

# Introduction to C

Module Code: GEEN1064

Module Name: Engineering Design and Implementation

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# C is god's programming language



# Why C?

Developed by Denis Ritchie (Steve Jobs eat your heart out)

- general-purpose (originally designed for UNIX)
- provides common ancestry
- structured programming language
- machine-independent
- low level



# First Program in C

This is the first program we are going to create in C. It is a tribute to Denis Ritchie program written in C.

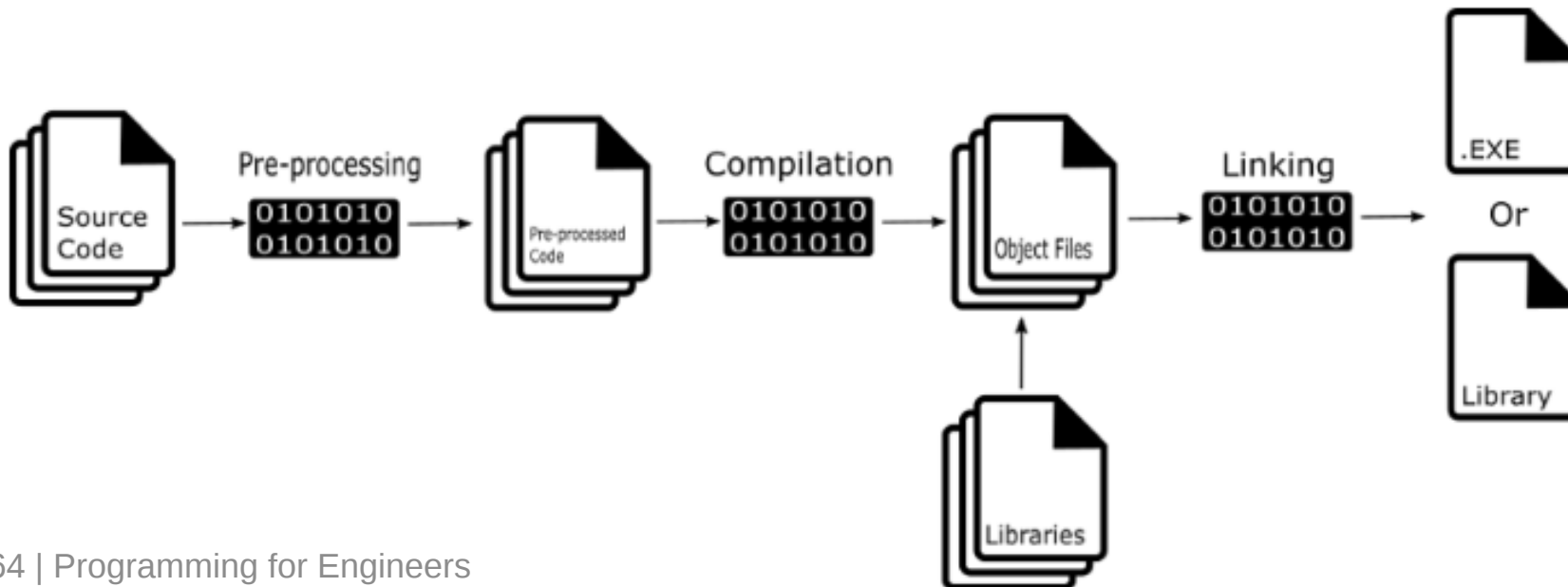
```
// library or header file that contains standard input/output operations
#include <stdio.h>

/*
    main() function every C program must have a main,
    it has a returnable 'int' this is for exit codes
*/
int main(void) // void means no input argument
{
    printf("Hello World!\n");
    printf("Goodbye World!\n");
    return 0; // return exit code 0, no error
}
```

# Compile the code

We are going to use `gcc` compiler to compile our `c` code; first argument is the source file[s], and `-o` means output file. The file extension in linux can be left blank or called whatever you want.

```
$ gcc helloworld.c -o helloworld.[out,exe,...]
```



## Execute the code

As we are using a terminal, we must prepend the newly created file with `./`. The `.` denotes the current directory. Since we want to run a file in our current directory and that directory is not in our `$PATH`, you need the `./` bit to tell the shell where the executable is.

### Output:

```
$ ./helloworld.exe  
Hello World!  
Goodbye World!
```

# Header Files

## Libraries

These files contain all scaffolding code that your `main()` will use as we do not want to overpopulate with excessive lines of code for readability.

Computers used to be too slow to compile a whole program in one single mega-blob where all the functions and types were visible.

To solve this, programs are split into c/h files which are each individually compiled into a machine code file (the 'object' file), and then linked together into an exe or dll.



# Header Files Continued

## usefulfunctions.h

```
#ifndef USEFULFUNCTIONS_H_    /* Include guard */
#define USEFULFUNCTIONS_H_

int sqr(int x); /* An example function declaration */

#endif // USEFULFUNCTIONS_H_
```

## usefulfunctions.c

```
#include "usefulfunctions.h" /* Include the header (not strictly necessary here) */

int sqr(int x) /* Function definition */
{
    return x * x;
}
```

# Revist helloworld.c

We are modifying the code to use our custom library:

```
#include <stdio.h> /* searches system header file directories */
#include "usefulfunctions.h" /* notice "" searches current directory */

int main(void) /* void means no input argument */
{
    printf("Hello World\n!"); /* using standard ouput function to printf()*/
    printf("%d\n",sqr(255));
    printf("Goodbye World!\n");

    return 0; /* return exit code 0, no error */
}
```

## Compile and run

We need to source all files needed to build our modified program.

Remember the header file points to the function in the `usefulfunctions.c` file.

```
$ gcc helloworld.c usefulfunctions.c -o helloworld.out
```

### Output:

```
$ ./helloworld.out  
Hello World!  
65025  
Goodbye World!
```

# Standard Input and Output

- `stdio.h` is a large file that contains many function declarations, in fact there are 827 lines of code for this header file alone.
  - [stdio.h source code](#)

You should feel a sense of accomplishment for the code you have written so far... just remember that someone wrote the code for your code to work .

## Primitive Data Types

C has several data types and all variables **must** have a data type

Data Type	Size (Bytes)	Range	Format Specifier
(unsigned)char	at least 1	−128 to 127 or 0 to 255	%c
(unsigned)short	at least 2	−32768 to 32767, 0 to 65535	%h
(unsigned)int	at least 2	−2, 147, 483, 648 to 2, 147, 483, 647 0 to 4294967295	%u , %d
long	least 4	−9, 223, 372, 036, 854, 775, 808 to 9, 223, 372, 036, 854, 775, 807	%l , %ll , %lld , %lli
unsigned long	at least 4	0 to 18, 446, 744, 073, 709, 551, 615	%lu , %llu
float	at least 2	$3.4e - 038$ to $3.4e + 038$	%f
(unsigned)double	at least 8	$1.7e - 308$ to $1.7e + 308$	%lf
long double	at least 10	$1.7e - 4932$ to $1.7e + 4932$	%Lf

# C Advanced Features

- Pointers and addressing, `int*` , `&var1` (more about this later)
- `struct`
  - Allows to combine data items of different kinds
  - ```
struct Books { char title[50]; char author[50]; int book_id;}
```

  
`book`
- `enum`
  - It consists of constant integrals or integers that are given names by a user.
  - ```
enum enum_name{int_const1, int_const2, int_const3, ... int_constN};
```
- `union`
  - allows to store different data types in the same memory location
  - ```
union Data { int i; float f; char str[20];} data;
```

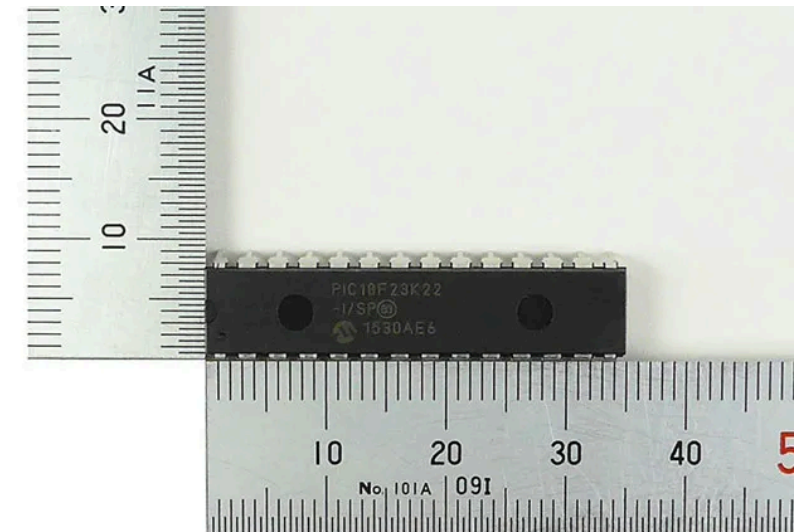
# Embedded C

```

ANSEL  = 0;      // Configure AN pins as digital I/O
ANSELH = 0;
C10N_bit = 0;    // Disable comparators
C20N_bit = 0;
//          76543210
TRISC  = 0b10000000; // PORTC is input
UART1_Init(9600); // Initialize UART PROTO

...

ANSELA = 0;      // Configure AN pins as digital I/O
ANSELB = 0;
ANSELC = 0;
TRISB  = 0;
    
```



# Objective-C

```
#import "MyClass.h"

@implementation MyClass
- (id)initWithString:(NSString *)aName
{
    // code goes here
}

+ (MyClass *)myClassWithString:(NSString *)aName
{
    // code goes here
}
@end
```





# Compilation

Throughout this lab we have been using `gcc` or 'the GNU Compiler Collection'. The GNU is a recursive acronym: 'GNU's Not Unix!'

Supports:

- C,
- embedded-C ,
- Objective-C,
- C++,
- Fortran,
- Ada,
- Go,
- and D

# Command Line Arguments

```
#include <stdio.h>

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

    printf("Program name %s\n", argv[0]);

    if( argc == 2 ) {
        printf("The argument supplied is %s\n", argv[1]);
    }
    else if( argc > 2 ) {
        printf("Too many arguments supplied.\n");
    }
    else {
        printf("One argument expected.\n");
    }
    return 0;
}
```

Let's do this now...