Curriculum
SE Foundations
Average: **137.49%**

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(/captain_logs/5596018/edit)

0x14. C - Bit manipulation

C

Weight: 1

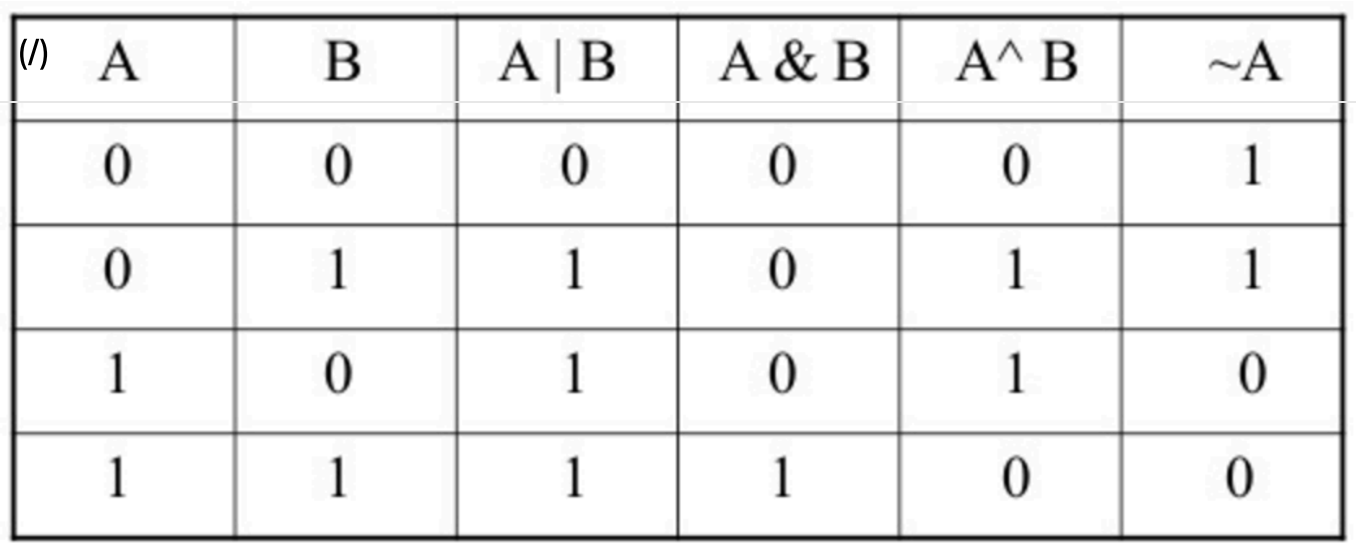
Project over - took place from Aug 31, 2023 6:00 AM to Sep 1, 2023 6:00 AM

An auto review will be launched at the deadline

In a nutshell…

- **Auto QA review:** 55.0/55 mandatory & 4.0/8 optional
- **Altogether: 150.0%**
    - Mandatory: 100.0%
    - Optional: 50.0%
    - Calculation: 100.0% + (100.0% * 50.0%) == **150.0%**

(/)



A	B	A|B	A & B	A^ B	~A
0	0	0	0	0	1
0	1	1	0	1	1
1	0	1	0	1	0
1	1	1	1	0	0

Resources

Read or watch:

- Operators in C - Part 6 (/rltoken/U23plDtAeWRnXKK_EzQRug)
- Operators in C - Part 7 (Bitwise Operators-II) (/rltoken/Bfym_wLbNRQgCv_XcIRTRg)
- Bitwise Operators 1: The AND Operation (/rltoken/hIPyd6L6Pg9OZ6zCXwo6aw)
- Bitwise Operators 2: The OR Operation (/rltoken/M1FRe-jfuKSDe4kle1ocsw)
- Bitwise Operators 3: The XOR Operation (/rltoken/ngPcZF4EFySsQpStXRH_nA)
- Bitwise Operators 4: The Logical Shift Operation (/rltoken/-8M7r6Omy5yZ-27f2HKbsg)
- Bit Manipulation (/rltoken/wTSa_lRda5k1rH6JTsSoFw)
- Bitwise Operators (/rltoken/avGgN526-UnTPvpunGviig)
- Google (/rltoken/-tOFAtANisYQthxNBmJB8g)
- Youtube (/rltoken/-PNa1vv5T3tqVVY4PRlGrg)

Learning Objectives

At the end of this project, you are expected to be able to explain to anyone (/rltoken/I5Fy78OBq-wgaGEpcgq2oA), **without the help of Google**:

General

- Look for the right source of information without too much help
- How to manipulate bits and use bitwise operators

Copyright - Plagiarism

- You are tasked to come up with solutions for the tasks below yourself to meet with the above learning objectives.
- You will not be able to meet the objectives of this or any following project by copying and pasting someone else’s work.
- You are not allowed to publish any content of this project.
- Any form of plagiarism is strictly forbidden and will result in removal from the program.

Requirements

General

- Allowed editors: `vi`, `vim`, `emacs`
- All your files will be compiled on Ubuntu 20.04 LTS using `gcc`, using the options `-Wall -Werror -Wextra -pedantic -std=gnu89`
- All your files should end with a new line
- A `README.md` file, at the root of the folder of the project is mandatory
- Your code should use the `Betty` style. It will be checked using betty-style.pl (https://github.com/alx-tools/Betty/blob/master/betty-style.pl) and betty-doc.pl (https://github.com/alx-tools/Betty/blob/master/betty-doc.pl)
- You are not allowed to use global variables
- No more than 5 functions per file
- The only C standard library functions allowed are `malloc`, `free` and `exit`. Any use of functions like `printf`, `puts`, `calloc`, `realloc` etc… is forbidden
- You are allowed to use _putchar (https://github.com/alx-tools/_putchar.c/blob/master/_putchar.c)
- You don't have to push `_putchar.c`, we will use our file. If you do it won't be taken into account
- In the following examples, the `main.c` files are shown as examples. You can use them to test your functions, but you don't have to push them to your repo (if you do we won't take them into account). We will use our own `main.c` files at compilation. Our `main.c` files might be different from the one shown in the examples
- The prototypes of all your functions and the prototype of the function `_putchar` should be included in your header file called `main.h`
- Don't forget to push your header file
- All your header files should be include guarded

Quiz questions

Great! You've completed the quiz successfully! Keep going! (Show quiz)

Tasks

0. 0

mandatory

Score: 100.0% (*Checks completed: 100.0%*)

Write a function that converts a binary number to an `unsigned int`.

- Prototype: `unsigned int binary_to_uint(const char *b);`
- where `b` is pointing to a string of `0` and `1` chars

- Return: the converted number, or 0 if
  - there is one or more chars in the string `b` that is not `0` or `1`
  - `b` is `NULL`

```
julien@ubuntu:~/0x14. Binary$ cat 0-main.c
#include <stdio.h>
#include "main.h"

/**
 * main - check the code
 *
 * Return: Always 0.
 */
int main(void)
{
    unsigned int n;

    n = binary_to_uint("1");
    printf("%u\n", n);
    n = binary_to_uint("101");
    printf("%u\n", n);
    n = binary_to_uint("1e01");
    printf("%u\n", n);
    n = binary_to_uint("1100010");
    printf("%u\n", n);
    n = binary_to_uint("0000000000000000000110010010");
    printf("%u\n", n);
    return (0);
}
julien@ubuntu:~/0x14. Binary$ gcc -Wall -pedantic -Werror -Wextra -std=gnu89 0-main.c 0-bina
ry_to_uint.c -o a
julien@ubuntu:~/0x14. Binary$ ./a
1
5
0
98
402
julien@ubuntu:~/0x14. Binary$
```

Repo:

- GitHub repository: `alx-low_level_programming`
- Directory: `0x14-bit_manipulation`
- File: `0-binary_to_uint.c`

Done! Check your code Get a sandbox QA Review

1. 1

mandatory

Score: 100.0% (*Checks completed: 100.0%*)
(/)

Write a function that prints the binary representation of a number.

- Prototype: `void print_binary(unsigned long int n);`
- Format: see example
- You are not allowed to use arrays
- You are not allowed to use `malloc`
- You are not allowed to use the `%` or `/` operators

```
julien@ubuntu:~/0x14. Binary$ cat 1-main.c
#include <stdio.h>
#include "main.h"

/**
 * main - check the code
 *
 * Return: Always 0.
 */
int main(void)
{
    print_binary(0);
    printf("\n");
    print_binary(1);
    printf("\n");
    print_binary(98);
    printf("\n");
    print_binary(1024);
    printf("\n");
    print_binary((1 << 10) + 1);
    printf("\n");
    return (0);
}
julien@ubuntu:~/0x14. Binary$ gcc -Wall -pedantic -Werror -Wextra -std=gnu89 1-main.c 1-prin
t_binary.c _putchar.c -o b
julien@ubuntu:~/0x14. Binary$ ./b
0
1
1100010
10000000000
10000000001
julien@ubuntu:~/0x14. Binary$
```

Repo:

- GitHub repository: `alx-low_level_programming`
- Directory: `0x14-bit_manipulation`
- File: `1-print_binary.c`

(✓)Done! Check your code >_ Get a sandbox QA Review

2. 10

mandatory

Score: 100.0% (*Checks completed: 100.0%*)

Write a function that returns the value of a bit at a given index.

- Prototype: `int get_bit(unsigned long int n, unsigned int index);`
- where `index` is the index, starting from `0` of the bit you want to get
- Returns: the value of the bit at index `index` or `-1` if an error occured

```
julien@ubuntu:~/0x14. Binary$ cat 2-main.c
#include <stdio.h>
#include "main.h"

/**
 * main - check the code
 *
 * Return: Always 0.
 */
int main(void)
{
    int n;

    n = get_bit(1024, 10);
    printf("%d\n", n);
    n = get_bit(98, 1);
    printf("%d\n", n);
    n = get_bit(1024, 0);
    printf("%d\n", n);
    return (0);
}
julien@ubuntu:~/0x14. Binary$ gcc -Wall -pedantic -Werror -Wextra -std=gnu89 2-main.c 2-get_
bit.c -o c
julien@ubuntu:~/0x14. Binary$ ./c
1
1
0
julien@ubuntu:~/0x14. Binary$
```

Repo:

- GitHub repository: `alx-low_level_programming`
- Directory: `0x14-bit_manipulation`
- File: `2-get_bit.c`

(✓)Done! Check your code >_ Get a sandbox QA Review

3. 11

mandatory

Score: 100.0% (*Checks completed: 100.0%*)

Write a function that sets the value of a bit to `1` at a given index.

- Prototype: `int set_bit(unsigned long int *n, unsigned int index);`
- where `index` is the index, starting from `0` of the bit you want to set
- Returns: `1` if it worked, or `-1` if an error occurred

```
julien@ubuntu:~/0x14. Binary$ cat 3-main.c
#include <stdio.h>
#include "main.h"

/**
 * main - check the code
 *
 * Return: Always 0.
 */
int main(void)
{
    unsigned long int n;

    n = 1024;
    set_bit(&n, 5);
    printf("%lu\n", n);
    n = 0;
    set_bit(&n, 10);
    printf("%lu\n", n);
    n = 98;
    set_bit(&n, 0);
    printf("%lu\n", n);
    return (0);
}
julien@ubuntu:~/0x14. Binary$ gcc -Wall -pedantic -Werror -Wextra -std=gnu89 3-main.c 3-set_
bit.c -o d
julien@ubuntu:~/0x14. Binary$ ./d
1056
1024
99
julien@ubuntu:~/0x14. Binary$
```

Repo:

- GitHub repository: `alx-low_level_programming`
- Directory: `0x14-bit_manipulation`

- File: `3-set_bit.c`

(/)

Done! Check your code Get a sandbox QA Review

4. 100

mandatory

Score: 100.0% (*Checks completed: 100.0%*)

Write a function that sets the value of a bit to `0` at a given index.

- Prototype: `int clear_bit(unsigned long int *n, unsigned int index);`
- where `index` is the index, starting from `0` of the bit you want to set
- Returns: `1` if it worked, or `-1` if an error occurred

```
julien@ubuntu:~/0x14. Binary$ cat 4-main.c
#include <stdio.h>
#include "main.h"

/**
 * main - check the code
 *
 * Return: Always 0.
 */
int main(void)
{
    unsigned long int n;

    n = 1024;
    clear_bit(&n, 10);
    printf("%lu\n", n);
    n = 0;
    clear_bit(&n, 10);
    printf("%lu\n", n);
    n = 98;
    clear_bit(&n, 1);
    printf("%lu\n", n);
    return (0);
}
julien@ubuntu:~/0x14. Binary$ gcc -Wall -pedantic -Werror -Wextra -std=gnu89 4-main.c 4-clea
r_bit.c -o e
julien@ubuntu:~/0x14. Binary$ ./e
0
0
96
julien@ubuntu:~/0x14. Binary$
```

Repo:

- GitHub repository: `alx-low_level_programming`

- Directory: `0x14-bit_manipulation`
- File: `4-clear_bit.c`

Done! Check your code Get a sandbox QA Review

5. 101

mandatory

Score: 100.0% (*Checks completed: 100.0%*)

Write a function that returns the number of bits you would need to flip to get from one number to another.

- Prototype: `unsigned int flip_bits(unsigned long int n, unsigned long int m);`
- You are not allowed to use the `%` or `/` operators

```
julien@ubuntu:~/0x14. Binary$ cat 5-main.c
#include <stdio.h>
#include "main.h"

/**
 * main - check the code
 *
 * Return: Always 0.
 */
int main(void)
{
    unsigned int n;

    n = flip_bits(1024, 1);
    printf("%u\n", n);
    n = flip_bits(402, 98);
    printf("%u\n", n);
    n = flip_bits(1024, 3);
    printf("%u\n", n);
    n = flip_bits(1024, 1025);
    printf("%u\n", n);
    return (0);
}
julien@ubuntu:~/0x14. Binary$ gcc -Wall -pedantic -Werror -Wextra -std=gnu89 5-main.c 5-flip
_bits.c -o f
julien@ubuntu:~/0x14. Binary$ ./f
2
5
3
1
julien@ubuntu:~/0x14. Binary$
```

Repo:

- GitHub repository: `alx-low_level_programming`

(/)
- Directory: `0x14-bit_manipulation`
- File: `5-flip_bits.c`

Done! Check your code Get a sandbox QA Review

6. Endianness

#advanced

Score: 100.0% (*Checks completed: 100.0%*)

Write a function that checks the endianness.

- Prototype: `int get_endianness(void);`
- Returns: `0` if big endian, `1` if little endian

```
julien@ubuntu:~/0x14. Binary$ cat 100-main.c
#include <stdio.h>
#include "main.h"

int main(void)
{
    int n;

    n = get_endianness();
    if (n != 0)
    {
        printf("Little Endian\n");
    }
    else
    {
        printf("Big Endian\n");
    }
    return (0);
}
julien@ubuntu:~/0x14. Binary$ gcc -Wall -pedantic -Werror -Wextra -std=gnu89 100-main.c 100-
get_endianness.c -o h
julien@ubuntu:~/0x14. Binary$ ./h
Little Endian
julien@ubuntu:~/0x14. Binary$ lscpu | head
Architecture:          x86_64
CPU op-mode(s):        32-bit, 64-bit
Byte Order:            Little Endian
CPU(s):                1
On-line CPU(s) list:   0
Thread(s) per core:    1
Core(s) per socket:    1
Socket(s):             1
NUMA node(s):          1
Vendor ID:             GenuineIntel
julien@ubuntu:~/0x14. Binary$
```

(/)
Repo:

- GitHub repository: `alx-low_level_programming`
- Directory: `0x14-bit_manipulation`
- File: `100-get_endianness.c`

☑ Done! Check your code >_ Get a sandbox QA Review

7. Crackme3

#advanced

Score: 0.0% (*Checks completed: 0.0%*)

Find the password for this program (https://github.com/alx-tools/0x13.c).

- Save the password in the file `101-password`
- Your file should contain the exact password, no new line, no extra space

```
julien@ubuntu:~/0x14. Binary$ ./crackme3 `cat 101-password`
Congratulations!
julien@ubuntu:~/0x14. Binary$
```

Repo:

- GitHub repository: `alx-low_level_programming`
- Directory: `0x14-bit_manipulation`
- File: `101-password`

☑ Done! Check your code Ask for a new correction >_ Get a sandbox QA Review