Assignment-1 report

ME-685A

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Note: This is resubmitted on 8th of June

Q-1) here to determine condition number of problem with given function:

- We are talking the expression as function of variable x and y
- Taking the absolute value of function value for range of values of x and y
- Taking norm of input data i.e. x and y
- Taking perturbation of 0.001 and determining absolute and norm of difference in function value for perturbed input data and actual input data, and difference of perturbed input and actual input respectively
- Calculating condition number as:

Condition number = $\dfrac{\frac{|\nabla f(x,y)|}{|f(x,y)|}}{\frac{\sqrt{\nabla x^2 + \nabla y^2}}{\sqrt{x^2 + y^2}}}$

Q-2) here we have used standard expression given to us with input as co-efficient of all powers of x

Q-3) 1st order differentiation of function f(x) if given by for central difference is:

f'(x)=$\frac{1}{2h}$(f(x+h)-f(x-h))$-\frac{1}{6}$ (f'''(x)h^3) $-O(h^4)$

3rd order differential is derived using two more points were function is evaluated:

f'''(x)=$\frac{1}{2h^3}$ (f(x+2h)-f(x-2h)-2f(x+h)+2f(x-h))$-\frac{1}{4} f(x)^V h^2$

substituting 3rd order derivative in formula of 1st order gives:

f'(x)=$\frac{1}{12h}$(8f(x+h)-8f(x-h)-f(x+2h)+f(x-2h))$+\frac{1}{30} f(x)^V h^4$

for 2nd order derivative:

from central difference we are having:

f''(x)=$\frac{1}{h^2}$(f(x+h)+f(x-h)-2f(x))$-\frac{1}{12}(f(x)^{IV} h^2)$ $-O(h^4)$

to eliminate f(x) from above equation we will use expression for 4th order derivative

f(x+2h)−f(x−2h)=2f(x) + 4f''(x) h^2 +$\frac{4}{3}$ $(f(x)^{IV}h^4)$ + $\frac{1}{60}(f(x)^{VI}h^6)$

making f(x) subject and using in expression of second order derivative will give:

f''(x)=$\frac{1}{3h^2}$(f(x+2h)+f(x−2h)−f(x+h)−f(x−h))−$\frac{5}{12}$ $(f(x)^{IV}h^2)$

Order of error:

- 1st derivative =error of order 4
- 2nd derivative =error of order 2
- 3rd derivative =error of order 2

Q-4) Assuming valley is between mountain ridge and sea

- Taking a reference point and assigning distance to lighthouse and peak, this leads to one dimension very large compare to other
- Here we are taking reference near peak
- And defining location of both reference gives
  Peak= (−a sin(5), a cos(5))
  Lighthouse= (b cos(10), b sin(10))

Q-5) by using the series and parallel connection of resistance:

- First equivalent resistance of system is calculated
- Then using the ohm's law:
  - emf=current*equivalent resistance, total current from battery is calculated
- And at each junction current gets divided in unequal amount which is computed using principal of parallel resistance i.e. for emf, all parallel branches have same emf
- Solution for suggested case
- (A) Current from battery: 0.08404611379695054; Current in each branch: [0.07549274823354413, 0.00706582372629283, 0.0011156563778385031, 0.00037188545927507866]
- (B) Current from battery: 0.2553656228071607; Current in each branch: [0.23390313157851794, 0.019278219292090504, 0.0018040437996725833, 0.0002831312521539564, 8.893748270255575e−05, 7.343462471109952e−06, 8.15939552034628e−07]

- (C) Current from battery: 0.08404612568118326; Current in each branch: [0.0754926175069841, 0.007064552113390854, 0.0011087278701576442, 0.00034827148885632764, 2.8704470913021307e-05, 2.6866238625467e-06, 4.2419578749619546e-07, 1.4141123126643063e-07]
- (D) Current from battery: 0.1740754823266365; Current in each branch: [0.1296225883668175, 0.04071680044717951, 0.00335586532078469, 0.00031403978594635173, 4.928616231258953e-05, 1.5481675120887495e-05, 1.2759903712522558e-06, 1.1936554156211088e-07, 1.8515292965481933e-08, 6.697269183675303e-09]
- Note: this program can work on any finite number of loops

Q-6) input are taken for number of rows and columns and based on that all element of co-efficient matrix and RHS matrix are asked for input

- Solution for suggested case is
- (A) [-0.0799999999999996, 2.1999999999999997, 1.16]
- (B) infinite possible solution
- (C) [0.25590872, 0.16218419, 0.12387938]
- (D) no possible solution