COP5615 – Distributed Operating Systems Principles
PROJECT 1

Team Members

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Problem Statement

The goal of this project is to use Erlang and the actor model and implement a bitcoin mining simulator that finds the string appended with the UFID such that the hash for the string using the SHA256 hashing algorithm has k or more preceding zeroes. The objective is to create a solid, multi-core-compatible solution to this problem using Erlang and the Actor Model.

Example

6

namitanamita;lkfs70 "0000007EB01A9C5C75868832211F9E5B148A4076D9197323F594B8098C8E701B" indicates that the coin with 6 leading 0 is **namitanamita;lkfs70** and it is prefixed by the Gatorlink ID **namitanamita.**

Implementation

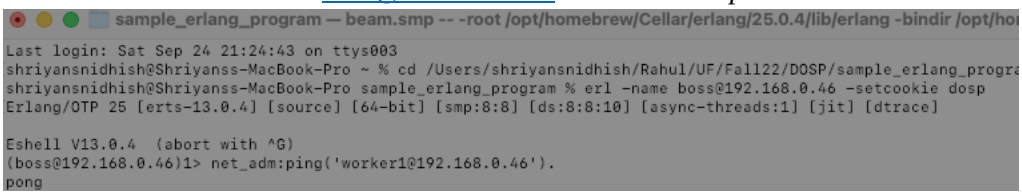
The implementation of the actor model for bitcoin mining using erlang begins by successfully delegating actors (processes) based on the size of the input and then making them perform hashing on the inputs and checking the hashed string has a specified number of leading zeroes as well as send the result i.e., mined bitcoin once the computation is done.

Input (leading number of zeros)	-	**4**
Number of workers delegated	-	**8**
Total process	-	**9 (8 workers, 1 boss)**
Bitcoins per actor	-	**4**
Total Bitcoins mined	-	**33 (including 1 coin from boss)**

Execution

Step 1: - Created new node for each actor on 2 different machines (1 boss node, 4 actor nodes on first machine and 4 actor nodes on second machine).

Command used: erl -name boss@192.168.0.46 -setcookie dosp.



Step 2: - Connect every node with each other and the boss (both machines).

Command used: - net_adm:ping('worker1@192.168.0.46').

```
Eshell V13.0.4  (abort with ^G)
(boss@192.168.0.46)1> net_adm:ping('worker1@192.168.0.46').
pong
```

Step 3: - Compiled the program on each node including boss.

Command used: - c(bitcoinminenew).

```
(boss@192.168.0.46)8> c(bitcoinminenew).
{ok,bitcoinminenew}
(boss@192.168.0.46)9> c(bitcoinminenew).
{ok,bitcoinminenew}
```

Step 4: - Run the program from boss node

Command used: - bitcoinminenew:main().

```
(boss@192.168.0.46)12> bitcoinminenew:main().
Enter number of leading zeroes:  4
```

Output

Case 1: - Input leading zeros = 4

```
(boss@192.168.0.46)16> net_adm:ping('worker5@192.168.0.234').
pong
(boss@192.168.0.46)17> bitcoinminenew:main().
Enter number of leading zeroes:  4
Mined Bitcoins with 4 leading zeros are :
Time Taken to Mine all the coins: 1.13 seconds
ok
namitanamita;797gz3   "000010D58BF7E0A2F5EB4682B407A5E079C83D05092179FE6766F8FECF988E9A"
namitanamita;pidg04   "000075BEE2EF4F6DC2CC75F6E00BE640C33A0F6F210C408312063BD7A8A91CE3"
namitanamita;iqigof   "00008DD68F8DB24A8F6B3DD91BC0E0F839FC8E417B0BA0530C2189CABEC593C6"
namitanamita;yf50zk   "000042B052B868C48B6A2592B0D750241761D42D2F4A97B254450E1159CFA9E6"
namitanamita;mzu2ct   "0000753E234D9BE16CC3BA6F325BA27A2D02604AB8A08885F6DDB552AE90F904"
namitanamita;k1nf7o   "000026F8ABA04589E1E8F53C90404D1ACC1504041900AEF24F68F43CF701C65A"
namitanamita;10n50d   "00009A00B9F4FE0A988980C9C0288820051ED0BECBAC3BA4A6B556F04236AFA3"
namitanamita;wbzzdd   "00004549C0268E1C6788E2BECF44688337DFE412F1370EC6F0D83C8DEECB4124"
namitanamita;2ojg75   "00009B46EF69E3523FC36C39319E9ED52980054C92226D5D36E26D9F4107CAAB"
namitanamita;0poi52   "0000599254902EB6688E4FF1EFA91B6DAFB793677F8BE122FB40B0CC6A309D44"
namitanamita;i9oz25   "00008BBBA44B24AAFFFBCC258DB46FD560B29683DD55CF360DB6722952F42BC6"
namitanamita;lkooj0   "0000F1A58C2D6568927A179CDC06F314DC021FDDF46FCCBEA1BE545FA1D8E0D7"
namitanamita;qa05li   "0000085438AA93A101236318D7C37A58FDA5E6CC7DF76AAC30EEFC35DDBFF7AC"
namitanamita;iax9g4   "0000FD5D18F9B13A0829906958BAD1ED9363C519D27BBA214FAB3ADC79B66B36"
namitanamita;d2y3bc   "00000CC77F42473E3C96CC825E9EE4D1788891B42747863EFD24E094F6C2F5DF"
namitanamita;zspzur   "0000FCCAB311F839678207BC25FB01676B43A229A1CD9CB76F1D3332A8361E90"
namitanamita;v3wxa8   "00004BD754577D96B313E188299962C3F6F81231572E6A997D4BD08AD8588D6E"
namitanamita;wtfwf2   "00002ABC0128A75214646FC0548E74C39C35DB55E950740EFB553493C04FCB5E"
namitanamita;y3vg88   "000005A8BAB80B294AD32E4594CD11E1973D032A1D61741A2C8195509F16CCFE"
namitanamita;eazgtk   "0000FEFD48DD8B3347877E6198A6E42B1CFF333A717D75A730C94835705C0938"
namitanamita;4mapps   "0000655FC0B29377356C71D82A87A006F0586B3EBBF32610BEE5A87A00B6533D"
namitanamita;1wfqk3   "000071ADEDE70D925C8069DB2BF5A0310641453291BBBA4C5D4807AACB32EBAF"
namitanamita;6xs8f2   "00007777DD35568FA639E43FE686CE0C7D51159FE23F8CC7EA77053EE7D85EA1"
namitanamita;groo2d   "000003EC96EA834D323E5F4CAAD4A26D7CDF6432A04B22016EBA94B0B189A50D"
namitanamita;fj9h8h   "000096F207F3E91EF8C8C4CECD8F1BF842563A2C16F22FFEAB323117E92752D0"
namitanamita;gza0ud   "00008BE0A67B38298D0E0E8F1BDD875E6C63EC70AB2A7C9CA0E238CA3E90DB3A"
namitanamita;m8bjp3   "00000C6429D51540CFC3F54A3AD414287D6D825CC4CBDB107765DA0B7E6DAB08"
namitanamita;ltkwpl   "00002B00F40CE6A3905CB864CA7A6310D50A5D4BB80E812D104B709567CEB4A7"
namitanamita;h5dn6c   "0000493FAA346F5D9BFB75374F27D1187A8BE543331D4E9AC8270C2620AD2FA1"
namitanamita;fz4s50   "000037E8DDC47370D8E8509D48EC410060D837E6C14BE13067A518FA5DD6D0C4"
namitanamita;pfq0hu   "00008950288B145DC95720FB33557A3B968973E88E92FF5A97182E6AA491A398"
namitanamita;cb0lc8   "000045C9710CD77CBC10E7D189E1AAC586468DE3340B5DECA3EA4688664FD022"
namitanamita;hokowv   "00009E19F84BF4C78FFFC0B2F9A8BA263E7FDDD33EBECC756085ACCF9678EA15"
```

Fig 1: - Coins mined with 4 leading zeros.

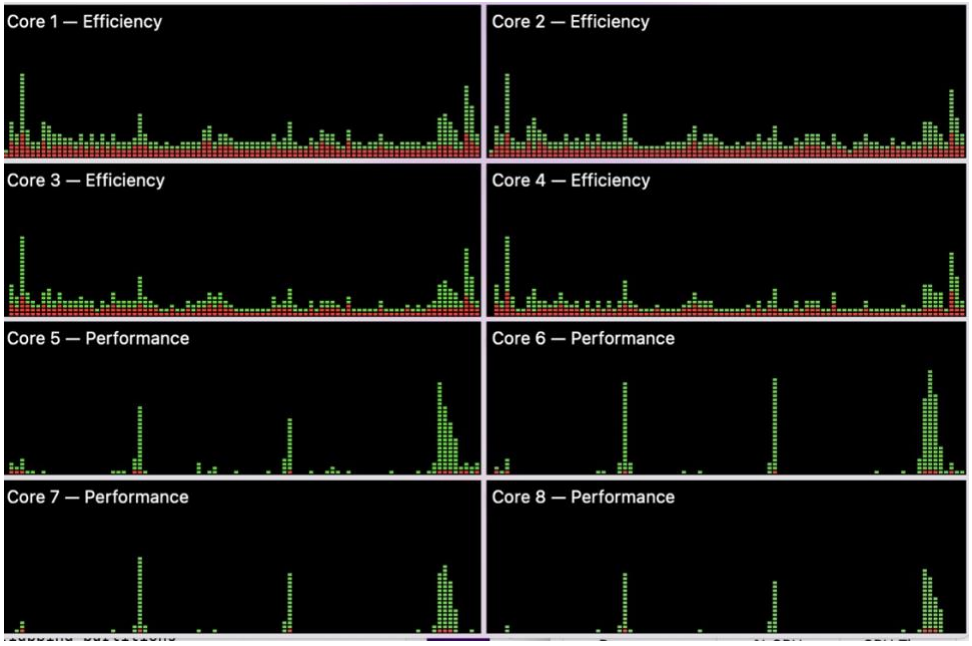


Fig 2: - CPU core usage before mining 1

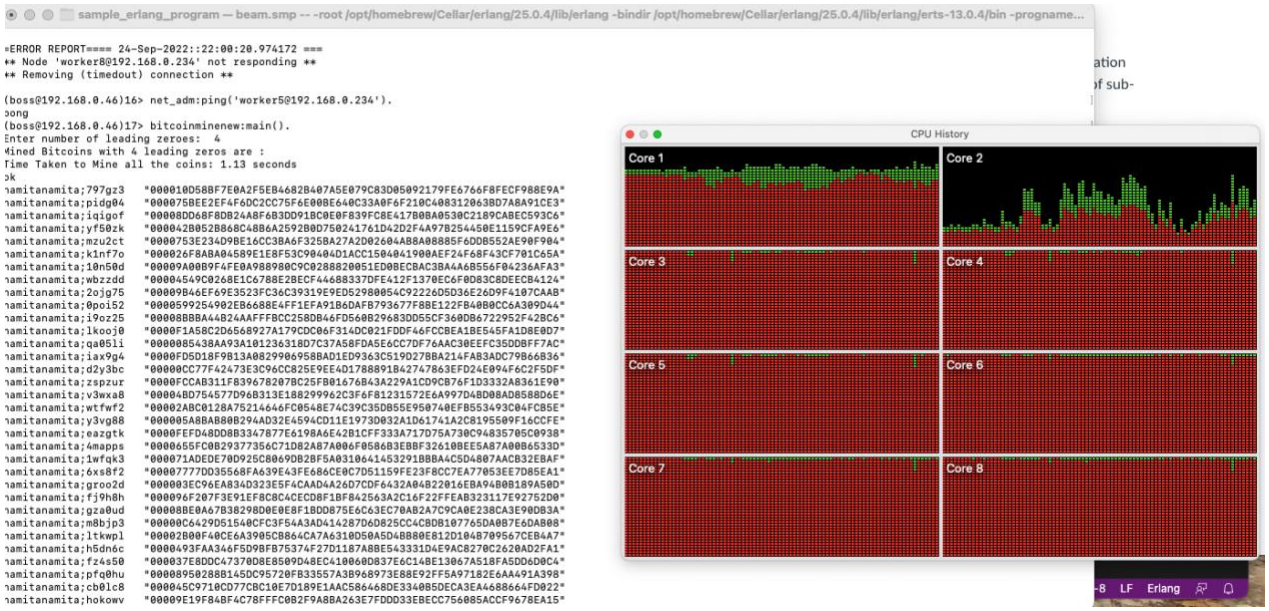


Fig 3: - CPU core usage while mining 1

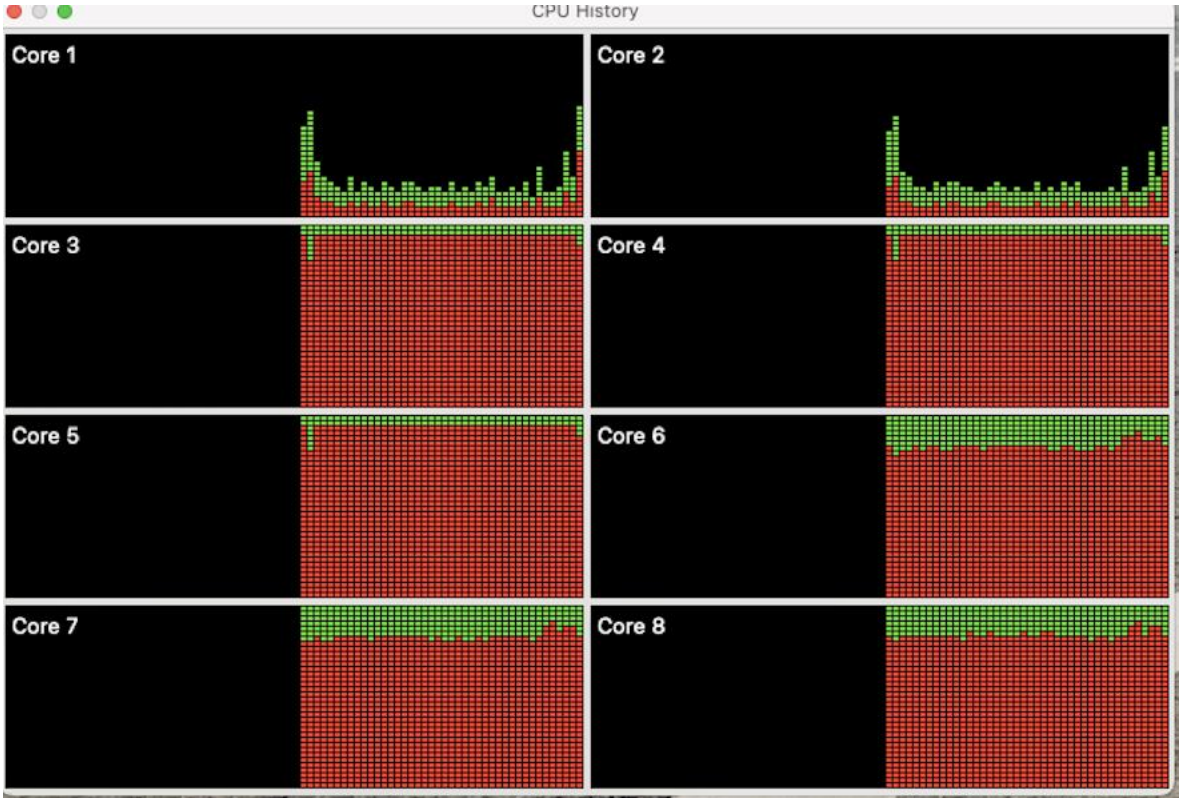


Fig 4: - Core usage before and while mining of machine 2.

Case 2: - Input leading zeros = 6

Fig 5: - Coins mined with 6 leading zeros.

```
(boss@192.168.0.46)3> net_adm:ping('worker5@192.168.0.234').
pong
(boss@192.168.0.46)4> nodes().
['worker1@192.168.0.46','worker4@192.168.0.46',
 'worker2@192.168.0.46','worker3@192.168.0.46',
 'worker5@192.168.0.234','worker6@192.168.0.234',
 'worker7@192.168.0.234','worker8@192.168.0.234']
(boss@192.168.0.46)5> c(bitcoinminenew).
{ok,bitcoinminenew}
```

Fig 6: - Boss connected to all the nodes on machine 1 and machine 2

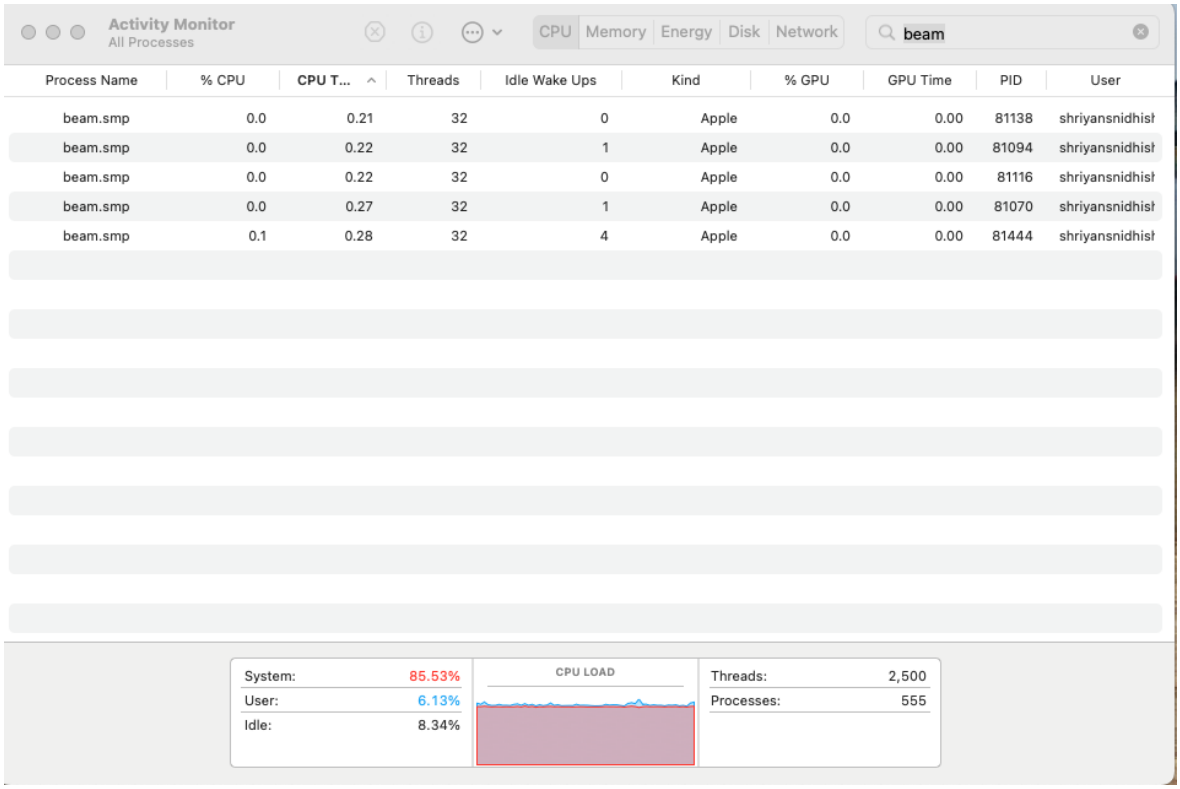


Fig 7: - Activity monitor of machine 1 with 1 boss and 4 workers node before mining.

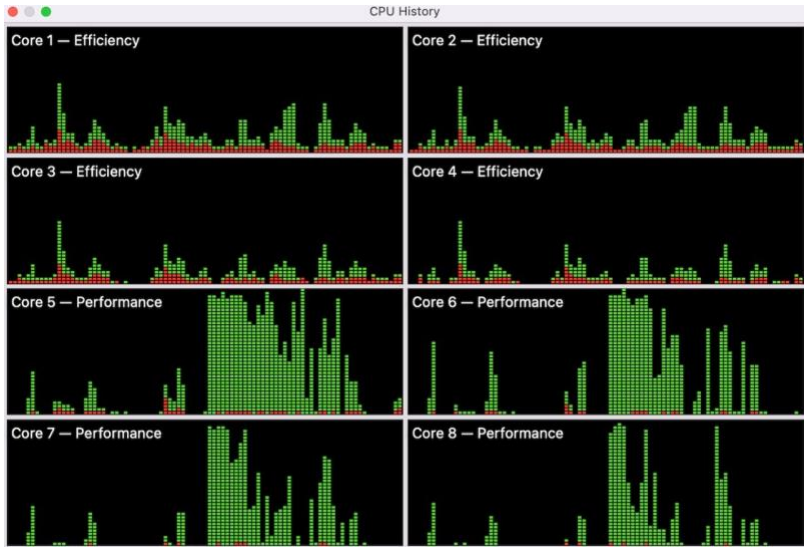


Fig 8: - CPU usage of machine 1 before mining.

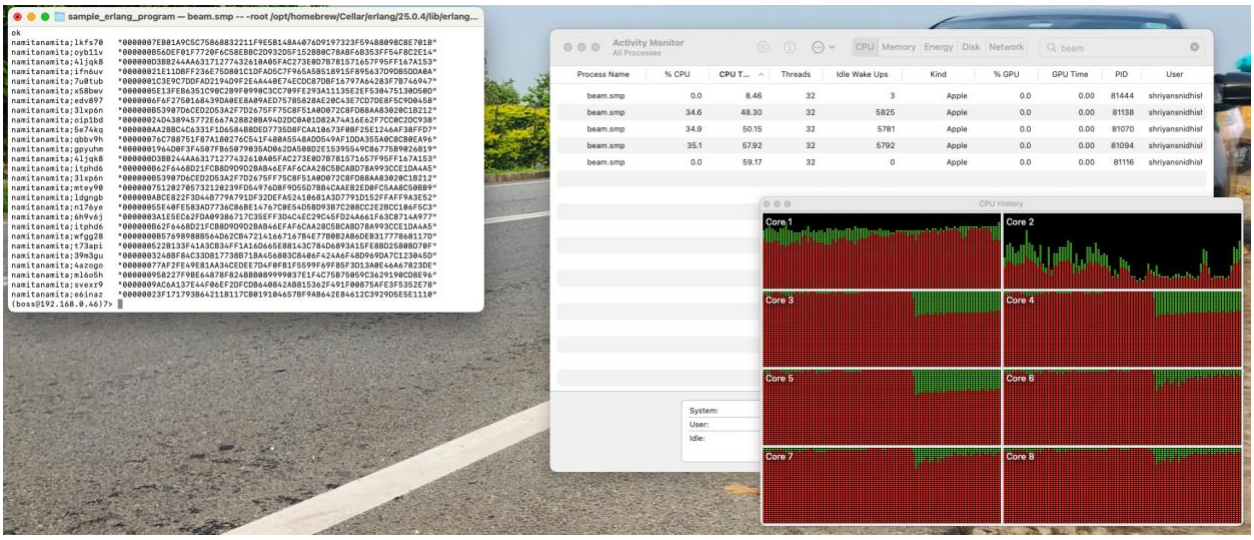


Fig 9: - Activity monitor and CPU usage of machine 1 with 1 boss and 4 workers node while mining.

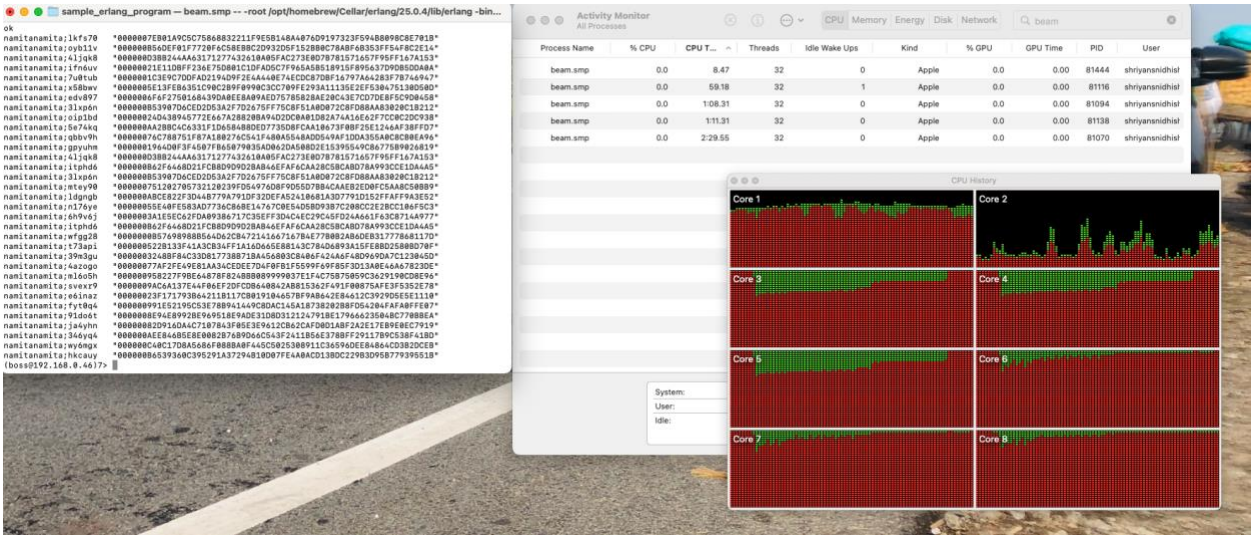


Fig 10: - Activity monitor and CPU usage of machine 1 with 1 boss and 4 workers node after mining.

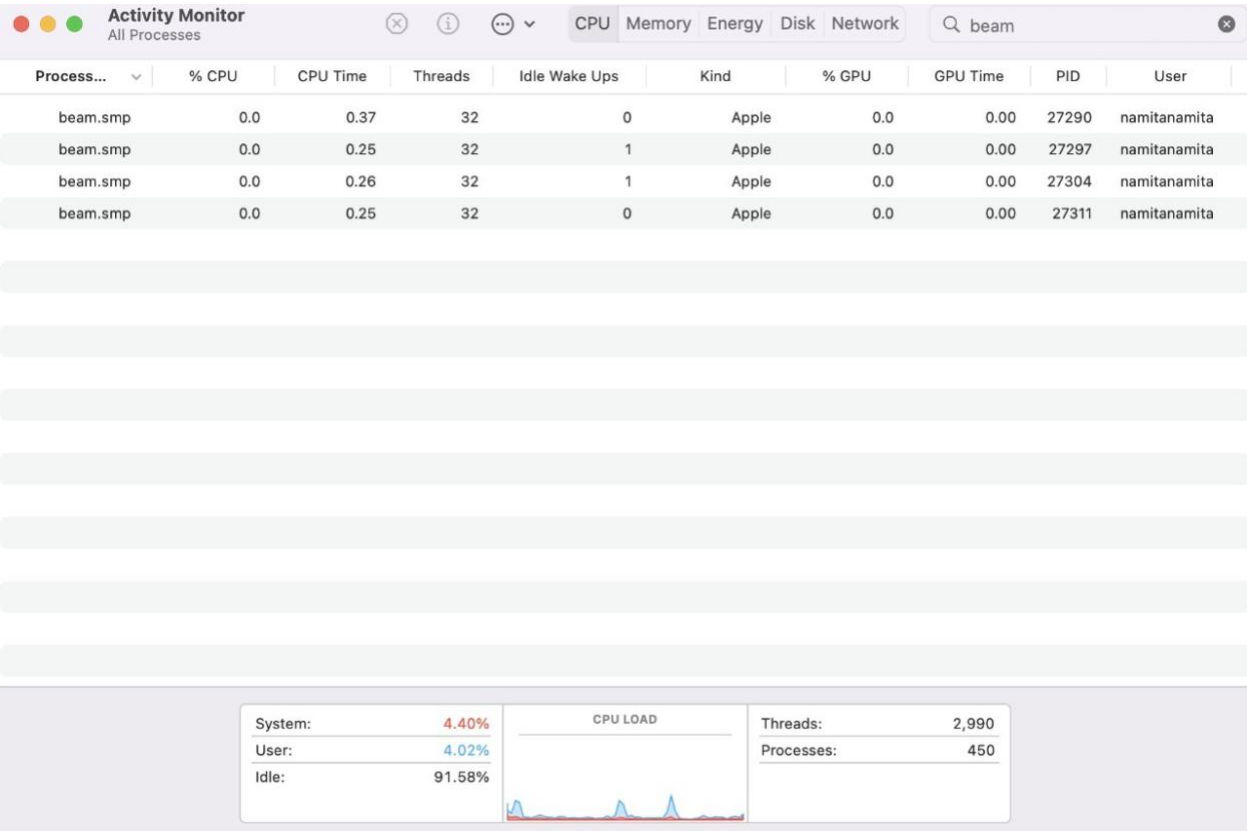


Fig 11: - Activity monitor of machine 2 with 4 workers node before mining.

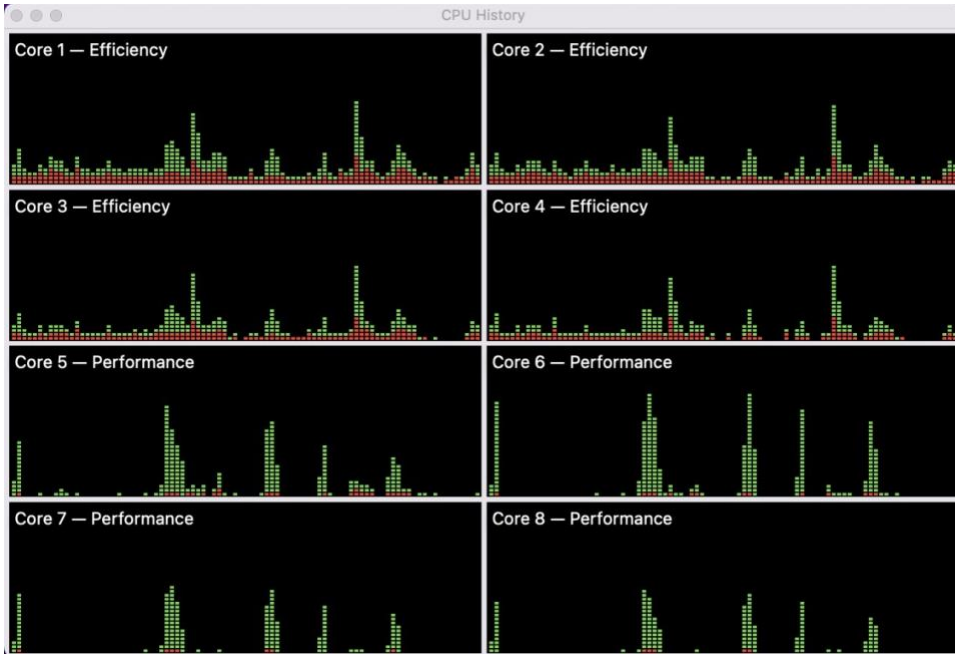


Fig 12: - CPU usage of machine 2 before mining.

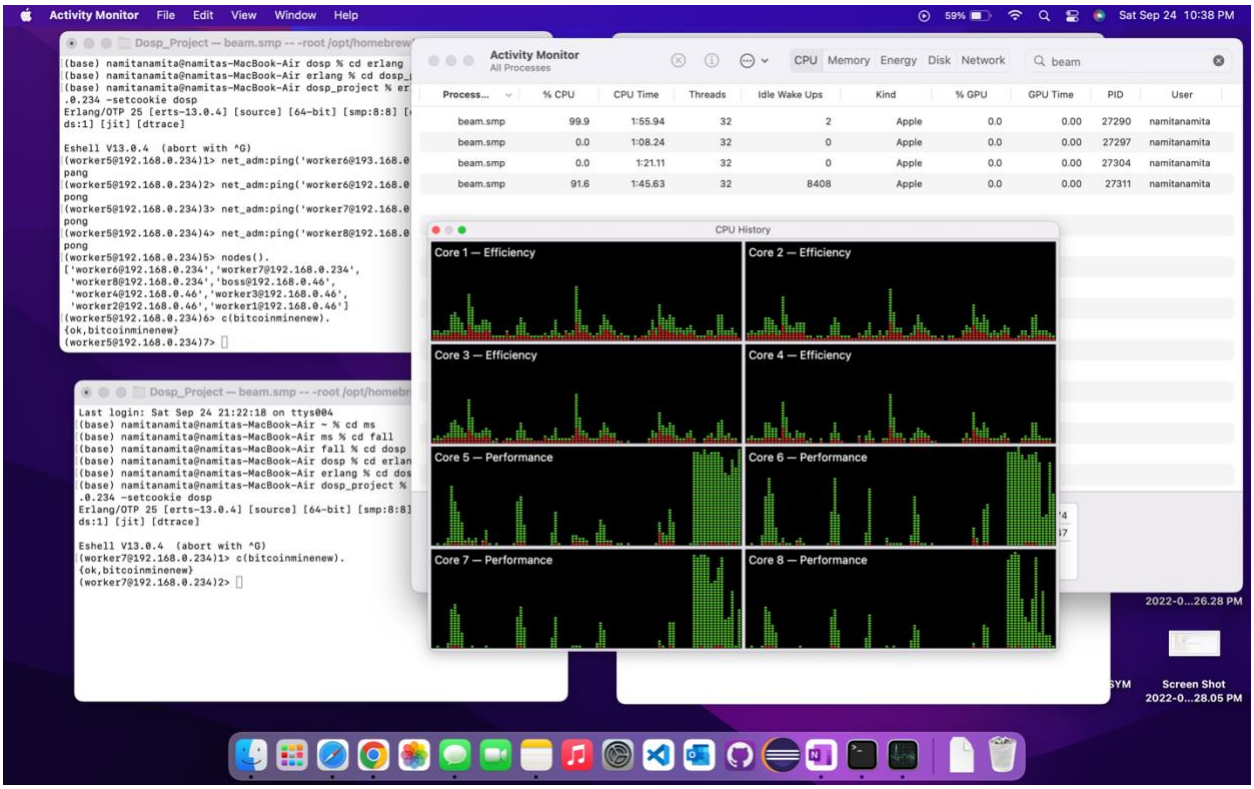


Fig 13: - Activity monitor and CPU usage of machine 2 with 4 workers node while mining.

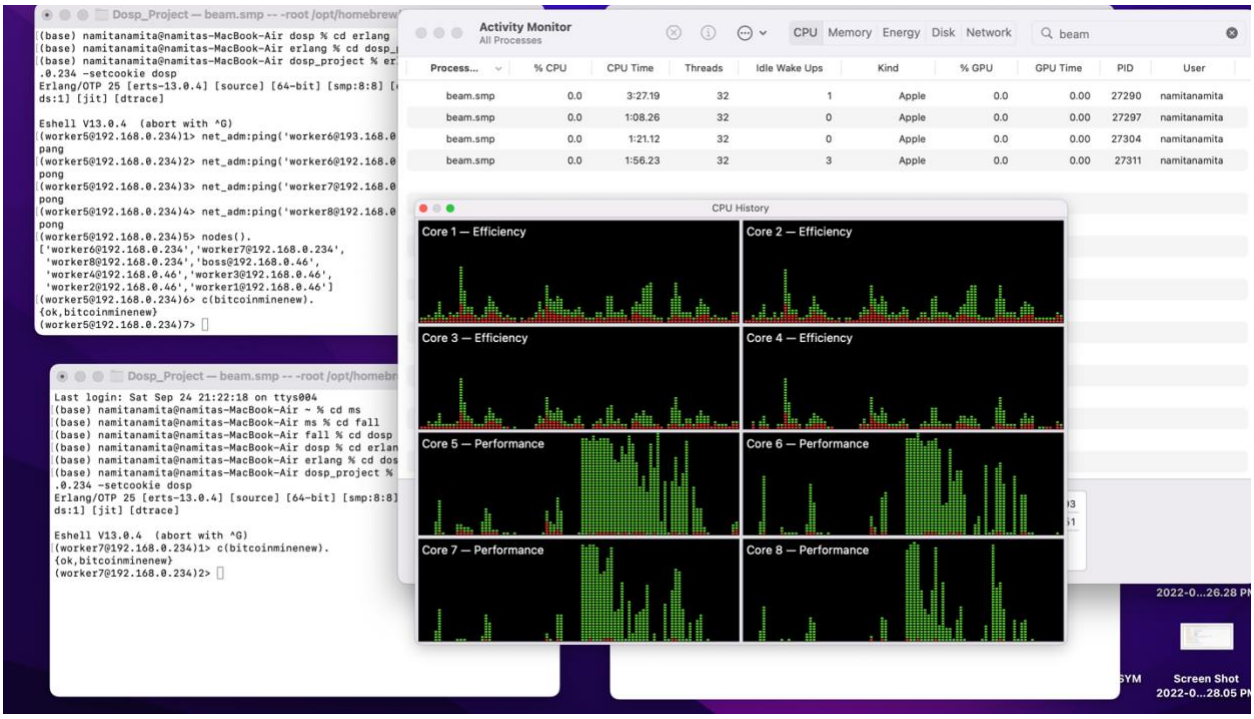


Fig 13: - Activity monitor and CPU usage of machine 2 with 4 workers node after mining.

Output analysis

No of leading zeros (K)	No of workers used	No of Strings per worker	Size of work unit (total strings/no of workers)	Running time	Coin with most 0s	Largest no of machines used
4	8	4	32/8 = **4**	CPU time = 5.2 Real time = 1.13 Ratio = CPU/Real = **4.60**	5	2
	4	8	32/4 = **8**	CPU time: - 2.4 Real time = 0.68 CPU/Real = **3.52**	5	2
6	8	4	32/8 = **4**	CPU time: - 13.8 Real time = 6.03 CPU/Real = **2.29**	7	2

Used machine Configurations: -

- Machine 1: - MacBook Pro 14inch 2021
    - RAM – 16gb
    - Processor – M1 Pro
    - SSD – 512gb
    - Cores – 8
- Machine 2: - MacBook Air 2020
    - RAM – 16gb
    - Processor – M1
    - SSD – 256gb
    - Cores - 8