Tools

Summer Term 2022

Exercise Sheet 4

Exercise 13 (Fortran, Shared Libraries, Makefiles, Dates, 9 p.)

Write a Fortran module `dates` that contains the following definitions:

- a data type `date` having three components `day`, `month`, and `year`
- a logical function `isLeapYear(year)` that checks if `year` is a leap year
- a subroutine `checkDate(d)` that checks if `d` is a valid date; if not, `d` is set to a default date (01.01.1970)
- a subroutine `incDay(d)` that sets `d` to the next day
- a subroutine `printDate(d)` that prints a date in the format `DD.MM.YYYY`

Use `contains` to include all functions and subroutines into the module.

Put your module in a directory `datemod`. Add a `Makefile` that compiles the module into a shared library.

Create a test program inside a directory `datetst`. Create another `Makefile` therein that links the library. The path where the compiler searches for `.mod`-files is set by the option `-I`.

Exercise 14 (Python, NumPy, SciPy, Power Method, 4 p.)

Solve Exercise 12 from Sheet 3 again—this time using Python, NumPy, and SciPy.

Create the matrix as a NumPy array. You can use the function `scipy.linalg.toeplitz` for its creation.

For comparison, also compute the maximum eigenvector using a NumPy or SciPy function.

Exercise 15 (BLAS, CBLAS, Sum of Absolute Values of a Vector, 6 p.)

a) (3 p.) Write a Fortran program that checks the performance of the BLAS level 1 operation for the sum of the absolute values of a vector (1-norm, $\sum_{i=1}^{n} |v_i|$).

- read in the size n of the vector v
- create the vector (set $v_i = \cos(i)$, $i = 1, \ldots, n$)
- compute the sum of the absolute values using a do-loop and measure the time
- compute the sum again by a BLAS call (the parameter `INCX` of the routine `DASUM` must be 1)

b) (3 p.) Do the same in C++ using the CBLAS interface.

Suggestion: Link and run the programs with different BLAS libraries.

(If you know OpenMP, you could also test OpenMP parallelizations of the loops.)

Hand in by: Mon., 04.07.2022 until 14:00 by email to `tools@studs.math.uni-wuppertal.de`.