COMP1511 - Programming Fundamentals

Term 3, 2019 - Lecture 11

What did we learn last week?

Assignment 1

- Everything you need to know about CS Paint!

Characters and Strings

- Using letters and words in C

Memory and Pointers

- Memory addresses and how to use them

What are we covering today?

Command Line Arguments

- Adding information to our program when it runs

Professionalism

- Some important skills as a programmer

Pointers continued

- Directly addressing memory

Characters and Strings Recap

Our new variable type: `char`

- Represents a letter
- Is also a number, an ASCII code, and we'll often use `int`s to represent a character
- When used in arrays, they're referred to as strings
- Strings often end before the end of the array they're stored in
- When they do, we store a null terminator `'\0'` after the last character

Strings in Code

Strings are arrays of type char, but they have a convenient shorthand

```
// a string is an array of characters
char word1[] = {'h','e','l','l','o'};
// but we also have a convenient shorthand
// that feels more like words
char word2[] = "hello";
```

Both of these strings will be created with 6 elements. The letters **`h,e,l,l,o`** and the null terminator **`\0`**

h	e	l	l	o	\0

Command Line Arguments

Sometimes we want to give information to our program at the moment when we run it

- The **"Command Line"** is where we type in commands into the terminal
- **Arguments** are another word for input parameters

```
$ ./program extra information 1 2 3
```

- This extra text we type after the name of our program can be passed into our program as strings

Main functions that accept arguments

`int main` doesn't have to have `void` input parameters!

```
int main(int argc, char* argv[]) {
}
```

- **argc** will be an "argument count"
- This will be an integer of the number of words that were typed in (including the program name)
- **argv** will be "argument values"
- This will be an array of strings where each string is one of the words

An example of use of arguments

```
#include <stdio.h>

int main(int argc, char *argv[]) {
    int i = 1;
    printf("Well actually %s says there's no such thing as ", argv[0]);
    while (i < argc) {
        fputs(argv[i], stdout);
        printf(" ");
        i++;
    }
    printf("\n");
}
```

Arguments in argv are always strings

But what if we want to use things like numbers?

- We can read the strings in, but we might want to process them

```
$ ./program extra information 1 2 3
```

- In this example, how do we read 1 2 3 as numbers?
- We can use a library function to convert the strings to integers!
- **`strtol()`** - "string to long integer" is from the stdlib.h

Code for transforming strings to ints

Adding together the command line arguments

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

int main(int argc, char *argv[]) {
    int total = 0;

    int i = 1;
    while (i < argc) {
        total += strtol(argv[i], NULL, 10);
        i++;
    }
    printf("Total is %d.\n", total);

}
```

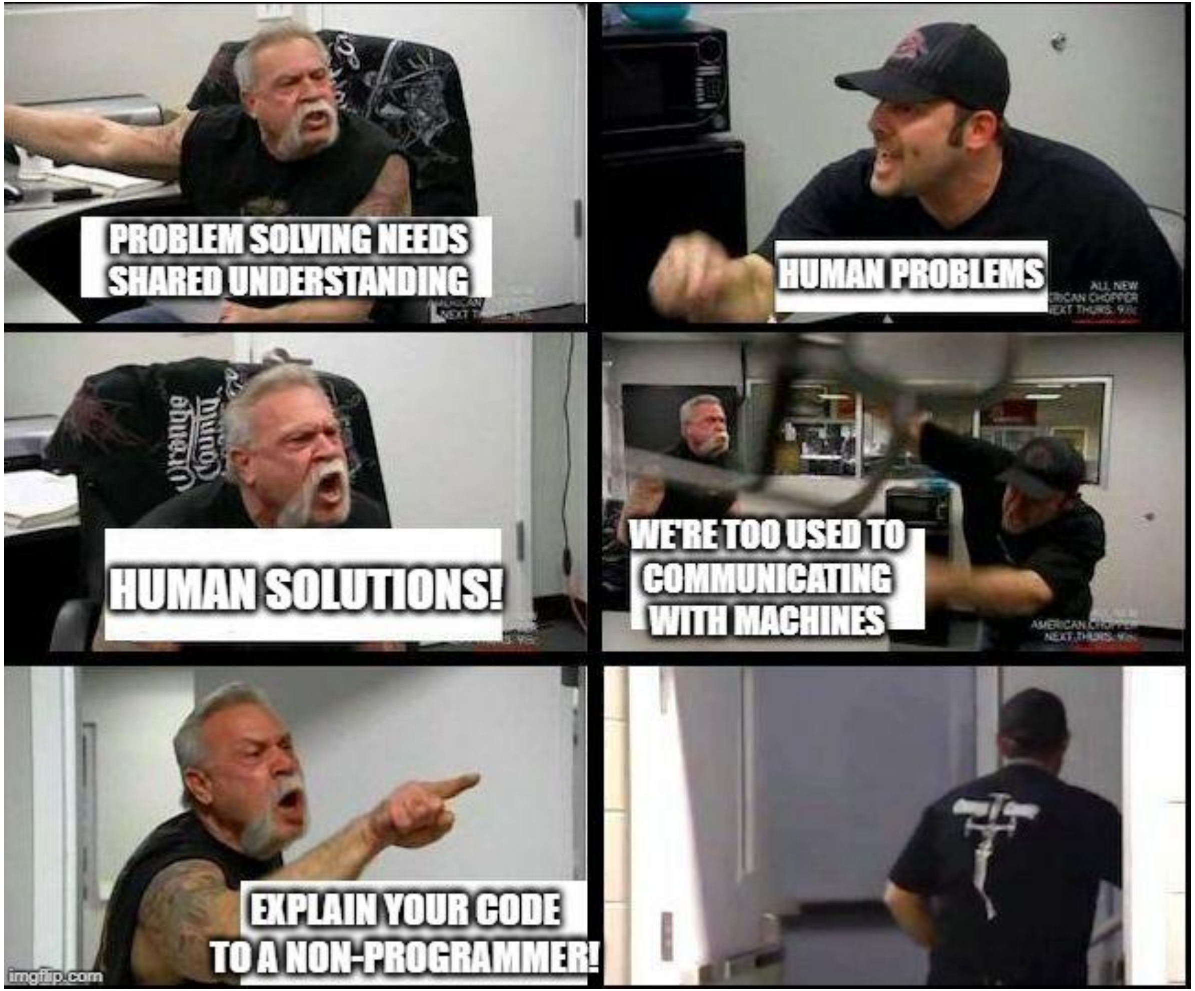
What does it mean to be a professional engineer?

Four pillars of being a professional:

1. Communication
2. Teamwork
3. Resilience
4. Technical Skills

Communication

Does everyone understand what you're working on?


PROBLEM SOLVING NEEDS SHARED UNDERSTANDING
HUMAN PROBLEMS
HUMAN SOLUTIONS!
WE'RE TOO USED TO COMMUNICATING WITH MACHINES
EXPLAIN YOUR CODE TO A NON-PROGRAMMER!
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Communication

Making sure everyone understands what you’re doing

- Problem solving in teams involves shared understanding
- In order to solve human problems, we must understand what people need and how we can help them
- The more we communicate with computers the more risk we have of treating people like machines
- The ability to explain our code is important to keep us on track
- It’s especially important to be able to explain your code to non-programmers

Teamwork

Code is very rarely created alone

Teams that get along are usually more successful than teams of pure skill

Teamwork

Code is very rarely created alone

- Teamwork involves sharing and compromise
- Can you work with other people’s ideas?
- Can you follow someone else’s style and structure?
- Can you adapt your structure so that other people can use it?
- Can you provide support to your teammates?
- Teams made of people who get along are usually more successful than teams made of very skilled individuals!

Resilience

Work is hard. We need to look after ourselves

- You shouldn't have to "survive" your job
- Dealing with "impossible situations"
- Failure is inevitable, what counts is how you recover, not whether you fail

Technical Skills

How's your programming?

- Yes, this comes last in the list
- It's still important but it can't be your only focus
- Still, we have the majority of our degrees to learn technical programming

More about Resilience and Surviving

You have an assignment due soon

- Success isn’t about getting everything done
- It’s about prioritising your effort so you don’t have to do as much work!

Priorities:

- What gets you the most marks with the least amount of time?
- Code Style?
- Clean, basic functionality?
- There are more marks in the earlier stages than later
- Aim for what you can achieve without burning out

Don’t Panic!

Surviving is about acting rationally in panicky situations

- Take a moment to breathe
- Figure out what your options are
- Break problems down into small bits
- Complete small pieces one at a time
- Aim for whatever gets you enough

WORKING LIKE CRAZY ON THE HARDEST THING YOU CAN THINK OF AND THEN FAILING
AIMING FOR JUST ENOUGH TO MAKE YOURSELF HAPPY
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Don’t Panic!

Surviving is about acting rationally in panicky situations

- Take a moment to assess where you’re up to
- Figure out what your options are
- Break everything down into small bits
- Complete small pieces one at a time
- Aim for whatever gets you the highest marks

Becoming a Professional

It doesn't have to happen yet . . . and it's always ongoing learning!

- Remember to communicate with colleagues
- Follow as well as lead when you're in a team
- Look after yourself
- And above all . . .
- **Care about yourself, the people around you and your work**

Break Time

Learning something new is better than being good at something!

Remember . . . as nice as high marks are, they're not the same as long term fulfilment

"I don't care who you are, where you're from, what you've done . . . as long as you love C." - The Backstreet Boys

Pointers Recap

Pointers are Memory Addresses

- We'll use pointers to remember where variables are
- The value stored in a pointer is an address in memory
- `*` is used to declare a pointer
- After it's created `*` is used to dereference a pointer - find the value of the variable the pointer is "aimed at"

```
int i = 100;
// create a pointer called ip that points at
// an integer in the location of i
int *ip = &i;
```

Pointers in use

- `&` is used to find the address of a variable
- It can be used to assign an address to a pointer

```
int i = 100;
// create a pointer called ip that points at
// the location of i
int *ip = &i;
printf("The value of the variable at %p is %d", ip, *ip);
```

Ok let's make a simple program

This program is called The Jumbler

- It will take some numbers as command line arguments
- It will jumble them a little, changing their order
- Then it will print them back out

- We'll make some use of functions and pointers here!

What functions do we want?

Deciding how to split up your functionality

- A function that reads the command line arguments as integers
- A function that swaps two numbers
- A function that swaps several numbers
- A function that prints out our numbers

Converting our Command Line Arguments

We'll read the command line arguments and convert them to ints

- Note that we're ignoring the first element of arguments because we know that it's the name of the program and not one of our numbers

```
void read_args(int nums[MAX_NUMS], char *arguments[], int argCount) {
    int i = 0;
    while (i < MAX_NUMS && i < argCount - 1) {
        nums[i] = strtol(arguments[i + 1], NULL, 10);
        i++;
    }
}
```

Printing our numbers

This is a trivial function

- The only issue is that we might have to work with an array that isn't full
- So we use numCount to stop us early if necessary

```
void print_nums(int nums[MAX_NUMS], int numCount) {
    int i = 0;
    while (i < MAX_NUMS && i < numCount) {
        printf("%d ", nums[i]);
        i++;
    }
}
```

Using Pointers to swap variable values

A simple swap function

- This function doesn't even know whether the ints are in arrays or not
- It sees two memory locations containing ints
- and uses a temporary int variable to swap them

```
void swap_nums(int *num1, int *num2) {
    int temp = *num1;
    *num1 = *num2;
    *num2 = temp;
}
```

Jumble performs some swaps

This function just loops through and swaps a few numbers

- This is a good candidate for a function that could be changed or written differently and just used by our main without thinking about it

```
void jumble(int nums[MAX_NUMS], int numCount) {
    int i = 0;
    while (i < MAX_NUMS && i < numCount) {
        int j = i * 2;
        if (j < MAX_NUMS && j < numCount) {
            swap_nums(&nums[i], &nums[j]);
        }
        i++;
    }
}
```

Using all the functions in the main

A nice main makes use of its functions

- It's very easy to read this main!
- It shows its steps using its function names
- There isn't much code to dig through

```c
int main(int argc, char *argv[]) {
    int numbers[MAX_NUMS];
    read_args(numbers, argv, argc);
    jumble(numbers, argc - 1);
    print_nums(numbers, argc - 1);
    return 0;
}
```

What did we learn today?

Command Line Arguments

- Reading input that's typed in with the program command

Professionalism

- Being ready for a career in computing

Pointers in Functions

- Using pointers in a program with functions