C Preprocessor

- C preprocessor manipulates ***text***

  file inclusion

  macros

  conditional compilation

- Invoked automatically by the C compiler

  try "**`lcc -E foo.c`**"

- File inclusion

  header files contain declarations for one or more C program files

  names of header file should end in "**`.h`**"

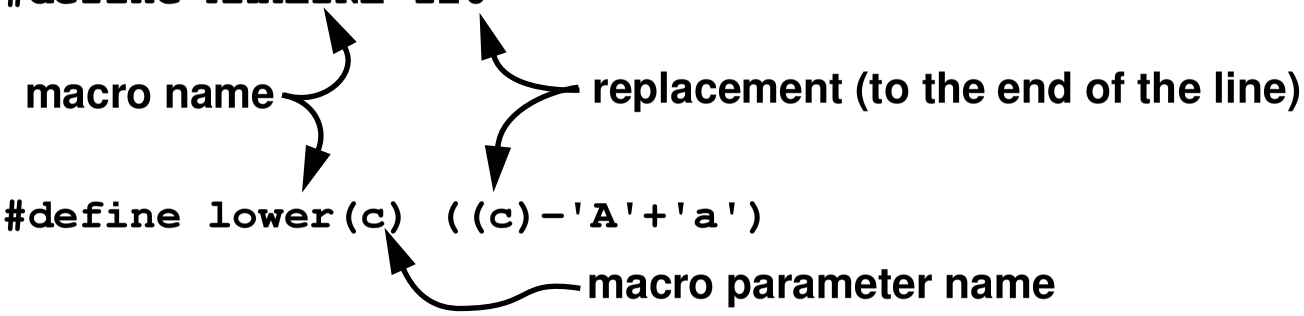
  specify system header filename with **`<...>`** — ***location independent***

```
#include <stdio.h>
#include "defs.h"
```

Macros

- Macros provide parameterized text substitution
- Macro ***definition***

```
#define MAXLINE 120
#define lower(c) ((c)-'A'+'a')
```



- Macro ***replacement***

```
char buf[MAXLINE+1];        becomes      char buf[120+1];
c = lower(buf[i]);                       c = ((buf[i])-'A'+'a');
```

More on Macros

```
#define plusone(x) x+1
```

- Good idea?

```
i = 3*plusone(2);
```
becomes `what?`

  - use parentheses liberally:

```
#define plusone(x) ((x)+1)
#define max(a,b) ((a)>(b)?(a):(b))
```

```
y = max(i++,j++);
```
becomes
```
y = ((i++)>(j++)?(i++):(j++));
```

  - avoid macros that use an argument more than ***once***

Conditional Compilation

- Removing macro definitions

  `#undef plusone`

- Conditional compilation

  `#ifdef` ***name***
  `#ifndef` ***name***
  `#if` ***expr***
  `#elif`
  `#else`
  `#endif`

  - header file **`defs.h`**:

```
    #ifndef DEFS_INCLUDED
    #define DEFS_INCLUDED

    #define MAXLINE 120
...
    #endif
```

- Use conditional compilation ***sparingly***

Basic Input/Output Functions

- C language has no I/O statements; use standard C ***library***
  - "**`#include <stdio.h>`**" before using the functions
  - **`int getchar(void)`** returns the next character in "stdin" or **`EOF`**
  - **`getchar()`** returns an **`int`**, not a **`char`**, to accommodate **`EOF`**
  - **`int putchar(int c)`** writes character **`c`** to the "stdout" and returns **`c`**

- A basic copy program:

```
#include <stdio.h>

int main(void) {
    int c;

    while ((c = getchar()) != EOF)
            putchar(c);
    return 0;
}
```

```
% copy < foo.c > bar.c
% copy < foo.c
% copy > bar.c
```

Formatted Output

- `int printf(const char *format, ...)`
- Writes `format` to stdout with the values of argument 2, 3, ..., ***n***

```
printf("error at line %d: %s\n", lineno, msg);
```

- ***Beware***:

  no type checking
  no type conversion
  no checking for the correct number of arguments

- Conversion specifications

`%d`	decimal	plus other formatting control, e.g. field widths
`%o`	octal	
`%x`	hexadecimal	
`%c`	char	
`%u`	unsigned	
`%e %f %g`	float & double	
`%s`	string	
`%%`	%	

- See `sprintf`, `fprintf`, `vfprintf`; and see `scanf`, `fscanf`, `sscanf` for ***input***

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