A6_Jeong,Wonryoel

Jeong, wonryeol

1/23/2021

Contents

4_page Implementation -basic

```
# 4_page Implementation

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(np.power(x,2) +np.power(y,2))

pi_hat=4*sum(t<=1)/MC_N
pi_hat
```

```
## 3.164
```

5_page Implementation - “The first-timer would write”

```
np.random.seed(1234)
MC_N = 10**3
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(np.power(x_i,2) +np.power(y_i,2))
    if t_i <= 1:
        count +=1

pi_hat=4*count/MC_N

pi_hat
```

```
## 3.056
```

9_page Implementation

```
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]
```

```
end_time = time.time()

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

```
## Time difference of  19.487095832824707 sec
```

10_page Convergence trajectory

```
np.random.seed(1234)
beg_time = time.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
    if n>MC_N :
        break

    n +=1
    count +=1
    old_est = new_est

print(new_est)
```

```
## [3.14020486]
```

```
end_time = time.time()

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

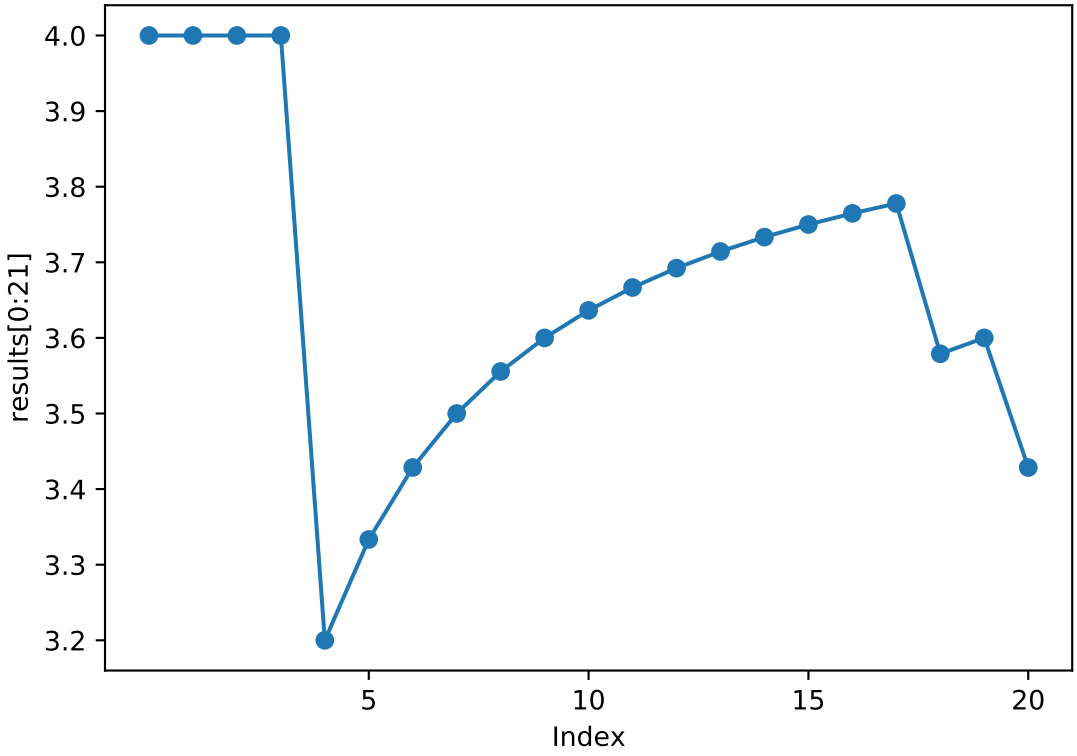
```
## Time difference of  19.05980110168457 sec
```

10_page Graphs

```
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 0x7f969572af60>, <matplotlib.axis.XTick object at 0x7f969572ab38>
```

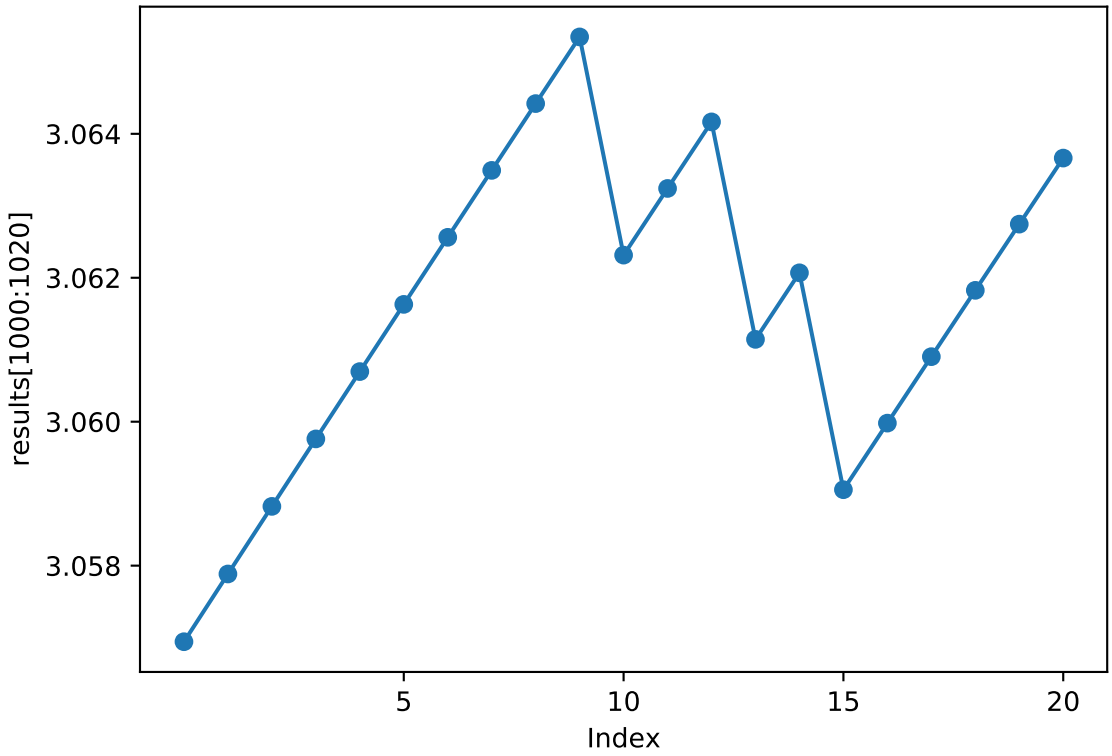
```
plt.show()
```




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

```
## ([<matplotlib.axis.XTick object at 0x7f96963dab00>, <matplotlib.axis.XTick object at 0x7f96963da6d8>
```

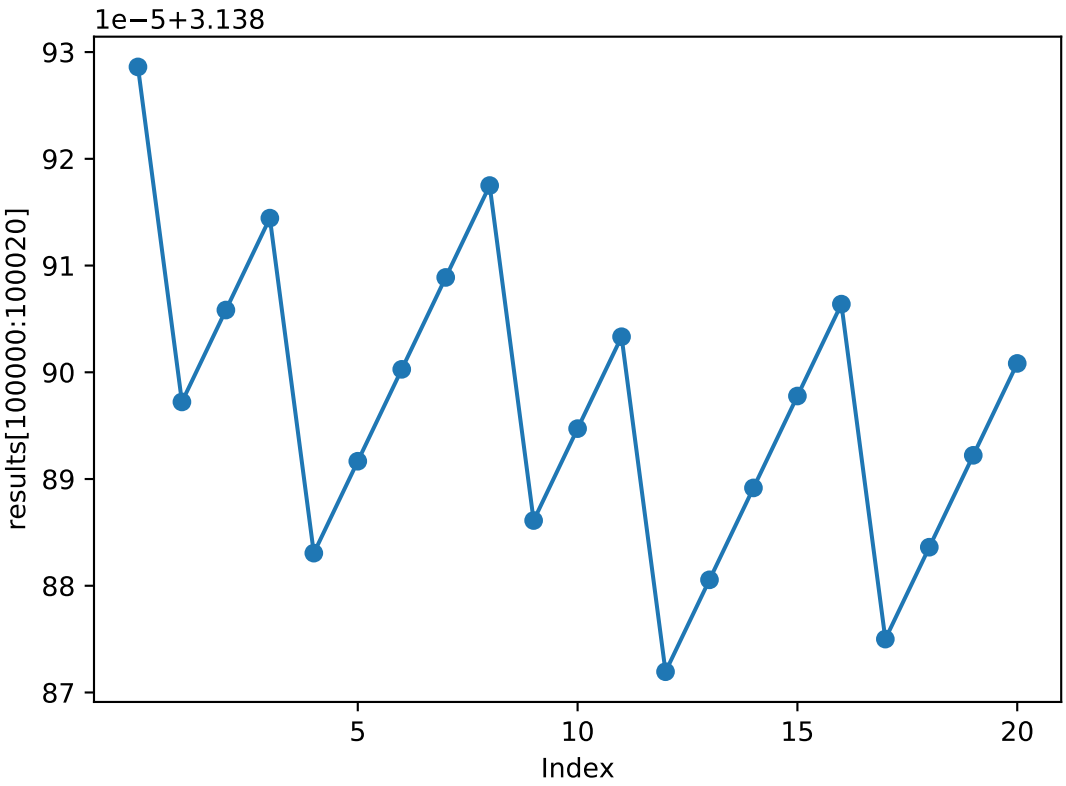
```
plt.show()
```




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

```
## ([<matplotlib.axis.XTick object at 0x7f9696440128>, <matplotlib.axis.XTick object at 0x7f969643bcc0>
```

```
plt.show()
```


1e−5+3.138
93
92
91
90
89
88
87
results[100000:100020]
5
10
15
20
Index