

### Using LAPACK

For this assignment, you will use an LAPACK routine to solve the linear least squares problem below on Stampede. To turn in your assignment, upload your program, Makefile that builds the program, and answers to the questions below to a directory named <username-hw4> in your SVN repository, where <username> is your Miner username.

**Example 3:** Let us imagine that we are studying a physical system that gets hotter over time. Let us also suppose that we expect a linear relationship between time and temperature. That is, we expect time and temperature to be related by a formula of the form

$$T = at + b,$$

where  $T$  is temperature (in degrees Celsius),  $t$  is time (in seconds), and  $a$  and  $b$  are unknown physical constants. We wish to do an experiment to determine the (approximate) values for the constants  $a$  and  $b$ . We allow our system to get hot and measure the temperature at various times  $t$ . The following table summarizes our findings

$t$ (sec)	0.5	1.1	1.5	2.1	2.3
$T$ ( $^{\circ}\text{C}$ )	32.0	33.0	34.2	35.1	35.7

Find the least squares solution to the linear system that arises from this experiment

$$\begin{cases} 0.5a + b = 32.0 \\ 1.1a + b = 33.0 \\ 1.5a + b = 34.2 \\ 2.1a + b = 35.1 \\ 2.3a + b = 35.7 \end{cases} \iff \begin{bmatrix} 0.5 & 1 \\ 1.1 & 1 \\ 1.5 & 1 \\ 2.1 & 1 \\ 2.3 & 1 \end{bmatrix} \begin{bmatrix} a \\ b \end{bmatrix} = \begin{bmatrix} 32.0 \\ 33.0 \\ 34.2 \\ 35.1 \\ 35.7 \end{bmatrix}.$$

1. What LAPACK routine will you use to solve this problem and why did you choose it?
2. Write a program to solve the problem using your chosen LAPACK routine. (Hint: Modify `lapacke_dgels_row.c` that is provided with the MKL examples).
3. Compile and link the program with the LAPACK library using the LAPACKe extensions. Write the command you used to compile and link your program below and explain each part.
4. Run the program to obtain the solution to the least squares problem. Write the solution below.