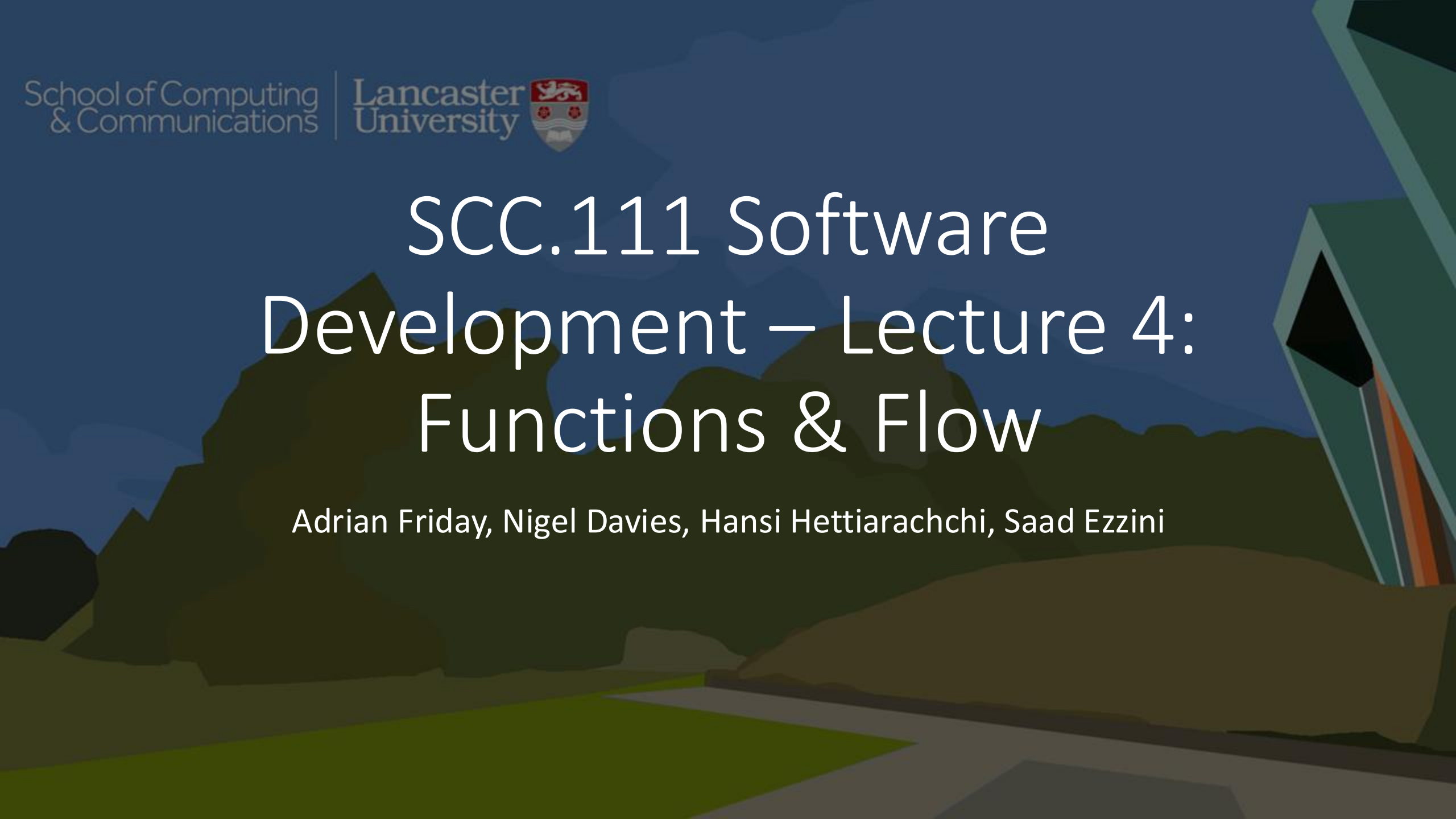


# SCC.111 Software Development – Lecture 4: Functions & Flow

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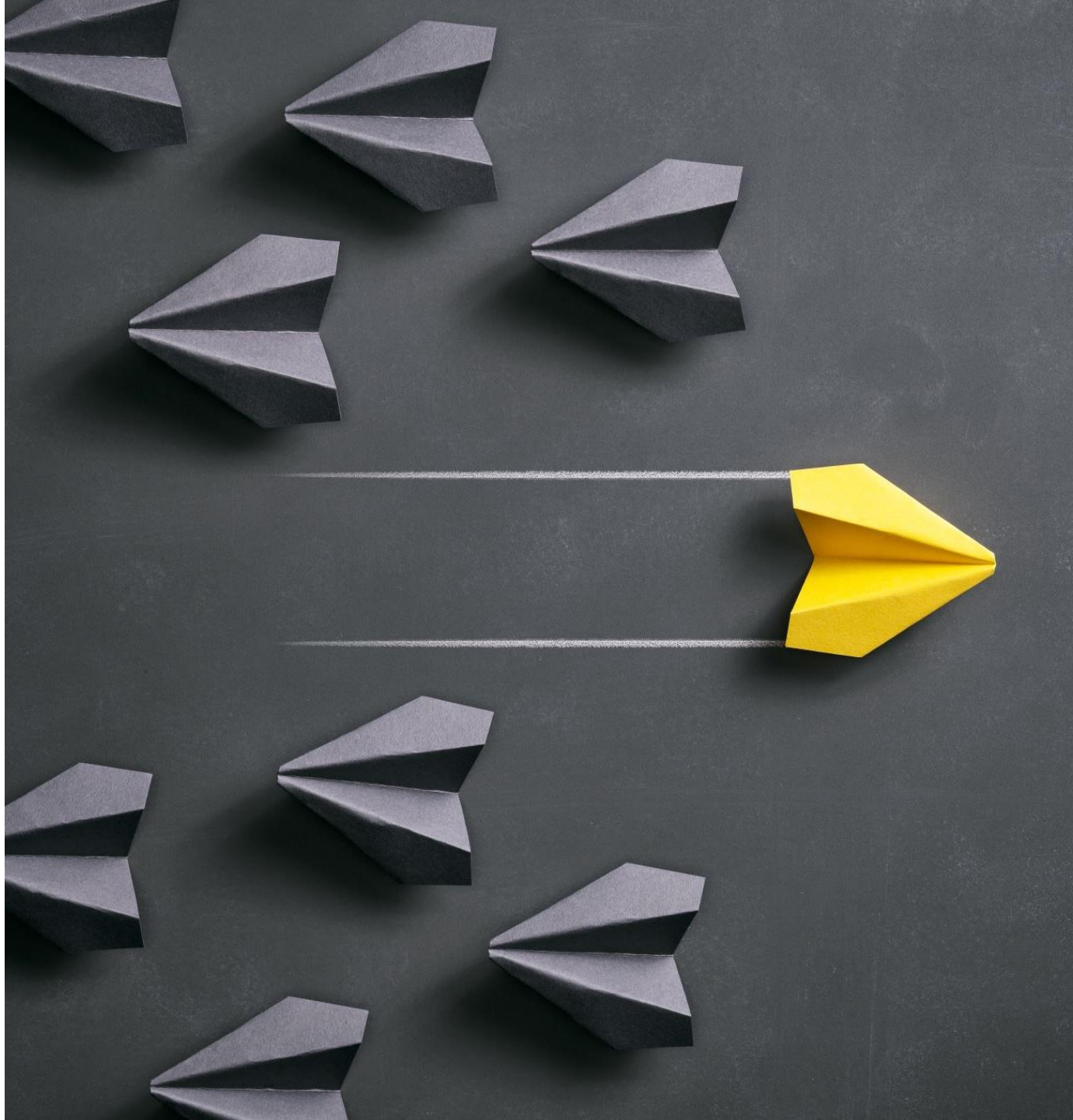
# Today: Flow into functions

- Extending our knowledge on how code flows
- How and when to declare our own functions
- Flow of data through functions (parameter passing)
- How function calls change program flow



# Recall we said that, our code moves at different scales

Between programs… (later courses…)

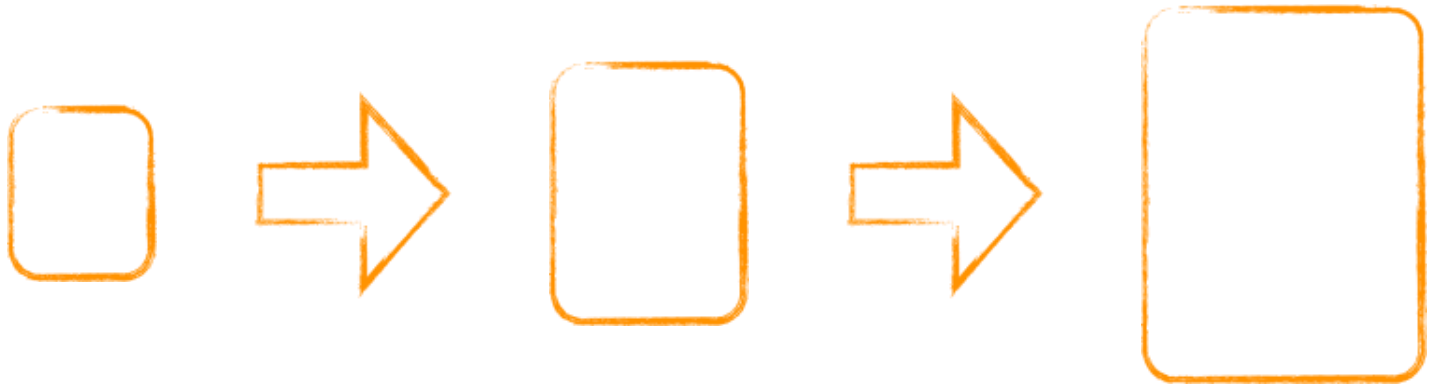
Between blocks of code (*this* lecture)

Between statements of the program (*last* lecture)

Even, within expressions within the statements as they're evaluated (*last* lecture)

# Solving by problem decomposition

- We solve pretty much all problems by repeatedly decomposing it into a series of smaller steps until the problem is tractable.



Iterative refinement

# Sometimes it makes sense

- To package up sets of statements into functional unit
- Or blocks of statements we would otherwise repeat
- Makes our code easier to maintain and reuse (we write less code and have fewer places to change it!)

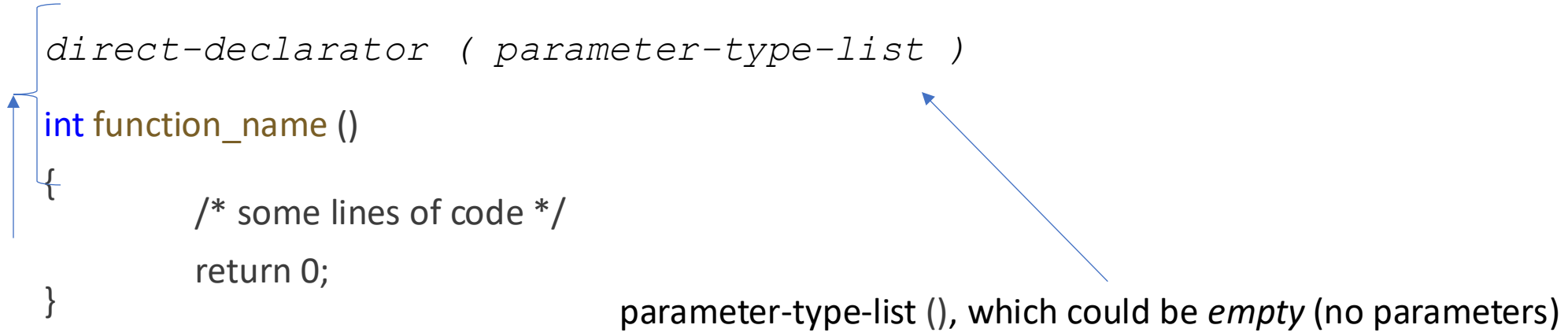

# An example

# Let’s design a solution on paper

# Functions in C

- Most programming languages give us some support for this:
  - C lets us define functions which package and name specific functionality
  - And libraries – sets of pre-compiled functions we can call (defined by header files!)
  - Later, we might even bundle up our functions to create our own libraries!

# C functions follow the form:



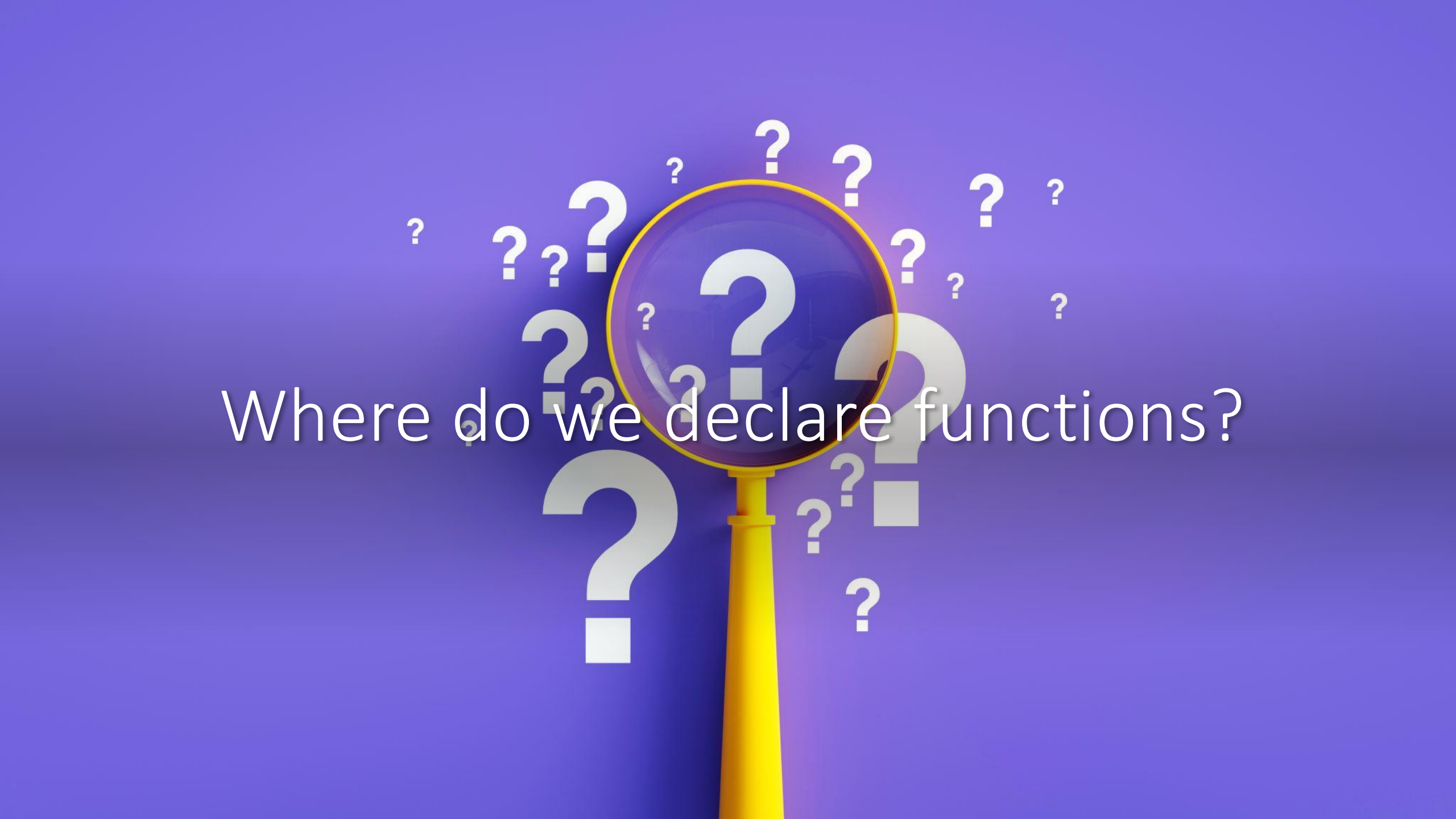

- A function may only return a simple *arithmetic type* (e.g. an ‘int’), or nothing ‘void’ (no return)
- They are followed by a *compound-statement, i.e. {…},* the function body

# Beep!

```
#include <stdio.h>

void beep(int howManyTimes)
{
  // Create ‘beeps’, set to 0, loop until beeps reaches ‘howManyTimes’ value

  for (int beeps = 0; beeps < howManyTimes; beeps++) {
    printf("Beep!\n");
    sleep(1);
  }
}

int main()
{
  // Make bigtrak beep some number of times

  beep(5);

  return 0;
}
```

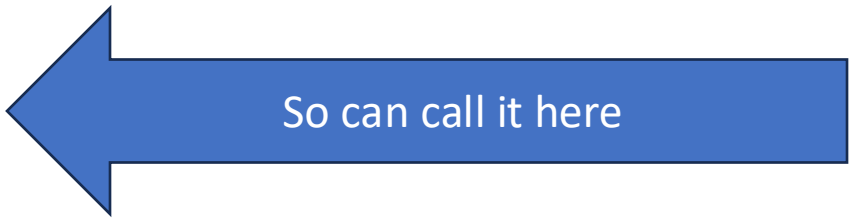
# main () as a function

```
/* I'm a function, the 'entry point' to the program
   I take no parameters and return a code to the shell
   Strictly, main is: int main(int argc, char *argv[])
   but more on this later! */

int main()
{
  // do something, then return
}
```


Where do we declare functions?

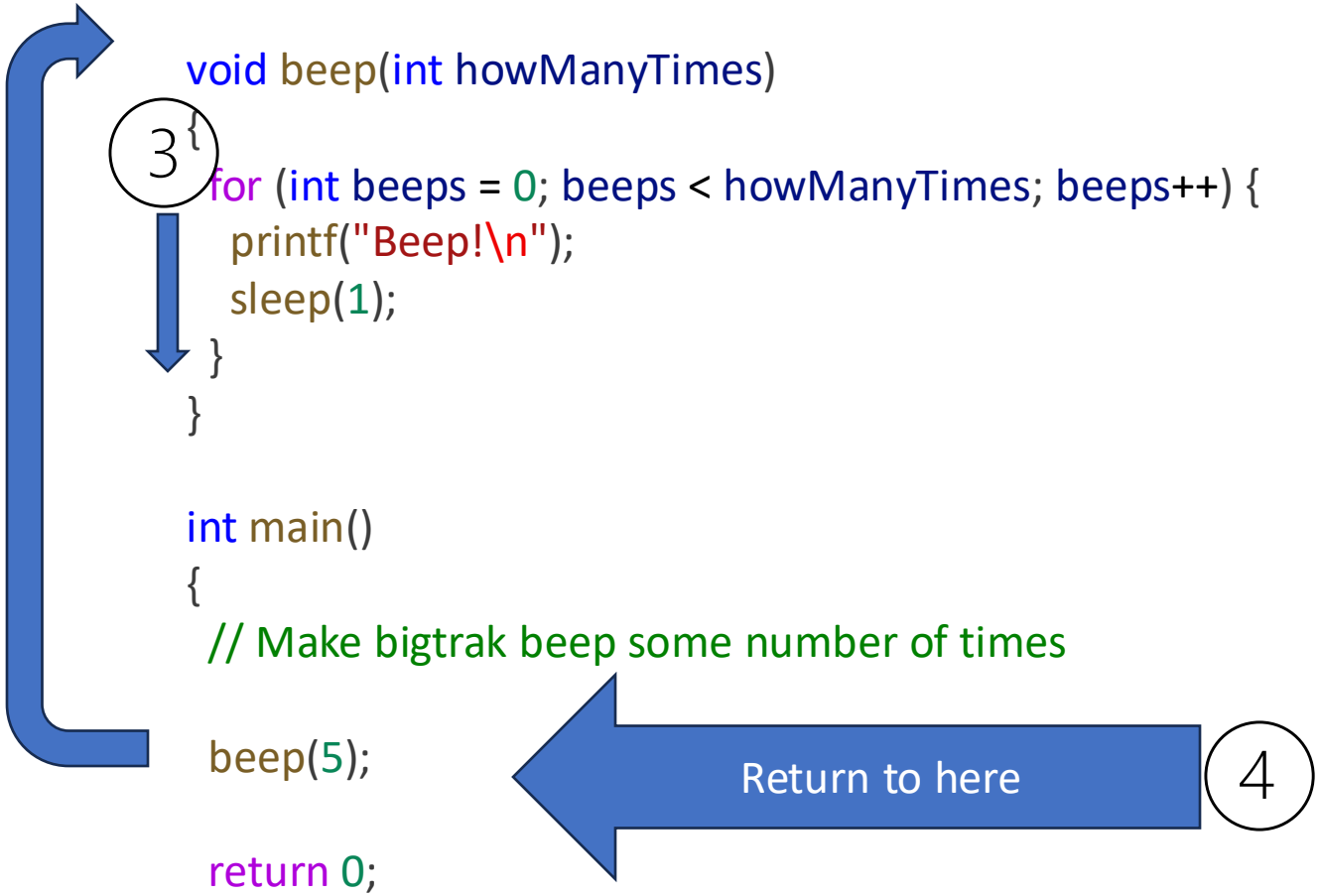
# We can declare functions before use

```
#include <stdio.h>

void beep(int howManyTimes)
{
  for (int beeps = 0; beeps < howManyTimes; beeps++) {
    printf("Beep!\n");
    sleep(1);
  }
}

int main()
{
  // Make bigtrak beep some number of times

  beep(5);

  return 0;
}
```

# The new ‘flow’

```c
#include <stdio.h>

void beep(int howManyTimes)
{
  for (int beeps = 0; beeps < howManyTimes; beeps++) {
    printf("Beep!\n");
    sleep(1);
  }
}

int main()
{
  // Make bigtrak beep some number of times

  beep(5);

  return 0;
}
```



# Data flows as well!

# The flow of data

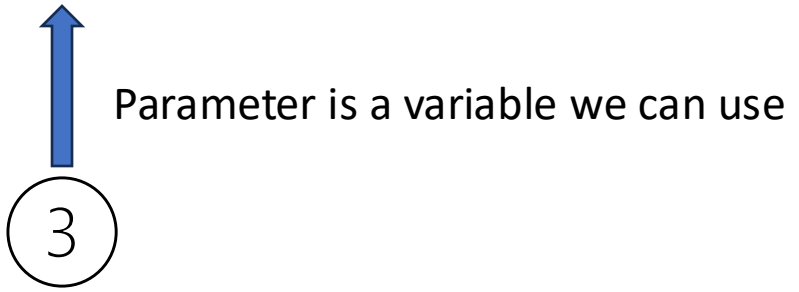
```
int main()
{
  printf("Hello, world\n");
}
```

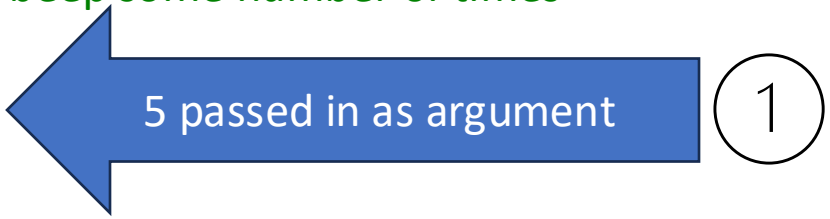
"Hello, world\n" is data that ‘gets passed’ into printf

A variable inside the function (the argument) becomes "Hello, world\n"

# Similarly

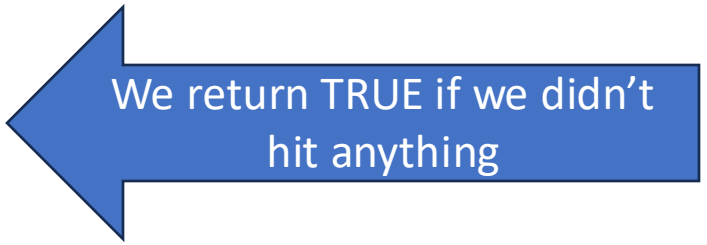
```c
#include <stdio.h>

void beep(int howManyTimes)
{
  for (int beeps = 0; beeps < howManyTimes; beeps++) {
    printf("Beep!\n");
    sleep(1);
  }
}

int main()
{
  // Make bigtrak beep some number of times

  beep(5);

  return 0;
}
```

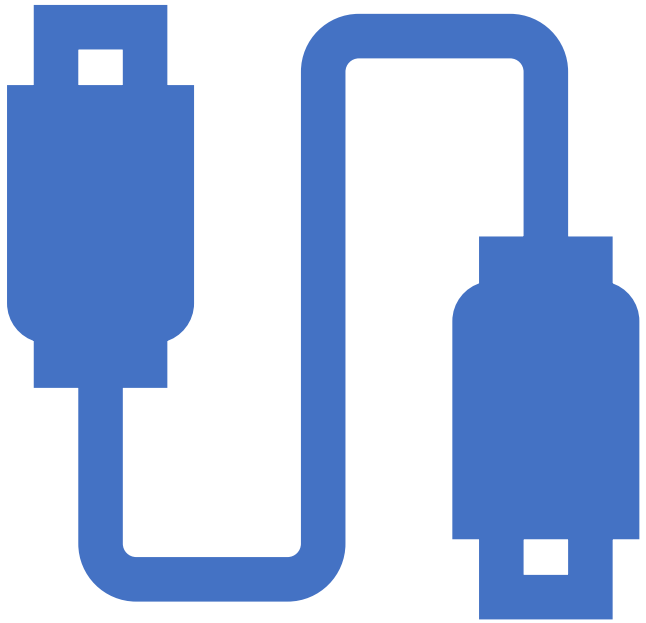
# Results are returned from functions too

```
#include <stdio.h>

int move_forward(int howManyTimes)
{
  while (howManyTimes > 0 && sense_obstacle() == 0) {
    motor_on();
    sleep(1);
    motor_off();
    howManyTimes--;
  }

  return howManyTimes == 0;
}

int main()
{
// Make bigtrack move forward

  if (move_forward(5))
    printf("Success!\n");
  else
    printf("Oh no!\n");

  return 0;
}
```




The function effectively 'evaluates' to the returned result

A function declaration is like a ‘socket’ with a precise specification. We can ‘plug’ into (or ‘call’) it, iff our arguments match



# ‘Formal’ and ‘actual’ parameters

- The function **declaration** specifies type information for each parameter (formal parameter list), and the caller must pass actual parameters that match these in **both** type and position!

Declaration

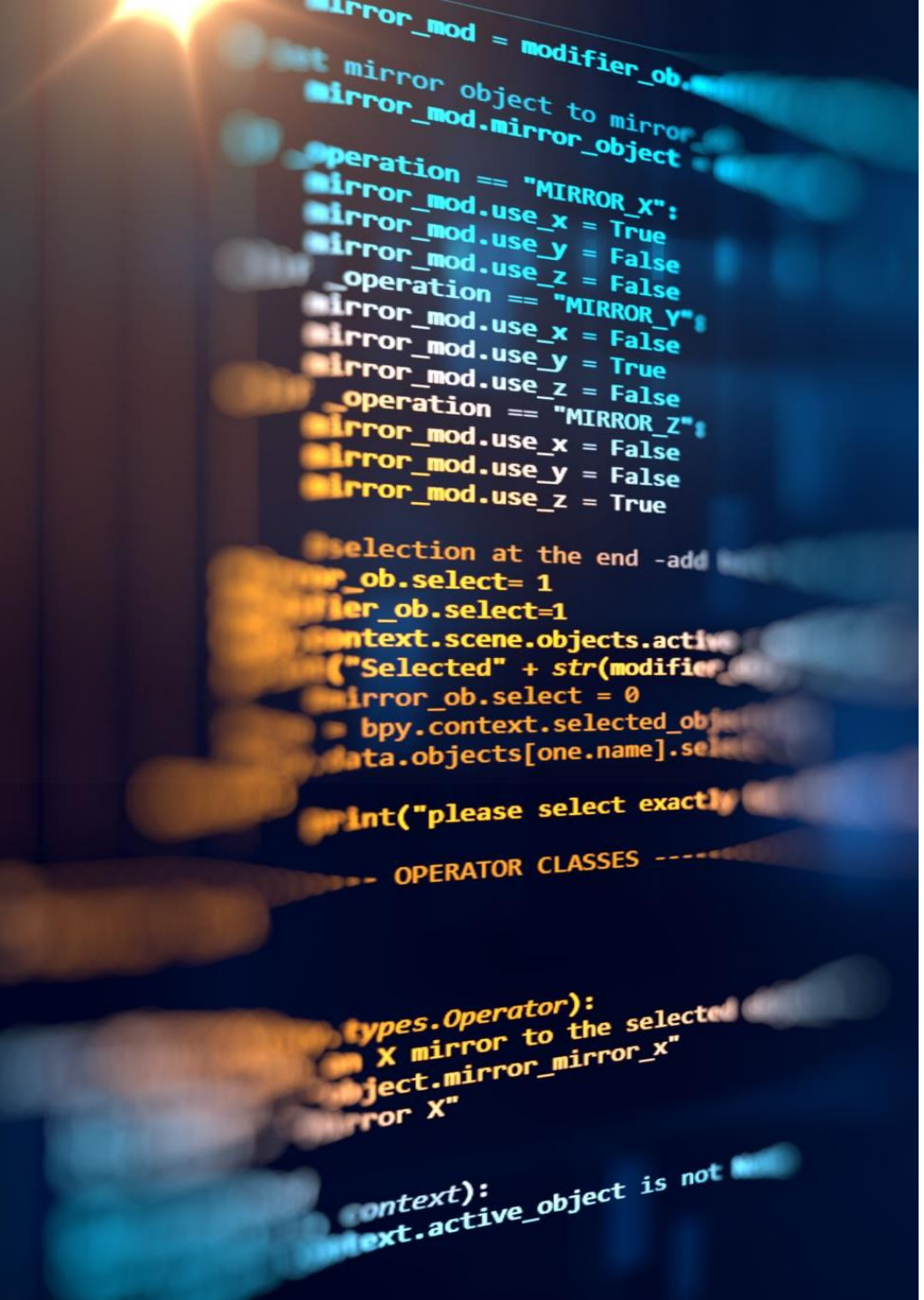
```
float buy_coffees(int howMany, float cost) { … }
```

Call

```
float totalCost = buy_coffees(10, 4.50);
```

In C, the parameter values in the function are only ever a copy of what's passed in (*pass by value*)!

Even if the formal and actual parameters are variables with the same name, they exist in 'different scopes' (*more later*)




# Summary

- You should understand
  - That we can create reusable sub-units of code called functions
  - That programs flow into and out of functions
  - How information (variables) take information in and out of a function