0) {
        return acc
    }
20: return fact(n - 1, n * acc)
}
```

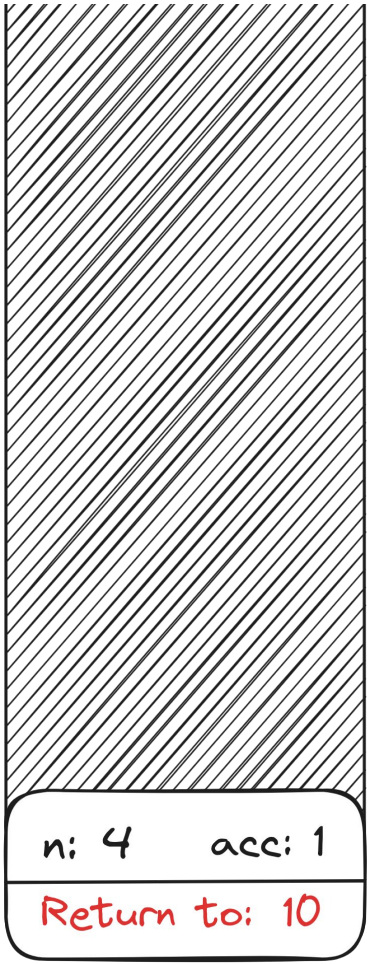

Execution:

10: **fact(4, 1)**



```
function fact(n, acc) {
    if (n == 0) {
        return acc
    }
20: return fact(n - 1, n * acc)
}
```



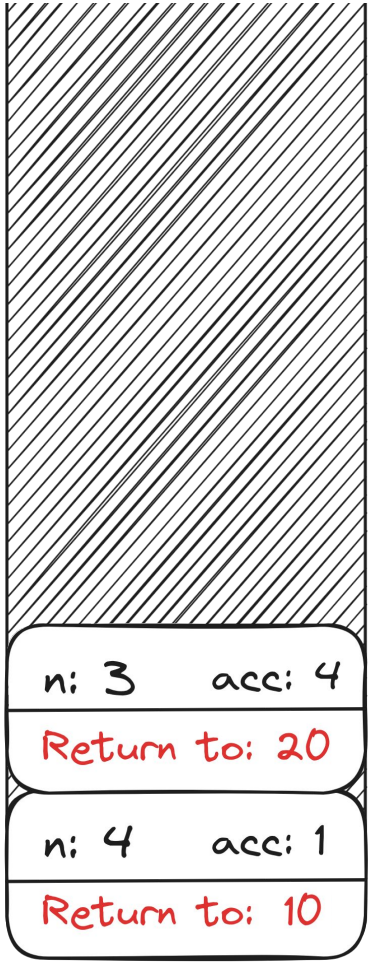


```
function fact(n, acc) {
    if (n == 0) {
        return acc
    }
20: return fact(n - 1, n * acc)
}
```

Execution:

10: `fact(4, 1)`

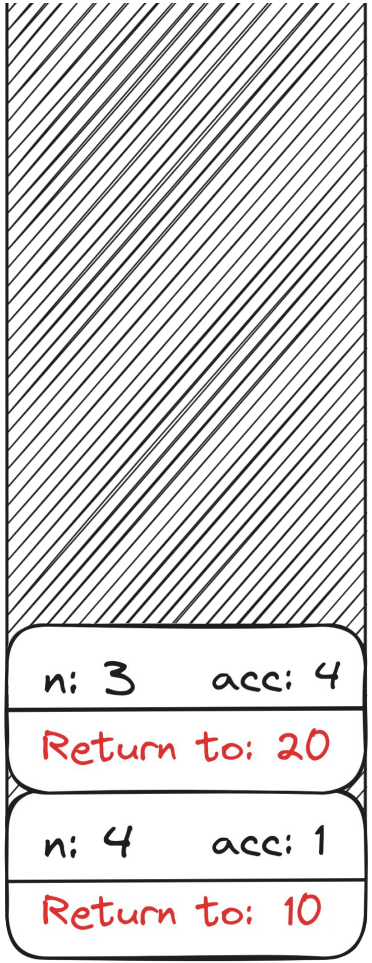
↳ **`fact(3, 4)`**



```
function fact(n, acc) {
    if (n == 0) {
        return acc
    }
20: return fact(n - 1, n * acc)
}
```

Execution:

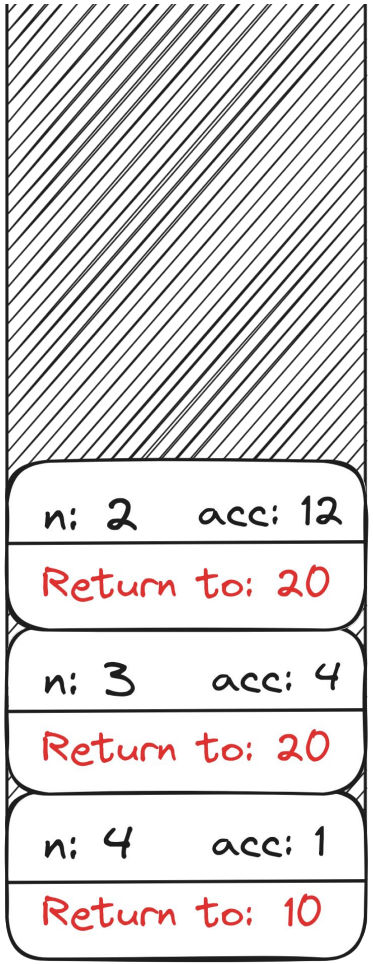
```
10: fact(4, 1)
    ↳ fact(3, 4)
```



```
function fact(n, acc) {
    if (n == 0) {
        return acc
    }
20: return fact(n - 1, n * acc)
}
```

Execution:

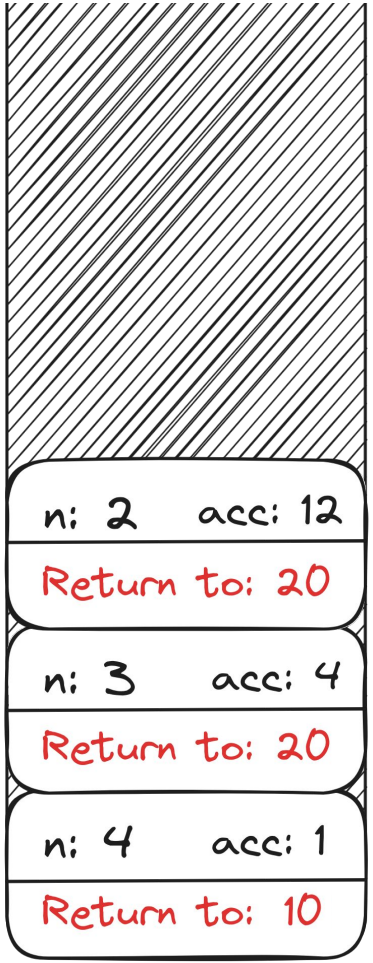
```
10: fact(4, 1)
    ↳ fact(3, 4)
        ↳ fact(2, 12)
```



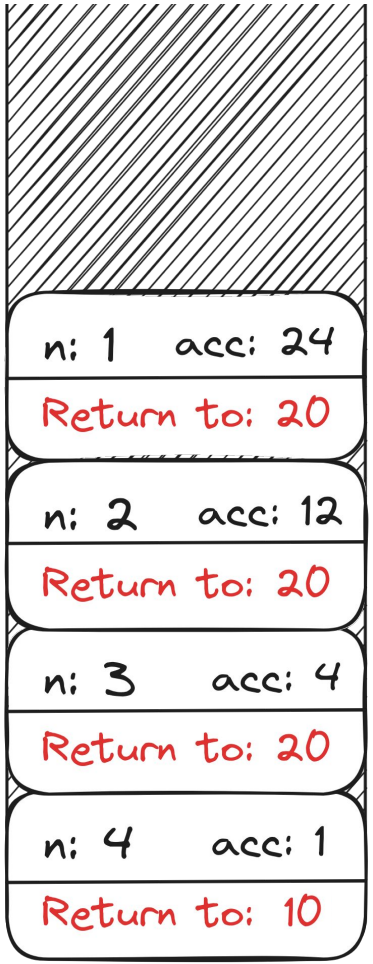
```
function fact(n, acc) {
    if (n == 0) {
        return acc
    }
20: return fact(n - 1, n * acc)
}
```

Execution:

```
10: fact(4, 1)
    ↳ fact(3, 4)
        ↳ fact(2, 12)
```



```
function fact(n, acc) {
    if (n == 0) {
        return acc
    }
20: return fact(n - 1, n * acc)
}
```



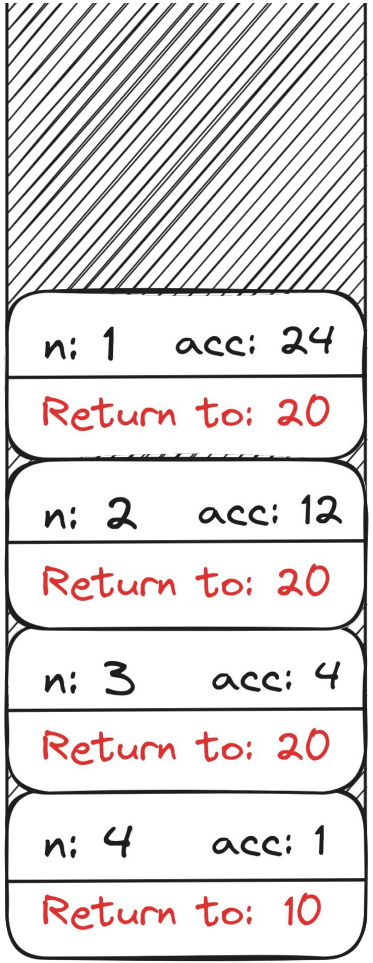
Execution:

```
10: fact(4, 1)
    ↳ fact(3, 4)
        ↳ fact(2, 12)
            ↳ fact(1, 24)
```

```
function fact(n, acc) {
    if (n == 0) {
        return acc
    }
20: return fact(n - 1, n * acc)
}
```

Execution:

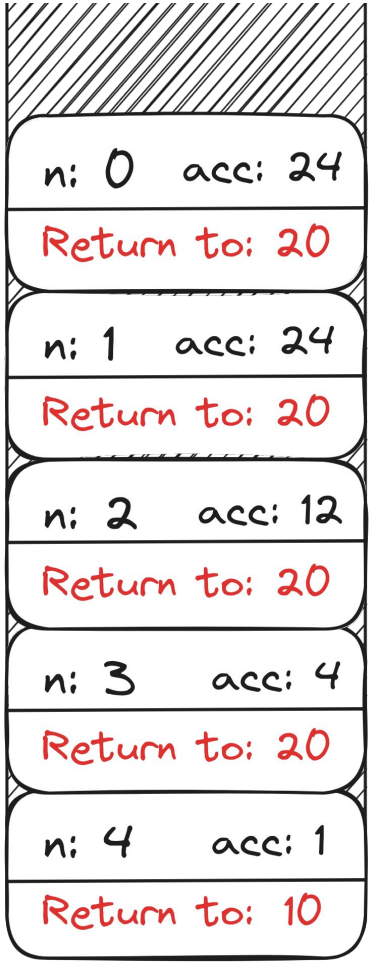
```
10: fact(4, 1)
    ↳ fact(3, 4)
        ↳ fact(2, 12)
            ↳ fact(1, 24)
```



```
function fact(n, acc) {
    if (n == 0) {
        return acc
    }
20: return fact(n - 1, n * acc)
}
```

Execution:

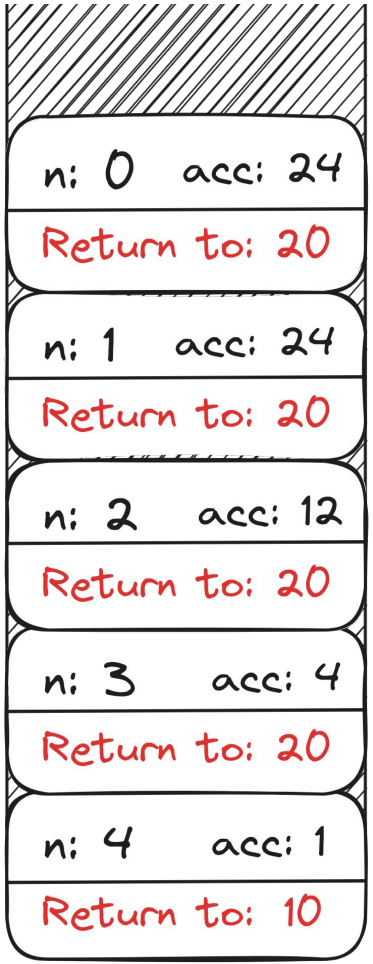
```
10: fact(4, 1)
    ↳ fact(3, 4)
        ↳ fact(2, 12)
            ↳ fact(1, 24)
                ↳ fact(0, 24)
```



```
function fact(n, acc) {
    if (n == 0) {
        return acc
    }
20: return fact(n - 1, n * acc)
}
```

Execution:

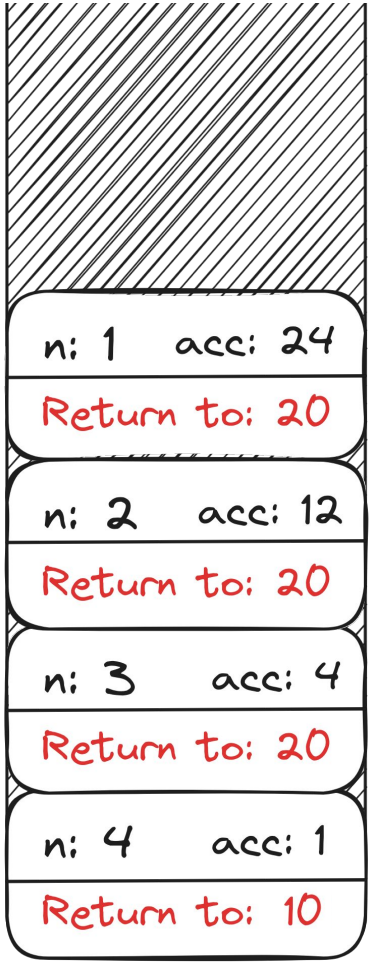
```
10: fact(4, 1)
    ↳ fact(3, 4)
        ↳ fact(2, 12)
            ↳ fact(1, 24)
                ↳ fact(0, 24) = 24
```



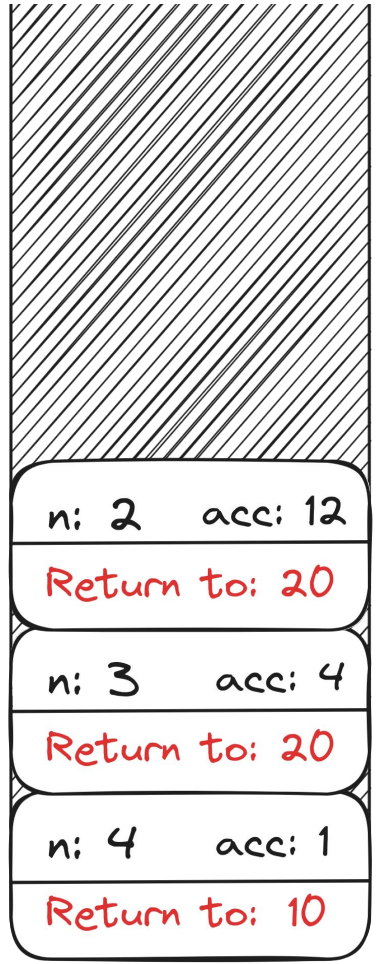
```
function fact(n, acc) {
    if (n == 0) {
        return acc
    }
20: return fact(n - 1, n * acc)
}
```

Execution:

```
10: fact(4, 1)
    ↳ fact(3, 4)
        ↳ fact(2, 12)
            ↳ fact(1, 24) = 24
```



```
function fact(n, acc) {
    if (n == 0) {
        return acc
    }
20: return fact(n - 1, n * acc)
}
```



Execution:

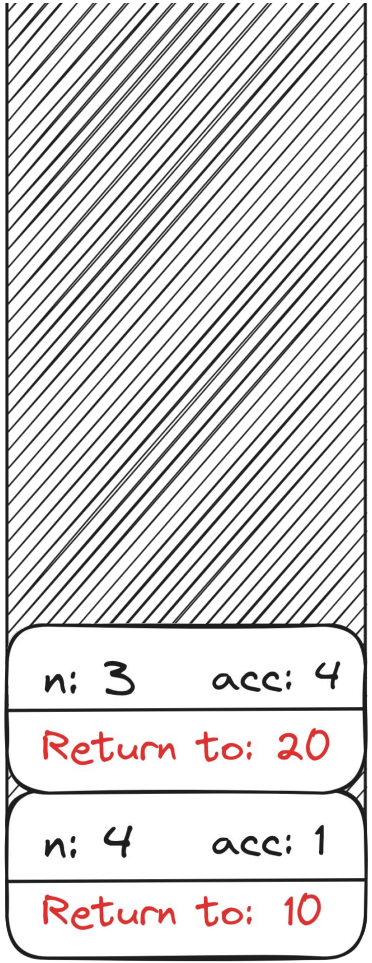
```
10: fact(4, 1)
    ↳ fact(3, 4)
        ↳ fact(2, 12) = 24
```

```
function fact(n, acc) {
    if (n == 0) {
        return acc
    }
20: return fact(n - 1, n * acc)
}
```

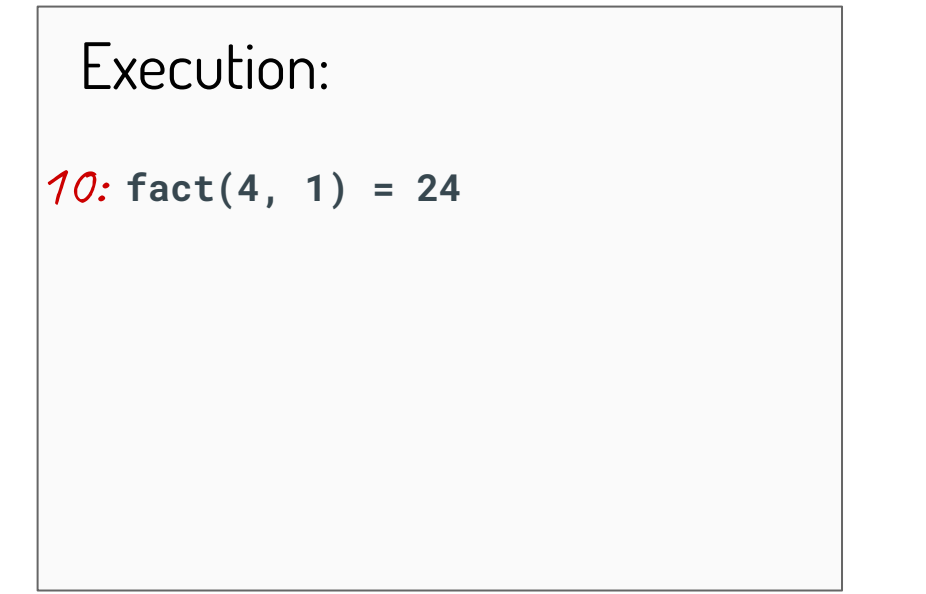
Execution:

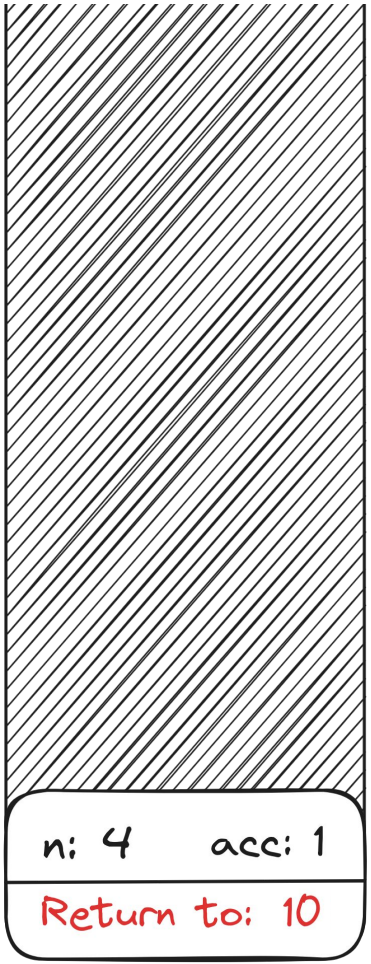
10: `fact(4, 1)`

↳ **`fact(3, 4) = 24`**



```
function fact(n, acc) {
    if (n == 0) {
        return acc
    }
20: return fact(n - 1, n * acc)
}
```

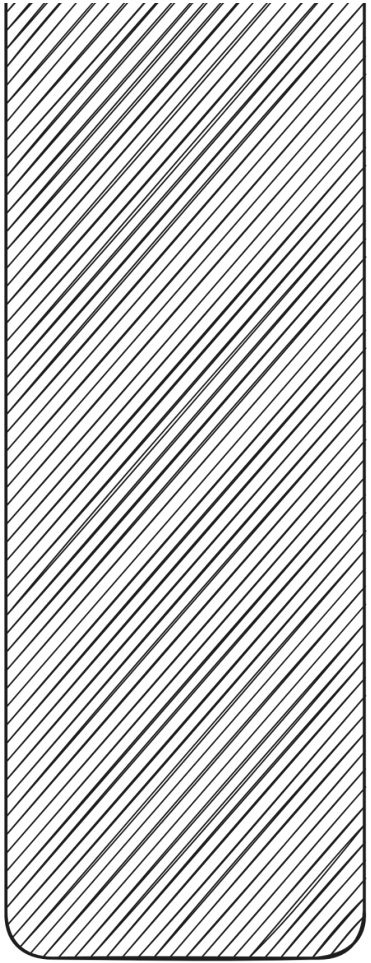




```
function fact(n, acc) {
    if (n == 0) {
        return acc
    }
20:  return fact(n - 1, n * acc)
}
```

Execution:

10: **24**



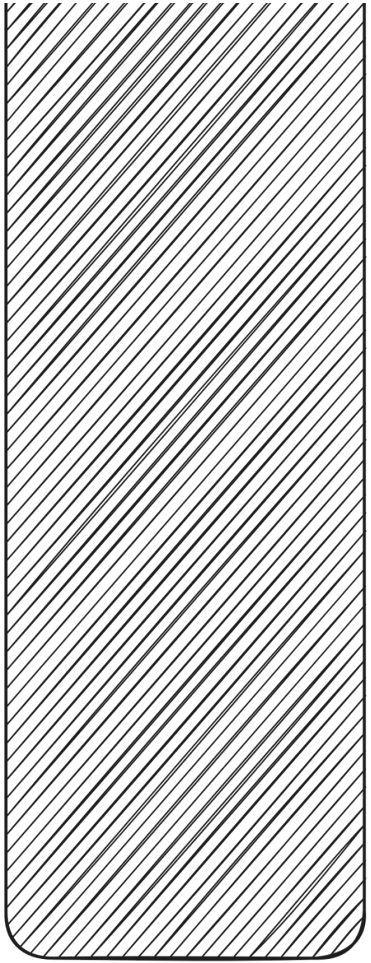
Questions

- Time?
- Space?
- Can we do better?

```
function fact(n, acc) {
    if (n == 0) {
        return acc
    }
20:  return fact(n - 1, n * acc)
}
```

Execution:

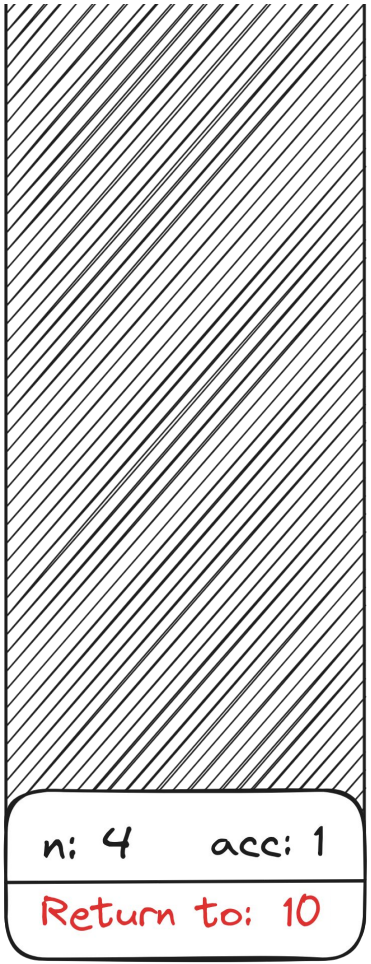
10: fact(4, 1)



```
function fact(n, acc) {
    if (n == 0) {
        return acc
    }
20: return fact(n - 1, n * acc)
}
```


Execution:

10: **fact(4, 1)**



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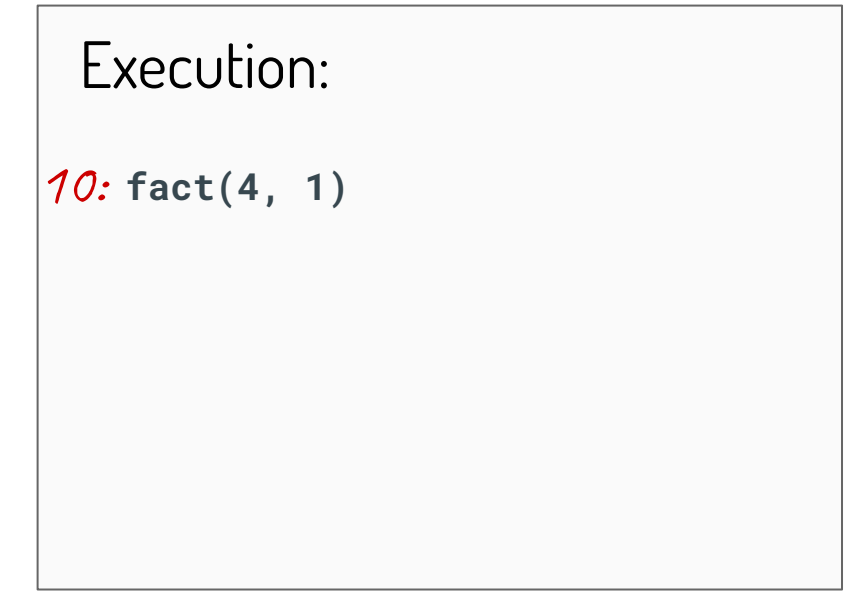
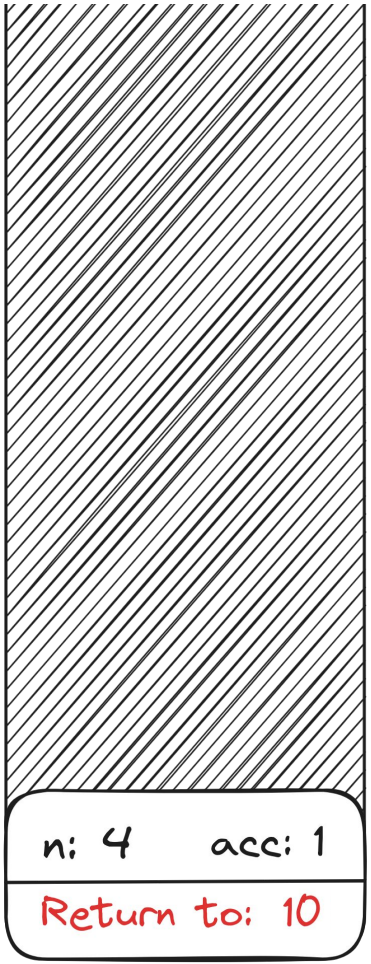
    if (n == 0) {
        return acc
    }
20: return fact(n - 1, n * acc)
}
```





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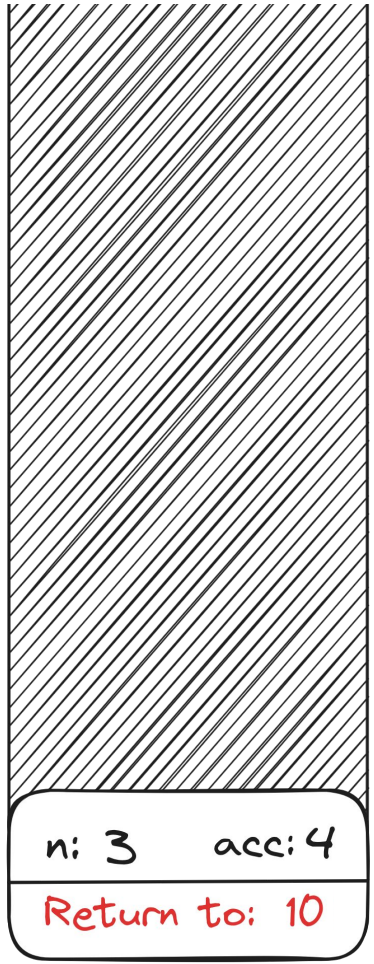
    if (n == 0) {
        return acc
    }
20: return fact(n - 1, n * acc)
}
```



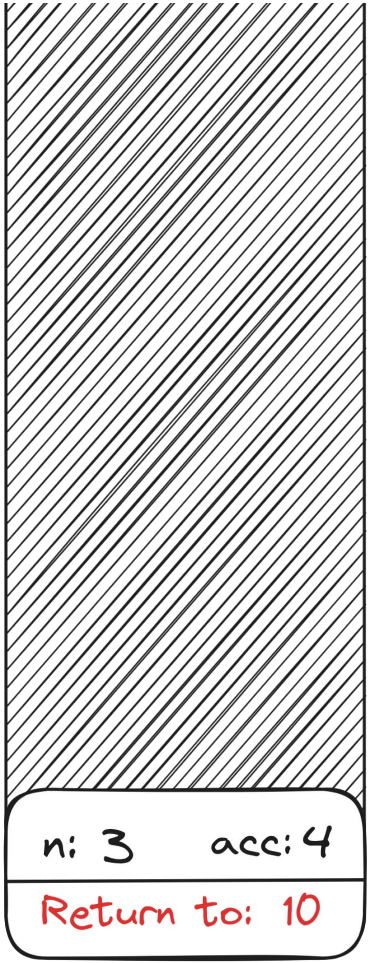
Execution:

```
10: fact(4, 1)
    ↳ fact(3, 4)
```

```
function fact(n, acc) {
    if (n == 0) {
        return acc
    }
20: return fact(n - 1, n * acc)
}
```

Execution:

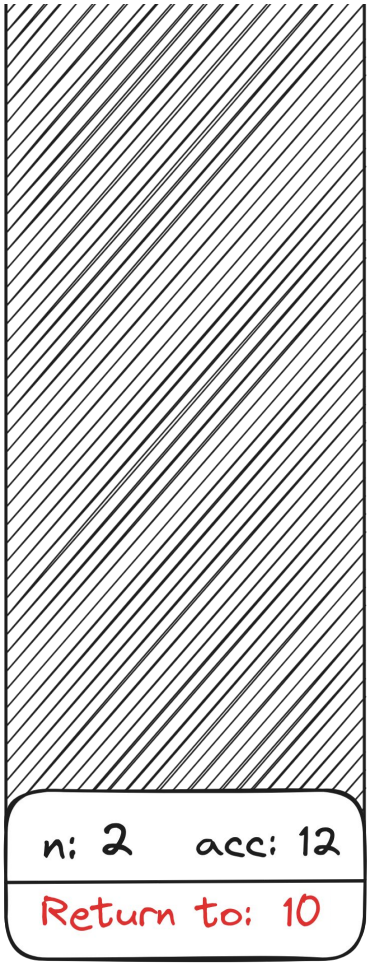
```
10: fact(4, 1)
    ↳ fact(3, 4)
```



```
function fact(n, acc) {
    if (n == 0) {
        return acc
    }
20: return fact(n - 1, n * acc)
}
```

Execution:

```
10: fact(4, 1)
    ↳ fact(3, 4)
      ↳ fact(2, 12)
```



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    if (n == 0) {
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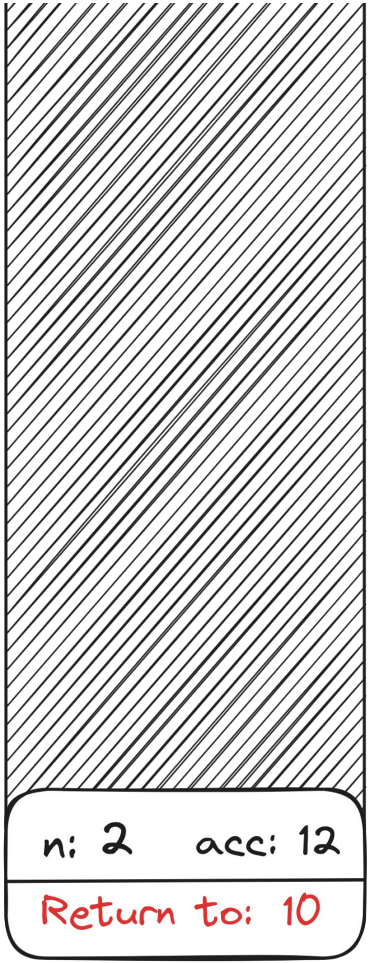
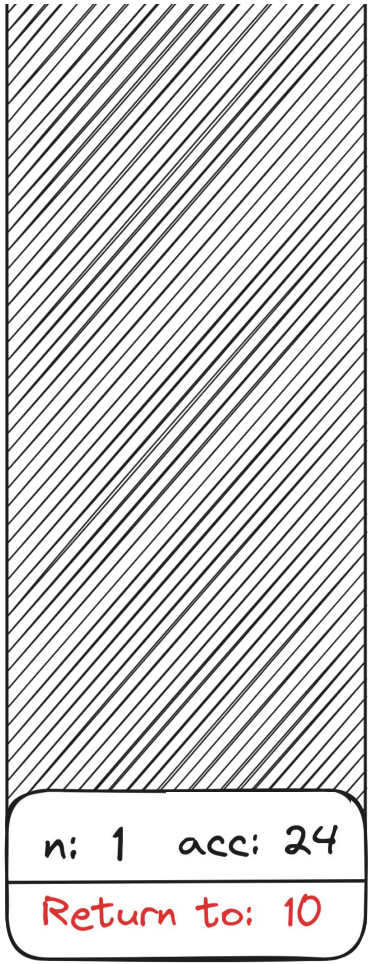
    }
20: return fact(n - 1, n * acc)
}
```

Execution:

```
10: fact(4, 1)
    ↳ fact(3, 4)
        ↳ fact(2, 12)
```



```
function fact(n, acc) {
    if (n == 0) {
        return acc
    }
20: return fact(n - 1, n * acc)
}
```



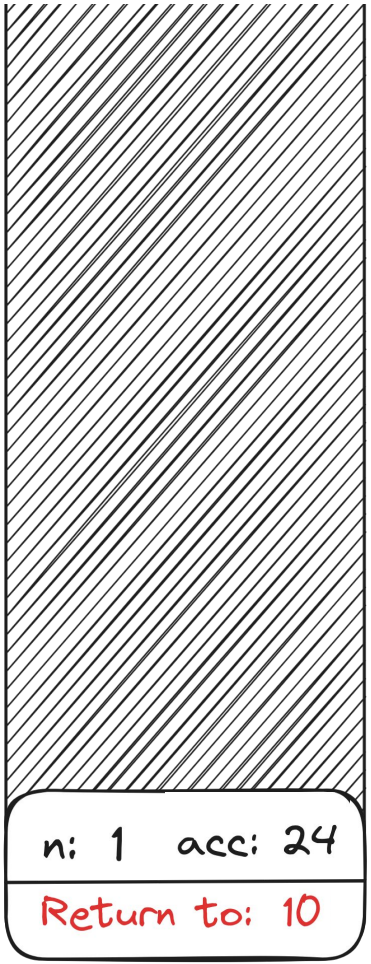
Execution:

```
10: fact(4, 1)
    ↳ fact(3, 4)
        ↳ fact(2, 12)
            ↳ fact(1, 24)
```

```
function fact(n, acc) {
    if (n == 0) {
        return acc
    }
20: return fact(n - 1, n * acc)
}
```

Execution:

```
10: fact(4, 1)
    ↳ fact(3, 4)
        ↳ fact(2, 12)
            ↳ fact(1, 24)
```



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    if (n == 0) {
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    }
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}
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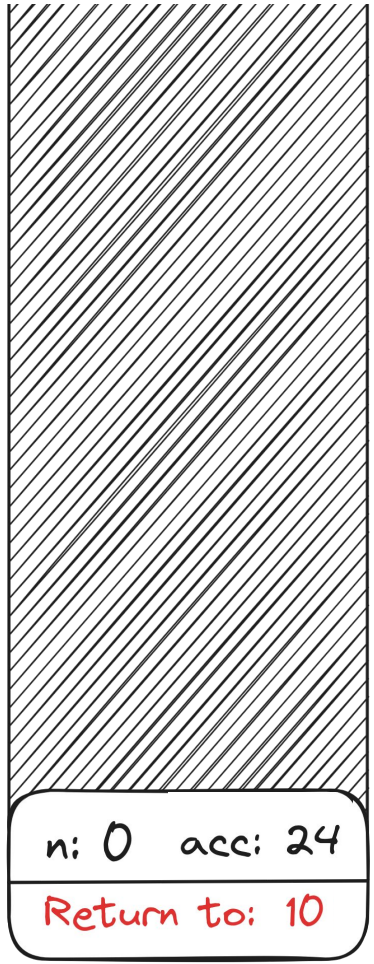


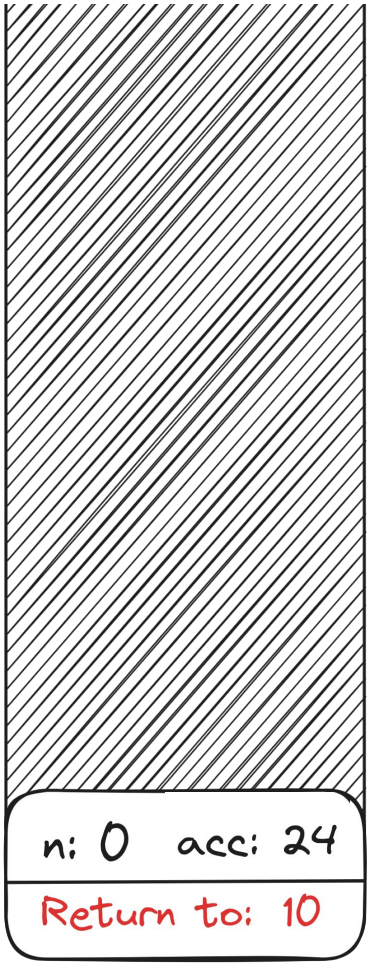
Execution:

```
10: fact(4, 1)
    ↳ fact(3, 4)
        ↳ fact(2, 12)
            ↳ fact(1, 24)
                ↳ fact(0, 24)
```

```
function fact(n, acc) {
    if (n == 0) {
        return acc
    }
20: return fact(n - 1, n * acc)
}
```

Execution:

```
10: fact(4, 1)
    ↳ fact(3, 4)
        ↳ fact(2, 12)
            ↳ fact(1, 24)
                ↳ fact(0, 24) = 24
```



```
function fact(n, acc) {
    if (n == 0) {
        return acc
    }
20:  return fact(n - 1, n * acc)
}
```

Execution:

10: **24**