SyDe 312
Numerical Methods

Who? What? Where?

- Stephen Birkett, Systems Design Engineering
- research
  - piano technology and design
  - physical systems modelling and simulation
  - Motion Research Group (MoRG)
  - postmodern piano team project
- E3-3158 Ext3792
- http://real.uwaterloo.ca/~sbirkett

Course resources

- listserv syde312@yahoogroups.com
  - announcements
  - discussion
  - clarification
  - help
- webpage http://real.uwaterloo.ca/~sbirkett/syde312.htm
  - course material/topics/info/hot stuff
  - lecture slides
  - assignments & solutions
  - tests & solutions

What is SyDe312?

- looks, feels, smells, and tastes like a math course
- isn't really a math course
- you'll definitely learn some math but remember....
- ...math is the servant of the engineer not the master [not all math profs would agree with that sentiment]

Why study numerical methods?

- can't we rely on computer software packages to solve numerical problems now?
- up to a point yes but...
- ... moderately complicated problems [or even simple pathological problems] can lead to numerical difficulties that can
  - require fancy footwork to get an accurate answer or
  - completely fail to get any sort of answer

Numerical *analysis*

- is for mathematicians
- deep understanding of fundamental principles of computational algorithms
- implications of choosing between different methods
- prediction of convergence rates
- complex error analysis until you drop from exhaustion

Numerical *methods*

- is for engineers
- = *applied* numerical analysis
- understanding at a practical level
- an effective algorithm is necessary to solve a problem at hand or analyse experimental data
  - how to choose the 'best' method
  - how to implement it
  - how to recognize when things have gone bad or might go bad
  - how to correct a numerical disaster
- get an 'accurate enough' answer 'quickly enough'

Course outline

0. Numerical computation
I. Linear algebra
II. Root finding and nonlinear systems
III. Curve fitting and interpolation
IV. Differentiation and quadrature
V. Integration of differential equations

Powerpoint

- evil

Lectures

- use a combination of overhead slides and board notes
  - balance can be adjusted ....
- printed lecture slides provided for note taking
  - also available on the website for reference
- caveat: the material tends to get a little <d r y> at times
  - I'll try to boost the interest level when we get in the thick of it
  - the variety of rather different topics does help keep things moving
  - be careful to look for common elements to tie different topics together

Business stuff and the small print

- official business conducted on the course webpage
- main communication route via course listserv and email
- assigned problems... submit your work for feedback whenever you want, but no grades are given
- solutions posted online at appropriate times
- three midterm tests (15% each) and final exam (55%)
- a scientific calculator is a minimum requirement [Zehrs type]
- fancy calculator is optional [but no griping later if you choose not to buy one]
- one and a half TAs available for help
- main text has many worked examples...study them carefully
- optional small 'crash course' book for Matlab

Continuous feedback please

- I mean it
- I appreciate and listen to all feedback as we go along
- if something is a problem then tell me because it can often be fixed easily
- remember you guys are our paying customers....