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19BCE245

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# BlockChain Technology

## Practical 3

### Proof of Work

#### • Code :

```
import datetime
import hashlib
import random
import json
# import JSON
# from flask import jsonify

# def compute_hash(index, previous_hash, timestamp,
# data):
#     return hashlib.sha256((str(index) +
# str(previous_hash) + str(timestamp) +
# json.dumps(data)).encode('utf-8')).hexdigest()

def compute_hash(hash_data):
    return
hashlib.sha256(hash_data.encode('utf-8')).hexdigest()

def proof_of_work(hash_data, difficulty):
    nonce = 1
    if difficulty==1:
        difficulty = random.randint(1, 5)
    print('current difficulty level is :
',difficulty)
    while True:
        temp_hash =
compute_hash(hash_data+str(nonce))
        if temp_hash[:difficulty] == '0'*difficulty:
```

```

        break
        nonce +=1
    return temp_hash,nonce,difficulty

class Block:
    def __init__(self, index, data, previous_hash,
reward):
        self.index = index
        self.data = data
        self.previous_hash = previous_hash
        self.timestamp = str(datetime.datetime.now())
        hash_data = str(self.index) +
str(self.previous_hash) + str(self.timestamp) +
json.dumps(self.data)
        self.hash,self.nonce,self.difficulty =
proof_of_work(hash_data,-1)
        self.reward = reward

    def print_block_details(self):
        print(f'Details for block indexed at {self.index}
: ')

        print(f'\tData : {self.data}')
        print(f'\tTimeStamp : {self.timestamp}')
        print(f'\tHash : {self.hash}')
        print(f'\tPrevious Hash : {self.previous_hash}')
        print(f'\tReward : {self.reward}')
        print(f'\tNonce : {self.nonce}')
        print(f'\tDifficulty : {self.difficulty}')

class Blockchain:
    # chain = []
    def __init__(self, total_reward, partician):
        self.chain = []
        self.partician = partician
        self.total_reward = total_reward - partician
        genesis_block = Block(len(self.chain)
+1, 'Aayush\'s Blockchain!',0, self.partician)
        self.chain.append(genesis_block)

    def add_block(self, data):
        assigned_reward = 0
        if self.total_reward-self.partician>0:
            self.total_reward -= self.partician

```

```

        assigned_reward = self.partician
    elif self.total_reward>0:
        assigned_reward = self.total_reward
        self.total_reward = 0
    new_block = Block(len(self.chain)+1, data,
self.chain[-1].hash, assigned_reward)
    self.chain.append(new_block)

def get_previous_block(self):
    return self.chain[-1]

def get_specific_block(self,index):
    return self.chain[index]

def print_block(self, block):
    block.print_block_details()

def chain_validation(self):
    hash_data,_,__ =
proof_of_work(str(self.chain[0].index) +
str(self.chain[0].previous_hash) +
str(self.chain[0].timestamp) +
json.dumps(self.chain[0].data), self.chain[0].difficulty)
    if self.chain[0].hash != hash_data:
        return False
    print('\t> genesis block is validated.')
    for i in range(1,len(self.chain)):
        if self.chain[i].previous_hash !=
self.chain[i-1].hash:
            return False
        hash_data,_,__ =
proof_of_work(str(self.chain[i].index) +
str(self.chain[i].previous_hash) +
str(self.chain[i].timestamp) +
json.dumps(self.chain[i].data), self.chain[i].difficulty)
        if self.chain[i].hash != hash_data:
            return False
        if i != len(self.chain)-1 and
self.chain[i].hash != self.chain[i+1].previous_hash:
            return False
        print(f'\t> {i+1}th block is validated.')
    return True

```

```

if __name__ == "__main__":
    total_reward = int(input('Enter total reward you want
to assign your chain : '))
    partician = total_reward
    while partician>=total_reward:
        partician = int(input('Enter partician reward
value which will be assinged to each block : '))
        if partician>=total_reward:
            print('Partician value should be less then
reward value.')

    myBlockChain = Blockchain(total_reward, partician)

    while True:
        print("""MENU :
1. Add block
2. View Specific block
3. View Last block
4. Validate chain
5. Exit""")
        choice = int(input("Choice : "))
        # try:
        if choice==1:
            data = input('\t\tEnter data for the block :
')
            myBlockChain.add_block(data)
            print(f'Added block at index
{len(myBlockChain.chain)}')
        elif choice==2:
            index = int(input('\t\tEnter block index :
'))
            try:
myBlockChain.print_block(myBlockChain.get_specific_block(
index-1))
            except:
                print('# Invalid index entered!')
        elif choice==3:
myBlockChain.print_block(myBlockChain.get_previous_block(
))
        elif choice==4:

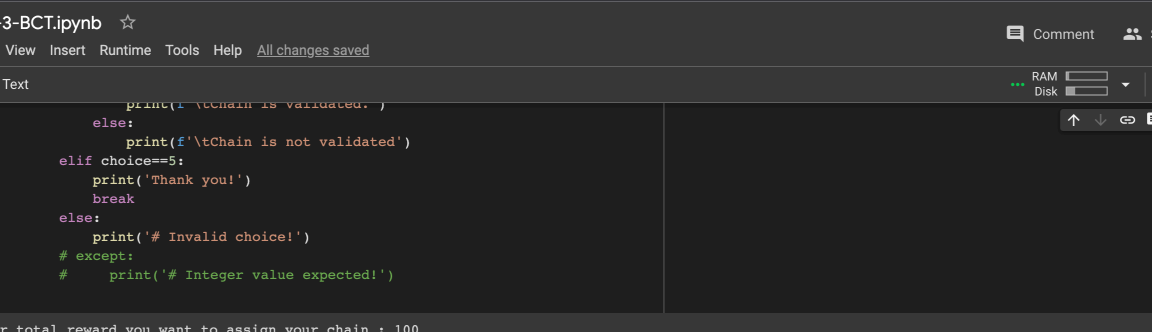
```

```

    if myBlockchain.chain_validation():
        print(f'\tChain is validated.')
    else:
        print(f'\tChain is not validated.')
elif choice==5:
    print('Thank you!')
    break
else:
    print('# Invalid choice!')
# except:
#     print('# Integer value expected!')

```

- **Output :**



```
34         print(f'\tChain is validated. ')
35     else:
36         print(f'\tChain is not validated')
37     elif choice==5:
38         print('Thank you!')
39         break
40     else:
41         print('# Invalid choice!')
42     # except:
43     #     print('# Integer value expected!')
44
45 ... Enter total reward you want to assign your chain : 100
46 Enter partician reward value which will be assigned to each block : 10
47 current difficulty level is : 2
48 MENU :
49     1. Add block
50     2. View Specific block
51     3. View Last block
52     4. Validate chain
53     5. Exit
54 Choice : 1
55
56         Enter data for the block : Aayush's BlockChain
57 current difficulty level is : 4
58 Added block at index 2
59 MENU :
60     1. Add block
61     2. View Specific block
62     3. View Last block
63     4. Validate chain
64     5. Exit
65 Choice : 1
66
67         Enter data for the block : My roll number is 19BCE245
68 current difficulty level is : 3
69 Added block at index 3
70 MENU :
71     1. Add block
72     2. View Specific block
73     3. View Last block
74     4. Validate chain
75     5. Exit
76 Choice : 1
77
78         Enter data for the block : My roll number is 19BCE245
79 current difficulty level is : 3
80 Added block at index 3
81 MENU :
82     1. Add block
83     2. View Specific block
84     3. View Last block
85     4. Validate chain
86     5. Exit
87 Choice : 1
88
89         Enter data for the block : My roll number is 19BCE245
90 current difficulty level is : 3
91 Added block at index 3
92 MENU :
93     1. Add block
94     2. View Specific block
95     3. View Last block
96     4. Validate chain
97     5. Exit
98 Choice : 1
99
100         Enter data for the block : My roll number is 19BCE245
101 current difficulty level is : 3
102 Added block at index 3
103 MENU :
104     1. Add block
105     2. View Specific block
106     3. View Last block
107     4. Validate chain
108     5. Exit
109 Choice : 1
110
111         Enter data for the block : My roll number is 19BCE245
112 current difficulty level is : 3
113 Added block at index 3
114 MENU :
115     1. Add block
116     2. View Specific block
117     3. View Last block
118     4. Validate chain
119     5. Exit
120 Choice : 1
121
122         Enter data for the block : My roll number is 19BCE245
123 current difficulty level is : 3
124 Added block at index 3
125 MENU :
126     1. Add block
127     2. View Specific block
128     3. View Last block
129     4. Validate chain
130     5. Exit
131 Choice : 1
132
133         Enter data for the block : My roll number is 19BCE245
134 current difficulty level is : 3
135 Added block at index 3
136 MENU :
137     1. Add block
138     2. View Specific block
139     3. View Last block
140     4. Validate chain
141     5. Exit
142 Choice : 1
143
144         Enter data for the block : My roll number is 19BCE245
145 current difficulty level is : 3
146 Added block at index 3
147 MENU :
148     1. Add block
149     2. View Specific block
150     3. View Last block
151     4. Validate chain
152     5. Exit
153 Choice : 1
154
155         Enter data for the block : My roll number is 19BCE245
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163     5. Exit
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172     3. View Last block
173     4. Validate chain
174     5. Exit
175 Choice : 1
176
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180 MENU :
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184     4. Validate chain
185     5. Exit
186 Choice : 1
187
188         Enter data for the block : My roll number is 19BCE245
189 current difficulty level is : 3
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191 MENU :
192     1. Add block
193     2. View Specific block
194     3. View Last block
195     4. Validate chain
196     5. Exit
197 Choice : 1
198
199         Enter data for the block : My roll number is 19BCE245
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202 MENU :
203     1. Add block
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206     4. Validate chain
207     5. Exit
208 Choice : 1
209
210         Enter data for the block : My roll number is 19BCE245
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213 MENU :
214     1. Add block
215     2. View Specific block
216     3. View Last block
217     4. Validate chain
218     5. Exit
219 Choice : 1
220
221         Enter data for the block : My roll number is 19BCE245
222 current difficulty level is : 3
223 Added block at index 3
224 MENU :
225     1. Add block
226     2. View Specific block
227     3. View Last block
228     4. Validate chain
229     5. Exit
230 Choice : 1
231
232         Enter data for the block : My roll number is 19BCE245
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234 Added block at index 3
235 MENU :
236     1. Add block
237     2. View Specific block
238     3. View Last block
239     4. Validate chain
240     5. Exit
241 Choice : 1
242
243         Enter data for the block : My roll number is 19BCE245
244 current difficulty level is : 3
245 Added block at index 3
246 MENU :
247     1. Add block
248     2. View Specific block
249     3. View Last block
250     4. Validate chain
251     5. Exit
252 Choice : 1
253
254         Enter data for the block : My roll number is 19BCE245
255 current difficulty level is : 3
256 Added block at index 3
257 MENU :
258     1. Add block
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260     3. View Last block
261     4. Validate chain
262     5. Exit
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264
265         Enter data for the block : My roll number is 19BCE245
266 current difficulty level is : 3
267 Added block at index 3
268 MENU :
269     1. Add block
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271     3. View Last block
272     4. Validate chain
273     5. Exit
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275
276         Enter data for the block : My roll number is 19BCE245
277 current difficulty level is : 3
278 Added block at index 3
279 MENU :
280     1. Add block
281     2. View Specific block
282     3. View Last block
283     4. Validate chain
284     5. Exit
285 Choice : 1
286
287         Enter data for the block : My roll number is 19BCE245
288 current difficulty level is : 3
289 Added block at index 3
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293     3. View Last block
294     4. Validate chain
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299 current difficulty level is : 3
300 Added block at index 3
301 MENU :
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303     2. View Specific block
304     3. View Last block
305     4. Validate chain
306     5. Exit
307 Choice : 1
308
309         Enter data for the block : My roll number is 19BCE245
310 current difficulty level is : 3
311 Added block at index 3
312 MENU :
313     1. Add block
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315     3. View Last block
316     4. Validate chain
317     5. Exit
318 Choice : 1
319
320         Enter data for the block : My roll number is 19BCE245
321 current difficulty level is : 3
322 Added block at index 3
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324     1. Add block
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326     3. View Last block
327     4. Validate chain
328     5. Exit
329 Choice : 1
330
331         Enter data for the block : My roll number is 19BCE245
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333 Added block at index 3
334 MENU :
335     1. Add block
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337     3. View Last block
338     4. Validate chain
339     5. Exit
340 Choice : 1
341
342         Enter data for the block : My roll number is 19BCE245
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344 Added block at index 3
345 MENU :
346     1. Add block
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348     3. View Last block
349     4. Validate chain
350     5. Exit
351 Choice : 1
352
353         Enter data for the block : My roll number is 19BCE245
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356 MENU :
357     1. Add block
358     2. View Specific block
359     3. View Last block
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361     5. Exit
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363
364         Enter data for the block : My roll number is 19BCE245
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368     1. Add block
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370     3. View Last block
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372     5. Exit
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375         Enter data for the block : My roll number is 19BCE245
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383     5. Exit
384 Choice : 1
385
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390     1. Add block
391     2. View Specific block
392     3. View Last block
393     4. Validate chain
394     5. Exit
395 Choice : 1
396
397         Enter data for the block : My roll number is 19BCE245
398 current difficulty level is : 3
399 Added block at index 3
400 MENU :
401     1. Add block
402     2. View Specific block
403     3. View Last block
404     4. Validate chain
405     5. Exit
406 Choice : 1
407
408         Enter data for the block : My roll number is 19BCE245
409 current difficulty level is : 3
410 Added block at index 3
411 MENU :
412     1. Add block
413     2. View Specific block
414     3. View Last block
415     4. Validate chain
416     5. Exit
417 Choice : 1
418
419         Enter data for the block : My roll number is 19BCE245
420 current difficulty level is : 3
421 Added block at index 3
422 MENU :
423     1.
```

**• Full output text :**

Enter total reward you want to assign your chain : 100  
Enter partician reward value which will be assinged to each  
block : 10

current difficulty level is : 2

MENU :

1. Add block
2. View Specific block
3. View Last block
4. Validate chain
5. Exit

Choice : 4

current difficulty level is : 2

> genesis block is validated.

Chain is validated.

MENU :

1. Add block
2. View Specific block
3. View Last block
4. Validate chain
5. Exit

Choice : 1

Enter data for the block : Aayush's BlockChain

current difficulty level is : 3

Added block at index 2

MENU :

1. Add block
2. View Specific block
3. View Last block
4. Validate chain
5. Exit

Choice : 1

Enter data for the block : My roll number is

19BCE245

current difficulty level is : 2

Added block at index 3

MENU :

1. Add block
2. View Specific block
3. View Last block
4. Validate chain
5. Exit

Choice : 3

Details for block indexed at 3 :

Data : My roll number is 19BCE245

TimeStamp : 2022-10-11 16:19:01.592967

Hash :

0011c6931286dc936956d9d0543933ec2cd0537c667c8f54af5355130a5e59  
55

Previous Hash :  
0005f950f7a42b592680cd11d94894ec713c6894819d1720af17c6011f8537  
93

Reward : 10  
Nonce : 175  
Difficulty : 2

MENU :

1. Add block
2. View Specific block
3. View Last block
4. Validate chain
5. Exit

Choice : 2

Enter block index : 2  
Details for block indexed at 2 :  
Data : Aayush's BlockChain  
TimeStamp : 2022-10-11 16:18:51.893747  
Hash :  
0005f950f7a42b592680cd11d94894ec713c6894819d1720af17c6011f8537  
93

Previous Hash :  
00b44e7051101ec8071492f121db6ae2810101ae879c17bbcaaf007b9cd4ef  
50

Reward : 10  
Nonce : 4922  
Difficulty : 3

MENU :

1. Add block
2. View Specific block
3. View Last block
4. Validate chain
5. Exit

Choice : 4

current difficulty level is : 2  
> genesis block is validated.  
current difficulty level is : 3  
> 2th block is validated.  
current difficulty level is : 2  
> 3th block is validated.  
Chain is validated.

MENU :

1. Add block
2. View Specific block
3. View Last block
4. Validate chain
5. Exit

Choice : 5

Thank you!

**• Learning Outcomes :**

From this practical, I learned about proof of work.

Proof of work (PoW) is a type of cryptographic proof in which one party (the prover) demonstrates to others (the verifiers) that a specific amount of computational effort has been expended. Verifiers can then confirm this expense with little effort on their part.

Here I generate difficulty level randomly and then generate suitable hash value based on that in proof of work. Also chain validation is performed accordingly.