

MTH 307: Programming and Data Structures

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1 C Programming

1.1 Writing a simple program

- Directive and the header `#include<stdio.h>`
- The function `int main (void)`
- Print a string literal using `printf()` function.
- Including comments within `/*---*/` or after `//`.

1.2 Variable and assignment

- Integer (`int`) and floating point (`float`) variable types.
- Variable declarations and assignment.
- Print the value of a `int` or `float` variable using `%d` and `%f`.
- Initialization of a variable.

1.3 Reading Input

- Reading a format string.
- Print the value of a `int` or `float` variable `x` using `%d` `%f`, and `&x`.

1.4 Constants and identifiers

- Defining constants using `#define`.
- Identifiers and keywords.

1.5 Formatted output

- Conversion specifiers: `%m.pd`, `%m.pe`, `%m.pf`, and `%m.pg`.
- Escape sequence: `\a` (Alert), `\a` (Backspace), `\n` (Newline), and `\t` (Horizontal tab).

1.6 Expressions

- Arithmetic operator: `+`, `-`, `*` (multiplication), `/` (division), and `%` (remainder).
- Operator precedence
- Simple assignment operator `=`
- Compound assignment operators: `+=`, `-=`, `*=`, and `/=`.
- Postfix increment and decrement operators: `i++` and `i--`.
- Prefix increment and decrement operators: `++i` and `--i`.

1.7 Formatted input

- How `scanf` works in the presence of the following in the format/input string:
 - White-space characters
 - Other characters

1.8 Selection statements

- Logical expressions
 - Relational operators: `<`, `>`, `<=`, `>=`
 - Equality operators: `==`, `!=`
 - Logical operators: `!`, `&&`, `||`
- The `if` statement.
- The `else` clause.
- Conditional expression: `?` and `:`
- The `switch` and `break` statements.

1.9 Loops

- The `while` statement.
- The `do` statement.
- The `for` statement.

1.10 Basic data types

- Integer types: short int, unsigned short int, int, unsigned int, long int, unsigned long int.
- Floating types: float, double, long double.
- Character types
 - Escape sequences.
 - Reading and writing using %c, getchar(), and putchar().

2 Data Structures in C programming

2.1 Arrays

- One-dimensional arrays
 - Arrays subscripts.
 - Array initialization.
 - The sizeof operator.
- Multidimensional array.
 - Initialization.
 - Constant arrays.
- Sorting techniques
 - Bubble sort.
 - Selection sort.
 - Insertion sort.
- Searching techniques

- Binary search.
- Fibonacci search.

2.2 Pointers

- Declaring pointer variables.
- The address operator `*`.
- The indirection operator `&`.
- Pointer assignment.
- Pointers as arguments and return vales.
- Using pointers of array processing.
- Advanced features in pointers
 - Dynamic memory allocation using `malloc`, `calloc`, and `realloc`.
 - The `free` function.
 - The `NULL` pointer.
 - The `->` operator.

2.3 Structures

- Structure variables
 - Declaration.
 - Initialization.
 - Operations on structure variables.
- Structure types
 - Declaring a structure tag.

- Defining a structure type.
- Nested structures.
- Arrays of structures.

2.4 Unions

- Using unions to save space.
- Using unions to build mixed data structures.

2.5 Basic data structures and their implementation

- Stack.
- Queues
 - Regular queue.
 - Dequeue.
 - Priority queue.
- Linked List and Double Linked List.
- Trees
 - n-nary tree
 - Heap tree.

3 Introduction to GAP