

MIT 16.90 Spring 2014: Problem Set 1

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Due: Tuesday Feb 18, in class

Problem 1.1 *Reading Assignment*

- Unit I: Convergence
 - Unit I: Zero stability and the Dalquist Equivalence Theorem
 - Unit I: Systems of ODEs and eigenvalue stability
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Problem 1.2 *Two-step schemes with highest local order of accuracy*

Consider numerical schemes for solving the first order ODE

$$\frac{du}{dt} = f(u)$$

1. Within the class of explicit two-step schemes of the form

$$v^{n+1} = \alpha_1 v^n + \alpha_2 v^{n-1} + \beta_1 \Delta t f(v^n) + \beta_2 \Delta t f(v^{n-1})$$

What choices of $\alpha_1, \alpha_2, \beta_1, \beta_2$ has the highest order of accuracy? Why?

2. Within the class of implicit two-step schemes of the form

$$v^{n+1} = \alpha_1 v^n + \alpha_2 v^{n-1} + \beta_0 \Delta t f(v^{n+1}) + \beta_1 \Delta t f(v^n) + \beta_2 \Delta t f(v^{n-1})$$

What choices of $\alpha_1, \alpha_2, \beta_0, \beta_1, \beta_2$ has the highest order of accuracy? Why?
