# Welcome!

## COMP1511 18s1

Programming Fundamentals

# COMP1511 18s1
# — Lecture 7 —
## Strings

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chars
arrays of chars
strings

## Before we begin…

**introduce** yourself to the person sitting next to you

**why** did they decide to study **computing**?

## Overview

**after this lecture, you should be able to…**

understand the basics of **chars**

understand what **ASCII** is

understand the basics of **strings**

write programs using **strings** to solve simple problems

(**note**: you shouldn't be able to do all of these immediately after watching this lecture. however, this lecture should (hopefully!) give you the foundations you need to develop these skills. remembe

programming is like learning any other language, it takes consistent and regular practice.)

## Admin

**Don't panic!**

course **style guide** published

**week 4 weekly test** due friday

don't be scared!

**assignment 1** out now

work on it regularly!

additional **autotests** added to the assignment

don't forget about **help sessions**!

see course website for details

## Beyond Numbers

we've mostly seen numbers thus far

```
int age = 18;
double pi = 3.14
```

what else might we want to store?

## Letters and Words

what about words?

```
printf("andrew is awesome");
```

## Letters and Words

what about words?

```
printf("andrew is awesome");
```

**"andrew is awesome"**

## Letters and Words

words in C are called **strings**

```
printf("andrew is awesome");
```

**“andrew is awesome”**

^ this is a **string**

## introducing: **strings**

## Strings

a **string** is an **array** of **characters**.

note: a **character** is a “printed or written letter or symbol”.

## Characters

a **character** generally refers to a **letter**, **number**, **punctuation**, etc.

in C we call it a `char`

## Characters in C

in C we call it a `char`

```
// making an int
int age = 18;

// making a char
char letter = 'A';
```

`char` s go inside single quotes, i.e. `'` .
strings go inside double quotes, i.e. `"` .

## Characters in C

`char` stores small integers.

8 bits (almost always).

mostly used to store **ASCII** character codes

don't use for individual variables, only arrays

only use `char` for characters

(not to store e.g. numbers between 0-9)

## ASCII

**ASCII** is a way of **mapping numbers** to **characters**.

it contains:

upper and lower case **English letters**: A-Z and a-z

**digits**: 0-9

common **punctuation** symbols

special non-printing characters: e.g newline and space.

## ASCII

**you don't have to memorize ASCII codes!**

single quotes give you the ASCII code for a character:

```
printf("%d", 'a'); // prints 97
printf("%d", 'A'); // prints 65
printf("%d", '0'); // prints 48
printf("%d", ' ' + '\n'); // prints 42 (32 + 10)
```

don't put ASCII codes in your program - use **single quotes** instead!

## ASCII

let's try it out!

## Reading chars

`getchar()`

reads a **byte** from standard input
returns an **int**

returns a special value if it **can't** read a byte
otherwise returns an integer (0..255)
(ASCII code)

let's try it out!

## getchar

consider the following code:

```
int c1, c2;
printf("Please enter first character:\n");
c1 = getchar();
printf("Please enter second character:\n");
c2 = getchar();
printf("First %d\nSecond: %d\n", c1, c2);
```

what should this do?

what does it actually do?

(how can we fix it?)

## getchar

```
int c1, c2;
printf("Please enter first character:\n");
c1 = getchar();
printf("Please enter second character:\n");
c2 = getchar();
printf("First %d\nSecond: %d\n", c1, c2);
```

what should this do? **read two typed characters**

what does it actually do? **read one typed character + enter**

## getchar

how can we fix it?

```
int c1, c2;
printf("Please enter first character:\n");
c1 = getchar();

getchar(); // extra getchar to catch the newline

printf("Please enter second character:\n");
c2 = getchar();
printf("First %d\nSecond: %d\n", c1, c2);
```

## End Of Input

**scanf** or **getchar** will fail if there isn't any more input

eg if you're reading from a file and reach the end of the file

**getchar** returns a special value to indicate no more input is available

we call this value **EOF**

(how could you check this with **scanf**?)

## Reading until End of Input

```
int c;
c = getchar();
while (c != EOF) {
    printf("’%c’ read, ASCII code is %d\n", c, c);
    c = getchar();
}
```

reading numbers until end of input with scanf:

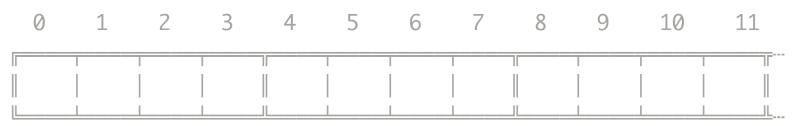
```
int num;
// scanf returns the number of items read
while (scanf("%d", &num) == 1) {
    printf("you entered the number: %d\n", num);
}
```

## Strings

strings are an **array** of **characters**

## Remember Arrays?

A series of boxes with a common type,
all next to each other



## Arrays in C

```
// Declare an array with 10 elements
// and initialises all elements to 0.
int myArray[10] = {0};
```

```
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9
```

## Arrays in C

```
int myArray[10] = {0};
// Put some values into the array.
myArray[0] = 3;
myArray[5] = 17;
```

```
| 3 | 0 | 0 | 0 | 0 | 17 | 0 | 0 | 0 | 0 |
| 0 | 1 | 2 | 3 | 4 | 5  | 6 | 7 | 8 | 9
```

## Character Arrays

we can make an array of **chars** in the same way

```
char myArray[10] = {0};
// Put some values into the array.
myArray[0] = 65;
myArray[5] = 70;
```

```
| 65 | 0 | 0 | 0 | 0 | 70 | 0 | 0 | 0 | 0 |
| 0  | 1 | 2 | 3 | 4 | 5  | 6 | 7 | 8 | 9
```

## How long is a piece of string?

you don't always know the **length** of a string in advance

e.g. **name** could be "Andrew", or "Tom"

(6 characters vs 3 characters)

```
// "Andrew" is 6 letters long
name[0] = 'A';
name[1] = 'n';
name[2] = 'd';
name[3] = 'r';
name[4] = 'e';
name[5] = 'w';

// "Tom" is 3 letters long
name[0] = 'T';
name[1] = 'o';
name[2] = 'm';
```

## How long is a piece of string?

we need a way to know how long the string is!

```
name[0] = 'A'; name[1] = 'n'; name[2] = 'd';
name[3] = 'r'; name[4] = 'e'; name[5] = 'w';
```

```
 ---------------------------------------
| A | N | D | R | E | W |   |   |   |   |
 ---------------------------------------
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9
```

(please **never** write code on one line like this! it's only here so the slides fit)

## How long is a piece of string?

we need a way to know how long the string is!

```
name[0] = 'T'; name[1] = 'o'; name[2] = 'm';
```

```
 ---------------------------------------
|'T'|'O'|'M'| R | E | W |   |   |   |   |
 ---------------------------------------
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9
```

printing **name** would print **TOMREW**

## Null Terminator

we do this in C using a **null terminator**

any function (e.g. printf) working with a string interprets this as "end of string".

```
name[0] = 'T';
name[1] = 'o';
name[2] = 'm';
name[3] = '\0';
```

## Null Terminator

```
|'T'|'O'|'M'|'\0'| E | W |   |   |   |   |
  0   1   2    3    4   5   6   7   8   9
```

printing **name** would now print **TOM**

## Sidenote: Uninitialised Arrays

what happens if we don’t initialise our array?

let’s try it and see!

## Sidenote: Uninitialised Arrays

what’s wrong with this code?

```
int array[SIZE];

int i = 0;
while (i < SIZE) {
    printf("%d\n", array[i]);
    i++;
}
```

## Sidenote: Uninitialised Arrays

the array has not been **initialised**

```
int array[SIZE];

int i = 0;
while (i < SIZE) {
    printf("%d\n", array[i]);
    i++;
}
```

```
| ? | ? | ? | ? | ? | ? | ? | ? | ? | ? |
```

## Sidenote: Uninitialised Arrays

solution: initialise the array first

(note: you could also initialise all the values in a loop)

```
int array[SIZE] = {0};

int i = 0;
while (i < SIZE) {
    printf("%d\n", array[i]);
    i++;
}
```

```
┌───┬───┬───┬───┬───┬───┬───┬───┬───┬───┐
│ 0 │ 0 │ 0 │ 0 │ 0 │ 0 │ 0 │ 0 │ 0 │ 0 │
└───┴───┴───┴───┴───┴───┴───┴───┴───┴───┘
```

## Sidenote: Uninitialised Arrays

**dcc** can catch this for you if you tell it to use **valgrind**

```
dcc -o blah blah.c --valgrind
```