COP5615 Distributed Operating System Principles-Project 1

Bitcoin-Miner-Actor-Model

Team:

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Built On

- Programming language: Erlang
- Operating System: MacBook Air
- Programming Tool: Visual Studio Code

Project Definition:

Bitcoins are the most popular crypto currency in common use. At their heart, bitcoins use the hardness of cryptographic hashing to ensure a limited “supply” of coins. In particular, the key component in a bitcoin is an input that, when “hashed” produces an output smaller than a target value. In practice, the comparison values have leading 0’s, thus the bitcoin is required to have a given number of leading 0’sProject Requirements

Input

The input provided (as command line to yourproject1.fsx) will be, the required number of 0’s of the bitcoin.

Output

Print, on independent entry lines, the input string, and the correspondingSHA256 hash separated by a TAB, for each of the bitcoins you find. Obviously, your SHA256 hash must have the required number of leading 0s (k= 3 means3 0’s in the hash

notation). An extra requirement, to ensure every group finds different coins, is to have the input string prefixed by the gator link ID of one of the team members.

Example:

1

adobra;kjsdfk11
0d402337f95d018438aad6c7dd75ad6e9239d6060444a7a6b26299b261aa9a8b

indicates that the coin with 1 leading 0 is adobra;kjsdfk11 and it is prefixed by the gatorlink ID adobra.

Workflow

This project prints multiple coins after mining with k leading zeros. So, we get multiple bitcoins with k leading zeros. Program is run as follows:

- k is some integer >= 0
- we first start the server node and server starts mining coins even when no clients are available, once a client or worker is available server accommodates the worker in mining.

Server node

- This project consists of 2 files on server side. miningServer and findBitcoin. Initially when server node is started, server's IP is used by workers to connect to it and contribute to improving mining capability.
- Server initially divide CPU core into 5, out of which 4 cores are utilized to run server process using multiple threads (4 actors).
- The server function creates hash and displays valid bitcoin that is with 4 leading zeros.
- Meanwhile server allows connection of other clients and receive output from them. Received output from worker is now tested and the output that meets the required criteria is printed.

Client node

- miningClient will now be connected to server on the given IP address (mentioned in code). The worker will create 4 more actors and then start the same hash computation for random strings using a recursive loop.
- Whenever a match is found with leading zeros, it sends a response back to the server, that result has been found.

How to run the code:

- Navigate into the erlang shell and type the following commands to run both server and client on single host.

  erl -name sadhvi@192.168.0.206

  c(miningServer).

  c(miningClient).

  c(findBitcoin).

  miningSever:start(4).

- Type the following commands to run server and client on different hosts.

  change the IP address to different machine.

  erl -name divya@192.168.0.58

  c(miningClient).

  c(findBitcoin).

  miningClient:start_pong().

Output for the program when K = 4

The result of running the program for 4 leading zeros on single host

```
{ok,miningServer}
(sadhvi@192.168.0.206)21> c(findBitcoin).
{ok,findBitcoin}
(sadhvi@192.168.0.206)22> c(miningClient).
{ok,miningClient}
(sadhvi@192.168.0.206)23> miningServer:start().
server call invoked..
Done with all BitCoin Mining
ok
6       sadhvithula;yRhBmXMMIU  0000A514AA9DA425F11EA654C24C678B5289BA6EAA8DC36760CBB66BE054B829
7       sadhvithula;8ese0hNVq6  0000F64849FC676498F8372FA0F406C7050F8A5CC9F9E2260720172B1D05135A
6       sadhvithula;ROUBSuOGiP  0000C6CFD280DB198F0CC9A2E41C2591DC2A27A8121BEDBE402A4F2ADE1D7CCD
6       sadhvithula;nmyWMh3T9F  00006D75FA891E33C23DA36E5886261C062005ADE7D100489D9E517FFB88FE53
7       sadhvithula;kHHm7jvGsU  000091D0F00ED42738EEF9D46F8336381E8E03FB5930071521C4E90BEFB363CA
5       sadhvithula;PwP3ChsDk1  000017B73D840A72066A274F457C8720A07D8DE0D24F1B9123FDC39F6B014CE2
7       sadhvithula;x4qapj2Fa1  000042BF3E6232D4E18ACE699F731817EFF63A719EE393EE41EA7A957FDC8D8C
7       sadhvithula;51IZDlU1LQ  00006F5A328CC7180A20D20CD38F0C4384A1A7E3BFE7AD80B22457369C37A048
6       sadhvithula;bnujEGOiQg  0000B22CD3CC522A77EED869FEBF43495CFFFEEE98D1C222960AF3BB4CF5E8FA
7       sadhvithula;XRb1EEsYyl  0000952509C5B05C1F0FB0B6B5799AFDD08D34CBE75C59A2B34E4685CD89AE80
7       sadhvithula;dCwmkTSx4N  00008F30C986B22EF4D6388E3B04D38BE4F36C97F2A2108F3869E24B7FA26367
7       sadhvithula;KWOdpMmBDI  000054BC1A75585F92CF3E955EEA0D7CA957D2310ED99292DE0C4C065398B2E1
5       sadhvithula;qe53pa88KK  000078EE0E76DC47A0C375479A662D721E3D615784A3683B6C7CD59C7D7F733B
6       sadhvithula;WncC8zRTME  00009D7B1E0993EA8EC9C4F4B8A58DDDEA7E9F25B97D9F0D79627B885911BC25
7       sadhvithula;0NygeErA14  00004191F35883277C36E15511F3A1D93F8D1341A954939463DEF9338301F5CD
6       sadhvithula;SmHNEk0y3I  0000F841A1AE9CE44AF67E15E9A41D0123D62FA72DFBC73A4C94D1AAB1D3A4CA
6       sadhvithula;yExqjRHQjV  00000FC9FD4F17645439CBBDAC7158101AE8FD7DB64CF15085F06AD1845908AF
7       sadhvithula;pFC4Xtmu2z  0000F115CC940773FD1B3D980101693F015A180EA89E2A7E1CD566CACFE08C5B
6       sadhvithula;m8jpepgBtP  0000E525284D8A3784E33749F1F640A54A3A2C7443094A2E5B34807C8B28D55C
6       sadhvithula;JlK6JIALBL  000031D40BEAF3458135B27559AEF7161BE77317474E0CED886DD9DB13F7685E
5       sadhvithula;9qkxL08DtZ  00001352A7EDF7F2FDD6ADDB54D97D7B903ABE521731833BF8FFD3779143911F
7       sadhvithula;6KnAcrlHmk  00004BBA2F8605C6EB9ADFB92256B5A3BDA783636FA8912568B1CAD52E5FA48A
6       sadhvithula;5ASma8vV40  00005850BFDC17C10E5D4ED29673C5313CAFE4638D33223CC7832798E9313CA7
5       sadhvithula;obubzcah0W  0000C170033F9EE8FE42DD214BA41CDC90986B9901AB1B208128A970B4C51762
6       sadhvithula;tpzugXjVR8  0000B61CD9C4F0C696C733267CF9951AAA84D6E393F13B13275C67251DB81E7A
5       sadhvithula;OX58BjHoSP  0000506FBC85B0871FF6B5A4C7D89232F6C7FD61BB8BBDF058FE15DE7D33EF35
6       sadhvithula;X7j2fmyByn  0000430096 00D7B963DFC0C6225A4D1ED7B36B1B3E04E85F85A52DB257D0F0C3
5       sadhvithula;5W45fOyJnM  000094F0FB9722A2671542E8FFDD1BFC9F5D1A82FED721559F4FED2C621CD3FE
6       sadhvithula;yULW8lHvRv  0000541E280DAC80D302E820A69FE8A83F687CCD5DDEBDF2BE0E8661FEA5ACC4
6       sadhvithula;Tcy6lCWnjw  00004F3982BE7637E4C00C82F3A959A98E335EDB6688E2E834876E1BAC108824
6       sadhvithula;XZ6xqQcIKi  0000591F677A48FFB4D6F36B8BD29B168CEC4F7EE5EE70230A7CCC41EE77F5A6
5       sadhvithula;yTqUZxoDoF  00002AE223F15A3188A616494C0CDAFC2DB71421AF0FCCCCA778EB0A99B3F29D
6       sadhvithula;bZu3NsN0gr  0000AD086742247 51C697F2104AF4662A06F97172C1EDC222AF077D7EBD4A261
6       sadhvithula;Ke280WCHRE  00003C57AE350FE694D56B59578EC06B9BD33322B784227706B988E11AF89E4C
6       sadhvithula;Vjtq986Jwj  000074D02C9B7A0705CB00BE1B776978285EF8FFE943ECDF9AEDD0EAA8972077
6       sadhvithula;8Akn0lKOpJ  0000402A194C57CB78B21912ECFFD67EF447105EDB4BFAAD47E9E047CCF1C2F1
6       sadhvithula;5ZXbANBksv  0000921C8C6E677F10FE77FAE6D14F2A5675DC98F746456BE2FB8F2C6D39E8C9
5       sadhvithula;nP0ECPxJnr  0000AB683FC8747BDA38118127F8BD14A3A2769FB3733BE93E3393DCF1862A55
5       sadhvithula;okE7zLevrq  000039308D1409ED68FA8CF13897DA4BB76E62C5A117F3F21C33F2F3D3722F5D
5       sadhvithula;qCxUQKz0QG  0000AC300803F6AAB68BB7C556AD388E9EFF7CE3160EB455922C05F8A5281008
5       sadhvithula;E5rPSSPd5R  00006DF60AA02982BB0B1724440F845C3CC4C7DE71EA8784ABE688A36DA8E089
7       sadhvithula;fN8Tzr5iOj  0000502A83571DF473339FE88A09E419C7D8725BEF5EFB0674A0C4849AA702B8
6       sadhvithula;LmX64WVOM3  000048F0FD29778E3617137D4451A9C62BF3C3D0FC703A1D5E6DF7E0995A2A0D
6       sadhvithula;L41k4BK3oj  00002C19D25BA51982D07D8F07E4DDB44CD733D6667BCF8C327EDB3467DF572D
5       sadhvithula;BdHN4h5a7j  00008CDBFD2B8ADD43B1817C0479E383ADBF0FC61A2B65449F0D38BB1BBD899A
6       sadhvithula;gzdxMlK7qT  0000A10147E83D3D091687CDAC6AAF0A42E2D6546F75F66B124BC6E5D9ED9B34
5       sadhvithula;MfYC44GQlk  00005176C830F7F9505BACB1D4313FDE882393035837C7D2A0C7686A7095DC9
5       sadhvithula;12tXXTJWDy  0000CEBCD2D6C775BCE524425E2B9528E758CF777AB4DA32018917074 39C99A8
5       sadhvithula;2LeTeUkcSx  00003A6B605B85793A21726CE4A4CE9BFCB23B379172348FF3FA9347EAA5DA3A
Completed BitCoin Mining 7
Completed BitCoin Mining 6
Completed BitCoin Mining 5
(sadhvi@192.168.0.206)24>
```

The result of running the program on different hosts

```
(divya@192.168.0.61)4> miningClient:start_pong().
Server id <0.100.0>
Done with all BitCoin Mining
Call Sent
ok
2       sadhvithula;eBhBJklevl  00000AAD40E0F3BB3E784DE02A0CC31A28772747E540743B81FA540FFF2BC834
1       sadhvithula;00mXpsvrlO  00000938E779C2C300C6616D724F9572C03AE5BA17BEDF337F078791056CE110
7       sadhvithula;wTwth5Sso7  00000C83B3D0ADDE5E552886D5D2EECF5A76EDB95B197A5B3C646E47110C99E0
6       sadhvithula;LzYyf6yXlu  00000619F998B648665487D993F34C7B000152BCAD51EEC0F2CE1F90C20C314B
5       sadhvithula;GgRA9f7jq3  000003F382EB3201FC208B1F6D391F4A301F505A96B73FA0078EE9409D445007
6       sadhvithula;PAqsb9dmdq  0000056540DFAE38A5D9ED4268CDC8D2FCAB27D5619049797ED0242AABBCBF15
1       sadhvithula;tLUXT0lBC2  0000068DAD7CDD250AAC8606786363100C1F9E1F681E41B0F18B6E24115B1844
5       sadhvithula;46g1psxA6K  00000F4E68C510889270E098FE471FD3CCF06B914A337A4F8C8CA9DA1900BB80
7       sadhvithula;VWMmiBeczs  00000C377D451DFA6E9AB5F0AA74A7451260483F13DD22E5040F1640BC8C1703
0       sadhvithula;YsI7rXB7Vl  000006F9176CC8C3E31EC53E124FB1DE12958D27ACBEE5BFA505E5CE92AF1998
6       sadhvithula;pekgpptCad  00000F1489DA263245EC81723F82F723EF619165A335607A82202389AD1220F1
Completed BitCoin Mining 7
Completed BitCoin Mining 0
Completed BitCoin Mining 6
Completed BitCoin Mining 1
Completed BitCoin Mining 5
Completed BitCoin Mining 3
Completed BitCoin Mining 2
Completed BitCoin Mining 4
```

Output:

sadhvithula;yRhBmXMMIU

0000A514AA9DA425F11EA654C24C678B5289BA6EAA8DC36760CBB66BE054B829

sadhvithula;8ese@hNVq6

0000F64849FC676498F8372FA0F406C7050F8A5CC9F9E2260720172B1D05135A

sadhvithula;ROUBSUOGiP

sadhvithula;nmyWMh3T9F

0000C6CFD280DB198FOCC9A2E41C2591DC2A27A8121BEDBE402A4F2ADE1D7CCD

00006D75FA891E33C23DA36E5886261C062005ADE7D100489D9E517FFB88FE53

sadhvithula;kHHm7jvGsU

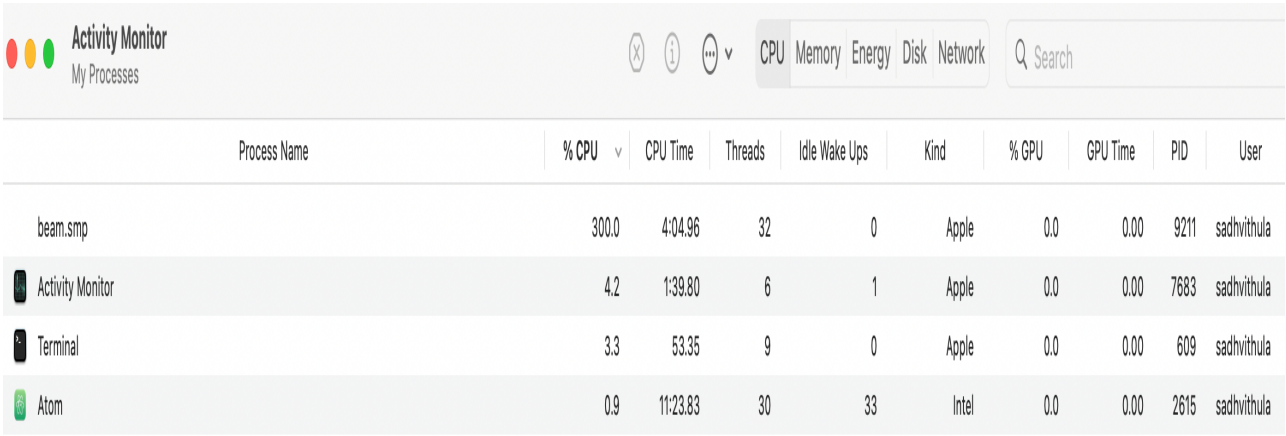
000091D0F00ED42738EEF9D46F8336381E8E03FB5930071521C4E90BEFB363CA

Ratio of CPU to Real Time

The running time for the above as reported by time for the above and report the time.

Real: 00:00:02.262, CPU: 00:00:04.496

RATIO of CPU TIME to REAL TIME = 2 (Approximately)



Process Name	% CPU	CPU Time	Threads	Idle Wake Ups	Kind	% GPU	GPU Time	PID	User
beam.smp	300.0	4:04.96	32	0	Apple	0.0	0.00	9211	sadhvithula
Activity Monitor	4.2	1:39.80	6	1	Apple	0.0	0.00	7683	sadhvithula
Terminal	3.3	53.35	9	0	Apple	0.0	0.00	609	sadhvithula
Atom	0.9	11:23.83	30	33	Intel	0.0	0.00	2615	sadhvithula

The coin with most number of leading zeroes

The coin with the most 0s we managed to found was for k = 7.

```
sadhvithula;aVk8jKqIvU
```

```
0000000A019EDC38B629D29A083F93541CB45A4A478C77EA19E558360F6EC603
```

```
{ok,miningServer}
(sadhvi@192.168.0.206)6> c(findBitcoin).
{ok,findBitcoin}
(sadhvi@192.168.0.206)7> miningServer:start().
server call invoked..
Done with all BitCoin Mining
ok
6       sadhvithula;aVk8jKqIvU  0000000A019EDC38B629D29A083F93541CB45A4A478C77EA19E558360F6EC603
(sadhvi@192.168.0.206)8>
```

Largest number of working machines we were able to run our code with

The Maximum number of working machines on which we ran our code = 2 (Mine and teammate's systems).

Work unit:

In one request from the server, each worker actor works on a set of 4 tasks. Considering this set of tasks as a work unit we found the following values for CPU time to Real time ratio:

Number of work units	CPU Time (ms)	Real Time (ms)	Ratio
100	1656	493	3.36
500	5843	1059	5.52
1000	23406	2791	8.39
10000	30703	3768	8.14
100000	34484	4278	8.06

hence our system had its best performance with 1000 work units.

Running time :

For finding the first bitcoin with 4 leading zeros -
CPU Time: 1552ms
Real Time: 523ms
Ratio: 2.96

CPU TIME and Utilization:

We have calculated the values for the following number of workers when number of work units assigned was 500:

Number of workers	CPU Time (ms)	Real Time (ms)	Ratio
12	1656	1059	5.52
24	19250	2769	6.95
120	44015	6958	6.325
600	187078	30644	6.12