Lab 01
Bit Lab

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About the Labs

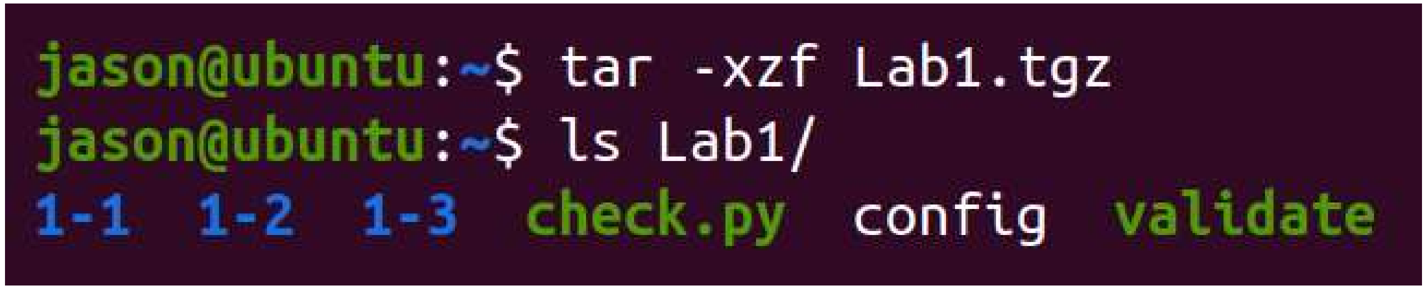
- **Labs account for 30% of the total score for the semester**
- **Three lab assignments**
  - **Lab 1:** Bit Lab (6%)
  - **Lab 2:** Reversing Lab (12%)
  - **Lab 3:** Cache Lab (12%)
- **Today: Lab 1 (Bit Lab)**
  - Three small C programming exercises
  - Puzzles using *bit-level* operations (a.k.a. *Data Lab* in *CSAPP*)
- **Another goal of lab 1 is to become familiar with Linux and learn how to work with the skeleton code**

General Information

- **Check the *Assignment* tab on *Cyber Campus***
  - Please find the attached skeleton code (**`Lab1.tar/Lab1.tgz`**)
  - Submit your work within the same post
- **Deadline: April 3rd Thursday 23:59**
  - Late submission deadline: **April 4th** Friday 23:59 **(-20% penalty)**
  - A delay penalty is uniformly applied **(not problem by problem)**
- **Please carefully read the instructions on this slide deck**
  - This slide deck provides a step-by-step tutorial for the lab
  - Also includes important submission guidelines
    - **Failure of follow the submission guidelines will result in a penalty**

Skeleton Code Structure

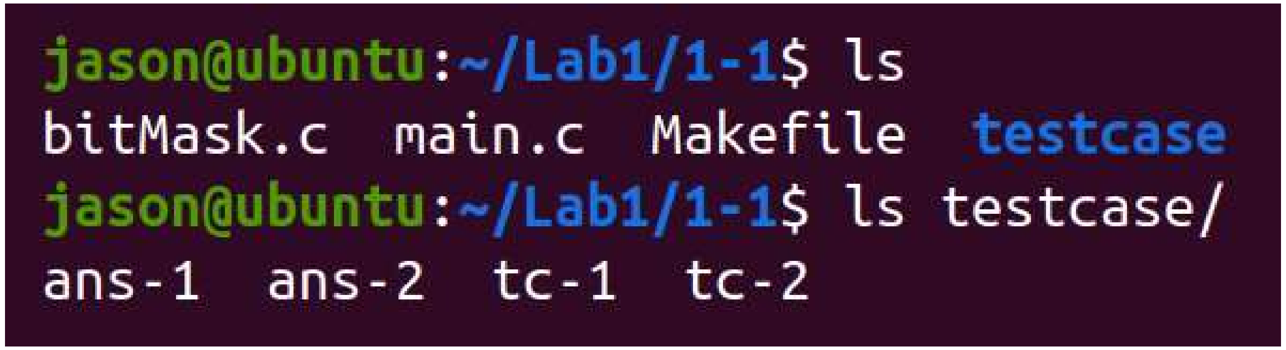
- **Copy `Lab1.tgz` to the CSPRO server and then decompress it**
  - Recommend to use cspro**2**.sogang.ac.kr (**Ubuntu 20.04**)
  - Do not decompress-and-copy; Do copy-and-decompress
- `1-1~1-3`**: Each directory contains a problem**
- `validate`**: Verifies if your code satisfies the constraints**
- `check.py`**: Script for self-grading (explained later)**
- `config`**: Used by grading script (you may ignore)**



```
jason@ubuntu:~$ tar -xzf Lab1.tgz
jason@ubuntu:~$ ls Lab1/
1-1  1-2  1-3  check.py  config  validate
```

Problem Directory (Example: 1-1)

- `bitMask.c`: **This is the only file that you have to fill in**
  - **Do NOT** make any modification to other files
- `main.c`: **This program will test your code in `bitMask.c`**
- `Makefile`: **You can build the program by typing `make`**
  - If you are unfamiliar with **`make`** or **`Makefile`**, please take a brief look at makefiletutorial.com/
- `testcase`: **Contains test cases and expected outputs**



```
jason@ubuntu:~/Lab1/1-1$ ls
bitMask.c  main.c  Makefile  testcase
jason@ubuntu:~/Lab1/1-1$ ls testcase/
ans-1  ans-2  tc-1  tc-2
```

Tasks

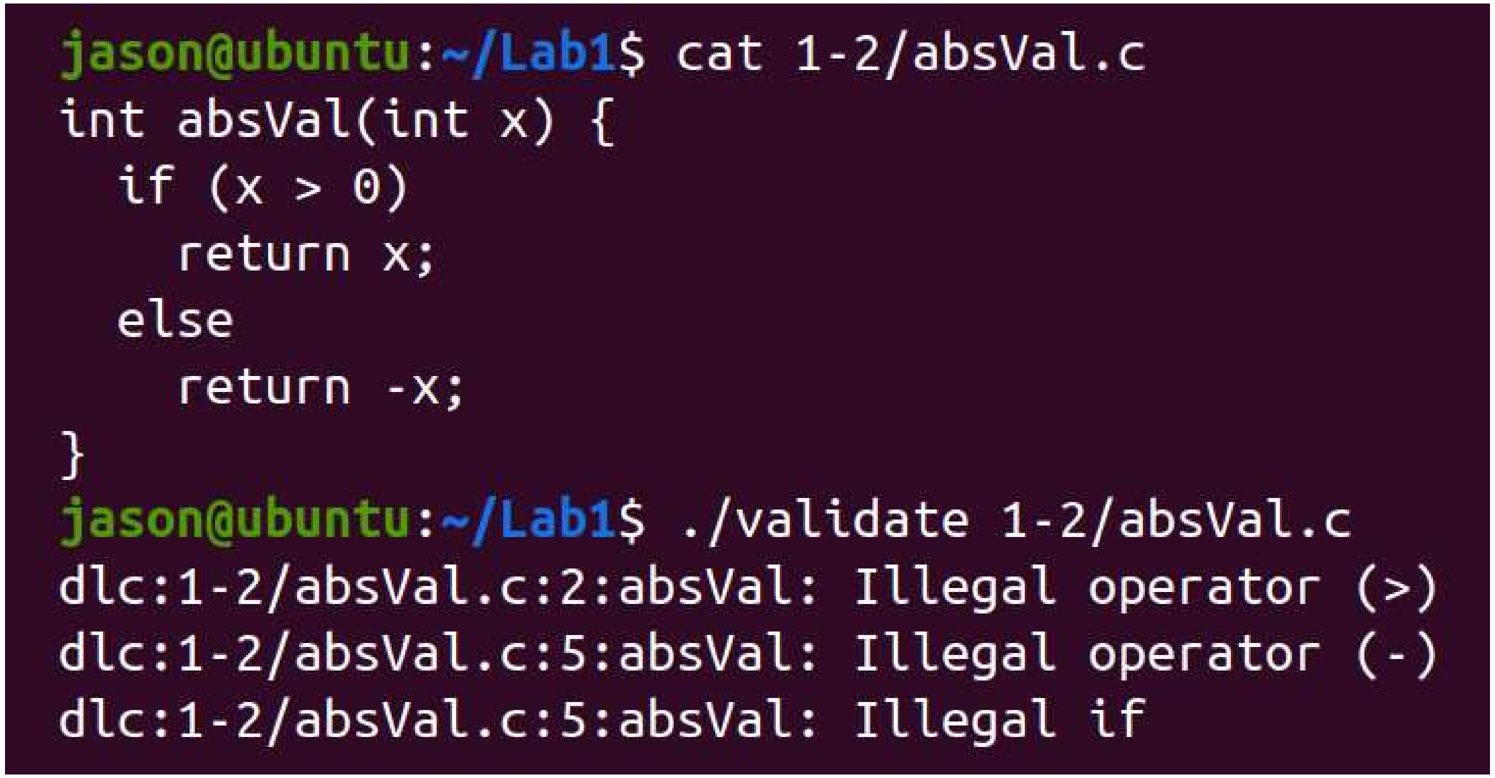
- For each problem, you have to implement a function
  - **Read the comments in each file carefully:** it provides examples and gives the assumptions regarding the input
- **Problem 1-1 (`bitMask.c`)**
  - `bitMask(x)`: return a mask that has **`32-x`** number of 0's followed by **`x`** number of 1's
- **Problem 1-2 (`absVal.c`)**
  - `absVal(x)`: return the absolute value of **`x`**
- **Problem 1-3 (`conditional.c`)**
  - `conditional(x, y, z)`: return **`z`** if **`x`** is 0, return **`y`** otherwise

Constraints

- **There are some constraints that your code must satisfy**
  - If your code does not satisfy them, you will get 0 point
  - Allowed operators: `! ~ & ^ | + << >>`
    - Do **NOT** use other operators such as `&& || - == < > ?`
  - Use `int` type only
    - Do **NOT** use other primitive types, structure, array, etc.
  - Write **straight-line code**
    - Do **NOT** use any control constructs such as `if`, `do`, `while`, `for`, `switch`, etc.
  - Do **NOT** define or call any additional functions
  - Do **NOT** include any headers such as `#include <stdio.h>`

Using the Validator

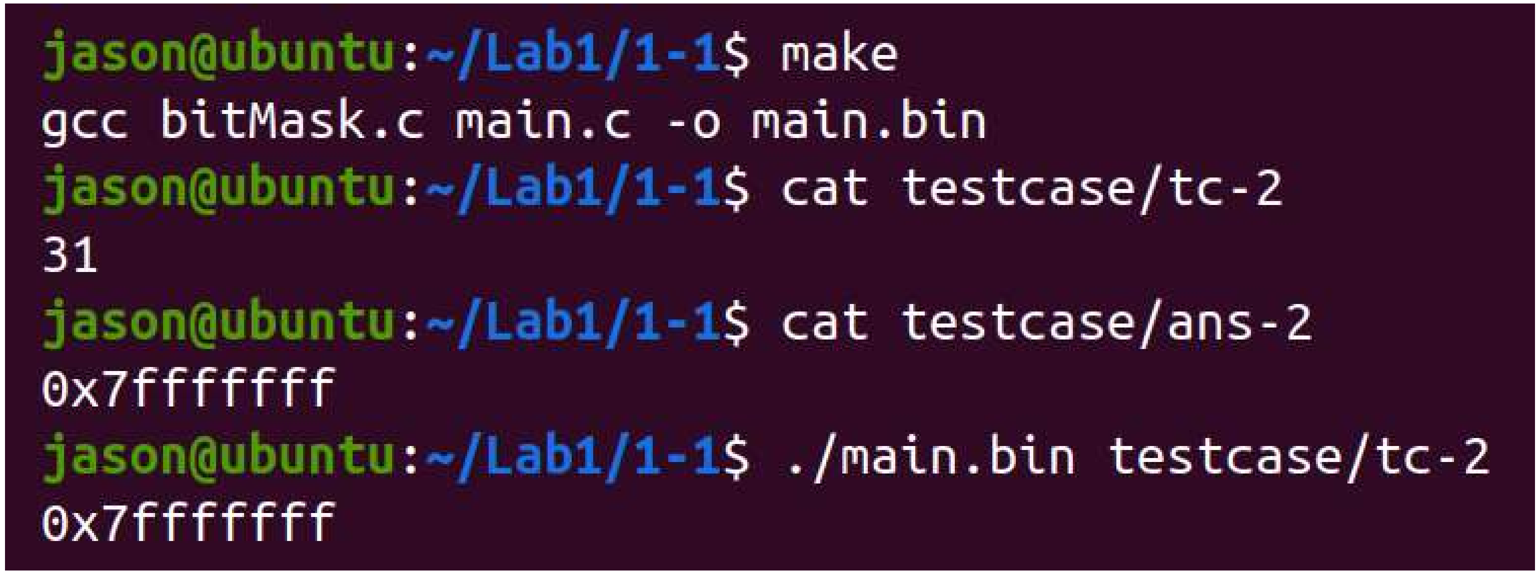
- **You can use `validate` to confirm whether your code satisfies the previous constraints**
  - It will print any illegal points found within the code you've written
  - If it does not print anything, your code has passed the validation



```
jason@ubuntu:~/Lab1$ cat 1-2/absVal.c
int absVal(int x) {
  if (x > 0)
    return x;
  else
    return -x;
}
jason@ubuntu:~/Lab1$ ./validate 1-2/absVal.c
dlc:1-2/absVal.c:2:absVal: Illegal operator (>)
dlc:1-2/absVal.c:5:absVal: Illegal operator (-)
dlc:1-2/absVal.c:5:absVal: Illegal if
```

Running Test Cases

- **After compiling the program with the `make` command, you can run it by providing the path of the test case file**
- **Some test cases and their expected outputs are already provided in the `testcase/` directory**
  - Output of running **`tc-N`** must match with **`ans-N`**



```
jason@ubuntu:~/Lab1/1-1$ make
gcc bitMask.c main.c -o main.bin
jason@ubuntu:~/Lab1/1-1$ cat testcase/tc-2
31
jason@ubuntu:~/Lab1/1-1$ cat testcase/ans-2
0x7fffffff
jason@ubuntu:~/Lab1/1-1$ ./main.bin testcase/tc-2
0x7fffffff
```

Must match

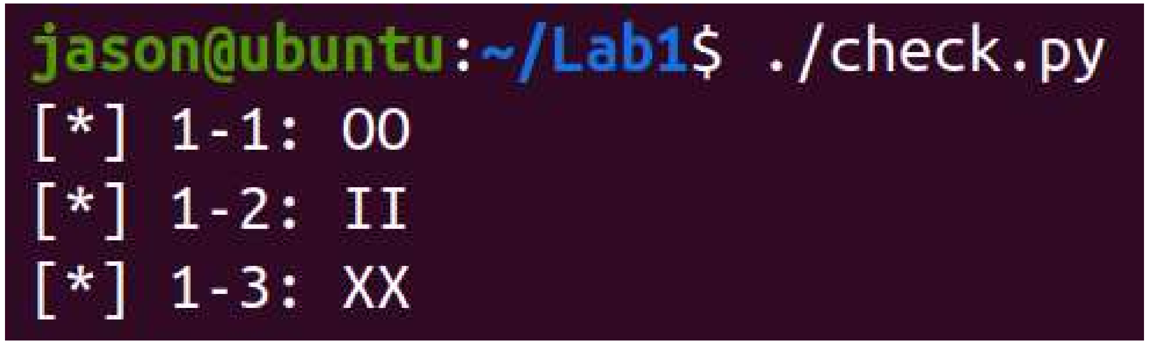
Self-Grading

- **After you believe everything is complete, run `check.py` to verify that you pass all the provided test cases**
  - Each character in the result has following meaning:

    `'O'`: correct, `'X'`: wrong,

    `'C'`: compile error, `'T'`: timeout

    `'I'`: failed to pass the validator, `'E'`: runtime error
  - So it is important to ensure that **`./check.py`** prints '**O**' for all cases



```
jason@ubuntu:~/Lab1$ ./check.py
[*] 1-1: OO
[*] 1-2: II
[*] 1-3: XX
```

Test Cases for Grading

- **We will use various test case sets to evaluate your code**
  - This means that even if you successfully pass all the provided test cases, it does not guarantee that you will receive full points.
- **Thus, you are encouraged to test your own code with various inputs**
- **Some students request additional test cases from us, but it is important to practice this independently**

Problem Information

- **Three problems in total**
  - Problem 1-1: **30 points**
  - Problem 1-2: **35 points**
  - Problem 1-3: **35 points**

- **You will receive points for each problem based on the number of test cases that your code passes**

Submission Guideline

- You should submit three C source files
  - Problem 1-1: `bitMask.c`
  - Problem 1-2: `absVal.c`
  - Problem 1-3: `conditional.c`

- **If the submitted file does not compile using the "`make`" command, no points are given for that problem**

- **Submission format**
  - Upload the three files listed above directly to *Cyber Campus* (**do not compress them into a zip file**)
  - **Do not change the file names** (e.g., by adding any prefixes or suffixes)
  - If your submission format is incorrect, you will get a **-20% penalty**