Assignment I: First Steps and 2D Plots

Due 8/29/2016

1. Plot functions:

1. Bessel function
$$j_0(x) = \frac{\sin x}{x} \tag{1}$$
for $x \in [0, 10]$. Write a code to create your data input file for *xmgrace* and take special care for $x \to 0$.

2. Legendre function of the second kind
$$\begin{aligned} Q_0(x) &= \frac{1}{2}\ln\left(\frac{1+x}{1-x}\right) \\ Q_3(x) &= \frac{5x^3-3x}{4}\ln\left(\frac{1+x}{1-x}\right) - \frac{5x^2}{2} + \frac{2}{3} \end{aligned} \tag{2}$$
for $x \in [-0.95, 0.95]$.Write a code to create your data input files for *xmgrace*.

2. Complex Numbers
A complex number z is defined in terms of its real and imaginary parts as
$$z = x + iy = r; e^{i\phi}, \tag{3}$$
where $r = \sqrt{x^2 + y^2}$ and $\phi = \tan^{-1}(\frac{y}{x})$.

(a) Write a program that gets the computer to print a table of the form

ϕ	x	y	$\sqrt{z}$	$\ln z$	atan(y/x)	atan2(y,x)
-4π	*	*	*	*	*	*
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
15π/4	*	*	*	*	*	*
4π	*	*	*	*	*	*

Here ϕ will increase with uniform steps, and the other columns are to be the computer's output. A start of the code is given as *cnumbers.f90*. Look up the relevant Fortran

intrinsic functions in the SunStudio 12 Fortran Library Reference under Fortran 95 Intrinsic Functions (see under references on the class URL). You may choose $r = 1.$ for the magnitude, but should try with more than one value.

(b) Make a plot of the output phases obtained with the arctangent functions versus the input phase ϕ.

(c) If your plotting program appears to be making some strange jumps, you may need to use more points near a multiple of $\pi/2$ and avoid being precisely "at" a multiple of $\pi/2$.

(d) If you compiler is not bright enough to automatically use a complex library routine when you feed it a complex number, you may have to look up the particular function name required to evaluate a complex function. See SunStudio 12 Fortran Library.

(e) State clearly where the computer has placed the cuts for the sqrt, ln, atan, and atan2 functions. Compare with the descriptions in the SunStudio 12 Fortran Library.