

Introduction to C

Module Code: GEEN1064

Module Name: EEngineering 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.

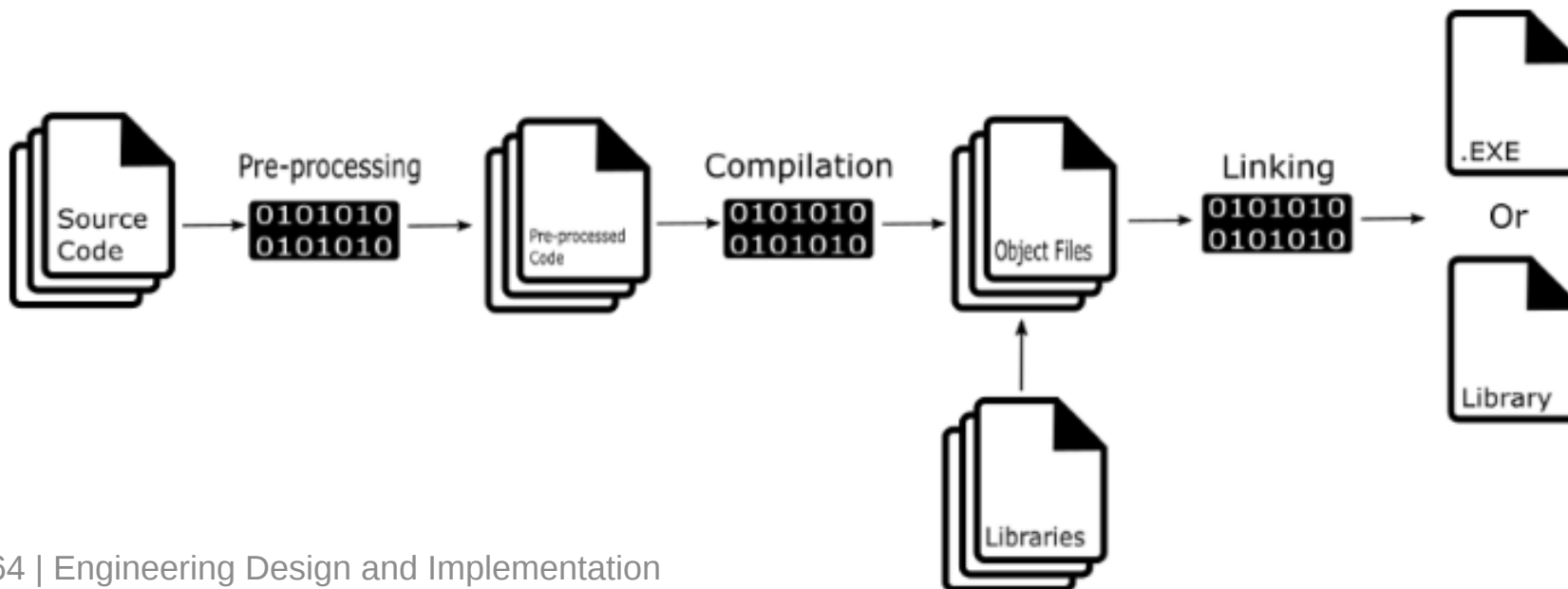
```
// library or header file that contains standard input/output operations
#include <stdio.h>

/*
    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 output 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

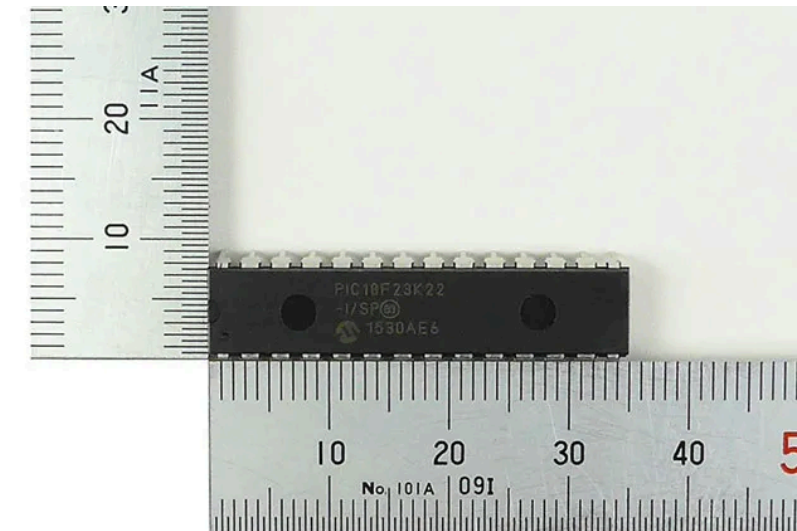
```

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;

```

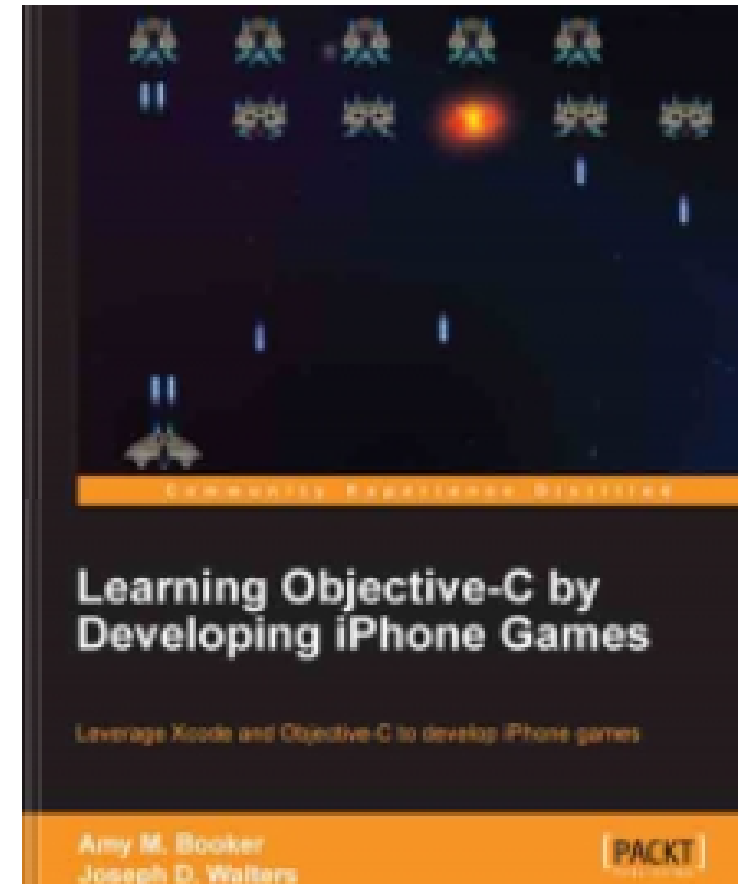


# Objective-C

```
#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...