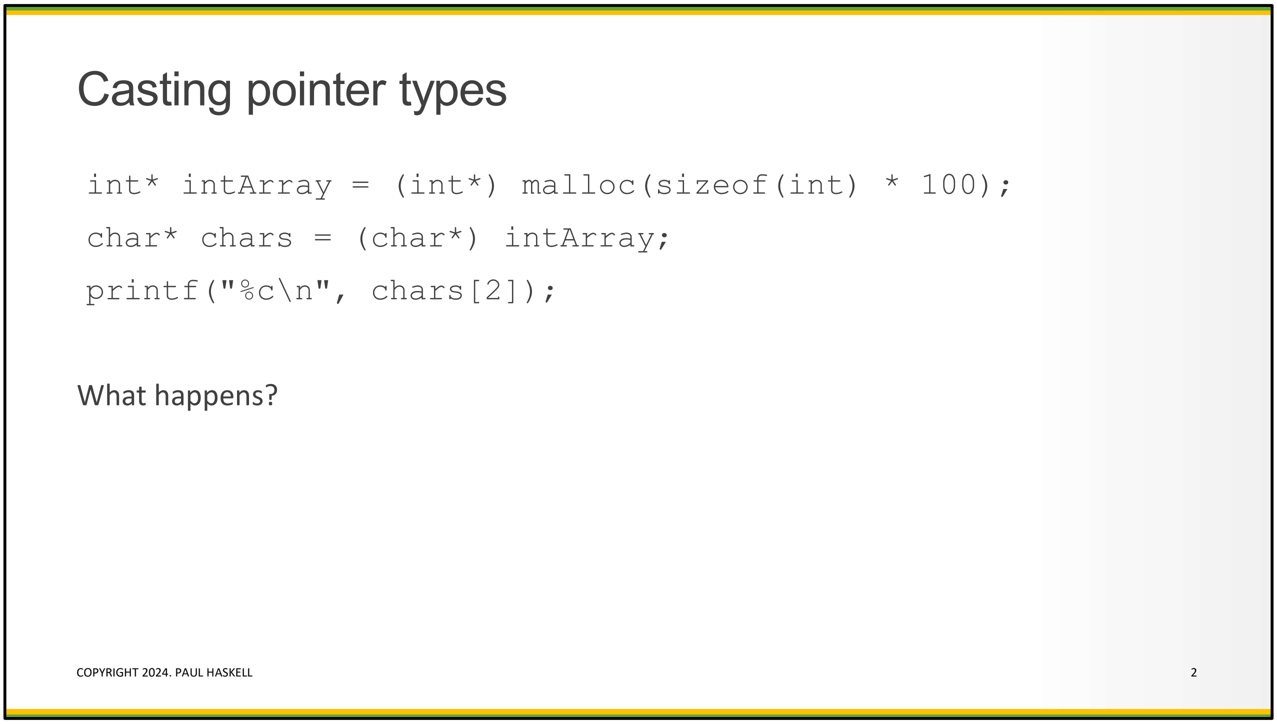
CS221
C and Systems Programming

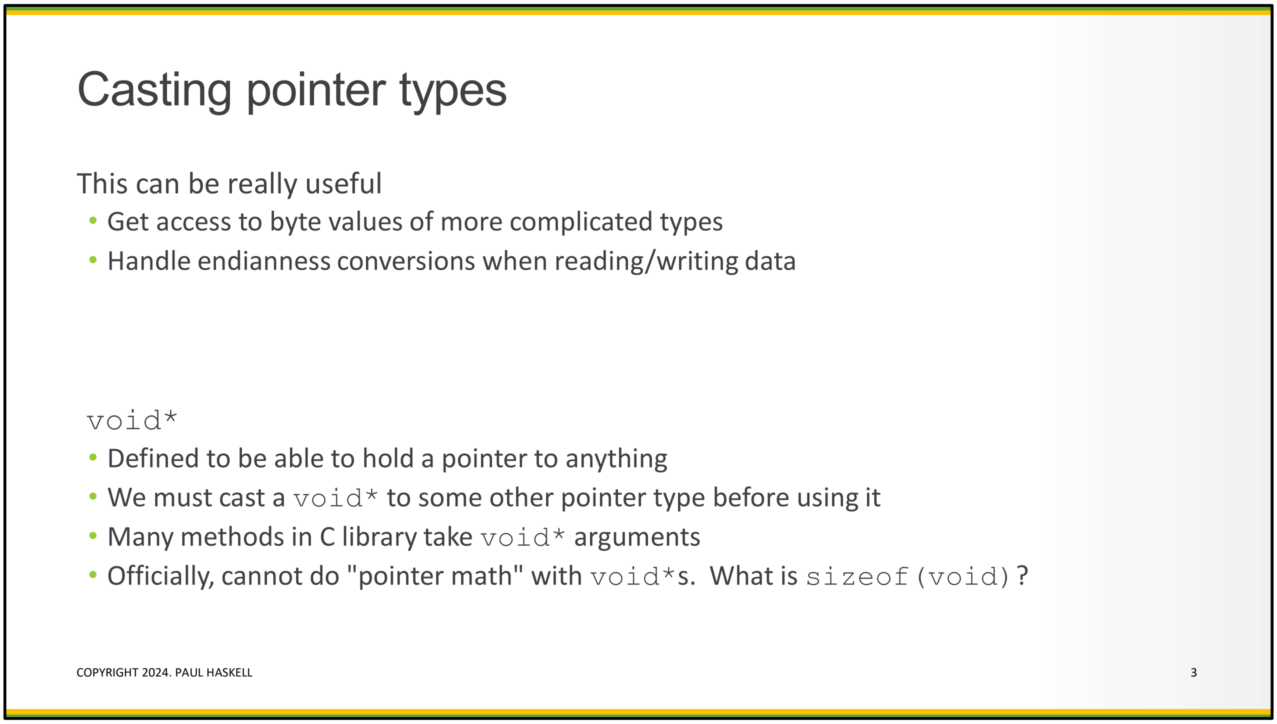


Casting pointer types

```
int* intArray = (int*) malloc(sizeof(int) * 100);
char* chars = (char*) intArray;
printf("%c\n", chars[2]);
```

What happens?

No conversions happen, no code runs. Computer INTERPRETS values in memory as an int, or a char. But values in memory don't change.
See simple.c



Casting pointer types

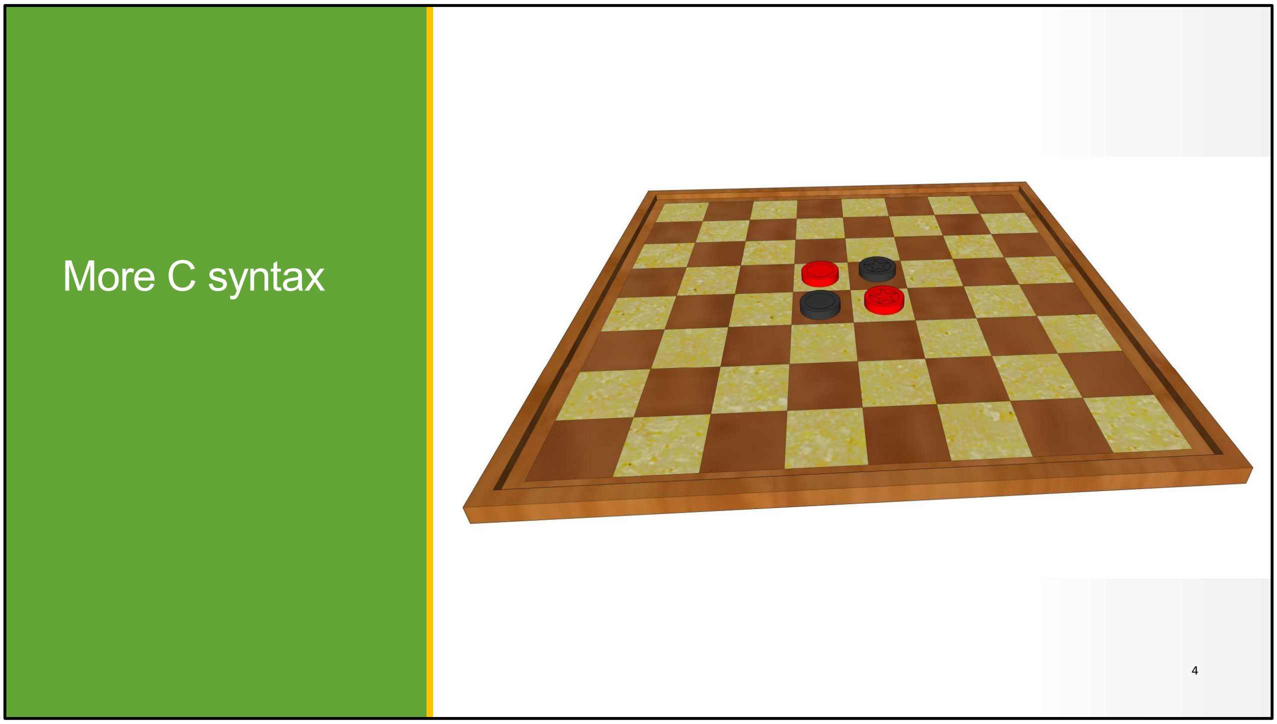
This can be really useful

- Get access to byte values of more complicated types
- Handle endianness conversions when reading/writing data

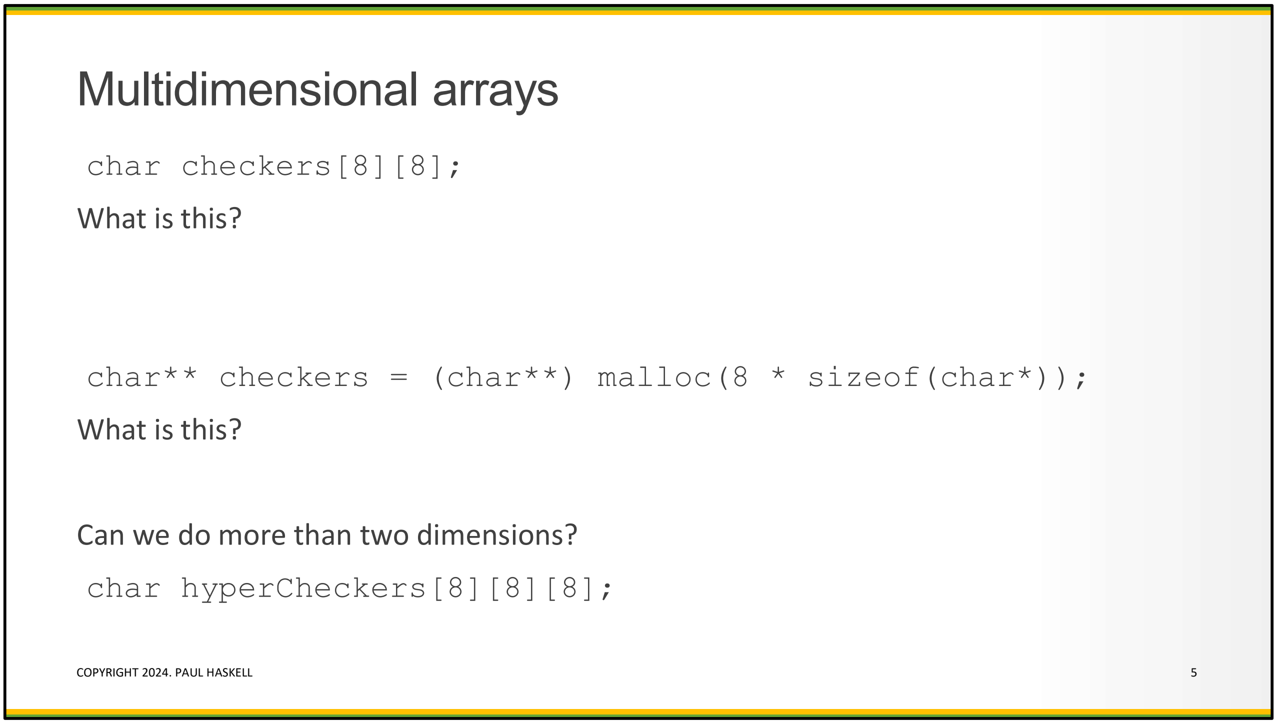
`void*`

- Defined to be able to hold a pointer to anything
- We must cast a `void*` to some other pointer type before using it
- Many methods in C library take `void*` arguments
- Officially, cannot do "pointer math" with `void*`s. What is `sizeof(void)`?

But of course this can be really dangerous!
(GNU defines sizeof(void) == 1, but NOT STANDARD)



More C syntax



Multidimensional arrays

```
char checkers[8][8];
```

What is this?

```
char** checkers = (char**) malloc(8 * sizeof(char*));
```

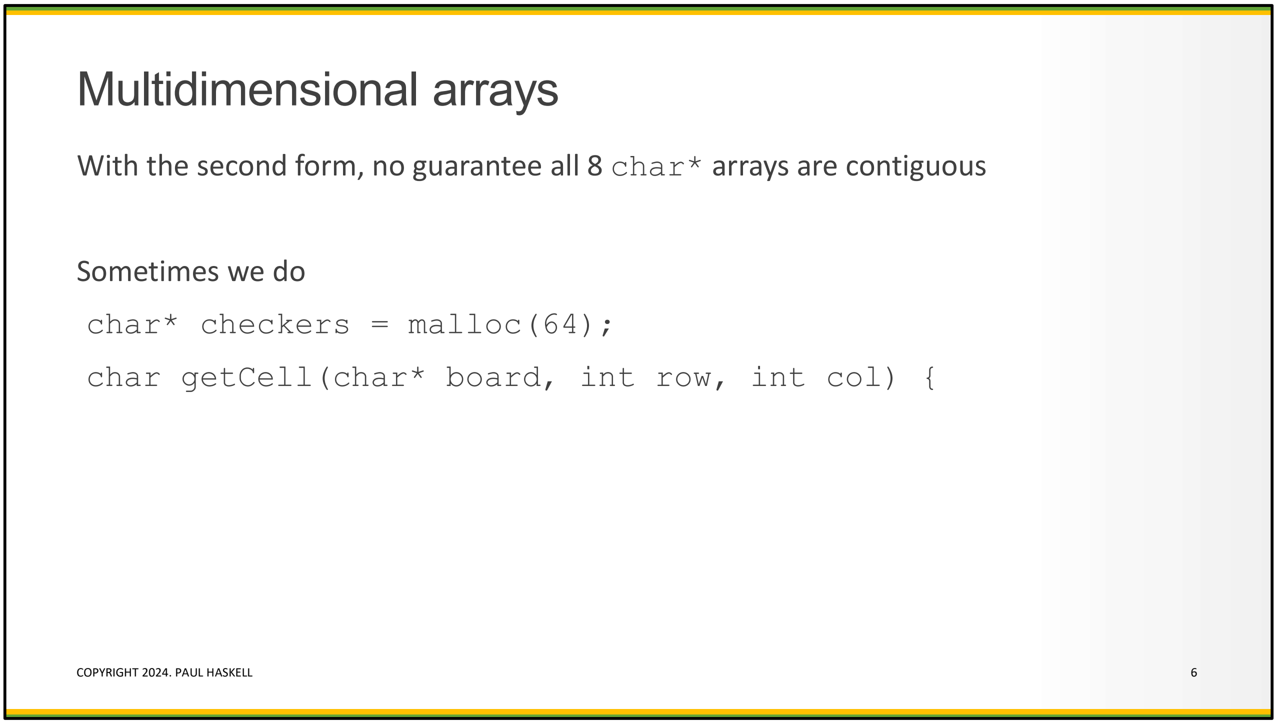
What is this?

Can we do more than two dimensions?

```
char hyperCheckers[8][8][8];
```

An array of 8 (arrays of 8 chars).
An array of 8 POINTERS TO chars. Need for(…) { checkers[i] = (char*) malloc(8); }

Pretty similar, huh? Second more work, but don't need to know sizes till runtime.



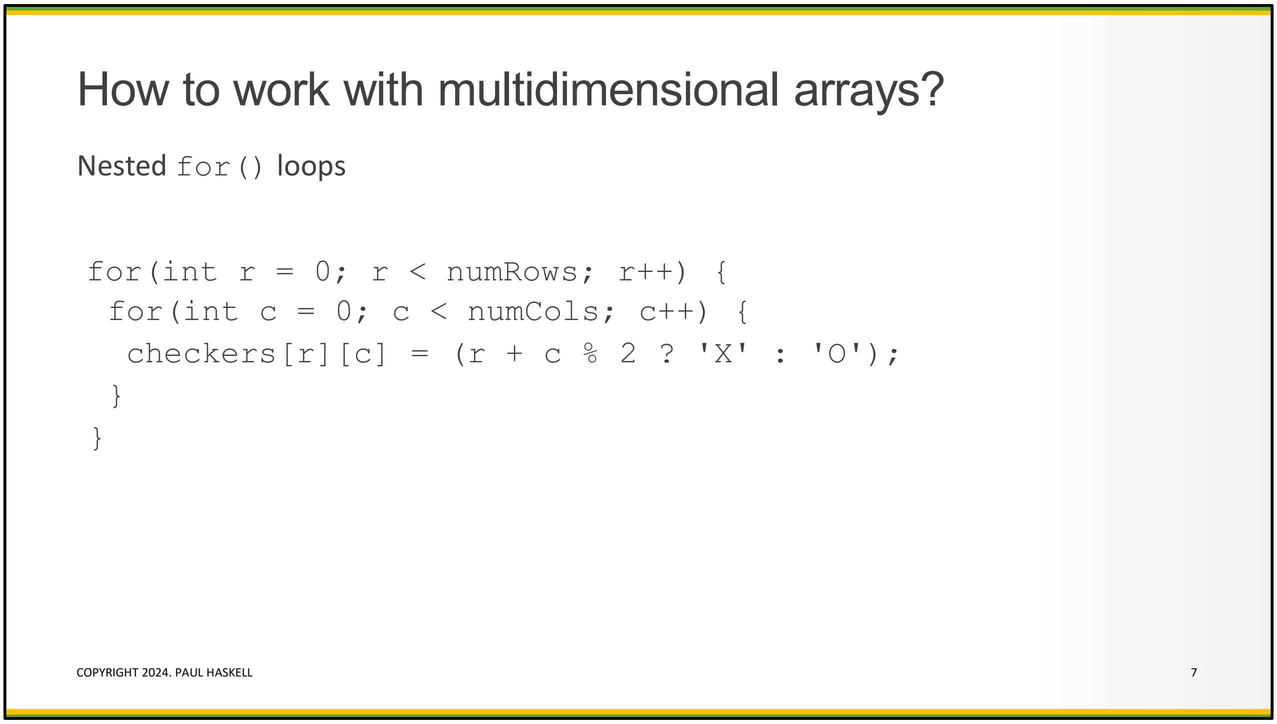
Multidimensional arrays

With the second form, no guarantee all 8 `char*` arrays are contiguous

Sometimes we do

```
char* checkers = malloc(64);
char getCell(char* board, int row, int col) {
```

What goes in the method?
return board[row*8+col]
Or
return board[row+8*col]

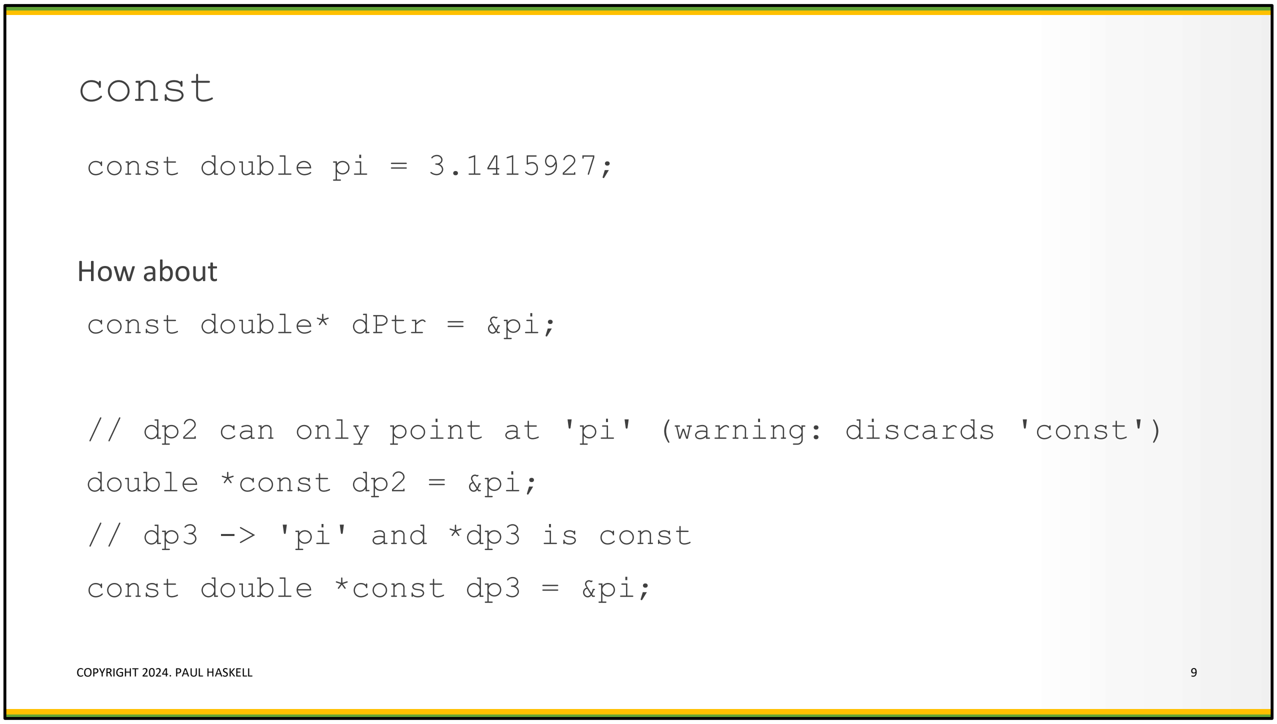


How to work with multidimensional arrays?

Nested `for()` loops

```
for(int r = 0; r < numRows; r++) {
 for(int c = 0; c < numCols; c++) {
  checkers[r][c] = (r + c % 2 ? 'X' : 'O');
 }
}
```

More new syntax



const

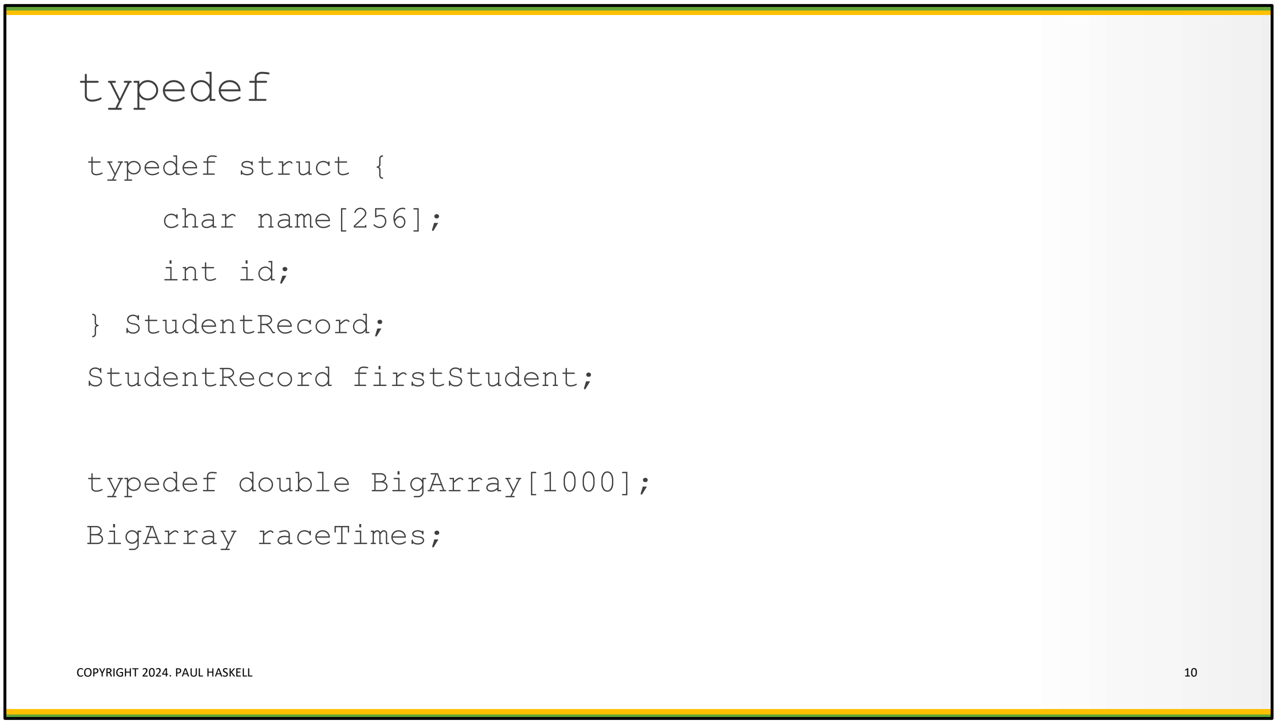
```
const double pi = 3.1415927;
```

How about

```
const double* dPtr = &pi;

// dp2 can only point at 'pi' (warning: discards 'const')
double *const dp2 = &pi;
// dp3 -> 'pi' and *dp3 is const
const double *const dp3 = &pi;
```

#1 pretty clear – just like Java's "final"
#2: Is the pointer 'const' or the double?
Read from RIGHT to LEFT: "a pointer to double that is const"
#3: const pointer to a double. Const pointer to a const double
See "constfun.c"

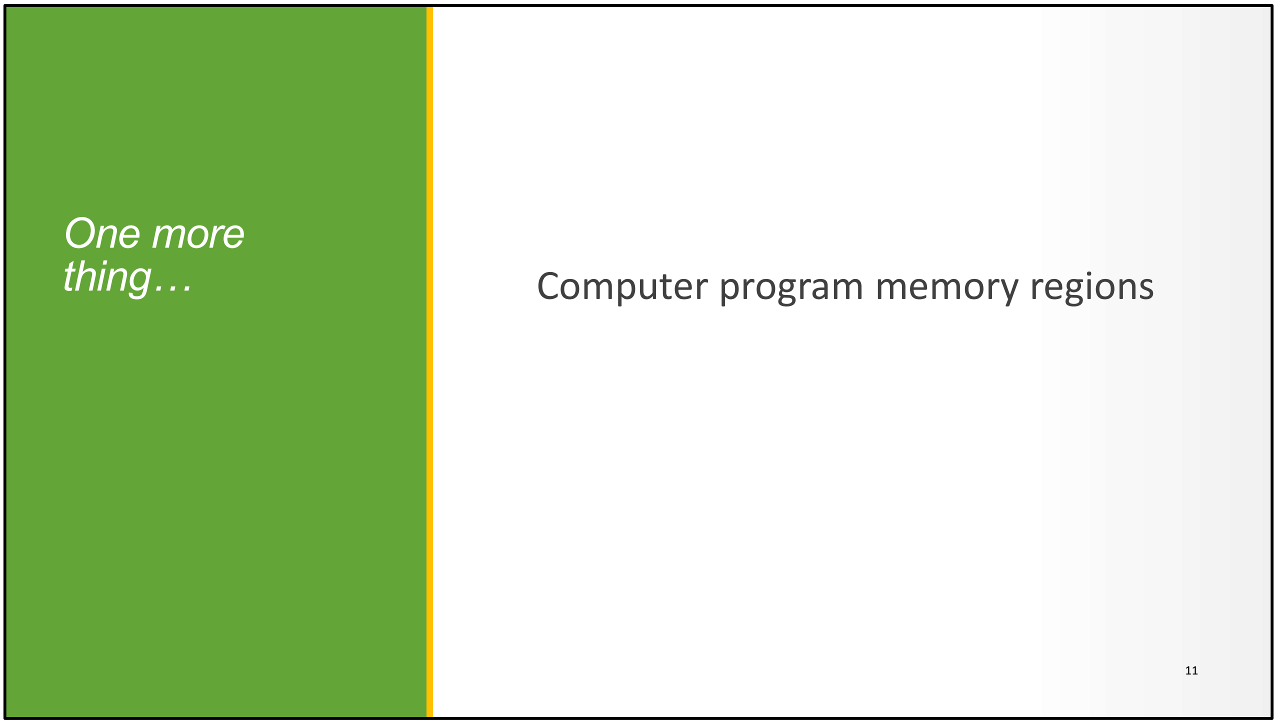


typedef

```
typedef struct {
    char name[256];
    int id;
} StudentRecord;
StudentRecord firstStudent;

typedef double BigArray[1000];
BigArray raceTimes;
```

typedef creates a new type, which can be used as if it were built in
Supposed variable name becomes the type's name



One more thing…

Computer program memory regions

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Run AddrDemo.c several times

- Stack addrs > Heap addrs
- Not always the same
- Not actual physical addresses: virtual addresses for this program. Look at how big values are!

Boundary between Heap and Stack not fixed. Heap goes UP, Stack goes DOWN.

Hopefully they don't cross!