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Chapter 1 : Applied Numerical Methods with MATLAB for Engineers and Scientists

*Practical Numerical Methods with C# [Jack Xu] on racedaydvl.com *FREE* shipping on qualifying offers. This book presents an in-depth exposition of the various numerical methods used in real-world scientific and engineering computations.*

Write your own review here. Natural law is about change. The change in the height of a glider is proportional to the angle of attack of its wings. The change in the speed of cars on a road is proportional to the number of cars. We understand nature in terms of flux and fluctuations. The language needed to describe this change is that of differential equations, which are notoriously difficult to solve. They are so difficult, in fact, that the vast majority of them must be solved by computer. Practical Numerical Methods with Python teaches you how to do exactly that. The course gives students the tools to examine a real-world problem and solve it using a computer. In the process, students learn the fundamentals of programming, scientific computing, and the open-source world. To help educate our fellows at the Perimeter Institute, my Ph. In the collaborative spirit that permeates Numerical Methods With Python, the course is team-taught by three different instructors across the world. All three are numerical-method experts who push the envelope of what problems can be solved using these techniques. They are Professor Lorena Barba, Dr. Ian Hawke, and Professor Carlos Jerez. Professor David Ketcheson of King Abdullah University also contributed to course planning, but ended up not teaching the course because his local numerical methods course was cancelled. Professor Lorena Barba is an associate professor of engineering and applied science at George Washington University. She leads a research group that studies computational methods with a focus on problems in physics and biology. Her group has studied topics as disparate as molecular dynamics, the aerodynamics of flying snakes, and using graphics cards to accelerate computational problem solving. She is also increasingly interested in education; Numerical Methods in Python contains many of the elements that she has advocated for, in particular interactive learning through the IPython notebooks. Ian Hawke is a researcher and instructor at the University of Southampton. Hawke is a leading expert in my own field, numerical relativity. He uses computers to study the catastrophic astrophysical events that create gravitational waves, such as black holes and neutron stars. Hawke is an expert in the computational relativistic fluid dynamics required to study these extreme objects. Hawke is a developer and maintainer of the Whiskey Code and Carpet Mesh Refinement Code for the Einstein Toolkit, which is a large numerical relativity codebase used by hundreds of researchers around the world. He is a leading expert in numerical methods for electromagnetism and he simulates phenomena like laser light passing through a crystal or the electromagnetic field inside a piezoelectric speaker. Most online courses have many video lectures, which often have high production value. Numerical Methods in Python has almost none of that Editors Note: Over the course of the class, there were a total of two video lectures, which were simply some hand-drawn slides on a tablet with a voice-over by Professor Barba. Instead, the bulk of the class material is presented through IPython notebooks. IPython is currently in the process of rebranding into Jupyter. The bulk of the class material is presented through IPython notebooks IPython notebooks are interactive documents. You can put anything into them: You can type a snippet of Python code into an IPython notebook and run it. This means that the instructors can explain a problem, describe the numerical method to solve it, and offer an example that the student can play with and extendâ€”all in the same document. A piece of an IPython notebook from the first lesson is included below. Instead, the instructors prepare an IPython notebook for students to play with, explore, and expand upon. The result is something much more interactive than traditional coursework, despite the large student to professor ratio. And for me, at least, it worked incredibly well. I found working through IPython notebooks much more fun than watching video lectures, and I think my fellows and I at the Perimeter Institute retained much more information than if we had absorbed it passively from a video. Students could reach them on the course forum, which by the end of the course was a thriving community where students helped each other, and on social media, especially Twitter. It assumes no prior programming experience and it covers a broad variety of topics, including simple ordinary differential equation methods, to computational fluid dynamics, reaction-diffusion problems such as one might encounter

in computational biology or chemistry, and boundary value problems such as one might encounter in electrical engineering. There is a price to such breadth, however, and that price is depth. Many times, I felt the presentation was a little too mathematically simplistic. All of the numerical methods covered are deeply interconnected by a number of mathematical formalisms such as finite differences or functional analysis , but this interrelatedness was not explored. Instead, the methods are motivated and described on a case-by-case basis. The result is that the field feels a bit disconnected and disjointed, especially in the computational fluid dynamics section. Some of my fellows at the Perimeter Institute felt confused by this picture. There is a more unified picture, and I wish it were presented. However, I think the instructors did the best possible job considering their constraints. This course seeks to give as many people as possible the foundations they need to solve difficult problems numerically. And in this goal, it succeeds admirably. So although I would have liked to see some topics covered in more depth, I think the instructors struck the right balance. They usually force you to take the examples presented in the lessons and build on them to solve a related, but new problem. I recommend trying them blind and then going to the class forum to ask for help when you get stuck. This is pretty accurate. Indeed, one really only needs to understand what a differential equation is, not how to actually solve one, in order to participate in this course. A typical university course in differential equations is an overview of techniques to solve differential equations by hand, and none of those techniques are relevant here. The class is very much self-paced and the online course never officially ended, so you can devote as much or as little time as you like per week. Indeed, the course material was released quite slowly; I often found myself waiting for new material to be released. Open-source and scientific ethics permeate the course structure. All of the IPython notebooks are housed on the collaborative website GitHub and distributed through the Git version control system, which is exactly how the open-source and scientific communities collaborate among themselves. The instructors also encourage and publicize efforts that build on their lessons. In other words, the instructors are teaching by example how an open-source or scientific project should be managed. Of course, this structure has educational benefits. So in many ways, open-source ideals and educational techniques are a match made in heaven. Inspired by this course, Professor Phillip B. Berkeley has converted his course on the statistics of auditing and litigation into IPython notebooks and placed them on a repository on Github. And a section on the numerical convergence in Practical Numerical Methods with Python has inspired a community discussion that eventually resulted in the beginnings of a whole open-source textbook on testing scientific code. Practical Numerical Methods with Python has been so successful in improving the broader community precisely because the creators have embraced the open-source ethics I describe above. The IPython notebooks make working through the material a blast, and I think I retain it better. The course teaches not only numerical techniques but open-source and scientific sensibilities, indoctrinating students into the open-source community. In summary, the course name is slightly wrong. Jonah is a Ph. In his spare time, he tries to make physics and math accessible for everyone on his blog. Class Central is looking for reviewers and regular contributors. Drop us a mail.

Chapter 2 : Practical Numerical Methods with - Download

This latest edition expands Practical Numerical Methods with more VBA to boost Excel's power for modeling and analysis using the same numerical techniques found in more specialized math software.

Boost the Power of Excel! Use Excel with VBA to obtain high precision numerical solutions to complex engineering problems. Create custom functions, macros, and user-forms with VBA to boost your Excel workbooks. Validate input, collaborate, and document results in Excel. Enhance Excel with a companion Suite of more than powerful VBA macros, functions, and forms for numerical analysis. Learn applied numerical methods from over working Excel Example Files from the book. Find roots to linear systems, eigenproblems, and nonlinear systems of equations in Excel using the Solver and advanced solution methods in VBA like the method of continuation. The Examples folder contains simulations of these methods. Propagate uncertainty in design calculations using bootstrapping, truncated Taylor series linearized models, and Monte Carlo methods with latin hypercube sampling. Model data in Excel with multivariable linear and nonlinear least-squares regression with Excel add-ins, the Solver, optimization macros, Jack Knife, Gauss-Newton or Levenberg-Marquardt methods with verification, validation, and uncertainty analysis. Interpolate single variable and bivariate data sets in Excel worksheets using lines, polynomials, rational functions, cubic splines, B Splines, and Hermite constrained splines. Get high precision numerical solutions in Excel for Calculus problems involving: Single and multiple integrals, Systems of ordinary differential equations, Second-order Boundary-value problems, and Partial differential equations. Use stochastic Monte Carlo methods in Excel for uncertainty and risk analysis, optimization, and integration. Simplify your work with user-defined functions that extend unit conversion, large cycle pseudo-random number generation, outlier tests, and yx graphing of worksheet functions and data. User Feedback - See what users are saying about the book. Errata - Updates and corrections. Please report any errors not listed in the errata. Thank you for visiting the PNM3 web site. Send Feedback by E-mail to Richard Davis:

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Chapter 3 : Numerical methods for ordinary differential equations - Wikipedia

Practical Numerical Methods with C# by Jack Xu This book presents an in-depth exposition of the various numerical methods used in real-world scientific and engineering computations. It emphasizes the practical aspects of C# numerical methods and mathematical functions programming, and discusses various techniques in details to enable you to.

Much effort has been put in the development of methods for solving systems of linear equations. Standard direct methods, i. Iterative methods such as the Jacobi method , Gaussâ€"Seidel method , successive over-relaxation and conjugate gradient method are usually preferred for large systems. General iterative methods can be developed using a matrix splitting. Root-finding algorithms are used to solve nonlinear equations they are so named since a root of a function is an argument for which the function yields zero. Linearization is another technique for solving nonlinear equations. Solving eigenvalue or singular value problems[edit] Several important problems can be phrased in terms of eigenvalue decompositions or singular value decompositions. For instance, the spectral image compression algorithm [4] is based on the singular value decomposition. The corresponding tool in statistics is called principal component analysis. Mathematical optimization Optimization problems ask for the point at which a given function is maximized or minimized. Often, the point also has to satisfy some constraints. The field of optimization is further split in several subfields, depending on the form of the objective function and the constraint. For instance, linear programming deals with the case that both the objective function and the constraints are linear. A famous method in linear programming is the simplex method. The method of Lagrange multipliers can be used to reduce optimization problems with constraints to unconstrained optimization problems. Numerical integration Numerical integration, in some instances also known as numerical quadrature , asks for the value of a definite integral. These methods rely on a "divide and conquer" strategy, whereby an integral on a relatively large set is broken down into integrals on smaller sets. In higher dimensions, where these methods become prohibitively expensive in terms of computational effort, one may use Monte Carlo or quasi-Monte Carlo methods see Monte Carlo integration , or, in modestly large dimensions, the method of sparse grids. Numerical ordinary differential equations and Numerical partial differential equations Numerical analysis is also concerned with computing in an approximate way the solution of differential equations , both ordinary differential equations and partial differential equations. Partial differential equations are solved by first discretizing the equation, bringing it into a finite-dimensional subspace. This can be done by a finite element method , a finite difference method, or particularly in engineering a finite volume method. The theoretical justification of these methods often involves theorems from functional analysis. This reduces the problem to the solution of an algebraic equation. List of numerical analysis software and Comparison of numerical analysis software Since the late twentieth century, most algorithms are implemented in a variety of programming languages. The Netlib repository contains various collections of software routines for numerical problems, mostly in Fortran and C. Also, any spreadsheet software can be used to solve simple problems relating to numerical analysis.

Chapter 4 : [PDF/ePub Download] practical numerical methods with c eBook

This book presents an in-depth exposition of the various numerical methods used in real-world scientific and engineering computations. It emphasizes the practical aspects of C# numerical methods and mathematical functions programming, and discusses various techniques in details to enable you to.

Chapter 5 : Practical Numerical Methods: Algorithms And Programs by Michael Kohn

Numerical methods for differential equations are relevant across all of science and engineering. This course is for anyone with mathematical, scientific or engineering backgrounds who wishes to develop a grounding in scientific computing.

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Chapter 6 : Numerical analysis - Wikipedia

This is a first course in numerical methods for advanced students in engineering and applied science. It was developed in , both as a massive open online course (MOOC) and a regular course at the George Washington University.

Chapter 7 : Announcing â€œPractical Numerical Methods with Pythonâ€• MOOC :: Lorena A. Barba Group

"Practical Numerical Methods with Python" is an open, online course hosted on an independent installation of the Open edX software platform for MOOCs. The MOOC (massive open online course) was run in for the first time by Prof. Barba at the George Washington University.