PROOF OF WORK-I

Blockchain Technology

Time: 60 mins

Introduction

In this class, the student/s will learn to implement proof of work on sandbox by validating the transaction as a miner using hash value and nonce.

New Blocks Introduced

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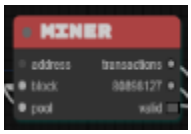
  User defined computational network added to the block

- 

  Performs hashing by finding a nonce value which matches the part of the block hash

Vocabulary

- **Random nonce** is a number which is tried to find the hash of the block.
- A **counte**r block runs for a range until a nonce matches the part of the hash.
- A **miner** block runs and tries different nonce values to mine the block by finding the nonce as a part of the hash.
- **Miners** verify the solution by the miner as a proof of work by the miner.
- **Proof of work** is a technique used by cryptocurrencies to verify the accuracy of new transactions that are added to a blockchain.

Learning Objectives

Student/s should be able to:

- ***Explore*** hashing using the different integer numbers as an input.
- ***Explain*** how a counter block can run until a block is mined.
- ***Explain*** how a miner mines a block by finding the nonce that matches the part of the hash.

Activities

1. **Class Narrative:** *(2 mins)*

    - Brief the student/s that they should validate the block to be added to the blockchain by solving mathematical puzzles to find the hash value with difficulty level.

- Explain that once a miner solves the puzzle and adds the block, other participants in the network can easily verify the solution. This is the "proof" that the miner has done the necessary work to validate the transactions in the block.

2. **Concept Introduction Activity:** *(5 mins)*

    - Let the student/s play the explore-activity to observe that the nonce value by miner matches the part of hash value of the block and block is said to be mined.
    - Introduce the consensus mechanism how it works when a transaction is shared on nodes, mined by the miner and again shared on the network for verification to get added on blockchain.
    - Lead the student/s to find the nonce to match with the hash value to validate the block.

3. **Activity 1: Verify the Random Nonce***(10 min)*

    Teacher Activity: *(5 mins)*

    - Explain that the mined nonce is the miner's proof of work for validating the block and is rewarded for the same.
    - Explain how to find a nonce and hash is generated using SHA-256 algorithm to verify the block.

    Student Activity: *(5 mins)*

    - Guide the student/s to use the sandbox platform to try random numbers as a nonce value to validate a block as a miner.

4. **Activity 2: Verify the Counter Nonce** *(20 min)*

    Teacher Activity: *(10 mins)*

    - Explain how an input value for nonce may not always match the part of the hash value and may require multiple trial and error. Hence, counter based or a random value which can fasten the mining for miners is used.
    - Demonstrate how to verify the counter nonce values with the part of hash value of the block using counter.

    Student Activity: *(10 mins)*

    - Guide the student/s to verify the counter nonce values and experiment with different difficulty levels.

5. **Activity 3: Verify the Miner Nonce***(10 mins)*

    Teacher Activity: *(5 mins)*

    - Explain the miner block in the sandbox which returns a nonce value which can be used to mine the hash values to add the block.

- Demonstrate replacing the counter block with the miner block and mine the hash value to validate the block.

  Student Activity: *(5 mins)*

- Guide the students to add the miner block to mine the nonce and verify it with the hash.

6. **Introduce the Post class project:** *(2 min)*
   - Add 4 blocks to the blockchain and validate the blocks by generating nonce using the Miner block.

7. **Test and Summarize the class learnings:** *(5 mins)*
   - Check for understanding through quizzes and summarize learning after respective activities.
   - Summarize the overall class learning towards the end of the class.
8. **Additional activities:**
   - Encourage the student/s to verify the nonce for a chain of blocks with different techniques.
   - Encourage the student/s to mine the nonce and verify the block chain with the hash using a miner block.

9. **State the Next Class Objective:** *(1 min)*
   - In the next classes, you will mine the nonce values to verify the block using code editor and html web page.

U.S. Standards:

CSTA: 2-AP-11, 2-AP-12, 2-AP-13, 2-AP-14, 2-AP-19

Links Table		
Activity	**Activity Name**	**Link**
Class Presentation	Proof of Work - I	https://s3-whjr-curriculum-uploads.whjr.online/58b32437-1bb8-4aef-836b-ab965f774e29.html
Explore Activity	Proof of Work - I	https://github.com/Tynker-Blockchain/TNK-M12-C92-SAS-BP
Teacher Activity 1	Verify the Random Nonce	https://github.com/Tynker-Blockchai

		n/TNK-M12-C92-TAS-BP
Teacher Reference: Teacher Activity 1 Solution	Verify the Random Nonce	https://github.com/Tynker-Blockchain/TNK-M12-C92-TAS
Student Activity 1	Verify the Random Nonce	https://github.com/Tynker-Blockchain/TNK-M12-C92-SAS-BP
Teacher Reference: Student Activity 1 Solution	Verify the Random Nonce	https://github.com/Tynker-Blockchain/TNK-M12-C92-SAS
Teacher Activity 2	Verify the Counter Nonce	https://github.com/Tynker-Blockchain/TNK-M12-C92-TAS-BP
Teacher Reference: Teacher Activity 2 Solution	Verify the Counter Nonce	https://github.com/Tynker-Blockchain/TNK-M12-C92-TAS
Student Activity 2	Verify the Counter Nonce	https://github.com/Tynker-Blockchain/TNK-M12-C92-SAS-BP
Teacher Reference: Student Activity 2 Solution	Verify the Counter Nonce	https://github.com/Tynker-Blockchain/TNK-M12-C92-SAS
Teacher Activity 3	Verify the Miner Nonce	https://github.com/Tynker-Blockchain/TNK-M12-C92-TAS-BP
Teacher Reference: Teacher Activity 3 Solution	Verify the Miner Nonce	https://github.com/Tynker-Blockchain/TNK-M12-C92-TAS
Student Activity 3	Verify the Miner Nonce	https://github.com/Tynker-Blockchain/TNK-M12-C92-SAS-BP
Teacher Reference: Student Activity 3 Solution	Verify the Miner Nonce	https://github.com/Tynker-Blockchain/TNK-M12-C92-SAS
Student's Additional Activity 1	Verify the Nonce Values	https://github.com/Tynker-Blockchain/TNK-M12-C92-SAS-BP
Teacher Reference: Student's Additional Activity 1 Solution	Verify the Nonce Values	https://github.com/Tynker-Blockchain/TNK-M12-C92-SAS
Student's Additional Activity 2	Verify the Nonce as a Miner	https://github.com/Tynker-Blockchain/TNK-M12-C92-SAS-BP
Teacher Reference: Student's Additional Activity 2 Solution	Verify the Nonce as a Miner	https://github.com/Tynker-Blockchain/TNK-M12-C92-SAS
Post Class Project	Validate the Blockchain	https://github.com/Tynker-Blockchain/TNK-M11-C92-PCP-BP
Teacher Reference: Post Class Project Solution	Validate the Blockchain	https://github.com/Tynker-Blockchain/TNK-M11-C92-PCP