CHEE 3602 – Topic 7: Ordinary differential equations

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Final thoughts

Remember

This topic barely scratches the surface of ODEs. The goal was to introduce some of the major considerations and common strategies that go into solving ODEs, but there is not enough time to cover all of the important concepts.

From fluid dynamics and heat exchangers to anti-missile defence, differential equations are one of the core pillars of numerical methods — this topic will not go away once you pass the final exam.

Summary

- Multi-point methods
  - using multiple points enables more efficient calculation by taking advantage of past calculations
- Adaptive step size
  - changing step size is an effective means of ensuring a specified error tolerance
- In practice, you should not have to choose between using multiple points and adaptive step size control
  - advanced modern algorithms routinely do both at once along with adaptive changes in estimate order and more

Further reading

The introduction to part II of the book offers an excellent introduction to differential equations. Everyone should read this section. Initial value problems and the Euler method are covered in 7.1-7.6. Section 7.9 covers a number of multi-point methods. You are directly responsible only for Adams-Bashforth, but it will be valuable to read up on the other methods in this section. Section 7.7.2 starts the discussion of the Runge-Kutta method, but all of section 7.7 would be useful to read.