In [1]:
```
import numpy as np
import scipy.io
import matplotlib.pyplot as plt
data = scipy.io.loadmat('hw5p1mat.mat')
```

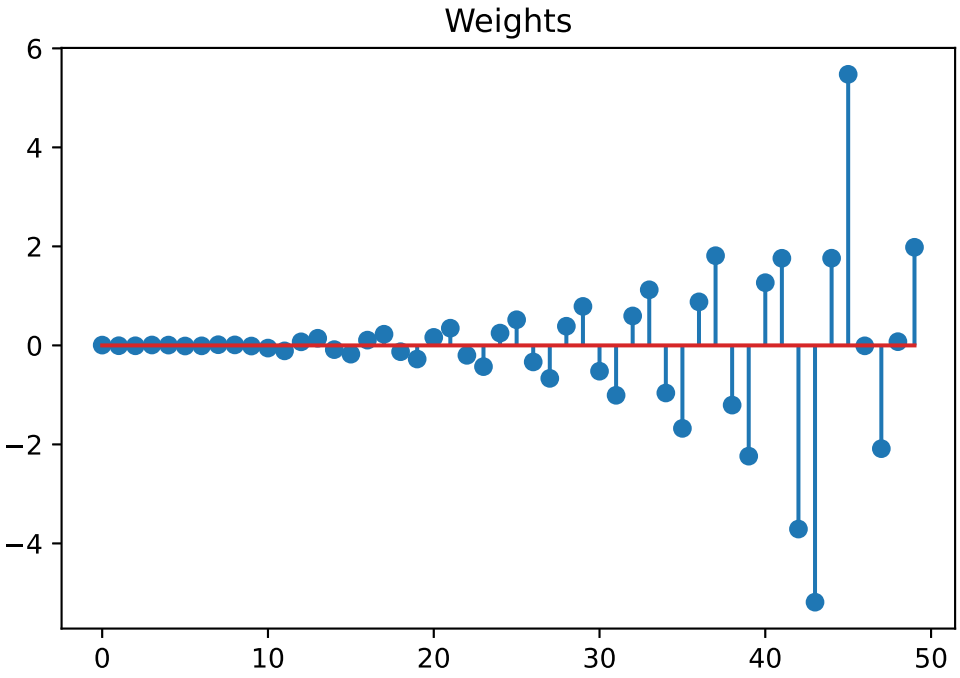
In [20]:
```
x=data['x'][0]
d=data['d'][0]

current_w=np.zeros(50)
step=.01
filterlen=50
running_error=[]
x=np.pad(x, (49, 0), 'constant')

for i in range(0,1000):
    e=d[i]-current_w.dot(x[i:i+filterlen])
    running_error.append(e**2)
    weight_change=2*step*e*np.array(x[i:i+filterlen])
    current_w+=np.array(weight_change)
print(current_w)
```

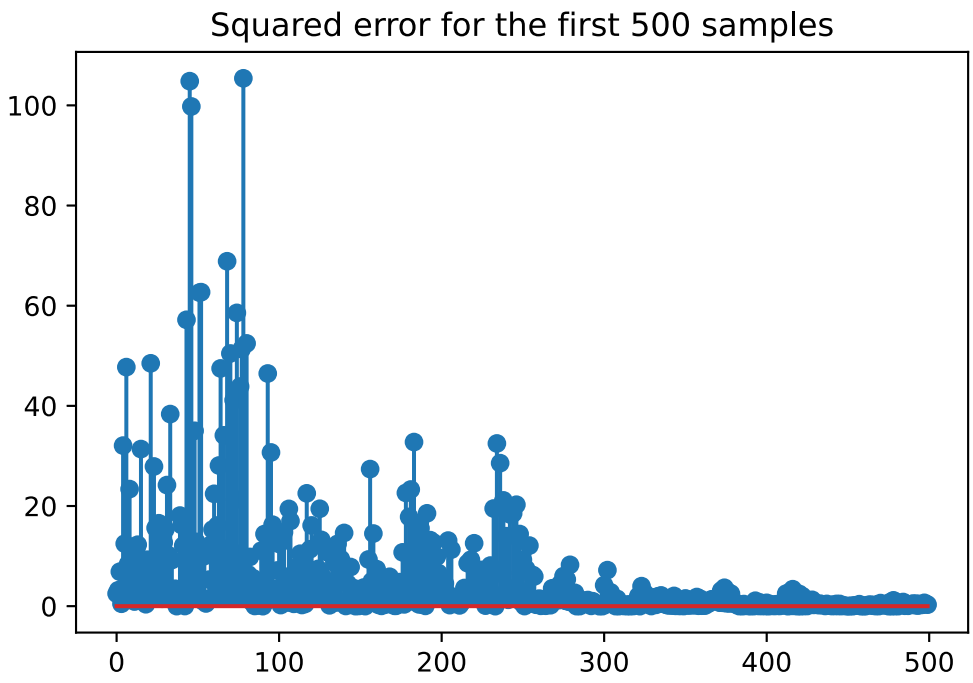
```
[ 0.00630043 -0.00620713 -0.00747929  0.00819144  0.0063942  -0.01208074
 -0.00880676  0.01406646  0.01020015 -0.01285023 -0.05394299 -0.11037684
  0.0723164   0.14445104 -0.08508728 -0.17669223  0.10670292  0.22566861
 -0.1270161  -0.27493465  0.16204262  0.34771903 -0.20028718 -0.42850318
  0.24877087  0.51833971 -0.33353762 -0.66576974  0.38732199  0.78757201
 -0.52098639 -1.00756901  0.59506115  1.12362084 -0.96075618 -1.67587999
  0.87980057  1.81222334 -1.2054793  -2.23703362  1.26711473  1.7600554
 -3.70965805 -5.18664002  1.76146401  5.47602711 -0.00859777 -2.08546388
  0.07544174  1.98182291]
```

In [21]:
```
plt.stem(np.linspace(0,49,50),current_w)
plt.title("Weights")
plt.show()
```



In [18]:
```
plt.stem(np.linspace(0,499,500),running_error[0:500])
plt.title("Squared error for the first 500 samples")
```

```
plt.show()
```



Problem 1 Part C

Do you think `h[n]` is an IIR or an FIR system?

It is IIR since this is a non linear system and the weights seem to grow exponentially

In [ ]:

(2) minimize: $\frac{1}{2}(e[n])^2 + \frac{1}{2}\lambda w^T[n] w[n]$

Let $= g(w[n])$

$\Rightarrow w[n+1] = w[n] - \eta \nabla g(w[n])$

$\frac{\partial}{\partial w[n]} \frac{1}{2}(e[n])^2 + \frac{1}{2}\lambda w^T[n] w[n] = e[n] u[n] + \frac{\partial}{\partial w[n]} \frac{1}{2}\lambda w^T[n] w[n]$

$= e[n] u[n] + \frac{1}{2}\lambda (2w[n])$

$= e[n] u[n] + \lambda w[n]$

$\Rightarrow w[n+1] = w[n] - \eta (e[n] u[n] + \lambda w[n])$