

COP5615 Fall 2022 Project 1: Bitcoin Mining

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Input

The input to the server program is an integer value “K” that is passed as an argument while running the server. This “K” is the number of leading zeros to be present in the output we get after the hash. Every hashed output for our given input, having K number of leading zeros is considered a *bitcoin*.

The input to the client program is the IP address of the server that communicates with the client to seek help in bitcoin mining.

Output

When an input “K” (the number of leading zeros in the output coin) is given, the server program starts and gradually accommodates the client to work on mining. The final output is the randomly generated Input string containing our gatorlink name with the hashed coin with K leading zeros.

How To Run

Run Server: `server:start(< Number of leading zeros >).`

Run Client: `client:start(< IP Address of server >).`

Workflow:

1. Compile the server and client programs using:
 `c(server).`
 `c(client).`
2. Register two nodes on two different machines using `erl -name server@<node-name>` and `erl -name client`.

```
(server@10.20.123.40)1> erl -name server@10.20.123.40
C:\Users\venka\OneDrive\Desktop>erl -name server@10.20.123.40
INFO REPORT      24-Sep-2022:12:41:33 207000
```

3. Provide the input K to the server as shown below.

```
Eshell V13.0.4 (abort with ^G)
(server@10.20.123.40)1> server:start(4).
```

- On providing the input K to the server, the server spawns workers and delegates tasks to mine bitcoins.
- Parallely, on a different machine, a client is started with server's IP address, which spawns its own workers and delegates mining tasks.
- Once, the client workers find bitcoins with K leading zeros, these coins are then sent to the server on the established server-client connection.

```
(client@Venkat)1> client:start("10.20.123.40").
true
```

- The output displays the combination of Input string and the coins mined with K leading zeros.

```
server@Venkat)2> server:start(4).
true
server@Venkat)3>
vpamarchy;74hadg15 0000ee06b6a36eee8569521288b14fd8bdf0f5a443cbbbd95212c3a1ef278e0d(server@Venkat)3>
vpamarchy;8hiwitznl2 0000d8883ed1568e07f91d36ed17ba444f220d59cfc3b750554a6ae7aa6daea2(server@Venkat)3>
vpamarchy;hw4x 0000615d8d40626eb2d21160919b52bfa543c6963ea38ae65834d0d603db8d97(server@Venkat)3>
vpamarchy;noq1k6 000072793e829925805ab84f9d159c7bd529319132c229f737a51aaa4213ac40(server@Venkat)3>
vpamarchy;ooze3j3o0 0000b565fd3df280e460174def6f37fb7f87e096fe807262d73c941edfc63c2e(server@Venkat)3>
vpamarchy;kxqhd 00002a881031882d3c74b00a3345b60a3552328fe90d4d8b5237d29e84da100a(server@Venkat)3>
vpamarchy;xjo 0000256c9709cccd920592d1724a8c4b3629b98c9e2d69173bc2f8874d766636(server@Venkat)3>
vpamarchy;xjo 0000256c9709cccd920592d1724a8c4b3629b98c9e2d69173bc2f8874d766636(server@Venkat)3>
vpamarchy;wgq4yrto6 0000b0d4a1382f28b326ab0a4a6b2a43a6bb86ae2bdfe12e3102baa12866f5cc(server@Venkat)3>
vpamarchy;w3mlkcch82 000039b0b53de44b8e295da52dd0989822f818419634a201b39cc0cc728878b8(server@Venkat)3>
vpamarchy;hkgpbh 0000b2f10332ea2a6ed6d48cd91d3a4be780d5b66921a3c0fe4b8071573acf72(server@Venkat)3>
vpamarchy;gi0u3e0w 000078c63b436470a05a68183cb9d26fee8841a839d87bfe0f4d74008ba7daf8(server@Venkat)3>
vpamarchy;wao8an17s 000058986a08de02f8c7d171a6a88e455e100a1ef5fb01108e5f0b5284ce28e3(server@Venkat)3>
vpamarchy;2eays 0000cb9bf13c8bd7135c482564b5970e0493c3c1a26381ca5d2b4c482e016e4d(server@Venkat)3>
vpamarchy;zkocaa 00002b344a99a8eab1a420ec386243058cf49e60374cce7e819b985eeee1d472(server@Venkat)3>
vpamarchy;fwxdsv 000048f003d3c40cef0ee7bcb4152408cfed8db7e03489b8f40c7946a8d3d59c(server@Venkat)3>
vpamarchy;ez4dwdbnb 0000045ab13ac46fff27f503546d282d136602a27c422e3ac1dc045e5cddb491(server@Venkat)3>
```

- To measure the performance, we temporarily introduced the erlang statistics function to measure CPU time and Real time.

The result of running program for 4 zeros: Input leading zeros: 4, fixed prefix GatorLink ID

vpamarchy;

```
server@Venkat)2> server:start(4).
true
server@Venkat)3>
vpamarchy;74hadg15 0000ee06b6a36eee8569521288b14fd8bdf0f5a443cbbbd95212c3a1ef278e0d(server@Venkat)3>
vpamarchy;8hiwitznl2 0000d8883ed1568e07f91d36ed17ba444f220d59cfc3b750554a6ae7aa6daea2(server@Venkat)3>
vpamarchy;hw4x 0000615d8d40626eb2d21160919b52bfa543c6963ea38ae65834d0d603db8d97(server@Venkat)3>
vpamarchy;noq1k6 000072793e829925805ab84f9d159c7bd529319132c229f737a51aaa4213ac40(server@Venkat)3>
vpamarchy;ooze3j3o0 0000b565fd3df280e460174def6f37fb7f87e096fe807262d73c941edfc63c2e(server@Venkat)3>
vpamarchy;kxqhd 00002a881031882d3c74b00a3345b60a3552328fe90d4d8b5237d29e84da100a(server@Venkat)3>
vpamarchy;xjo 0000256c9709cccd920592d1724a8c4b3629b98c9e2d69173bc2f8874d766636(server@Venkat)3>
vpamarchy;xjo 0000256c9709cccd920592d1724a8c4b3629b98c9e2d69173bc2f8874d766636(server@Venkat)3>
vpamarchy;wgq4yrto6 0000b0d4a1382f28b326ab0a4a6b2a43a6bb86ae2bdfe12e3102baa12866f5cc(server@Venkat)3>
vpamarchy;w3mlkcch82 000039b0b53de44b8e295da52dd0989822f818419634a201b39cc0cc728878b8(server@Venkat)3>
vpamarchy;hkgpbh 0000b2f10332ea2a6ed6d48cd91d3a4be780d5b66921a3c0fe4b8071573acf72(server@Venkat)3>
vpamarchy;gi0u3e0w 000078c63b436470a05a68183cb9d26fee8841a839d87bfe0f4d74008ba7daf8(server@Venkat)3>
vpamarchy;wao8an17s 000058986a08de02f8c7d171a6a88e455e100a1ef5fb01108e5f0b5284ce28e3(server@Venkat)3>
vpamarchy;2eays 0000cb9bf13c8bd7135c482564b5970e0493c3c1a26381ca5d2b4c482e016e4d(server@Venkat)3>
vpamarchy;zkocaa 00002b344a99a8eab1a420ec386243058cf49e60374cce7e819b985eeee1d472(server@Venkat)3>
vpamarchy;fwxdsv 000048f003d3c40cef0ee7bcb4152408cfed8db7e03489b8f40c7946a8d3d59c(server@Venkat)3>
vpamarchy;ez4dwdbnb 0000045ab13ac46fff27f503546d282d136602a27c422e3ac1dc045e5cddb491(server@Venkat)3>
```

Size of work unit giving the best performance

A single server without any clients connected: 100 actors

For multiple machines : 25 actors for an 8 core server machine based on trial-error. For any other combination, the CPU gets to its saturation and fails.

We are generating random strings in each worker and hence making sure there is very low probability of repeated input strings and hence no repeated bitcoins.

The running time and real time for above program

```
(server@Venkat)2> server:start(4).
Initial cpu time: {1031,563}
Initial real time: {20070,16792}true
(server@Venkat)3>
vpamarchy:ck7tkidh 00001de7face00bef73b3309f3424d33175961019e14ee0fb388f965d75ed478(server@Venkat)3>
vpamarchy:s4n8d8bj 000018417d4f8c2589e1969ba780998d7211fcb9ca004e103a9c90c8f84426ae(server@Venkat)3>
vpamarchy:703tffixt8 00006bdd2c3f8712ad5282b43257e3e0224a35f75bd9daede6459854165a3e27c(server@Venkat)3>
vpamarchy:xjo 0000256c9709cccd920592d1724a8c4b3629b98c9e2d69173bc2f8874d766636(server@Venkat)3>
vpamarchy:qrubr0 00004794ecf2848b06c0ae800182d9bfb35c0093ff4fb8e4ca7521e34ec6c279(server@Venkat)3>
vpamarchy:63aump 0000cb47765c371ffc54a35cd6abfe9d56b59f36206872328884dd182ca6d52(server@Venkat)3>
vpamarchy:ogct1 00000eb6a15adab2968ad16893225ac9481b31eb9ca31f6c383b4218738947a8(server@Venkat)3>
vpamarchy:xjo 0000256c9709cccd920592d1724a8c4b3629b98c9e2d69173bc2f8874d766636(server@Venkat)3>
vpamarchy:ptti53aa0 0000c503447e85883929f7066068c570730ef081fbbd037dddb0ee544d5752ab(server@Venkat)3>
vpamarchy:iy15txeuu 0000f35a7cf31b9a4029dec7781b27b5d73d118af6af48be05f6131da828ae0(server@Venkat)3>
vpamarchy:xjo 0000256c9709cccd920592d1724a8c4b3629b98c9e2d69173bc2f8874d766636(server@Venkat)3>
vpamarchy:gbfp68 0000bd01c58c7acc95c5bea7f02a8a7c885ae5b39c13711d4e73914e4a666cc7(server@Venkat)3>
vpamarchy:chugdh 00001c01a80ff9c671cb2e232cf7355091c947962dc87ec9b3fa75ddba29608(server@Venkat)3>
vpamarchy:f4ao7fut 0000e0440c2add53872da2e0ffcc624e2233ce47efc0d092ad54a48172e3f832c(server@Venkat)3>
vpamarchy:k5v3qh63j 00005c698ca9ae9195401708dd4852268aef91ec49bda5bed0f20bea5ac5b492(server@Venkat)3>
vpamarchy:xjo 0000256c9709cccd920592d1724a8c4b3629b98c9e2d69173bc2f8874d766636(server@Venkat)3>
vpamarchy:75d2kfhvun 0000a07b0a43e37530fae39275ee9f9924ddd2fe93155d036c87953d6852ec9(server@Venkat)3>
vpamarchy:xd040dvlzn 0000eccecb6ba2565a88a91d4ca32c7bb6a1ee0325ba682209a1a9efb84cc433(server@Venkat)3>
vpamarchy:a7mz6pc8 000039531909afa1deaafdca90427aa0a3cc92b24cde2572fc953242498eb290e(server@Venkat)3>
vpamarchy:dc4d41ql 0000107ff93c551d34311df73fad615ef20de022bcf803d24ae96981479c802b(server@Venkat)3>
vpamarchy:bfz21 0000a17bd7711ea4cd3305c05c043db3ea42b0dd17a8b99194c8b95ff86c0e7d(server@Venkat)3>
vpamarchy:xjo 0000256c9709cccd920592d1724a8c4b3629b98c9e2d69173bc2f8874d766636(server@Venkat)3>
vpamarchy:xoi12meyrp 0000e818007269d9bda9d10ff3c2b64420d001043d06eca430219d223a90efd1(server@Venkat)3>
vpamarchy:wi1lgw 000076076340056f0ecc6dbcdcd4f5bfeef24ab8dc828b975e5926834188(server@Venkat)3>
vpamarchy:lk7ck 000005436b9d8f452c2ab3e3d7959de7d8fa180dd7940b0dae1dd8dd37531ae3(server@Venkat)3>
vpamarchy:xjo 0000256c9709cccd920592d1724a8c4b3629b98c9e2d69173bc2f8874d766636(server@Venkat)3>
vpamarchy:7cpt1dlev6 0000ca558cbb3706c3372d7da7fb38b85b7a95895e8cbb3a00a63d7bb862ed44(server@Venkat)3>
vpamarchy:6ivtrp3 0000facc88b3b4812128148f1c5b229cd39ed4f94b7ac82d4aed0ba47324801(server@Venkat)3>
vpamarchy:ft17w 0000f40b4e816851accfc5b95eb7144149a0d3aba8e7932fb3334835ae87de(server@Venkat)3>
vpamarchy:vzso 0000ebea4b32e6963e438d277802e1b164b01076aa2be90d9a658fb3e056c9ca(server@Venkat)3>
vpamarchy:0ane 0000d75cec1e4f5aae9daecb940f4c687267a08ebf3140963189bf67d997f783(server@Venkat)3>
vpamarchy:vzso 0000eabea4b32e6963e438d277802e1b164b01076aa2be90d9a658fb3e056c9ca(server@Venkat)3>
vpamarchy:5evaglrnvk 0000205b4e57562de7c9f1c8254da91a84883aad0a7b1f489bf30ee2cd87bf4(server@Venkat)3>
vpamarchy:ibnljn8fj 0000c8979bb385732752820e592983c8ace9126503e6b1d2affb7a4f658e1dfe(server@Venkat)3>
vpamarchy:u54j4xb18 00000031391edeb1eabc367f8741c4b5a93605cd376f1d9ca7b826a64cb35b5(server@Venkat)3>
vpamarchy:8fyk 0000ce928a234edf8a9b5afb29a393edb9f4ea018c4dd83373c5a54214cf9f07(server@Venkat)3>
vpamarchy:we44sa0as6 00004712bca4c6786f469ad45c5a0f2498728ad408b0cf860fd7eb67cb6532ce(server@Venkat)3>
vpamarchy:uqmnzwo76 0000e83e2fc034d87fb73a42226dcb571dd45473fc73c0a2d9d65f7dccc2c8bf7(server@Venkat)3>
vpamarchy:vwvds27nlm 000096c13c7f76fc9f386a49c5c706732cc7841c6b5759748572a65d9f4a73e4(server@Venkat)3>
vpamarchy:xjo 0000256c9709cccd920592d1724a8c4b3629b98c9e2d69173bc2f8874d766636(server@Venkat)3>
vpamarchy:xjo 0000256c9709cccd920592d1724a8c4b3629b98c9e2d69173bc2f8874d766636(server@Venkat)3>
vpamarchy:ewg12bq 00008dcf905e3ed33011810419f824b83521bd71ab95ac7f177ba3a0de84b63d(server@Venkat)3>
vpamarchy:6cp8coa7 00007bcc137016e5a55844383199383be554d09f5dcdc8876064552345ff3040(server@Venkat)3>
vpamarchy:xjo 0000256c9709cccd920592d1724a8c4b3629b98c9e2d69173bc2f8874d766636(server@Venkat)3>
```

```

vpamarchy;vzso 0000ebea4b32e6963e438d277802e1b164b01076aa2be90d9a658fb3e056c9ca(server@Venkat)3>
vpamarchy;0ane 0000d75cec1e4f5aae9daecb940f4c687267a08ebf3140963189bf67d997f783(server@Venkat)3>
vpamarchy;vzso 0000ebea4b32e6963e438d277802e1b164b01076aa2be90d9a658fb3e056c9ca(server@Venkat)3>
vpamarchy;5evaglrnvk 0000205b4e57562de7c9f1c8254da91a84883aad0a7b1f489bf30ee2cd87bf4(server@Venkat)3>
vpamarchy;ibnljn8fj 0000c8979bb38573252820e592983c8ace9126503e6b1d2affb7a4f658e1dfe(server@Venkat)3>
vpamarchy;u54j4xb18 00000031391edeb1eabc367f8741c4b5a93605cd376f1d9ca7b826a64cb635b5(server@Venkat)3>
vpamarchy;8fyk 0000ce928a234edf8a9b5afb92a393edb9f4ea018c4dd83373c5a54214cf9f07(server@Venkat)3>
vpamarchy;we44sa0as6 00004712bca4c6786f469ad45c5a0f2498728ad408b0cf860fd7eb67cb6532ce(server@Venkat)3>
vpamarchy;uqmrnz0w76 0000e83e2fc034d87fb73a42226dcb571dd45473fc73c0a2d9d65f7dcc2c8bf7(server@Venkat)3>
vpamarchy;wwds27nlm 000096c13c7f76fc9f386a49c5c706732cc7841c6b5759748572a65d9f4a73e4(server@Venkat)3>
vpamarchy;xjo 0000256c9709cccd920592d1724a8c4b3629b98c9e2d69173bc2f8874d766636(server@Venkat)3>
vpamarchy;xjo 0000256c9709cccd920592d1724a8c4b3629b98c9e2d69173bc2f8874d766636(server@Venkat)3>
vpamarchy;ewg12bq 00008dcf905e3ed33011810419f824b83521bd71ab95ac7f177ba3a0de84b63d(server@Venkat)3>
vpamarchy;6cp8coa7 00007bcc137016e5a55844383199383be554d09f5dc8876064552345ff3040(server@Venkat)3>
vpamarchy;xjo 0000256c9709cccd920592d1724a8c4b3629b98c9e2d69173bc2f8874d766636(server@Venkat)3>
vpamarchy;tml6upweo 000001603876ac9497e8c0a04e96db996606cbcf30fd3d76bae516d05665912(server@Venkat)3>
vpamarchy;pxliig7j 000052d8e943615c8350de8c0924a1abab425072ff2e2f0a94647751d0fa1b43(server@Venkat)3>
vpamarchy;bybr8vjx 00004fd28d122f7010b71b26e1b1041109127e0f46dec03f37e41c7bc5d84064(server@Venkat)3>
vpamarchy;xjo 0000256c9709cccd920592d1724a8c4b3629b98c9e2d69173bc2f8874d766636(server@Venkat)3>
vpamarchy;2tumu6g 0000824cd8b85a5c724eb2872ac08716c2767e4ed4022fac959e6e29c6d3a3ac(server@Venkat)3>
vpamarchy;xjo 0000256c9709cccd920592d1724a8c4b3629b98c9e2d69173bc2f8874d766636(server@Venkat)3>
Final cpu time: {123390,100515}(server@Venkat)3>
Final real time: {51425,28137}(server@Venkat)3>

```

From the above screenshots, the difference between final and initial cpu time = $123390 - 1031 = 122359\text{ms}$

The difference between final and initial real time = $51425 - 20070 = 31355\text{ms}$

Therefore, ratio of cpu/real time = $122359/31355 = 3.90$ seconds

The coin with the most 0s program managed to find

No of zeros : 7 run on Windows 16GB RAM, 8 Core machine

```

[INFO] [9/24/2021 12:55:44 AM] [Thread 0001] [remoting (akka://client)] Starting remoting
[INFO] [9/24/2021 12:55:44 AM] [Thread 0001] [remoting (akka://client)] Remoting started; listening
addresses : [akka.tcp://client@localhost:2553]
[INFO] [9/24/2021 12:55:44 AM] [Thread 0001] [remoting (akka://client)] Remoting now listens on add
: [akka.tcp://client@localhost:2553]
I GOT WORK FROM THE BOSS

46432937#Qx1{<G| : 0000000E7B187250006A21D1FF5F82C43E6B2644B024F7ED489FF69D6B1A6D22
CPU time = 5285ms
Absolute time = 56979ms

```

The largest number of working machines you were able to run your code

No of machines: 4