

Assignment 2
SCP8082721 - QUANTUM INFORMATION AND COMPUTING
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Exc 1: Debugging subroutine

- ▶ The first step towards a sophisticated debugging algorithm is a subroutine that can print some variables at given locations

```
module debugger
  implicit none
contains
  subroutine db_print_int(var, debug, name)
    integer :: debug, var
    character (len = *) :: name
    if (debug == 1) then
      print *, "Debugger_level_1: variable_", name, "=", var
    end if

    if (debug == 2) then
      print *, "Debugger_level_2: variable_", name, "=", var
    end if
  end subroutine
end module
```

- ▶ This subroutine has two "levels" which can be used depending on how critical the error is (e.g. level 1 can be printing the matrix dimensions while level 2 is printing out all matrix elements if needed)
- ▶ this module works by defining beforehand which type of variable is supplied, in the final module there are more subroutines depending on the type (e.g. db_print_real etc.)

Exc 3: Some theory

- ▶ For given Matrix A the trace is given by summing the diagonal elements

$$Tr(A) = \sum_{i=1}^N A_{i,i}.$$

- ▶ The adjoint, or conjugate transpose is given by transposing the matrix and taking the complex conjugate of each element

$$A^{\dagger} = \overline{A}^T.$$

Exc 3: Code Development

- ▶ The new derived type was defined as following

```
type cmatrix
integer :: n, m
double complex, dimension(:, :), allocatable :: array, array_adj
double complex, allocatable :: array_tr
end type cmatrix
```

- ▶ The code includes following subroutines
 1. `cmatrix_init()` *initialization of matrix*
 2. `cmatrix_trace()` *computation of the corresponding trace*
 3. `cmatrix_adj()` *computation of the corresponding adjoint*
 4. `cmatrix_writetxt()` *writing the output in a given .txt file*

Exc 3: Test run

- Output of some test run in the .txt file is

```
-----Date/time: 20221107/200022.826-----  
Matrix is given by:  
      (0.761200011,8.7099999919E-02)      (0.398699999,0.412099987)  
      (8.999999845E-04,0.991699994)      (0.576099992,0.123400003)  
The trace of the matrix is given by:  
      (1.33730006,0.210500002)  
The explicit adjoint calculation yields:  
      (0.761200011,-8.7099999919E-02)      (8.999999845E-04,-0.991699994)  
      (0.398699999,-0.412099987)      (0.576099992,-0.123400003)
```