

# Inverse iteration

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## 1 Inverse iteration experimentation

For this set of exercises, create a random  $10 \times 10$  matrix  $X$ , a diagonal matrix  $D$  whose diagonal entries are  $(k/10)^2$  for  $k = 1, \dots, 10$ , and let  $A = XDX^{-1}$ . (Thus, you know the eigenvalues and their eigenvectors.)

### 1.1 1. Inverse iteration with shift 0

Starting with a random normalized vector, do 40 inverse iterations with shift  $\mu = 0$ . Within each iteration use a Rayleigh quotient to estimate the eigenvalue, and record in a vector how accurate that eigenvalue estimate is.

Make a semilog plot showing the error convergence as a function of the number of iterations. To this plot add a straight line corresponding to the asymptotic convergence estimate of the process.

### 1.2 2. Inverse iteration with shift 2

Repeat the previous part, with  $\mu = 2$ .

### 1.3 3. Rayleigh quotient iteration

Now start with  $\mu = 2$ , but use the Rayleigh quotient estimate to update  $\mu$  after each iteration. Try to verify that the eigenvalue convergence is approximately quadratic.