CS 765: Assignment 3
Building a layer-2 DAPP on top of Blockchain

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1   Introduction

In this assignment, we used Solidity to construct a decentralized application (Dapp) capable of performing transactions between peers in a distributed network. Each peer is represented by a node in a connected graph, and an edge between two peers denotes a "joint account" involving both of them, with both peers having some contribution to the total amount present in the account.

2   Methodology

In our Dapp, a transaction with some amount x being transferred from a node A to another node B is processed by first finding the shortest path along which the transaction is possible, followed by shifting contributions of nodes in the joint accounts that lie along this shortest path.

For instance, if this shortest valid path passes through the joint account between C and D, in the direction $C \rightarrow D$, then C's contribution in the joint account is reduced by x, whereas D's is increased by x. A transaction path is valid if the same operation can be performed on all joint accounts along the path while maintaining non-negative contributions in all accounts.

The function `sendAmount(user_id_1, user_id_2)` transfers a single coin from the node `user_id_1` to the node `user_id_2`. Our implementation uses Breadth-First Search (BFS) to obtain the shortest path, and it checks account balances while performing BFS so that only valid paths are considered. Thus, if at least one valid path is available for the transaction to take place, our implementation uses the shortest such path. If there is no such path at all, it returns a transaction failure.

3   Experiments and Insights

We observed the fraction of successful transactions (out of the last 100 transactions) as a function of total number of transactions at any point of time. The table below shows the results from our experiment.

Total txns so far	Successful txns (among last 100)
100	80
200	70
300	74
400	67
500	78
600	64
700	63
800	62
900	63
1000	64

Table 1: Observations on successful txns as a function of total txns.

The fraction of successful transactions as a function of total transactions has been displayed in the plot below. Although there are irregularities (due to randomness in the choice of transactions), we observe a decreasing trend in general. This can be attributed to the fact that account balances are equally distributed between both account holders in the beginning, but the distribution is likely to get skewed after a few transactions have occurred, making it more probable for certain transactions (which move from the lower contributor to the higher contributor in some accounts along the path) to fail. Thus, with more transactions, more joint accounts become blocked (in one direction), which results in a decreasing trend for the ratio of successful transactions to total transactions.
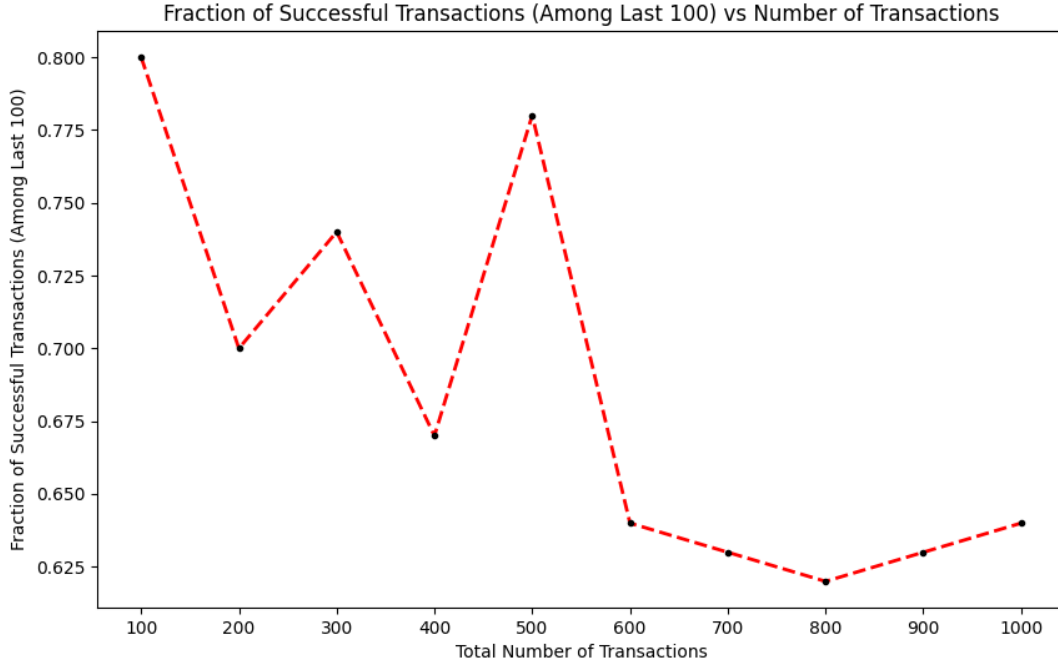

Figure 1: Fraction of Successful Transactions (Among Last 100) vs Number of Transactions