

Homework 3

Aasim Zahoor

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1 Problems

Link https://github.com/AasimZahoor/Comp_methods.git

Problem 1

In this problem I use two random matrices to test my matrix class. I used numpy's functionality to test some of the instances of the class. There were 7 instances in my class. So I tested addition, multiplication, transpose, trace, Determinant, Inverse and LU decomposition. The output is:

```
In [423]: runcell(1, '/Users/aj3008/Desktop/MS_3rd_Sem/
Comp_methods_in_AST/Comp_methods_hw/Hw_3/pb1.py')
.....[[1, 0, 0], [54.0, 1, 0], [27.0, 0.5111111111111111, 1]] [[1, 2,
33], [0, -90.0, -1776.0], [0, 0, 35.733333333333235]]

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Ran 7 tests in 0.008s

OK

In [424]: runcell(1, '/Users/aj3008/Desktop/MS_3rd_Sem/
Comp_methods_in_AST/Comp_methods_hw/Hw_3/pb1.py')
.....[[1, 0, 0], [54.0, 1, 0], [27.0, 0.5111111111111111, 1]] [[1, 2,
33], [0, -90.0, -1776.0], [0, 0, 35.733333333333235]]

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Ran 7 tests in 0.011s

OK

In [425]:
```

Problem 3

In the code for Problem 3 I have defined 3 functions. They are:

- **euler**(x_0, y_0, f, h, k) This function call euler method for solving ODE. The arguments are:
 x_0 =initial x value y_0 =initial y value f =function of x,y,t h =step size k =number of times
It returns x,y,t values in that order
- **heun**($x_0, y_0, f, h, k, p = 10$)
This function call Heun's method for solving ODE. The arguments are:
 x_0 =initial x value, y_0 =initial y value, f =function of x,y,t, h =step size, k =number of times, p =picard's iteration (Default value 10)
It returns x,y,t values in that order
- **rk**(x_0, y_0, f, h, k)
This function call RK-4 method for solving ODE. The arguments are:
 x_0 =initial x value, y_0 =initial y value, f =function of x,y,t, h =step size, k =number of times
It returns x,y,t values in that order

Problem 4

In this problem we are supposed to test the functions we wrote in problem 3 using the pendulum function. To model the function I have made a function called **f(b,c)**. This function takes two arguments, b = coefficient of y , c = coefficient of $g(x,t)$. This function returns an array where the first element gives $d(\theta)/dt$ and the second element returns $d(\omega)/dt$. They values of b is taken as 0.25 and c as 5, step size is 0.1 and k (number of times) is 50 (to see the difference between the three methods) and 200 (to see how damping works).

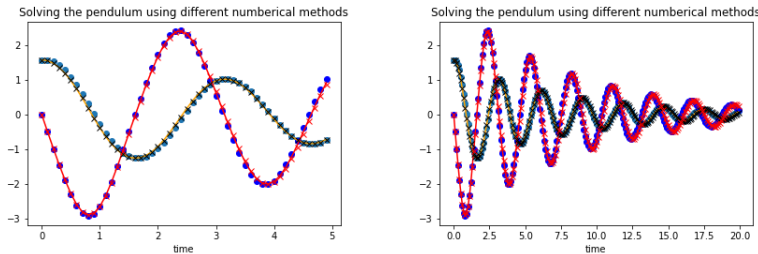


Figure: The figure on the left is for $k=50$ and one on the right is for $k=200$

Problem 5

In this problem we are supposed to test our methods on the given equation. I defined a function **f(1)** which returns the function given in pb5. It takes lambda as input and gives an array as out where first element is always 1 and second element gives dy/dt in terms of y and t . The reason it gives 1 as the first element is because my ODE solvers were made for 2 dependent variables and this has only 1.

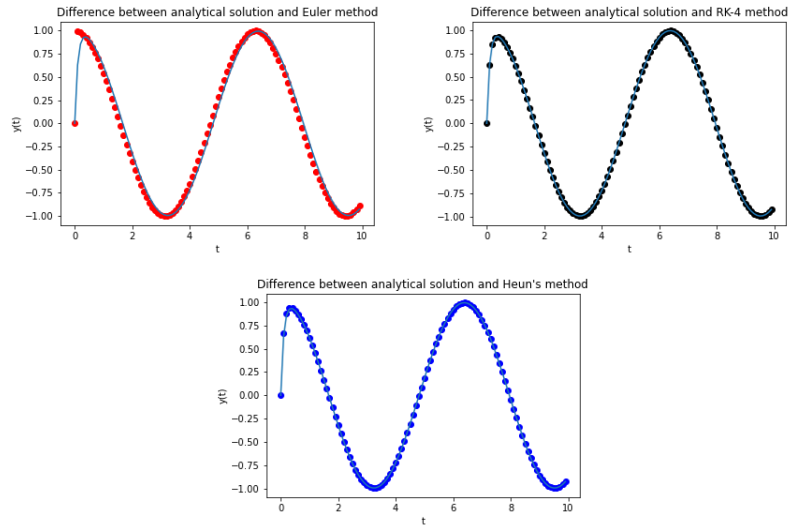


Figure: These figures shows the three methods against the analytical solution.