Assignment 2

https://github.com/jchryssanthacopoulos/quantum_information/tree/main/assignment_2

Quantum Information and Computing
AA 2022–23
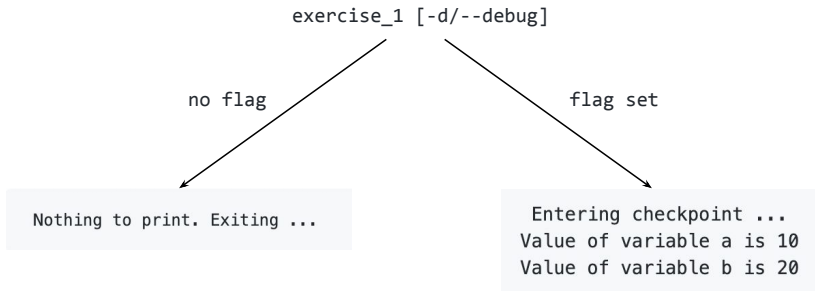
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8 November 2022

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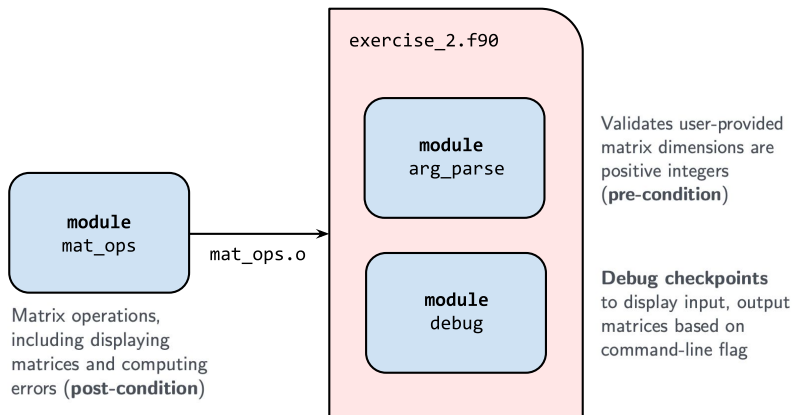Debug subroutine entered depending on flag

```
exercise_1 [-d/--debug]
```

no flag   flag set

```
Nothing to print. Exiting ...
```

```
Entering checkpoint ...
Value of variable a is 10
Value of variable b is 20
```

Exercise 2: Documentation (1)

Matrix multiplication program enhanced
to be fault tolerant and easier to debug

exercise_2.f90

module
arg_parse

module
debug

module
mat_ops

mat_ops.o

Matrix operations,
including displaying
matrices and computing
errors (**post-condition**)

Validates user-provided
matrix dimensions are
positive integers
(**pre-condition**)

Debug checkpoints
to display input, output
matrices based on
command-line flag

Less room for error and more visibility into results

```
# non-integers
$ compiled/exercise_2
 Enter number of rows, columns, and inner dimension:
a b c
 Dimensions need to be integers!

# non-positive integers
$ compiled/exercise_2
 Enter number of rows, columns, and inner dimension:
1, 2, -1
 Dimensions must be greater than zero!
```

Error checking

```
 Running in debug mode ...
 Matrix A =
   0.82   0.79
   0.80   0.99
 Matrix B =
   0.25   0.71
   0.48   0.96
 Product using matmul =
   0.58   1.35
   0.67   1.53
 Elapsed time for matmul = 1.7000000000E-05
 Product using row-col =
   0.58   1.35
   0.67   1.53
 Max abs error for row-col = 0.0000000000E+00
 Elapsed time for row-col = 3.0000000000E-06
 Product using col-row =
   0.58   1.35
   0.67   1.53
 Max abs error for col-row = 0.0000000000E+00
 Elapsed time for col-row = 2.0000000000E-06
```

Debug mode

Derived type implementing double complex matrix
with associated methods
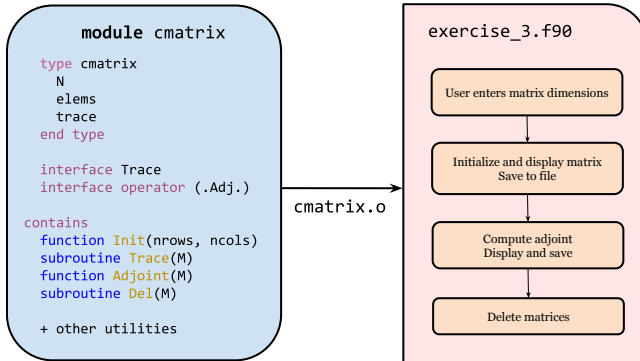
Program writes matrices to screen and files

```
 The original matrix is:
+0.6862 +0.6708i   +0.4096 +0.0576i
+0.8869 +0.4427i   +0.1159 +0.7512i
 The trace of M is +0.8021 +1.4219i
 Saving to file mat.txt ...
 The adjoint matrix is:
+0.6862 −0.6708i   +0.8869 −0.4427i
+0.4096 −0.0576i   +0.1159 −0.7512i
 The trace of M is +0.8021 −1.4219i
 Saving to file mat_adj.txt ...
 Deleting matrices ...
```

Program execution

```
mat_adj.txt

Dimensions:    2 x    2

 Matrix elements:
+0.6862 -0.6
+0.4096 -0.0
Trace:
+0.8021 -1.4
```

```
mat.txt

Dimensions:    2 x    2

 Matrix elements:
+0.6862 +0.6708i   +0.4096 +0.0576i
+0.8869 +0.4427i   +0.1159 +0.7512i
Trace:
+0.8021 +1.4219i
```

Saved files