1   Using Lapack Routines

LAPACK is a library package containing ready-to-use routines for Linear Algebra. LAPACK is written in FORTRAN language and are pre-compiled in a library. There are many specialized routines that can solve general linear equations, compute decompositions and solve general eigenvalue problems. To use lapack routines

1. Identify the routine you need.

2. Insert a prototype statement in your program.

3. Resolve differences be C and Fortran.

4. Link appropriate libraries.

To resolve differences between C and Fortran, some simple rules are as follows:

1. If the Fortran name of a routine is xxxxx, the corresponding name in C will be xxxxx_ . An underscore (_) character needs to be added to the fortran names.

2. As you know all arguments to a function in C are passed by values. In fortran the same are passed by addresses. This simply means that you must pass the addresses of variables to the fortran routine. The table of conversion is given here

Description	Fortran Declaration	C Declaration	Passing from C to Fortran
character variable	CHARACTER x	char x;	&x
Integer variable	INTEGER n	long n;	&n
float variable	REAL a	float a;	&a
float 1D array	REAL a(10)	float a[10];	&a[0]
float 2D array	REAL a(10,10)	float a[10][10];	&a[0][0]

To compile your program you need to link the libraries as follows:
```
cc your_program -llapack -lblas -lg2c -lm
```

Problem 1 *Find eigenvalues of the matrix*

$$\begin{bmatrix} 1 & 4 & 4 & 6 \\ 4 & 6 & 1 & 4 \\ 4 & 1 & 6 & 4 \\ 6 & 4 & 4 & 1 \end{bmatrix}$$

The matrix is symmetric and real. We identify a LAPACK routine named ssyev which computes all eigenvalues and optionally, all eigenvalues of a real symmetric matrix. At this point, read the manpage for this routine. This can be seen by a man command in linux, for example type man ssyev.
To see the prototype for ssyev and how it is used see sample program provided with this assignment. Change the matrix used in program to the one given above and obtain eigenvalues.

Problem 2 *Write a program to calculate the absolute-largest eigenvalue of a matrix by power method. Use the matrix given in the first problem.*

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Problem 3 *Tridiagonalize the matrix given in problem one of the Lab assignment. Use the Sturm sequence method to obtain the eigen values.*