# E1 python ver

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```
import numpy as np
import pandas as pd

R=np.hstack((np.repeat(-1.5,4),-0.5,np.repeat(-1.5,2),0)).reshape(-1,1)

states=np.arange(0,80,step=10)

P=np.matrix([[.1,0,.9,0,0,0,0,0],
             [.1,0,0,.9,0,0,0,0],
             [0,.1,0,0,.9,0,0,0],
             [0,0,.1,0,0,.9,0,0],
             [0,0,0,.1,0,0,.9,0],
             [0,0,0,0,.1,0,0,.9],
             [0,0,0,0,0,.1,0,.9],
             [0,0,0,0,0,0,0,1]]).reshape(8,8)


print(R.T)
```

```
## [[-1.5 -1.5 -1.5 -1.5 -0.5 -1.5 -1.5  0. ]]
```

```
print(P)
```

```
## [[0.1 0.  0.9 0.  0.  0.  0.  0. ]
##  [0.1 0.  0.  0.9 0.  0.  0.  0. ]
##  [0.  0.1 0.  0.  0.9 0.  0.  0. ]
##  [0.  0.  0.1 0.  0.  0.9 0.  0. ]
##  [0.  0.  0.  0.1 0.  0.  0.9 0. ]
##  [0.  0.  0.  0.  0.1 0.  0.  0.9]
##  [0.  0.  0.  0.  0.  0.1 0.  0.9]
##  [0.  0.  0.  0.  0.  0.  0.  1. ]]
```

```
gamma=1.0
epsilon=10**(-8)
```

```
v_old=np.array(np.zeros(8))
v_new=R+np.dot(gamma*P,v_old)

while np.max(np.abs(v_new-v_old))>epsilon:
    v_old=v_new
    v_new=R+np.dot(gamma*P, v_old)

print(v_new.T[-1])
```

```
## [[-5.80592905 -5.2087811  -4.13926239 -3.47576467 -2.35376031 -1.73537603
##   -1.6735376   0.        ]]
```

## Rewritten

```
gamma=1.0
epsilon=10**(-8)

v_old=np.array(np.zeros(8,)).reshape(8,1)
v_new=R+np.dot(gamma*P,v_old)

results=v_old.T
results=np.vstack((results,v_new.T))

while np.max(np.abs(v_new-v_old)) > epsilon:
    v_old=v_new
    v_new=R+np.dot(gamma*P, v_old)
    results=np.vstack((results,v_new.T))

results=pd.DataFrame(results, columns=states)
results.head()
```

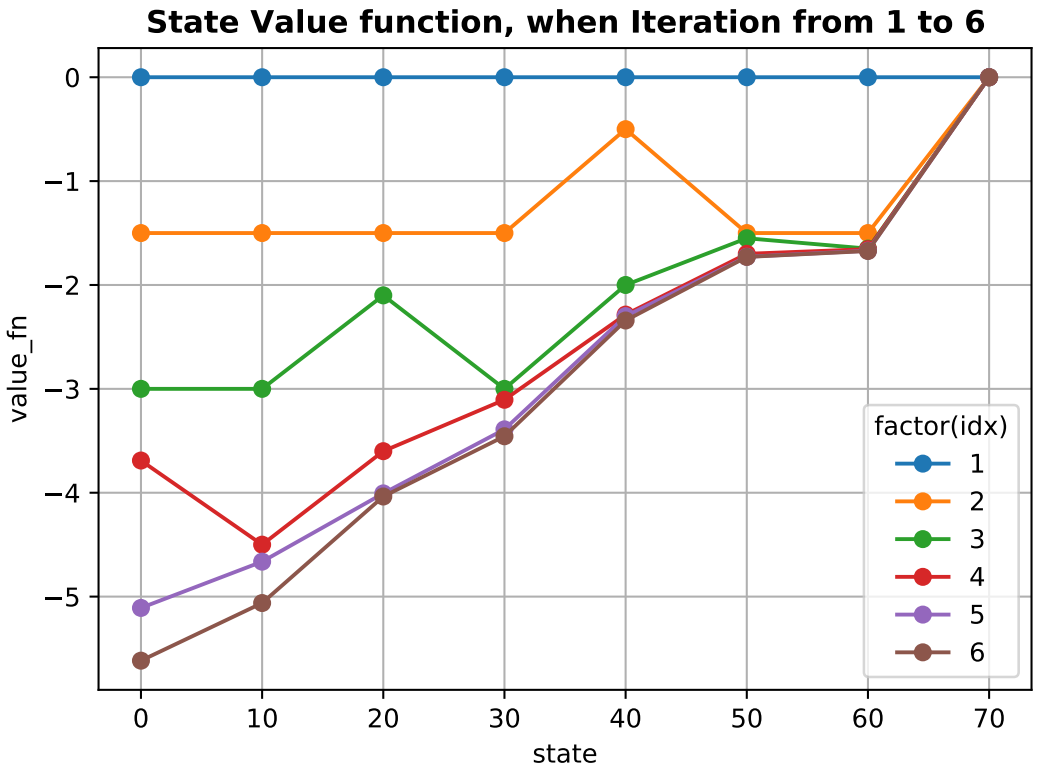
```
##       0       10      20     30     40      50     60   70
## 0  0.000  0.0000  0.0000  0.000  0.000  0.0000  0.000  0.0
## 1 -1.500 -1.5000 -1.5000 -1.500 -0.500 -1.5000 -1.500  0.0
## 2 -3.000 -3.0000 -2.1000 -3.000 -2.000 -1.5500 -1.650  0.0
## 3 -3.690 -4.5000 -3.6000 -3.105 -2.285 -1.7000 -1.655  0.0
## 4 -5.109 -4.6635 -4.0065 -3.390 -2.300 -1.7285 -1.670  0.0
```

```
results.tail()
```

```
##           0         10        20        30       40        50        60   70
## 18 -5.805929 -5.208781 -4.139262 -3.475765 -2.35376 -1.735376 -1.673538  0.0
## 19 -5.805929 -5.208781 -4.139262 -3.475765 -2.35376 -1.735376 -1.673538  0.0
## 20 -5.805929 -5.208781 -4.139262 -3.475765 -2.35376 -1.735376 -1.673538  0.0
## 21 -5.805929 -5.208781 -4.139262 -3.475765 -2.35376 -1.735376 -1.673538  0.0
## 22 -5.805929 -5.208781 -4.139262 -3.475765 -2.35376 -1.735376 -1.673538  0.0
```

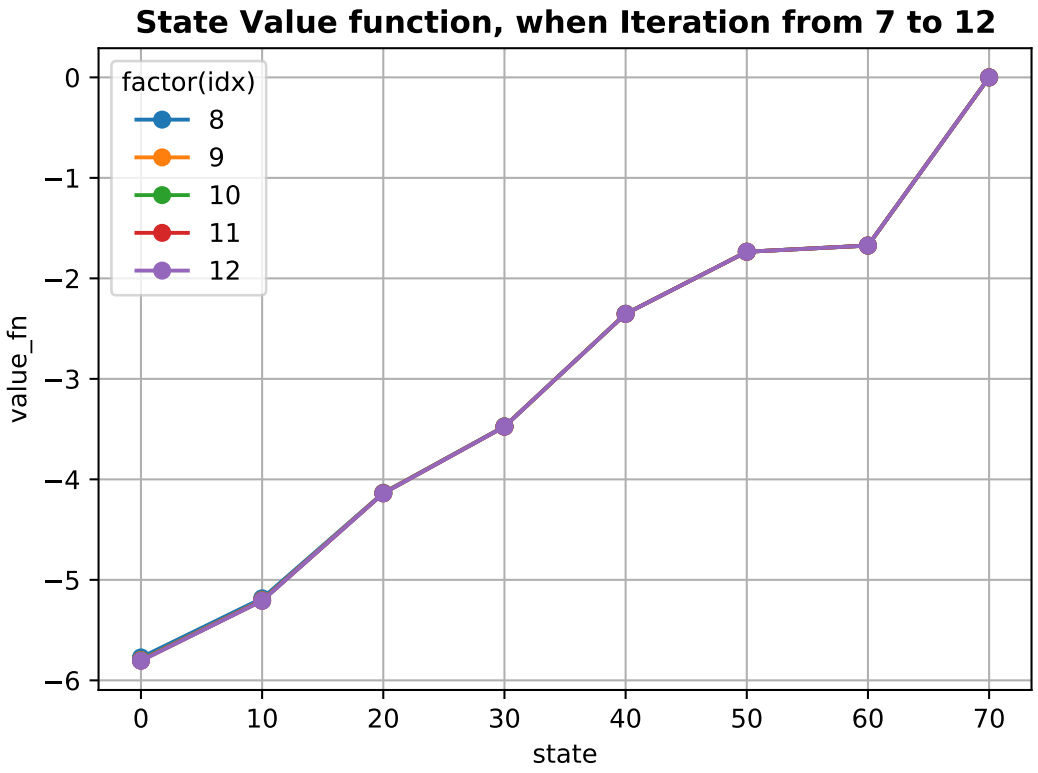
### Iteration from 1 to 6

```
import matplotlib.pyplot as plt

for i in range(0,6):
    plt.plot(states, results.iloc[i], marker='o', label=str(i+1))

plt.rcParams["figure.figsize"] = (16,16)
plt.grid(True)
plt.legend(title='factor(idx)')
plt.xlabel('state')
plt.ylabel('value_fn')
plt.title('State Value function, when Iteration from 1 to 6',fontweight='bold')
plt.show()
```



### Iteration from 7 to 12

```
for i in range(7,12):
    plt.plot(states, results.iloc[i], marker='o', label=str(i+1))

plt.rcParams["figure.figsize"] = (16,16)
plt.grid(True)
plt.legend(title='factor(idx)')
plt.xlabel('state')
plt.ylabel('value_fn')
plt.title('State Value function, when Iteration from 7 to 12',fontweight='bold')
plt.show()
```



**Iteration from 13 to 18**