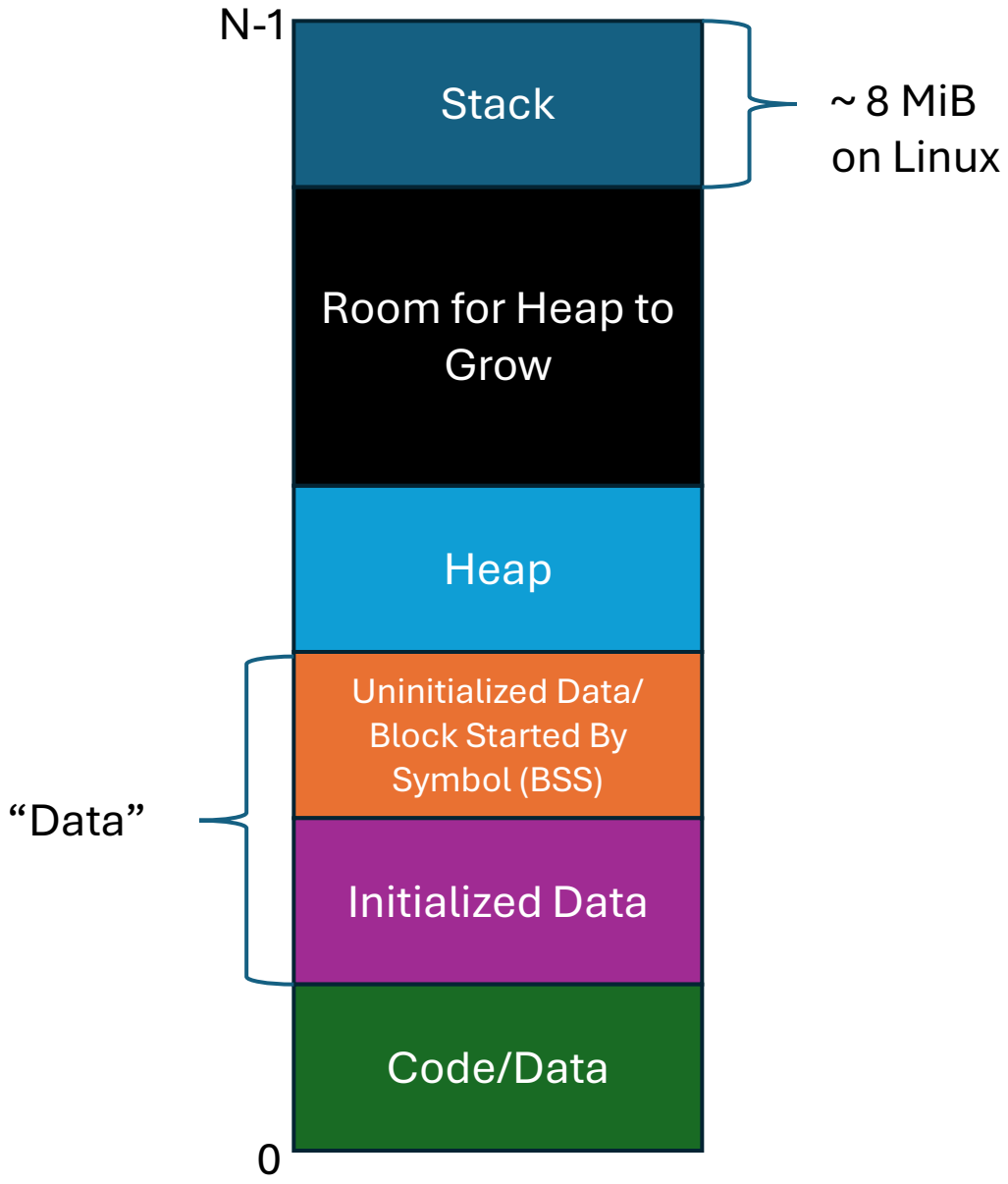
C Memory Layout

- The stack consists of “stack frames” or “activation records”. These contain local variables, and other details needed to execute a function
- The heap is for “Dynamic Storage”. We haven’t talked about that yet, but we will get there in week 7
- Uninitialized Data consists of global variables that haven’t been assigned a value
- Initialized Data consists of global variables that have been assigned a value
- The code segment holds the compiled code that is actually being executed



Pointer basics

- int *x; // declare a pointer
- Pointers store memory addresses, not the type specified

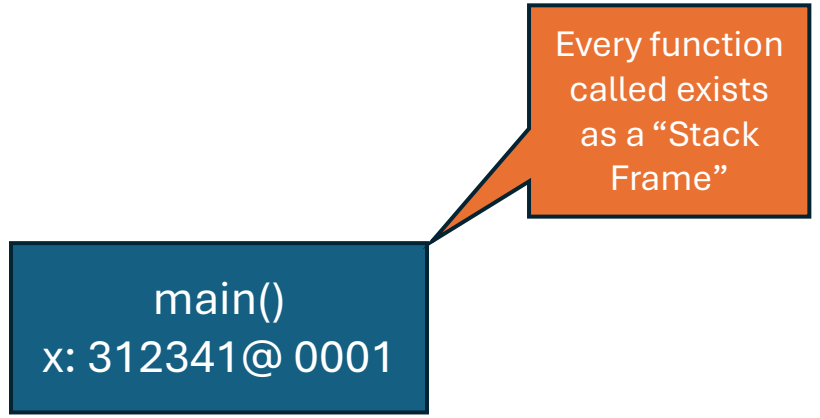
- *x // “Dereference” X – access what is stored at the address stored in the pointer
- int y; // normal int
- &y // “Address of” y – get the memory address of y;

- If X is a pointer and y is a normal int:
  x = &y; // X now “points” to y – its value is now y’s address

Inside the Stack Pointer_fun.c (without prints)

```
int main(int argc, char **argv) {
        int x;
        int y;
        x = 5;
        y = 9;
        swap_non_pointer(x,y);
        swap_with_pointers(&x, &y);
        return 0;
}

void swap_no_pointers(int x, int y) {
        int temp;
        temp = x;
        x = y;
        y = temp;
        return;
}
```



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void swap_no_pointers(int x, int y) {
        int temp;
        temp = x;
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}
```

main()
x: 312341@ 0001
y: 571123 @ 0002

Inside the Stack Pointer_fun.c (without prints)

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int main(int argc, char **argv) {
        int x;
        int y;
        x = 5;
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        swap_non_pointer(x,y);
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        int temp;
        temp = x;
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        return;
}
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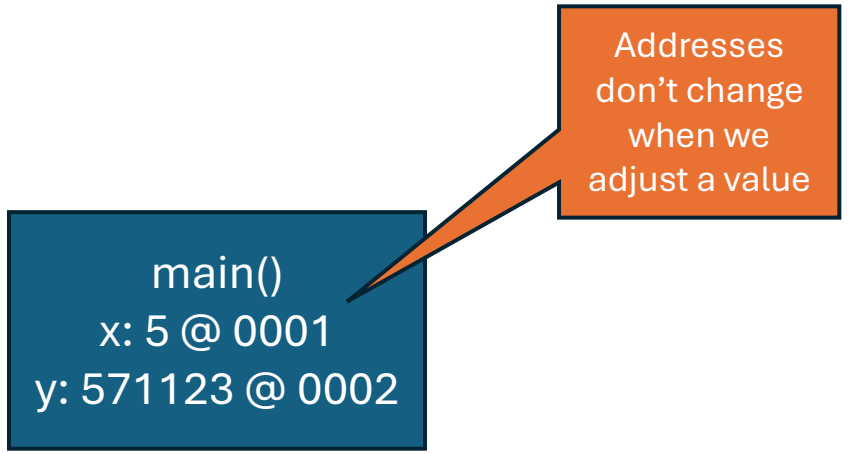

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x: 5 @ 0001
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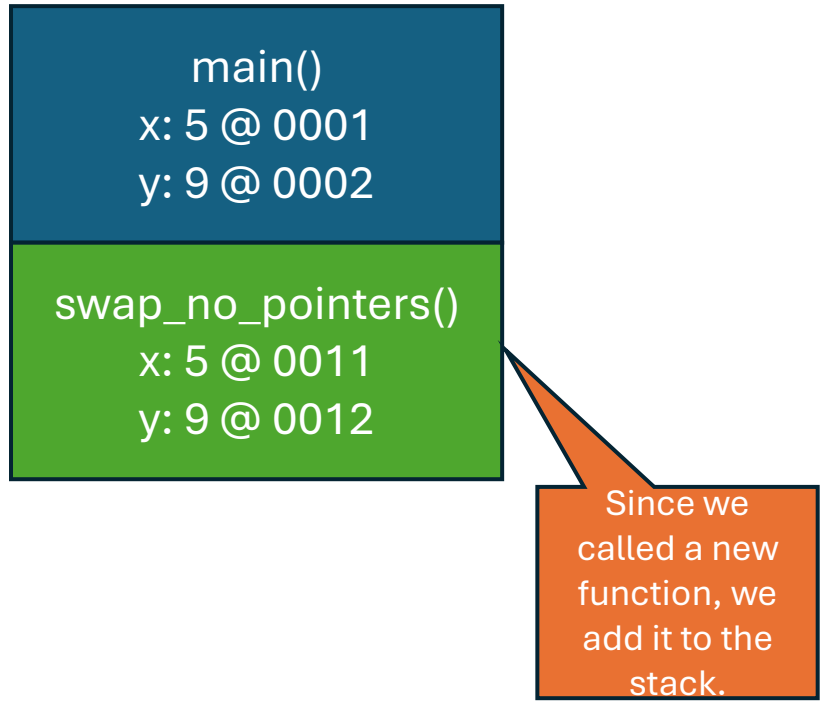

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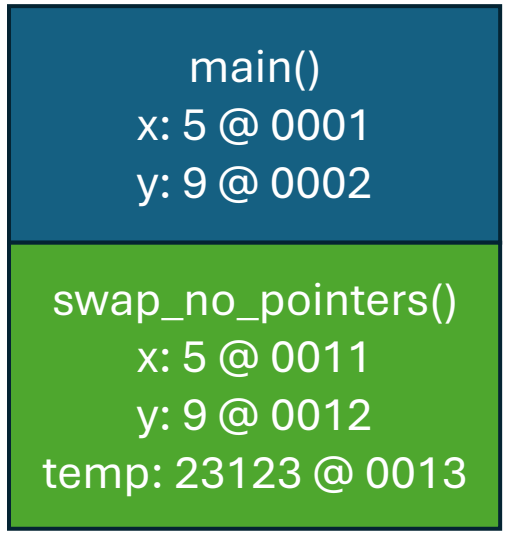

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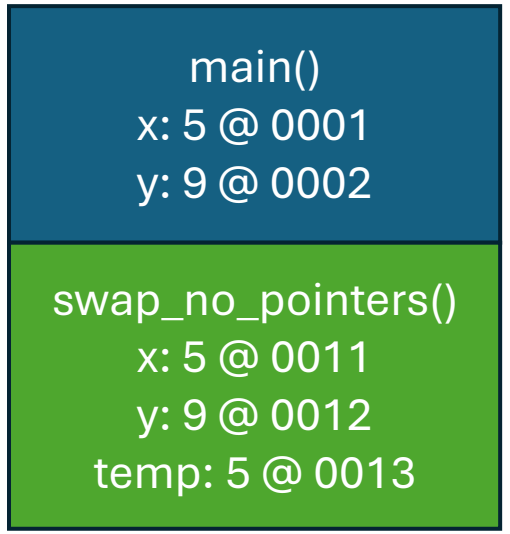

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}
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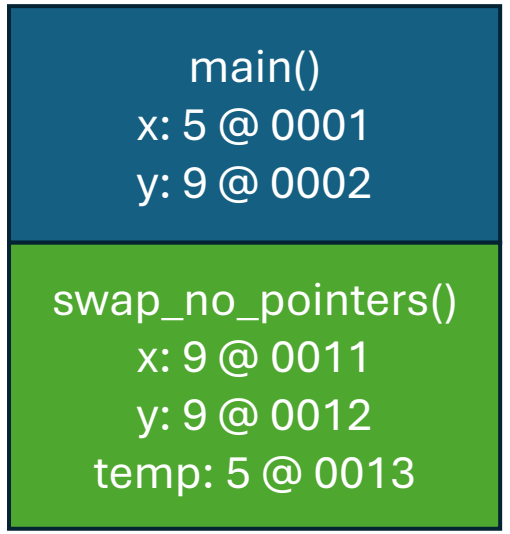

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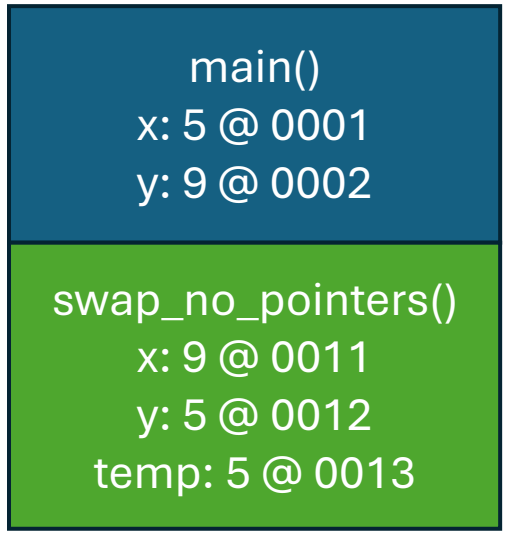

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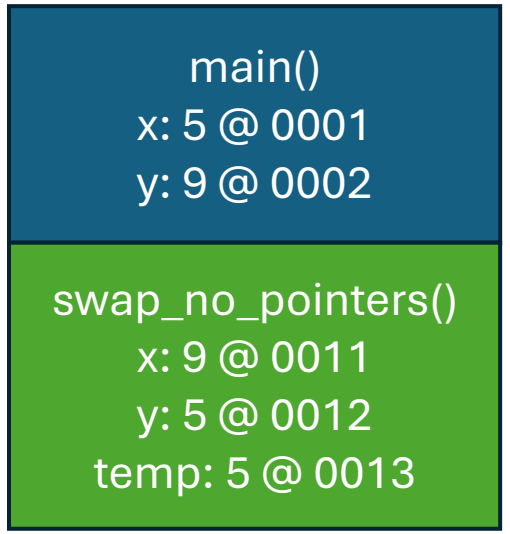

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        x = 5;
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        swap_non_pointer(x,y);
        return 0;
}

void swap_no_pointers(int x, int y) {
        int temp;
        temp = x;
        x = y;
        y = temp;
        return;
}
```

When we leave a function via a “return”, the stack frame is deleted, and those variables are removed from memory

main()
x: 5 @ 0001
y: 9 @ 0002

Inside the Stack Pointer_fun.c (Now with pointers)

```
int main(int argc, char **argv) {
        int x;
        int y;
        x = 5;
        y = 9;
        swap_pointers(&x, &y);
        return 0;
}

void swap_pointers(int *x, int *y) {
        int temp;
        temp = *x;
        *x = *y;
        *y = temp;
        return;
}
```

main()
x: 312341@ 0001

Inside the Stack Pointer_fun.c (Now with pointers)

```
int main(int argc, char **argv) {
        int x;
        int y;
        x = 5;
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        swap_pointers(&x, &y);
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        int temp;
        temp = *x;
        *x = *y;
        *y = temp;
        return;
}
```

main()
x: 312341@ 0001
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Inside the Stack Pointer_fun.c (Now with pointers)

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        int x;
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        int temp;
        temp = *x;
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        *y = temp;
        return;
}
```

main()
x: 5 @ 0001
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Inside the Stack Pointer_fun.c (Now with pointers)

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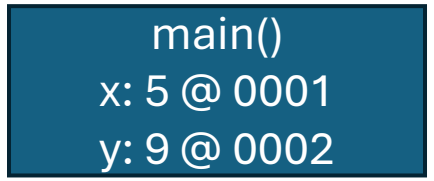

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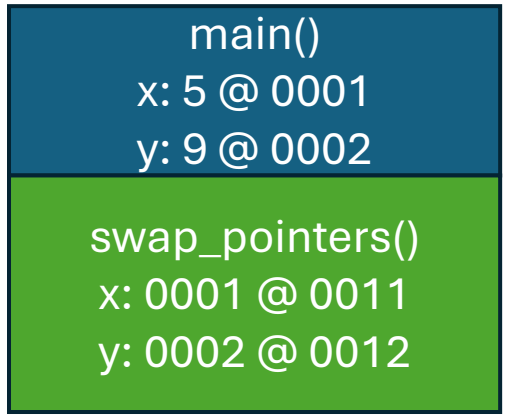

Since we want to use the same x & y in the function we call, we use &x and &y to send their addresses instead.
The pointers in the swap_pointers parameters can then store the address and reference the same x & y at 0001 and 0002

Inside the Stack Pointer_fun.c (Now with pointers)

```
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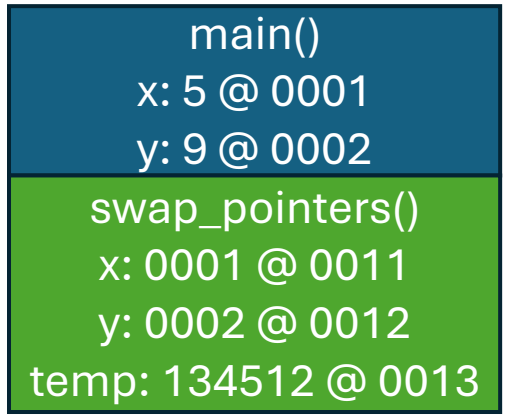

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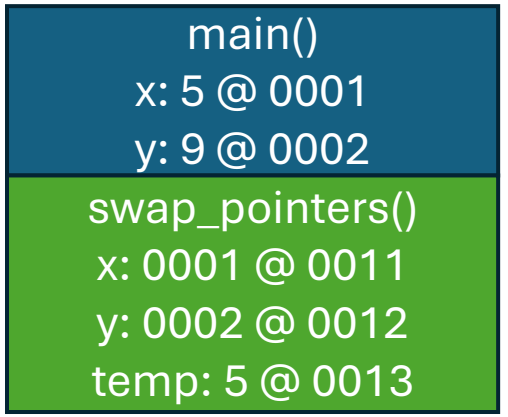
}
```

Since we dereference x, we set temp to 5 – the number at address 0001 – instead of 0001 itself



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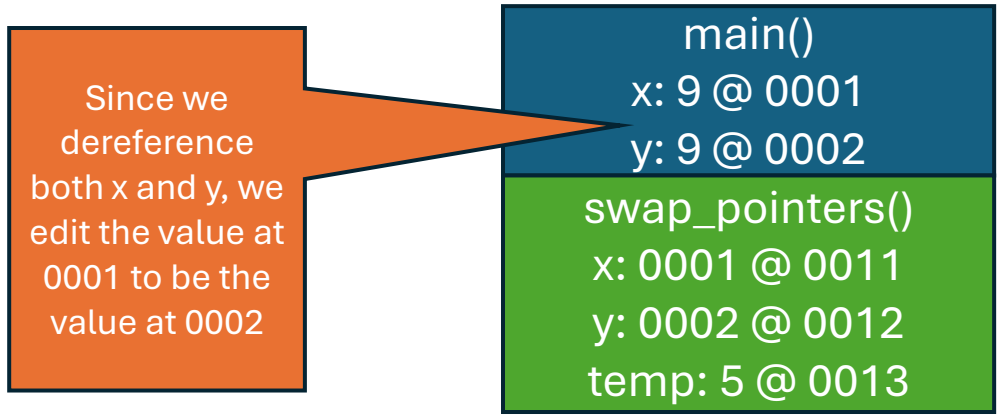

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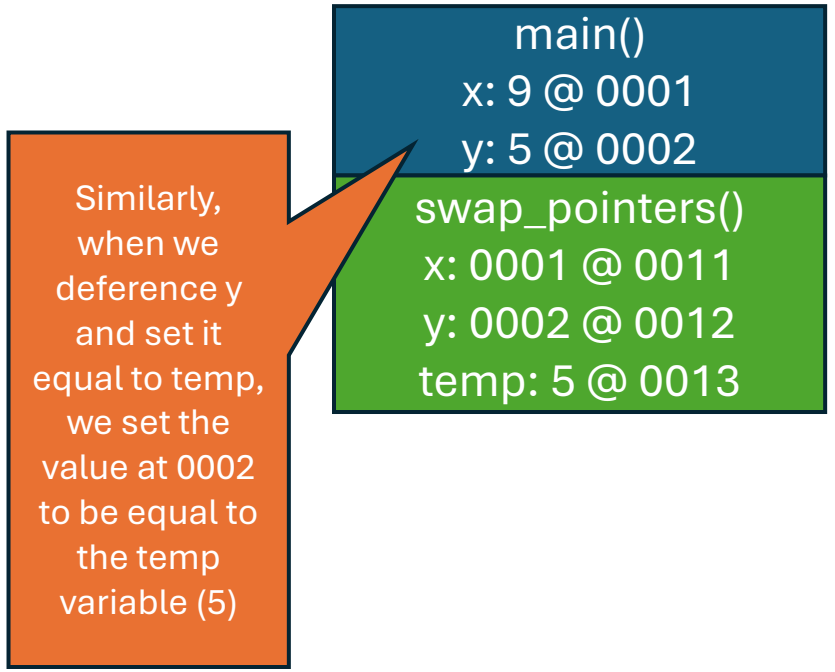

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        int temp;
        temp = *x;
        *x = *y;
        *y = temp;
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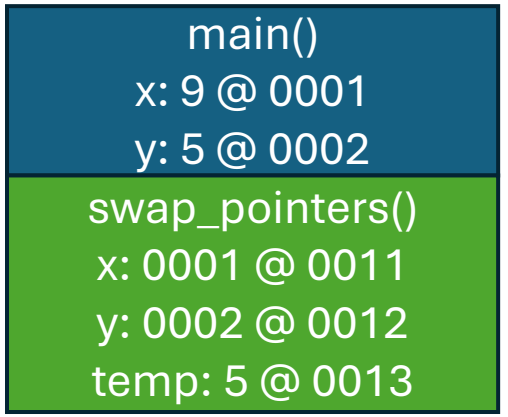
}
```

If we called another function here instead of returning, another new frame will be added.

Always we add a frame when a function is called, and delete that frame once we hit the “return” from that function



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        int temp;
        temp = *x;
        *x = *y;
        *y = temp;
        return;
}
```

main()
x: 9 @ 0001
y: 5 @ 0002

Again, since we hit a return, we delete the stack frame of the function we return from