Stack and Heap memory

Coventry University

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

I

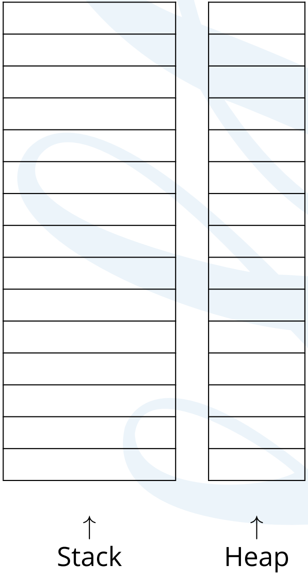
- When program is run, block of memory is allocated.
  - Called the stack.
- Each program has it’s own stack.
  - Each instance.
- As variables created and functions called they are put on the stack.
- When variables are destroyed/functions complete they are removed from the stack.
- Has limited size.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

A

```
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(var1,var2);
   sub(var1,var2);
   return 0;
}
```



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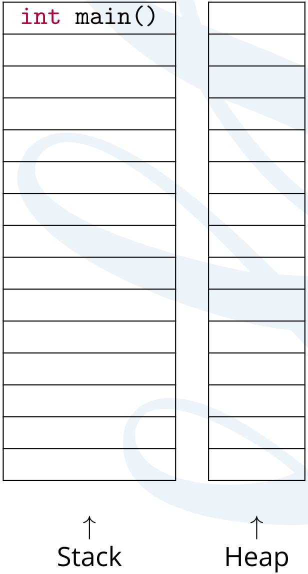

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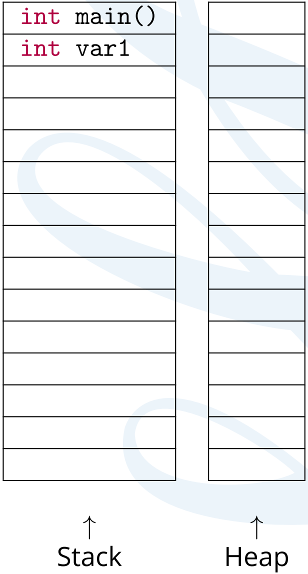

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      add(var1,var2);
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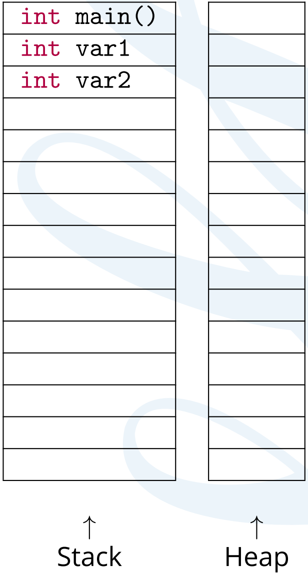

int main()

int var1

int var2

A

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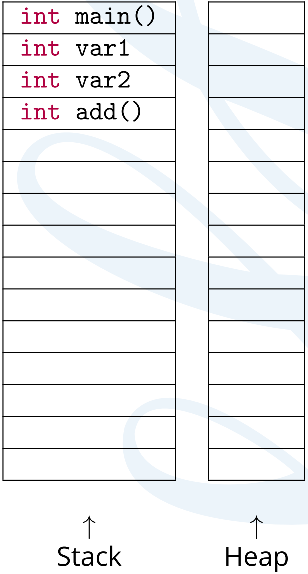

int main()

int var1

int var2

int add()

↑ Stack

↑ Heap

A

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   {
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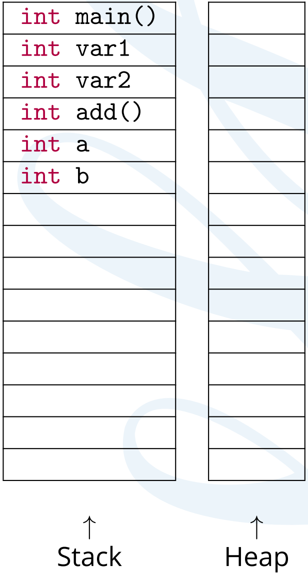

Stack	Heap
int main()	
int var1	
int var2	
int add()	
int a	
int b	

A

```
    int add( int a, int b)
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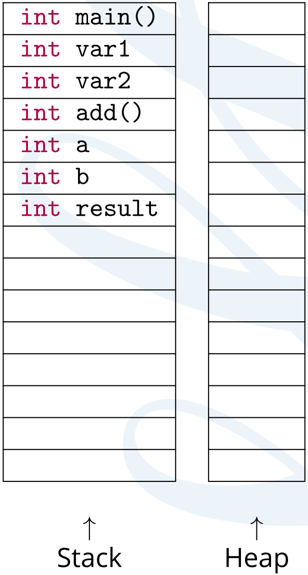

Stack
int main()
int var1
int var2
int add()
int a
int b
int result

A

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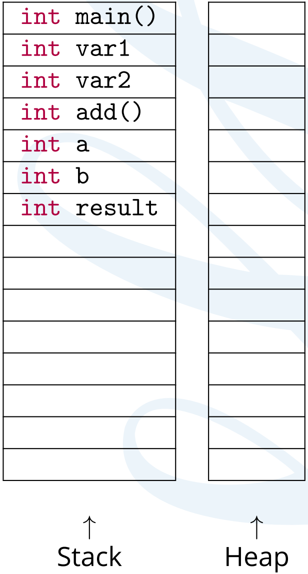

int main()
int var1
int var2
int add()
int a
int b
int result

↑ Stack

↑ Heap

A

```
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       }
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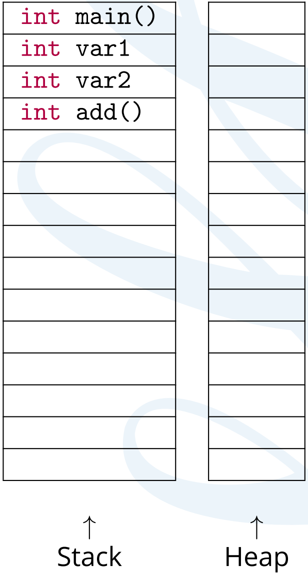

Stack
int main()
int var1
int var2
int add()

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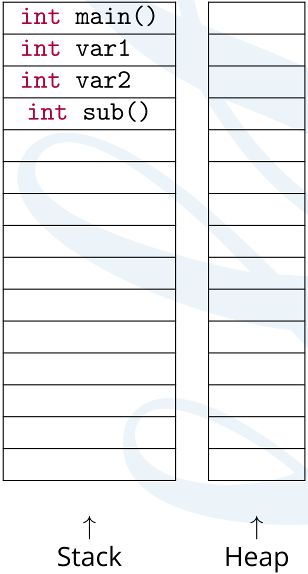

int main()

int var1

int var2

int sub()

↑ Stack

↑ Heap

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```
     int add( int a, int b)
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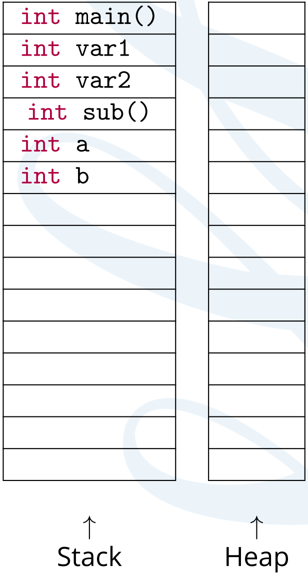

int main()

int var1

int var2

int sub()

int a

int b

↑ Stack

↑ Heap

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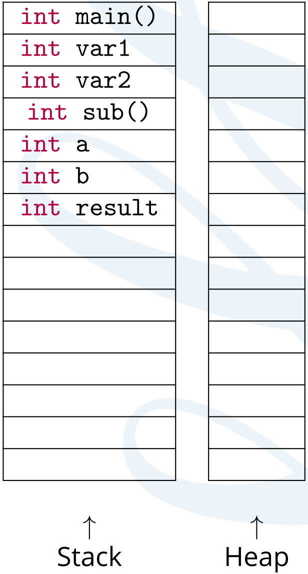

int main()

int var1

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int sub()

int a

int b

int result

↑ Stack

↑ Heap

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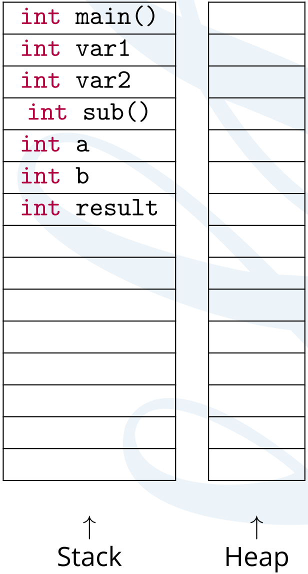

Stack	Heap
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int sub()	
int a	
int b	
int result	

↑ Stack

↑ Heap

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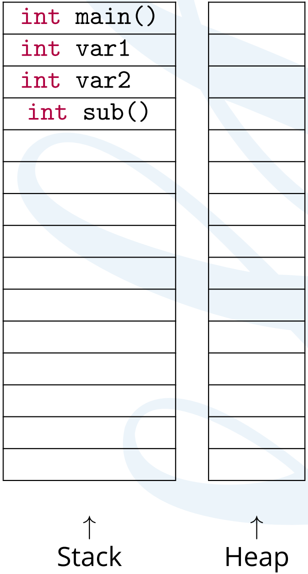

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int sub()

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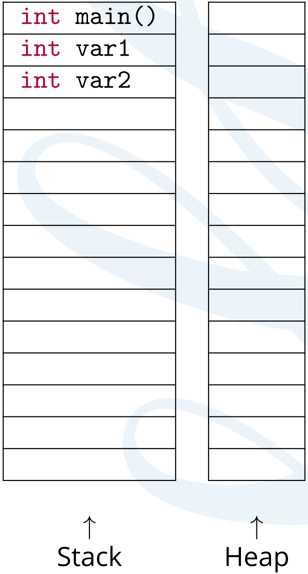

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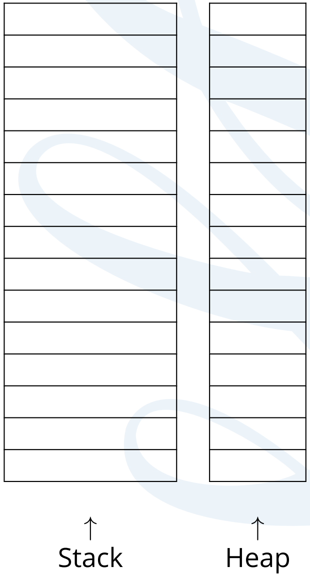


The Heap

I

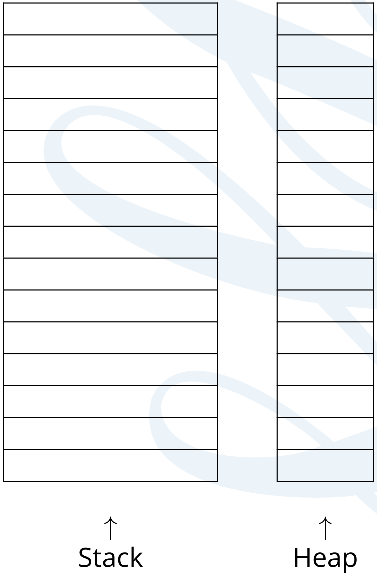
- Shared memory between all running programs.
- Very big in comparison to the stack.
- Dangerous, must remember to deallocate our memory.
  - Memory leaks.

A

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

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

   delete [] pointer1;
   return 0;
}
```



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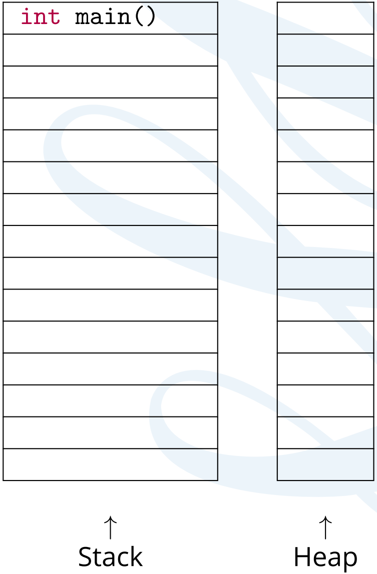

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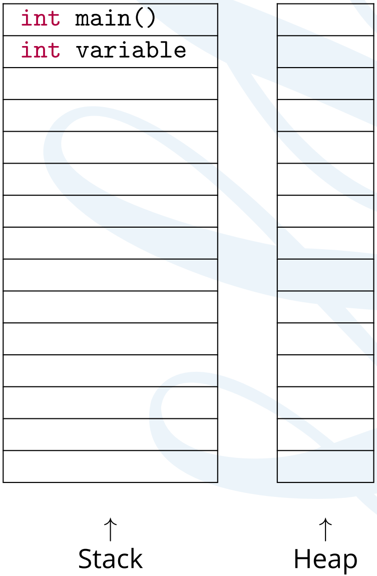

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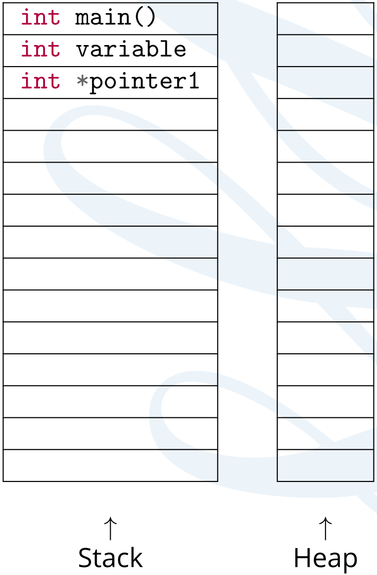

Stack
int main()
int variable
int *pointer1

A

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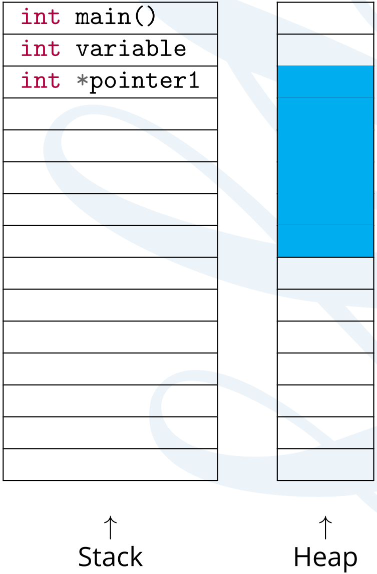

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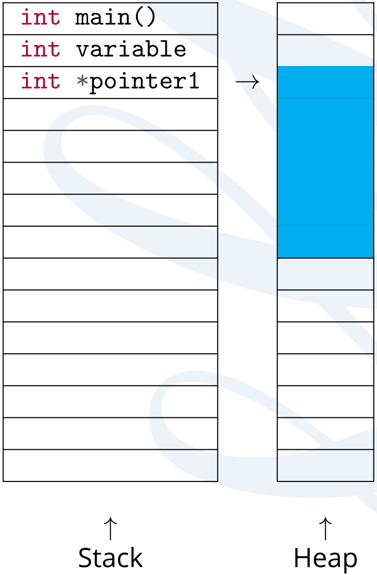

int main()

int variable

int *pointer1 →

↑ Stack

↑ Heap

A

```
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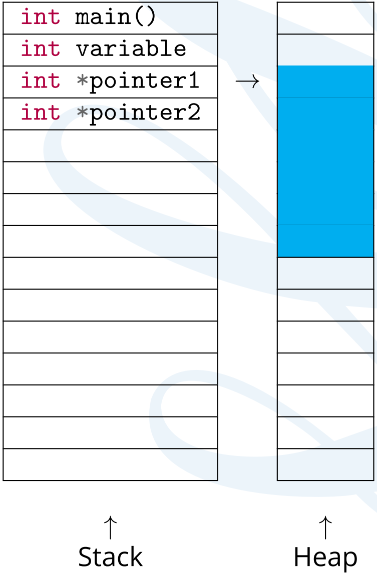

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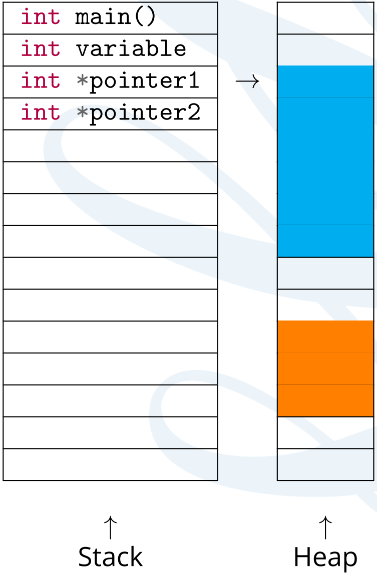

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         int main()
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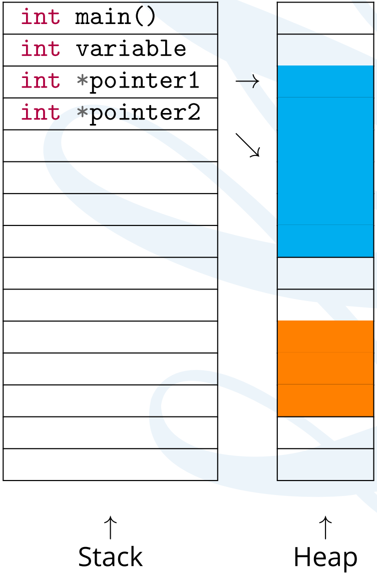

int main()

int variable

int *pointer1

int *pointer2

Stack

Heap

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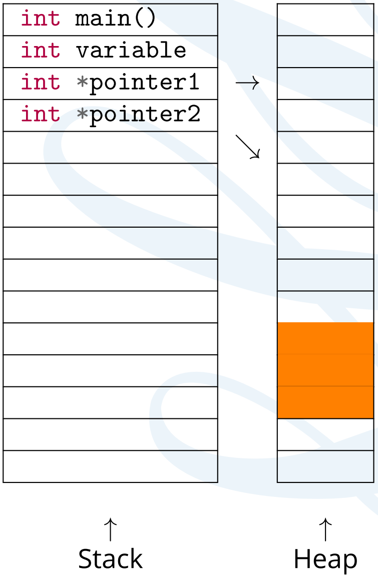

int main()
int variable
int *pointer1
int *pointer2

Stack

Heap

A

```
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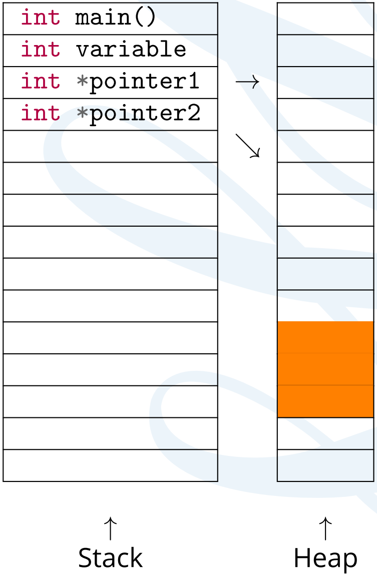

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Stack

Heap

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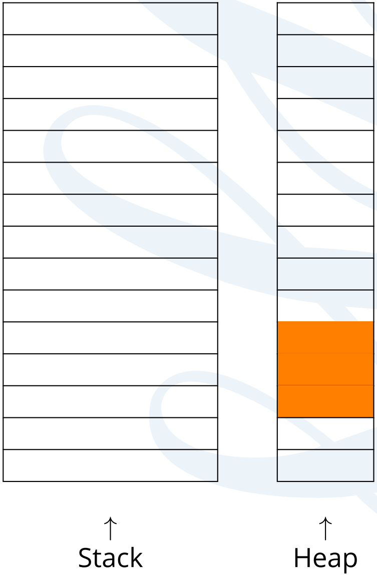

Differences

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