**Programming Assignment 1**

1. Complete the question of “find the power of a number” we discussed at the lecture in two versions, (1) linear time and (2) log time, based on the following code template:

int a, b, res;

std::cin >> a >> b; // ask user to input two numbers to a and b

// your solution code below

// …

std::cout << “a to the b is: ” << res << ‘\n’;

Paste your C++ code below for the two versions. You need to use if statement and while statement to implement the control flow.

* Linear-time solution code:
* Log-time solution code:

Measure the runtime of your program and complete the following table:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| a | b | res | Linear Time | Log Time  (divide and conquer) |
| 2 | 10 |  |  |  |
| 3 | 100 |  |  |  |
| 11 | 100000000 |  |  |  |
| 13 | 2147483647 |  |  |  |

In order to report the runtime of your program, you need to learn to use the ‘std::chrono’ library. There are many tutorials online available. Answer the following questions:

* 1. Do you see the result printed correctly? If not, why? [Hint: overflow]. Regardless of the correctness of ‘res’, you must see identical results for both versions, linear time and log time.
  2. Do you see significant runtime difference with no compiler optimization enabled?
  3. Do you see significant runtime difference when enabling -O3 optimization in your compiler?

1. Now, working on the same question, but output the result by taking a modulus operation on 7. That is, you need to compute “**res = ab % 7**”. You need to ***avoid overflow*** during the computation. [Hint: (a\*a\*a\*a) % 7 is mathematically equal to (a % 7) \* (a % 7) \* (a % 7) \* (a % 7)]

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| a | b | res | Linear Time | Log Time  (divide and conquer) |
| 2 | 10 |  |  |  |
| 3 | 100 |  |  |  |
| 11 | 100000000 |  |  |  |
| 13 | 2147483647 |  |  |  |

This is a question frequently asked by large software companies during the job interview.