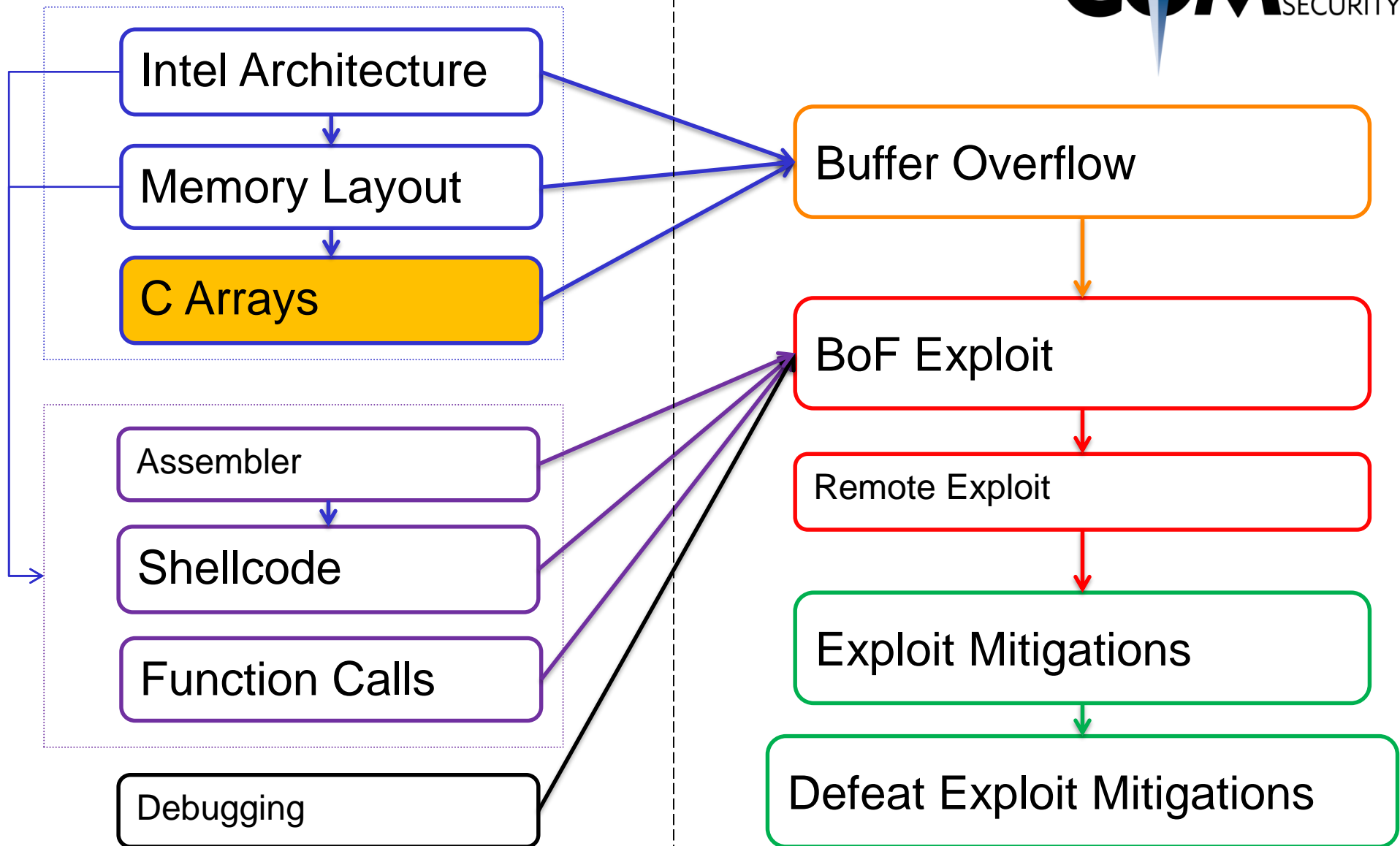


# C Arrays and Pointers

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Valid C code:

```
int array[5] = {1, 2, 3, 4, 5};
```

```
array[0] = 0;
```

```
array[4] = 0;
```

Valid C code:

```
int array[5] = {1, 2, 3, 4, 5};
```

```
array[0] = 0;
```

```
array[4] = 0;
```

```
array[5] = 0;
```

```
array[-1] = 0;
```

```
array[100] = 0;
```

```
printf("%i", array[1024]);
```

**“Valid”!**

Valid C code:

```
int array[5] = {1, 2, 3, 4, 5};
```

```
int *a = array;
```

```
a += 100;
```

```
*a = 0;
```

array	=	a	=	0x1000
array[2]	=	a + 2 * 4	=	0x1008
array[100]	=	a + 2 * 100	=	0x10C8

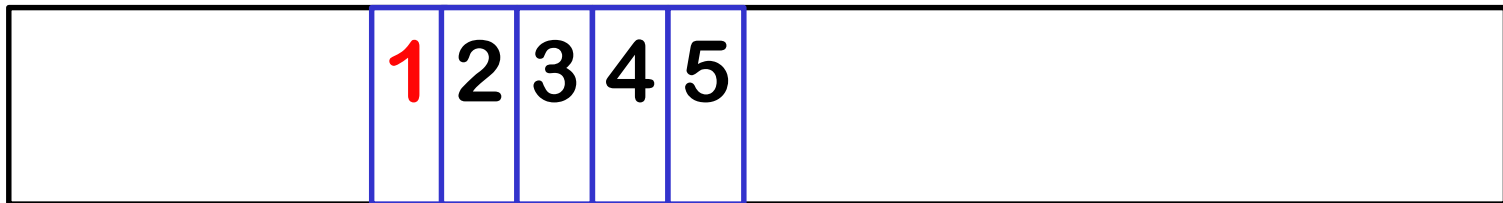
(int is 32 bit = 4 bytes)

Valid C code:

```
int array[5] = {1, 2, 3, 4, 5};
```

```
int *a = array;
```

**\*array = \*a = 1**

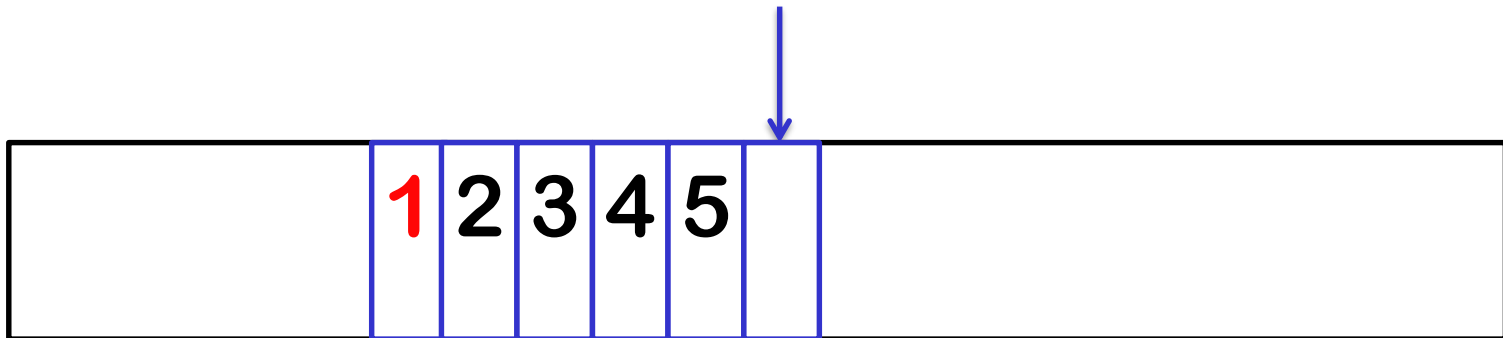


Valid C code:

```
int array[5] = {1, 2, 3, 4, 5};
```

```
int *a = array[5];
```

**\*array[5] = \*a = ?**





Other c code:

```
int a = 42;  
int *b = &a;
```

```
printf("%i", a);      // 42  
printf("%i", *b);    // 42
```

```
b++;
```

```
printf("%i", *b);    // ??
```

Other c code:

```
int a = 42;  
int *b = &a;
```

```
printf("%i", a);      // 42  
printf("%i", &a);    // 0x1000  
printf("%i", b);     // 0x1000  
printf("%i", *b);    // 42
```

```
b++;
```

```
printf("%i", b);     // 0x1004  
printf("%i", *b);    // ??
```

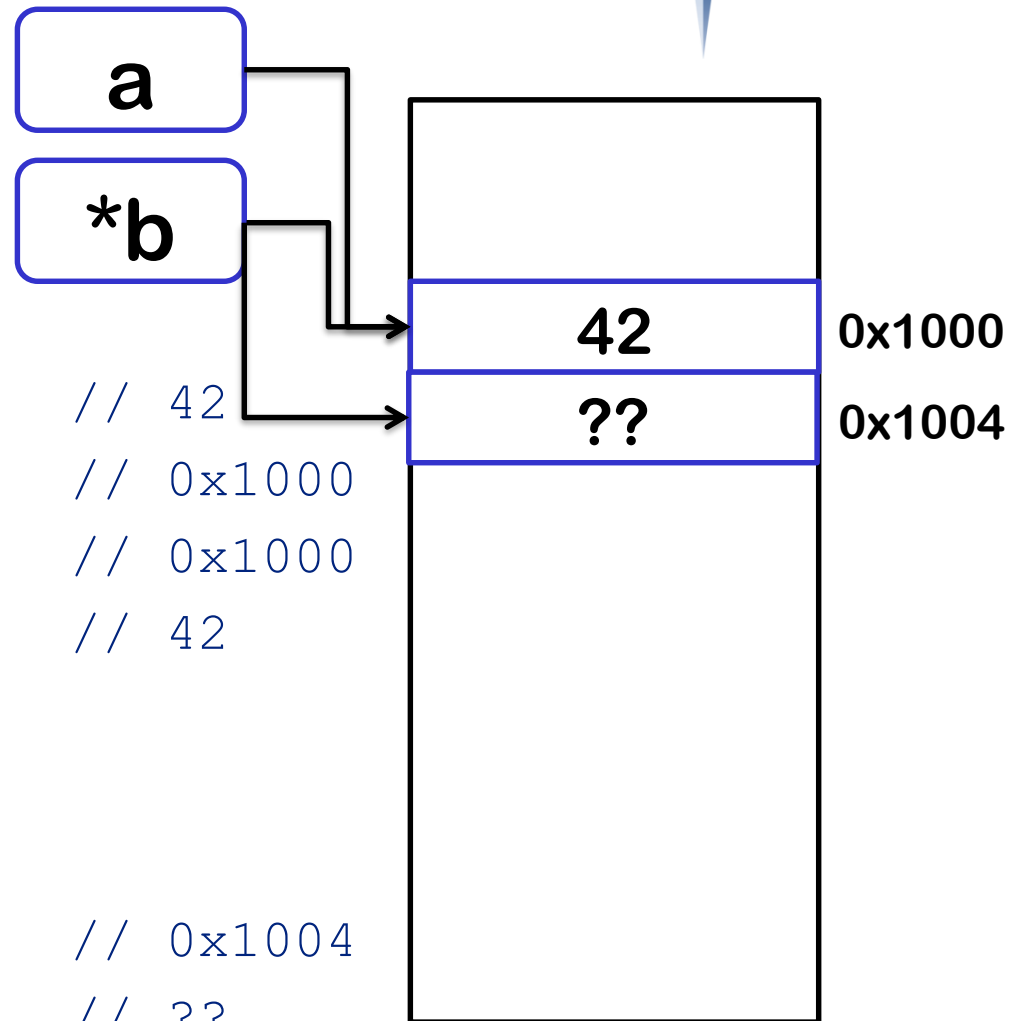
Other c code:

```
int a = 42;  
int *b = &a;
```

```
printf("%i", a);      // 42  
printf("%i", &a);    // 0x1000  
printf("%i", b);     // 0x1000  
printf("%i", *b);    // 42
```

```
b++;
```

```
printf("%i", b);     // 0x1004  
printf("%i", *b);    // ??
```



A vertical strip on the left side of the page shows a close-up of a computer keyboard with a yellow padlock resting on one of the keys.

strcpy()

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What is a common vulnerability?

```
strcpy(destination, source);  
strcpy(d, "Hallo");
```

What is a common vulnerability?

```
strcpy(destination, source);  
strcpy(d, "Hallo");
```

How much does strcpy() actually copy?

- ✦ Until source "ends"
- ✦ Where is the end?
- ✦ 0 byte \x00

"Hallo\x00"

strcpy() does not care about destination size

At all...

```
char destination[8];
```

```
char source[16] = "1234567890123456"
```

```
strcpy(destination, source);
```

strcpy() does not care about destination size

At all, because:

```
char destination[8];  
char *d = &destination;  
char source[16] = "1234567890123456"  
  
strcpy(d, source);
```



## Non-Arrays in C

C has:

- ✦ Basic Types (int, float)
- ✦ Enumerated Types
- ✦ Void Type (void)
- ✦ Derived Types

Derived types:

- ✦ Pointers
- ✦ Arrays
- ✦ Structure
- ✦ Union
- ✦ Function

**Arrays:** Multiple elements of the **same type** behind each other

**xxx** var[3] :



**Structs:** Multiple elements of **different types** behind each other

```
struct var {  
    short x;  
    long y;  
    char z[3];  
}
```



Enum is a special case of integer

Union is a special case of struct

Remember:

**Basic types** are stored **in memory**, and can be loaded into **registers**

- ✦ Pointers are a bit special basic type (they can be dereferenced), but are otherwise identical

**Derived types** are stored **in memory**, and **contain basic types**

- ✦ They cannot be loaded into a register, only some of their content can

Both are stored somewhere in memory, and therefore have an **address**.

**Basic types** are **modified in registers**

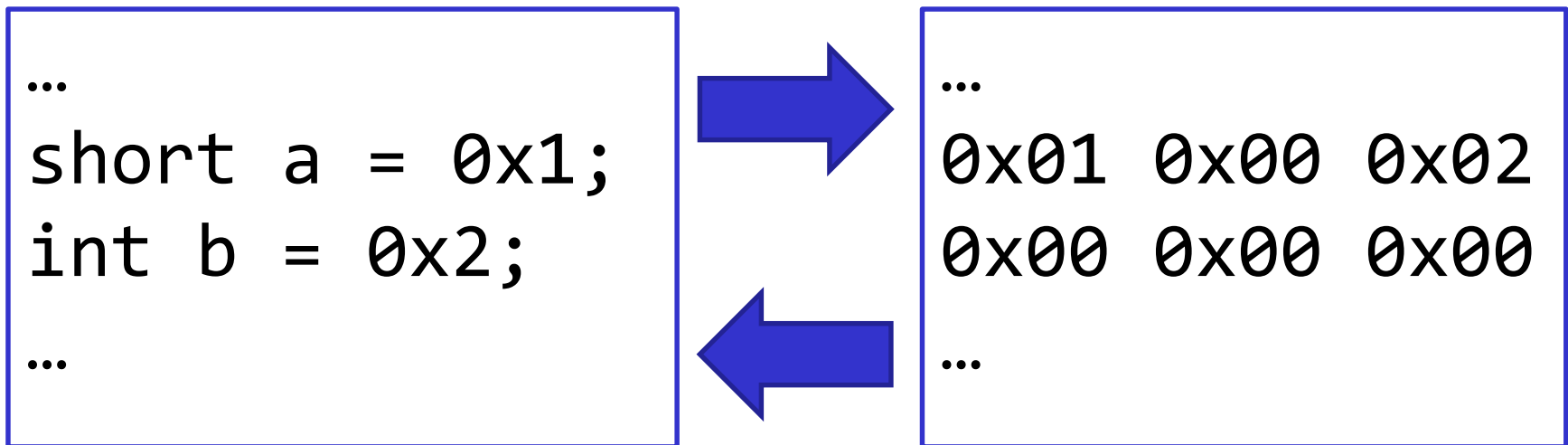
- ✦ Load from memory to register, modify, store into memory

## Developers:

- ✦ The memory holds some variables of mine, which hold my data

## Hackers:

- ✦ The memory contains data, which is associated with some variables



A vertical strip on the left side of the slide shows a close-up of a computer keyboard. A yellow padlock is attached to the keyboard, specifically over the 'Enter' key. The image is slightly blurred and has a blue tint.

## Conclusion

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## Recap:

- ✦ C does not care about buffer boundaries
- ✦ strcpy() does not care about size of destination buffer (only 0-byte in source buffer)
- ✦ One buffer can overflow into another buffer
- ✦ Local variables/buffers are adjoin to each other
- ✦ Pointer can point to any memory address