2.

a.

```
> svd(A)
$d
[1] 4.098872 2.361571 1.273669

$u
              [,1]         [,2]         [,3]
 [1,] -0.4201216 -0.07479925 -0.04597244
 [2,] -0.2994868  0.20009226  0.40782766
 [3,] -0.1206348 -0.27489151 -0.45380010
 [4,] -0.1575610  0.30464762 -0.20064670
 [5,] -0.1206348 -0.27489151 -0.45380010
 [6,] -0.2625606 -0.37944687  0.15467426
 [7,] -0.4201216 -0.07479925 -0.04597244
 [8,] -0.4201216 -0.07479925 -0.04597244
 [9,] -0.2625606 -0.37944687  0.15467426
[10,] -0.3151220  0.60929523 -0.40129339
[11,] -0.2994868  0.20009226  0.40782766

$v
              [,1]         [,2]         [,3]
[1,] -0.4944666 -0.6491758 -0.5779910
[2,] -0.6458224  0.7194469 -0.2555574
[3,] -0.5817355 -0.2469149  0.7749947
```

b.

```
> t(Q) %*% A
      docs
query d1 d2 d3
   q1  1  3  2
```

Figure 1: ola

```
> t(Q) %*%  decomposeA$u
 %*% diag(decomposeA$d)
 %*% t(decomposeA$v)

query [,1] [,2] [,3]
   q1    1    3    2
```

Figure 2: ola

c.

```
> U2
              [,1]         [,2]
 [1,] -0.4201216 -0.07479925
 [2,] -0.2994868  0.20009226
 [3,] -0.1206348 -0.27489151
 [4,] -0.1575610  0.30464762
 [5,] -0.1206348 -0.27489151
 [6,] -0.2625606 -0.37944687
 [7,] -0.4201216 -0.07479925
 [8,] -0.4201216 -0.07479925
 [9,] -0.2625606 -0.37944687
[10,] -0.3151220  0.60929523
[11,] -0.2994868  0.20009226
```

Figure 3: U_2

```
> S2
          [,1]     [,2]
[1,] 4.098872 0.000000
[2,] 0.000000 2.361571
```

Figure 4: S_2

```
> V2
           [,1]        [,2]
[1,] -0.4944666 -0.6491758
[2,] -0.6458224  0.7194469
[3,] -0.5817355 -0.2469149
> t(V2)
           [,1]        [,2]        [,3]
[1,] -0.4944666 -0.6458224 -0.5817355
[2,] -0.6491758  0.7194469 -0.2469149
```

Figure 5: V_2

```
> U2 %*% S2 %*% t(V2)
            [,1]         [,2]       [,3]
 [1,]  0.9661565  0.98503618 1.0453788
 [2,]  0.3002301  1.13274606 0.5974388
 [3,]  0.6659264 -0.14770988 0.4479400
 [4,] -0.1477099  0.93469041 0.1980556
 [5,]  0.6659264 -0.14770988 0.4479400
 [6,]  1.1138664  0.05034577 0.8473231
 [7,]  0.9661565  0.98503618 1.0453788
 [8,]  0.9661565  0.98503618 1.0453788
 [9,]  1.1138664  0.05034577 0.8473231
[10,] -0.2954198  1.86938082 0.3961113
[11,]  0.3002301  1.13274606 0.5974388
```

Figure 6: A_2

d.

```
> docs.coord
    coordinates
docs          x          y
  d1 -0.4944666 -0.6491758
  d2 -0.6458224  0.7194469
  d3 -0.5817355 -0.2469149
> query.coord
    coordinates
query         x          y
  q1 -0.2140026 0.1820571
```

Figure 7: Coordinates

Figure 8: Plot

e.
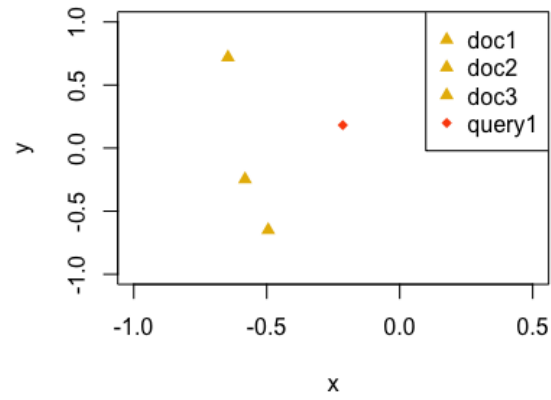
```
> t(Q) %*% A2

query      [,1]      [,2]      [,3]
   q1 1.118677 3.052473 1.840873
```