In [28]:

```
%matplotlib inline
import matplotlib.pyplot as plt
import numpy as np
```

In [4]:

```
H = np.array([[0,1,0,0,0],[1,0,0,0,0],[1.0/3,0,1.0/3,0,1.0/3],[0,0,1.0/2,0,1.0/2],
[1.0/5,1.0/5,1.0/5,1.0/5,1.0/5]])
```

In [5]:

```
H
```

Out[5]:

```
array([[ 0.        ,  1.        ,  0.        ,  0.        ,  0.        ],
       [ 1.        ,  0.        ,  0.        ,  0.        ,  0.        ],
       [ 0.33333333,  0.        ,  0.33333333,  0.        ,  0.33333333],
       [ 0.        ,  0.        ,  0.5       ,  0.        ,  0.5       ],
       [ 0.2       ,  0.2       ,  0.2       ,  0.2       ,  0.2       ]])
```

In [36]:

```
theta = 0.85
G=theta*H + (1-theta)*0.2
pi = np.array([0.2,0.2,0.2,0.2,0.2])
```

In [38]:

```
len(norm)
```

Out[38]:

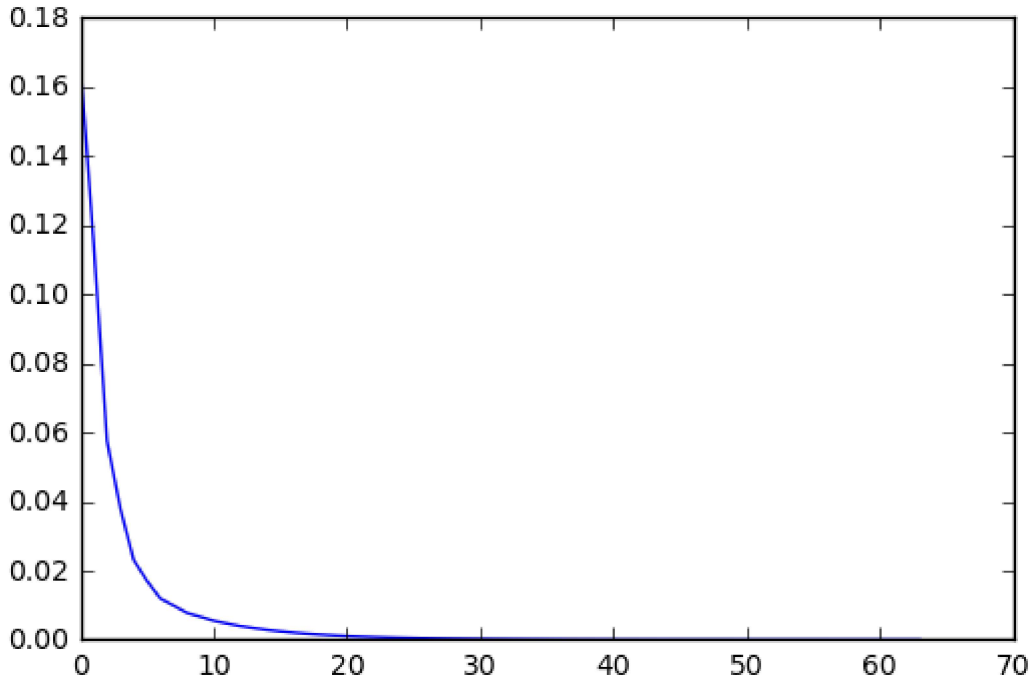
```
64
```

In [39]:

```
plt.plot(norm)
```

Out[39]:

```
[<matplotlib.lines.Line2D at 0x7f474d3ea150>]
```



In [35]:

```
pi_current
```

Out[35]:

```
array([ 0.39412997,  0.38032989,  0.09011066,  0.04531881,  0.09011066])
```

In [40]:

```
theta = 0.1
G=theta*H + (1-theta)*0.2
pi = np.array([0.2,0.2,0.2,0.2,0.2])
norm = []
pi_current = pi
for i in range(10000):
    pi_last = pi_current
    pi_current = pi_current.dot(G)
    dist = np.linalg.norm(pi_current-pi_last)
    norm.append(dist)
    if dist < 1e-6:
        break
```

In [41]:

```
len(norm)
```

Out[41]:

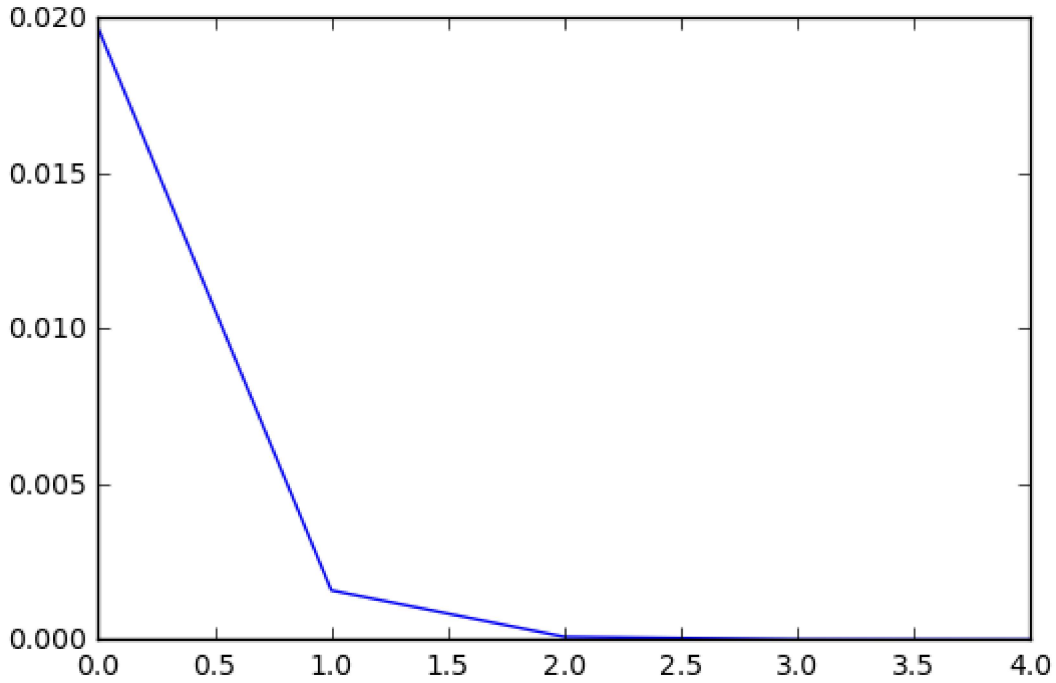
```
5
```

In [42]:

```
plt.plot(norm)
```

Out[42]:

```
[<matplotlib.lines.Line2D at 0x7f474d32c510>]
```



In [43]:

```
pi_current
```

Out[43]:

```
array([ 0.21117058,  0.2051142 ,  0.19985902,  0.18399718,  0.19985902])
```

In [44]:

```
G
```

Out[44]:

```
array([[ 0.18      ,  0.28      ,  0.18      ,  0.18      ,  0.18      ],
       [ 0.28      ,  0.18      ,  0.18      ,  0.18      ,  0.18      ],
       [ 0.21333333,  0.18      ,  0.21333333,  0.18      ,  0.21333333],
       [ 0.18      ,  0.18      ,  0.23      ,  0.18      ,  0.23      ],
       [ 0.2       ,  0.2       ,  0.2       ,  0.2       ,  0.2       ]])
```

In [45]:

```
theta = 0.3
G=theta*H + (1-theta)*0.2
pi = np.array([0.2,0.2,0.2,0.2,0.2])
norm = []
pi_current = pi
for i in range(10000):
    pi_last = pi_current
    pi_current = pi_current.dot(G)
    dist = np.linalg.norm(pi_current-pi_last)
    norm.append(dist)
    if dist < 1e-6:
        break
```

In [46]:

```
G
```

Out[46]:

```
array([[ 0.14,  0.44,  0.14,  0.14,  0.14],
       [ 0.44,  0.14,  0.14,  0.14,  0.14],
       [ 0.24,  0.14,  0.24,  0.14,  0.24],
       [ 0.14,  0.14,  0.29,  0.14,  0.29],
       [ 0.2 ,  0.2 ,  0.2 ,  0.2 ,  0.2 ]])
```

In [47]:

```
len(norm)
```

Out[47]:

```
9
```

In [48]:

```
pi_current
```

Out[48]:

```
array([ 0.23789696,  0.22299348,  0.1937425 ,  0.15162455,  0.1937425 ])
```

In [49]:

```
theta = 0.5
G=theta*H + (1-theta)*0.2
pi = np.array([0.2,0.2,0.2,0.2,0.2])
norm = []
pi_current = pi
for i in range(10000):
    pi_last = pi_current
    pi_current = pi_current.dot(G)
    dist = np.linalg.norm(pi_current-pi_last)
    norm.append(dist)
    if dist < 1e-6:
        break
```