DPST1091 / CPTG1391

Introduction to Programming

Week 3 – Lecture 2

Lecturer and Course Convener:

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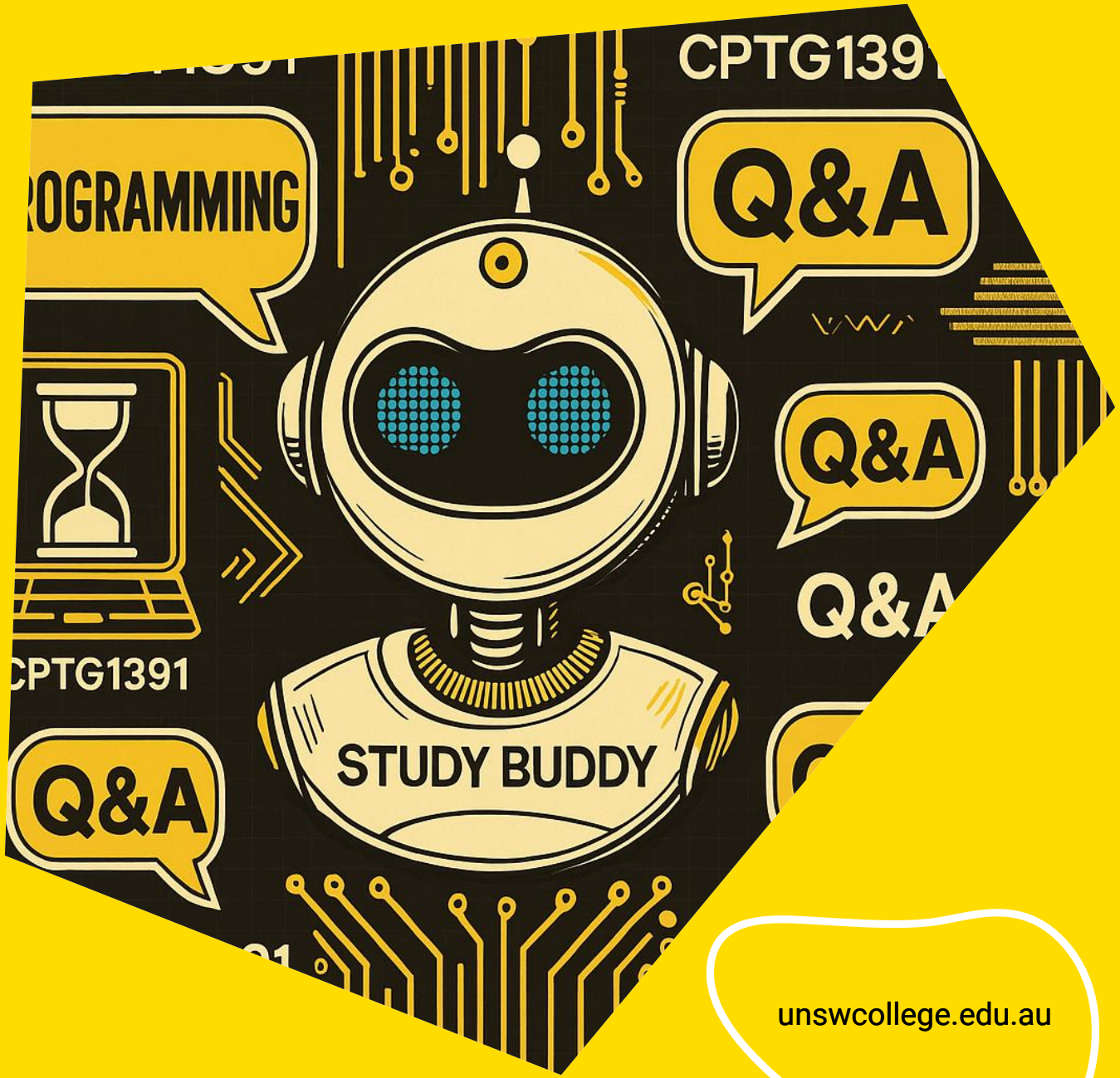
UNSW College

Static arrays



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Agenda

- **Last lecture**
  - Functions

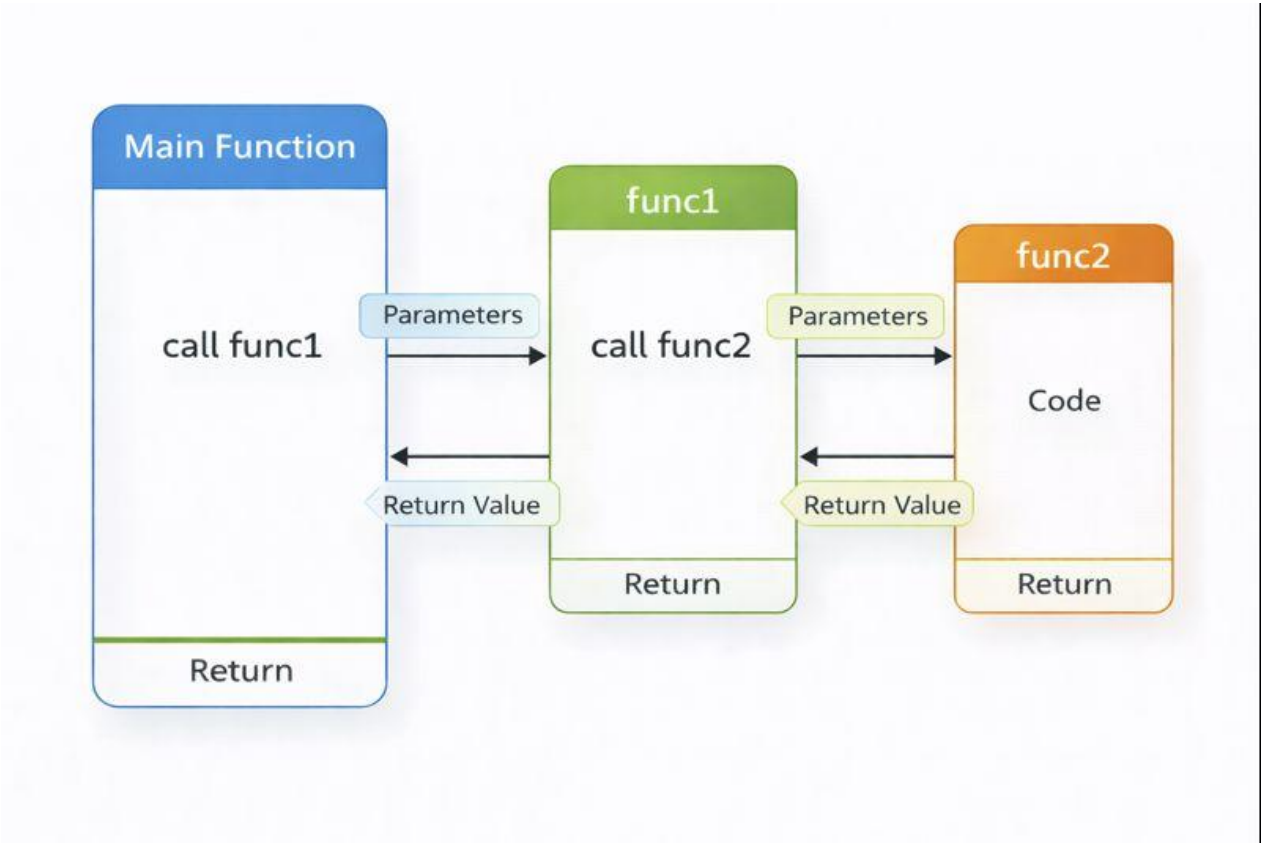
- **Today**
- **Static Arrays**

Functions recap

⟶Write once, use many times

⟶You can call the same function whenever you need it

⟶Variables in a function stay inside that function only



Example:

Factorial Function

Writing this code every time we need a factorial would be inconvenient.

```
// calculate factorial of n
int factorial(int n) {
    int result = 1;
    int i = 1;

    while (i <= n) {
        result = result * i;
        i++;
    }

    return result;
}
```

Things to remember:

Function prototype

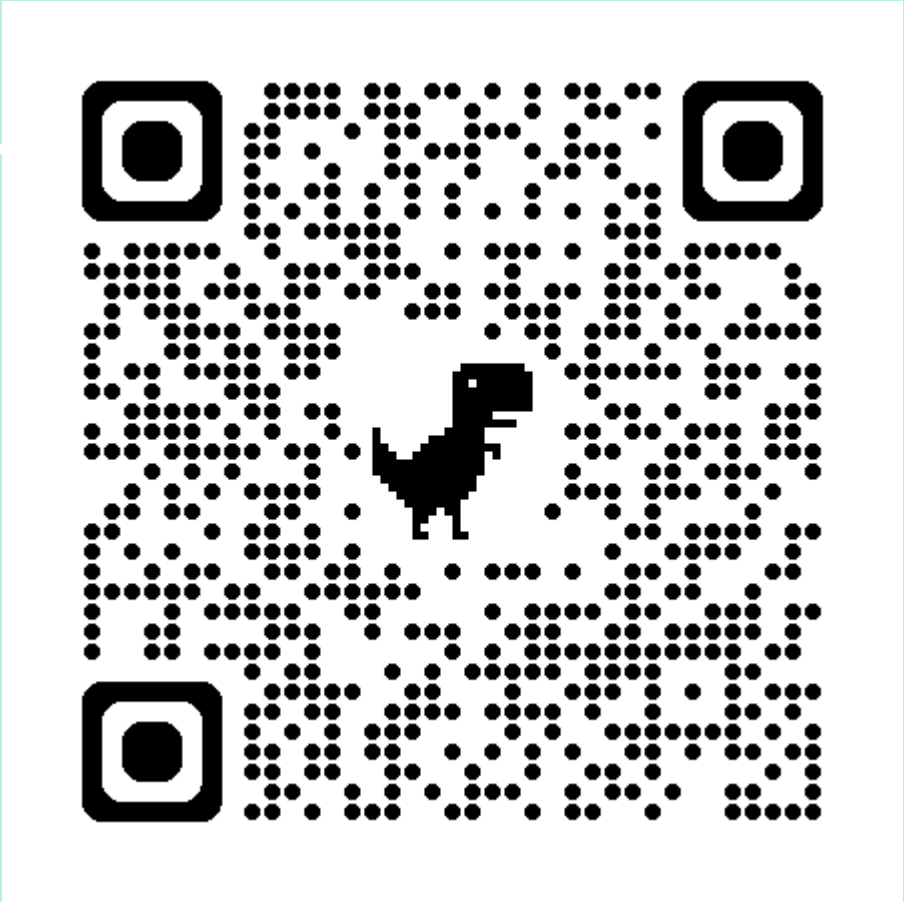
Call the function

Function definition (body)

```c
#include <stdio.h>

int factorial(int n);

int main(void) {
    int number;
    int fact;

    printf("Enter a positive integer: ");
    scanf("%d", &number);

    fact = factorial(number);

    printf("Factorial of %d is %d\n", number, fact);

    return 0;
}

// function to calculate factorial
int factorial(int n) {
    int result = 1;
    int i = 1;

    while (i <= n) {
        result = result * i;
        i++;
    }

    return result;
}
```

Demo

→function_recap.c
→function_recap_int.c



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Arrays

So far, we have used **one variable to store one value**.

This works fine when we only have a small number of values.

But what if we want to store many related values?

Example: Daily Temerature

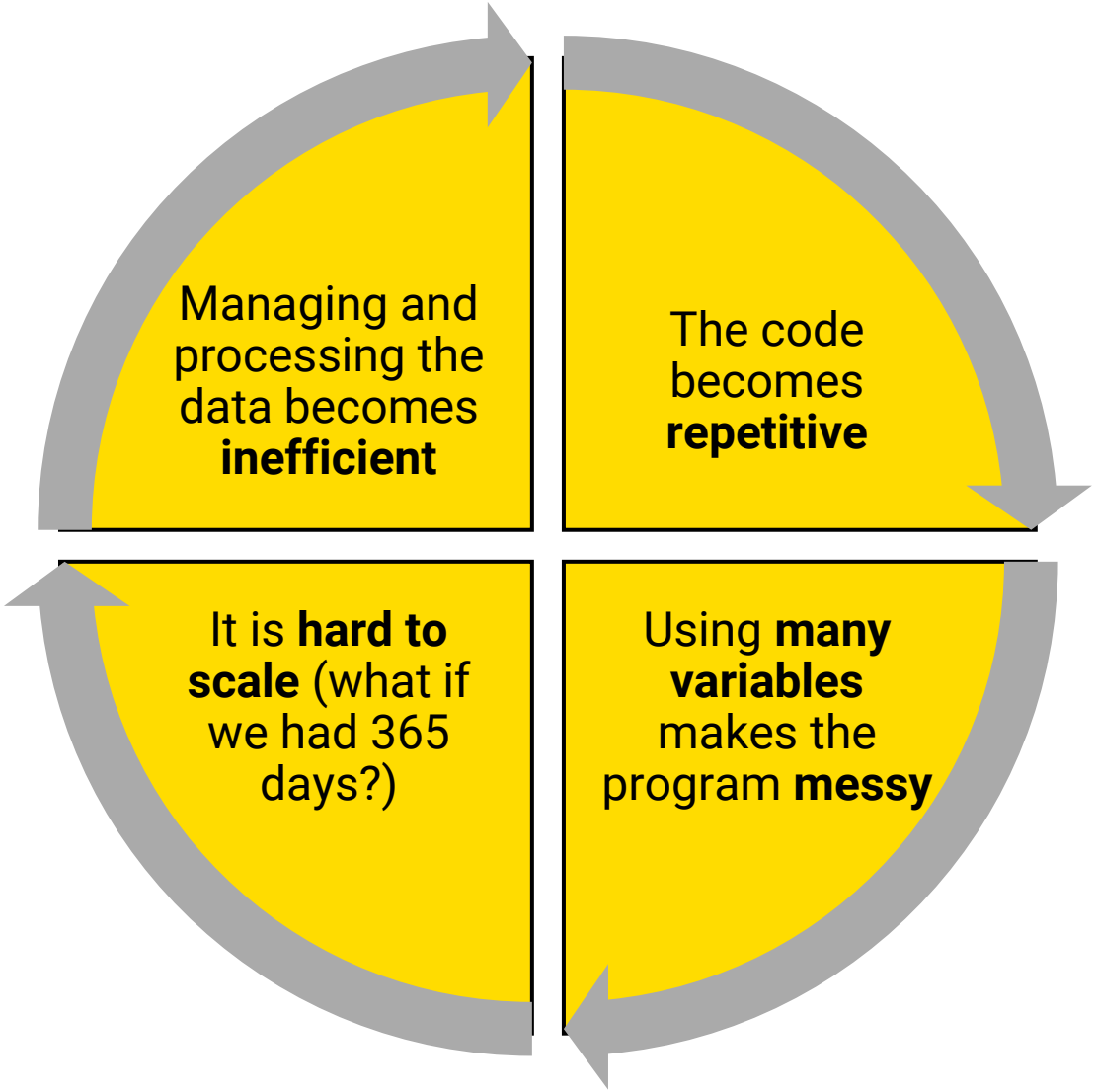
Suppose we record the temperature for each day of the week:

```
int mon = 22;
int tue = 24;
int wed = 23;
int thu = 26;
int fri = 28;
int sat = 25;
int sun = 21;
```

Now imagine we want to check if any day is **hotter than 25 degrees**:

```
if (mon > 25) {
    printf("Hot day\n");
}
if (tue > 25) {
    printf("Hot day\n");
}
// ... and so on
```

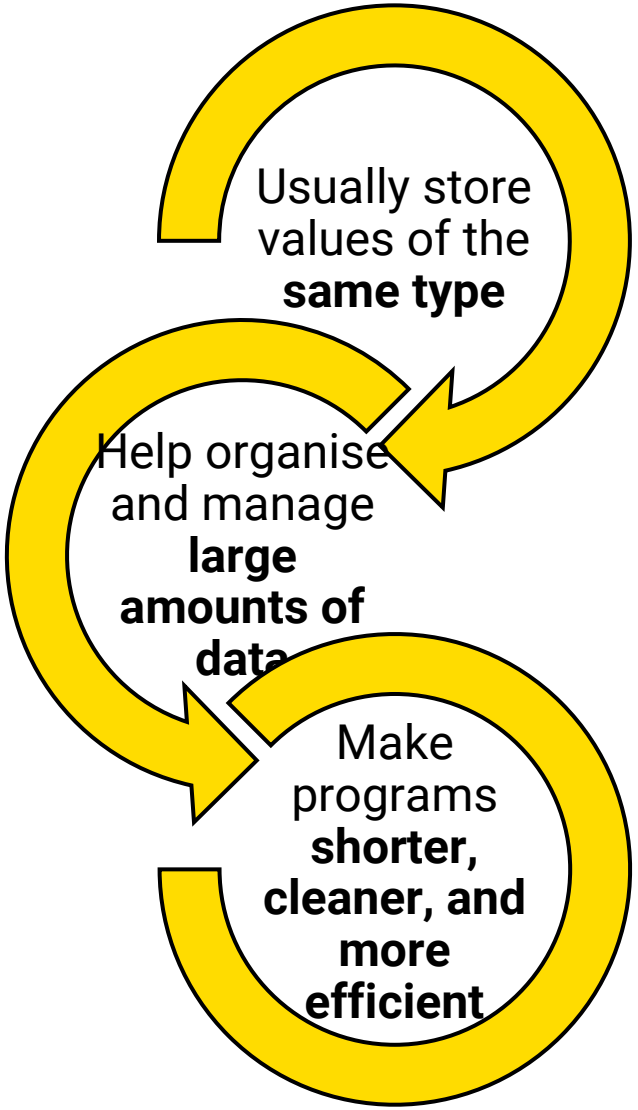
Problem with this approach is:



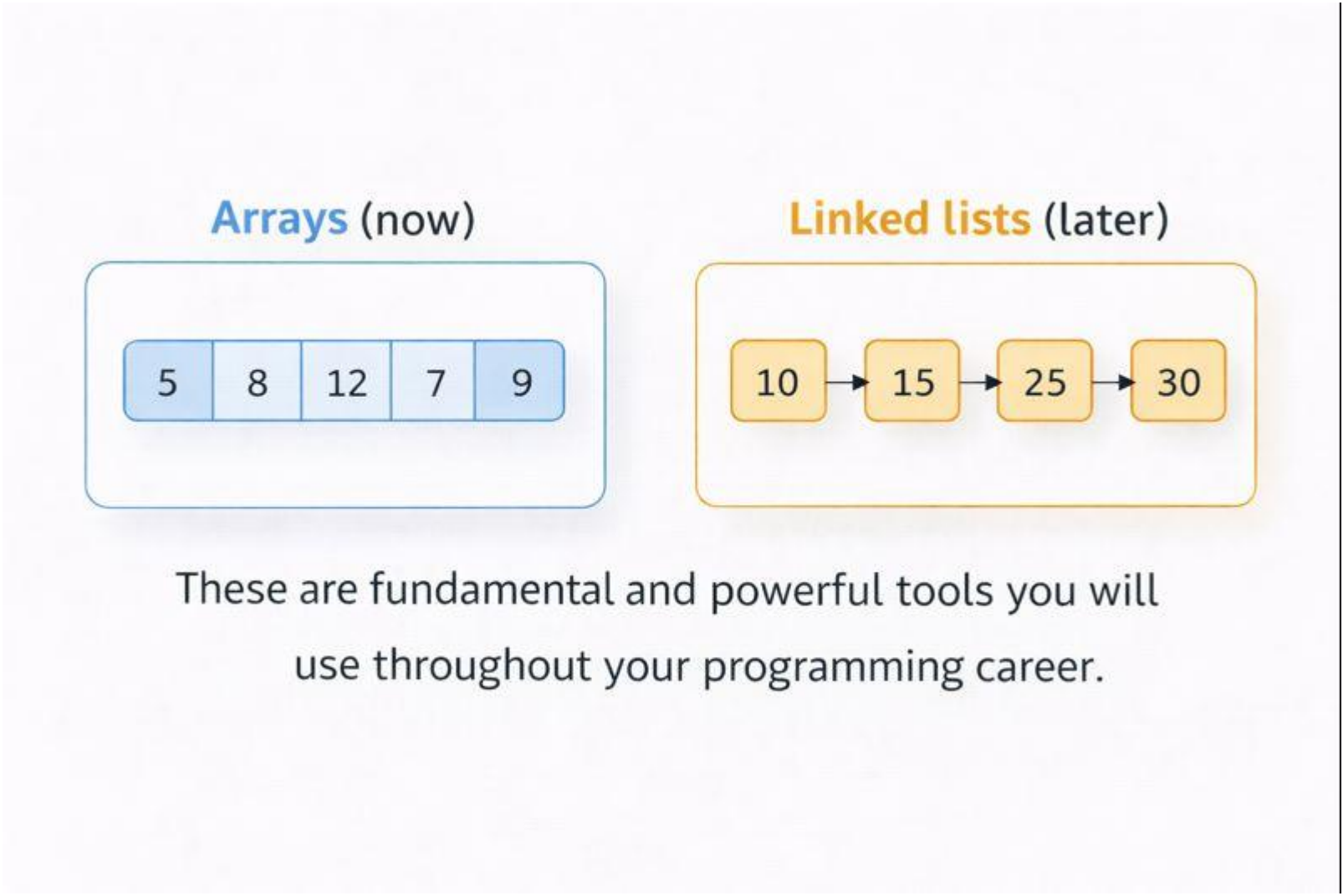
→ ***There must be a better way!***

Data Structures

In this course, data structures:



Data structures we will use in our course:




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!

Arrays

⟶C array is a collection of variables called array elements.

⟶All array elements must be the same type.

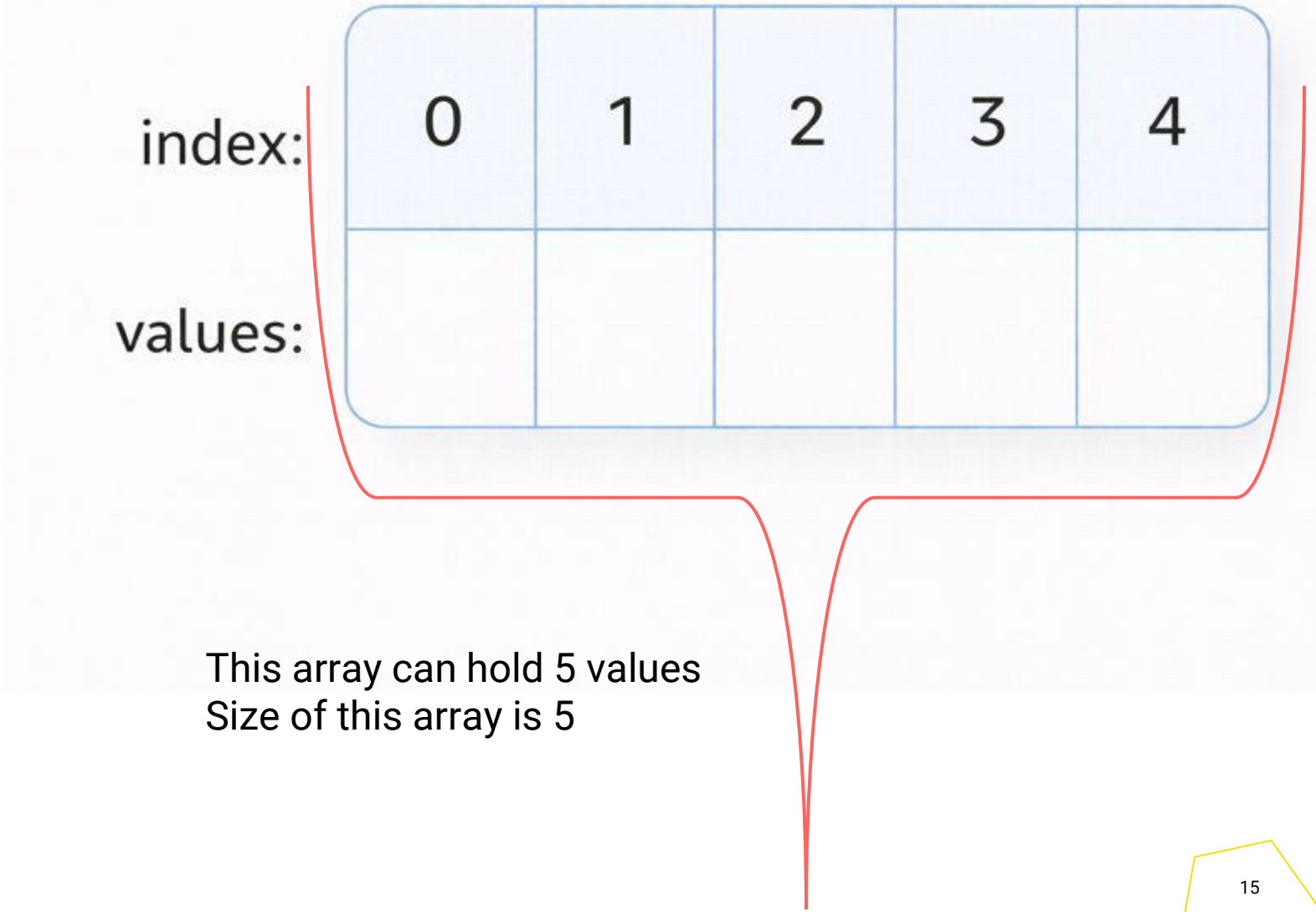
⟶Array elements don’t have a name

⟶Array elements accessed by a number called the array index.

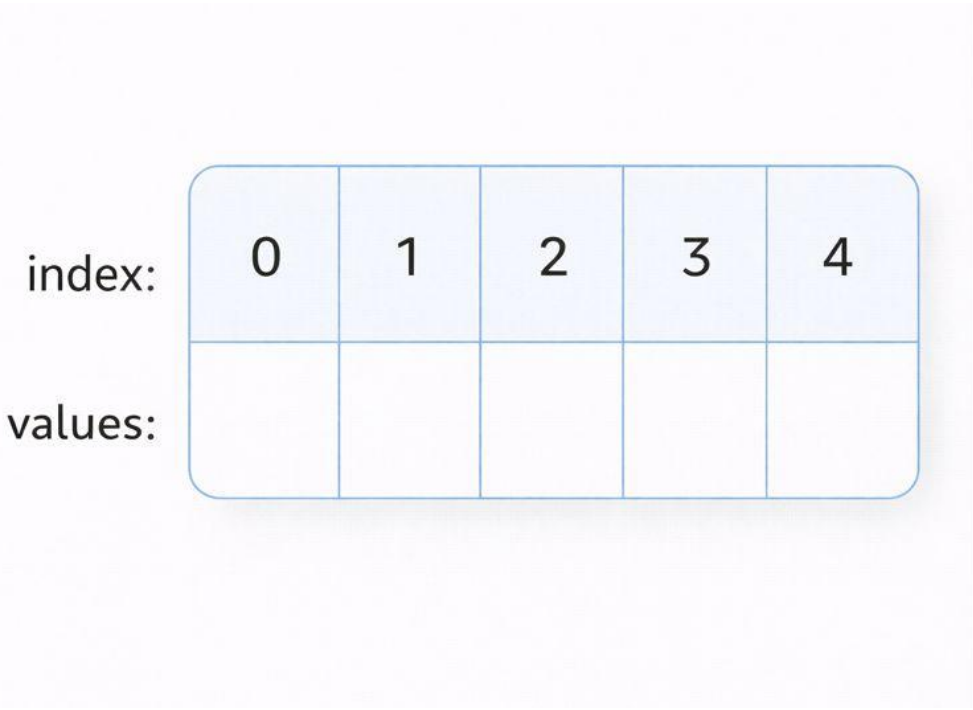
⟶Valid array indices for array with n elements are 0 .. n − 1

⟶Array can have millions/billions of elements.

You should specify the size of the Static Array



int array

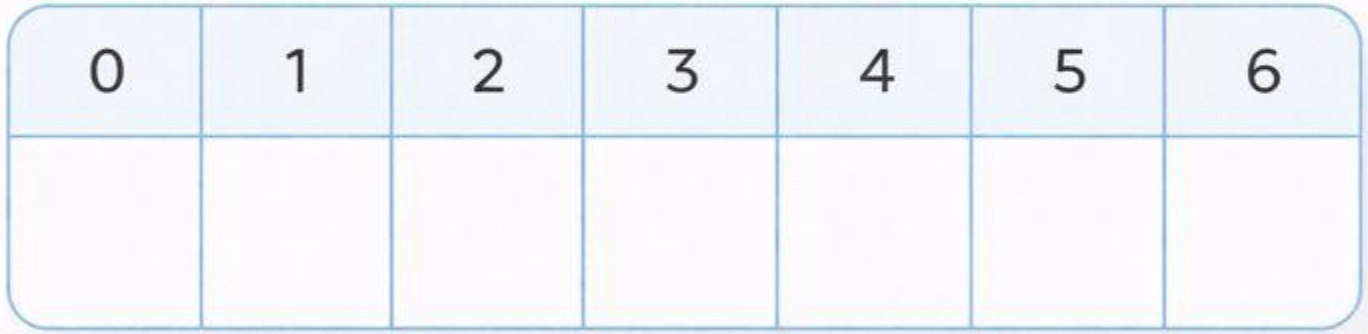


⟶ The array contains **5 elements of type int.**

⟶ With **each int using 32 bits**, the array requires **5 × 32 = 160 bits of memory.**

Array Declaration

```
int temperature_per_day[7];
```



Declare and initialise

→ You can initialise the array while declaration:

```
int temperature_per_day[7] = {22, 24, 23, 26, 28, 25, 21};
```

index	0	1	2	3	4	6
value	22	24	23	26	25	21

→ You can initialise all elements to 0:

```
int temperature_per_day[7] = {};
```

index	0	1	2	3	4	5	6
value	0	0	0	0	0	0	0

Accessing the elements

```c
int temperature_per_day[7];

// Assign values to elements
temperature_per_day[1] = 30;
temperature_per_day[2] = 28;
temperature_per_day[6] = 25;

// Use the values of elements
int today_temp = temperature_per_day[0];
printf("Today's temperature is %d\n", today_temp);


// Modify an existing element
temperature_per_day[0] = temperature_per_day[0] + 1;


// Use array elements in expressions
int difference = temperature_per_day[0] - temperature_per_day[1];


// check for hot days
if (temperature_per_day[0] > 30) {
    printf("It's a hot day!\n");
}
```

Reading Arrays

→Scanf can’t read an entire array.

→You must read the elements one by one:

```
scanf("%d", &temperature_per_day[0]);
scanf("%d", &temperature_per_day[1]);
scanf("%d", &temperature_per_day[2]);
scanf("%d", &temperature_per_day[3]);
scanf("%d", &temperature_per_day[4]);
scanf("%d", &temperature_per_day[5]);
scanf("%d", &temperature_per_day[6]);
```

→***Is this a good idea??***

Arrays and Loops

```c
int i = 0;

while (i < 7) {
    printf("Enter temperature for day %d: ", i);
    scanf("%d", &temperature_per_day[i]);
    i++;
}
```

```c
// Common mistakes

// 1. Forgetting &

scanf("%d", temperature_per_day[i]); // WRONG
```

```c
// 2. Going out of bounds

while (i <= 7)  // WRONG
```

Printing Arrays

→printf can’t print an entire array.

→You must print the elements one by one:

```
printf("%d", temperature_per_day[0]);
printf("%d", temperature_per_day[1]);
printf("%d", temperature_per_day[2]);
printf("%d", temperature_per_day[3]);
printf("%d", temperature_per_day[4]);
printf("%d", temperature_per_day[5]);
printf("%d", temperature_per_day[6]);
```

→***Is this a good idea??***

Arrays and Loops

```c
int i = 0;

while (i < 7) {
    printf("Temperature for day %d: %d\n", i, temperature_per_day[i]);
    i++;
}
```

What happens step by step

- *i starts at 0*
- *While i < 7:*
- *The value at temperature_per_day[i] is **read***
- *printf prints the index and its value*
- *i is incremented*
- *Loop stops after index 6*

```c
// Common mistakes

// Using & with printf

printf("%d\n", &temperature_per_day[i]); // WRONG

// Going out of bounds

while (i <= 7) // WRONG
```

Demo

→array.c

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Arrays and Functions

⟶ Arrays can be **passed** into functions just like other variables.

⟶ When **passing an array**, the function must also be told **how many elements** the array contains.

⟶ This allows the function to safely work with **arrays of different sizes.**

```
// Function that works with an array of integers of any length
void display_array(int length, int numbers[]);
```

Example

```c
void display_array(int length, int numbers[]);

int main(void) {
    int temperatures[] = {18, 21, 25, 19};
    int scores[] = {100, 75};

    display_array(4, temperatures);
    display_array(2, scores);

    return 0;
}

void display_array(int length, int numbers[]) {
    int i = 0;
    while i < length) {
        printf("%d ", numbers[i]);
        i++;
    }
}
```

Important Behaviour of Arrays in Functions

When an array is passed to a function, **the entire array is not copied**.

The function works with the **original array** created in `the caller function`.

Any changes made inside the function affect the array outside the function.

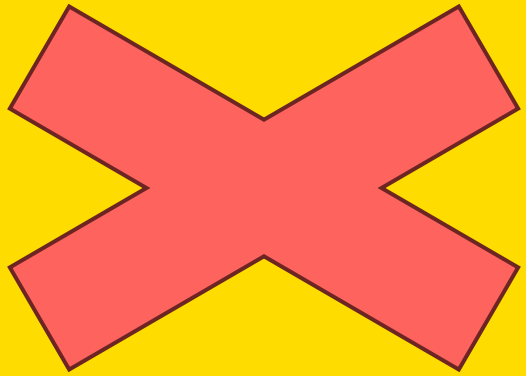
This behaviour will be explained in more depth in **later weeks**.

Initialising an Array Using a Function

→ A **function** can be used **to fill an array** with values.
→ The **array is created in main** and **passed** into helper functions.

```c
#define SIZE 5

int main(void) {
    int values[SIZE];

    read_values(SIZE, values);
    display_array(SIZE, values);

    return 0;
}

void read_values(int length, int array[]) {
    int i = 0;
    while (i < length) {
        scanf("%d", &array[i]);
        i++
    }
}
```

Returning Arrays from Functions



→ Trying to **return an entire array** from a function **does not work**.

→ Although the code **may compile**, it leads to serious **runtime problems**.

→ We will explore why this happens later in the course.

```c
// This does NOT work
int[] read_values(void) {
    int array[SIZE];

    for (int i = 0; i < SIZE; i++) {
        scanf("%d", &array[i]);
    }

    return array;   // ❌ invalid
}
```

Demo

→array_function.c

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Anonymous ongoing feedback
Anything you wanted to share with me

Voice of the Student

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See you soon …

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