PROJECT

Email the *commented* solution code (*.cpp, *hpp) as attachments to : `fysy160(at)gmail.com` **Subject line:** `Project`

1. Linear algebra with armadillo library combined with GSL integration.

   Using the Armadillo linear algebra library (`http://arma.sourceforge.net/docs.html`) and Gnu Scientific Library (GSL, `http://www.gnu.org/software/gsl/manual/html_node/`), implement a C++ program that calculates the eigenvalues, eigenvectors and the determinant of a complex matrix $\mathbf{A}$ where

   $$A_{kl} = \begin{cases} \int_k^{l+1} \frac{x^2}{x+k+l} dx & k \neq l \\ \\ \int_k^{k+1} \frac{e^x}{x+l*i+2} dx & k = l \end{cases}$$

   and i is the imaginary unit. The eigenvalues λ and eigenvectors x are solutions to the equation

   $$\mathbf{A}x = \lambda x$$

   Set the size of the complex matrix $\mathbf{A}$ to be 5×5 so then the index values k and l are $k, l = 0...4$. Furthermore, print the matrix $\mathbf{A}$, eigenvalues, eigenvectors and the value of the determinant to the screen and then check that the obtained eigenvectors really diagonalize the matrix $\mathbf{A}$, i.e. check that

   $$\mathbf{Q}^{-1}\mathbf{A}\mathbf{Q} = \mathbf{\Lambda}$$

   where $\mathbf{Q}$ is the matrix holding the eigenvectors in the columns and $\mathbf{\Lambda}$ is a diagonal matrix with the eigenvalues at the diagonal. Finally save the matrix $\mathbf{A}$ into file (in arma_ascii -format) using Armadillos matrix storing routine.

   Study carefully the Armadillo documentation about matrices and vectors, there you will find all the necessary functions to calculate what is asked. Remember to add comments to your implementation to explain what the program does.

Good Luck!

P.S. For checking your implementation, the eigenvalues should be something like this

```
(+8.681e+00,-9.466e+00)
(+4.578e+00,+3.416e+00)
(+4.266e+00,-3.113e+00)
(+4.813e-01,-2.088e-01)
(+1.418e+00,-9.256e-01)
```

where the first number refers to the real part and the second one to the imaginary part of the eigenvalue. The determinant should be something like this:

det $\mathbf{A}$ = `(-80.1339,-334.755)`