Name: _____

Date: _____

Collaborators: _____

(Collaborators submit their individually written assignments together)

Question:	1	2	3	4	5	6	Total
Points:	20	20	10	15	5	10	80
Score:							

Instructor/grader comments:

Orthogonal matrices

1. Consider the following symmetric matrix:

$$D = \begin{bmatrix} 2 & 0 & 1 \\ 0 & 2 & 0 \\ 1 & 0 & 2 \end{bmatrix}.$$

   (a) (10 points) Find the eigenvalues and eigenvectors

   (b) (10 points) Form from the eigenvectors that you found the orthogonal matrix Q. Verify that

$$A = Q^t D Q,$$

   where D is the diagonal matrix of eigenvalues of A.

Implementing deflation by subtraction algorithm to find all eigenvalues of a symmetric matrix

Implement deflation algorithm and determine its scaling properties.

2. (20 points) Write the matlab function with the following calling and return parameters

```
function [status, eigenvals] = mydeflate(A, tol, maxiter)
% MYDEFLATE find all eigenvalues of a symmetric matrix
% using the deflation algorithm and the power method
```

   that implements deflation by subtraction algorithm to finding all eigenvalues of a symmetric matrix. Your function have to repeatedly call `mypower` function to determine the largest eigenvalue.

   `status` is 0 upon success and non-zero upon a failure of power method (that is the failure to reach the convergence in `maxiter` or less power iterations). Abort the calculations (inside `mydeflate`) as soon as a failure is detected and return nonzero status indicator.

3. (10 points) Use the following parameters to conduct the testing of your function.

```
n = 10;
A = genspdm(n);
tol = 0.00000001;
maxit = 10000;
```

   The code for genspdm() is provided on the course website.

Compare the results produced by your code with the results produced by matlab's builtin `eig` function:

```
norm(sort(eigenvals) - sort(eig(A)))
```

Why does one needs the `sort` function? (If not sure, try without sorting.)

Store your code in **hw05a.m** matlab file.

4. (15 points) Use the code to investigate how the running time of your code depends on the size of the matrix n. Use matlab script similar to the following:

```
for i = 1:6
  n = 2^i;
  A = genspdm(n);
  tol = 0.00000001;
  maxit = 10000;

  tic();
  [stratus, eigenvals] = mydeflate(A, tol, maxit);
  mytiming(i) = toc();
end
```

Plot `log(mytimimg)` vs `log(n)`. If the graph is (approximately) linear, determing the slope. Place the code you wrote for this part of the homework in a single matlab file, e.g. **hw05b.m**

5. (5 points) Clearly describe your observations and conclusions in your project's readme file.

Gitlab

6. (10 points) Create a gitlab project called **hw05** (name it exactly as shown). Upload **all** required matlab code and create your readme file. Share the project with the instructor.