



ACM40660/PH502 Assignment 1

ICHEC

Deadline: 7th November 2023 at 5:30pm

1. Write a program that can carry out the following steps:

(a) Use a set of loops to generate the following matrix:

$$\begin{pmatrix} 1 & \frac{1}{2} & \frac{1}{3} & \frac{1}{4} \\ \frac{1}{2} & \frac{1}{3} & \frac{1}{4} & \frac{1}{5} \\ \frac{1}{3} & \frac{1}{4} & \frac{1}{5} & \frac{1}{6} \\ \frac{1}{4} & \frac{1}{5} & \frac{1}{6} & \frac{1}{7} \end{pmatrix}$$

(b) Write a function that calculates the determinant (<http://en.wikipedia.org/wiki/Determinant>) of any 3x3 matrix.

$$\begin{aligned} \det \begin{pmatrix} a & b & c \\ d & e & f \\ g & h & i \end{pmatrix} &= a \det \begin{pmatrix} e & f \\ h & i \end{pmatrix} - b \det \begin{pmatrix} d & f \\ g & i \end{pmatrix} + c \det \begin{pmatrix} d & e \\ g & h \end{pmatrix} \\ &= a(ei - fh) - b(di - fg) + c(dh - eg) \\ &= aei + bfg + cdh - afh - bdi - ceg \end{aligned}$$

(c) Use Cramer's rule (http://en.wikipedia.org/wiki/Cramer's_rule) to calculate the determinant of the 4x4 matrix above.

$$\begin{aligned} \det \begin{pmatrix} a & b & c & d \\ e & f & g & h \\ i & j & k & l \\ m & n & o & p \end{pmatrix} &= a \det \begin{pmatrix} f & g & h \\ j & k & l \\ n & o & p \end{pmatrix} - b \det \begin{pmatrix} e & g & h \\ i & k & l \\ m & o & p \end{pmatrix} \\ &\quad + c \det \begin{pmatrix} e & f & h \\ i & j & l \\ m & n & p \end{pmatrix} - d \det \begin{pmatrix} e & f & g \\ i & j & k \\ m & n & o \end{pmatrix} \end{aligned}$$

(d) Write the matrix and the determinant to the standard output using a formatted print statement.

2. Write a program to calculate the geometric series S_n

$$S_n = a + ar^1 + ar^2 + ar^3 + \dots + ar^n = \frac{a(1 - r^{n+1})}{(1 - r)}$$

(a) Create a loop that runs from 1 to 3.

(b) Design a switch/case construct that selects for three different values of n, a, r .

(c) Find S_n using these three sets of values for both the summation (middle) and the formula (right).

(d) Compare the two results.

(e) Values are: $n = 10000, a = 2.0, r = 0.01$ and $n = 500, a = 0.01, r = 1.1$ and $n = 100, a = 0.0001, r = 2.0$.

(f) Comment on the results.

Some general points:

1. the main point is to get the program to do what the question asks (use either FORTRAN or C),
2. make sure your code is syntactically correct (i.e. it compiles on sciprog),
3. use the compile option "-Wall" and remove any warnings,
4. comment your code and place any observations as comments,
5. make sure the work is your own and upload the completed code to BrightSpace/Canvas.