DPST1091 / CPTG1391
Introduction to Programming
Week 3 – Lecture 1

Lecturer and Course Convener:

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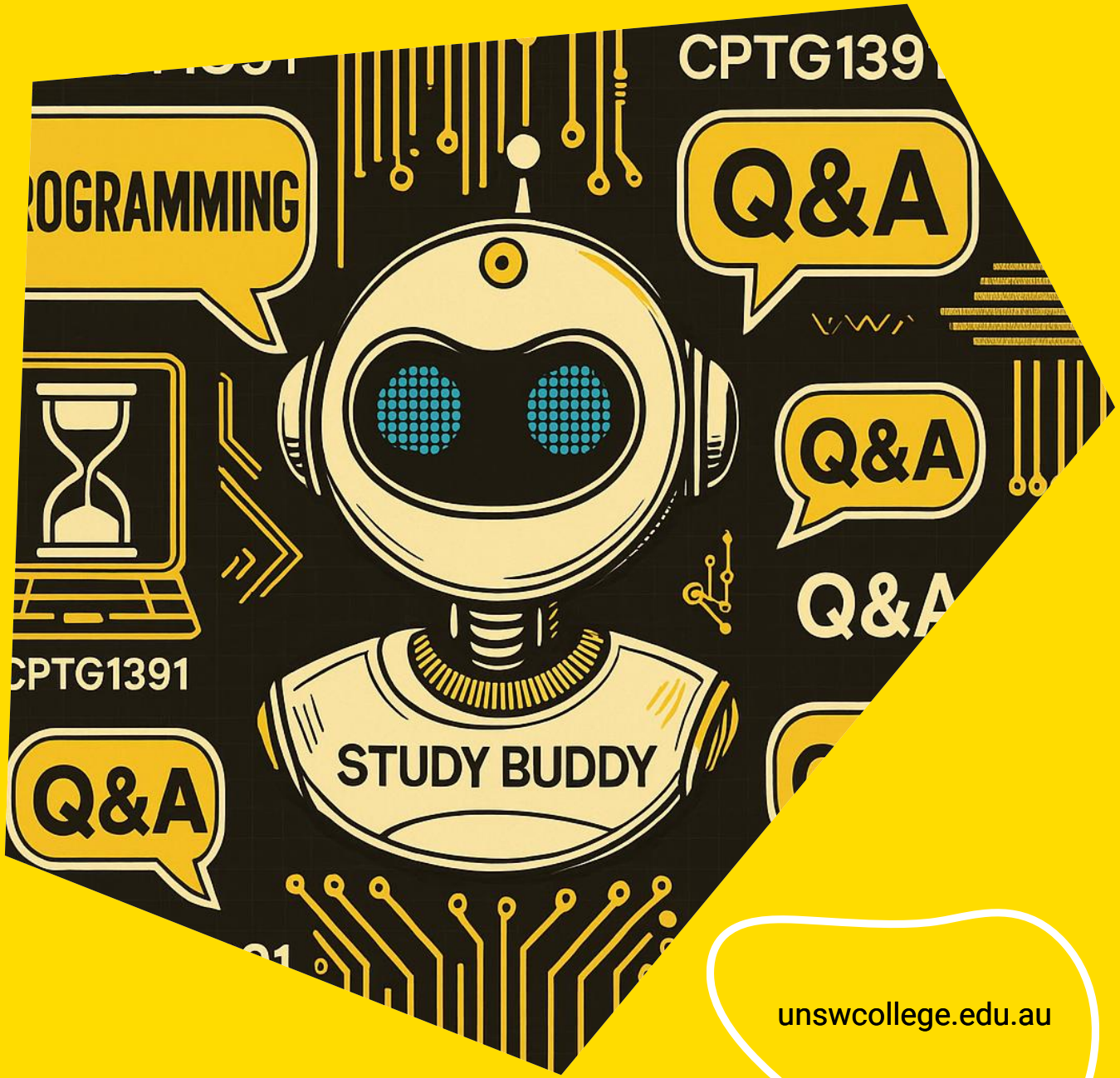
Functions



Agenda

- **Last lecture**
  - Nested Loops
  - Custom Data Types

- **Today**
  - Functions

Nested Loops recap

⟶A **while loop inside another while loop** is called a **nested loop.**

⟶This structure is very useful for processing **two-dimensional data**, such as **grids and matrices**.

```
     Column →   1   2   3   4   5
Row 1           1   2   3   4   5
Row 2           1   2   3   4   5
Row 3           1   2   3   4   5
Row 4           1   2   3   4   5
Row 5           1   2   3   4   5
```

Think of the grid like a **table** made of **rows** and **columns**.

⟶ **Rows** go **across** (left to right).

⟶ **Columns** go **down** (top to bottom).

Full program:

```
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5
```

```c
#include <stdio.h>

#define ROWS 5
#define COLUMNS 5

int main() {
    int i = 0;

    while (i < ROWS) {
        int j = 1;
        while (j <= COLUMNS) {
            printf("%d ", j);
            j++;
        }
        printf("\n");
        i++;
    }

    return 0;
}
```

Demo

→Nested_loops_recap.c

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It may include extra comments and may not always follow ideal coding style

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Structs recap

→ A **struct** is a user-defined data type that groups different kinds of data together in a single unit.

→ Each field in a struct has its **own space in memory** and can be accessed individually.

→ Structs are useful when you want to store information as a **well-organised record**, such as details about a person, a student, or a product.

```
struct product {
    int id;
    double price;
};
```

Enums recap

⟶**enum** (enumeration) is a user-defined data type in C that consists of **named integer constants.**

⟶Gives **meaningful names to numbers**, improving code readability.

```
enum Weekday { MONDAY,
               TUESDAY,
               WEDNESDAY,
               THURSDAY,
               FRIDAY
             };
```

Demo

→enum_coffee_recap.c

→Struct_enum_book_recap.c

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IT'S BREAK TIME!
#include <stdio.h>
#define ON_BREAK 1
int main(){
// Time for a 10 minute break! Switch to PARTY_MODE
#define PARTY_MODE ON_BREAK
if (PARTY_MODE == ON_BREAK) ;
print("Program will resume in 10 minutes...");
sleep(600);
// Take a break
exit(0);
}
10 MINUTES BREAK!
BRB
CHIPS
Relax... We'll be back soon!

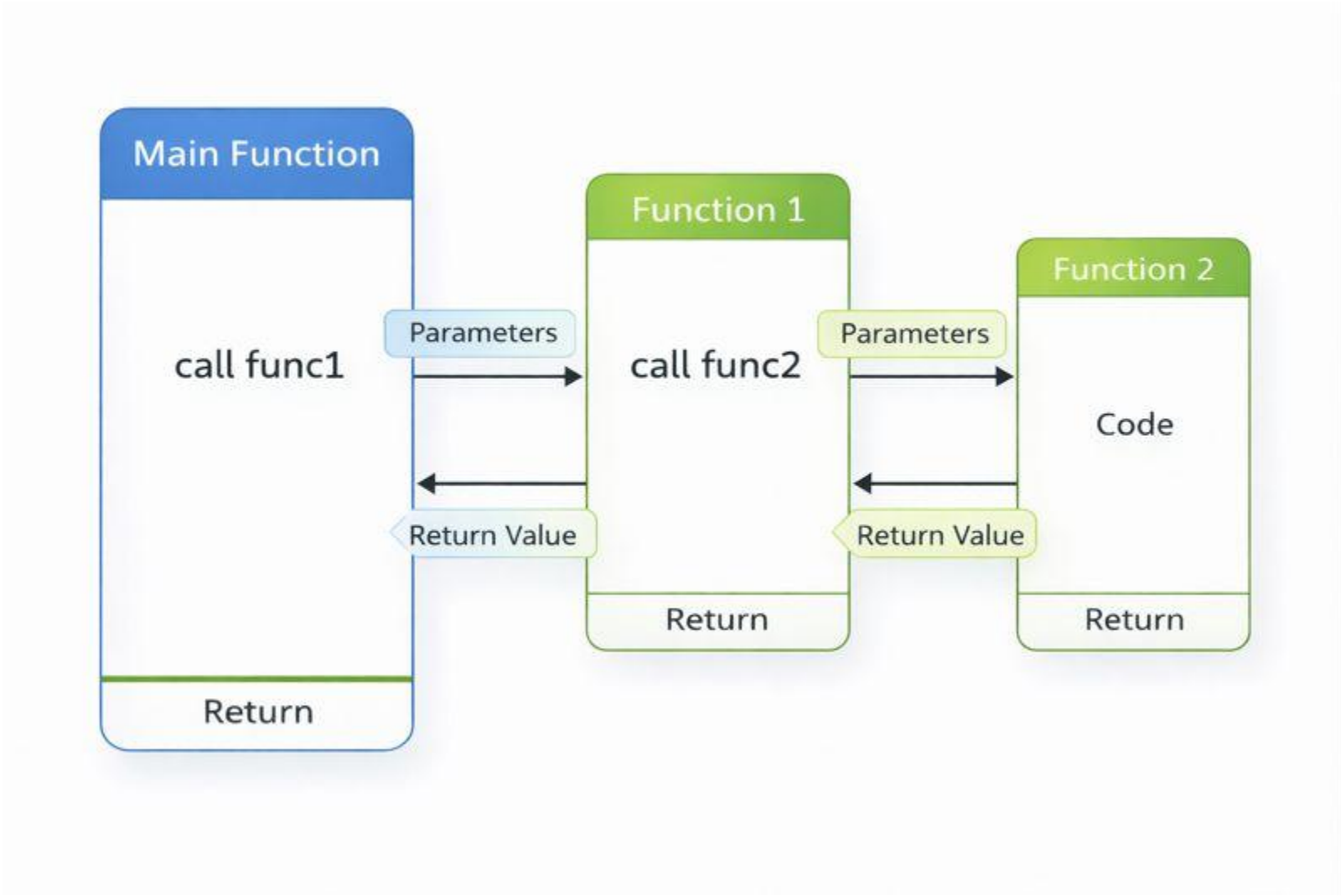
Functions

Functions allow you to:

- separate out “**encapsulate**" a piece of code serving a single purpose
- **test** and verify a piece of code
- **reuse** the code
- **shorten** code resulting in easier modification and debugging

Functions we already use: ***main(), printf(), scanf()***

How it works in a simple diagram



Demo

→function_hello.c

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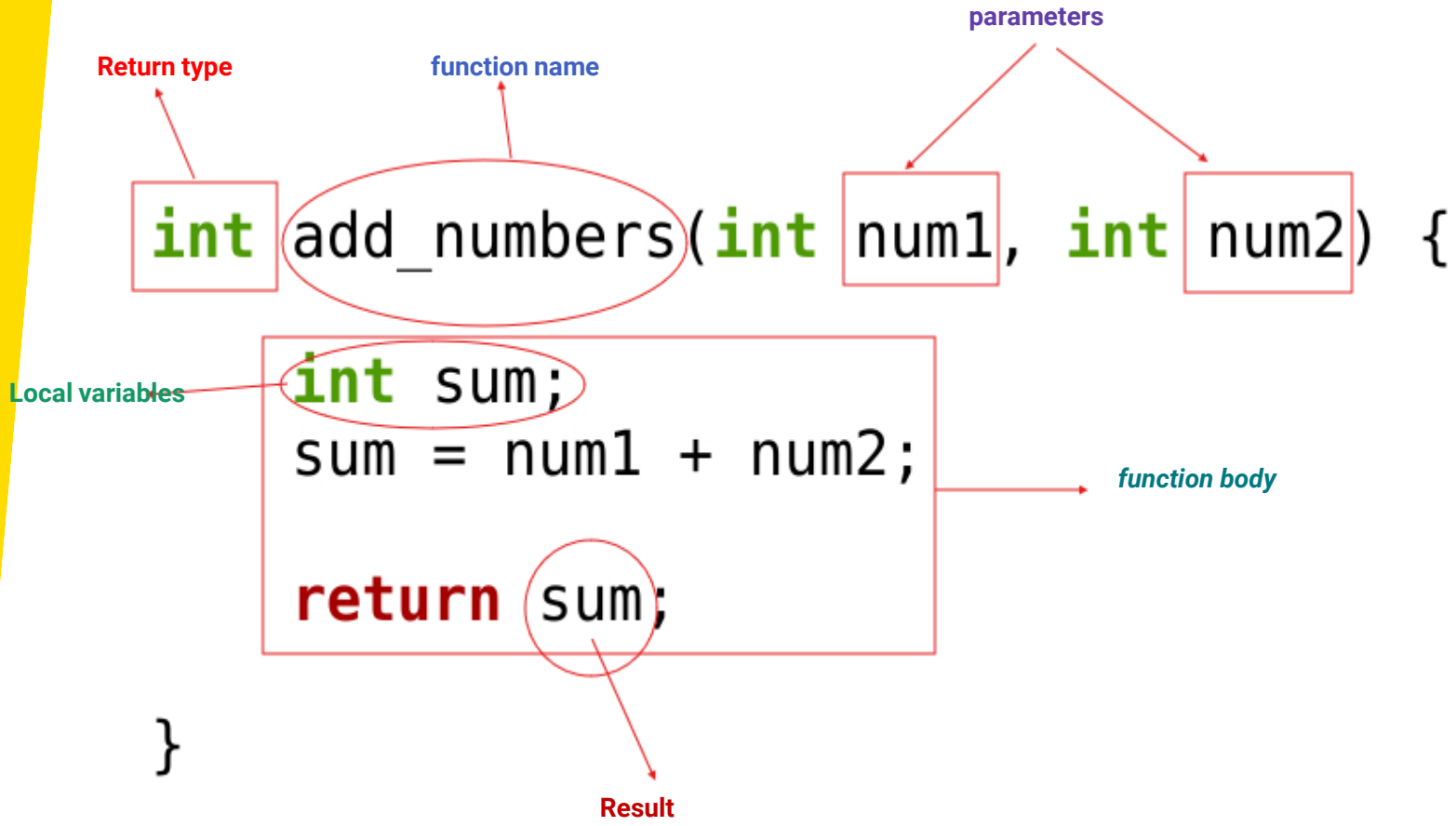
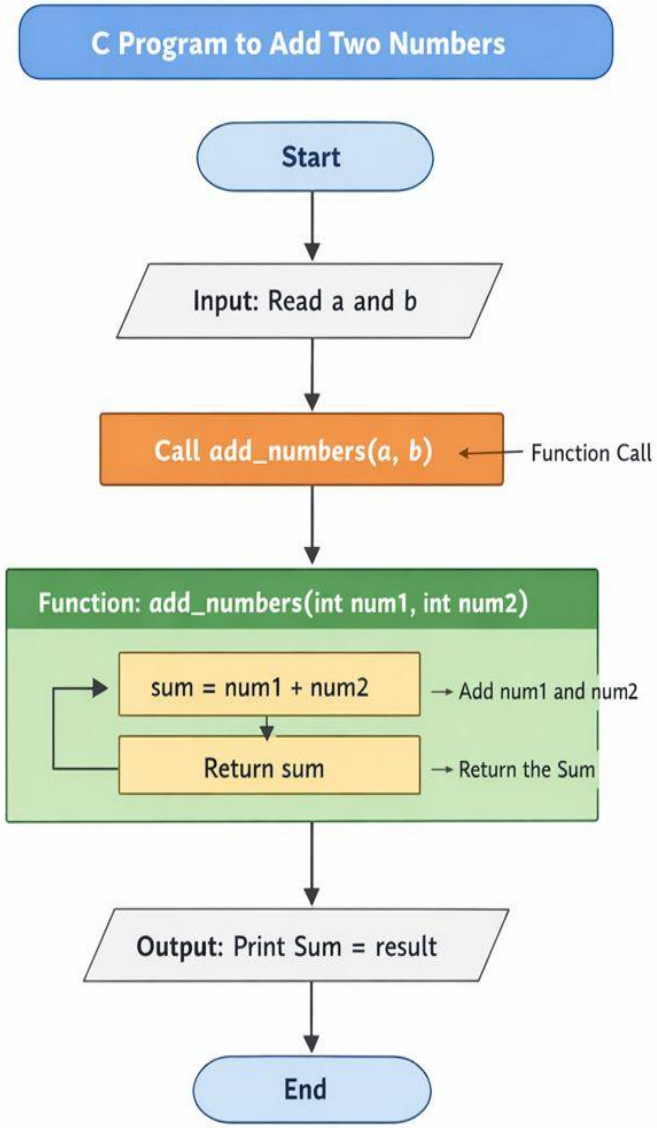
Structure of a Function

1. Return type
2. Function name
3. Parameters (inside brackets, comma separated) – input
4. Variables (only accessible within the body of function)
5. Return statement – output/results



Flowchart of Calling a function



The return Statement

- when a **return statement is executed**, the function **terminates**.
- the returned expression will be evaluated and, if necessary, **converted** to the type expected by the calling function.
- all **local variables and parameters** will be **thrown away** when the function **terminates**.
- functions can be declared as returning **void**, which means that **nothing is returned**. A **return** without a value statement can still be used to terminate such a function.

Function Properties

- function have a **type** - the type of the value they **return**
- type **void** for functions that return **no value**
- function can not return **arrays** (we will see later)
- function have their own **variables** created when function called and **destroyed** when function returns
- **return** statement **stops** execution of a function
- **return** statement specifies value to return, unless function is of type **void**
- **run-time error** if end of **non-void function** reached **without return**

A full Program:

```c
#include <stdio.h>

// Function prototype
double cube(double x);

int main(void) {
    double a, b;

    printf("42 cubed is %lf\n", cube(42.03));

    a = 2;
    b = cube(a);

    printf("2 cubed is %lf\n", b);

    return 0;
}

// calculate x to the power of 3
double cube(double x) {
    double result;
    result = x * x * x;
    return result;
}
```

Calling function cube

Functions with No Return Value (called procedures too)

Some functions do not to compute a value.
They are useful for "**side-effects**" such as output.

```
void print_sign(int b) {
    if (b < 0) {
        printf("negative");
    } else if (b == 0) {
        printf("zero");
    } else {
        printf("positive");
}
```

Demo

→function_void.c

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Function Parameters

- functions take **0 or more** parameters
- parameters are variables **created each time function** called and destroyed when function returns
- C functions are ***call-by-value*** (but beware arrays)
- parameters initialized with the value **supplied by the caller**
- if parameters **variables changed** in the function **has no effect outside the function**

```c
#include <stdio.h>

// Function prototype
void change_values(int x, int y);

int main(void) {
    int a = 5;
    int b = 10;

    printf("Before function call: a = %d, b = %d\n", a, b);

    // Call-by-value: copies of a and b are passed
    change_values(a, b);

    // Original variables are unchanged
    printf("After function call: a = %d, b = %d\n", a, b);

    return 0;
}

// Function definition (after main)
void change_values(int x, int y) {
    // Parameters are created when the function is called

    x = x + 10;
    y = y + 20;

    printf("Inside function: x = %d, y = %d\n", x, y);

    // Parameters are destroyed when the function returns
}
```

Function Prototypes

Specifies key information about the function:

- function return type
- function name
- number and type of function parameters

Allows top-down order of functions in file More readable
Allows us to have function definition in separate file.

Example prototypes:

```
double power(double x, int n);
void print_sign(int b);
```

Demo

→function_add.c

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Library functions

⟶ Over 700 function are defined in the C standard library.

⟶ You'll need to use less than 20 of these in this course.

⟶ The C compiler needs to see a prototype for these functions before you use them.

⟶ You do this indirectly with **#include** line

⟶ For example, **stdio.h** contains prototypes for **printf** and **scanf**

```c
#include <stdio.h>

int main(void) {

    printf("I love Programming!\n");

}
```

Example:

```c
#include <stdio.h>
#include <math.h>

int main(void) {
    double number = 9.0;
    double result1, result2;

    // Using sqrt() from math.h
    result1 = sqrt(number);

    // Using pow() from math.h
    result2 = pow(number, 2);

    printf("Square root of %.2f is %.2f\n", number, result1);
    printf("%.2f squared is %.2f\n", number, result2);

    return 0;
}
```

structs and functions

A structure can be passed as a parameter to a function:

```
void print_student(student s) {

        printf("%s z%d\n", s.name, s.zid);

}
```

A function can **return a structure**:

```
student read_student(int zid, double marks) {

        student s;
        s.zid = zid;
        s.marks = marks;

        return s;

}
```

Demo

→function_struct.c

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Voice of the Student

Anonymous ongoing feedback
Anything you wanted to share with me

Voice of the Student

26T1 Voice of the Student – Fill out form

See you soon …

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