A6 Python

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차 례

p.9 Implementation

```python
np.random.seed(1234)
beg_time=time.time()
old_est=0
n=1
MC_N=10**6
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
    if n > MC_N:
        break
    n+=1
    old_est=new_est

print(new_est)
```

```
## 3.1402048597951002
```

```python
end_time=time.time()
print(end_time-beg_time,' secs')
```

```
## 17.31825590133667  secs
```

p.10 Convergence trajectory

```python
np.random.seed(1234)
old_est=0
n=1
MC_N=10**6
results=[]
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.append(new_est)

    if n >= MC_N :
        break

    n+=1
    old_est=new_est

plt.plot(results[:20],marker='o')
plt.title('Estimate '+r'$\pi$'+' trying 20 times',fontweight='bold')
plt.xlabel('Index')
plt.ylabel('results[0:20]')
plt.xticks([5,10,15,20])
```
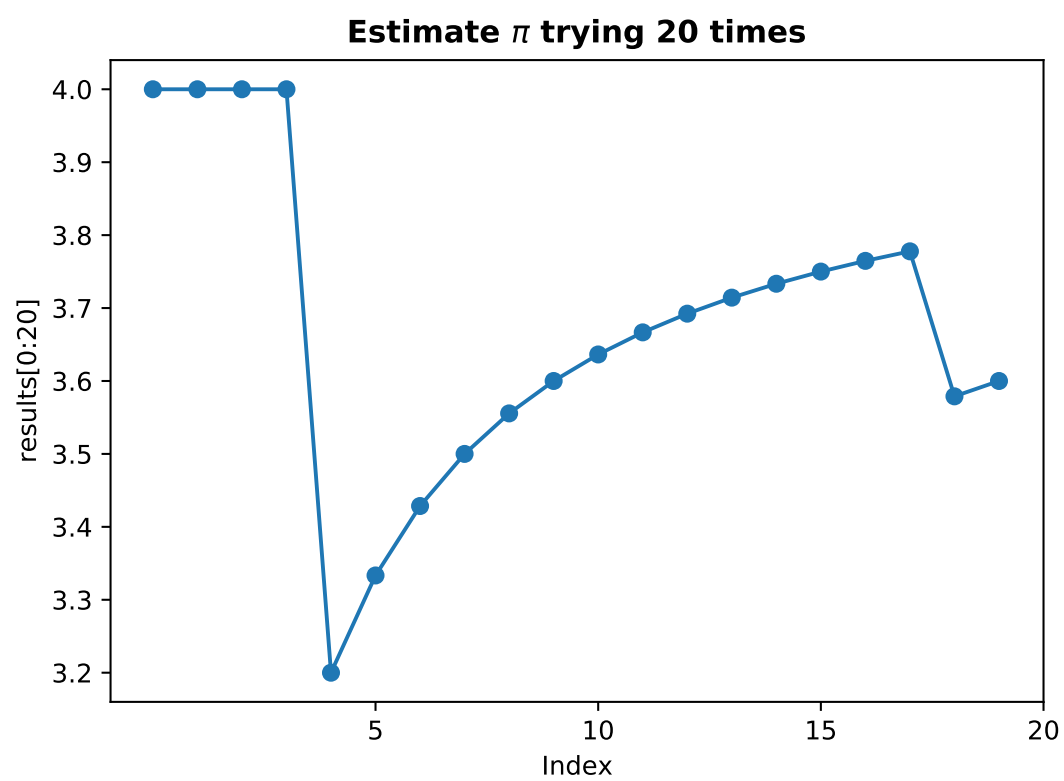
```
## ([<matplotlib.axis.XTick object at 0x00000000455380F0>, <matplotlib.axis.XTick object at 0x000000
```

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

Estimate π trying 20 times

```
plt.plot(results[1000:1020],marker='o')
plt.title('Estimate '+r'$\pi$'+' trying 1020 times',fontweight='bold')
plt.xlabel('Index')
plt.ylabel('results[1000:1020]')
plt.xticks([5,10,15,20])
```

```
## ([<matplotlib.axis.XTick object at 0x0000000045679080>, <matplotlib.axis.XTick object at 0x000000
```
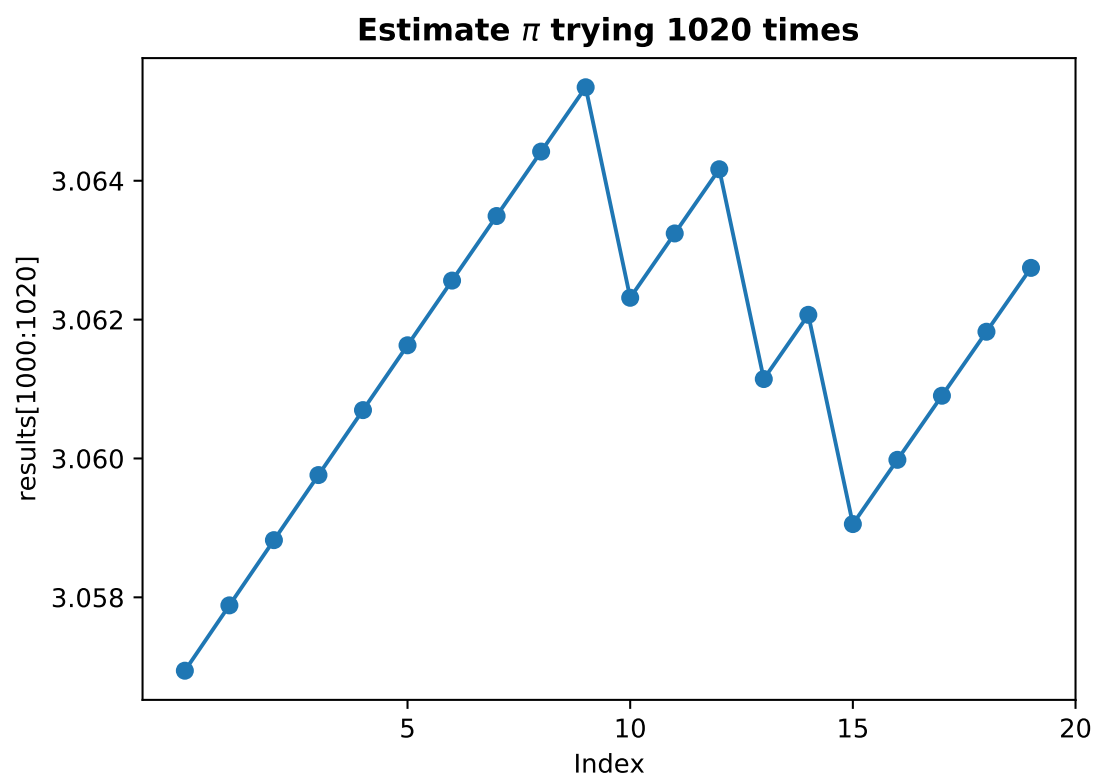
```
plt.show()
```

```
plt.plot(results[100000:100020],marker='o')
ax=plt.gca()
ax.get_yaxis().get_major_formatter().set_useOffset(False)
plt.title('Estimate '+r'$\pi$'+' trying 100020 times',fontweight='bold')
plt.xlabel('Index')
plt.ylabel('results[100000:100020]')
plt.xticks([5,10,15,20])
```

```
## ([<matplotlib.axis.XTick object at 0x00000000456EE2E8>, <matplotlib.axis.XTick object at 0x000000
```

```
plt.show()
```

Estimate π trying 100020 times