Warning: These notes are not complete, it is a Skelton that will be modified/add-to in the class. If you want to us them for studying, either attend the class or get the completed notes from someone who did

CSE2301

Functions and Compiler Directives

Functions

- Function is a small program that may receives some data, perform some computations, and may return a value.

```
Return_type function_name(arguments declaration)
{
  declaration
  statements
}
```

- In C, call is by value (example).
- void if doesn't return anything

```
int power(int base, int exp)
{
   int i, p = 1;
   for (i = 1; i <= exp; ++i)
      {
         p *= base;
      }
   return p;
}
```

strcpy

```
void strcpy(char *s, char *t) {
 int i;
 i=0;
 while(  t[i] != '\0' ) {
        s[i]=t[i];
        i++;
        }
s[i]='\0';
}
```

strcpy

```
void strcpy(char *s, char *t) {
 int i;
 i=0;
 while( (s[i] = t[i]) != '\0' )
        i++;
}
```

strcpy

```
void strcpy(char *s, char *t) {
 while( (*s = *t) != '\0' ) {
        s++;
        t++;
        }
}
```

strcpy

```
void strcpy(char *s, char *t) {
 while( (*s++ = *t++) != '\0' );
}
```

Declaration

- Before the use, functions must be declared.

`int mysum(int a, int b);`

Function may return a value using `return`

Retruning a value from a function that returns void is an error

Not returning a value from a function that returns a value is unpredictable.

Scope

- Variables do exist within their block.
- For functions, all variables are created at the time the function is called, and vanishes after the function returns (automatic variables).
- If a variable is declared before main, then it is visible to all functions in the file, but could be overridden by declaring a variable by the same name in a function.

Scope

- Usually, an external variable must be declared `extern` in any function that uses it (`extern char line[];`)
- If the function in the same file as the variable declaration, no need for `extern`
- If a variable is declared `static` outside of main, it is not visible to other files (only in this file).

Example

extern.c

```
#include <stdio.h>
int myfun(int){
extern i;
printf("%d\n",i);
int j;
j=myfun(i);
printf("%d
%d\n",i,j);
}
```

extern1.c

```
#include <stdio.h>
int i=1o;
int myfun(int) {
      printf("myfun: %d\n",j);
      i=17;
      return 7;
}
```

```
10
myfun:  10
17  7
```

Scope

- `static` could be used also with functions.
- If a variable in a function is declared `static`, the variables does not vanish after the function returns, it stays in the memory so the next call to the function will find the old value.
- static variables are initialized to 0.

Preprocessor

- Preprocessor processes the file before compilation.
- It handles `#define` and `#include`

```
#define ON 1
#define OFF 0
#define square(x) ((x)*(x))
#define square(x) x*x ???
#define square(x) x*x; ?
```

Preprocessor

- Conditional inclusion

```
#if !defined(HDR)
#define HDR
//include the file here

#endf
```

```
#ifdef HDR
#define HDR
```

`#undef x` undefines x

Preprocessor

- Formal parameters are not replaced within quoted strings.
- ## means concatenate
- If the parameter name is proceeded by a # in the replacement text, the combination will be expanded into a quoted string with the parameter replaced by the actual argument

```
#define dprint(expr) printf(#expr " = %g \n", expr)
```

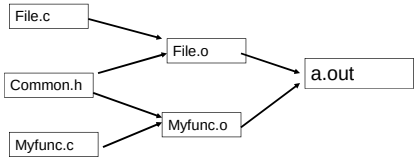
Preprocessor

- #ifdef can also be used for conditional compilation.

Compilation

- `cc file.c` produces a.out
- Compiling a C program
  - Converting the .c file into assembly .s
  - Compiling the assembly into a machine code (object code) .o
  - Linking the .o file to the code library and is named a.out
- What happens when you have several files

Compilation

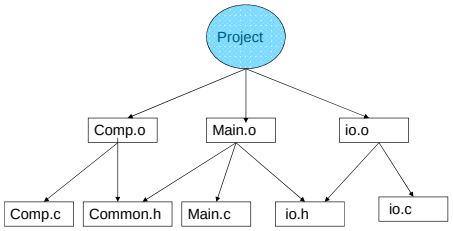


- We can produce the .o file using
- cc –c File.c

Compilation

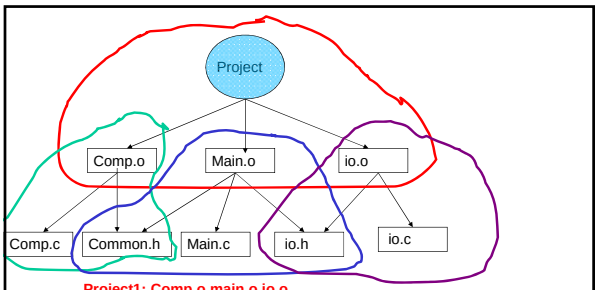
- Usually, your program will be divided into several files.
- Be careful with global variables and functions name.
- Every file will be compiled into its .o
- Finally, all the .o files can be compiled to produce a.out
- `cc File.o Myfunc.o`

Dependency Graph



Compilation

- If we changed one file, there is no need to recompile all the files.
- Make files are used to manage that
- The name of the file is makefile or Makefile




```
Project1: Comp.o main.o io.o
      cc Comp.o main.o io.o –o Project
Comp.o : Comp.c Common.h
      cc –c Comp.c
Main.o: Main.c Common.c io.h
      cc –c Main.c
io.o:      io.h io.c
      cc –c io.c
```

Makefile

- Each dependency is handled as

Target: source files

Command (preceded by a tab)

- To compile just type **make**

Macros in Makefile

```
OBJECTS = Comp.o Main.o io.o
Project: $(OBJECTS)
      gcc $(OBJECTS) –o Project
Comp.o: Comp.c Common.h
      gcc –c Comp.c
Main.o: Main.c Common.h io.h
      gcc –c Main.c
io.o: io.c io.h
      gcc –c io.c
```

Standard C Library

• **assert.h**	• assertions
• **ctype.h**	• character mappings
• **errno.h**	• error numbers
• **math.h**	• math functions
• **limits.h**	• metrics for ints
• **signal.h**	• signal handling
• **stdarg.h**	• variable length arg lists
• **stddef.h**	• standard definitions
• **stdio.h**	• standard I/O
• **stdlib.h**	• standard library functions
• **string.h**	• string functions
• **time.h**	• date/type functions

Standard C Libraries

- • Utility functions **stdlib.h**
  - **atof, atoi, rand, qsort, getenv,**
  - **calloc, malloc, free, abort, exit**
- • String handling **string.h**
  - **strcmp, strncmp, strcpy, strncpy, strcat,**
  - **strncat, strchr, strlen, memcpy, memcmp**
- • Character classifications **ctype.h**
  - **isdigit, isalpha, isspace, isupper, islower**
- • Mathematical functions **math.h**
  - **sin, cos, tan, ceil, floor, exp, log, sqrt**