C-Programming Review
Pointers & Arrays

Computer Science Department
University of Central Florida

COP 3502 – Computer Science I

POINTERS

Review of pointers

- What is a Pointer?
  - **An Address!**

Review of pointers

- A pointer is just a memory location.
- A memory location is simply an integer value, that we interpret as an address in memory.
- The contents at a particular memory location are just a collection of bits – there's nothing special about them that makes them `int`s, `char`s, etc.
  - How you want to interpret the bits is up to you.

  - Is this... an `int` value?

    ... a pointer to a memory address?

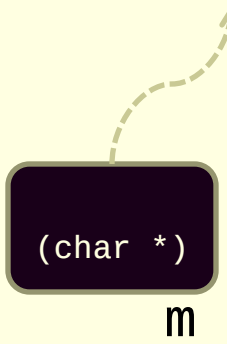
    ... a series of `char` values?

Review of pointer variables

- A pointer variable is just a variable, that contains a value that we interpret as a memory address.
- Just like an uninitialized int variable holds some arbitrary “garbage” value,

  an uninitialized pointer variable points to some arbitrary “garbage address”

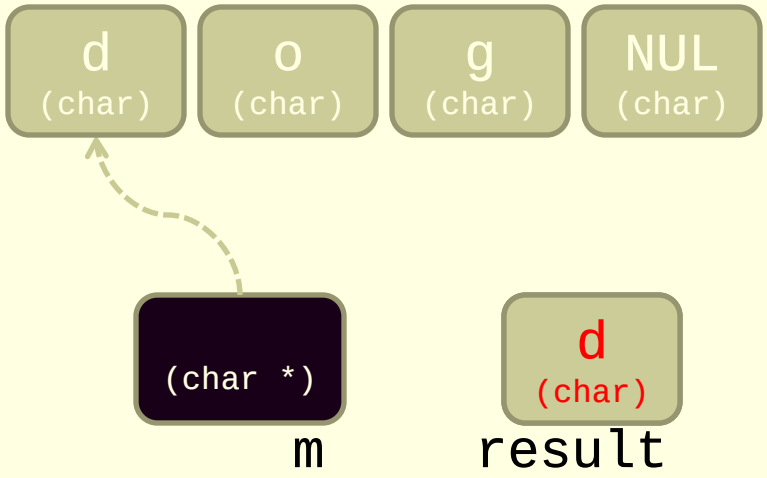
```
char *m;
```



Indirection operator *

- Moves from address to contents

```
char  *m = "dog";

char result = *m;
```



`m` gives an address of a `char`

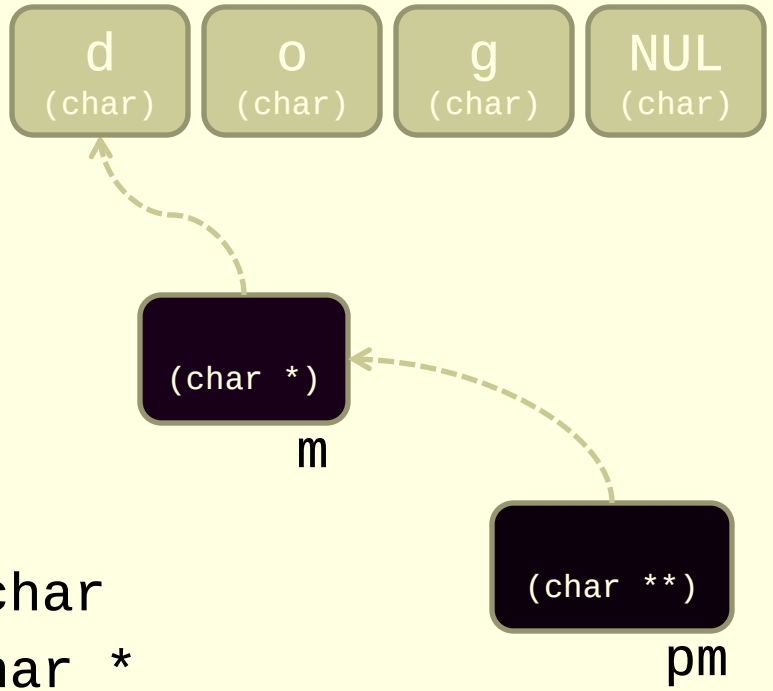
`*m` instructs us to take the contents of that address

`result` gets the value `'d'`

Address operator &

- Instead of contents, returns the address

```
char  *m = "dog",
      **pm = &m;
```



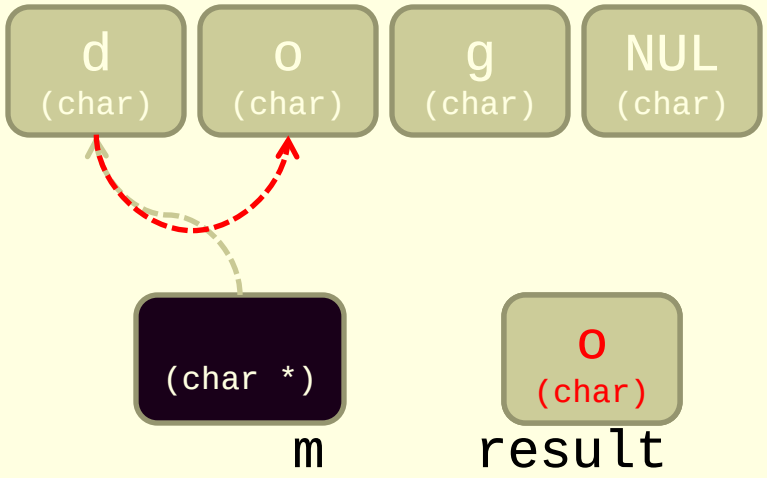
pm needs a value of type `char **`

- Can we give it `*m`? No – type is `char`
- Can we give it `m`? No – type is `char *`
- `&m` gives it the right value – the *address* of a `char *` value

Pointer arithmetic

- C allows pointer values to be incremented by integer values

```
char  *m = "dog";

char result = *(m + 1);
```



`m` gives an address of a `char`

`(m + 1)` gives the `char` one byte higher

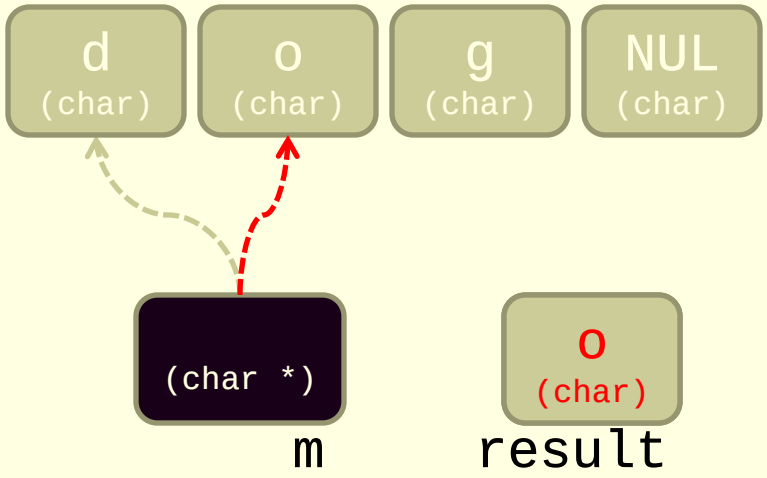
`*(m + 1)` instructs us to take the contents of that address

`result` gets the value `'o'`

Pointer arithmetic

- A slightly more complex example:

```
char  *m = "dog";

char result = *++m;
```



`m` gives an address of a `char`

`++m` changes m, to the address one byte higher,
and returns the new address

`*++m` instructs us to take the contents of that location

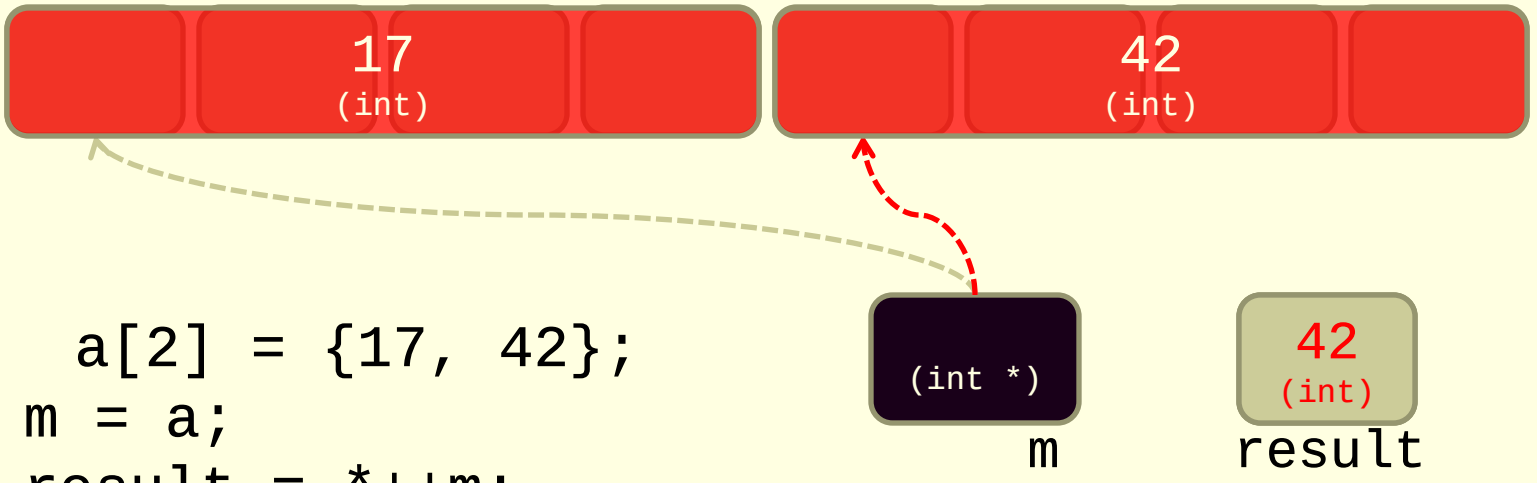
`result` gets the value `'o'`

Review of pointers

- Again:
- What is a Pointer?
  - **An Address!**

Pointer arithmetic

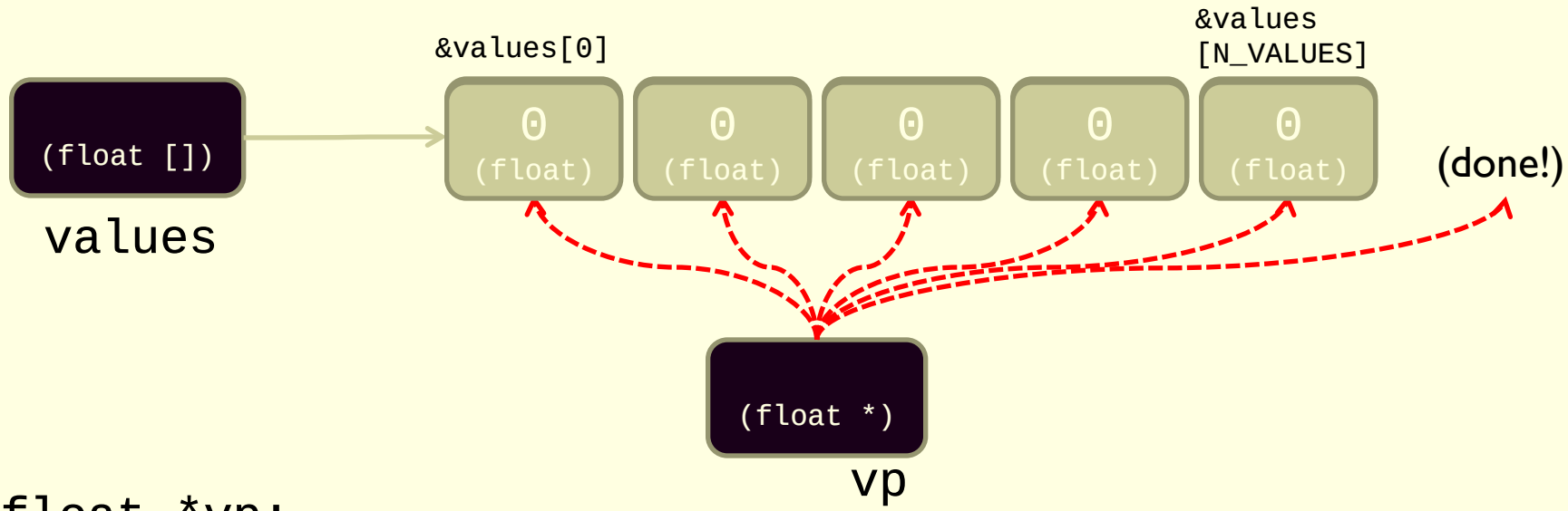
- How about multibyte values?
  - **Q:** Each `char` value occupies exactly one byte, so obviously incrementing the pointer by one takes you to a new `char` value...
    But what about types like `int` that span more than one byte?
  - **A:** C "does the right thing": increments the pointer by the size of one `int` value




```
int  a[2] = {17, 42};
int m = a;
int result = *++m;
```

Example: initializing an array

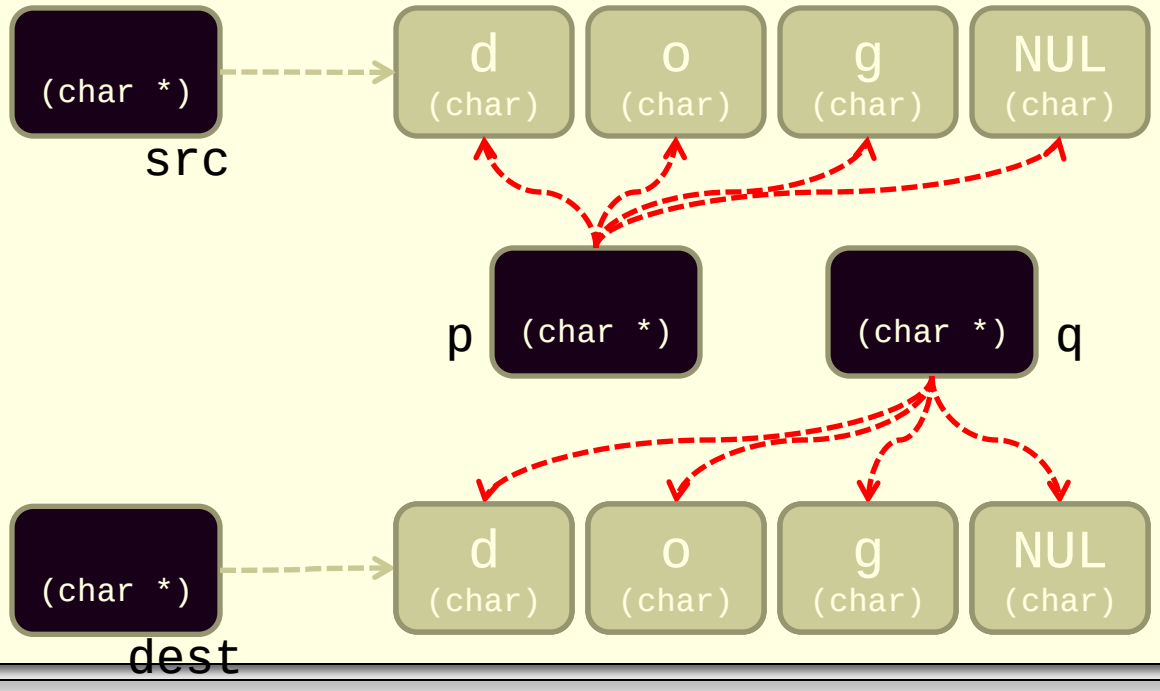
```
#define N_VALUES 5
float values[N_VALUES];
```




```
float *vp;
for ( vp = &values[0]; vp < &values[N_VALUES]; )
   *vp++ = 0;
```

Example: `strcpy` "string copy"

```
char *strcpy(char *dest, const char *src) {
   const char *p;
   char *q;
   for(p = src, q = dest; *p != '\0'; p++, q++)
      *q = *p;
   *q = '\0';
   return dest;
}
```



Review of pointers

- One final time:
- What is a Pointer?
  - **An Address!**

ARRAYS

Review of arrays

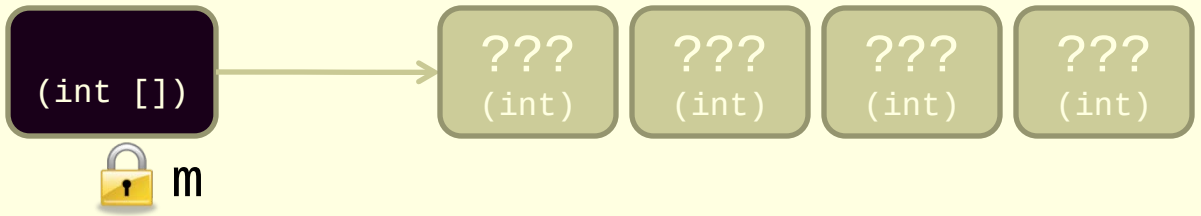
- There are no array variables in C – only array *names*
  - Each name refers to a **constant <u>pointer</u>**

Review of arrays

Review of arrays

- There are no array variables in C – only array *names*
  - Each name refers to a **constant <u>pointer</u>**
  - Space for array elements is allocated at declaration time
- Can't change where the array name refers to…
  - but you can change the array elements,

    via **<u>pointer</u> arithmetic**




```
int m[4];
```

Subscripts and pointer arithmetic

- `array[subscript]` equivalent to `*(array + (subscript))`

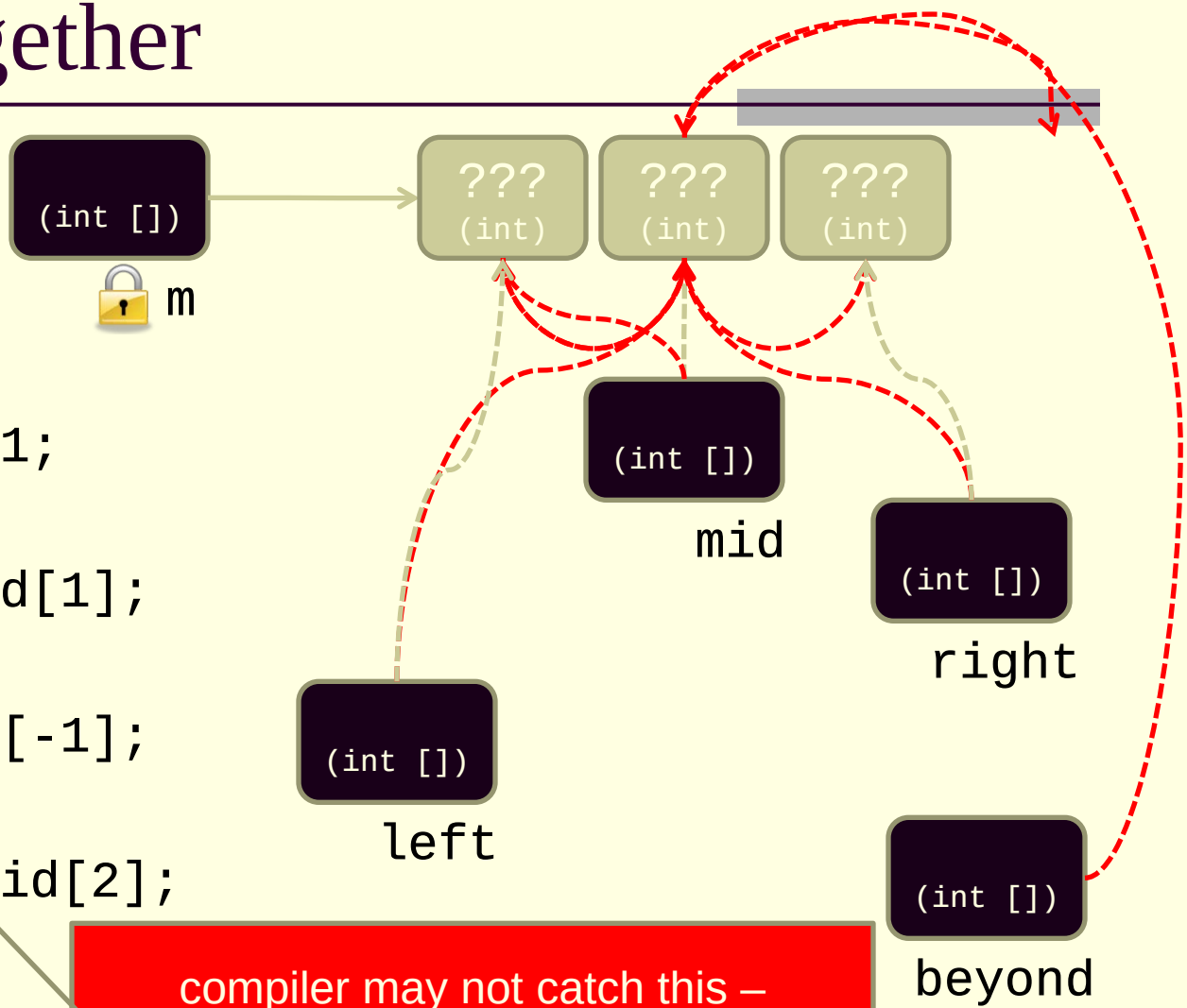
- Strange but true: Given earlier declaration of `m`, the expression `2[m]` is legal!
  - Not only that: it's equivalent to

```
*(2+m)
*(m+2)
m[2]
```

Array names and pointer variables, playing together

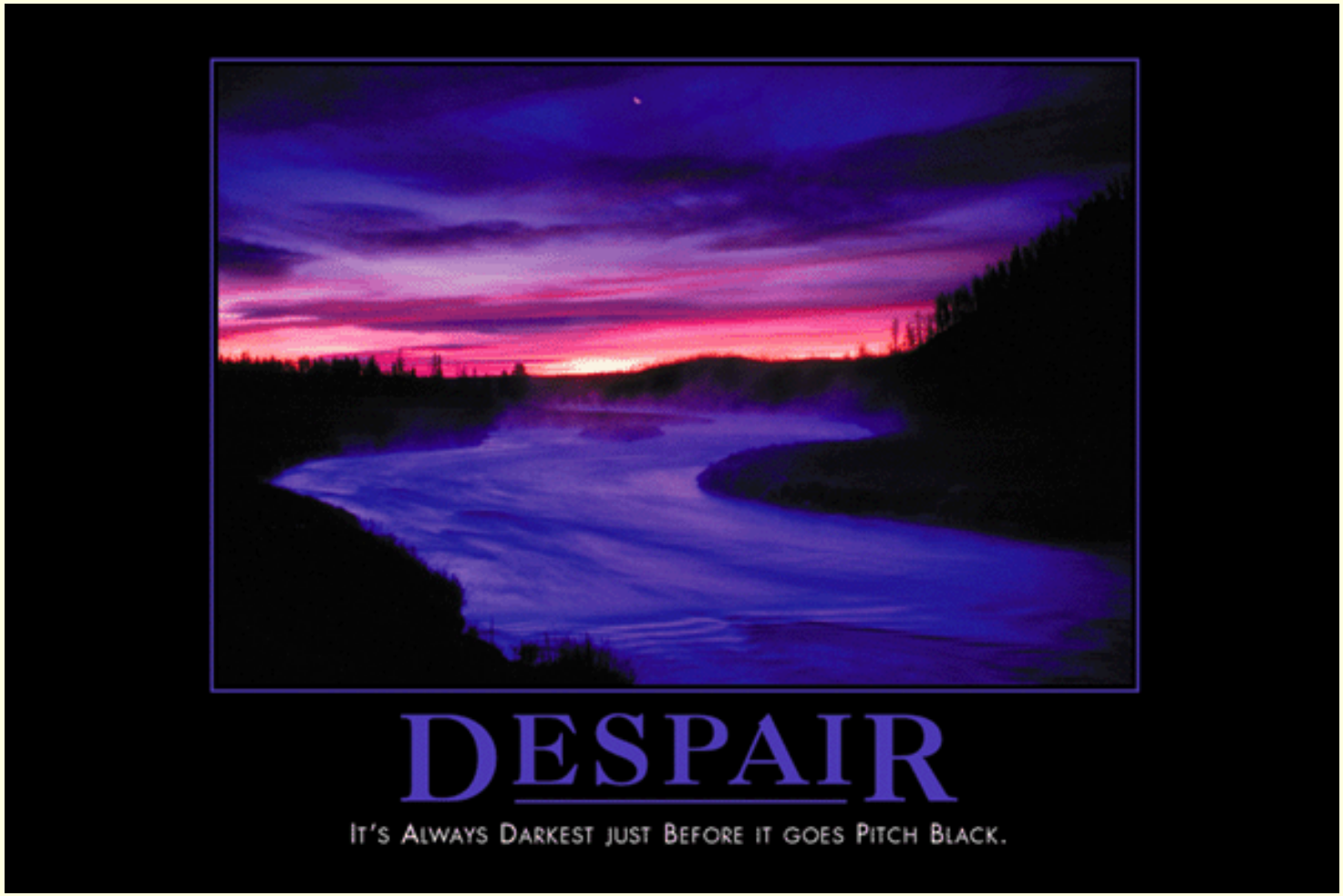
```
int m[3];

int *mid = m + 1;

int *right = mid[1];

int *left = mid[-1];

int *beyond = mid[2];
```

subscript OK with pointer variable



compiler may not catch this – runtime environment certainly won't

Demotivator Time



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