

Q1: Three Dice Decentralized Consensus Algorithm

4 steps of Decentralized Consensus:

1. Independent verification of each transaction

This process is responsible by every full node based on a comprehensive list of criteria. The transactions creation and verification process is as following:

- a. collecting UTXO, unspent transaction outputs, tracked by bitcoin full nodes
- b. providing the appropriate unlocking scripts
- c. constructing new outputs assigned to a new owner
- d. every bitcoin node that receives a transaction will verify the transaction

2. Independent aggregation of transaction into candidate blocks

This process is responsible by mining nodes based on demonstrated computation through a proof-of-work algorithm. The mining node's responsibility is to:

- a. maintain a local copy of the blockchain
- b. listen for new transactions and new blocks discovered by other nodes
- c. collect, validate and relay new transactions like any other bitcoin node
- d. try to mine a new candidate block by finding a solution to the proof-of-work algorithm

3. Independent verification of each block

This process is responsible by every node. The validation process is:

- a. the node received newly solved blocks sent from the miners
- b. the node validates the newly solved blocks
- c. the validated blocks are added to the blockchain
- d. the node propagate the valid blocks

4. Independent selection of blockchain

This process is responsible by every node. It includes the assembly of blocks into chains and the selection of the chain with the most proof-of-work. Only the new blocks satisfying validation criteria are maintained by every node.

The three dice decentralized consensus algorithm is a kind of proof-of-work.

Item	Three dices
Encoding	Dice 1 + Dice 2 + Dice 3
Objective	throw three dices whose sum is less than a specified number (target)
All possibilities	3 ~18
Related to mining	the player conducts a proof-of-work by throwing three dices with combined values that is less than the target
Total possible outcomes	$6*6*6 = 216$
Easy target	target is 12: the player must throw 11 or less to win. the probability of win is $(1+3+6+10+15+21+25+27+27) / 216 = 135/216$
Difficult target	target is 5: the player must throw 4 or less to win. the probability of win is $(1+3) / 216 = 4/216$

Combinations of three dices:

combinations	sum	combinations	sum
1	3	27	11
3	4	25	12
6	5	21	13
10	6	15	14
15	7	10	15
21	8	6	16
25	9	3	17
27	10	1	18