Introduction

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Parts of the course materials are courtesy of Prof. Roger Jang

Scientific Computing

- We have learned many concepts and theorems in Linear Algebra and other Math courses
  - Rank, null space...
  - Linear transformation
  - Eigenvalues
  - Gauss elimination
  - QR decomposition
  - ...
- But where are their applications?
- More importantly, how do we write code to solve the real problems!

Approach of This Course

- Application orientated!

- We focus on
  - Problem solving
  - Hands-on coding
  - Data/approach visualization
  - Real-world applications

- We will learn how to write programs solving real-life problems

Three Pillars of This Course
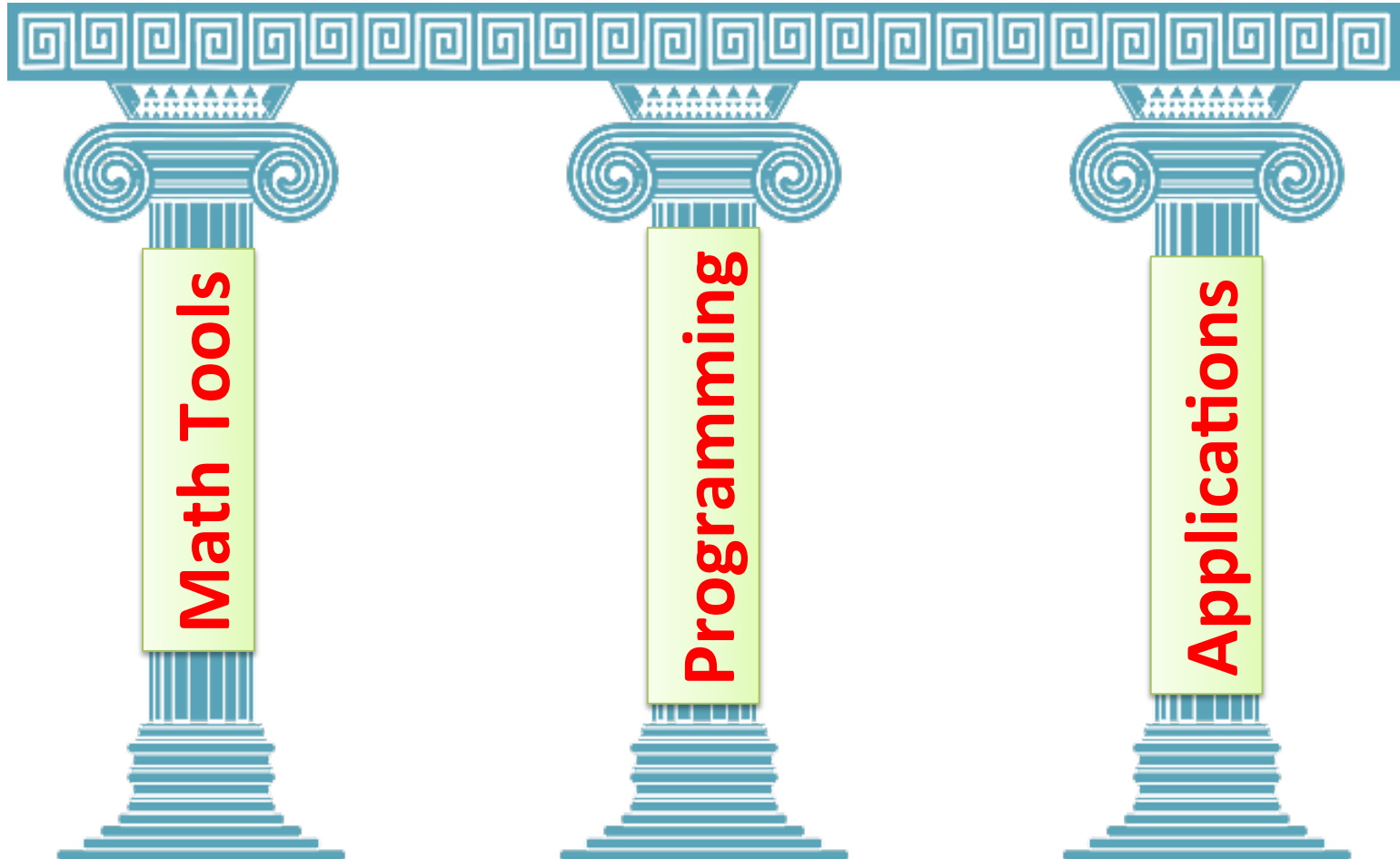
Math Tools

- Least-squares estimate
- Approximation
- Interpolation
- PDF modeling
- Data clustering
- Pattern recognition
- Dynamic programming
- Numerical optimization
- ……

Programming

- Symbolic computing

- Numerical computing

- Matrix computation

- Programming paradigms

- Animation and visualization

- Audio and image processing

- …

Applications

- Personal financial computing
  - Loan and mortgage
  - Insurance
- Least-square estimate
  - Data fitting
- Data clustering
  - Image data compression
  - Object identification
- Classification
  - Texts, audio, images…

- Principal component analysis
  - Dimensionality reduction
  - Data fitting
- Page rank
  - Google's page rank
  - Team ranking
- Dynamic programming
  - Object tracking
- Fractals
- …….

Prerequisites

- STEM (science, technology, engineering, and mathematics) students
  - Calculus: must
  - Linear algebra: must
  - Probability: better to have taken it already
- Non-STEM students
  - Please talk to me before taking the course

Course Format

- Time: Tuesdays 1:20 p.m. - 2:10 p.m., Fridays 1:20 - 3:10 p.m.
- Location: Delta 109
- Office hour: Tuesdays 3:30 p.m.- 4:20 p.m. at Delta 643
- TA:
  - Fang-Yu Shih (scoly_840805 AT yahoo.com.tw)
  - Hsin-Yu Chang (cindy321123 AT yahoo.com.tw)
- Labs (weekly assignment demo): Tuesdays 7:00 - 9:00 p.m. at EECS 328.
- Website: http://nmsl.cs.nthu.edu.tw/index.php/courses

Tentative Plan and Textbooks

- Mathematics typesetting with Latex (2 weeks)
  - "More Math Into Latex", G. Gratzer, 4th Ed., Springer, available online at NTHU's Library at http://link.springer.com/book/10.1007%2F978-0-387-68852-7
- Symbolic computing with SageMath (3 weeks)
  - "Sage for Undergraduates", G. Bard, American Mathematical Society, online version at http://www.gregorybard.com/books.html
- Numerical computing and visualization with Matlab/Octave (10 weeks)
  - "Experiments with Matlab", C. Moler, available online at http://www.mathworks.com/moler/exm/index.html
  - "Numerical Computing with Matlab", C. Moler, available online at http://www.mathworks.com/moler/index_ncm.html

Grading

- Weekly assignments (40% + 5% Bonus): 15 times, 3% each
  - Assignments are given on the last slide of each topic
  - Students turn in their assignments during weekly labs
  - TAs grade assignments during labs
  - Scores will be announced online in real-time
- Midterm (25%) on Latex (10%) and SageMath (15%)
- Final Exam (35%) on Matlab/Octave
- No curving….

Tentative Schedule

Week	Tuesdays 1:20-2:10	Fridays 1:20-3:10	Sample Solutions
1: Sep 11	Introduction	Holidays (No Lecture)	
2: Sep 28	Latex 1: Latex Basics	Latex 1: Latex Basics	
3: Sep 25	Latex 2: Math, Figures, and Tables	Latex 2: Math, Figures, and Tables	
4: Oct 2	Conference Travel (No Lecture)	Midterm Exam 1 (Latex)	
5: Oct 9	SageMath 1: Using SageMath	SageMath 1: Using SageMath	
6: Oct 16	Conference Travel (No Lecture)	Conference Travel (No Lecture)	
7: Oct 23	SageMath 2: Number Theory	SageMath 3: RSA Public Key Cryptosystem	
8: Oct 30	Matlab 1: User Interface	Matlab 1: User Interface	
9: Nov 6	Matlab 2: 2D and 3D Graph	Midterm Exam 2 (SageMath)	
10: Nov 13	Matlab 2: 2D and 3D Graph	Matlab 3: More Graph, Animation, and GUI	
11: Nov 20	Matlab 3: More Graph, Animation, and GUI	Matlab 3: More Graph, Animation, and GUI	
12: Nov 27	Matlab 4: Matrix	Matlab 4: Matrix	
13: Dec 4	Matlab 4: Matrix	Matlab 4: Matrix	
14: Dec 11	Matlab 5: K-Means Clustering	Matlab 5: K-Means Clustering	
15: Dec 18	Matlab 6: Data Fitting and Regression Analysis	Matlab 6: Data Fitting and Regression Analysis	
16: Dec 25	Matlab 6: Data Fitting and Regression Analysis	Matlab 7: Audio Processing	
17: Jan 1	Matlab 7: Audio Processing	Matlab 8: TBD	
18: Jan 8	Final Exam (Matlab)		

May switch them, dep. on progress

Questions?