

C Program Structure and Keywords

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Hello World

Hello World in C

```
1 #include <stdio.h>
2
3 int main(){
4     printf("Hello, world!");
5 }
```

Program Structure

Preprocessor Macros

- `#include`: include header files
- `#define`: define constants/macros
- Conditional macros: `#if`, `#ifdef`, `#ifndef`, `#else`, `#elif`,
`#endif`: compile conditionally
- `#undef`: remove macro definitions

The `main` Function

- Entry point of C programs
- Return type (`int`) indicates exit status
- Function name: `main`
- Parentheses for parameters (empty for now)
- Curly braces {} define the body

Defining Variables

- Syntax: `data_type variable_name;`
- Must end with semicolon `;`
- Variables must be declared before use
- Can assign values at declaration

Semicolons and Statements

- Semicolon ends a statement. Two statements in one line:
 - `int x = 10; int y = x + 5;`
 - Discouraged in practice
- Multiple statements form the body of functions
- Common source of beginner errors

Calling Functions

- Syntax: `functionName(arguments);`
- Parentheses hold arguments/parameters (can be empty)
- Arguments or parameters are inputs to a function
- Must match function definition
- More on functions in a dedicated lecture

Brackets in C

- Parentheses `()` : grouping expressions and function calls
- Curly braces `{}` : define a block of code
- Square brackets `[]` : array indexing

Comments

- Single-line, starts with double slashes (//)
- Multi-line, starts with /* and ends with */ , this syntax is often discouraged
- Instead begin the lines with double slashes for multiline comments

```
1 // this is a single line comment  
2  
3 /* this is  
4 a multiline comment */  
5  
6 // this is also  
7 // a multiline comment
```

Escape Sequences

- `\n`: newline
- `\t`: tab
- `\\"`: backslash
- `\\"`: double quote
- `\'`: single quote

Whitespace and Indentation

- Whitespace is ignored (except in texts inside quotation marks)
- Indentation improves readability
- Use a single tab or four spaces for one level of indentation
- Example:

```
if(condition){  
    statement;  
}
```

Coding Conventions

- Meaningful variable names that represents the purpose and use of the variable
- Consistent indentation
- Opening brace `{` on the same line as keyword
- Use comments for clarity

Keywords in C

Data Types and Values

- `int`: integer type
- `float`: single precision floating-point
- `double`: double precision floating-point
- `char`: single character
- `void`: no return value / no data
- `signed`, `unsigned`: signed/unsigned integers
- `short`, `long`: specify integer size

Control Flow

- `if, else`: conditional branching
- `switch, case, default`: multi-way branching
- `for, while, do`: loops
- `break`: exit loop or switch
- `continue`: skip current iteration
- `goto`: jump to label (use sparingly)
- `return`: exit function, optionally returning value

Structuring

- `struct` : group related variables
- `union` : store different types in same memory
- `enum` : named integer constants
- `typedef` : define a type alias

Pointer and Address-of Operators

- `datatype *varname`: declares a pointer
- `*varname`: dereferences a pointer to access the value
- `&varname`: gives the memory address of a variable
- Example:

```
1 #include <stdio.h>
2
3 int main(){
4     int x = 10;
5     int *p = &x;      // p points to x
6
7     printf("%x", p);    // prints the hex address of x
8     printf("\n%d", *p);  // prints 10
9 }
```

Storage Classes

- `auto` : default local variable storage
- `register` : hint to store variable in CPU register
- `static` : preserve value between function calls
- `extern` : variable defined elsewhere

Memory and Miscellaneous

- `const`: read-only variable
- `volatile`: variable may change unexpectedly
- `restrict`: pointer optimization hint
- `inline`: suggest inline function expansion
- `_Atomic`: atomic variable access
- `_Thread_local`: thread-local storage
- `_Noreturn`: function does not return
- `sizeof`: size of object or type
- `_Alignas`, `_Alignof`: memory alignment
- `_Generic`: type-generic selection (C11)

Preprocessor Keywords

- `#define` : define macro or constant
- `#include` : include header file
- `#if` : conditional compilation
- `#ifdef` : compile if macro defined
- `#ifndef` : compile if macro not defined
- `#else` , `#elif` : alternative conditions
- `#endif` : end conditional
- `#undef` : undefine macro
- `#line` : set line number for compiler messages
- `#error` : generate compilation error
- `#pragma` : compiler-specific instruction

Exercise

Exercise

- Modify the hello-world program to print something else.
- Modify the greetings example to print something else.

Questions?
