```
import numpy as np
import scipy.stats
```

```
data = [8.1, 8.2, 8.1, 8.2, 8.2, 7.4, 7.3, 7.4, 8.1, 8.1, 7.9, 7.8, 8.2, 7.9, 7.9, 8.1,
8.1]
data = np.array(data)
```

```
def init():
    mu1 = np.random.random_sample() * 4 + 6.0
    mu2 = np.random.random_sample() * 4 + 6.0
    var1 = np.random.random_sample() * 2.0
    var2 = np.random.random_sample() * 2.0
    w = np.random.random_sample()
    return mu1, mu2, var1, var2, w
```

```
def get_prob(x, mu, var):
    return scipy.stats.norm(mu, np.sqrt(var)).pdf(x)
```

```
def e_step(mu1, mu2, var1, var2, w):
    soft_label = np.zeros(shape = data.shape)
    for i, x in enumerate(data):
        soft_label[i] = (w * get_prob(x, mu1, var1)) / (w * get_prob(x, mu1, var1) + (1
- w) * get_prob(x, mu2, var2))
    return soft_label
```

```
def m_step(mu1, mu2, var1, var2, w, soft_label):
    mu1 = np.sum(data * soft_label) / np.sum(soft_label)
    mu2 = np.sum(data * (1.0 - soft_label)) / np.sum(1.0 - soft_label)
    var1 = np.sum((data - mu1) * (data - mu1) * soft_label) / np.sum(soft_label)
    var2 = np.sum((data - mu2) * (data - mu2) * (1.0 - soft_label)) / np.sum(1.0 -
soft_label)
    w = np.sum(soft_label) / data.shape[0]
    return mu1, mu2, var1, var2, w
```

```
def EM():
    mu1, mu2, var1, var2, w = init()
    for i in range(100):
        soft_label = e_step(mu1, mu2, var1, var2, w)
        mu1, mu2, var1, var2, w = m_step(mu1, mu2, var1, var2, w, soft_label)
    return mu1, mu2, var1, var2, w
```

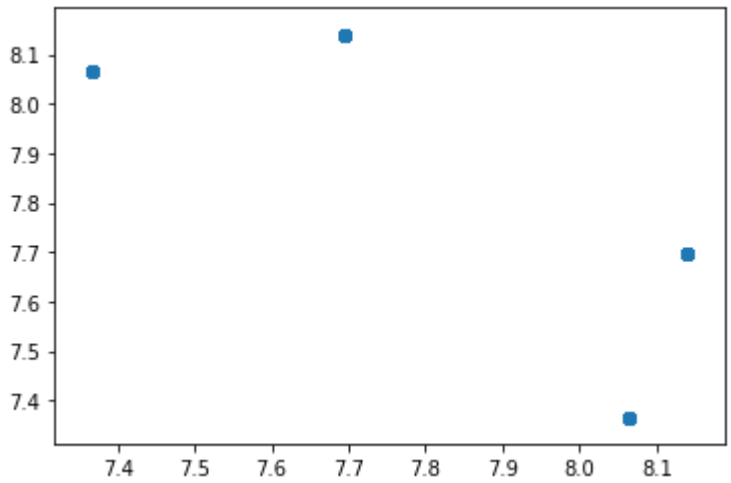
```
res_list = []
for i in range(100):
    res_list.append(EM())
```

```
res_conv_list = []
for res in res_list:
    if res[0] < 1e5:
        res_conv_list.append(res)
```

```
import matplotlib.pyplot as plt
```

```
res_conv_list = np.array(res_conv_list)
```

```
plt.scatter(res_conv_list[:, 0], res_conv_list[:, 1])
plt.savefig("mu_mode")
```




```
plt.scatter(res_conv_list[:, 2], res_conv_list[:, 3])
plt.savefig("sigma_mode")
```