

DISTRIBUTED OPERATING SYSTEMS (COP 5615)

Project 1 [Bitcoin Miner]

Swara Lawande (UFID : 6081-3129)

Vikash Pandian Kasipandi (UFID : 1305-9614)

- Steps to Run:
 1. To run the server program use the command :
`dotnet fsi BitcoinMiner.fsx <Number of zeroes>`
 2. To run the client program use :
`dotnet fsi RemoteBitcoinMiner.fsx <IP of machine where BitcoinMiner is hosted>`
 3. To exit the program and get the Real time and CPU time press enter.
- In order to mine bitcoins, we need to generate random strings and hash them using the SHA-256 function. As this hash function works only in one direction (we cannot retrieve the string from its hash value), it highly increases the complexity of the problem as we need to process a huge number of strings to find the bitcoins. We can leverage the distributed architecture to divide the huge problem size and process subsets of the problem simultaneously.
- In order to avoid two actors from working on the same subset, we assign the actors an input length (length of random strings to be hashed). No two dissimilar strings will ever be mapped to the same hash value. Therefore, any two actors at a given point of time will never deal with the same input as the string lengths will always be different.
- To determine the number of actors, we tried using various combinations and figured that it performs best when the number of actors is equal to the number of cores on the machine. Therefore, we spawn actors dynamically using the following command:

```
let actorCount = Environment.ProcessorCount
```

- The result of running our code with input 4 is shown in the below screenshots:

Server Miner

```
Administrator: Command Prompt
[INFO][9/25/2021 3:43:26 AM][Thread 0001][remoting (akka://bitcoin-miner-server)] Remoting now listens on addresses: [akka.tcp://
/bitcoin-miner-server@192.168.0.184:3536]
lawande.s;IJOjcc5bJi0zIl 00002627a54f20e98d7c5cf6f2f2ec37e94a8fe0a0e9e80e6f567f104960446a
lawande.s;gOYN4Rf4kD6Wi 00008cd23fde285fad64527d693a4a867c4c3eea04536ea6c611465b730854f2
lawande.s;huEbuKq3KUSASx1rw 000093f1cbb751d750150836f8246b7484eb2d3dc106d50c1f31256f36326d
lawande.s;PCFK0FMy49qEkru 000077ab2e3c93c428204f94287f1fb431865ecc65372cdb7527c605680df08
lawande.s;2Z0Wxwym 0000ee73361178aea14f69d5fe34740c13f01149c6aae61943969e401ae404d1
lawande.s;UvOjKvcJ3hmFY9uHd 00009c8088ad5e08de9d7f8a83cb9da93b35fe902f537dd336d3ba6634388a15
lawande.s;qQJTABRAyHT 00002d80bb5d746682df1519093ec7e3c0189e8e3ab01c50077abb9c929594789
lawande.s;FtHUZtCo4NgeXN 0000baa52f4c8693ee5b6a48ac7a69d5ad14bab5a85329cc556bb2b5f76dd220
lawande.s;Yst3x8fbckQnXu 0000a3161955457686177304fc0a1a69277b2f3bbba0a1ef2cf688793d151f5f
lawande.s;mCstvIIRpsCu8S2 000022c40635cd9a43229eb5bb080e559a6cc6cad7be0ab49ad2cc23b6b1269
lawande.s;jt11H5Ri 0000d40288b551be93127f7b551f8f0853e574a5db2eb85c175cb847bcbcc004
lawande.s;3U7berOV91o15Qc 00006db6918d0e0d2353c41c8400ba26e346f64069305b8d32cec12b632c63a4
lawande.s;L6GV5oNUUM 0000da2cedeb3d215f7ce23981968ab1e0d93bc6a652cf23a236d3bb6770c2f7
lawande.s;lKU08lJY 0000da9ceda940da4504eb1ee5734be32ea1b02dae0d92c98325566e00994955
lawande.s;sSLWpWfMNX 000085defaaaa7e160961605f4e29ac3bdf62903f0eefeffd43d62b551323e13
lawande.s;1jg8J9G2q81Nn 00007911e2ac86f4d5eeb3a18ea9e0d293c67f909000931ca5c06f71345de1
lawande.s;S46oupeseyfyNkeTmM4 000052a71e15f10b2a9fa8d4779f35037890f4e4a9e06a34c4f90327fac74052
lawande.s;ASkEjUrReS9ld 0000e03e965e465dcaeb4d4f03dd5154a9e1c3543f0e891884a980710c94c8c0
lawande.s;L7xIAzERClItTtxt 000073846bfc4de3b089ab87cec812c9a44a9bd93059b414d87eb4eaf1ddc2a
lawande.s;8NuMecGneo2QmPoWib 0000b941b5c2d79574a96e6a82fde17109642a095ffbe7df5e492d3248edefae
lawande.s;ZkqKMDnJ 0000aa6f04498c2104e8222e2e8e60223818d255222f3c6bd0483393a3a5ee0
lawande.s;xEbyppyr0s9 000097c134f5a852fd27074786e647590cc3c6630fa7368a561c805105141b08
Available
vikashpakasipand;UpCz2DaA 00004b7649cdf6fd49fd0fd825cfb040afe5c22cb6261f57937a27f7998331c5
lawande.s;Zq8eBda3z 0000273c8413fafdf61f3ec2cf1f9c1729140ae0ede90b9cfe00c40fbdc144a3
vikashpakasipand;yoqFr5jh 0000f174097806f2a971106863c54e09a3a91eda407f0c7052d1dbb57768db2
vikashpakasipand;RMqYoJlGFM 00002c64068ef607e89ef230f6b2912722dcccac267ef51c53a2b2d590115ca9
lawande.s;jVgKFvNm 00007586d58807f2ae0402a27205b7956377102e79b163781eaca0240a379763
vikashpakasipand;jglL780f 000064faf4a0bed73e74d317eab08e632fd1dde84a4502c95bbb06ebdde63a12
vikashpakasipand;HR5UCLNhy2I6 0000c237fc95f9f00b29d3bc41259167e41697f40ec81b42c52714e8f8771
vikashpakasipand;W80dLSeoUtnKa 00009db493d869841a80a3c400a8ec7c5b8641aeafce4307043e1d7eb34a4ec4
lawande.s;uVY4X47 000097d0351dde392478effd150700ad18a0f32dd120e26193761a7faad1542
```

Remote Miner

```
Select Administrator: Command Prompt - dotnet fsi RemoteBitcoinMiner.fsx 192.168.0.184
C:\Users\Vikash\source\repos\Project1\BitcoinMining_Simulator>dotnet fsi RemoteBitcoinMiner.fsx 192.168.0.184
Real: 00:00:00.000, CPU: 00:00:00.000, GC gen0: 0, gen1: 0, gen2: 0
[INFO][9/25/2021 3:45:02 AM][Thread 0001][remoting (akka://remote-system)] Starting remoting
[INFO][9/25/2021 3:45:02 AM][Thread 0001][remoting (akka://remote-system)] Remoting started; listening on addresses : [a
kka.tcp://remote-system@localhost:57580]
[INFO][9/25/2021 3:45:02 AM][Thread 0001][remoting (akka://remote-system)] Remoting now listens on addresses: [akka.tcp:
//remote-system@localhost:57580]
```

- To measure the performance of our system we compare the Real running time to the CPU running time. The ratio of CPU to Real running time is close to ~ 5 almost every time we have run it. One instance is shown below:

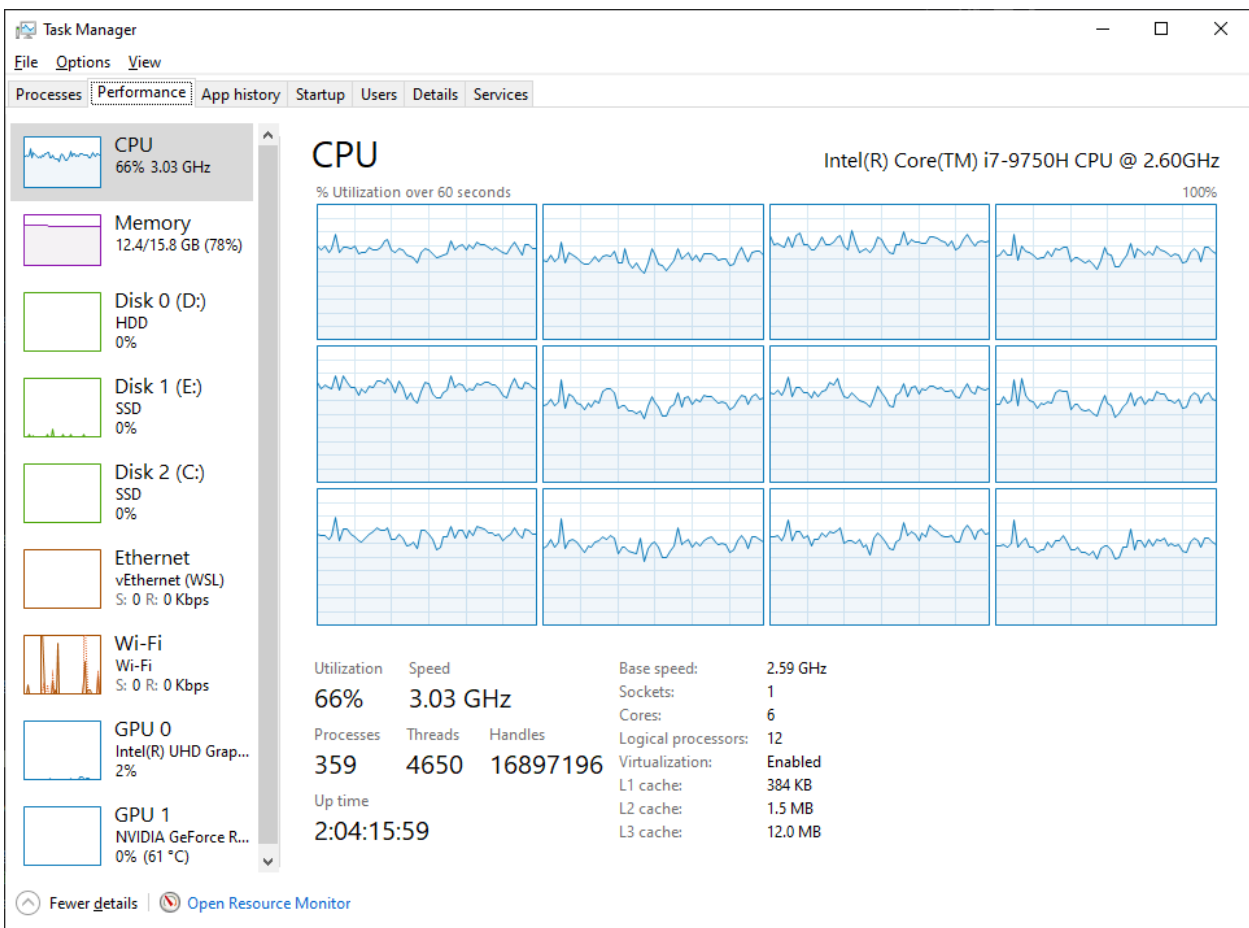
```
Administrator: Command Prompt
rSystem@192.168.0.184:3536]
lawande.s;uKb078oE 000000ad55c37f8b00acf888293e1117877e51eb69d8a84670a759304a29740
Real: 00:01:21.142, CPU: 00:06:34.875, GC gen0: 22130, gen1: 11, gen2: 1
C:\Users\Vikash\source\repos\Project1\BitcoinMining_Simulator>dotnet fsi BitcoinMiner.fsx 8
```

Also, a screenshot of CPU utilization while running our program is given below:

Machine Used:

Processor: Intel(R) Core(TM) i7-9750H CPU @ 2.60GHz

OS: Windows 10



- The coin with the most number of zeros we could mine is lawande.s;uKb078oE which has the hash value as:
0000000ad55c37f8b00acf888293e1117877e51eb69d8a84670a759304a29740 Refer below screenshot:

```
Administrator: Command Prompt - dotnet fsi BitcoinMiner.fsx 7
C:\Users\Vikash\source\repos\Project1\BitcoinMining_Simulator>dotnet fsi BitcoinMiner.fsx 7
Real: 00:00:00.000, CPU: 00:00:00.000, GC gen0: 0, gen1: 0, gen2: 0
[INFO][9/25/2021 3:04:58 AM][Thread 0001][remoting (akka://MyActorSystem)] Starting remoting
[INFO][9/25/2021 3:04:58 AM][Thread 0001][remoting (akka://MyActorSystem)] Remoting started; listening on addresses : [akka.tcp:
//MyActorSystem@192.168.0.184:3536]
[INFO][9/25/2021 3:04:58 AM][Thread 0001][remoting (akka://MyActorSystem)] Remoting now listens on addresses: [akka.tcp://MyActo
rSystem@192.168.0.184:3536]
lawande.s;uKb078oE 0000000ad55c37f8b00acf888293e1117877e51eb69d8a84670a759304a29740
```

- In order to test the real distributed nature of our program, we tried to run it on multiple machines. We hosted our server miner on one machine and the remote miners on 3 separate machines and it ran successfully using all cores available.