

# Stack and Heap memory

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# Overview

- 1 Stack and Heap
  - Stack
  - Heap

# Stack and Heap

C

- Memory model used so far is a simplification.
- Actually two places in memory that variables can go.
  - The stack and the heap.
- Both are just regions of the same physical memory.
  - Are managed differently.

# The stack

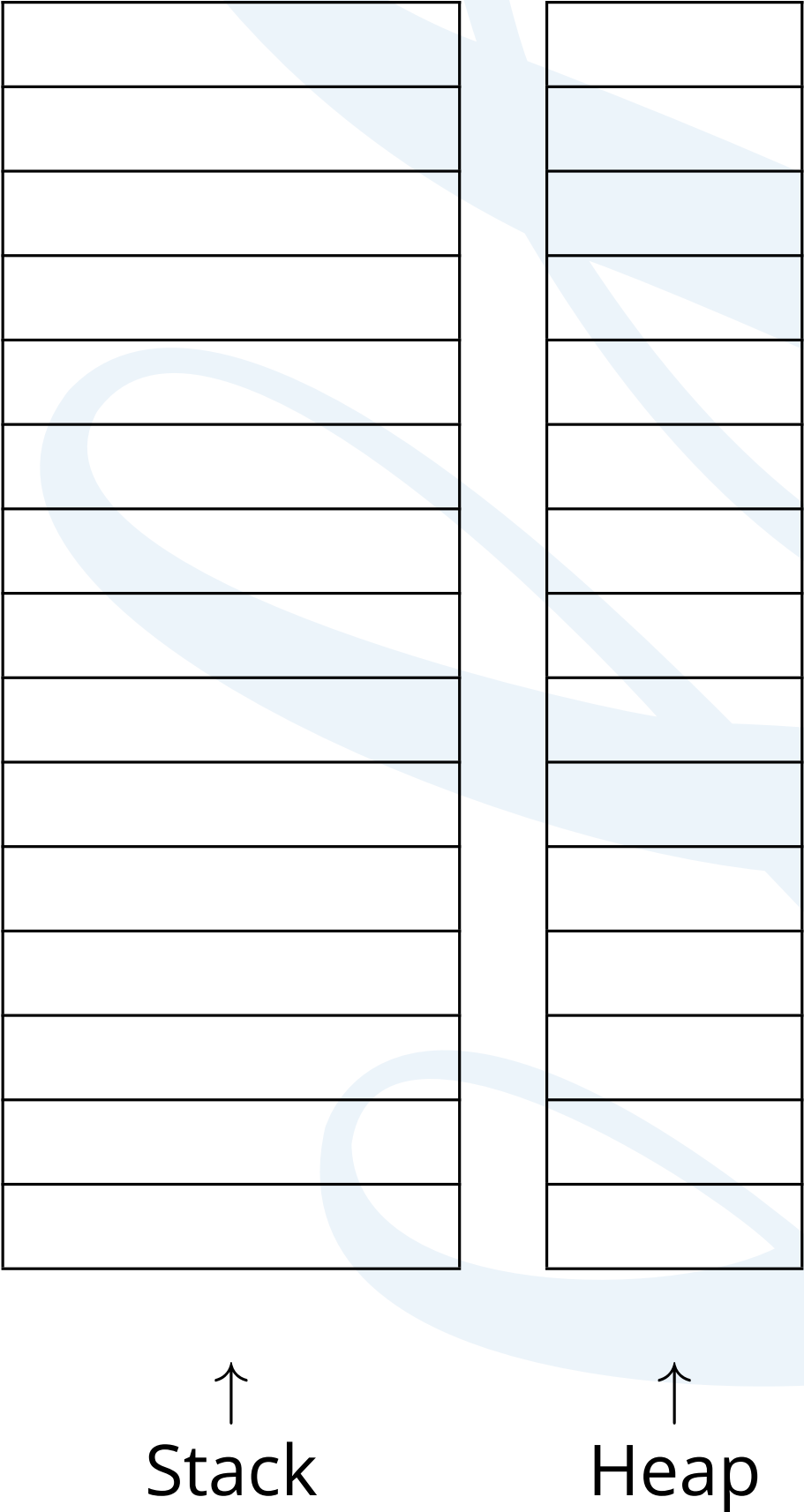


- When program is run, block of memory is allocated.
  - Called the stack.
- Each program has it's own stack.
  - Each instance.
- As variables created and functions called they are put on the stack.
- When variables are destroyed/functions complete they are removed from the stack.
- Has limited size.
  - Recursive functions can fill the stack if not careful.

```
int add( int a, int b)
{
    int result = a+b;
    return result;
}

int sub( int a, int b )
{
    int result = a-b;
    return result;
}

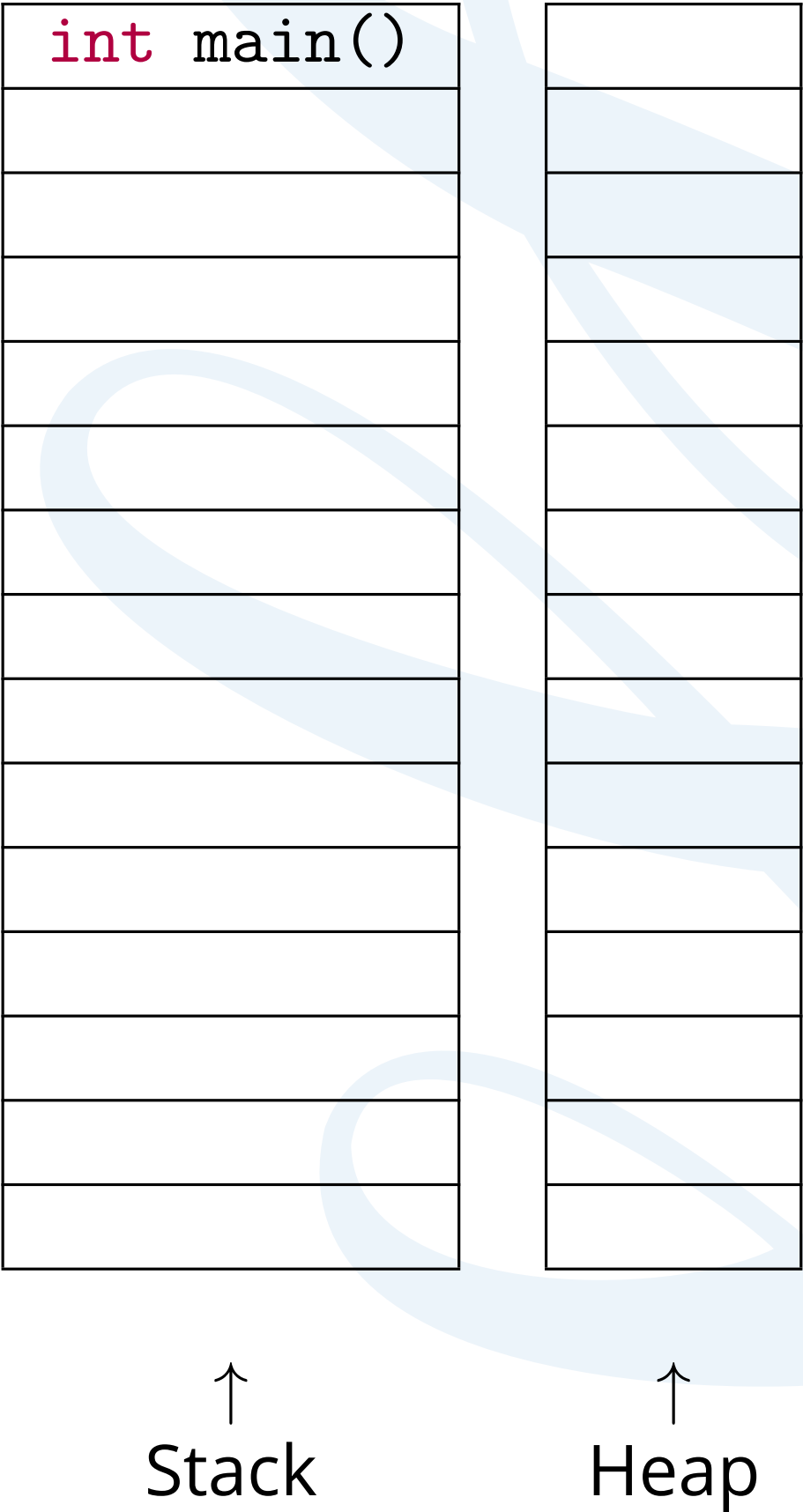
int main()
{
    int var1 = 42;
    int var2 = 1;
    add(a,b);
    sub(a,b);
    return 0;
}
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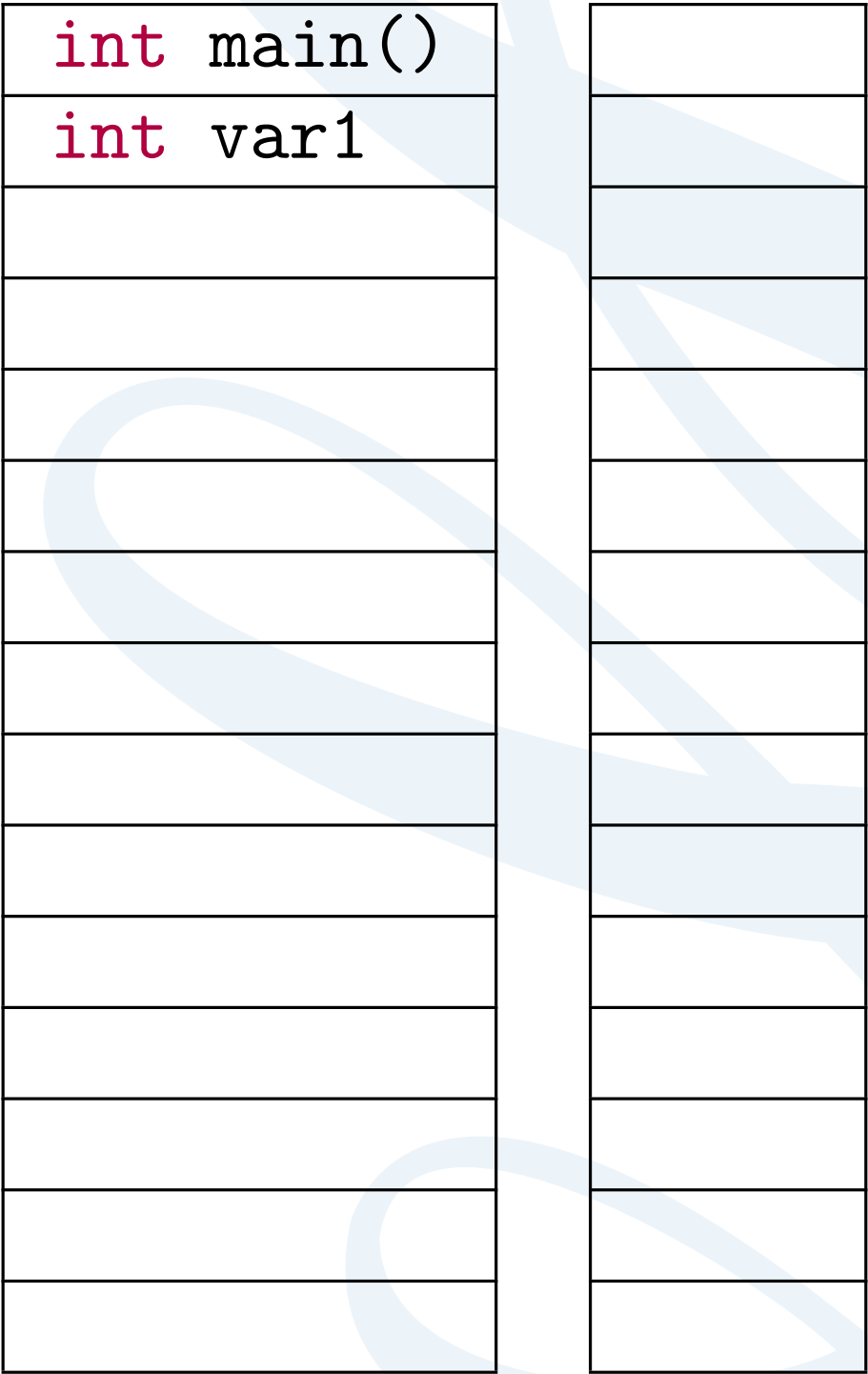


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⇒



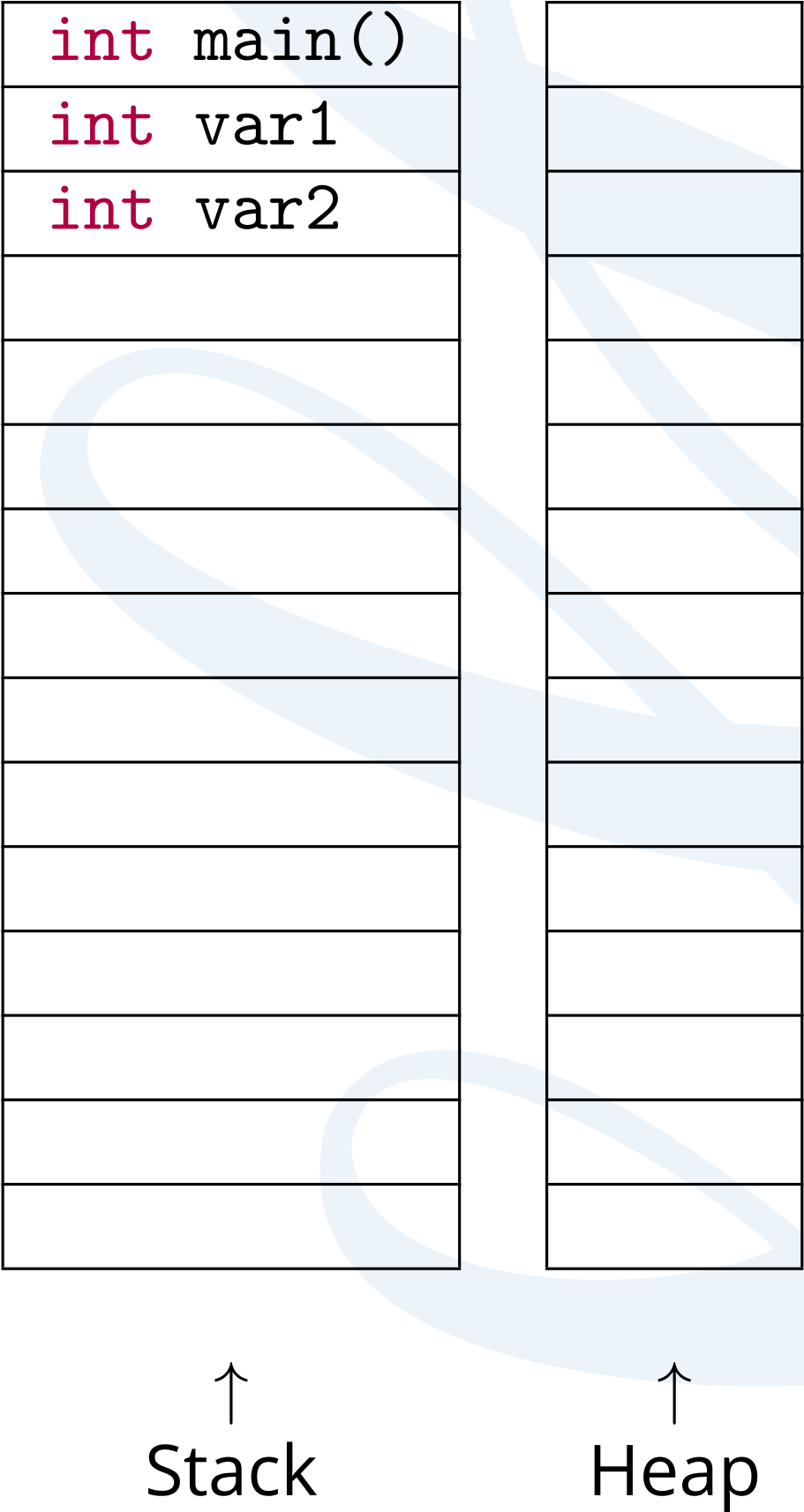
↑  
Stack

↑  
Heap

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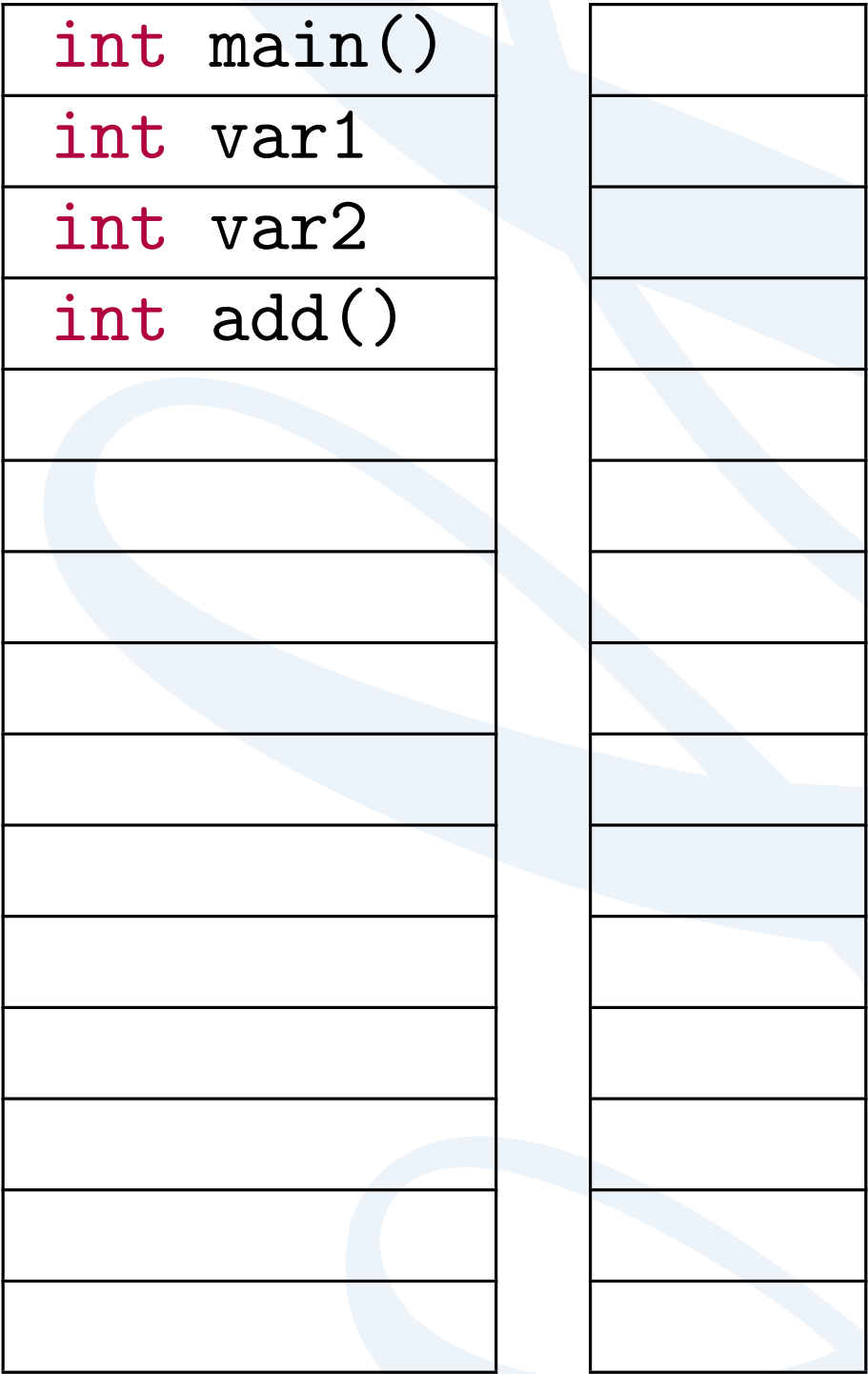


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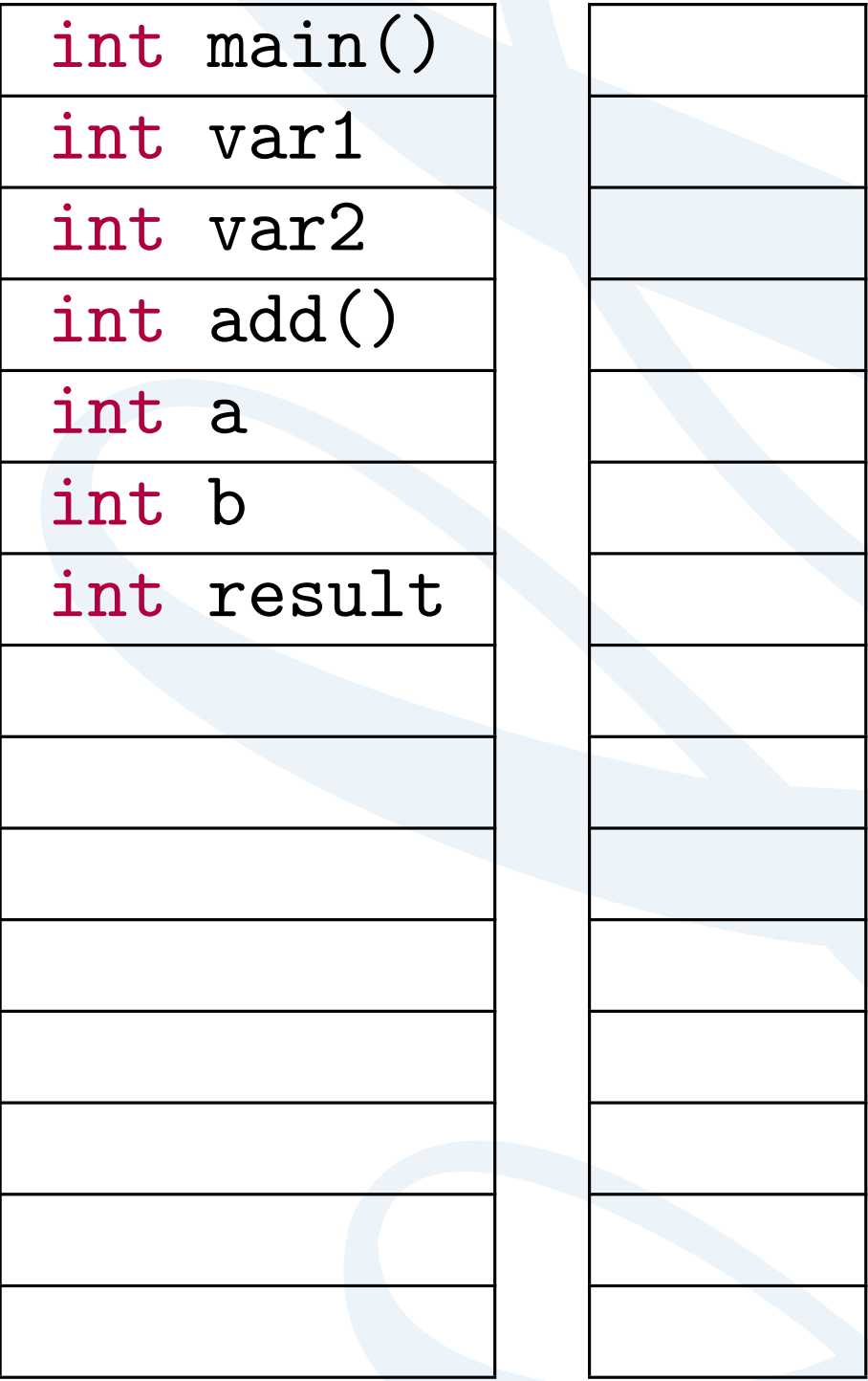


↑  
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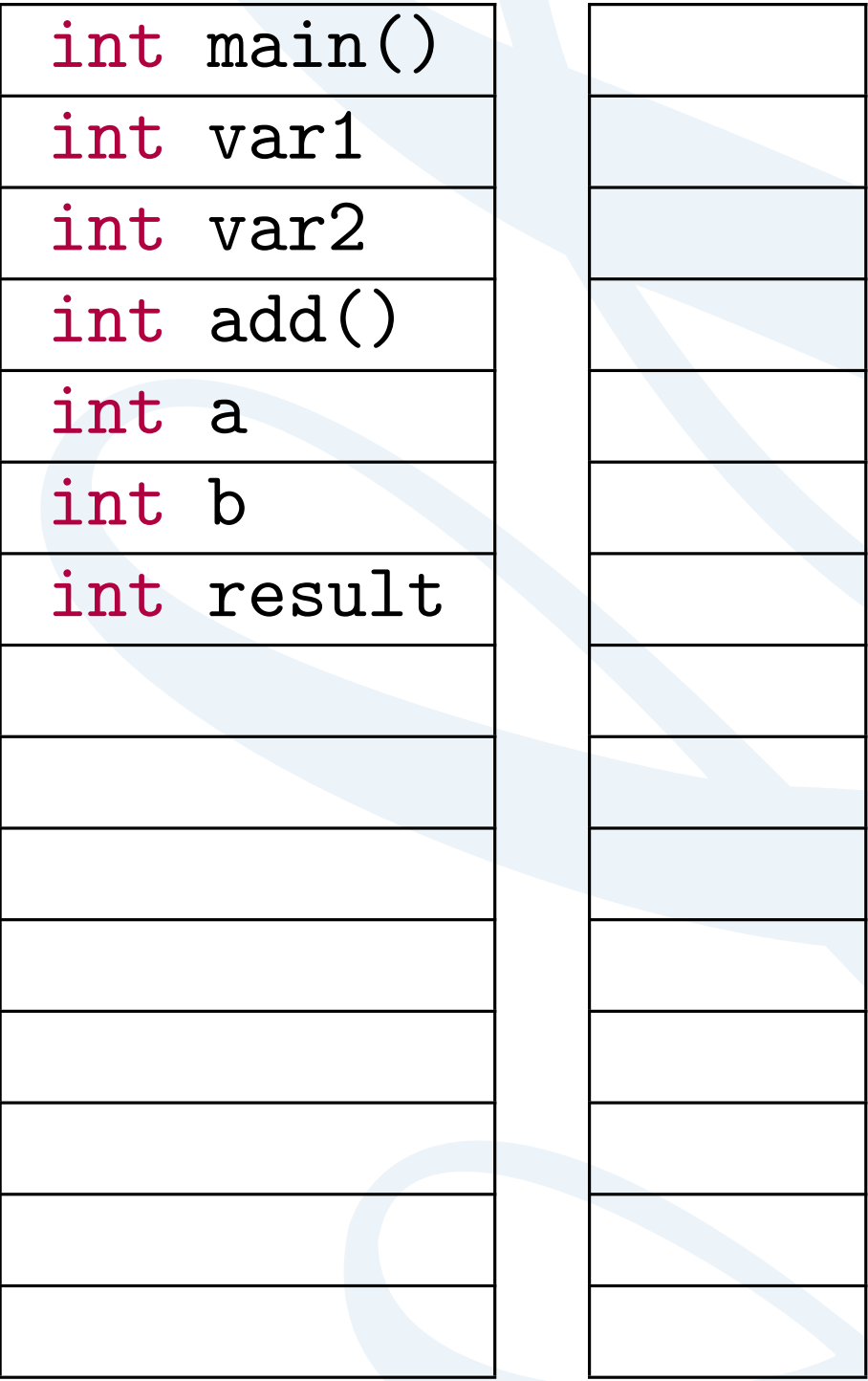


↑ Stack      ↑ Heap

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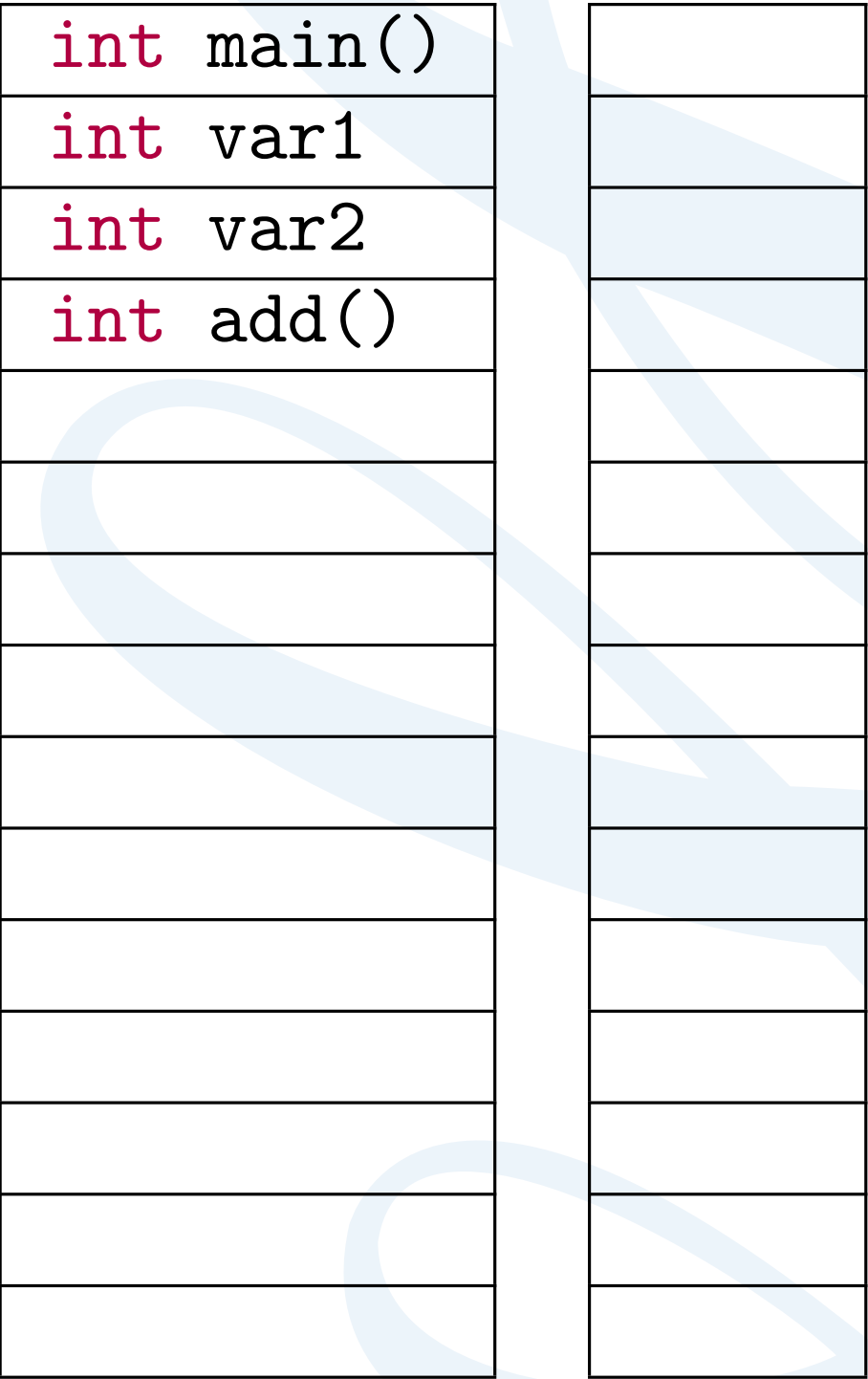
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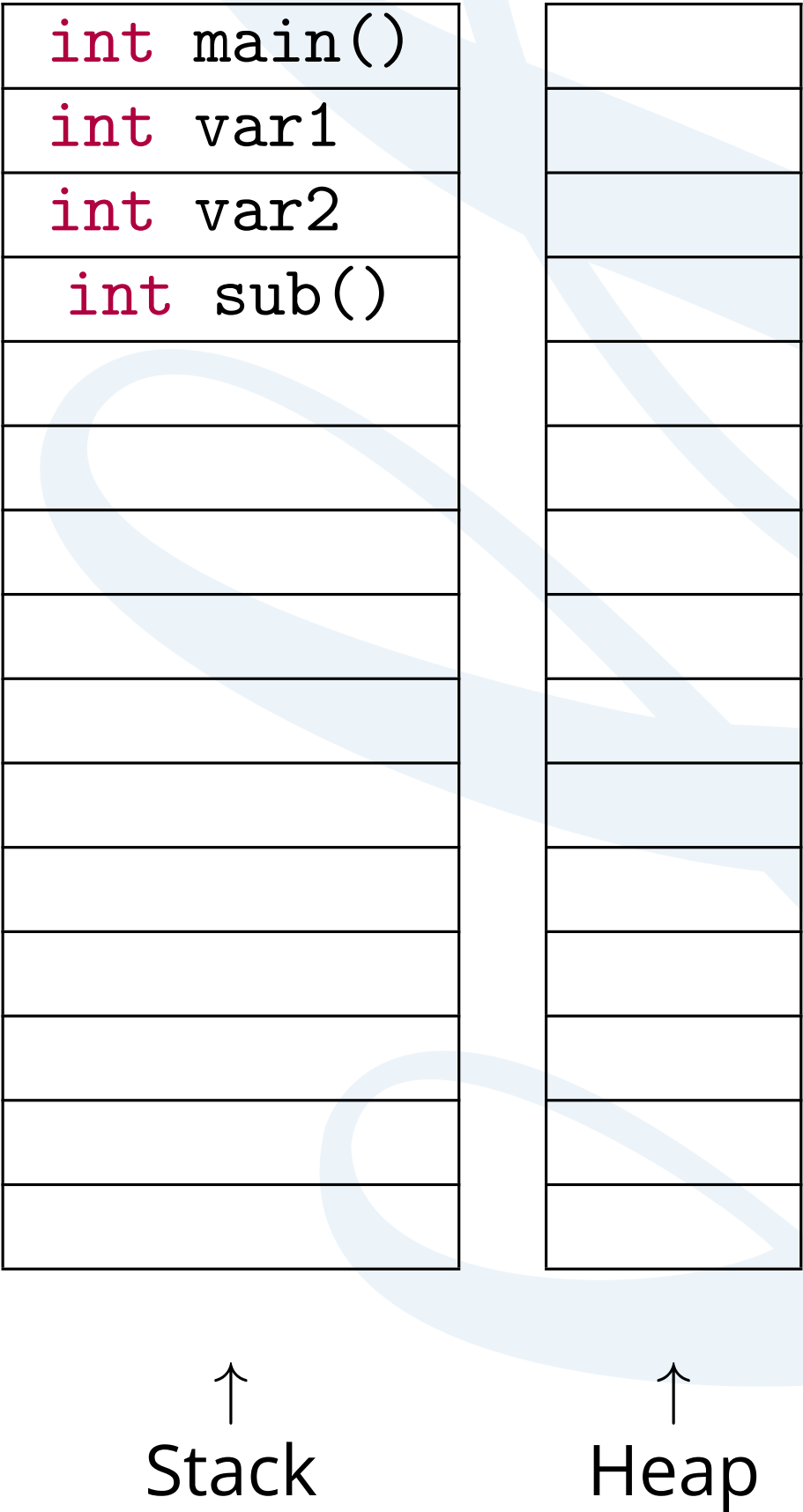
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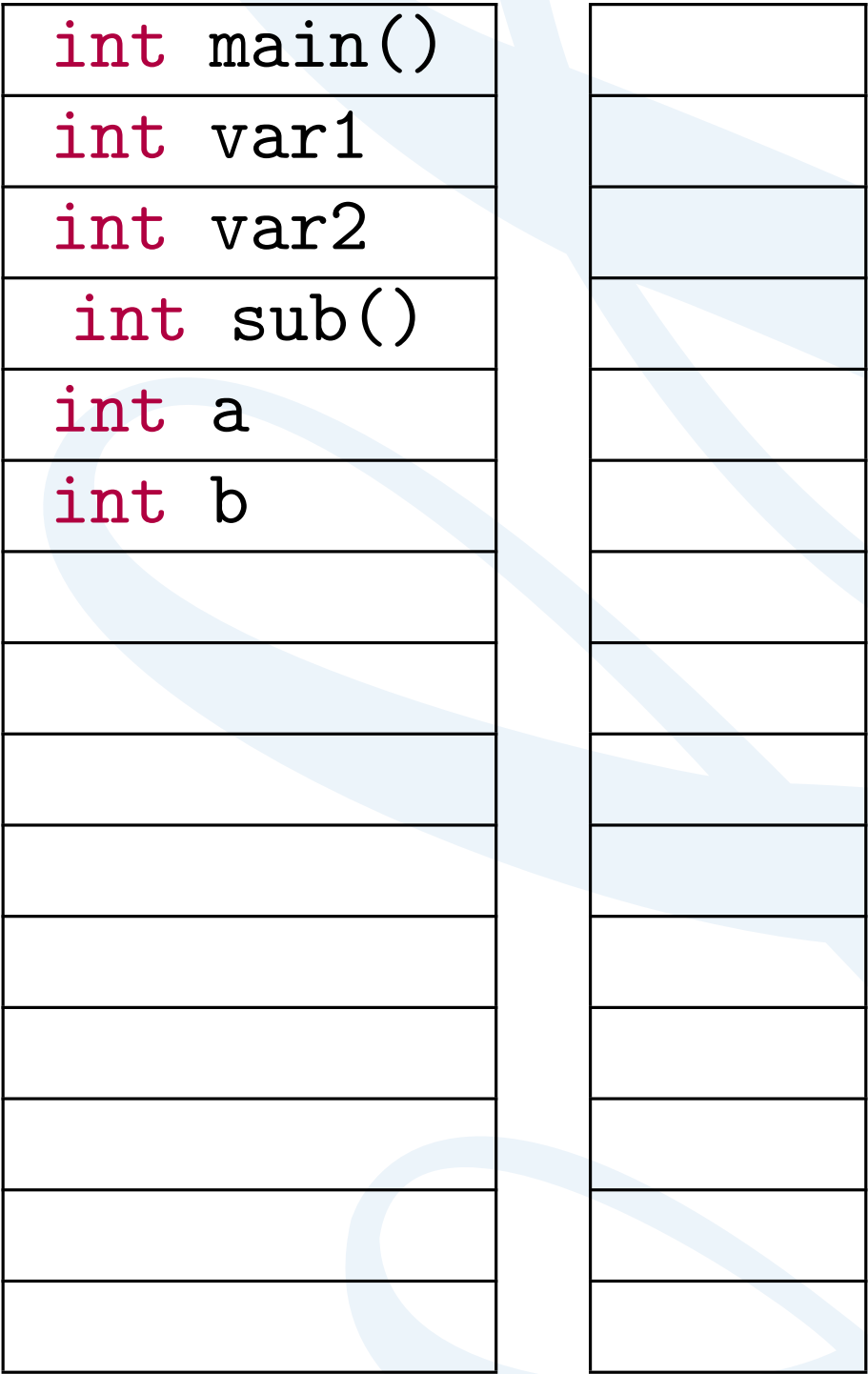
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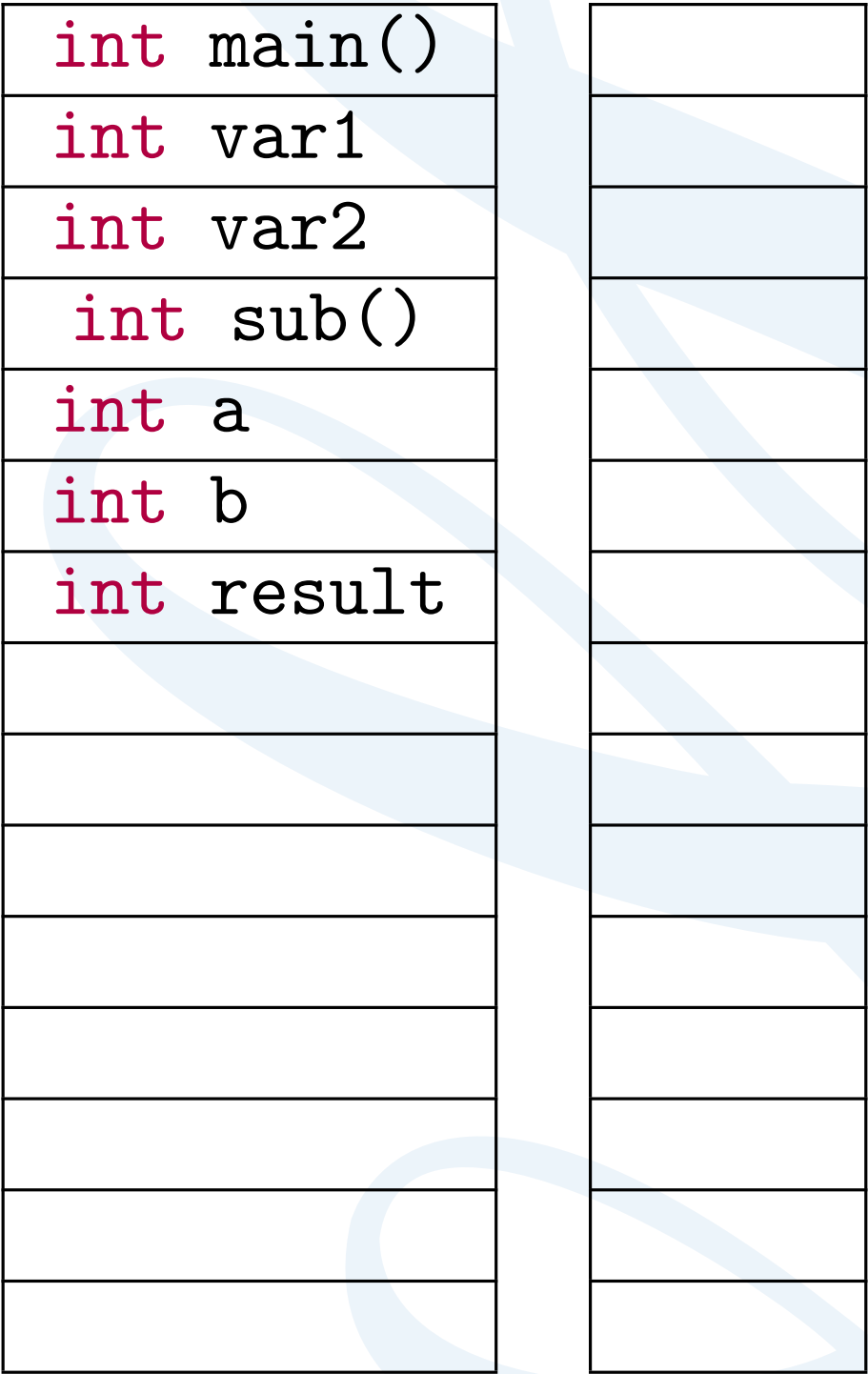
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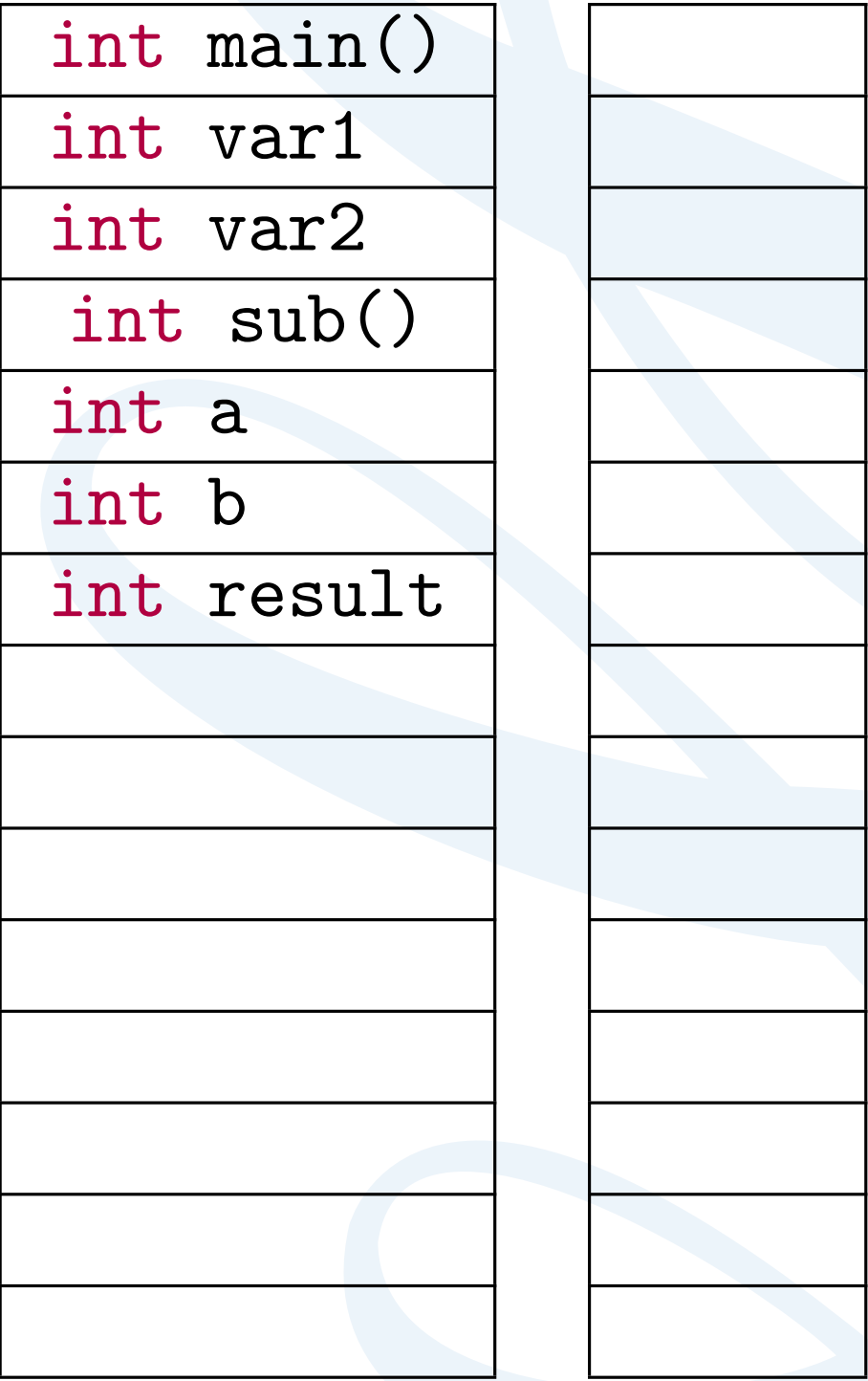
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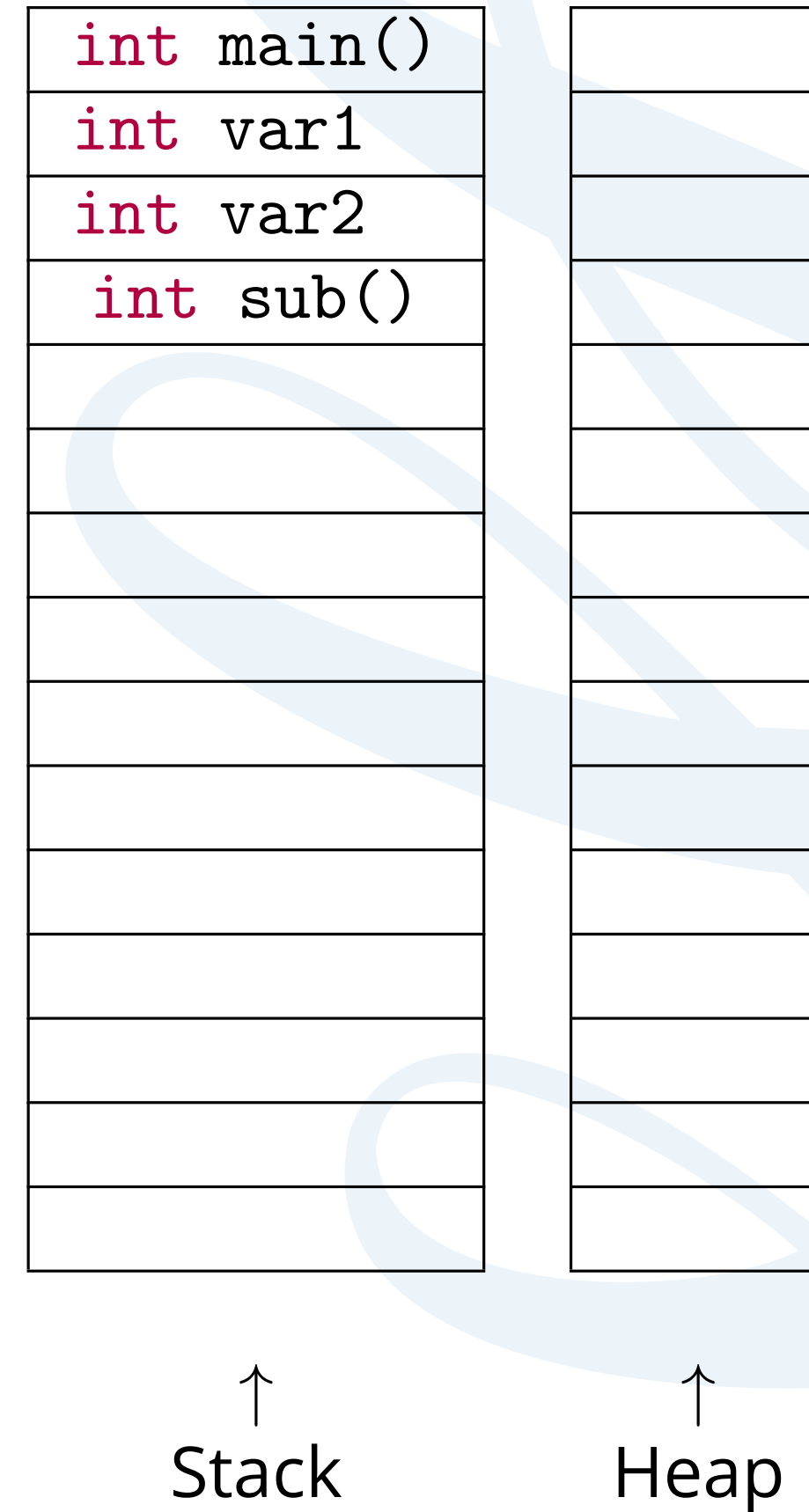
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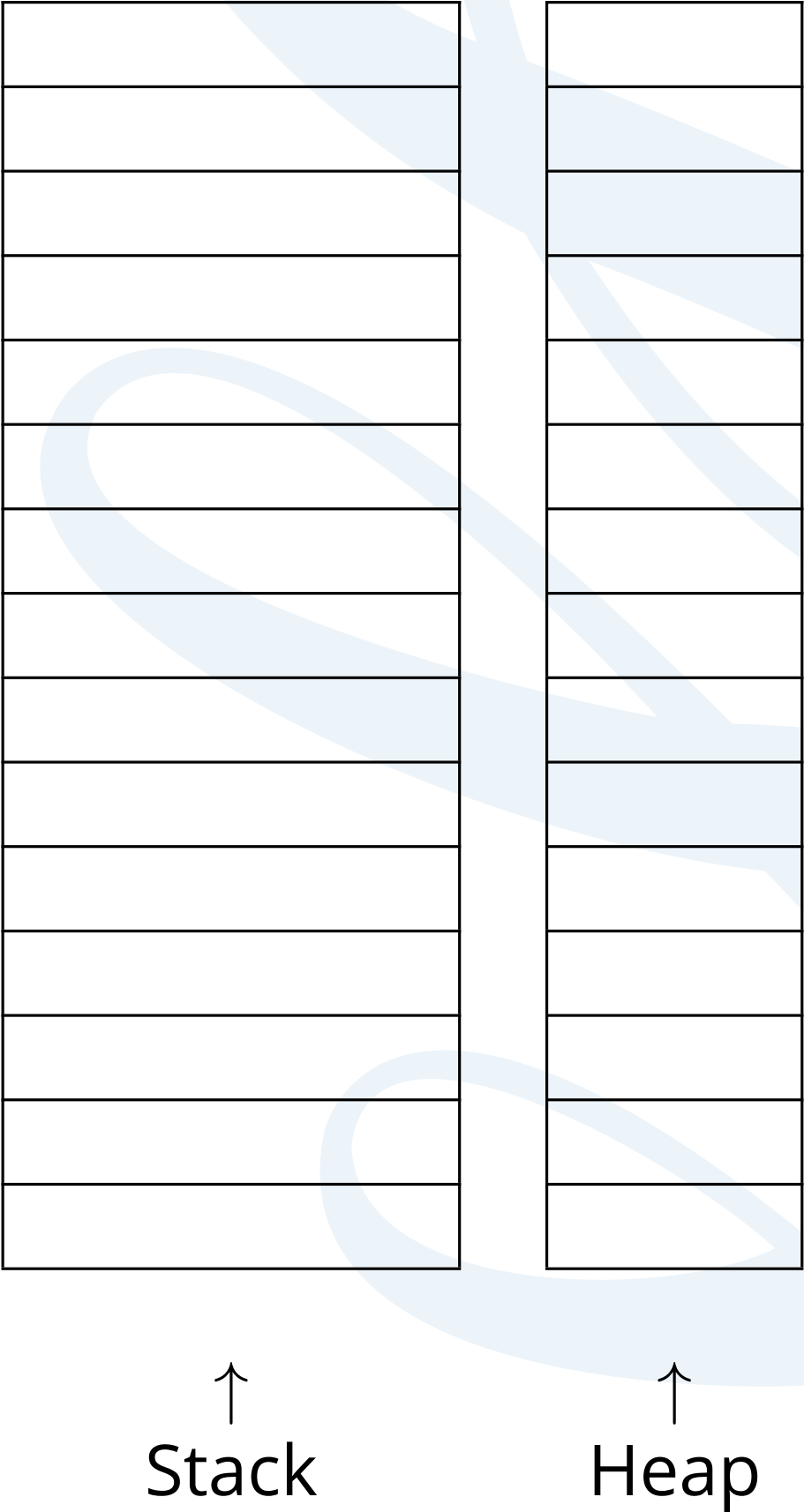
 $\Rightarrow$ 



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# The Heap

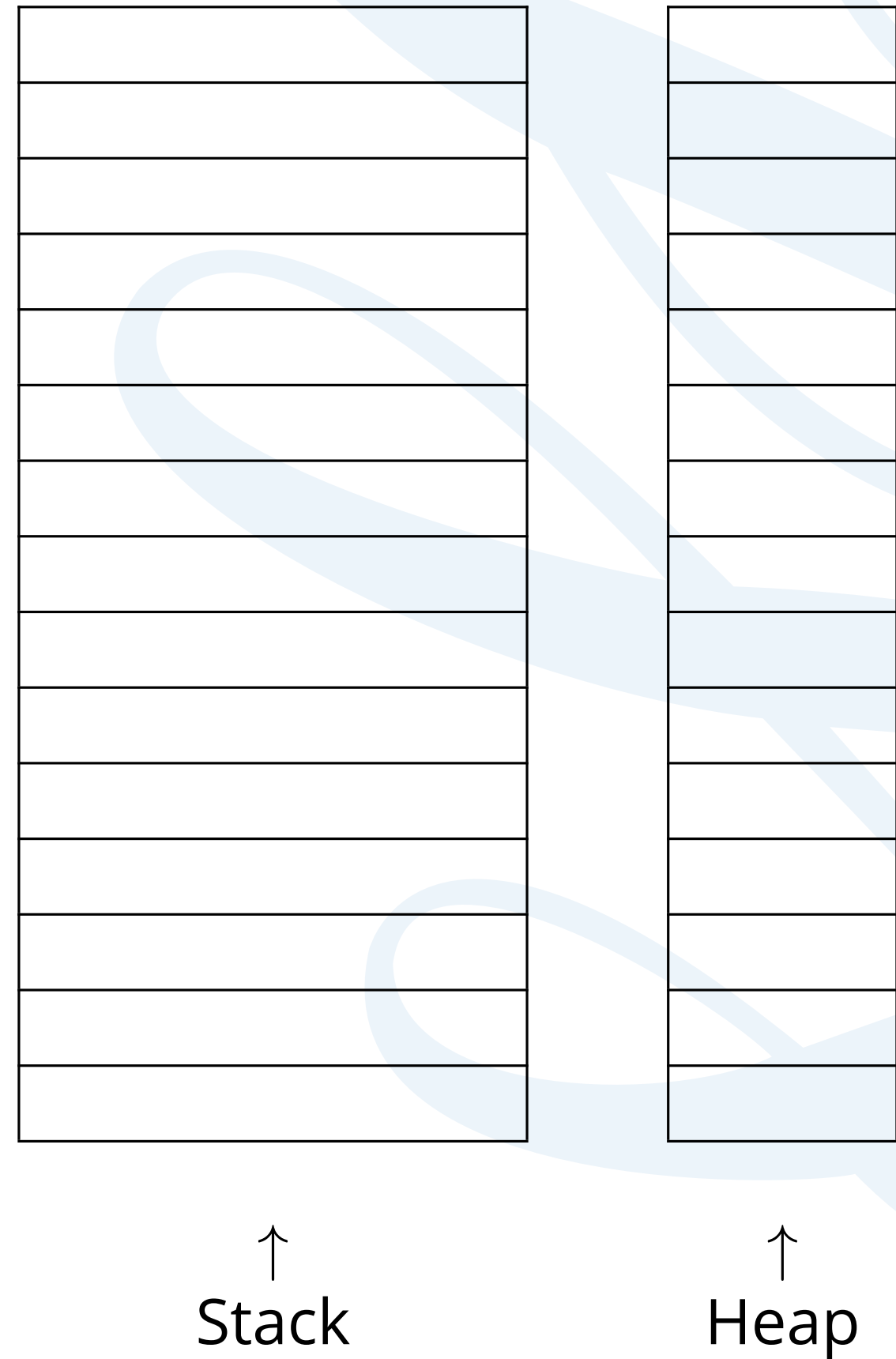


- Shared memory between all running programs.
- Very big in comparison to the stack.
- Dangerous, must remember to deallocate our memory.
  - Memory leaks.

```
int main()
{
    int variable = 42;
    int *pointer1;
    pointer1 = new int[6];

    int *pointer2;
    pointer2 = new int[3];

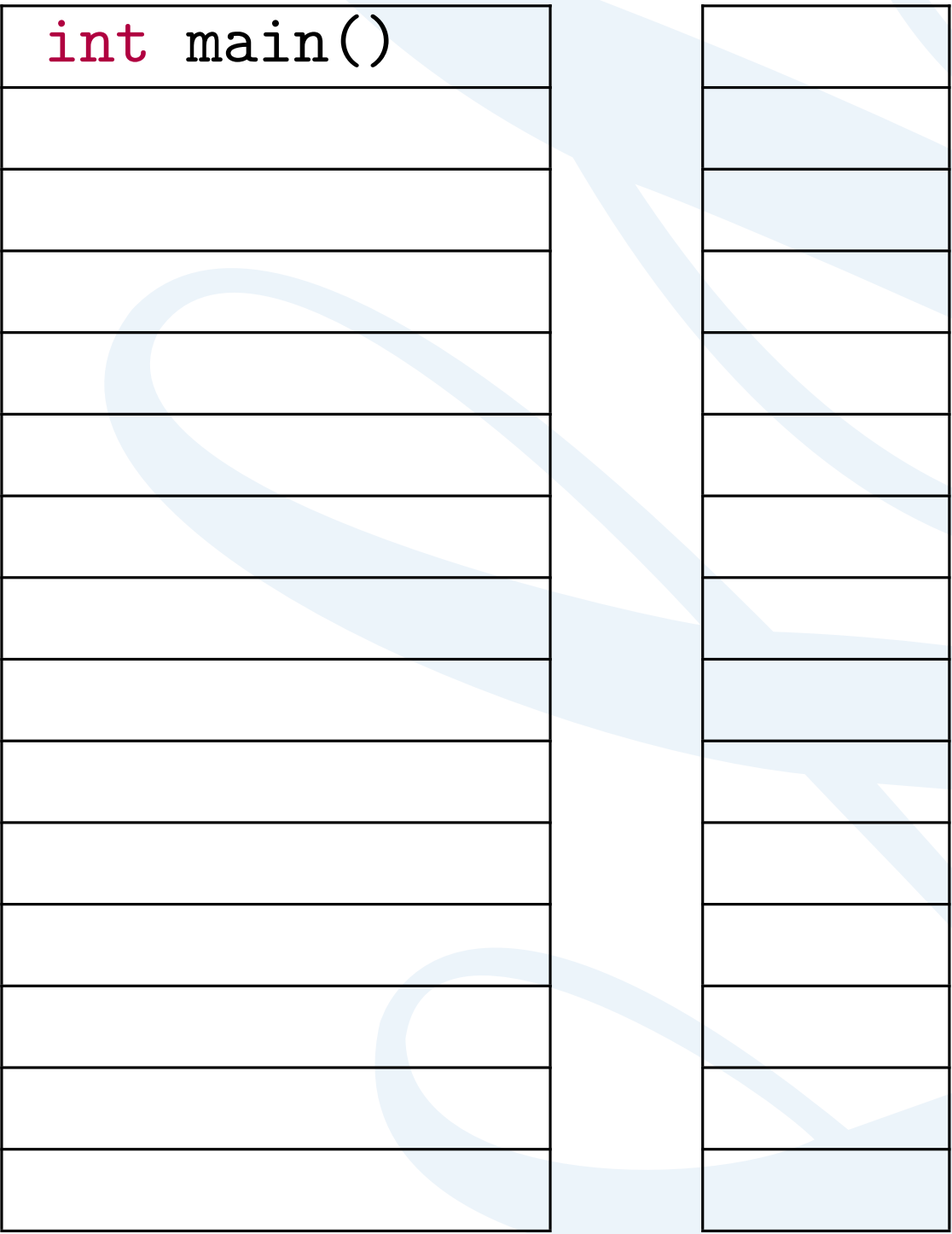
    delete [] pointer1;
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↑  
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↑  
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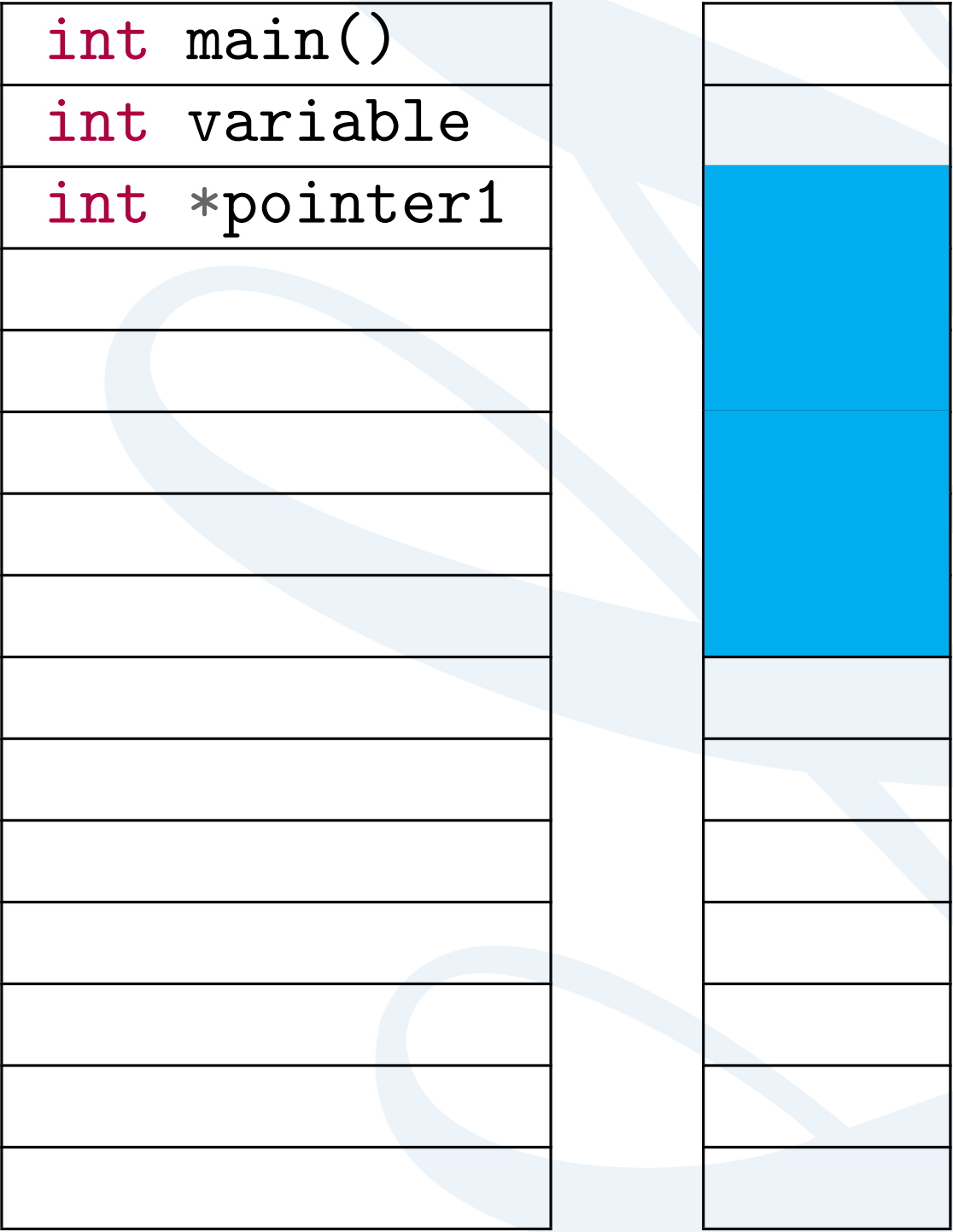




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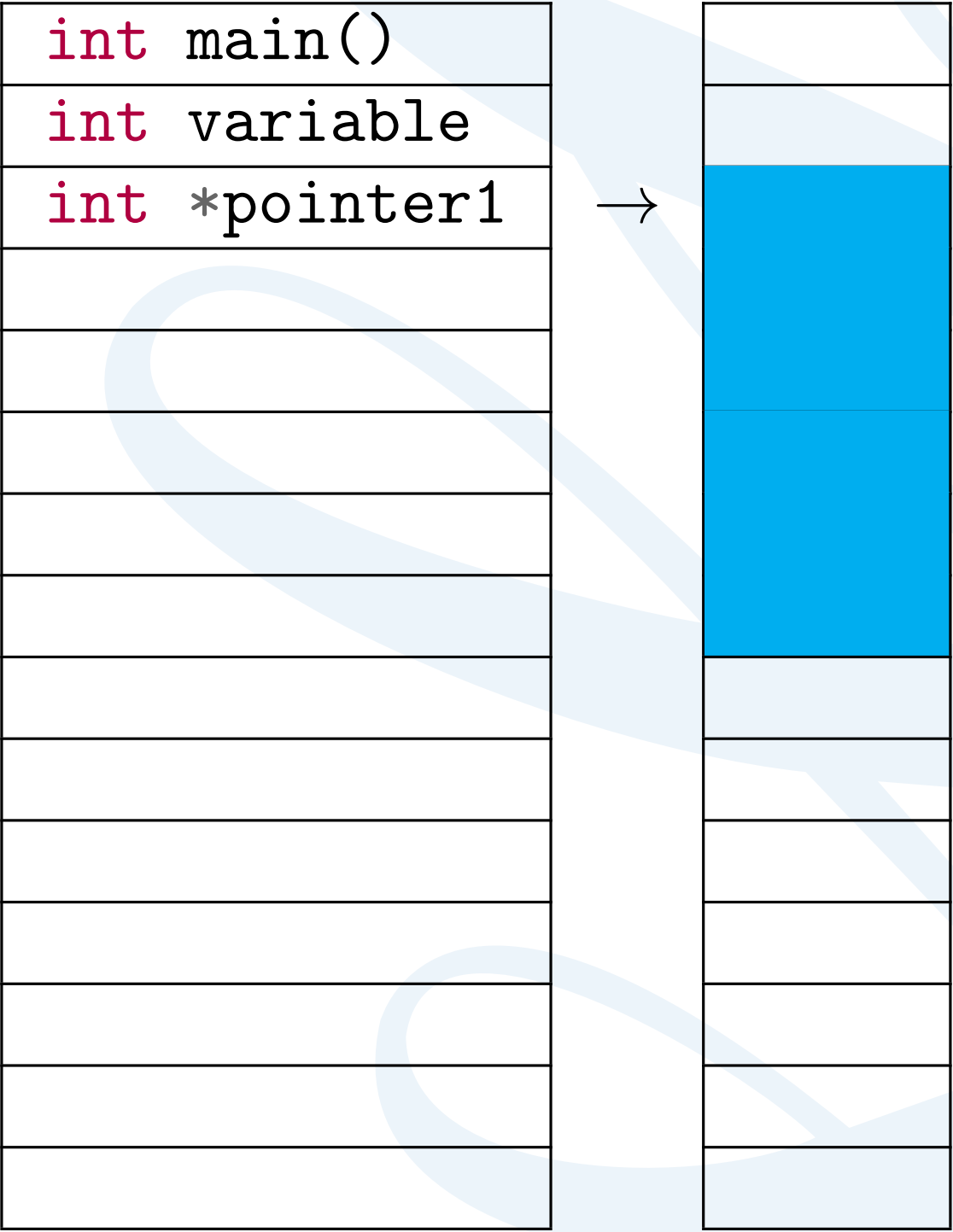
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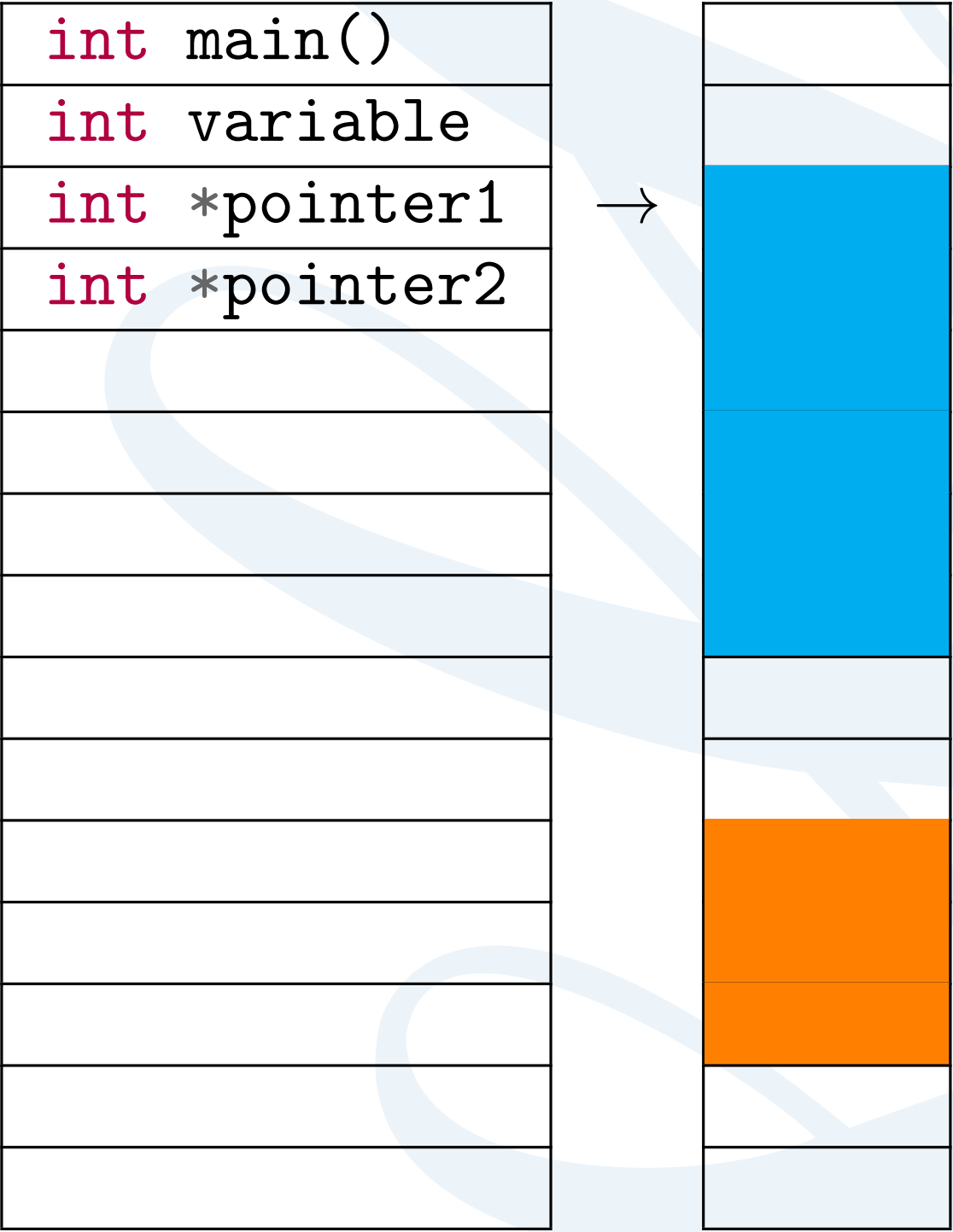
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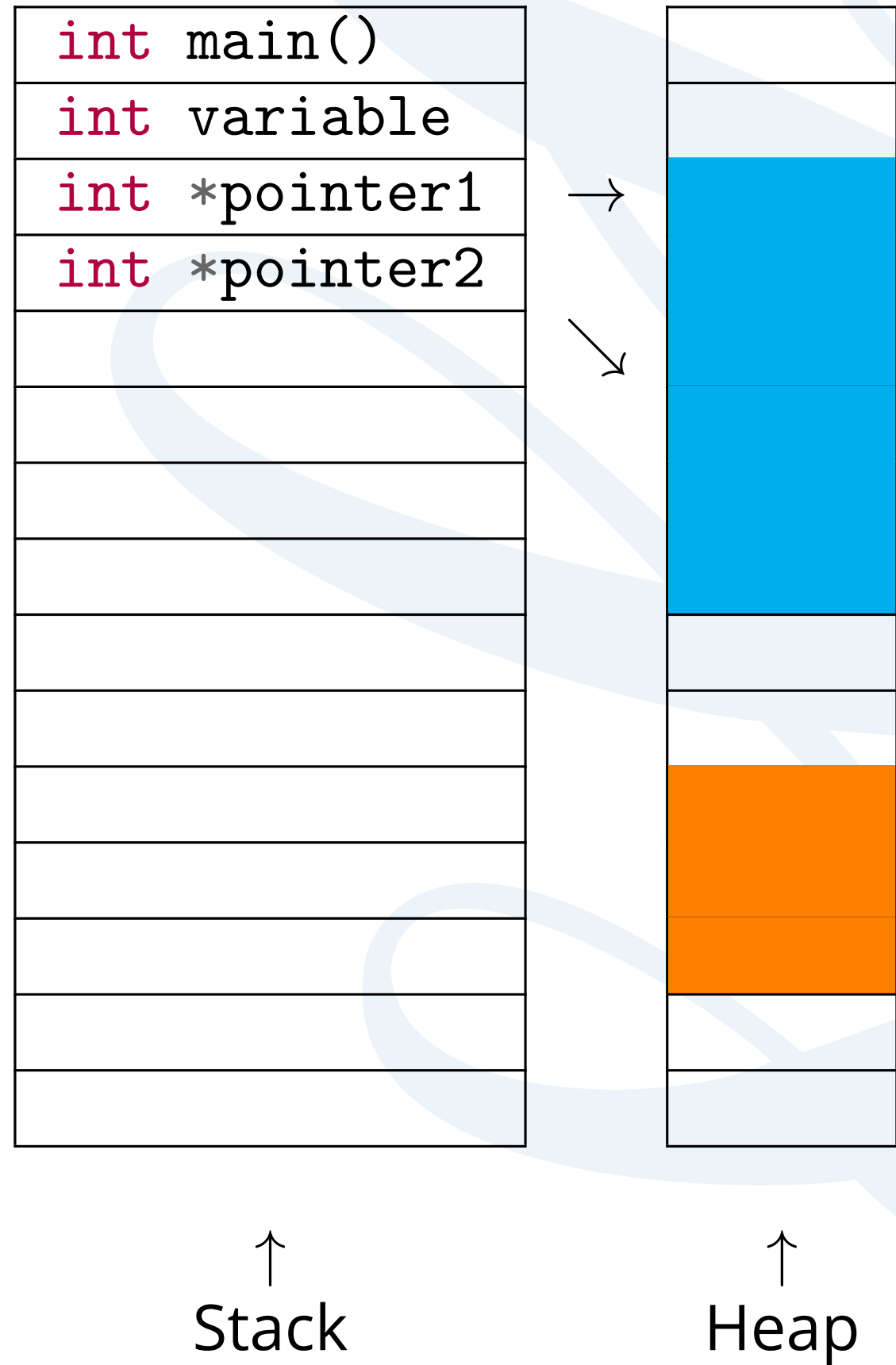
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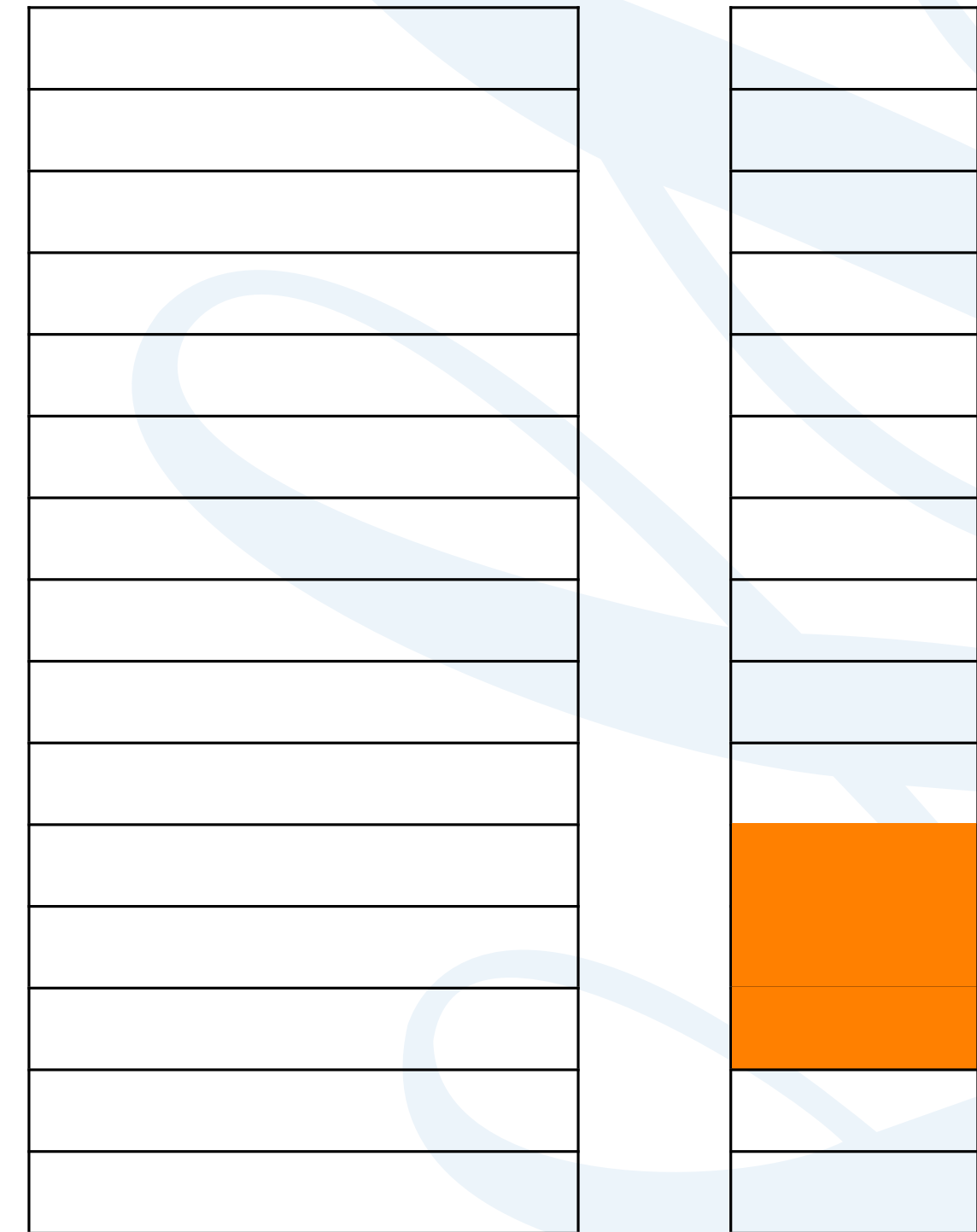




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↑  
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# Differences

## Stack

- Fast - processors typically have special instructions for dealing with stacks quickly.
- Contiguous - everything in one block, easier to know where to put next variable/function.
- Small - limited size.
  - Trying too variables will fill stack and cause “stack overflow”.

## Heap

- Huge - relative to the stack.
- Dangerous - must remember to deallocate otherwise have memory leaks.

# The End