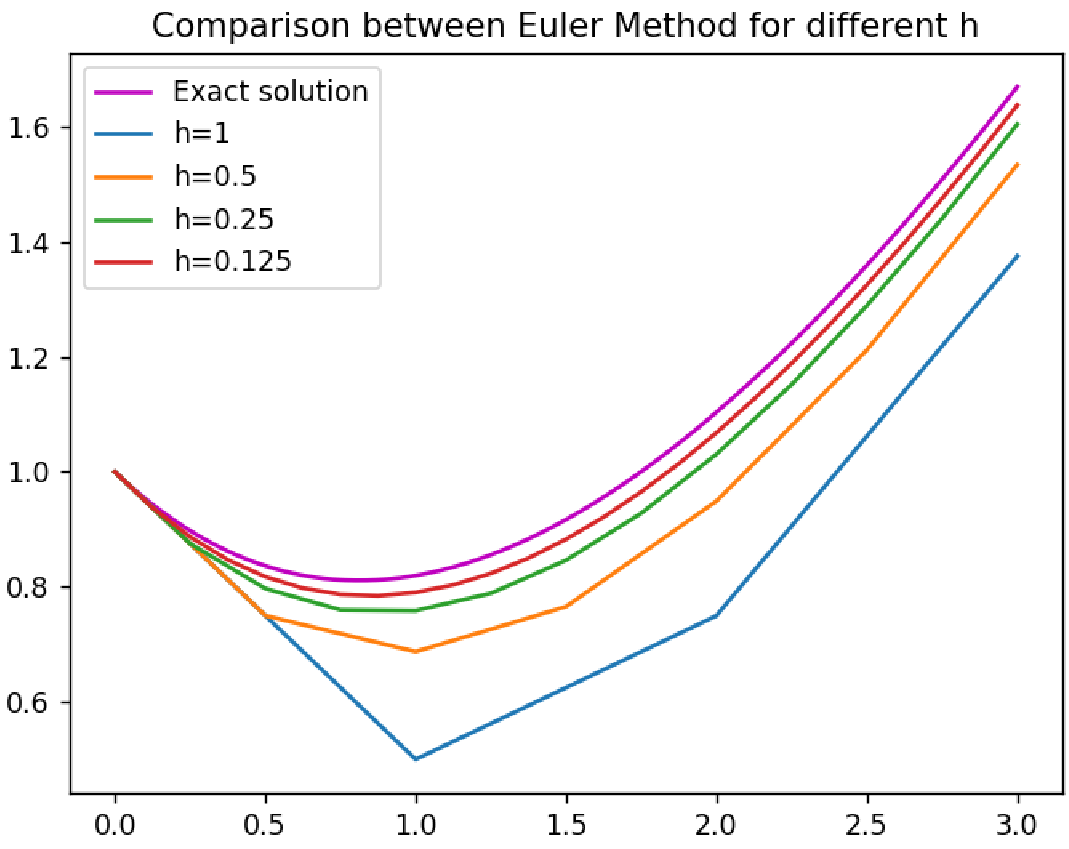
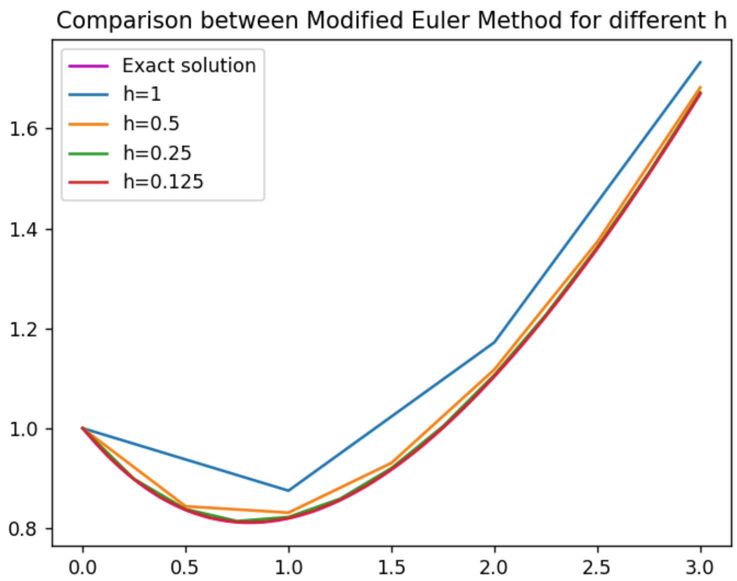
Problem1

Part a

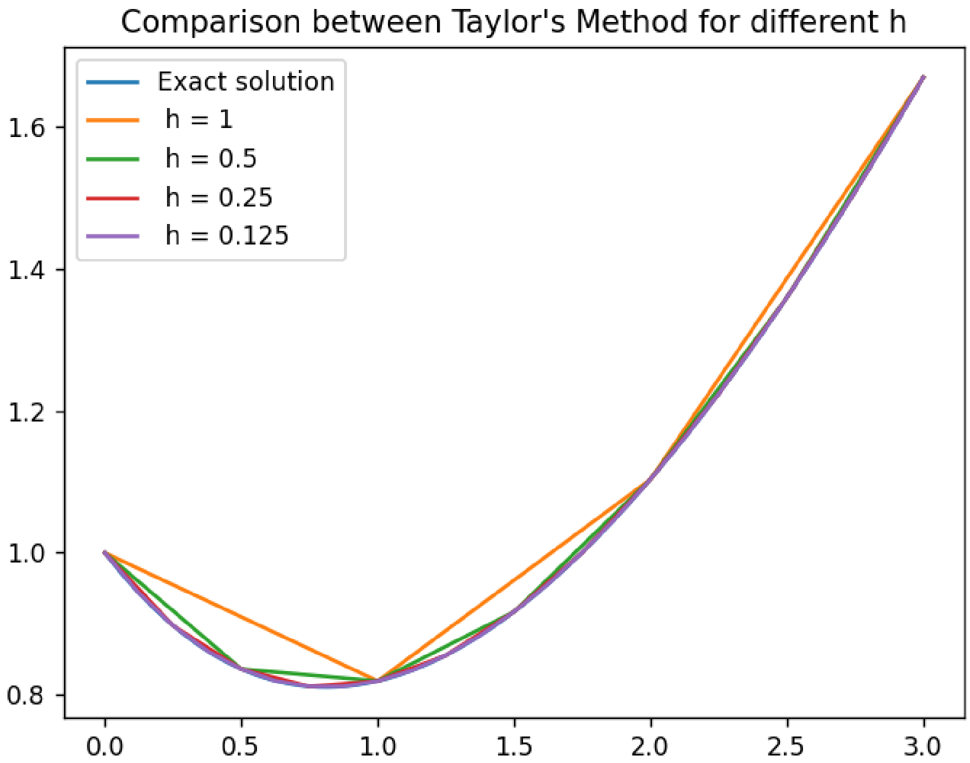


We can clearly see that higher the step size, we get a better approximation to the actual value.

Part b



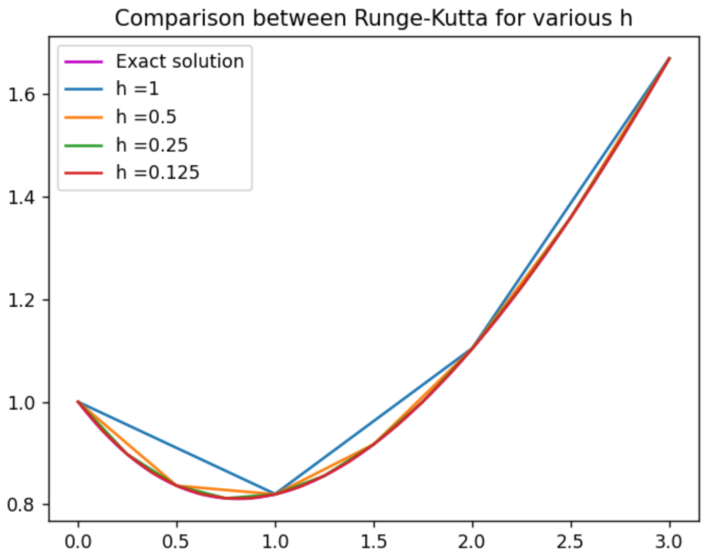
Similarly we can see that although the modified Euler produces better approximation when compared to Euler method for the same step size, it still obeys the rule that smaller h leads to better approximation.



Part c

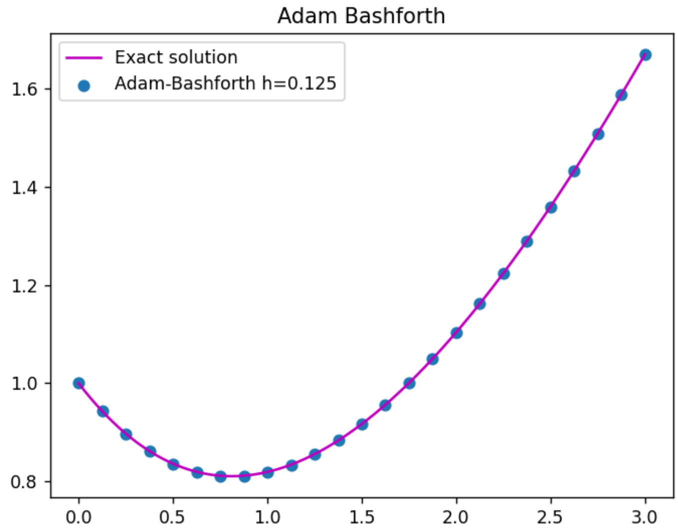
Taylor method is better than Modified Euler for the same step size but, it still obeys the rule that smaller h leads to better approximation.

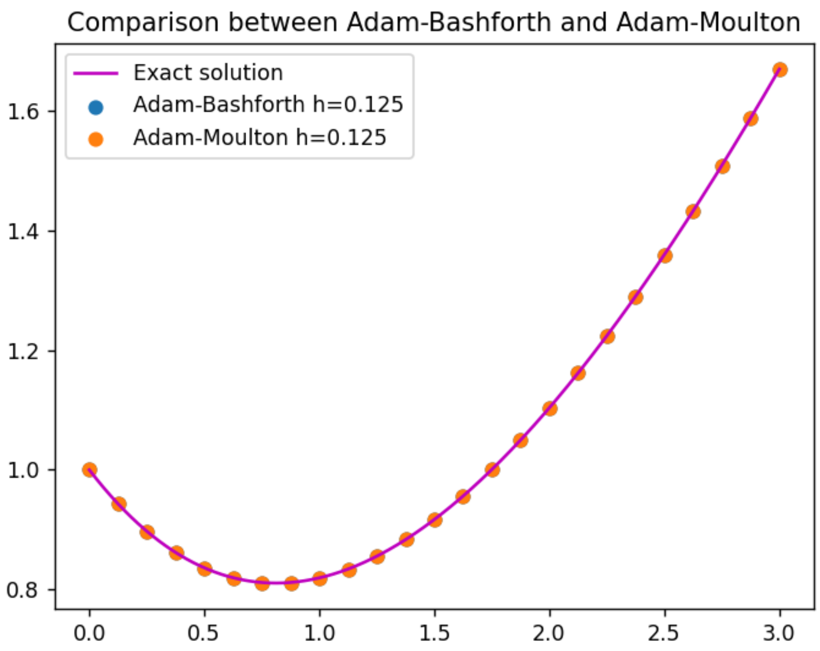
Part d



It is hard to compare whether Taylor method is better than Runge-Kutta but theoretically it holds, we can see that it still obeys the rule that smaller h leads to better approximation.

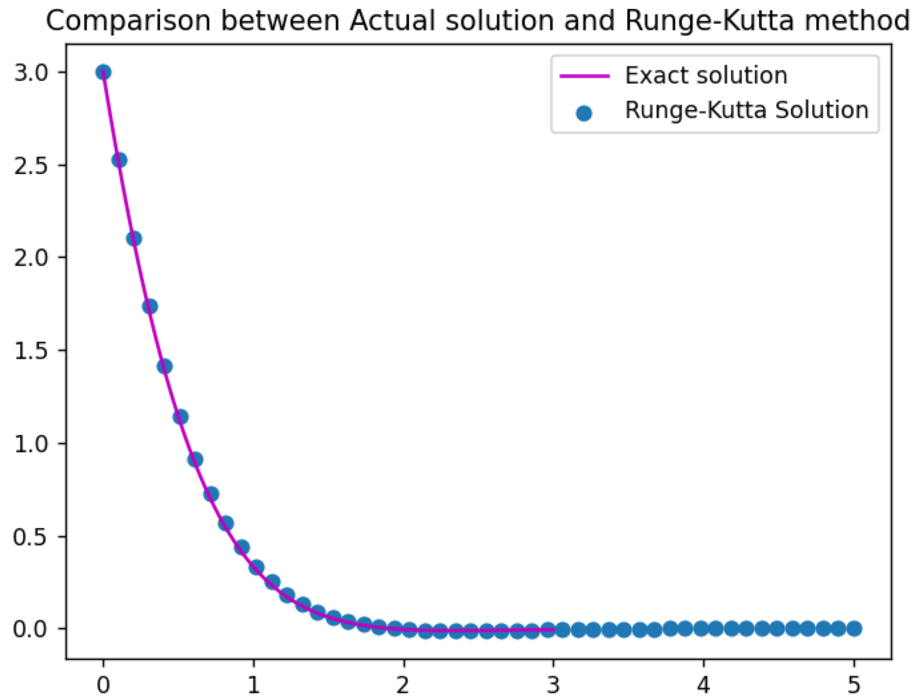
Part e and f





The deviation from the actual value between Adam Bashforth and Adam-Moulton method is not much but the implicit method provided much better approximation.

Problem 2



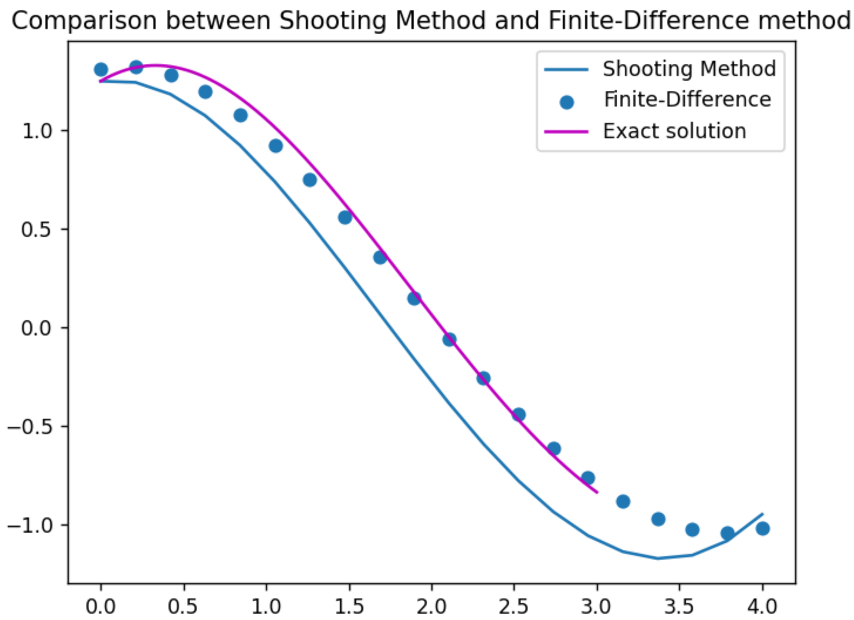
The Runge Kutta method to solve the system of equations works well for this case as we convert them into system of differential equations

U1 = y ; U2 = y’

U1’ = U2

U2’ = -(4*U2 + 5*U1)

Problem 3



The Finite Difference method coincides almost perfectly with the exact solution, but there is significant deviation in the Shooting method it is due to instabilities as we use Runge-Kutta which is intrinsically as IVP but we are changing it to a BVP which make it lose information. This is just more apparent in our case.