A6_Exercises

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차 례

implementation basic (P. 4)

```python
import numpy as np
np.random.seed(1234)
MC_N = 10**3
x = np.random.uniform(0,1,MC_N)*2-1
y = np.random.uniform(0,1,MC_N)*2-1
t = np.sqrt(x**2+y**2)
pi_hat = 4*sum(t<=1)/MC_N
print(pi_hat)
```

```
## 3.06
```

implementation for (P. 5)

```python
import numpy as np
np.random.seed(1234)
MC_N = 10**6
count = 0
for MC_i in range(MC_N):
    x_i = np.random.uniform(0, 1) * 2 - 1
    y_i = np.random.uniform(0, 1) * 2 - 1
    t_i = np.sqrt(x_i**2+y_i**2)
    if t_i <=1:
        count = count+1
pi_hat = 4*count/MC_N
print(pi_hat)
```

```
## 3.140204
```

implementation time (P. 9)

```python
import numpy as np
from time import time
np.random.seed(1234)
beg_time = time()
old_est = 0
n = 1
MC_N = 10**6
while True:
    x_i = np.random.uniform(0, 1) * 2 - 1
```

```python
    y_i = np.random.uniform(0, 1) * 2 - 1
    t_i = np.sqrt(x_i**2+y_i**2)
    A_n = 4*(t_i<=1)
    new_est = ((n-1)/n)*old_est + (1/n)*A_n
    if(n>MC_N):
        break
    n = n+1
    old_est = new_est
end_time = time()
print(new_est)
```

```
## 3.1402048597951002
```

```python
print('Time difference of ',end_time-beg_time, 'secs')
```

```
## Time difference of  7.615655899047852 secs
```

Convergence trajectory

```python
import numpy as np
import matplotlib.pyplot as plt
np.random.seed(1234)
old_est = 0
n = 1
MC_N = 10**6
results = np.repeat(0,MC_N+1).astype('float')
while True:
    x_i = np.random.uniform(0, 1) * 2 - 1
    y_i = np.random.uniform(0, 1) * 2 - 1
    t_i = np.sqrt(x_i**2+y_i**2)
    A_n = 4*(t_i<=1)
    new_est = ((n-1)/n)*old_est + (1/n)*A_n
    results[n] = new_est
    if(n>=MC_N):
        break
    n = n+1
    old_est = new_est
```

```python
plt.plot(results[1:21],marker='o')
plt.xlabel('Index')
```
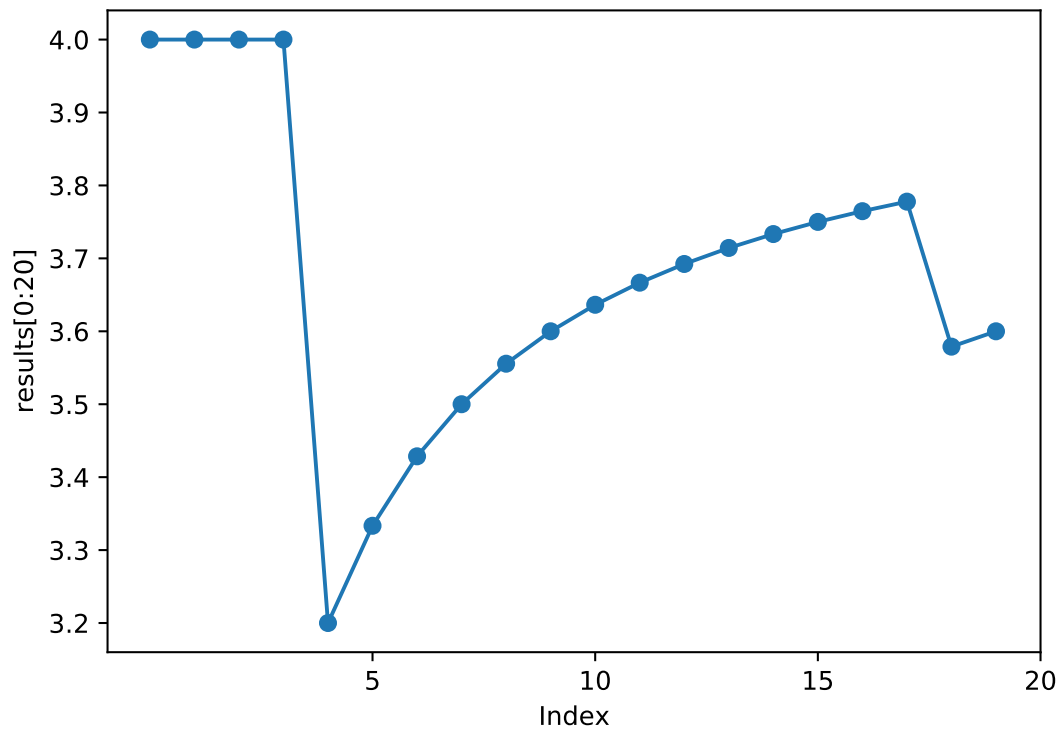
```
plt.ylabel('results[0:20]')
plt.xticks([5,10,15,20])
```

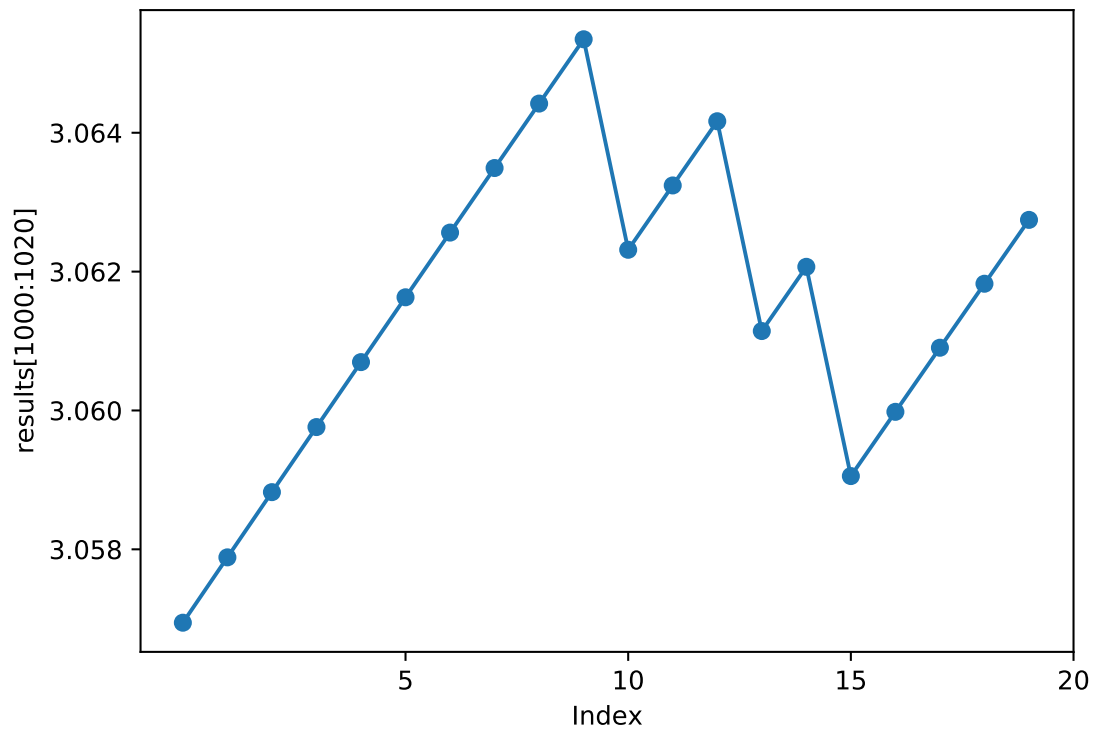## ([<matplotlib.axis.XTick object at 0x0000000020F22710>, <matplotlib.axis.XTick object at 0x00000000276D2D68>,

```
plt.show()
```



```
plt.plot(results[1001:1021],marker='o')
plt.xlabel('Index')
plt.ylabel('results[1000:1020]')
plt.xticks([5,10,15,20])
```

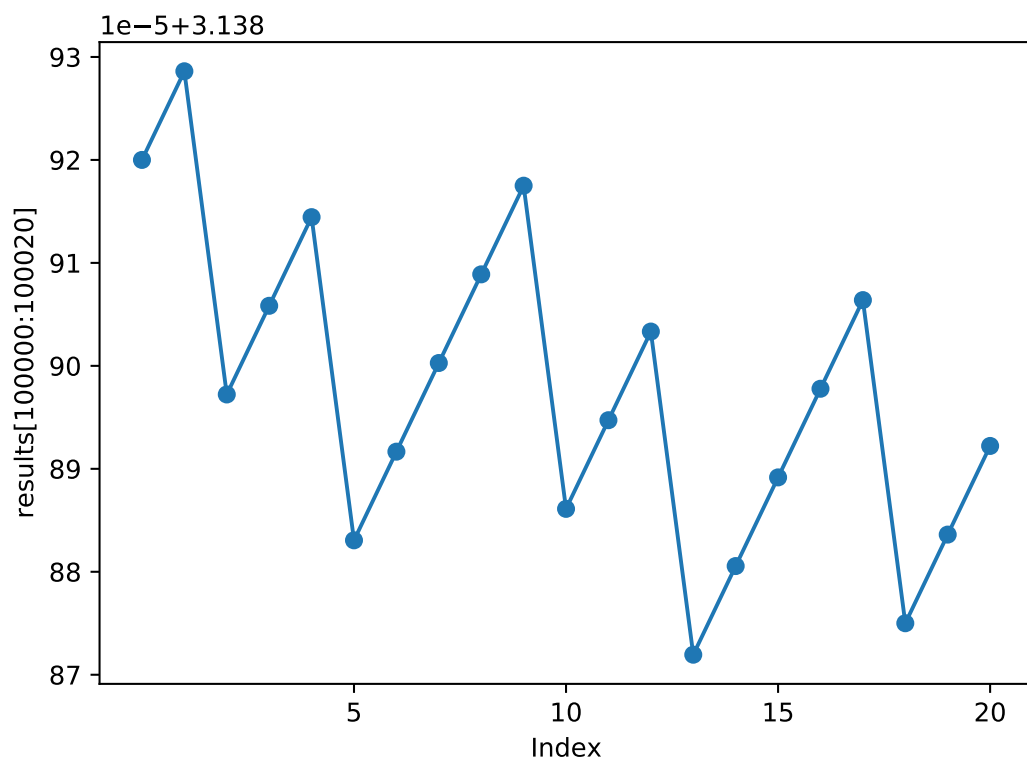## ([<matplotlib.axis.XTick object at 0x0000000027932668>, <matplotlib.axis.XTick object at 0x000000002784D358>,

```
plt.show()
```

```
plt.plot(results[100000:100021],marker='o')
plt.xlabel('Index')
plt.ylabel('results[100000:100020]')
plt.xticks([5,10,15,20])
```

([<matplotlib.axis.XTick object at 0x0000000027AA7A58>, <matplotlib.axis.XTick object at 0x0000000027AA75F8>,

```
plt.show()
```

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