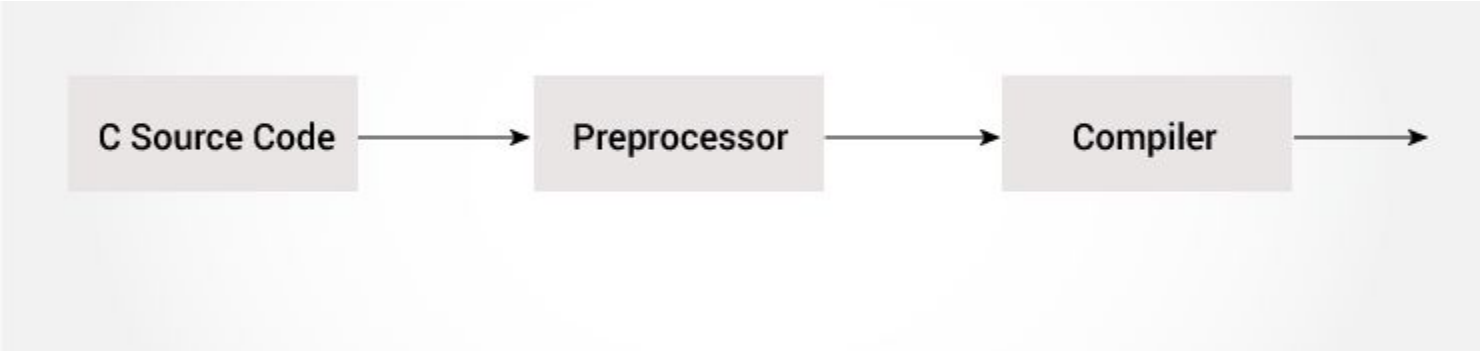
Preprocessor and Macros

C preprocessor directive

- The C preprocessor is a micro processor that is used by compiler to transform your code before compilation.
- It is called micro preprocessor because it allows us to add macros.



C Macros

- A macro is a segment of code which is replaced by the value of macro. Macro is defined by #define directive. There are two types of macros:
- Object-like Macros
- Function-like Macros

Object-like Macros

- The object-like macro is an identifier that is replaced by value. It is widely used to represent numeric constants. For example:
- #define PI 3.14
- Here, PI is the macro name which will be replaced by the value 3.14.

Function-like Macros

- The function-like macro looks like function call. For example:
- #define MIN(a,b) ((a)<(b)?(a):(b))
- Here, MIN is the macro name.

C Predefined Macros

- ANSI C defines many predefined macros that can be used in c program.

	Macro	Description
1	_DATE_	represents current date in "MMM DD YYYY" format.
2	_TIME_	represents current time in "HH:MM:SS" format.
3	_FILE_	represents current file name.
4	_LINE_	represents current line number.
5	_STDC_	It is defined as 1 when compiler complies with the ANSI standard.

C predefined macros example

```
#include <stdio.h>
 void main() {
   printf("File :%s\n", __FILE__ );  //file name
   printf("Date :%s\n", __DATE__ );  //current date
   printf("Time :%s\n", __TIME__ );  //current time
   printf("Line :%d\n", __LINE__ );  //current line number
   printf("STDC :%d\n", __STDC__ );  //compiler standard
}
```

C #include

- The #include preprocessor directive is used to paste code of given file into current file.
- It is used include system-defined and user-defined header files. If included file is not found, compiler renders error.
- By the use of #include directive, we provide information to the preprocessor where to look for the header files. There are two variants to use #include directive.
- #include <filename>
- #include "filename"

- The **#include <filename>** tells the compiler to look for the directory where system header files are held.
- The **#include "filename"** tells the compiler to look in the current directory from where program is running.

#include directive example

```
#include <stdio.h>
main() {
  printf("Hello C");
}
```

- #include notes:
- **Note 1:** In #include directive, comments are not recognized. So in case of #include <a//b>, a//b is treated as filename.
- **Note 2:** In #include directive, backslash is considered as normal text not escape sequence. So in case of #include <a\nb>, a\nb is treated as filename.
- **Note 3:** You can use only comment after filename otherwise it will give error.

C #define

- The #define preprocessor directive is used to define constant or micro substitution. It can use any basic data type.
- Syntax:
- #define token value

```
#include <stdio.h>
#define PI 3.14
main() {
  printf("%f",PI);
}
```

an example of #define to create a macro.

```
#include <stdio.h>
#define MIN(a,b) ((a)<(b)?(a):(b))
void main() {
   printf("Minimum between 10 and 20 is: %d\n", MIN(10,20));
}
```

Conditional Compilation

- In C programming, you can instruct preprocessor whether to include a block of code or not. To do so, conditional directives can be used.
- It's similar to a if statement with one major difference.
- The if statement is tested during the execution time to check whether a block of code should be executed or not whereas, the conditionals are used to include (or skip) a block of code in your program before execution.

C #if

- The #if preprocessor directive evaluates the expression or condition.
- If condition is true, it executes the code otherwise #elseif or #else or #endif code is executed.

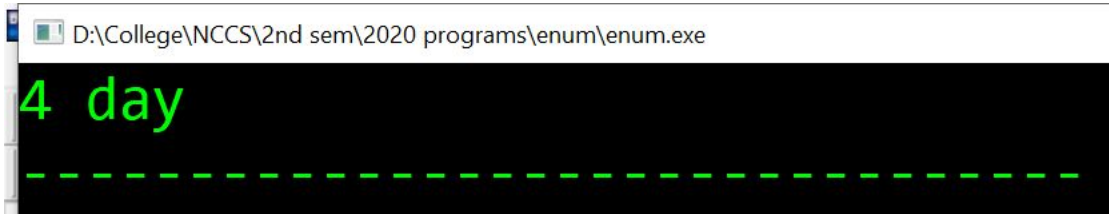
```
#include <stdio.h>
#include <conio.h>
#define NUMBER 0
void main() {
#if (NUMBER==0)
printf("Value of Number is: %d",NUMBER);
#endif
getch();
}
```

```
#include <stdio.h>
#include <conio.h>
#define NUMBER 1
void main() {
clrscr();
#if (NUMBER==0)
printf("1 Value of Number is: %d",NUMBER);
#endif

#if (NUMBER==1)
printf("2 Value of Number is: %d",NUMBER);
#endif
getch();
}
```

Enumeration

```
#include <stdio.h>
enum week{ sunday, monday, tuesday, wednesday, thursday,
friday, saturday};
int main()
{
enum week today;
today=wednesday;
printf("%d day",today+1);
return 0;
}
```



typedef in c

- typedef is a keyword used in C language to assign alternative names to existing datatypes.
- Its mostly used with user defined datatypes, when names of the datatypes become slightly complicated to use in programs.
- Following is the general syntax for using typedef,
  - typedef <existing_name> <alias_name>

```
#include<stdio.h>
#include<conio.h>
void main()
{
	typedef int nccs;
	nccs a,b,c;
	a=10,b=20;
	c=a+b;
	printf("%d",c);
	getch();
}
```

Structure definition using typedef

```
#include<stdio.h>
typedef struct employee
{
   char name[50];
   int salary;
}emp;
void main( )
{
   emp e1;
   printf("\nEnter Employee record:\n");
   printf("\nEmployee name:\t");
   scanf("%s", e1.name);
```

```
    printf("\nEnter Employee salary: \t");
    scanf("%d", &e1.salary);
    printf("\nstudent name is %s", e1.name);
    printf("\nroll is %d", e1.salary);
}
```

typedef and Pointers

- typedef can be used to give an alias name to pointers also.
- Here we have a case in which use of typedef is beneficial during pointer declaration.
- In Pointers * binds to the right and not on the left.
- int* x, y;
- By this declaration statement, we are actually declaring x as a pointer of type int, whereas y will be declared as a plain int variable.
- typedef int* IntPtr;
- IntPtr x, y, z;
- But if we use typedef like we have used in the example above, we can declare any number of pointers in a single statement.

Memory and string handling function

1	**void *memchr(const void *str, int c, size_t n)** Searches for the first occurrence of the character c (an unsigned char) in the first n bytes of the string pointed to, by the argument *str*.
2	**int memcmp(const void *str1, const void *str2, size_t n)** Compares the first n bytes of *str1* and *str2*.
3	**void *memcpy(void *dest, const void *src, size_t n)** Copies n characters from src to *dest*.
4	**void *memmove(void *dest, const void *src, size_t n)** Another function to copy n characters from *str2* to *str1*.
5	**void *memset(void *str, int c, size_t n)** Copies the character c (an unsigned char) to the first n characters of the string pointed to, by the argument *str*.

Example of memcpy

```
#include <stdio.h>
#include <string.h>

int main () {
  char src[50] = "Nepal";
  char dest[50];
  strcpy(dest,"Helloooo!!");
  printf("Before memcpy dest = %s\n", dest);
  memcpy(dest, src, strlen(src)+1);
  printf("After memcpy dest = %s\n", dest);
  return(0);
}
```

Example of memcmp

```
#include <stdio.h>
#include <string.h>
int main () {
  char str1[15]="nccs";
  char str2[15]="NCCS";
  int ret;
  ret = memcmp(str1, str2, 5);
  if(ret > 0) {
    printf("str2 is less than str1");
  } else if(ret < 0) {
    printf("str1 is less than str2");
  } else {
    printf("str1 is equal to str2");
  }
  return(0);
}
```

Example of memchr

```
#include <stdio.h>
#include <string.h>
int main ()
{
   char str[] = "nccs college";
   char ch = 'e';
   char *ret;

   ret = memchr(str, ch, strlen(str));
   printf("%s", ret);
   return(0);
}
```

Example of memset

```
#include <stdio.h>
#include <string.h>
int main ()
{
   char str[50];
   strcpy(str,"This is string.h library function");
   puts(str);
   memset(str,'$',7);
   puts(str);
   return(0);
}
```

```
D:\College\NCCS\2nd sem\2019 batch\programs\macros\memset.exe
This is string.h library function
$$$$$$$ string.h library function

--------------------------------
Process exited after 3.222 seconds with return value 0
Press any key to continue
```

Command Line Argument

```
#include<stdio.h>
void main(int argc,char *argv[])
{
    int a,b,c;
    a=atoi(argv[1]);
    b=atoi(argv[2]);
    c=a+b;
    printf("%d numbers of argument is passed",argc);
    printf("file name is %s",argv[0]);
    printf("sum is %d",c);
}
```