Coursework 1 (grading weight 20%):

Submission due: 07 March 2022 (5 pm Malaysia Time) via Moodle (link would soon be active for submissions)

1. The problem: Supply Chain Mapping using Blockchain

Supply chain of the products we mostly see on the market is not preserved and traceable. We need that the supply chain record entries are linked to each other and they are preserved and traceable.

1.1. How to solve this problem?

Pick any product of your choice (e.g., anyone that you recently purchased, or imagine any product. Examples: apples, ball pen, rice cooker, laptop, car, etc.

Create a *blockchain* for your product by understanding it's complete supply chain. You can search online to get an idea and you can assume as well. Data can be fictitious but should make sense and should be as close as possible to usual supply chain of that product in the real-world.

2. Details:
2.1. What is blockchain?

Blockchain is a modern data & communication security technology, in which data is stored in blocks of information, cryptographically hashed for security, and chained together for tracking and traceability.

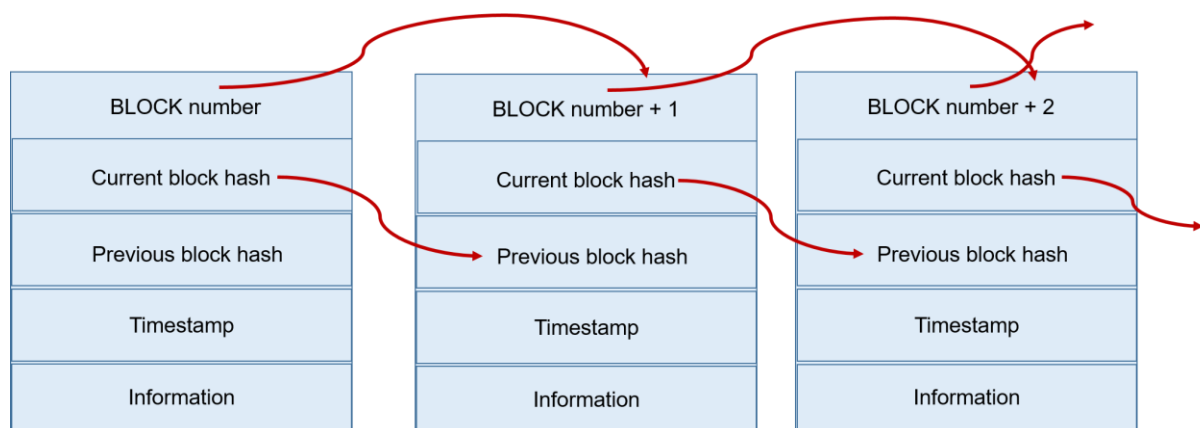Blockchain looks like as shown in Figure 1.

Figure 1. An abstract example of a blockchain.

2.2. What is supply chain record?

The products that we buy from stores reach there by going through several stages from the production to the shelves (where they are sold). That entire chain of stages is called supply chain in economics. For this coursework, supply chain record refers to the significant stages of product processing (from production to selling). Each stage should be represented by a block of information and all blocks should be

connected to each other to create a chain. For example, banana sold at store Lotus's Semenyih might have gone through these stages: stage 1: production (farm id, farm name, farm location, harvest timestamp, etc.), stage 2: transportation (transporter id, name, pick up timestamp, etc.), stage 3: storage (some info here…), so on……stage n: Lotus's Semenyih (some info here…). For each of these stages, you need to create a separate block. Each block gets connected to another through next block's hash.

So, what your block should contain? Look at Figure 1, each part of block should contain the following?

- Block number (first block has number 0, each subsequent one incremented by one.
- Current block hash (generate a random number, e.g., through random number generator function)
- Previous block hash (first block's previous block hash and current block hash are the same, every subsequent block should have its preceding block's hash. Which means that the random number you generated for your current block should be reused for the next one.)
- Timestamp (the time and date of the record of this block's info)
- Information (all information that is relevant to each block. Do a brief research to make sure you write what is closely related to reality. If you find any real data, you can use it, otherwise, any dummy data would work.

The number of blocks in each student's blockchain depends on the product you have chosen, as well as your understanding of different important stages in it.

For example, we need something like shown in Figure 2.

BLOCK i	BLOCK i + 1
4f5s6d4fsd	tbf5348dfs
4f5s6d4fsd	4f5s6d4fsd
20220204: 15:05	20220205: 11:37
Farm ID: 26447 | Name: Dasmarinas Farm | Type: AAA Cavendish | Location: East Manila, Lot 1404-1420, 43500…	Transporter ID: 147885 | PosLaju Cargo | ……….

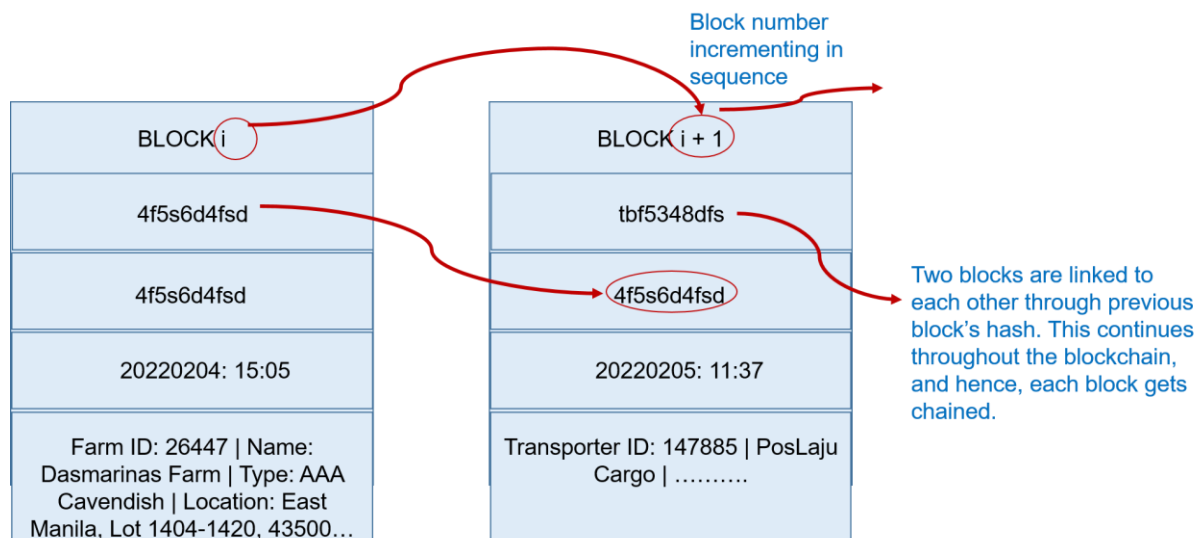Figure 2. An example of banana supply chain blocks.

Figure 3. Details of the banana supply chain blocks and their connection.

Please note that our main purpose is to get the information in the desired (blocked and chained) form mentioned above. Therefore, it does not necessarily have to look like the example above.

It can be as below:

Block i | 4f5s6d4fsd | 4f5s6d4fsd | 20220204: 15:05

| Farm ID: 26447 | Name: Dasmarinas Farm | Type: AAA Cavendish | Location: East Manila, Lot 1404-1420, 43500… |

Block i+1 | tbf5348dfs | 4f5s6d4fsd | 20220205: 11:37

 | Transporter ID: 147885 | PosLaju Cargo | ……….|…

So on….

(use any separator (e.g. |) to separate each part of the block. While to separate each block from each other, you can print each block on the next line (or any other idea you would like to use). Make sure each block is distinguishable.

Note: in the above example, you can see that each block is linked to another through previous block's hash (the 3rd part of the block). But in the case of the first block, as there is no previous block, your system can store the current block hash in that column. Which means that you should have a check in your program if a block is the first one, then it's previous block hash and current block hash can be the same, otherwise, generate a random hash/number for the new block.

3. Hints:

You are encouraged to use your own knowledge, instincts, and ideas to achieve the goal, but you may need the following data structures/features of C++ to achieve the goal:

- Array
- Pointers
- Vectors
- Array of pointers (maybe)
- Random number generator to generate hash (e.g.
  https://www.cplusplus.com/reference/cstdlib/rand/) – make sure that you store
  the random number of each block somewhere, because you'll need to use it
  for the next block.
- Loops
- Control statements (if-else....)
- Etc…

The above problem might look complicated to some, but if you keep in mind the desired outcome, you'd realize that it's not that complicated. It would rather give you a good exposure to a very promising technology of blockchain.

I hope you'll enjoy doing this.

4. Submission:

Please submit the following consolidated (file name should be studentID_Name_CW1):

1. All program files ((i). Working source code (.cpp file), (ii). Object file (.o), (iii). Executable file/application)
2. Screenshots of (i). significant output, (ii). Running time of your program (the time shown with the output, usually in seconds).
3. A short report in which you discuss three things (no minimum length requirement. Just write to comprehensively explain these points): (i). How was your overall experience regarding doing this coursework? (ii.) key things you've learned while doing this coursework? (iii). Noteworthy difficulties you faced (and why?). (iv). References (including those from where you got the supply chain related information for your product).

5. Grading:
1. Correctness (how close to reality your data and stages of supply chain are): 8 marks
2. Programming (the use of techniques, commenting in code, code cleanliness and readability): 8 marks
3. Overall presentation (presentable output, data, submission, report): 4 marks.

Thank you.

All the best.