

# **Some Remarks on Undergraduate Computational Science**

by

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**<http://www4.ncsu.edu/eos/users/w/white/www/white/teach99.htm>**

## **Calculus must make room for computation science**

- **Reduce the calculus from 12 credits to 9 credits**
- **Use computing tools to do the more technical parts of calculus**
- **Consolidate the numerical aspects of calculus**

## Attributes of Computation Science

- *Cross disciplines:*  
applications, mathematics and computing
- *Illustrate the process:*  
application, model, method, computation and assessment
- *Model types:*  
deterministic/statistical, continuous/discrete,  
simplistic/complex

## **Computation Tool Criteria**

- **Should be useful to the present course**
- **Used in at least one subsequent course**
- **Professional computing tool**

**Examples: Spreadsheets for life and management students**  
**Matlab for many engineering students**

## **Introduction to Computation Science**

- **A single three-credit course or three one credit courses**
- **To be taken after two semesters of calculus**
- **To include use of Matlab and**
  - **computational calculus**  
symbolic, numeric, loops, algorithms
  - **differential equation models**  
first and second order, systems, ode45
  - **matrix models**  
linear systems, least squares, eigenvalues

## Lower Level Computation Courses in NCSU Math

- **Four one-credit courses**
  - **Calculus with Maple (distributed over calculus 1,2,3)**
  - **Ma 132: spreadsheets with calculus for the life and management sciences**
  - **Ma "2yy": matrix applications and computations uses Matlab**
  - **Ma 302: application and numerical ODE uses Matlab**
- **Ma "325": introduction to applied mathematics**
  - **taken after multivariable calculus**
  - **five three-week modules on a spectrum of applications**
  - **used to formulate a plan of study for the last two years**

## Upper Level Computation Courses in NCSU Math

- **Ma 402: computational mathematics uses Matlab, Fortran, heat and mass transfer and introduces HPC**
- **Ma 437: application of abstract algebra uses Maple**
- **Ma 573,4: industrial math uses Matlab and physical laboratory**
- **Ma "583": introduction to parallel computing uses MPI**

## **Discussion of the three one-credit course option**

- **Advantages include:**
  - **flexibility in content**
  - **can implement incrementally**
  - **can involve younger and more computationally inclined faculty**
- **Main disadvantages include:**
  - **students tend not to seriously study a one-credit course**
  - **courses that meet once a week during the semester get neglected**
  - **perhaps meeting three times a week for five weeks would be a better format**

## Discussion of the one three-credit course option

- **Advantages include:**
  - cohesive treatment of computation science
  - traditional sized course
  - only use computationally literate faculty
- **Main disadvantages include:**
  - must make room in a 120 credit hour degree
  - may need to revamp the content the very traditional calculus sequence
  - suitable textbooks may be sparse