Dr. Dirk Zimmer

Virtual Physics

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Exercise 11: Integration Methods

Task 1: (from Exam WS 2010/2011)

Below you find the Butcher Tableau of an RK method of 3rd order.

0	0	0	0
1/3	1/3	0	0
2/3	0	2/3	0
1	1/4	0	3/4

Perform one integration step of this method on the following system!

$$dx/dt = -x^2 - 2 + 3t$$

Start at t=0 with $x_{t=0} = 1$. The step-size h is 1.

Return the result for $x_{t=1}$ as well as for the two sub-steps

Compute with rational numbers.

Task 2: (from Exam WS 2011/2012)

Below you find the coefficients for the BDF methods of different orders.

	α_{t+h}	α_t	α_{t-h}	α_{t-2h}	α_{t-3h}
BDF 1	1	-1			
BDF 2	3/2	-2	1/2		
BDF 3	11/6	-3	3/2	-1/3	
BDF 4	25/12	-4	3	-4/3	1/4

Perform 3 integration steps of the highest applicable BDF method on the following system!

$$dx/dt = 2x - t + 1$$

Start at t=0 with $x_{t=0} = -1$. The step-size h is 1.

Return the result for $x_{t=1}$, $x_{t=2}$, and $x_{t=3}$.

Compute with rational numbers.