Computational Physics HW2

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1 EX1

I calculated the machine precision using the equation

$$\epsilon = 2^{-b}, \tag{1}$$

where b is the number of bits (52 for a double and 23 for a float). I calculated a precision of $1.19209e-07$ for a float and $2.22045e-16$ using both equation 1 and the program.

2 EX2

Table 2 gives a sample of stretch-factors calculated using both equations. The maximum value of β for which the fractional error is one part in one thousand or less is 0.9999999999999999.

β	γ	ϵ	γ
0.9	2.29416	0.1	2.29416
0.99	7.08881	0.01	7.08881
0.999	22.3663	0.001	22.3663
0.9999	70.7124	0.0001	70.7124
0.99999	223.607	1e-05	223.607
0.999999	707.107	1e-06	707.107

3 EX7

We have a kronecker delta potential which yields the Schrodinger Equation

$$\frac{-\hbar^2}{2m}\frac{d^2\psi}{dx^2} - V\delta(x)\psi = E\psi \tag{2}$$

Following Griffiths, the solution is

$$\psi = \begin{cases} e^{ikx} + \left(\frac{1}{1-i\beta} - 1\right) e^{-ikx}, & x \geq 0 \\ \frac{1}{1-i\beta} e^{ikx}, & x < 0 \end{cases} \tag{3}$$

where,

$$k = \frac{\sqrt{2mE}}{\hbar} \tag{4}$$

and

$$\beta = \frac{mV}{\hbar^2 k}. \tag{5}$$

The reflection coefficient is

$$R = \frac{1}{1 + (2\hbar^2 E/mV^2)}. \tag{6}$$

The transmission coefficient is

$$T = \frac{1}{1 + (mV^2/2\hbar^2 E)} \tag{7}$$

4 EX8

x	$\sin(ix)$	$i\sinh(x)$	$\cos(ix)$	$\cosh(x)$
-5	(-0,-74.2032)	(-0,-74.2032)	(74.2099,-0)	(0,74.2099)
-3	(-0,-10.0179)	(-0,-10.0179)	(10.0677,-0)	(0,10.0677)
0	(0,0)	(0,0)	(1,0)	(0,1)
2	(0,3.62686)	(0,3.62686)	(3.7622,-0)	(0,3.7622)
4	(0,27.2899)	(0,27.2899)	(27.3082,-0)	(0,27.3082)

5 EX9

a	b	c	x_1	x_2
(1,0)	(4,0)	(0,0)	(0,0)	(-4,0)
(1,0)	(4,0)	(2,0)	(-0.585786,0)	(-3.41421,0)
(1,0)	(4,0)	(6,0)	(-2,1.41421)	(-2,-1.41421)
(1,0)	(4,0)	(-6,0)	(1.16228,0)	(-5.16228,0)
(1,0)	(4,0)	(-4,0)	(0.828427,0)	(-4.82843,0)
(1,0)	(4,0)	(0,0)	(0,0)	(-4,0)
(1,0)	(4,0)	(-6,0)	(1.16228,0)	(-5.16228,0)
(1,0)	(2,0)	(0,0)	(0,0)	(-2,0)
(1,0)	(2,0)	(6,0)	(-1,2.23607)	(-1,-2.23607)

6 EX10

I cannot download eign on my current (borrowed) machine so I will try this problem again once I fix my laptop.

Eigenvalue 0 = (0,0)
Eigenvalue 1 = (0,0)
Eigenvalue 2 = (0,6.95314e-310)