AM 207

ADVANCED SCIENTIFIC COMPUTING: MONTE CARLO METHODS FOR INFERENCE AND DATA ANALYSIS, AND STOCHASTIC OPTIMIZATION

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NW 235.1

All About Randomness

- Solve your problems using random numbers and uncertainty.

Outline

- Why care about this course
- What is the course about
- Who is helping you learn the material
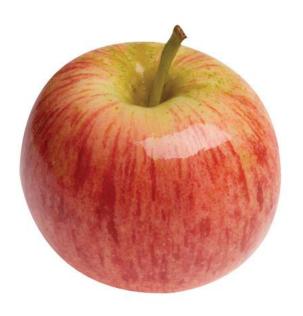- How will we learn it

Why

- Sometimes defining your problem in a deterministic way is very hard / infeasible
- But computers nowadays are fast
- It is easier and faster to let the Computer run for a day than think for a week
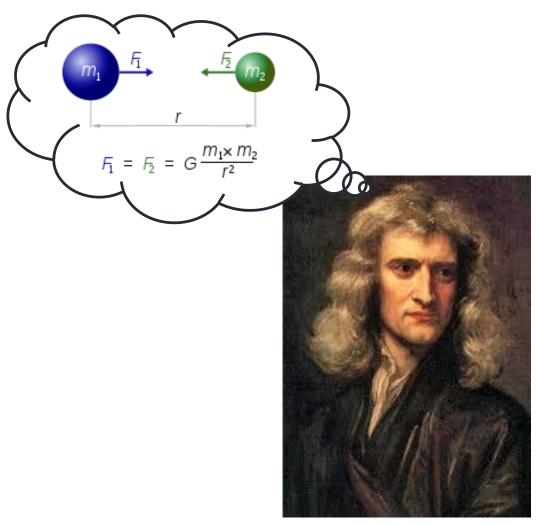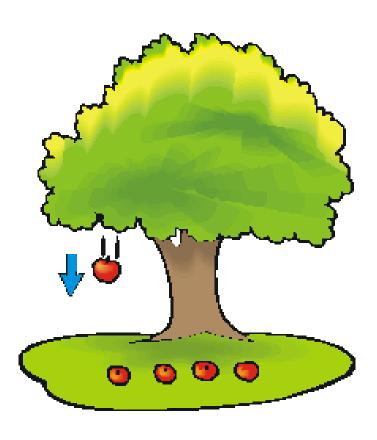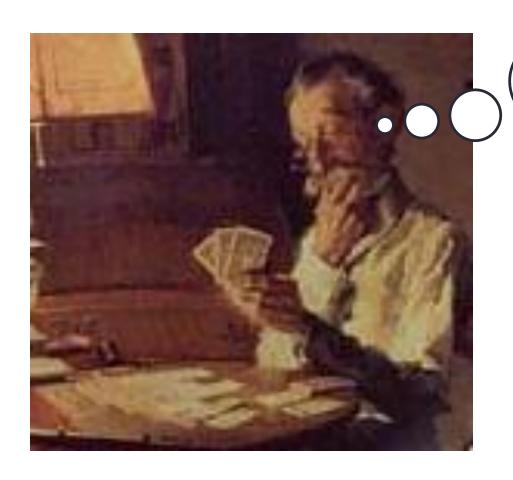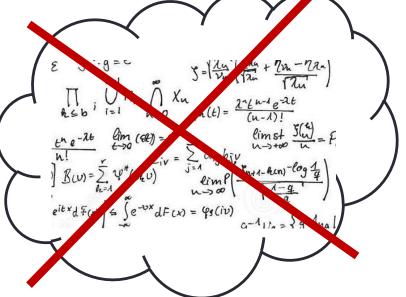
Apples to Cards

Deterministic Modeling

$$F_1 = F_2 = G\frac{m_1 \times m_2}{r^2}$$

The Monte Carlo Way (1946)

The Monte Carlo Way
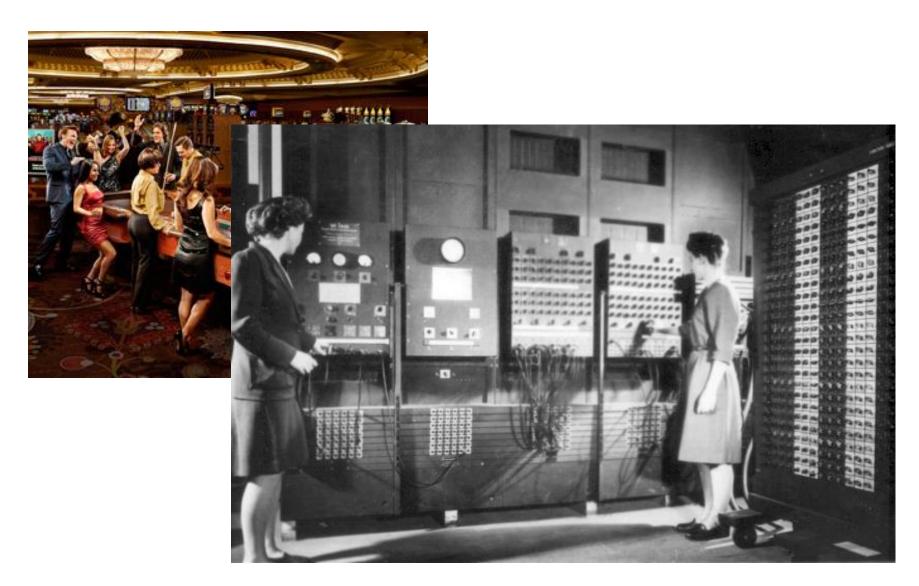
The Isaac Newton of Monte Carlo

- Stanislaw Ulam
- 13 April 1909 – 13 May 1984
- Polish-American mathematician

- Spend 1936-1939 in Harvard
    working on ergodic theory

- Worked later on Manhatten Project
- Teller-Ulam design is the basis for
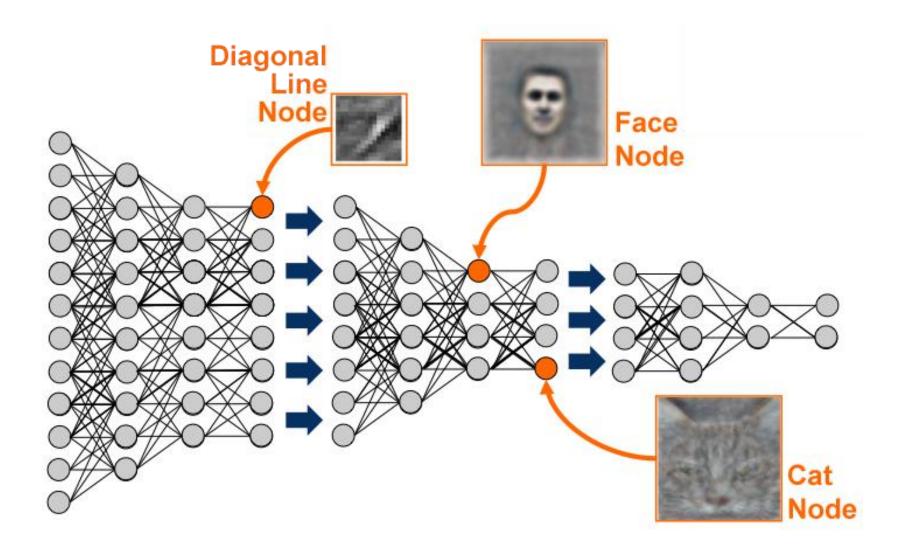   all thermonuclear weapons

Code Name Monte Carlo

Monte Carlo Applications

- Model evolution of galaxies
- Weather forecasting
- Predict energy output of a wind farm
- Wireless network panning
- Computational biology (Bayesian inference in phylogeny)
- Computer graphics: 3D rendering by random ray tracing
- Game AIs (Monte Carlo tree search)

Stochastic Optimization - Deep Learning

Who

- Verena Kaynig-Fittkau
- Pavlos Protopapas

SURVIVAL STRATEGIES

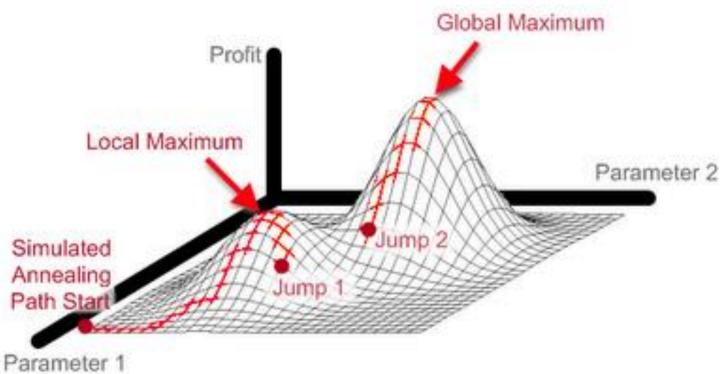The adventurous travels of Mr Anderson and how this course saved his life.
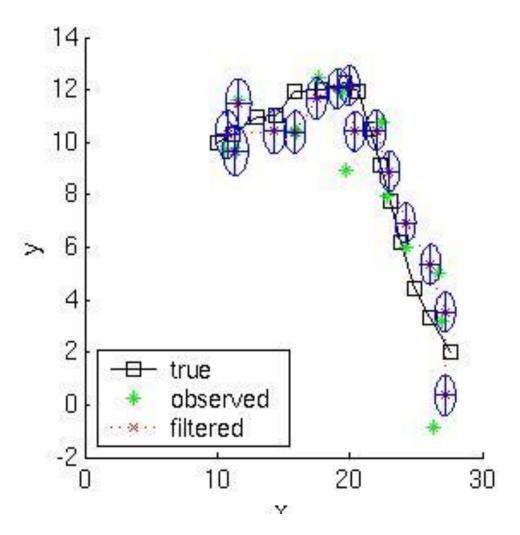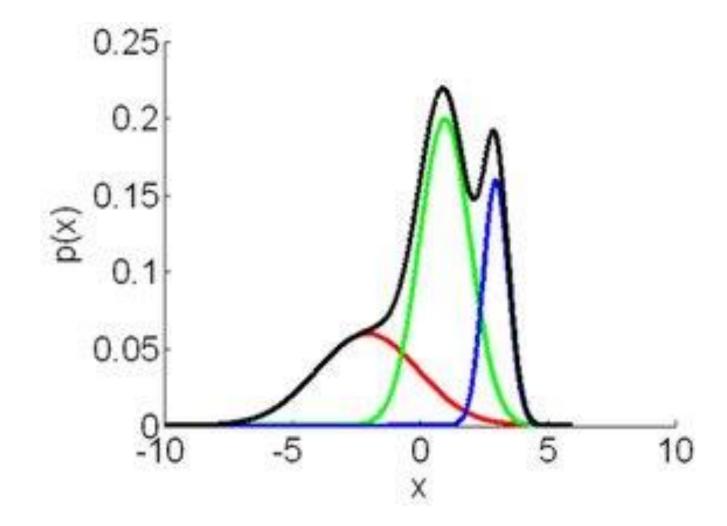
DANGER

POISON

Simulated Annealing can escape local minima with chaotic jumps

What - Course Syllabus

- http://am207.org/syllabus.html

Who

- Verena Kaynig-Fittkau
- Pavlos Protopapas

- Patrick Ohiomoba
- Rafael Martinez Galarza
- Yang Chen
- Xufei Wang
- Michael Lackner
- Adi Peleg

- YOU

How

- Lecture
- Lab
- Homework

- Office hours
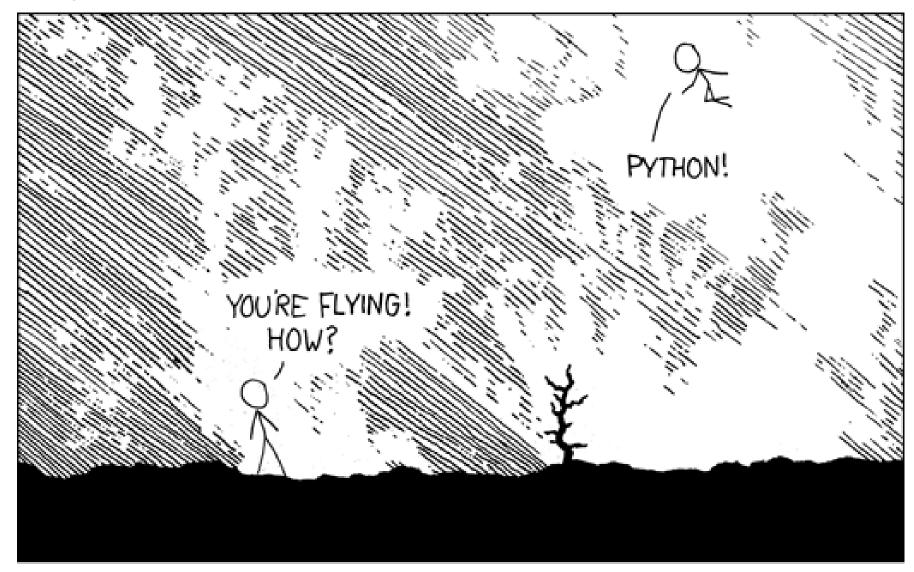- Piazza
- Final project

Homework

- 10 assignments
- Out: Thursday afternoon
- Due: Following Wednesday midnight
- Late days:
  - May use up to 1 per assignment
  - Not more than 4 total
  - Otherwise we deduct points

- Dropbox:
  - Folders are timed
  - Might close few minutes early
  - **It is your responsibility to be on time!**

Homework

- 55% of your grade
- Work you submit must be your own! Discuss in groups, program / write on your own
- Please see also guidelines on the webpage

- Ipython notebooks
- Treat them as reports, not only as code!

- HW0 comes out today, not graded, but do submit!
- Otherwise we don't grade HW1.

Python

Python Resources

- Google is your best friend

- Enthought training in python with academic license:
- https://training.enthought.com/courses

- SEAS Python tutorial:
- https://wiki.harvard.edu/confluence/pages/viewpage.action?pageId=162432141

Grading

5 = Exceptional / above and beyond

4 = Solid / no mistakes (or really minor)

3 = Good / some mistakes

2 = Fair / some major conceptual errors

1 = Poor / did not finish?

0 = Did not participate / did not hand in

Grading is holistic, not subtract half a point here, half a point here, its about the learning process.

Piazza

- https://piazza.com/class/i5895rpjkez7on?cid=4

- This is a very valuable resource, ask, and save time, answer and show off!
- Let's apply Stackoverflow rules

- Counts as participation
- Participation is 5% of your final grade

Final Project

- Your chance to show off what you learned

- Hand-ins:
  - written paper (<= 6 pages)
  - screencast
  - poster
  - optional: webpage

- 40% of your grade

Is This Course For Me?

- Fond of math and statistics
- Basic statistical knowledge
- There is going to be magic and beauty!

- Basic background in programming
- Python knowledge helps

- Willing to learn new software and tools
- Read online documentation

HW0

- Out this afternoon

- Not graded, but you need to submit!

- General Python setup
- Example exercise

Github

- All materials are in the github repository
- https://github.com/AM207/2015

- Just pull to get lecture and lab notes, and homework assignments

- If you don't feel comfortable with git you can also download them from the webpage.