

# Summary of course and the final exam

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Spring 2016

## Learning outcomes

Our ideal about knowledge on computational science

Does that match the experiences you have made this semester?



## Topics we have covered this year

- Linear algebra and eigenvalue problems. (Lecture notes chapters 6.1-6.5 and 7.1-7.5 and projects 1 and 2).
- Ordinary differential equations (Lecture notes chapter 8 and projects 3 and 4 )
- Partial differential equations (Lecture notes chapter 10 and project 4)
- Monte Carlo methods in physics (Lecture notes chapters 11, 12 and 13, project 4)

## Linear algebra and eigenvalue problems, chapters 6.1-6.5 and 7.1-7.5

- Know Gaussian elimination and LU decomposition (project 1)
- How to solve linear equations (project 1)
- How to obtain the inverse and the determinant of a real symmetric matrix

- Cubic spline
- Tridiagonal matrix decomposition (project 1)
- Householder's tridiagonalization technique and finding eigenvalues based on this
- Jacobi's method for finding eigenvalues (project 2)

### **Monte Carlo methods in physics (Chapters 11, 12 and 13)**

- Random walks and Markov chains
- Metropolis algorithm (project 4)
- Applications to statistical physics systems (project 4)

### **Ordinary differential equations (Chapter 8)**

- Euler's method and improved Euler's method, truncation errors (projects 3 and 4)
- Runge Kutta methods, 2nd and 4th order, truncation errors (projects 3 and 4)
- Leap-frog and Verlet algorithm (projects 3 and 4)
- How to implement and solve a second-order differential equation, both linear and non-linear.
- How to make your equations dimensionless.

### **Partial differential equations, chapter 10**

- Set up diffusion, Poisson and wave equations up to 2 spatial dimensions and time
- Set up the mathematical model and algorithms for these equations, with boundary and initial conditions. The stability conditions for the diffusion equation.
- Explicit, implicit and Crank-Nicolson schemes, and how to solve them. Remember that they result in triangular matrices (project 4).
- Diffusion equation in two dimensions.

## Final presentation

- Introduction with motivation
- Give a short overview of the theory and numerical algorithms employed
- Discuss the implementation of your algorithm and how you verified it and validated it
- Present and discuss your results
- Summary, conclusions and perspectives
- Anything else you think is important. Useful to have backup slides

In total your talk should have a duration of 20-25 minutes, but longer is also ok. The style for the final presentation follows very much the way the lay out your reports.

## What? Me worry?





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Best wishes to you all and thanks so much for your efforts this semester

