| Pointers          |   |
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# **Pointers** ..... **Memory** - All data (variables) are stored in memory - You can think of memory as a big grid - Each segment of this grid has a unique identifier Visualising memory with addresses

## So far, we have only dealt with values

- We can also access the address
- By storing that address in a variable, we have a pointer

| temory    | 32 bits | _       |           |        |         |
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#### **Pointer Syntax**

#### To declare a pointer

<type> \*
<name of variable>

^ The \* means don't request the storage to store <type>, but requests memory to store a memory address of <type>

#### Syntax example:

int \*pointer

struct student

\*student

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## Visualise pointer declaration

// declare a pointer to an
integer
int \*number; // operating
system returns 0x17

| 0×01: 'a' | 0×02: 0.35 |                 |                         |
|-----------|------------|-----------------|-------------------------|
|           |            |                 |                         |
|           |            |                 |                         |
| 0×19: 'J' | 0×20: 'A'  | 0×21: 'k'       | 0×21: 'E'               |
|           |            |                 |                         |
|           |            |                 |                         |
|           | 0×19: U    | 0×19: U 0×20: W | 0×19: U 0×20: W 0×21: K |

| Address of operator | 8 |
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- What if we want to query what the address of a variable is?
- We can use the address\_of operator:

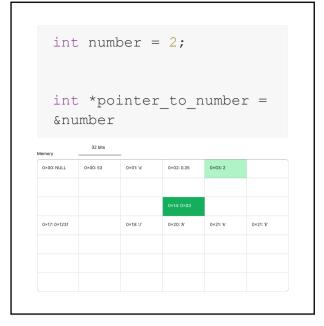
&

#### Syntax of address of: &

<variable>

#### **Example**

int number = 2; &number // the address
of number



#### **Dereferencing**

- Dereferencing is simply accessing the value at the address of a pointer
- It uses the \* symbol again (which causes confusion)
- \*my\_int\_pointer -> will
  get the integer at the
  address location

#### Three components to pointers in code

```
int main(void) {
    // Declare an integer
    int my_age = 23;

    // Declare an integer pointer
    // Assign it the address of my_age
    int *pointer_to_my_age = &my_age;

    // Print out the address and value
at the pointer
    printf("Pointer is: %p value is:
%d\n", pointer_to_my_age,
*pointer_to_my_age)
    return 0;
}
```

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### **Common mistakes** int number; int \*number ptr; number ptr = 1. number; 2. \*number ptr = &number; ..... Syntax cheat sheet - Declare a pointer: int \*int pointer; - Address of: &my variable; - Dereference (Get the value at a pointer): \*int pointer; **Demo** Goals: Create a variable Get the address of that variable Create a pointer variable Use it!

## But JAKE, why are they *USEFUL*

 Let's look at an example with pointers and parameters

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# How can we edit a variable within a function?

#### Pass by reference\*

 Technically pass-reference-by-value but it's fine!

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In the previous example, by passing the memory ...... address, we can change ..... the value in place and main will point to the updated ...... value! ..... ..... ..... pointers and arrays void double\_array\_of\_ints(int data[], int size) { for (int I = 0; I < size; I++) data[i] = data[i] \* 2; int main(void) { int data $[5] = \{1, 2, 3, 4, 5\};$ double\_array\_of\_ints(data, 5); //is data doubled? ^ does data in main contain the doubled values?

......

How?

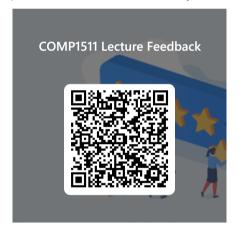
#### **Arrays decay to pointers**

- Arrays point to the memory location which contains the first element
- As arrays are contiguous, we can then move through the memory sequentially to find the next values
- Very cool!

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#### Feedback

https://forms.office.com/r/K3PjvWebtD



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