**LAPACK**

LAPACK is a library of Fortran 77 subroutines for solving the most commonly occurring problems in numerical linear algebra. It has been designed to be efficient on a wide range of modern high-performance computers. The name LAPACK is an acronym for Linear Algebra PACKage. LAPACK can solve systems of linear equations, linear least squares problems, eigenvalue problems, and singular value problems. LAPACK can also handle many associated computations such as matrix factorizations or estimating condition numbers.

In order to use LAPACK routines, you need to call them properly within your main program, and there is no need to copy the routines themselves to the end of your code. For FORTRAN compilation in LINUX (FORTRAN 90) when LAPACK routines are used, type:

```bash
gfortran program_filename.f90 -o output_filename -llapack
```

The executable will automatically include the library parts needed and there is no change in the execution command:

```.output_filename```

General LAPACK driver routines are named in the form of XYYZZ or XYYZZZ, where **X** represents the data type, **YY** represents the type of matrix and **ZZ** or **ZZZ** represents the computation performed. Real data types are represented by X=S, whereas complex data types which are X=C. The matrix types we mainly use in ENGS 105 will be **general** and **banded** storage schemes which are represented by YY = GE and YY = GB, respectively. There are a number of different computations possible with the driver routines. Here are some of the most useful ones you may utilize for the homework in this class.

- **SGEMM/CGEMM**: Performs matrix-matrix multiplication.
- **SGESV/CGESV**: Solves a general system of linear equations AX=B.
- **SGBSV/CGBSV**: Solves a system of linear equations AX=B where A is banded.
- **SGESVD/CGESVD**: Computes the singular value decomposition (SVD) of a general rectangular matrix.
- **SGBSVD/CGBSVD**: Computes the singular value decomposition (SVD) of a banded matrix.
- **SGETRF/CGETRF**: Computes an LU factorization of a general matrix, using partial pivoting with row interchanges.
- **SGBTRF/CGBTRF**: Computes an LU factorization of a banded matrix, using partial pivoting with row interchanges.
• **SGETRI/CGETRI**: Computes the inverse of a general matrix, using the LU factorization computed by SGETRF/CGETRF.

• **SGETRS/CGETRS**: Solves a general system of linear equations $AX=B$, $A^TX=B$ or $A^H X = B$, with a general $N \times N$ matrix $A$ using the LU factorization computed by SGETRF/CGETRF.

• **SGBTRS/CGBTRS**: Solves a general system of linear equations $AX=B$, $A^TX=B$ or $A^H X = B$, with a general banded matrix $A$ using the LU factorization computed by SGETRF/CGETRF.

**Notes:**

• LAPACK routines will possibly change the input variables. Therefore, be cautious when you use these variables following the call to the routines. (It is a good idea to have a duplicate before calling the routines.)

• If you use banded storage schemes, try a smaller problem first to ensure you're setting up your banded storage properly. Here is the LAPACK user guides section on banded storage.

This report has been put together by Amir Golnabi (Courtesy of Colin Carpenter and Prof. D. Lynch) on 02/17/2009.

References:

• [http://www.netlib.org/lapack/](http://www.netlib.org/lapack/)