

A6_손민상

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차 례

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page 4

```
import numpy as np

np.random.seed(1234) # fix the random seed
MC_N = 10**3
x= np.random.uniform(0,1,MC_N)*2-1 # runif() generates U(0,1)
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
pi_hat
```

```
## 3.06
```

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```
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(0,1,1)*2-1
    y_i= np.random.uniform(0,1,1)*2-1
    t_i = np.sqrt(x_i**2+y_i**2)
    if t_i <= 1:
        count +=1

pi_hat=4*count/MC_N
pi_hat
```

```
## 3.140204
```

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```
import numpy as np
import time

np.random.seed(1234)
beg_time = time.time()
old_est = 0
n = 1
MC_N = 10**6
old_est = 0
while True:
    x_i= np.random.uniform(0,1,1)*2-1
    y_i= np.random.uniform(0,1,1)*2-1
    t_i = np.sqrt(np.power(x_i,2) +np.power(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

print(new_est)
```

```
## [3.14020486]
```

```
import time

end_time = time.time()
print("Time difference of ",(end_time-beg_time),'sec')
```

```
## Time difference of 18.444674730300903 sec
```

```
import numpy as np

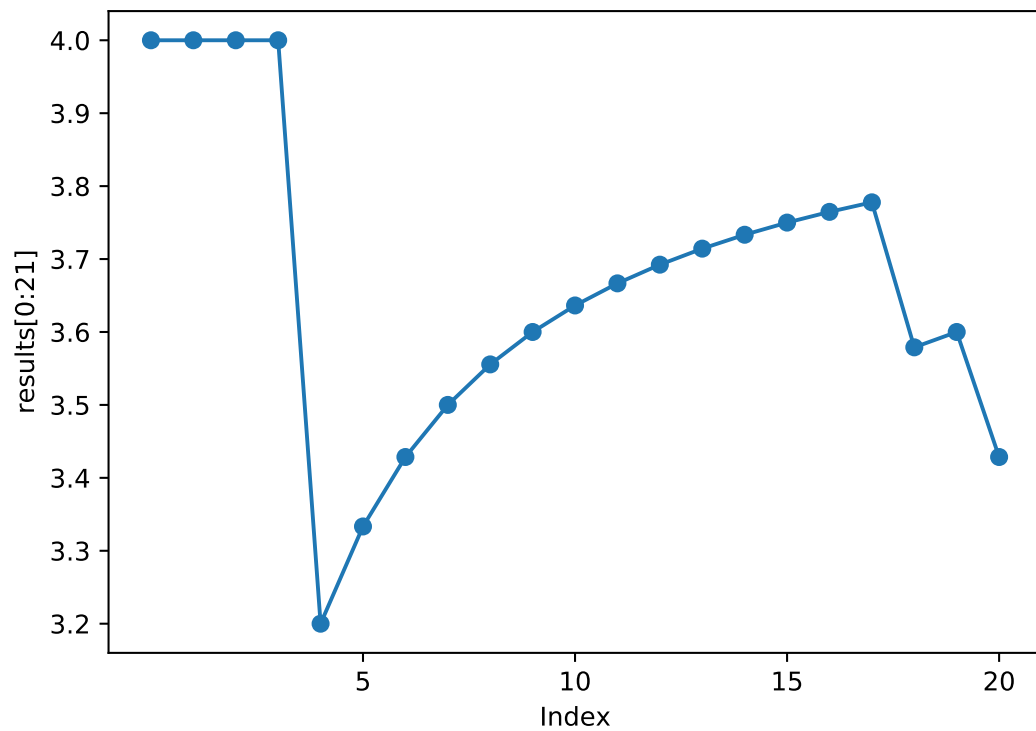
np.random.seed(1234)
beg_time = time.time() # to time
old_est = 0
n = 1
MC_N = 10**6
old_est = 0
results = np.zeros(MC_N+1)
count = 0
while True:
    x_i= np.random.uniform(0,1,1)*2-1
    y_i= np.random.uniform(0,1,1)*2-1
    t_i = np.sqrt(np.power(x_i,2) +np.power(y_i,2))
    A_n = 4*(t_i<=1)
    new_est = ((n-1)/n)*old_est + (1/n)*A_n
    results[count] = new_est # to save
    if n>MC_N :
        break
    n +=1
    count +=1
    old_est = new_est
```

```
import matplotlib.pyplot as plt
```

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

```
## ([<matplotlib.axis.XTick object at 0x00000000046F76D8>, <matplotlib.axis.XTick object at 0x00000000046F7278>]
```

```
plt.show())
```



```
import matplotlib.pyplot as plt
```

```
plt.plot(results[1000:1021],marker='o')
```

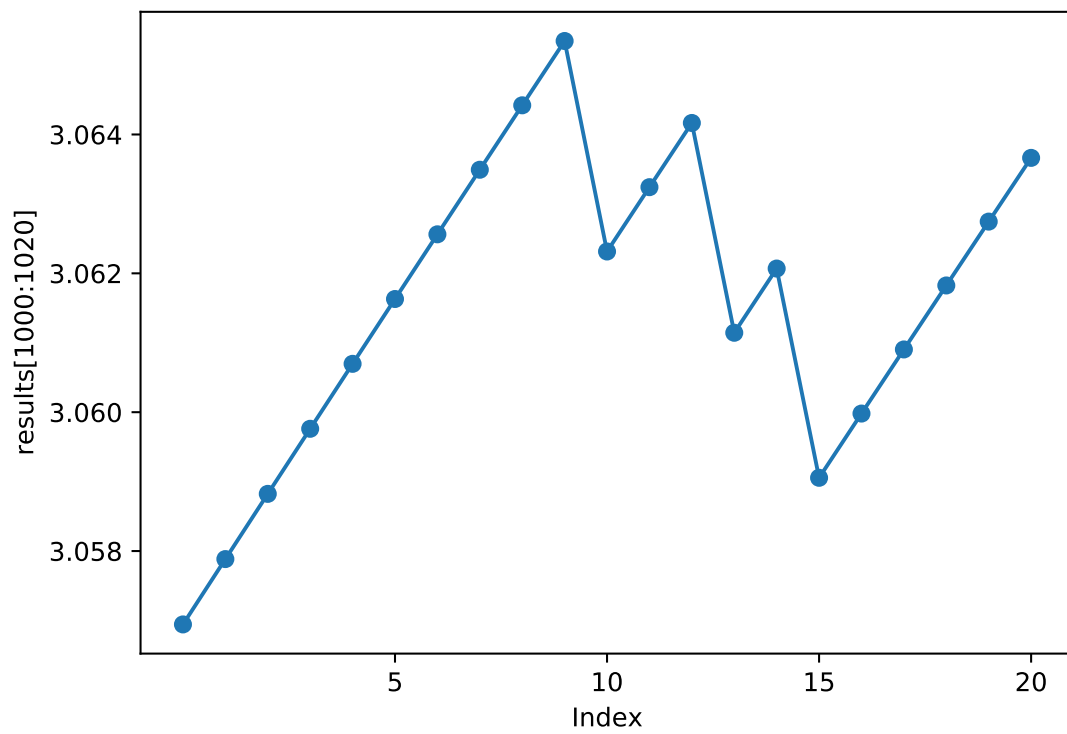
```
plt.xlabel('Index')
```

```
plt.ylabel('results[1000:1020]')
```

```
plt.xticks([5,10,15,20])
```

```
## ([<matplotlib.axis.XTick object at 0x00000000047C78D0>, <matplotlib.axis.XTick object at 0x0000000002BDA4208>]
```

```
plt.show()
```



```
import matplotlib.pyplot as plt
```

```
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 0x0000000004978AC8>, <matplotlib.axis.XTick object at 0x00000000049786A0>]
```

```
plt.show()
```

