DPST1091 / CPTG1391

Introduction to Programming

Week 2 – Lecture 2

Lecturer and Course Convener:

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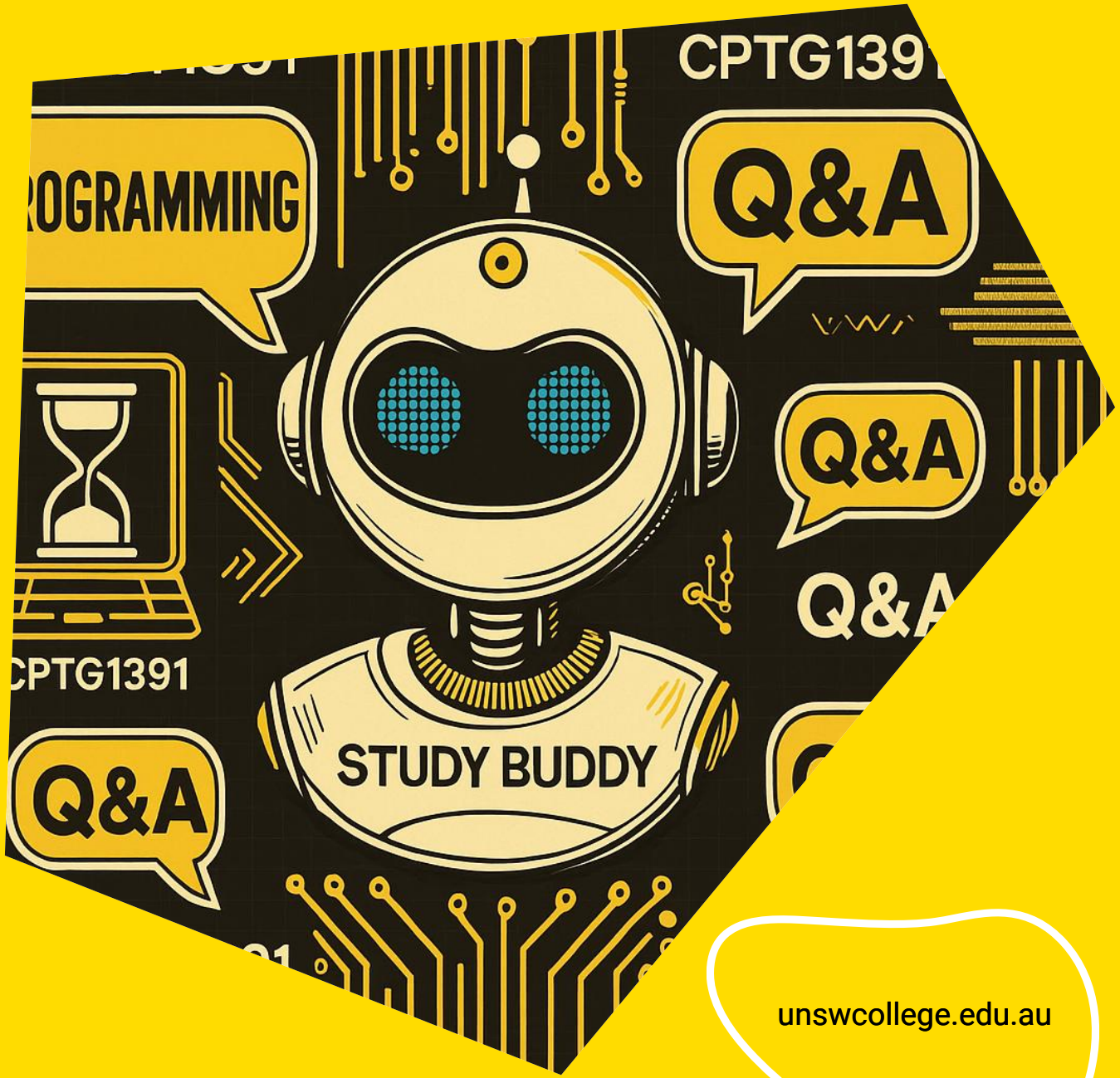
Custom Data Types



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Agenda

- **Last lecture**
  - Control Flow
  - Conditions
  - Loops

- **Today**
  - Nested Loops
  - Custom Data Types

if statements recap

```
if(<condition>) {
    do_if_true();
} else if(<second_condition>) {
    do_if_second_true();
} else {
    do_if_both_false();
}
```

⟶ A **condition** is a value that is either **true (1)** or **false (0)**.

⟶ We can **compute a condition** by evaluating an expression.

⟶ For example, *temperature < 0* will be **true (1)** if *temperature* is below zero.

⟶ Conditions are widely used in C, such as in **if statements**, ***while* loops**, and other control structures.

while loops

```
while(<condition>) {
    do_something_until_condition_is_true;
}
```

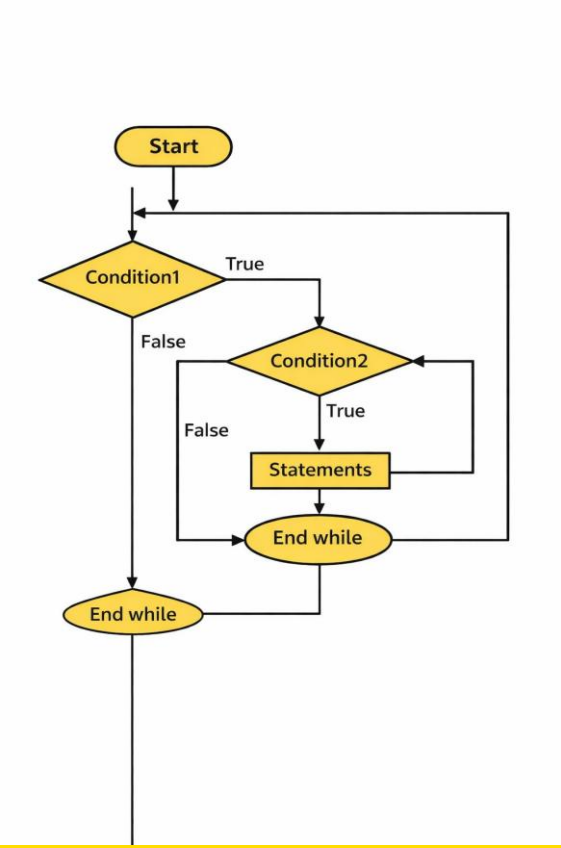
⟶If the condition is **true**, execute the body of the loop.

⟶After the body finishes, **check the condition again**.

⟶If the condition is still **true**, execute the body again.

⟶Repeat this process until the condition becomes **false**.

Nested while loops



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

⟶Each time the **outer loop** executes once, the **inner loop** runs completely from start to finish.

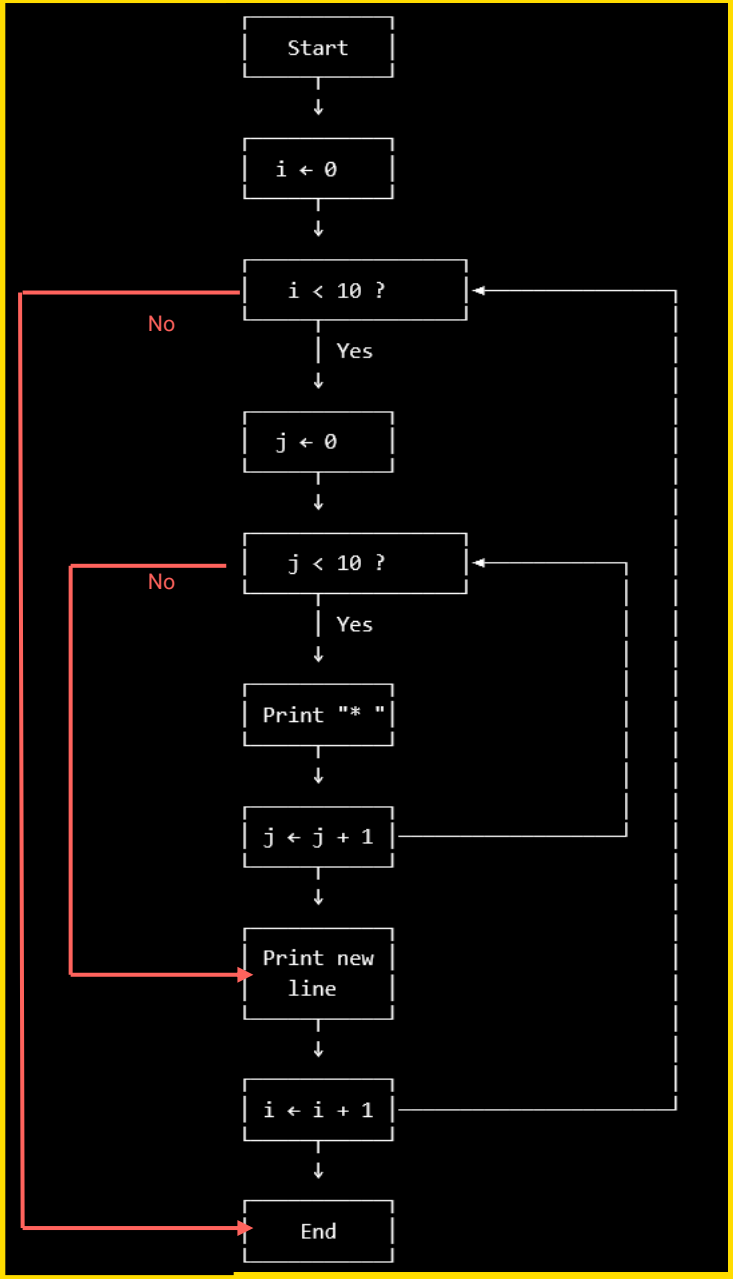
⟶This means the **inner loop may execute many times**, depending on the number of iterations of the outer loop.

⟶Need a separate loop counter variable for each nested loop.

⟶For example, How can we produce a grid of * like this, using code?

```
* * * * *
* * * * *
* * * * *
* * * * *
* * * * *
```

Example:




```
// print a square of 10x10 asterisks

int i = 0;
while (i < 10) {

    int j = 0;
    while (j < 10) {
        printf("* ");
        j = j + 1;
    }
    printf("\n");
    i = i + 1;
}
```

What about a half-pyramid?

```
1
12
123
1234
12345
```

```c
#include <stdio.h>

int main(void) {
    int row = 1;

    // Outer loop: for each row
    while (row <= 5) {
        int num = 1;

        // Inner loop: print numbers from 1 up to current row number
        while (num <= row) {
            printf("%d", num);
            num++;
        }

        // Move to next line after finishing a row
        printf("\n");
        row++;
    }

    return 0;
}
```

Demo

→while_recap.c
→nested_loops.c

Live lecture code is written for teaching, not perfection.
It may include extra comments and may not always follow ideal coding style

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Custom Data Types

→ Up to this point, we've been using C's **built-in data types**, such as **int, char**, and **double**.

→ Each of these types can hold **only a single value** at a time.

→ But what if we need to **store a collection of related values together**?

→ For example, information related to a **student**

```c
#include <stdio.h>

int main(void) {
    int student_age = 21;
    char first_initial = 'A';
    int current_year = 3;

    return 0;
}
```

→ **The above variables are related …**

→ **We can define our own data types (structures) to store a collection of types.**

structs

- structs hold multiple values (fields)
- struct are heterogeneous - fields can be different type
- struct field selected using name
- struct fields are fixed
- struct syntax:

```
struct <struct_name> {
    data_type identifier;
    data_type identifier;
}
```

Example:

define a struct that holds a student details

```
struct student {
    int zid;
    double totallabMarks;
    double assignment1Mark;
    double assignment2Mark;
}
```

To use, we simply say:

```
struct student pantea;
```

Notice, **no values**... we are only **defining**.

the . operator

To access the actual data of the structure:

```
// Declare a student variable
struct student pantea;

// Assign values to the student's fields
pantea.zid = 12345678;
pantea.totallabMarks = 85.5;
pantea.assignment1Mark = 40.0;
pantea.assignment2Mark = 42.0;
```

The whole program:

```c
#include <stdio.h>

// Define the student struct
struct student {
    int zid;
    double totallabMarks;
    double assignment1Mark;
    double assignment2Mark;
};

int main(void) {

    // Declare a student variable
    struct student pantea;

    // Assign values to the student's fields
    pantea.zid = 12345678;
    pantea.totallabMarks = 85.5;
    pantea.assignment1Mark = 40.0;
    pantea.assignment2Mark = 42.0;

    // Print the student's details
    printf("Student Details:\n");
    printf("ZID: %d\n", pantea.zid);
    printf("Total Lab Marks: %.2f\n", pantea.totallabMarks);
    printf("Assignment 1 Mark: %.2f\n", pantea.assignment1Mark);
    printf("Assignment 2 Mark: %.2f\n", pantea.assignment2Mark);

    return 0;
}
```

Demo

→struct_book.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!

Another custom data type:

enum

→ ENUMS (enumerations) is a custom data type, which describes set of possible values in a programmer-defined category

→ For example, days of the week

→ **Syntax**

```
enum enum_name { value1, value2, value3, ... };
```

→ **Example:**

```
enum weekdays { Mon, Tue, Wed, Thu, Fri, Sat, Sun };
```

Example:

```c
#include <stdio.h>

// Define an enumeration for the days of the week
enum weekdays { Mon, Tue, Wed, Thu, Fri, Sat, Sun };

int main(void) {
    // Declare a variable of type enum weekdays
    enum weekdays day;

    // Assign a value using one of the enumerated names
    day = Sat;

    printf("The value of day (Sat) is: %d\n", day);

    return 0;
}
```

- Enums let a variable hold only certain predefined values.
- They give easy-to-read names, like ***Sat*** for **Saturday**.
- No need to remember numbers for each value (0, 1, 2…).
- Using ***#define*** works, but too many can make the code messy

Struct and enum

```c
// Define an enum for book condition
enum book_condition { New, Used, Damaged };

// Define a struct for a book
struct book {
    enum book_condition condition;
    double price;
};
```

Full program:

```c
#include <stdio.h>

// Define an enum for book condition
enum book_condition { New, Used, Damaged };

// Define a struct for a book
struct book {
    enum book_condition condition;
    double price;
};

int main(void) {
    // Declare a book variable
    struct book my_book;

    // Assign values to the book
    my_book.condition = Used;
    my_book.price = 29.99;

    // Print book details
    printf("Book Details:\n");
    printf("Price: $%.2f\n", my_book.price);

    // Print condition as text
    printf("Condition: ");
    if (my_book.condition == New) {
        printf("New\n");
    } else if (my_book.condition == Used) {
        printf("Used\n");
    } else if (my_book.condition == Damaged) {
        printf("Damaged\n");
    }

    return 0;
}
```

Demo

⟶enum_coffee.c

⟶struct_enum_book.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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