EE231002 Introduction to Programming

Lab04. Solving Integer Equations

Due: Oct. 24, 2020

In this lab, we want to find the number of positive integers, $n >= 2$, that satisfies the following integer equation,

$$n^3 = a^2 + b^2. \tag{4.1}$$

where both a and b are also positive integers, $a, b >= 1$.

For example, $n = 5$ is such a number since with $a = 2$ and $b = 11$, we have

$$5^3 = 125 = 4 + 121 = 2^2 + 11^2. \tag{4.2}$$

Please write a `C` program as efficiently as possible to find all possible n, for $2 <= n <= 5000$. Example output is shown below.

```
$ ./a.out
1: n1 ^ 3 = a1 ^ 2 + b1 ^ 2
2: n2 ^ 3 = a2 ^ 2 + b2 ^ 2
......
k: nk ^ 3 = ak ^ 2 + bk ^ 2
k solutions found for n <= 5000.
```

Note that, `n1`, `n2`, $\cdots$, `nk`, `a1`, $\cdots$, `ak`, `b1`, $\cdots$, `bk`, are all positive intergers, and k is the number of n that satisfies Equation (4.1). As shown in Equation (4.1), there is an `i` such that `ni = 5`, `ai = 2` and `bi = 11` or `ai = 11` and `bi = 2`.

The efficiency of a program is usually reflected in the execution time. To measure the execution time, Unix system provides a `time` command. For example,

```
$ time ./a.out
```

can produce an output line at the end of the program execution as following.

```
3.943u 0.002s 0:03.96 99.4%      0+0k 0+0io 0pf+0w
```

where the first number is the CPU time used by the `a.out` program measured in seconds.

Notes.

1. Create a directory **lab04** and use it as the working directory.
2. Name your program source file as **lab04.c**.
3. The first few lines of your program should be comments as the following.

```
// EE231002 Lab04. Solving Integer Equations
// ID, Name
// Date:
```

4. After finishing editing your source file, you can execute the following command to compile it,

   $ gcc lab04.c

   If no compilation errors, the executable file, **a.out**, should be generated, and you can execute it by typing

   $ time ./a.out

5. Typical outputs of the program execution have been shown above. You should try to minimize the execution time.
6. After you finish verifying your program, you can submit your source code by

   $ ~ee2310/bin/submit lab04 lab04.c

   If you see a "submitted" message, then you are done. In case you want to check which file and at what time you submitted your labs, you can type in the following command:

   $ ~ee2310/bin/subrec lab04

   It will show the submission records for lab04.