Pharma Supply Chain System using Smart Contracts

# Introduction

The pharmaceutical industry faces significant challenges related to the security and integrity of the supply chain, including issues such as counterfeiting, diversion, and theft. These challenges can compromise patient safety, reduce the effectiveness of drugs, and cause financial losses for companies. Traditional paper-based supply chain management systems are outdated and inefficient, increasing the likelihood of errors and delays in the supply chain. There is a need for a more secure and transparent system that can enable efficient tracking and tracing of drugs from the point of manufacture to the point of consumption.

One promising solution is to use blockchain technology to create a Pharma Supply Chain System using Smart Contracts. Blockchain technology allows for the creation of a transparent and immutable record of every transaction in the supply chain. It helps to prevent fraud, counterfeiting, and other illegal activities while improving efficiency, reducing costs, and enhancing security.

# Python Code Overview

The provided Python code is an implementation of a simple blockchain that can be used to track drug entries in a pharmaceutical supply chain. The code is designed to collect drug-related information, store it in a blockchain, and ensure the integrity of the data through a proof-of-work mechanism.

## Blockchain Class

The `Blockchain` class is the core component of this implementation. It manages the creation of blocks, transactions, and the overall chain. Here are the key methods and attributes:

- `\_\_init\_\_`: Initializes the blockchain with an empty chain and transactions list. It also creates the genesis block (the first block in the chain).  
- `create\_block`: Creates a new block with a proof of work, a hash of the previous block, and the current list of transactions. After creating the block, the transactions list is cleared.  
- `add\_transaction`: Adds a transaction to the current list of transactions. A transaction in this context includes details such as Drug ID, Manufacturer, Batch Number, and Expiration Date.  
- `get\_prev\_block`: Returns the last block in the chain.  
- `proof\_of\_work`: Implements a simple proof-of-work algorithm to ensure that creating a new block requires computational effort. This is a key security feature in blockchain technology.  
- `hash`: Generates a SHA-256 hash of a block.  
- `is\_chain\_valid`: Validates the integrity of the blockchain by ensuring that the hashes and proofs of work are correct for all blocks.

## Simulated Usage

The script simulates the usage of the blockchain in a pharmaceutical supply chain scenario. Here's what it does:

1. The user is prompted to enter the number of drug entries they want to add.  
2. For each entry, the user provides details such as Drug ID, Manufacturer, Batch Number, and Expiration Date.  
3. The collected transactions are displayed in a tabular format using the `tabulate` library.  
4. Each transaction is added to the blockchain.  
5. A new block is mined (created) and added to the chain, ensuring that the data is secured using the proof-of-work mechanism.  
6. The validity of the blockchain is checked to ensure data integrity.  
7. Finally, the entire blockchain is printed out.

# Conclusion

This Python code provides a basic implementation of a blockchain for tracking pharmaceutical products. While it is a simple example, it demonstrates key concepts that could be extended to a full-scale Pharma Supply Chain System using Smart Contracts. Such a system could greatly enhance the security, transparency, and efficiency of the pharmaceutical supply chain, helping to prevent issues such as counterfeiting and ensuring the safety and efficacy of drugs.