Distributed Operating Systems (COP 5615)
Project 1

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Outline:

We have implemented distributed system model using AKKA actor models and F# to mine bitcoins. We are using various actors to generate random strings, hash the strings using a SHA256 algorithm, and to mine the coins depending on the input. We are using two different systems namely Client and Server systems. The Client system calls the server system and displays the results obtained both from Client and server actors. The worker actors from both Client and server systems concurrently keep mining the bitcoins.

System 1: Client.fsx

Implementation:

- The client system spawns the mainActor and takes the input from the terminal.
- The input here is the number of leading 0's for the bitcoin.
- The boss actor splits the tasks evenly and allocates them to the ServerMainActor of the remote machine boss and to the worker actors in the client system.
- The tasks allocated to the ServerMainActor of the remote machine assigns them to the child actors of the server system.

Steps to compile and run:

1. Extract the zip file – unzip project1.zip
2. For single system implementation: run - dotnet fsi Client_single.fsx 2
3. For Two-system implementation: run - dotnet fsi Client.fsx 2 (after running the second system)

System 2: Server.fsx (Remote machine)

Implementation:

- It spawns the ServerMainActor and receives the tasks assigned by the Client system
- The child actors of the Server system send the coins mined to the ServerMainActor, which in turn send them to the Client to display in the result.
- The input for the Server.fsx is the ip address of the Client system.

Steps to compile and run:

1. Extract the zip file – unzip project1.zip
2. First start system 2 using: (Server Machine) dotnet fsi Server.fsx "10.20.108.1"
3. Then start system 1 using: (Client Machine) dotnet fsi Client.fsx 2

I. Size of the Work unit:

- The actor workers receive the request from the boss actors to mine the coins. We take the number of actors to be equal to the number of processors. We obtained the best performance for the work unit of the same number of actors as the processors.

II. Result Of the Running Program for input 4:

- The result of the code to find the bitcoin with 4 leading 0's is as follows:

```
PROBLEMS  9    OUTPUT    DEBUG CONSOLE    TERMINAL

coin found in remote000034ED9EE595881E41910C3690A4A148A4E6051895E641F0CC81E49B596876
done
PS C:\Users\racha\FirstIonideProject> dotnet fsi rastr.fsx 4
Real: 00:00:00.000, CPU: 00:00:00.000, GC gen0: 0, gen1: 0, gen2: 0
[DEBUG][9/25/2021 12:06:05 AM][Thread 0001][EventStream] StandardOutLogger started
[DEBUG][9/25/2021 12:06:05 AM][Thread 0001][EventStream(rem)] Logger log1-DefaultLogger [DefaultLogger] started
[DEBUG][9/25/2021 12:06:05 AM][Thread 0001][EventStream(rem)] StandardOutLogger being removed
in info ---------------------------------------------------------
1
coin found in client system rmarri8HivFbWf
hash of coin 00007A09B768233764982214AB04923421451A382E9C203CB6719F98733A614C
[DEBUG][9/25/2021 12:09:13 AM][Thread 0012][EventStream] Shutting down: StandardOutLogger started
[DEBUG][9/25/2021 12:09:13 AM][Thread 0012][EventStream] All default loggers stopped
Real: 00:03:08.358, CPU: 00:03:48.078, GC gen0: 557, gen1: 98, gen2: 3
PS C:\Users\racha\FirstIonideProject> dotnet fsi rastr.fsx 4
```

lll. Running Time & Ratio of CPU time to Real time:
  - CPU time: 00:00:03.781
  - Real time: 00:00:01.425
  - Ratio: CPU time/ Real time = 2.6533

```
PROBLEMS  9    OUTPUT    DEBUG CONSOLE    TERMINAL                                                          powershell  + ∨

Real: 00:00:00.000, CPU: 00:00:00.015, GC gen0: 0, gen1: 0, gen2: 0
[DEBUG][9/25/2021 1:13:50 AM][Thread 0001][EventStream] StandardOutLogger started
[DEBUG][9/25/2021 1:13:50 AM][Thread 0001][EventStream(client)] Logger log1-DefaultLogger [DefaultLogger] started
[DEBUG][9/25/2021 1:13:50 AM][Thread 0001][EventStream(client)] StandardOutLogger being removed
in info ---------------------------------------------------------
3
3
coin found in client system rmarrivKO8aauF 00BBA92282461B47EB31BCEA04B5C4FDDED3F876CC215936392E2F384C0EB1ABcoin found in client system 3
rmarriQriUvii1 00F71612BEA8C73E0C3E9FE2B2E178742000782BEDE4F4DD2F1535969EC74152

coin found in client system rmarriVQTEhBGV 004E780F3F682F22099512CDEFD8A01E3191E703793FFF663B062F1D516EB091
4
coin found in client system rmarriNFLKyaAA 001BDDA4F10AC2335B3DDD4D23DDEAC44624E0C1DFCBFC4EE3774F2473E64597
5
coin found in client system rmarriU5S2thDO 00E8D01648F0D54CD14BE8FA0702617742334DEE4D8D306E9A2F19BCB643A4AC
6
coin found in client system rmarriI36jfVQ0 007747F80A8A6E4A03075D1454FC235C4D1DEE4BCD60E5A45746372606D7EECC
7
coin found in client system rmarrivONLdov3 00E5E96F6C29F188EE16ECC678F3A5FD60E34F1EA1CBE2A0F87317D69B423420
8
coin found in client system rmarrioHdFQp3U 009AB6A64E2E248547713FF367C4A7E3046CAB9E64D7EFE65CB3DB67AD78096F
9
coin found in client system rmarrigsqbKkjd 0058D312E3BC5369CF6143772E4405B941C8B374F10A630249B4CBA16F4F2083
10
coin found in client system rmarri0ohC3biJ 001B61FA6957D4829FCAFA885281E98A293A39981CBD2FE699FF9E8D4AF92274
11
coin found in client system rmarriV2eNUwI0 00B062044674416BD9E34ADC768E65E6C72EBADA2EE3A9EFAE8B65A4CFF7DB1C
[DEBUG][9/25/2021 1:13:51 AM][Thread 0015][EventStream] Shutting down: StandardOutLogger started
[DEBUG][9/25/2021 1:13:51 AM][Thread 0015][EventStream] All default loggers stopped
Real: 00:00:01.425, CPU: 00:00:03.781, GC gen0: 54, gen1: 8, gen2: 0
```

lV. Bitcoin with most 0's managed to find:

- The bitcoin with highest number of leading 0's that we managed to find is the coin with 5 leading
  0's.

```
Real: 00:00:00.000, CPU: 00:00:00.000, GC gen0: 0, gen1: 0, gen2: 0

single.fsx(104,62): warning FS0044: This construct is deprecated. Use RoundRobinGroup constructor with IEnumerable<string> parameter [1.1.0]

[DEBUG][9/25/2021 3:16:37 AM][Thread 0001][EventStream] StandardOutLogger started
[DEBUG][9/25/2021 3:16:37 AM][Thread 0001][EventStream(Coins)] Logger log1-DefaultLogger [DefaultLogger] started
[DEBUG][9/25/2021 3:16:37 AM][Thread 0001][EventStream(Coins)] StandardOutLogger being removed
From Sys 1 :: rmarrihGdvqM2i    0000097065FEE4103EF06A4BF01A8D59FA56D2A7549FB6BAE57404C824078BE8
From Sys 1 :: rmarriImt@R2rK    000008E655CAE080F6843F886DD7FA194C7C0BE5F6F9F9730DF62ED1E57E4335
[DEBUG][9/25/2021 3:17:38 AM][Thread 0016][EventStream] Shutting down: StandardOutLogger started
[DEBUG][9/25/2021 3:17:38 AM][Thread 0016][EventStream] All default loggers stopped
Real: 00:01:00.510, CPU: 00:02:32.875, GC gen0: 2482, gen1: 558, gen2: 8
```

V. Highest Number of Machines working parallelly:

- Because of the lack of systems, we were only able to run the programs on two machines. But, based on the statistics of the performance we obtained, we are sure that it can run on more than two server machines with one client machine.