

1. Please answer one of the following questions:

- (i) Consider the linear model

$$f(x) = c_1 + c_2 \log x + c_3 \exp x$$

with unknown parameters  $c_i$ . Use the least squares method to find the values of the parameters that best fit the data in `file-3.dat`. This file has the following format: The first line of the file consists of a single integer  $n$  telling how many data points there are. Each subsequent line specifies  $x_j$  and  $y_j$  where  $y_j \approx f(x_j)$  as two floating point numbers separated by spaces.

- (ii) The file `matrix.c` contains C code that defines the matrix  $A \in \mathbf{R}^{14 \times 14}$ . Use the power method and inverse power method to find  $\|A\|_2$  and  $\|A^{-1}\|_2$  to at least 10 significant digits. Then compute  $\text{cond}_2(A)$ .

2. [Extra Credit and Math/CS 666] Let  $A \in \mathbf{R}^{n \times n}$  be a square invertible matrix. Consider the algorithm

Repeatedly factorize  $A = QR$  and replace  $A$  with  $RQ$

described on page 122 of *Numerical Algorithms* by Justin Solomon. Write a program that implements this algorithm using one of the  $QR$  factorization routines written in class. Note that since  $A$  is square, then  $R$  and  $Q$  are also square. Under certain conditions the diagonal elements of  $R$  will converge to the eigenvalues of  $A$  up to a possible sign difference as the program runs. Starting with the matrix contained in the file `extra.c` print the diagonal elements of  $R$  at each iteration to show whether and how they converge.