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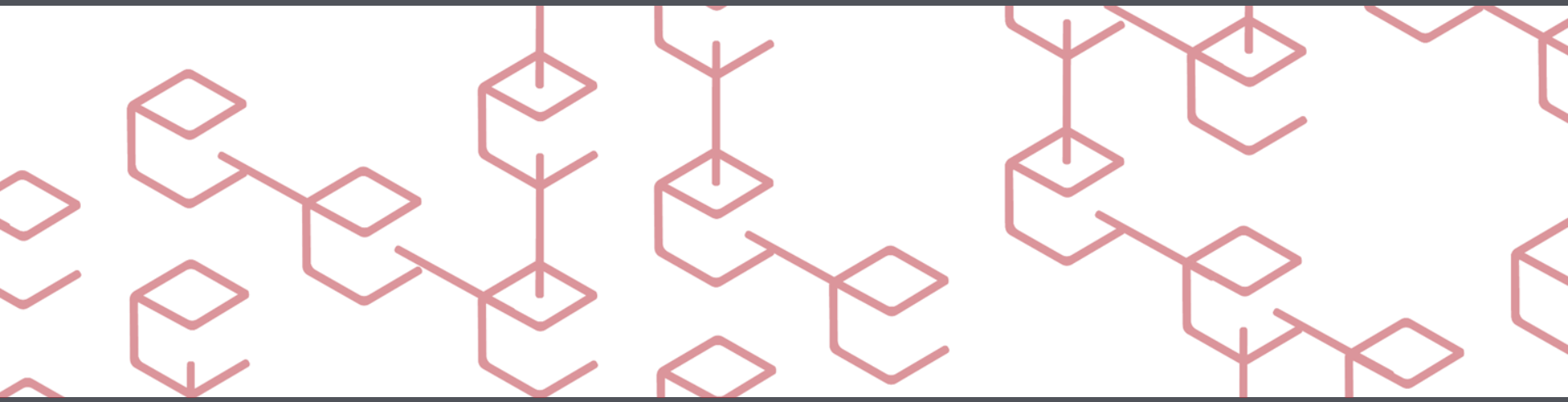
Practical Exercises and Coursework Support



Coursework Assignment: Hints and Tips

Assignment Tasks

Options

Choose ¾ of the following options:

1. Threading during Proof-of-Work
2. Adjusting the Difficulty Level in Proof-of-Work
3. Mining Settings
4. Your own idea

35 marks (15 for implementation and 20 for report)

Research and reference to other Blockchain implementations highly recommended for these sections.

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Threading during Proof-of-Work

- Utilise the full computational power available using:
  - Possible Solution: Multi-threading e.g. C# Threads
  - Advanced Solution: GPU implementation e.g. CUDA C
- Requirements:
  - E-Nonce (Prevent duplication of work)
  - Coordination of threads
- Reporting Suggestion:
  - You can perform a comparison study comparing mining times of single- vs. multi-threaded solution
    - Vary difficulty level to examine the point at which overheads are overcome

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Adjusting the Difficulty Level in PoW

- "Dynamic" or "Adaptive" Difficulties
  - Decide your own 'block time' and implement an appropriate algorithm
- Principles and Requirements
  - Establish a target block time
  - Continuously call Mine()
  - Calculate the "Mine Rate" based on previous block timestamps
  - Adjust the difficulty based on the difference between target and actual/observed block time
- Note the current implementation adjusts difficulty by a factor of 16 with each step which you may find to be too significant – consider alternative solutions.

Adjusting the Difficulty Level in PoW

Starting off:

- Need to have revised thread management in C#
- Please refer to the notes already provided
- Can start with a moderate level of difficulty say 5 and
- Now you need to benchmark this i.e. measure how long it takes with or without threads and how many threads to satisfy a workable level of difficulty and block time
- This just means repeating the PoW using Mine() for different levels of difficulty with or without threads

Block time = timestamp for block (n) – timestamp for block (n-1)

Adjusting the Difficulty Level in PoW

- Exponential growth function
- In the **exponential growth** of f(x), the **function** doubles every time you add one to its input x. In the **exponential decay** of g(x), the **function** shrinks in half every time you add one to its input x … e.g., Adaptive Proof of Work (APoW)
    - Establish a target block time
    - Calibration "*Block-To-Block Stair-Stepping*"
        - > **Median** block time of a batch of N recently-mined blocks
    - Exponential Decay Difficulty Adjustments
        - > Adjusts the difficulty according to $\mathbf{3}^{\frac{delay}{blocktime}}$
        - > After a significant spike in hash rate and difficulty followed by a huge drop in hash rate and difficulty, each new block becomes much easier until the difficulty stabilizes according to the true size of the network
        - > Combat attacks (Selfish mining)

Mining Settings

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- Selection of pending transactions for mining
- Possible Options:
  1. **Greedy** (Largest fees)
  2. **Unpredictable** (Random)
  3. **altruistic** (Oldest existing)
  4. **Address based** (Personal transactions)

This just requires

i) Use the existing code to create many transactions with variable amounts and fees

i) Write code to deliver that is to select the right transactions from the transaction pool in each of the 4 case

ii) Using the Windows Form to create the 4 buttons that would select and display the right number of transactions up to a stated limit according the selection strategies 1-4 above.

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Your own idea

Possible Suggestions

1) Implementation of a different consensus algorithm (e.g. Proof-of-Stake)
2) Create multiple nodes running in a local network, automating the generation of transactions.
3) (Advanced) Smart Contracts