

**Homework 9:** If a matrix has dimension  $n \times n$  and has  $n$  linearly independent eigenvectors, it is *diagonalizable*. This means that there exists a matrix  $P$  such that  $P^{-1}AP = D$  where  $D$  is a diagonal matrix, and the diagonal is made up of the eigenvalues of  $A$ .

$P$  is constructed by taking the eigenvectors of  $A$  and using them as the columns of  $P$ . Your task is to write a program that finds the eigenvectors of  $A$  and checks to see if they are linearly independent (think determinant). If they are not, then it tells you so and exits. Otherwise, it outputs  $P, P^{-1}$ , and  $D$ .

**Some guidance:** Read through the following steps *before* you try to write any code!

- You are asked to write a program that takes a matrix  $A$  as input, and outputs either an error message, or three other matrices  $P, P^{-1}$ , and  $D$ . I would suggest writing a Matlab *function* (as opposed to a script), although the task can be done in any number of ways.
- Assume the input matrix  $A$  is always going to be square. Then, the first thing your function should do is to find the eigenvectors of  $A$ .
- Next you need to check whether the eigenvectors are linearly independent. How can you use the Matlab function `det()` to do this?
- If the eigenvectors are linearly *independent* then they can be used to construct the matrix  $P$ . If they are linearly *dependent* then your function should return an error message and quit evaluation.
- Once you have  $P$ , how do you easily find  $P^{-1}$ ?
- Now how do you find  $D$  using  $P$  and  $P^{-1}$ ?
- Functions can give more than one output if you use define them as follows:

```
function [P Pinv D] = matDiag(A)
```

You capture the output from the command window by typing

```
>> [P Pinv D] = matDiag(A)
```

where  $A$  is a square matrix you've already defined. You're telling Matlab here to expect three outputs from the function `matDiag()`, which you're storing in variables called `P`, `Pinv`, and `D`.