In [1]:
```
import numpy as np
import random
import matplotlib.pyplot as plt
```

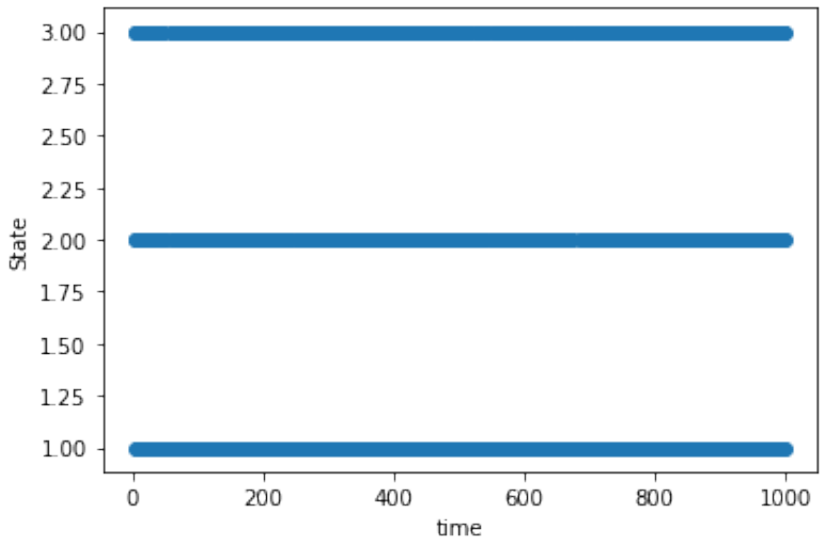
Q1 a)

In [2]:
```
#PROBLEM 1
n = 3
P = np.array([[0, 0.6, 0.4],
              [0.3, 0, 0.7],
              [0.85, 0.15, 0]])

trajectory = np.zeros((6000,2))
sims = 1000
reward = []
current = 1
time = 0
i = 0
while time < 1000:
    if current == 1:
        t12 = np.random.exponential(1/.6)
        t13 = np.random.exponential(1/.4)
        t_out = min(t12,t13)
        if t12 < t13:
            next_state = 2
        else:
            next_state = 3


    elif current == 2:
        t21 = np.random.exponential(1/.6)
        t23 = np.random.exponential(1/1.4)
        t_out = min(t21,t23)
        if t21 < t23:
            next_state = 1
        else:
            next_state = 3

    elif current == 3:
        t31 = np.random.exponential(1/2.55)
        t32 = np.random.exponential(1/0.45)
        t_out = min(t31,t32)
        if t31 < t32:
            next_state = 1
        else:
            next_state = 2
```

```
            next_state = 2

    time = time + t_out
    trajectory[i,0] = time
    trajectory[i,1] = next_state
    reward.append(next_state**2)
    current = next_state
    i += 1
```

In [3]:
```
times = trajectory[:,0]
times = times[times != 0]
X = trajectory[:,1]
X = X[X != 0]
plt.scatter(times,X)
plt.xlabel('time')
plt.ylabel('State')
```

Out[3]: Text(0, 0.5, 'State')



Q1 b)

Stimulation result = 7.075

The long run expectation we have here is 4.59578947368421. The absolute difference between stimulation result and formula result is 2.47921052631579, and the percentage difference is 53.9452588181402%.

In [4]:
```
total_rew = np.sum(reward)
lr_avg = total_rew/1000
lr_avg
```

Out[4]: 7.075

In [14]:
```
Math_lr_exp = (179/475) + 4*(132/475) + 9*(164/475)
print("The long run expectation we have here is {}.     The absolute d
```

```
The long run expectation we have here is 4.59578947368421.     The ab
solute difference between stimulation result and formula result is 2.
47921052631579, and the percentage difference is 53.9452588181402%.
```

In [ ]:
```

```