9) (a)

```
#read matrix
A = matrix(c(10, 7, 8, 7,
             7, 6, 6, 5,
             8, 6, 10, 9,
             7, 5, 9, 10), nrow = 4, byrow = TRUE)
eigen(A)
```

```
## $values
## [1] 30.4375830  4.0468404  0.8764022  0.6391745
##
## $vectors
##            [,1]       [,2]       [,3]       [,4]
## [1,] -0.5263856  0.5551497  0.4771728 -0.4324732
## [2,] -0.3915365  0.4740296 -0.3372886  0.7129036
## [3,] -0.5490379 -0.2839068 -0.6609934 -0.4254904
## [4,] -0.5178559 -0.6216926  0.4707763  0.3517006
```

(b) The accuracy is the l_2 norm of the last two iterated eigenvector.

```
initial_pos = matrix(rnorm(4), ncol=1)
error = 1
accurate = 1e-4
itera = 0

last_pos = initial_pos
while(error >= accurate)
{
  current_pos = A %*% last_pos
  current_pos = current_pos / sqrt(sum(current_pos^2))
  error = sqrt(sum((current_pos-last_pos)^2))
  last_pos = current_pos
  itera = itera + 1
}
current_pos = A %*% last_pos
lambda = sqrt( sum(current_pos^2) / sum(last_pos^2) )
print(list("eigenvalue" = lambda, "eigenvector" = current_pos,
           "iteration" = itera))
```

```
## $eigenvalue
## [1] 30.43758
##
## $eigenvector
##          [,1]
## [1,] 16.02190
## [2,] 11.91742
## [3,] 16.71139
## [4,] 15.76229
##
## $iteration
## [1] 7
```

c)

```
svd(A)
```

```
## $d
## [1] 30.4375830  4.0468404  0.8764022  0.6391745
##
## $u
##            [,1]       [,2]       [,3]       [,4]
## [1,] -0.5263856 -0.5551497  0.4771728 -0.4324732
## [2,] -0.3915365 -0.4740296 -0.3372886  0.7129036
## [3,] -0.5490379  0.2839068 -0.6609934 -0.4254904
## [4,] -0.5178559  0.6216926  0.4707763  0.3517006
##
## $v
##            [,1]       [,2]       [,3]       [,4]
## [1,] -0.5263856 -0.5551497  0.4771728 -0.4324732
## [2,] -0.3915365 -0.4740296 -0.3372886  0.7129036
## [3,] -0.5490379  0.2839068 -0.6609934 -0.4254904
## [4,] -0.5178559  0.6216926  0.4707763  0.3517006
```

d)

```
svd(A[1:3,])
```

```
## $d
## [1] 26.084899  2.835989  0.731587
##
## $u
##            [,1]       [,2]        [,3]
## [1,] -0.6181017  0.4778392 -0.62419547
## [2,] -0.4604058  0.4235486  0.78014941
## [3,] -0.6371630 -0.7695949  0.04179621
##
## $v
##            [,1]       [,2]       [,3]
## [1,] -0.5559217  0.5594071 -0.6103705
## [2,] -0.4183311  0.4473206  0.7686105
## [3,] -0.5397329 -0.4696578  0.1439266
## [4,] -0.4739604 -0.5161294 -0.1263764
```