Recursive Function Call Stack

Supplement to Recursion lecture

Tracing the Call Stack

Start with the original function call at the bottom of the stack.

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def addCards(cards):
    if cards == [ ]:
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        smallerProblem = cards[1:]
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addCards([5, 2, 7, 3])
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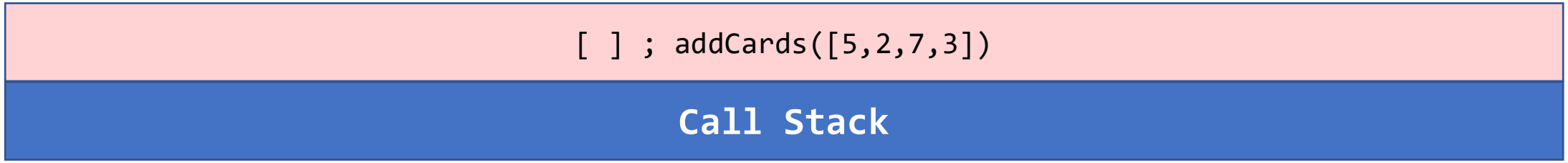

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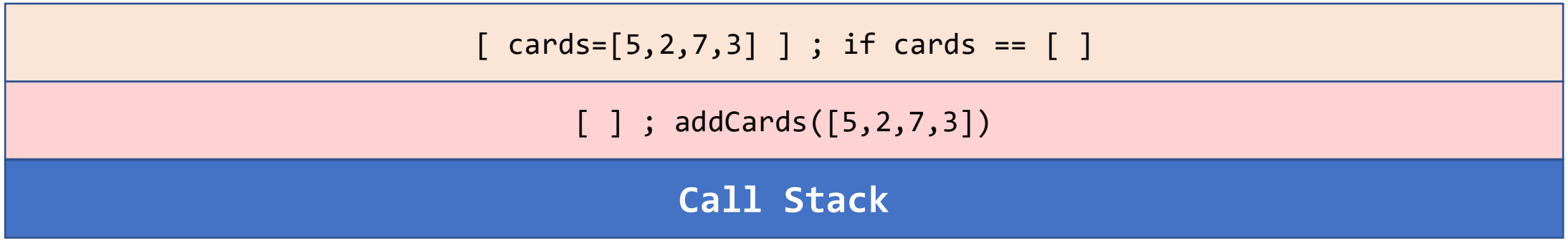

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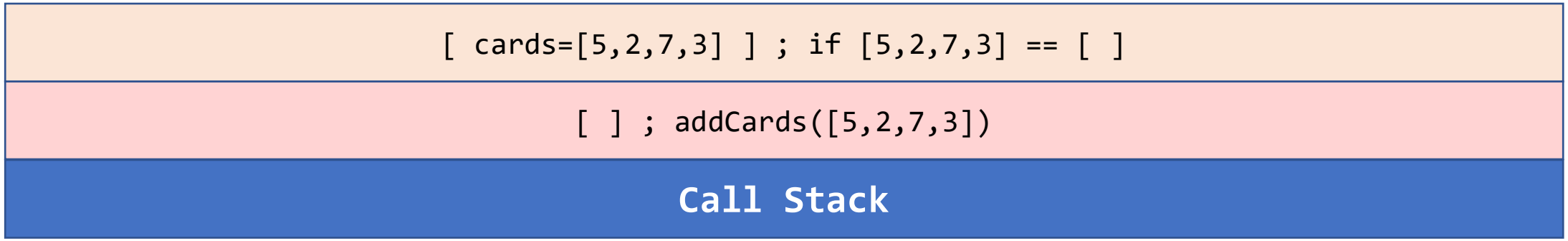

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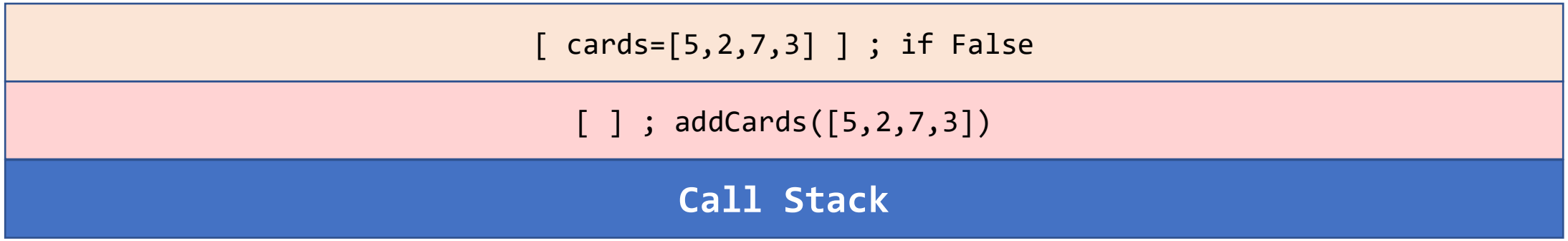

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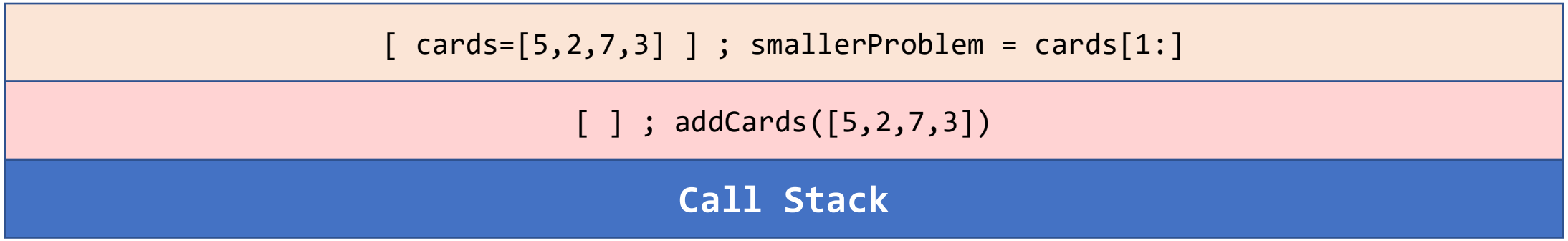

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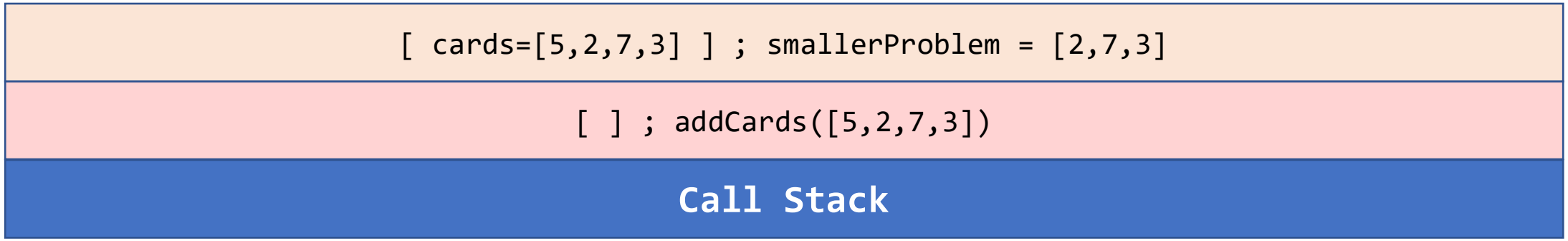

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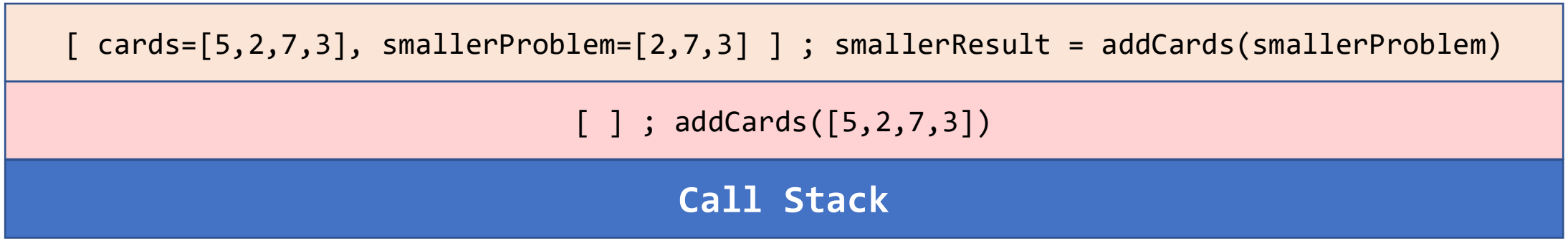

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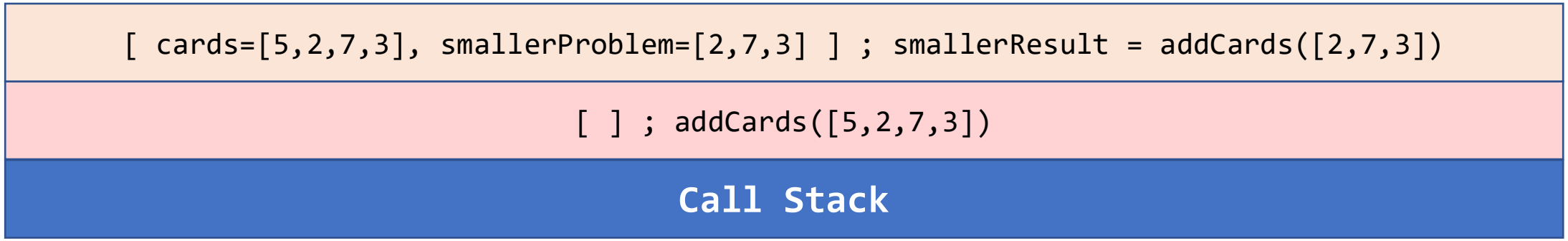

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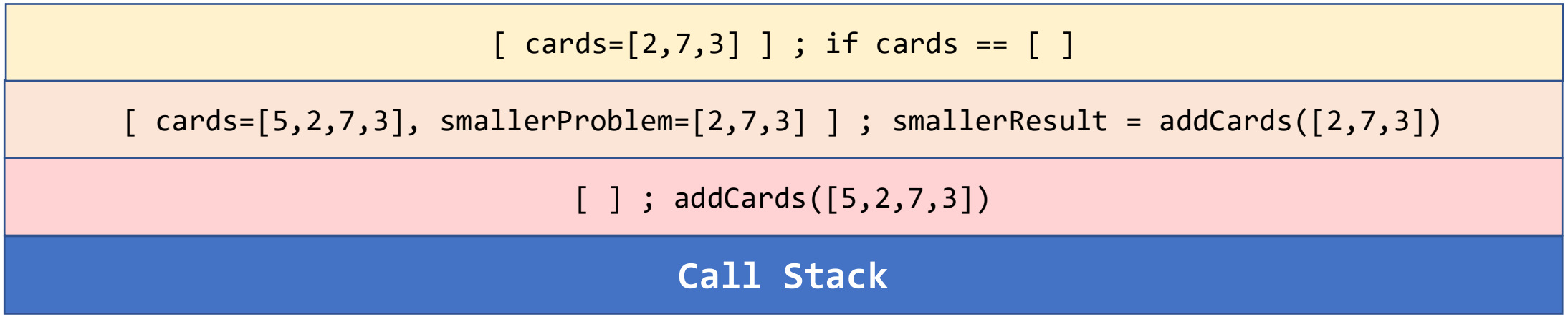

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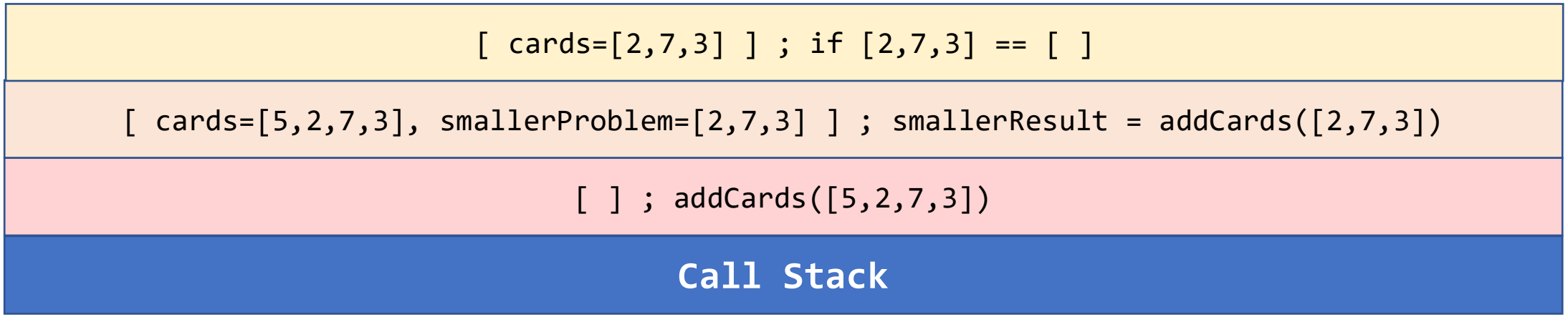

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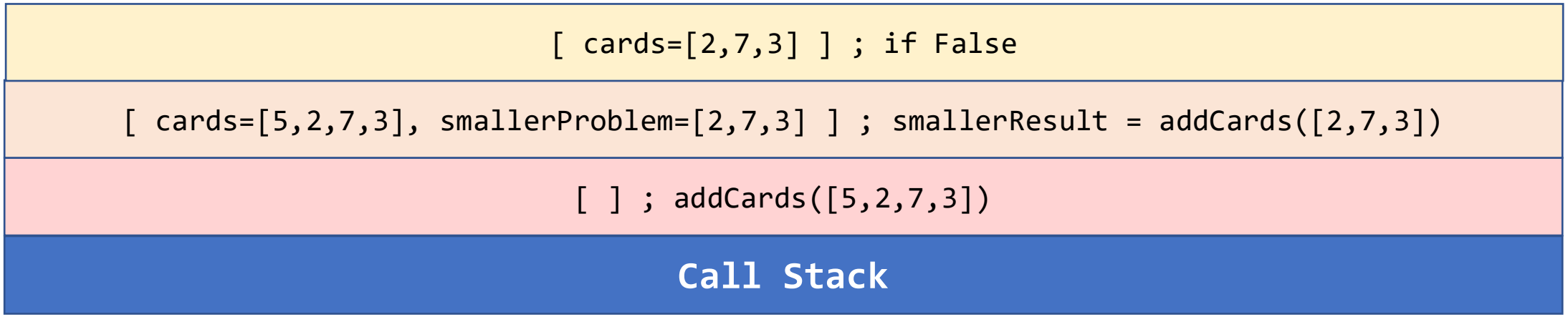

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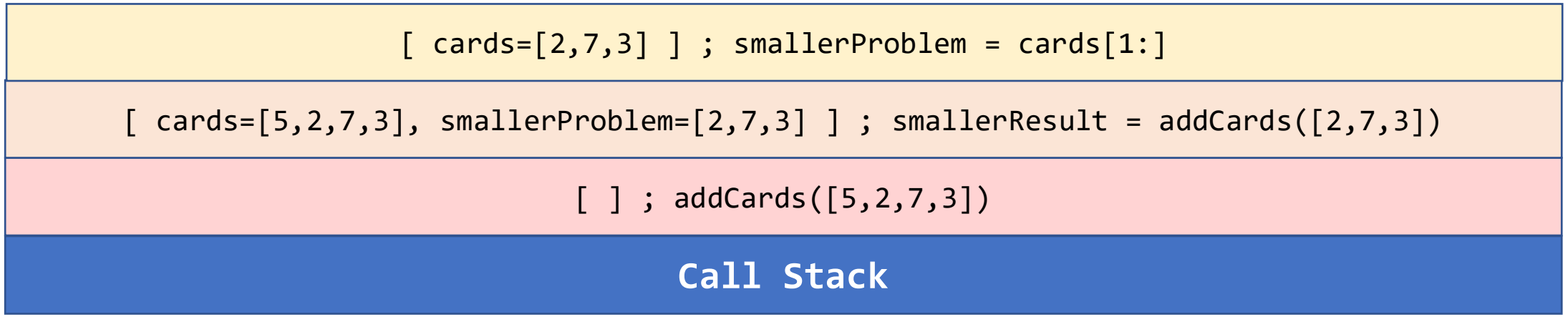

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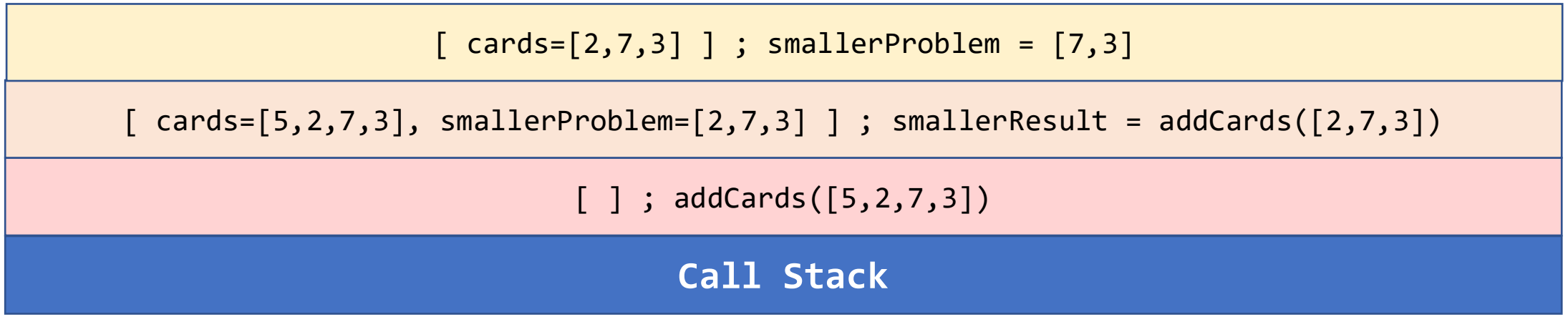

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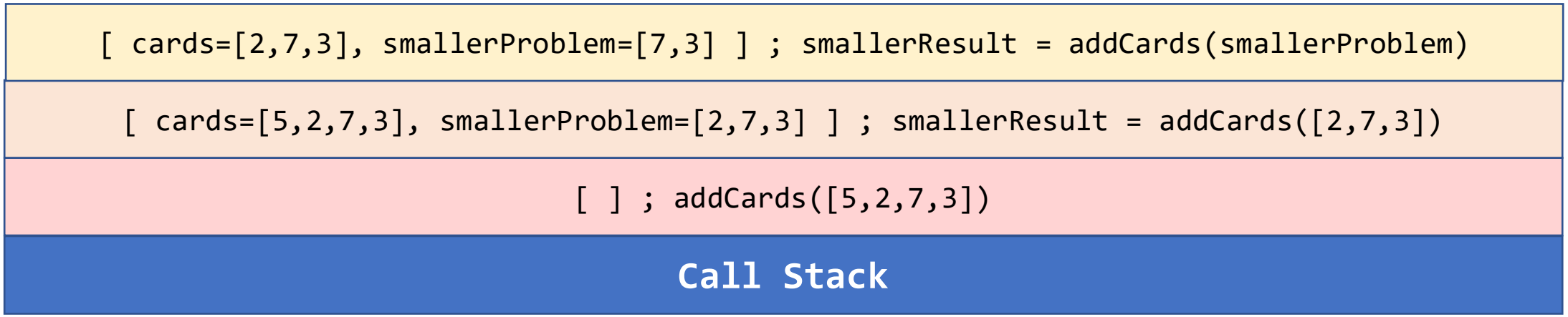

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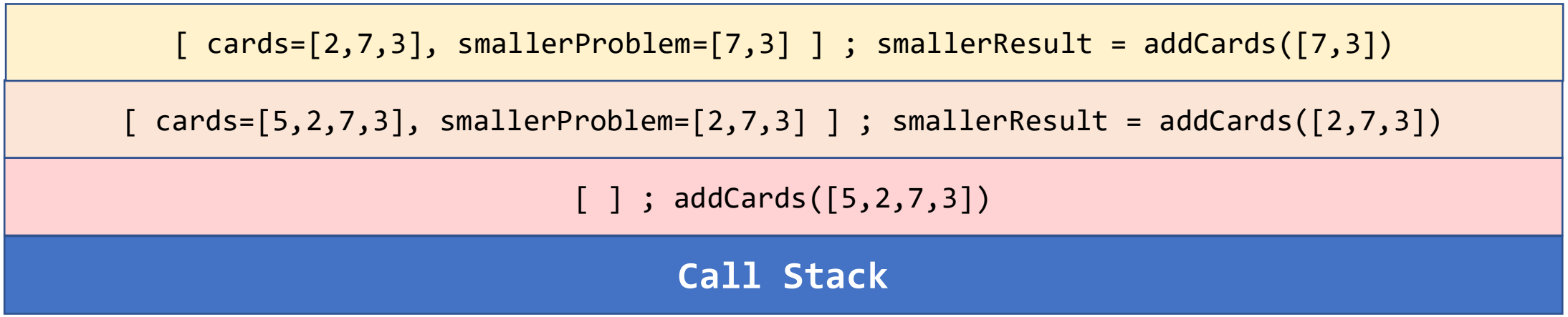

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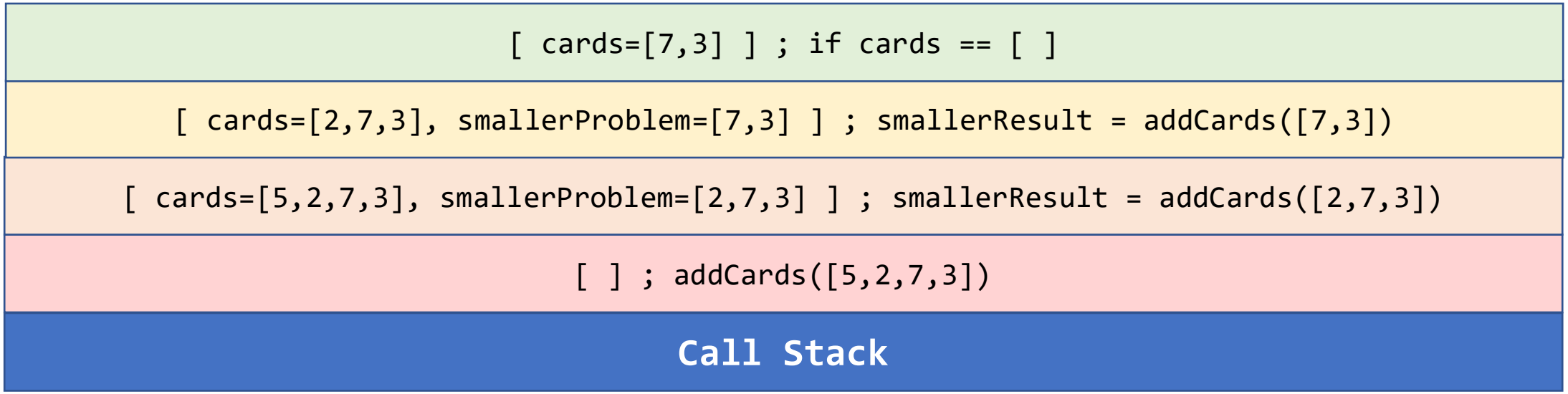

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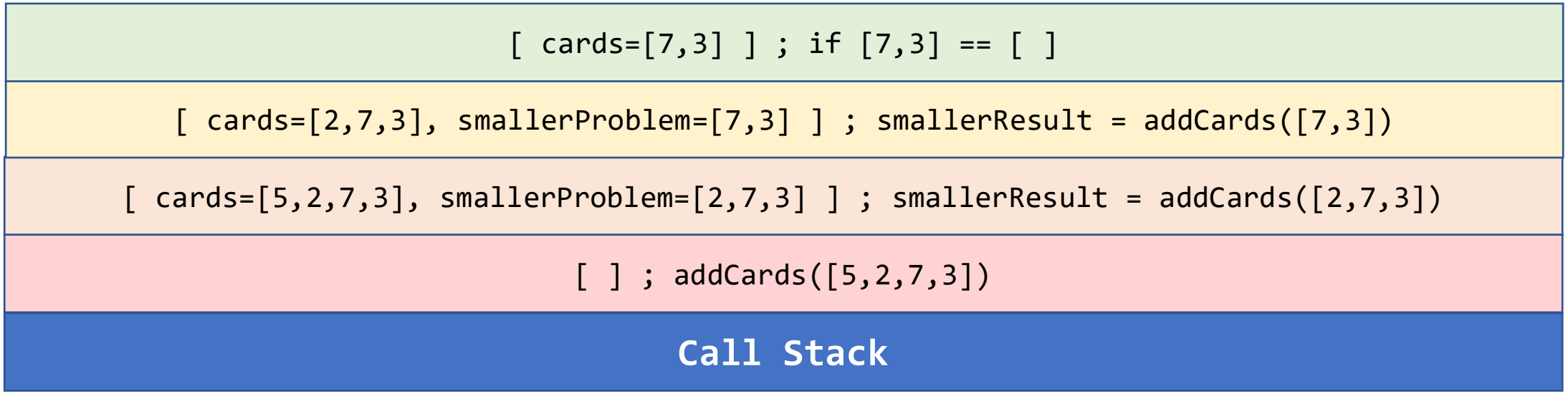

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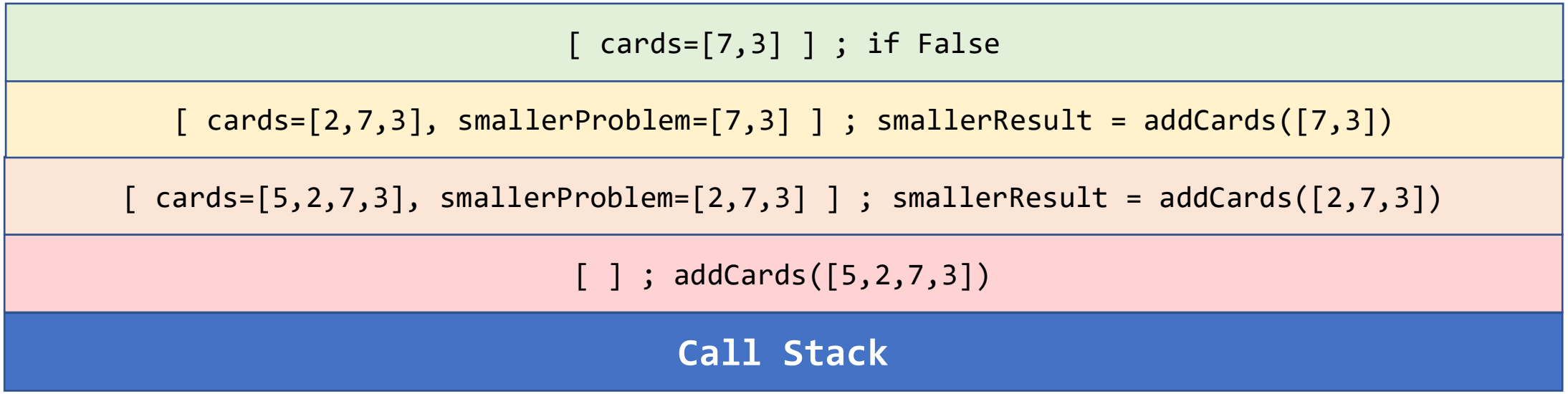

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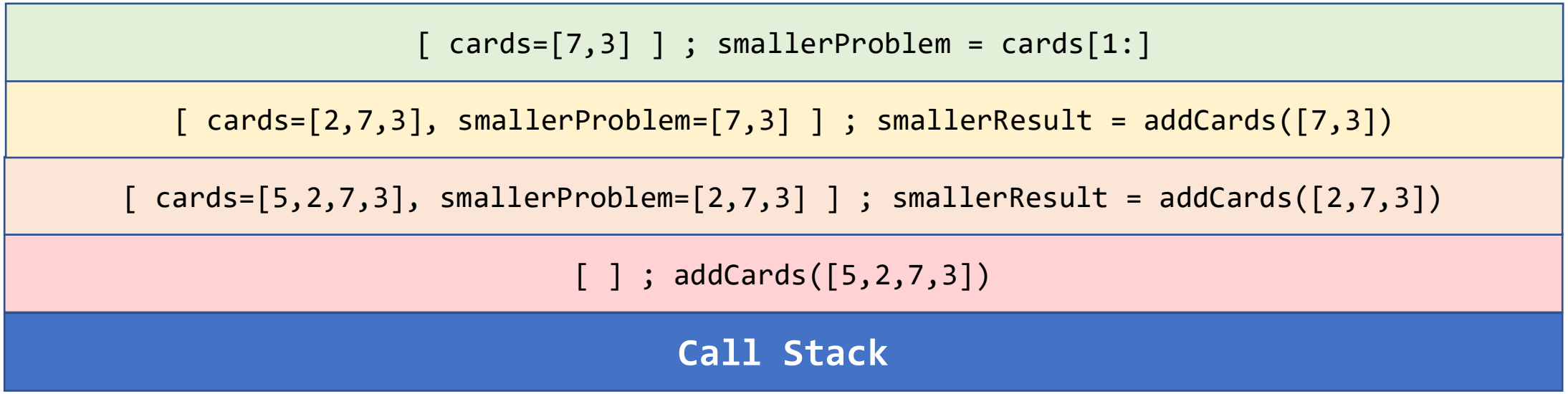

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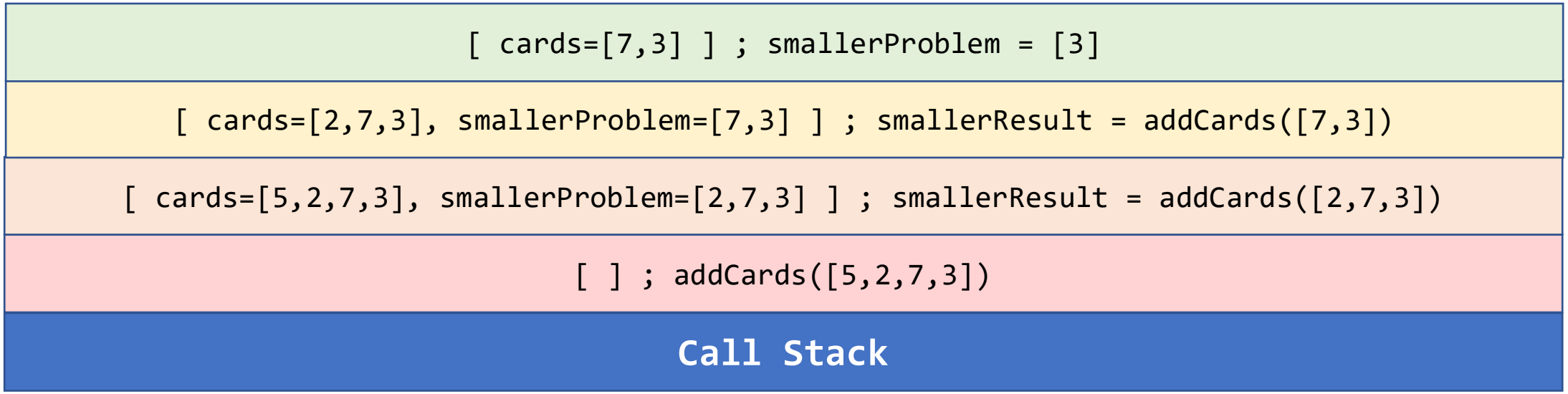

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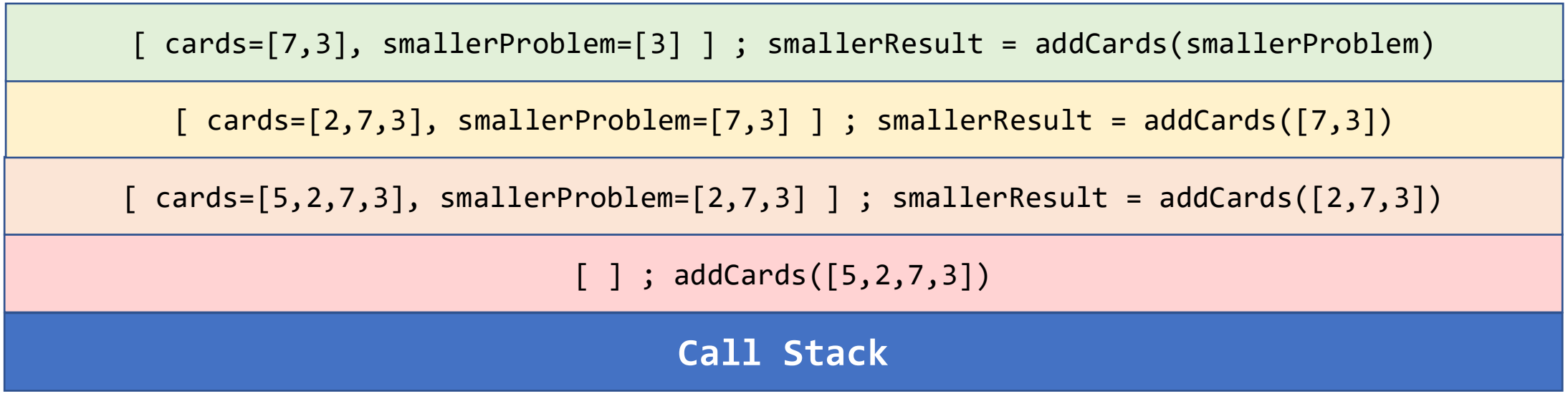

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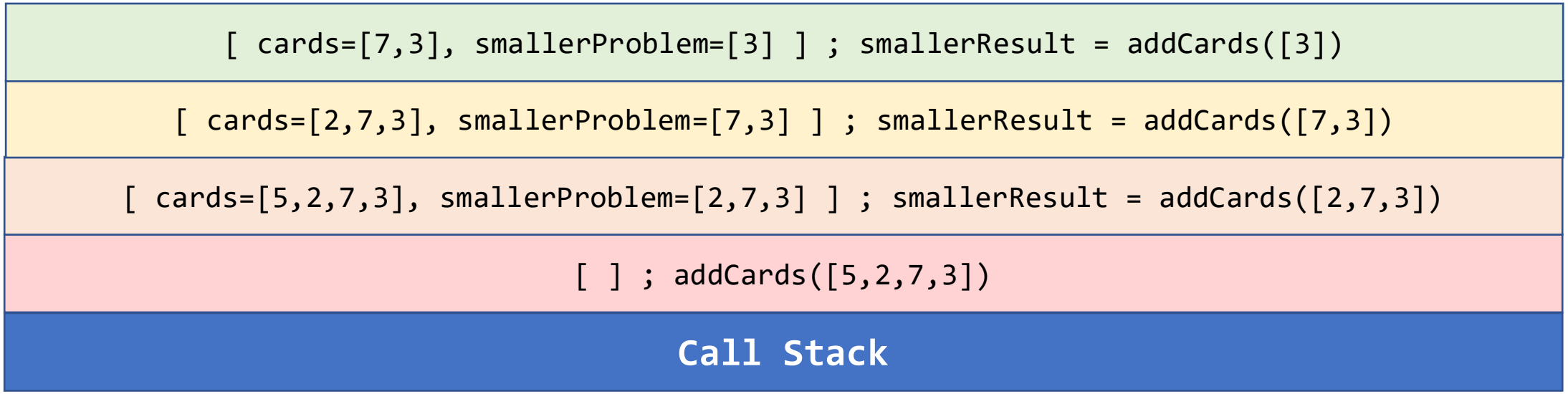

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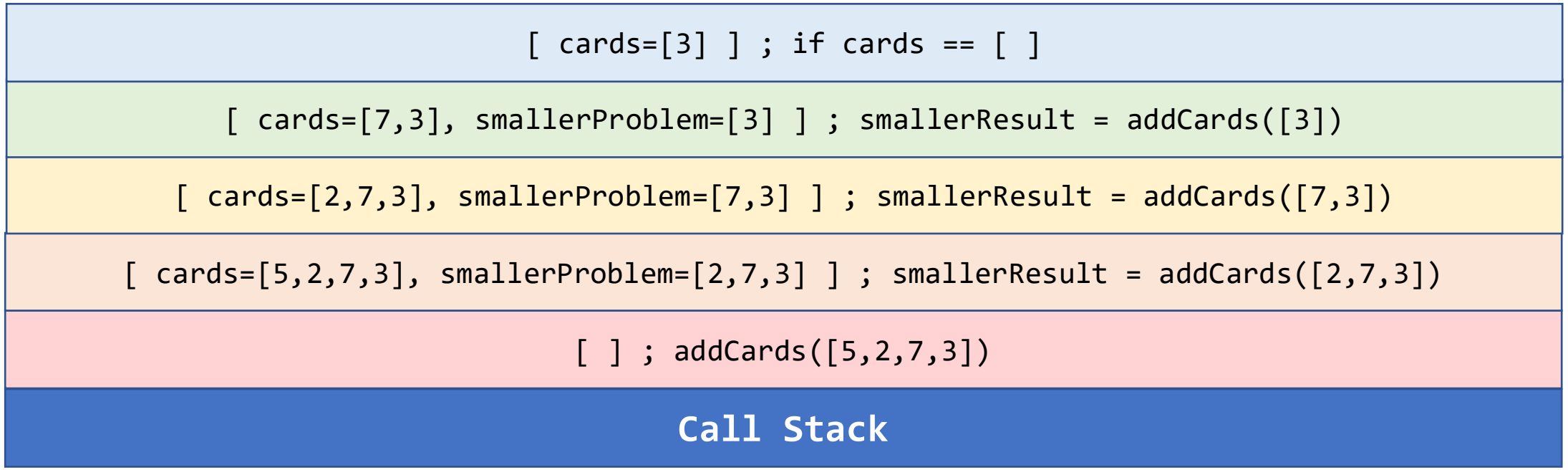

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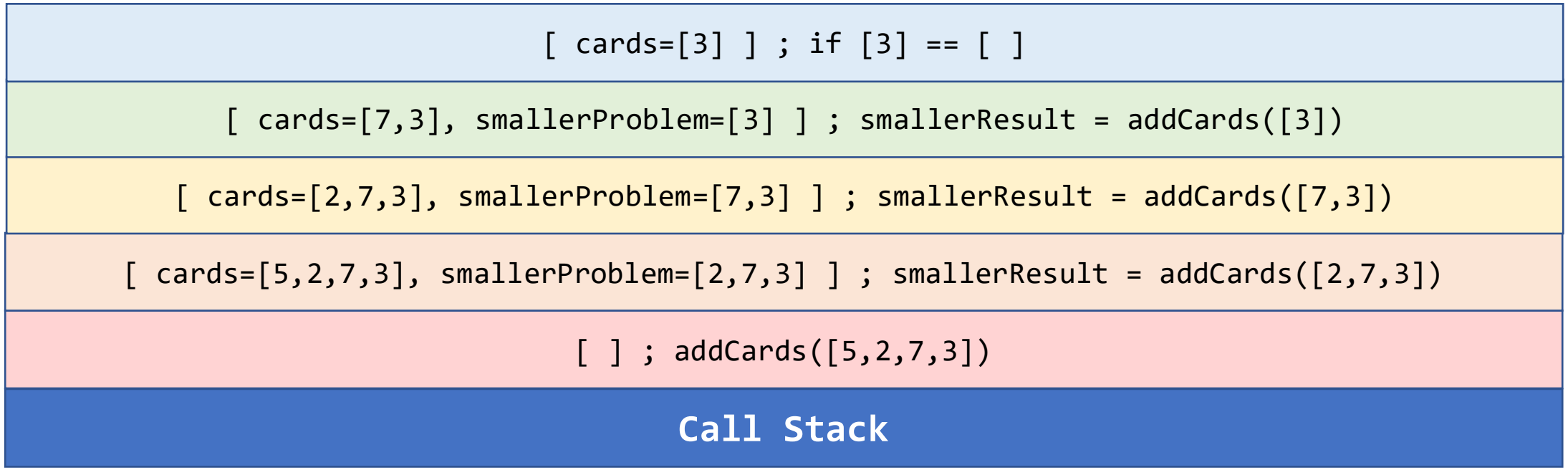

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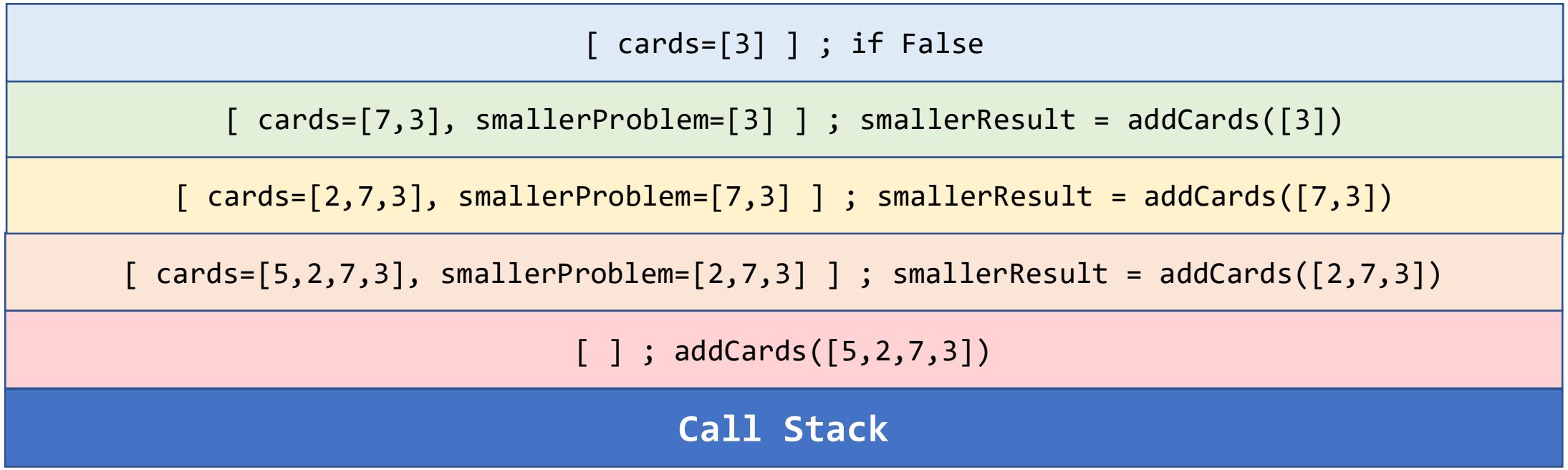

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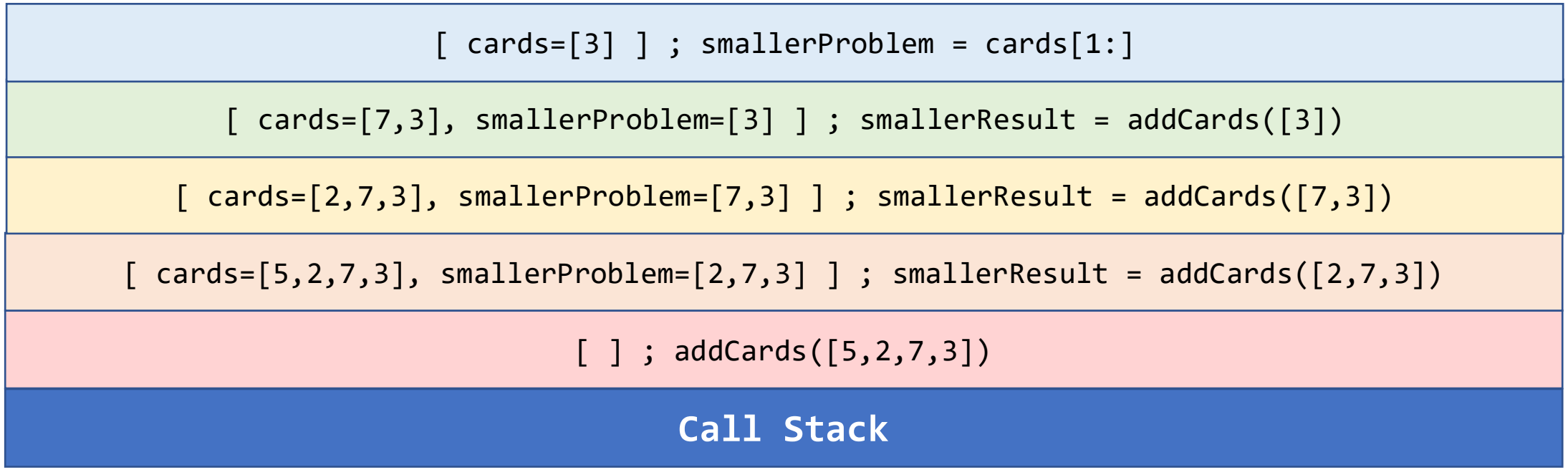

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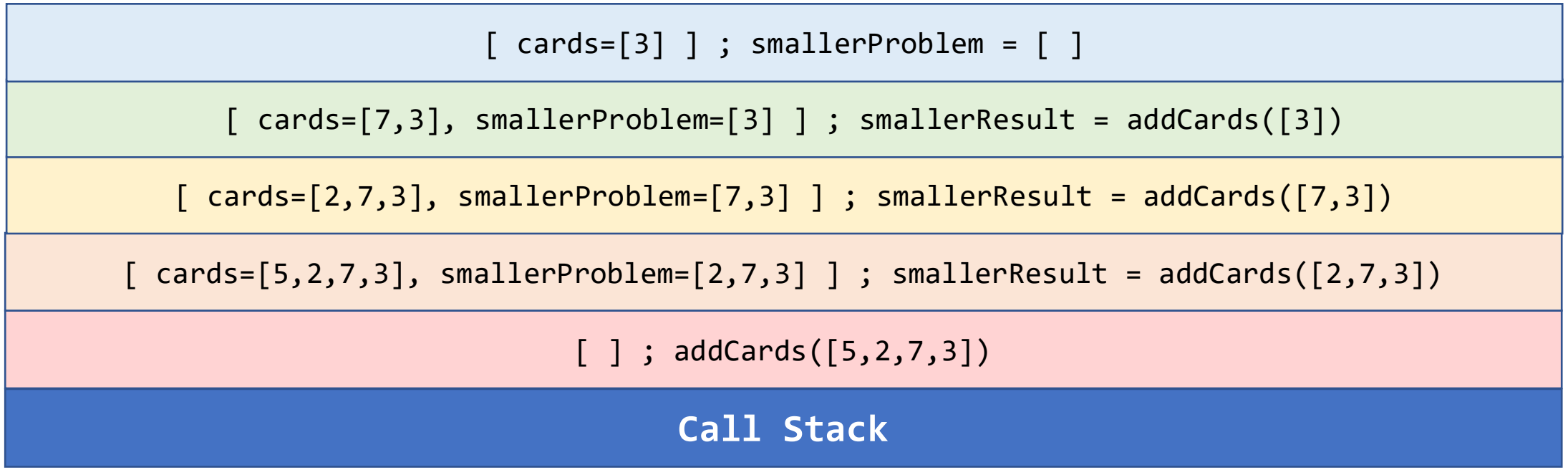

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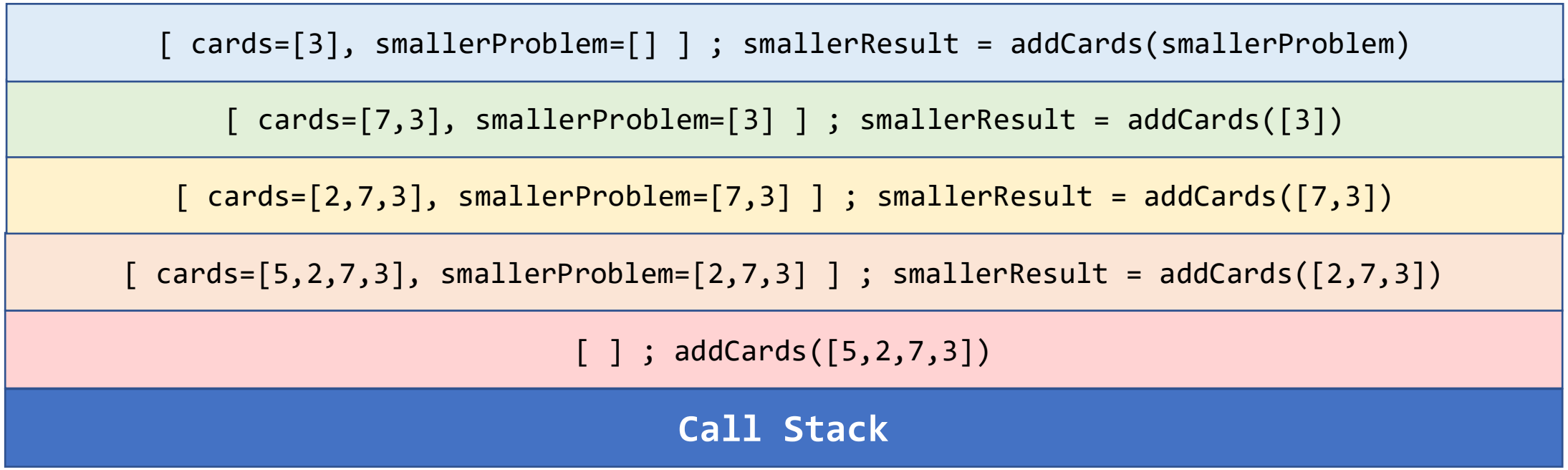

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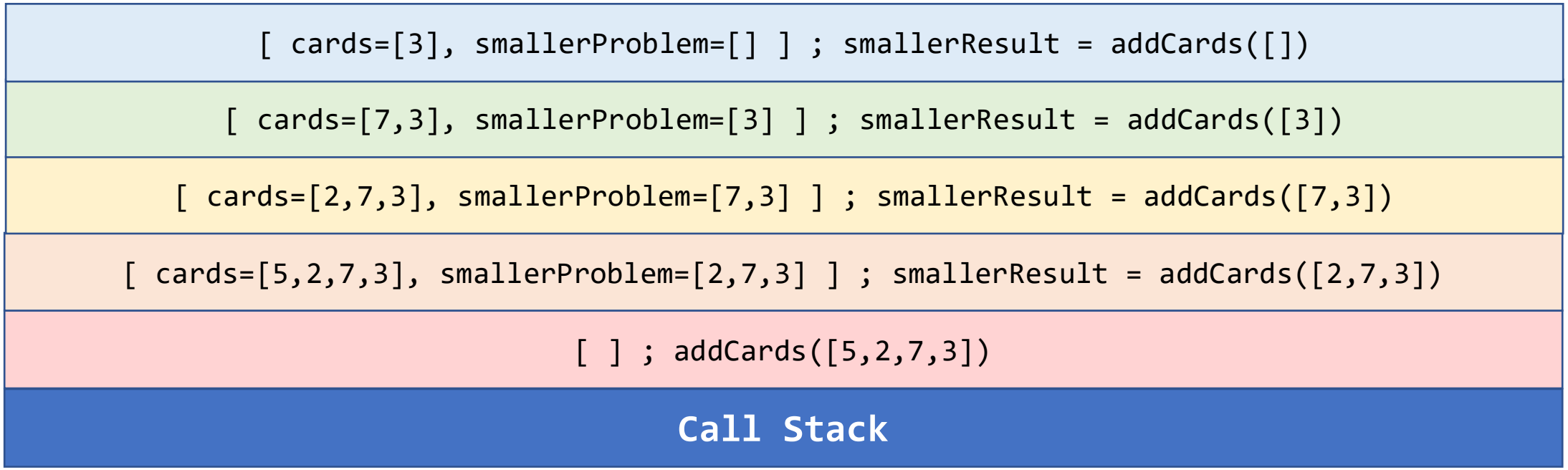

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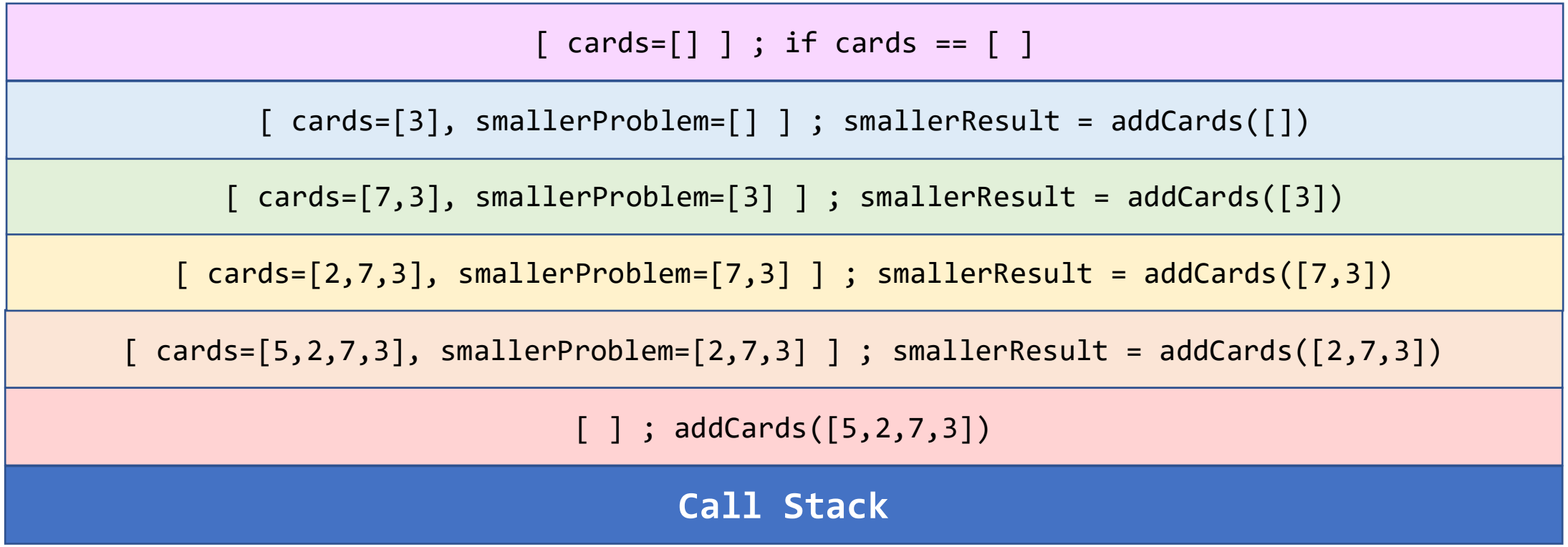

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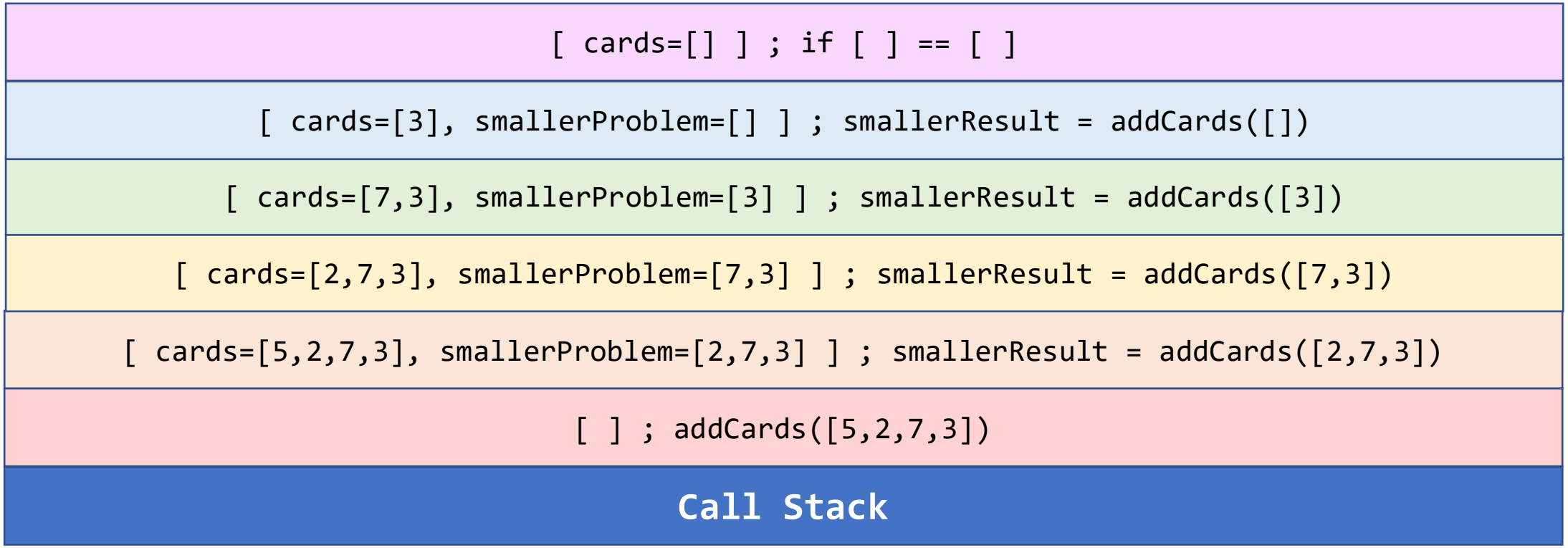

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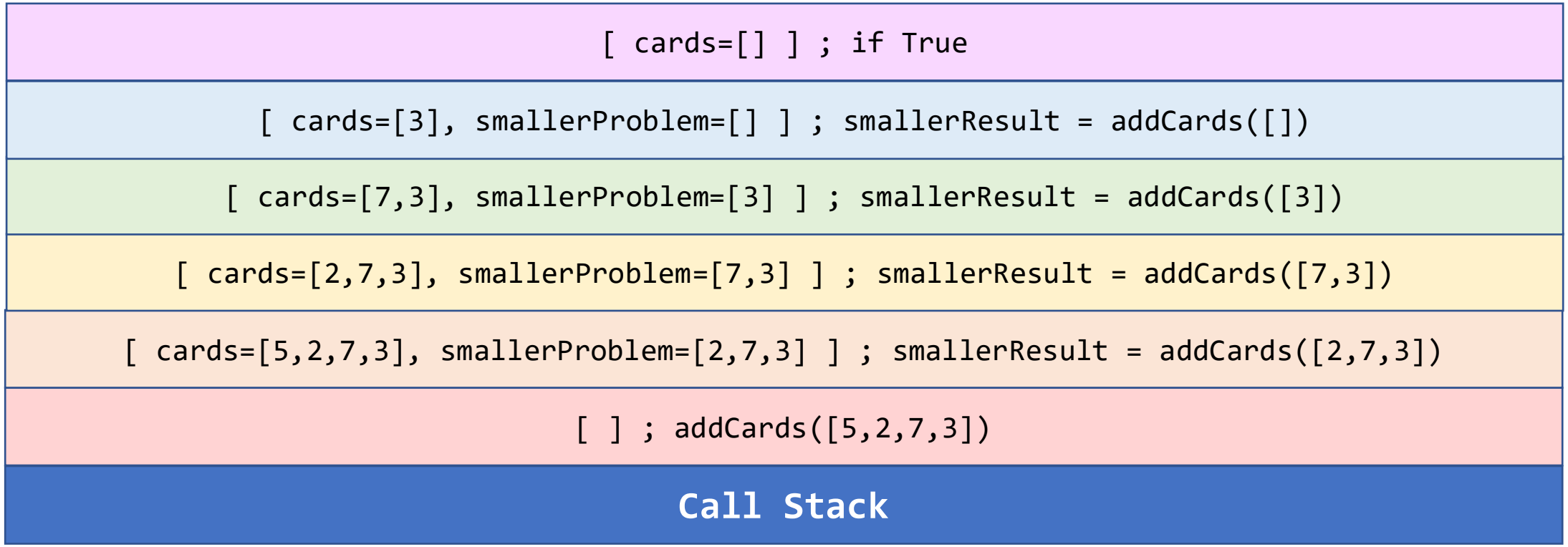

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We can immediately return 0 to the next layer of the stack- the **4th call**.

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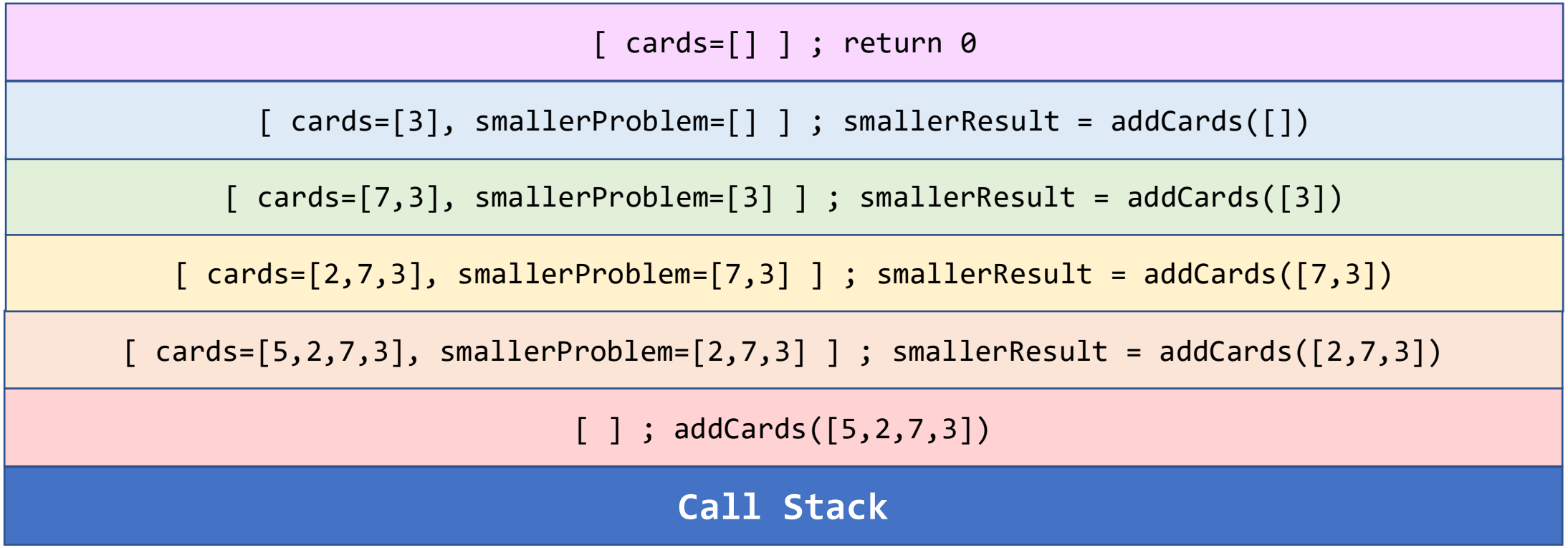
```

5th call



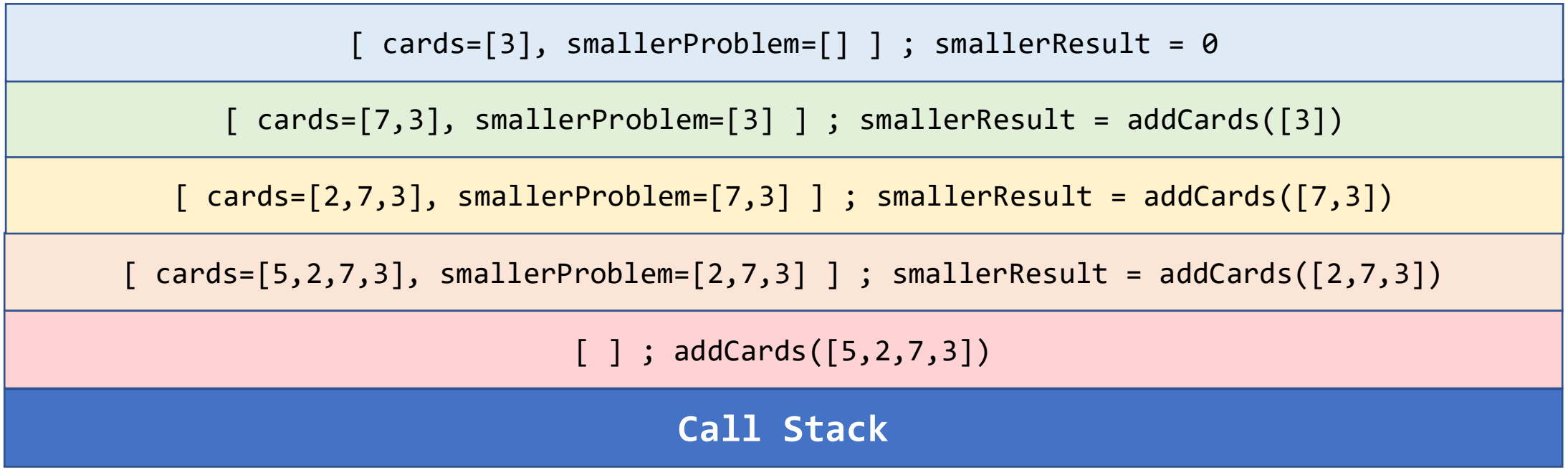
Tracing the Call Stack

```
def addCards(cards):
    if cards == [ ]:
        return 0
    else:
        smallerProblem = cards[1:]
        smallerResult = addCards(smallerProblem)
        return cards[0] + smallerResult

addCards([5, 2, 7, 3])
```

4th call

Back in the 4th call, the returned value takes the place of the function call, and a new var is saved.



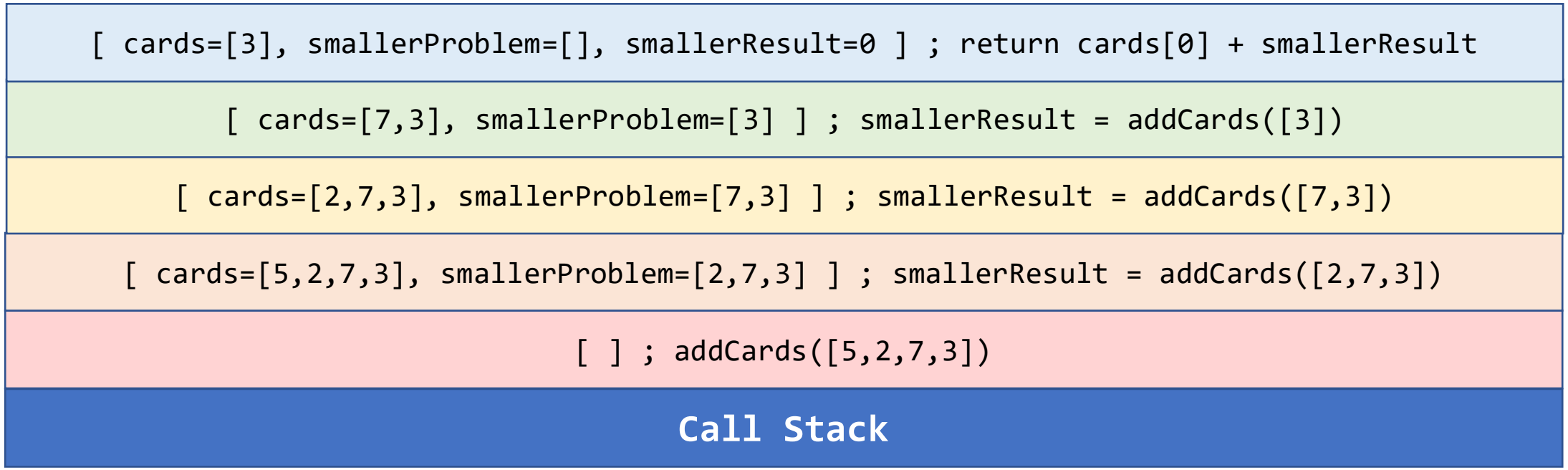
Tracing the Call Stack

Look up the values in cards[0] and smallerResult, add them, and return the result to the next layer of the stack – the **3rd call**.

```
def addCards(cards):
    if cards == [ ]:
        return 0
    else:
        smallerProblem = cards[1:]
        smallerResult = addCards(smallerProblem)
        return cards[0] + smallerResult

addCards([5, 2, 7, 3])
```

4th call



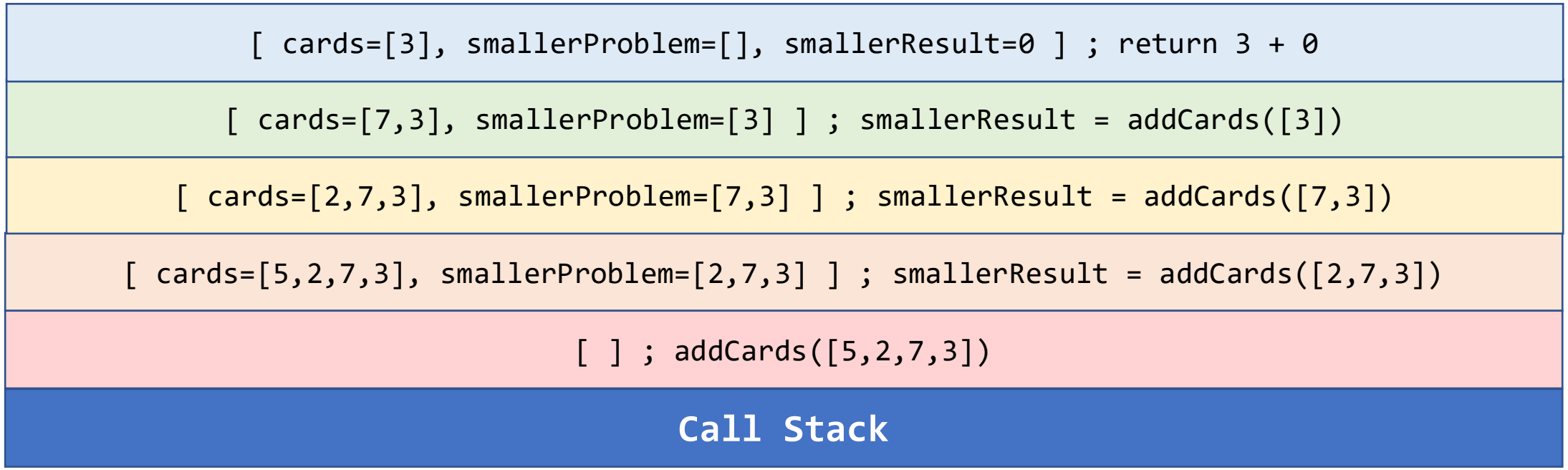
Tracing the Call Stack

Look up the values in cards[0] and smallerResult, add them, and return the result to the next layer of the stack – the **3rd call**.

```
def addCards(cards):
    if cards == [ ]:
        return 0
    else:
        smallerProblem = cards[1:]
        smallerResult = addCards(smallerProblem)
        return cards[0] + smallerResult

addCards([5, 2, 7, 3])
```

4th call



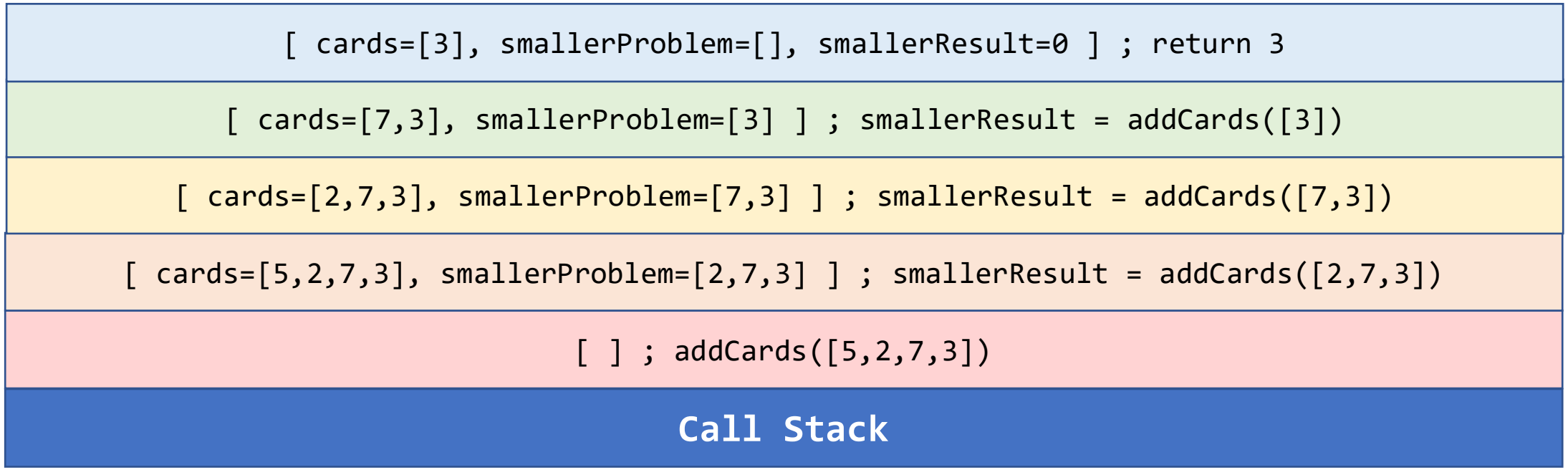
Tracing the Call Stack

Look up the values in cards[0] and smallerResult, add them, and return the result to the next layer of the stack – the **3rd call**.

```
def addCards(cards):
    if cards == [ ]:
        return 0
    else:
        smallerProblem = cards[1:]
        smallerResult = addCards(smallerProblem)
        return cards[0] + smallerResult

addCards([5, 2, 7, 3])
```

4th call



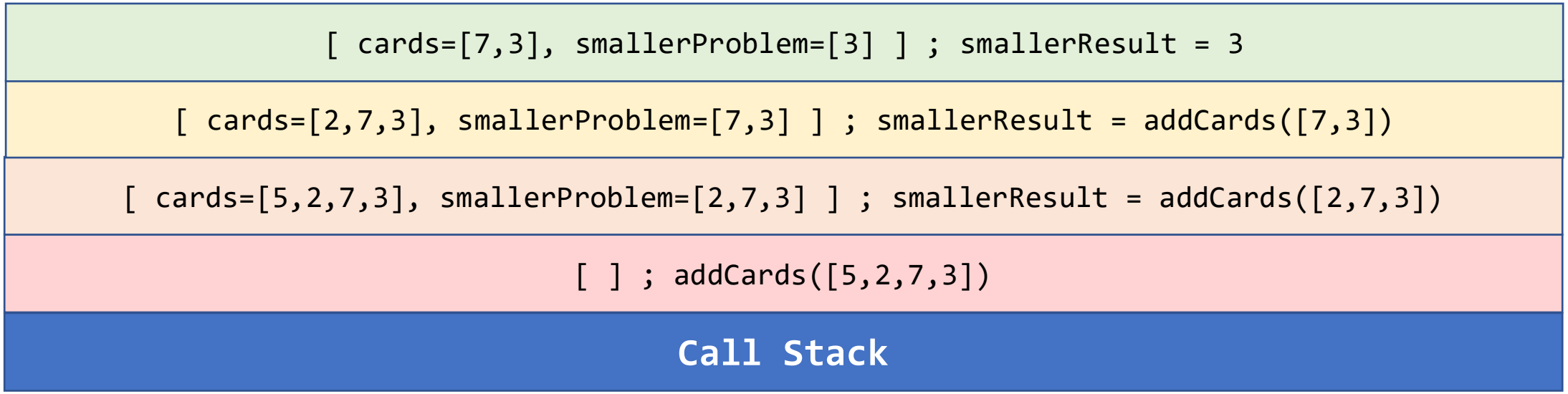
Tracing the Call Stack

Back in the 3rd call, the returned value takes the place of the function call, and a new var is saved.

```
def addCards(cards):
    if cards == [ ]:
        return 0
    else:
        smallerProblem = cards[1:]
        smallerResult = addCards(smallerProblem)
        return cards[0] + smallerResult

addCards([5, 2, 7, 3])
```

3rd call



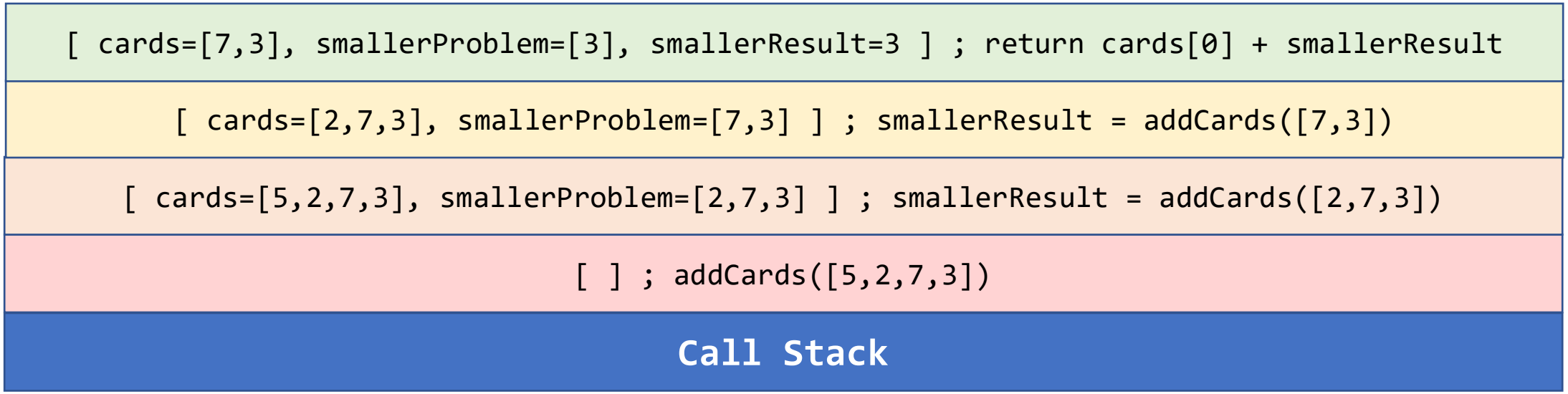
Tracing the Call Stack

Look up the values in cards[0] and smallerResult, add them, and return the result to the next layer of the stack – the **2nd call**.

```
def addCards(cards):
    if cards == [ ]:
        return 0
    else:
        smallerProblem = cards[1:]
        smallerResult = addCards(smallerProblem)
        return cards[0] + smallerResult

addCards([5, 2, 7, 3])
```

3rd call



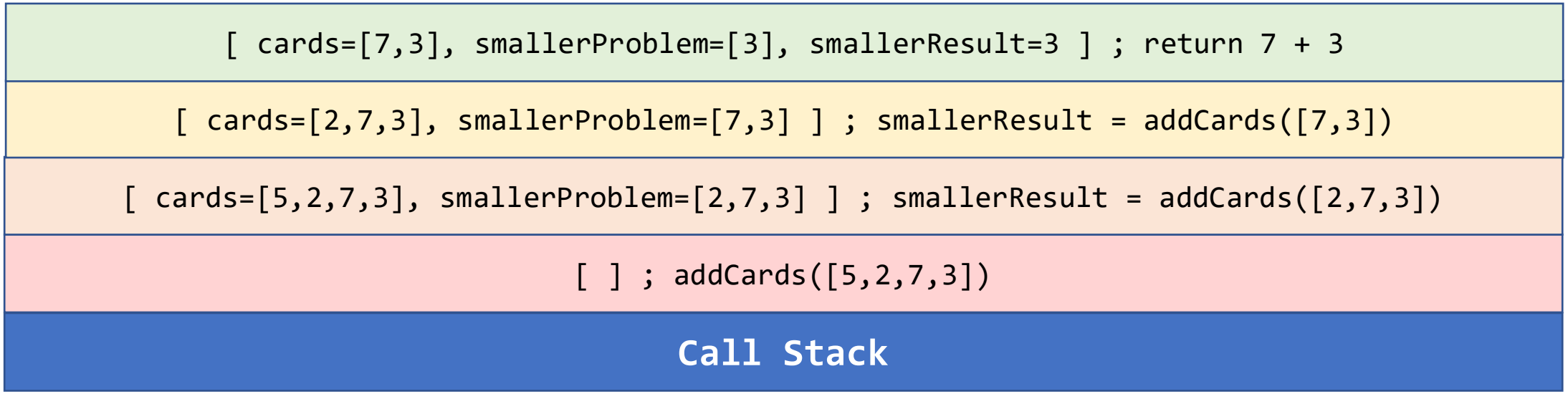
Tracing the Call Stack

Look up the values in cards[0] and smallerResult, add them, and return the result to the next layer of the stack – the **2nd call**.

```
def addCards(cards):
    if cards == [ ]:
        return 0
    else:
        smallerProblem = cards[1:]
        smallerResult = addCards(smallerProblem)
        return cards[0] + smallerResult

addCards([5, 2, 7, 3])
```

3rd call



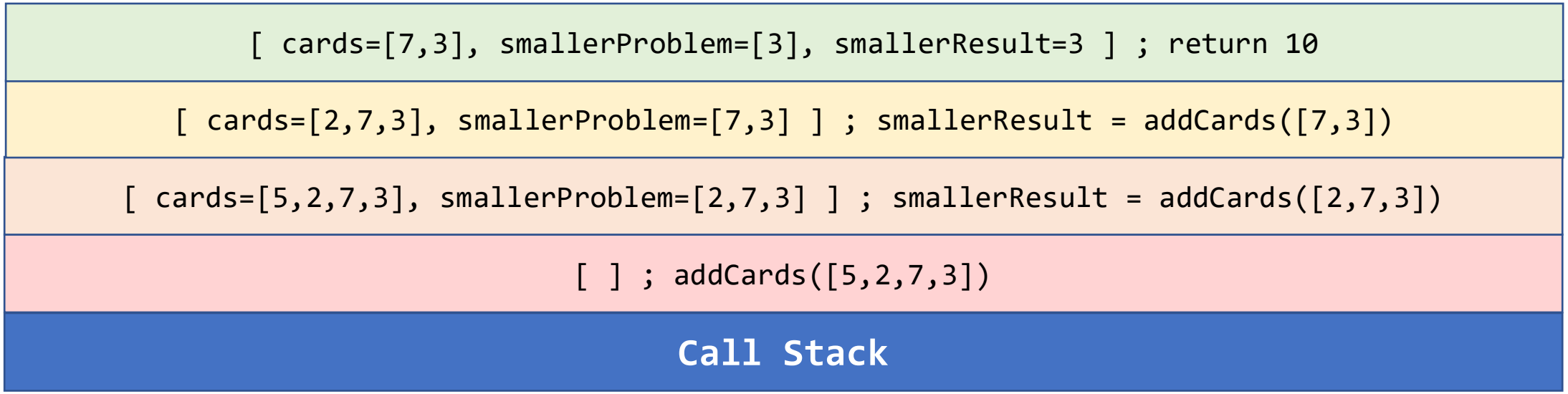
Tracing the Call Stack

Look up the values in cards[0] and smallerResult, add them, and return the result to the next layer of the stack – the **2nd call**.

```
def addCards(cards):
    if cards == [ ]:
        return 0
    else:
        smallerProblem = cards[1:]
        smallerResult = addCards(smallerProblem)
        return cards[0] + smallerResult

addCards([5, 2, 7, 3])
```

3rd call



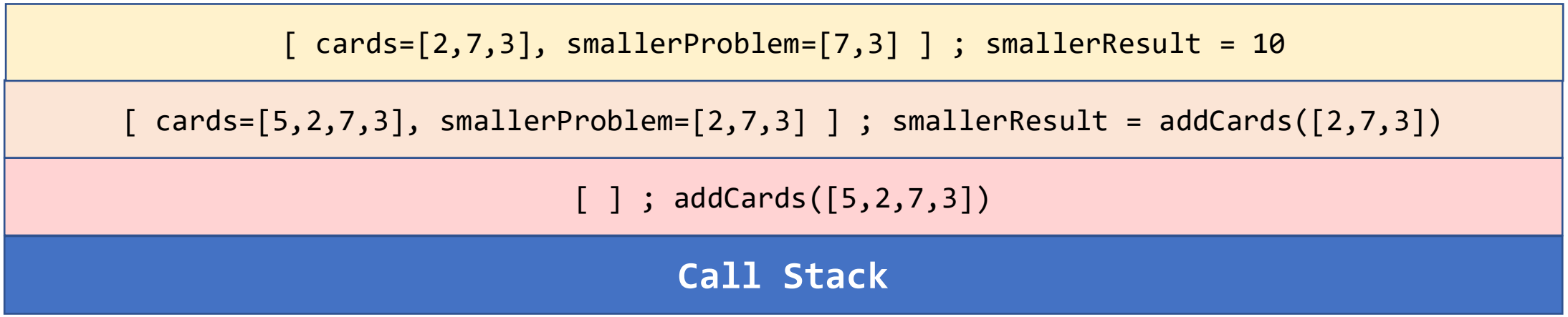
Tracing the Call Stack

Back in the 2nd call, the returned value takes the place of the function call, and a new var is saved.

```
def addCards(cards):
    if cards == [ ]:
        return 0
    else:
        smallerProblem = cards[1:]
        smallerResult = addCards(smallerProblem)
        return cards[0] + smallerResult

addCards([5, 2, 7, 3])
```

2nd call



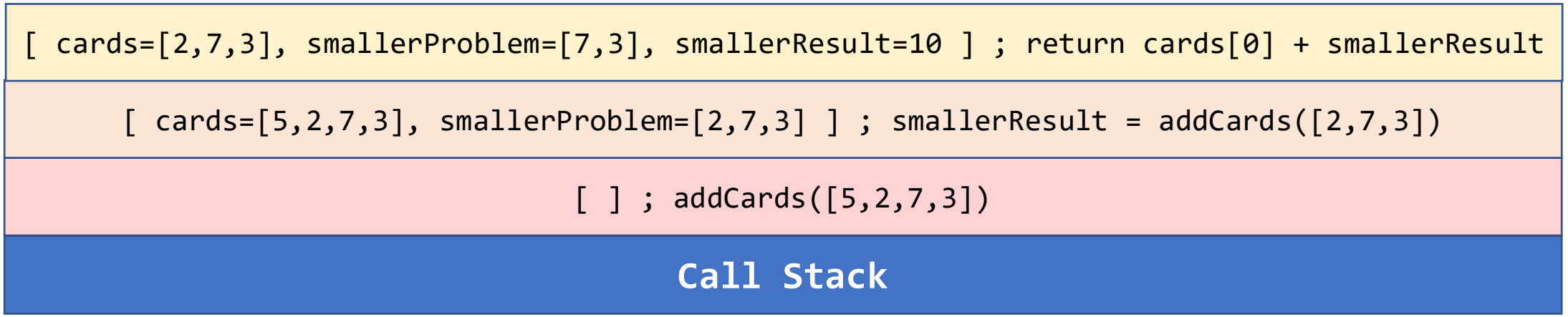
Tracing the Call Stack

Look up the values in cards[0] and smallerResult, add them, and return the result to the next layer of the stack – the **1st call**.

```
def addCards(cards):
    if cards == [ ]:
        return 0
    else:
        smallerProblem = cards[1:]
        smallerResult = addCards(smallerProblem)
        return cards[0] + smallerResult

addCards([5, 2, 7, 3])
```

2nd call



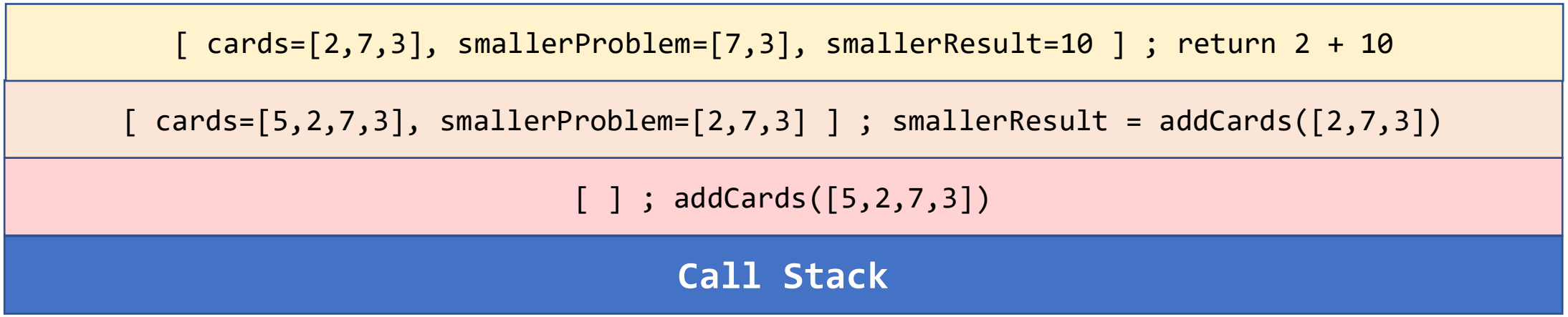
Tracing the Call Stack

Look up the values in cards[0] and smallerResult, add them, and return the result to the next layer of the stack – the **1st call**.

```
def addCards(cards):
    if cards == [ ]:
        return 0
    else:
        smallerProblem = cards[1:]
        smallerResult = addCards(smallerProblem)
        return cards[0] + smallerResult

addCards([5, 2, 7, 3])
```

2nd call



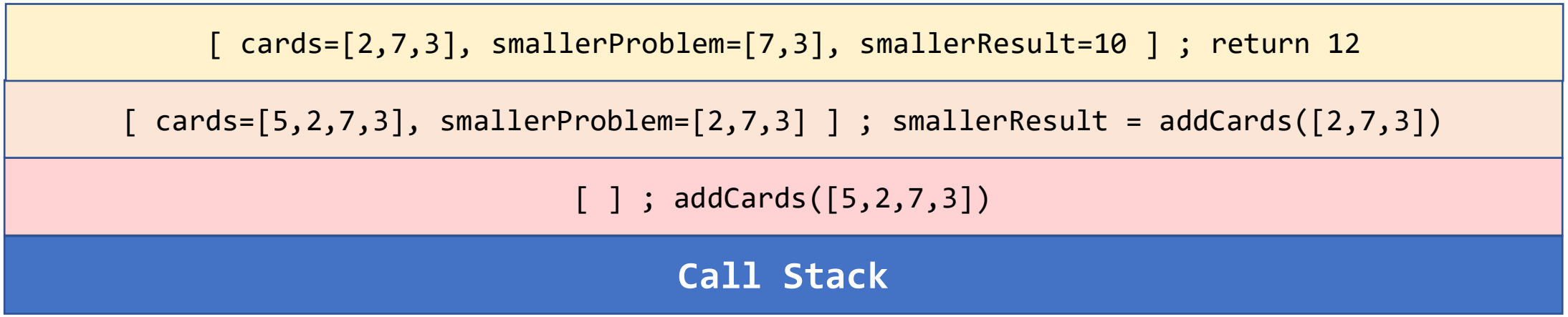
Tracing the Call Stack

Look up the values in cards[0] and smallerResult, add them, and return the result to the next layer of the stack – the **1st call**.

```
def addCards(cards):
    if cards == [ ]:
        return 0
    else:
        smallerProblem = cards[1:]
        smallerResult = addCards(smallerProblem)
        return cards[0] + smallerResult

addCards([5, 2, 7, 3])
```

2nd call



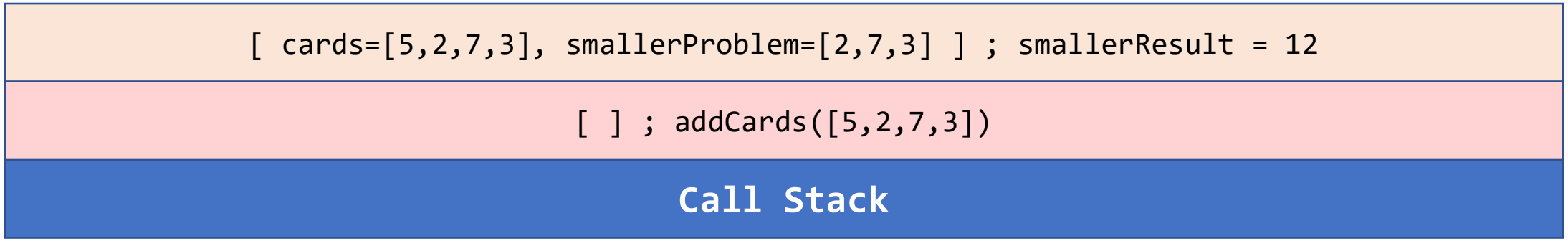
Tracing the Call Stack

Back in the 1st call, the returned value takes the place of the function call, and a new var is saved.

```
def addCards(cards):
    if cards == [ ]:
        return 0
    else:
        smallerProblem = cards[1:]
        smallerResult = addCards(smallerProblem)
        return cards[0] + smallerResult

addCards([5, 2, 7, 3])
```

1st call



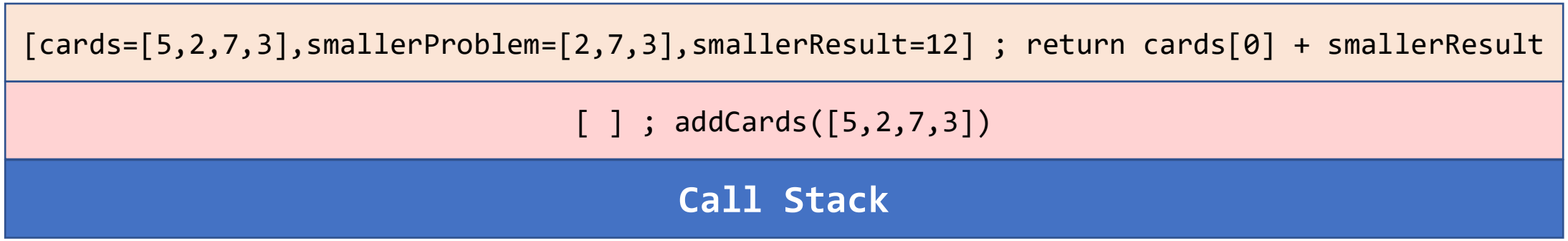
Tracing the Call Stack

Look up the values in cards[0] and smallerResult, add them, and return the result to the next layer of the stack – the **original call**.

```
def addCards(cards):
    if cards == [ ]:
        return 0
    else:
        smallerProblem = cards[1:]
        smallerResult = addCards(smallerProblem)
        return cards[0] + smallerResult

addCards([5, 2, 7, 3])
```

1st call



Tracing the Call Stack

Look up the values in cards[0] and smallerResult, add them, and return the result to the next layer of the stack – the **original call**.

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def addCards(cards):
    if cards == [ ]:
        return 0
    else:
        smallerProblem = cards[1:]
        smallerResult = addCards(smallerProblem)
        return cards[0] + smallerResult

addCards([5, 2, 7, 3])
```
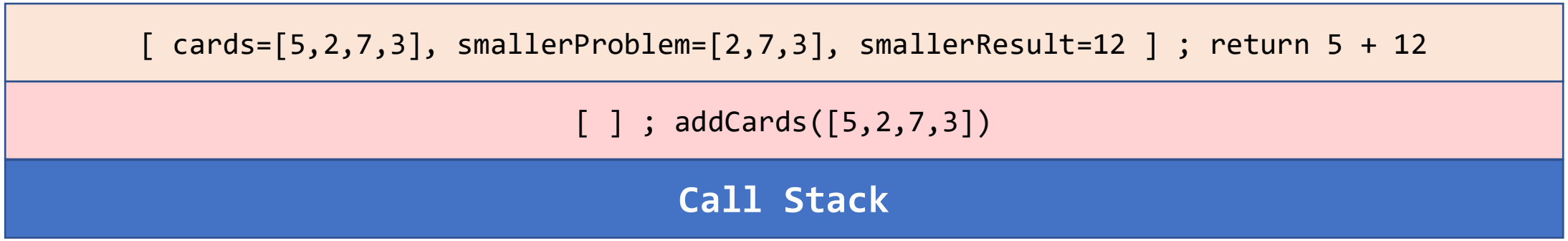

1st call

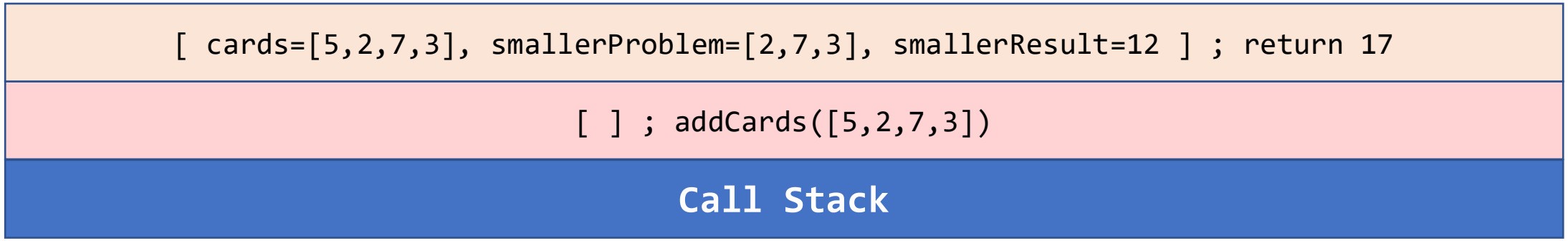


Tracing the Call Stack

Look up the values in cards[0] and smallerResult, add them, and return the result to the next layer of the stack – the **original call**.

```
def addCards(cards):
    if cards == [ ]:
        return 0
    else:
        smallerProblem = cards[1:]
        smallerResult = addCards(smallerProblem)
        return cards[0] + smallerResult

addCards([5, 2, 7, 3])
```

1st call



Tracing the Call Stack

We've finally finished making recursive calls, and we're done!

addCards([5, 2, 7, 2]) evaluates to 17.

```
def addCards(cards):
    if cards == [ ]:
        return 0
    else:
        smallerProblem = cards[1:]
        smallerResult = addCards(smallerProblem)
        return cards[0] + smallerResult

addCards([5, 2, 7, 3])
```

done!