

1. Implement Monte Carlo integration using uniform sampling and importance sampling and compute the integral in file `hw4_mc_integration.m`. Fill in the remaining code.
2. Implement Bayesian inference example provided in the lecture (robot and landmark example) using rejection sampling and importance sampling. The basic set up is in the file `hw4_sampling.m`. Fill in the remaining code.
3. Suppose all vectors in the unit square are transformed by a 2x2 matrix Ax .
 - a) what is the shape of the transformed region (all Ax) ?
 - b) for which matrices A is that region a square ?
 - c) for which A is it a line ?
 - d) for which A is the new area still 1 ?
4. Find eigenvalues and eigenvectors of the matrix

$$A = \begin{bmatrix} 1 & -1 \\ 2 & 4 \end{bmatrix}$$

Show that the determinant equals product of eigenvalues.

5. Suppose that matrix A has eigenvalues 0, 1, 2 with eigenvectors v_0, v_1, v_2 . Describe the null space of the matrix and the column space. Solve the equations $Ax = v_1 + v_2$. Show that $Ax = v_0$ has no solution.
6. In what range of a and b is the following equations a Markov Process ?

$$u_{k+1} = Au_k = A = \begin{bmatrix} a & b \\ 1-a & 1-b \end{bmatrix} u_k, u_0 = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

Compute $u_k = S\Lambda^k S^{-1}$ for any a and b .

Under what condition on a and b does u_k approach a finite limit as $k \rightarrow \infty$? .