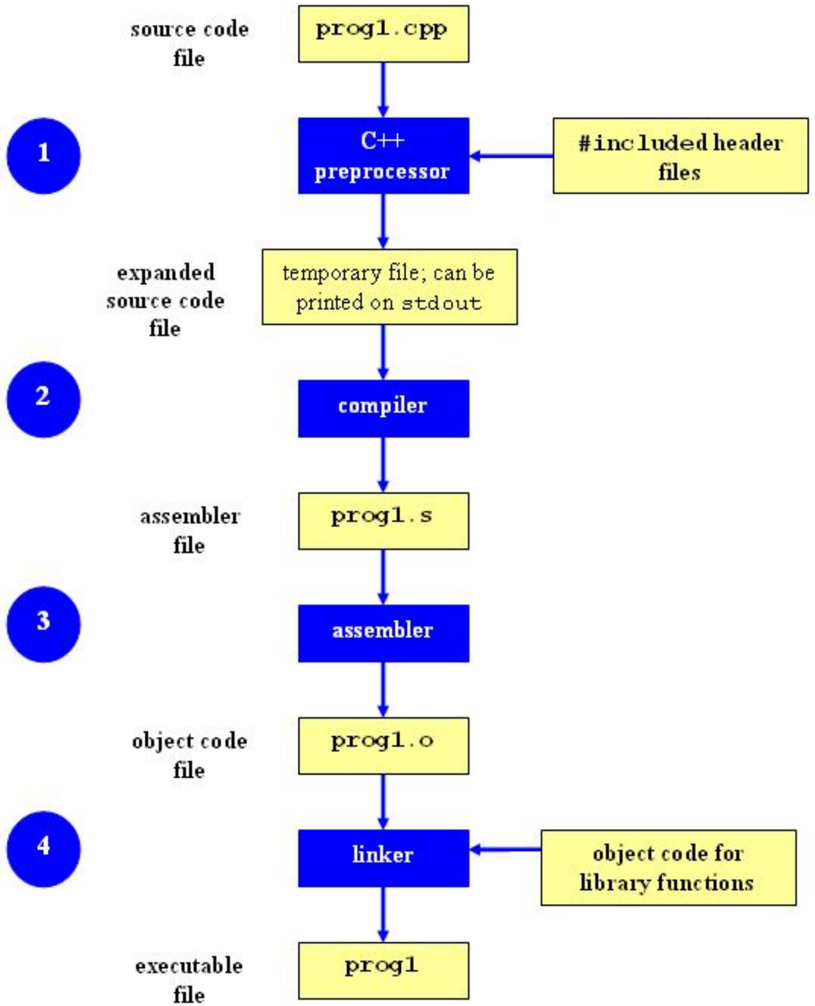
CSE 374 Lecture 15

Week 6: More preprocessor, Multiple Files

Compiling in more detail

Compilation process is actually multi-step

Multi-file compilation requires knowing more details



```
# Stop after the preprocessor and
  store the preprocessed C file in
  file.pp
  $ gcc -E file.c > file.pp

# Stop after the compiler and store
  the assembly code in file.s
  $ gcc -S file.c

# Stop after the assembler and
  store the machine code in file.o
  $ gcc -c file.c
```

Preprocessor Review (and header files)

The preprocessor rewrites code before the compiler gets it.

Has multiple roles:

- **Include header files**
- **Define Constants**
- **Define Macros**
- **Conditional Compilation**

```
#include <stdlib.h>
#include <userfile.h>
```

Header files

- Always use ‘.h’,
- Headers include function, struct, constant declarations
- Never include function implementations
- Never include ‘.c’

```
$gcc -l : look in specific directories
```

Symbolic Constants & Macros

- ➔ Creates TOKEN to represent more text
- ➔ Preprocessor:
  - ◆ Replaces all matching TOKENS in rest of file
  - ◆ Knows where words start and end
  - ◆ Has no notion of scope (not the compiler)
- ➔ Can shadow another #define
- ➔ Use #undef to remove

Constants:

```
#define SYMBOLIC_CONSTANT value
#define NOT_PI 22/7
#define VERSION 3.14
#define FEET_PER_MILE 5280
#define MAX_LINE_SIZE 5000
```

Macros

Replace all matching “calls” with “body” but with text of arguments where the parameters are (just string substitution)

Gotchas (understand why!) ->

Macros DO NOT avoid performance overhead of a function call (maybe true in 1975, not now)

Macros CAN BE more flexible though (type-inspecific)

```
#define TWICE_AWFUL(x) x*2
#define TWICE_BAD(x) ((x)+(x))
#define TWICE_OK(x) ((x)*2)
double twice(double x) {
    return x+x; }
```

```
y=3;
z=4;
w=TWICE_AWFUL(y+z);   [y+z*2]
z=TWICE_BAD(++y);     [++y + ++y]
z=TWICE_BAD(y++);     [y++ + y++]
```

Justifiable Macros

Parameterized macros are generally to be avoided (use functions)

There are things functions cannot do:

```
#define NEW_T(t, howmany) ((t*)malloc((howmany)*sizeof(t))

#define PRINT(x) printf("%s:%d %s\n", __FILE__, __LINE__,x)
```

Be very careful with syntax if you do use them

Conditional Compilation

```
#ifdef FOO
// only compiled if FOO is defined
#endif

#ifndef FOO
// only compiled if NOT FOO
#endif

#if FOO > 2
// only compiled if FOO > 2
#endif
```

```
// use DBG_PRINT for debug-printing
#ifdef DEBUG
#define DBG_PRINT(x) printf("%s",x)
#else
// replace with nothing
#define DBG_PRINT(x)
#endif

DBG_PRINT("hello world!\n");

$ gcc -D DEBUG foo.c
// or with #define
```

#ifndef: header file inclusion

```
#ifndef FOO_H

#define FOO_H
```

and end it with:

```
#endif
```

- Assuming nobody else defines SOME_HEADER_H (convention)
    - first #include "some_header.h" will do the define and include the rest of the file
    - second and later will skip everything
- More efficient than copying the prototypes over and over again
- In presence of circular includes, necessary to avoid “creating” an infinitely large result of preprocessing

Linked List Continued

- One set of code to define linked list:
  - Linkedlist.h
  - Linkedlist.c
- Another piece of code uses it:
  - Linkedlistclient.c
  - Also include linkedlist.h

Compile with

```
$gcc -o lldemo linkedlist.c
   linkedlistclient.c
```