

Scientific Computation

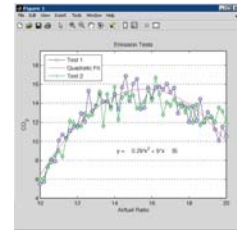
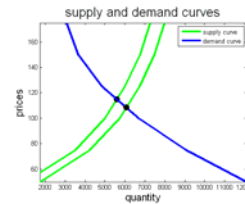
MATLAB Examples



CS112 Scientific Computation
Department of Computer Science
Wellesley College

Data visualization and analysis

- Graphical display of data
- Statistical analysis of data
- Fitting functions to data



MATLAB Examples 1-2

Sunspots

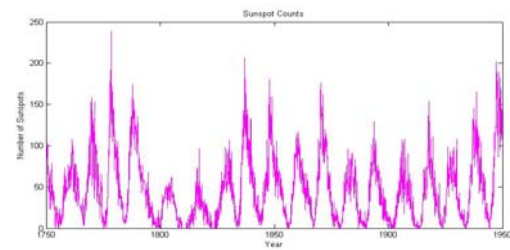
- Discovered independently by Christoph Scheiner (1610) and Galileo (1613)
- Indicate disturbances in the sun's magnetic field
- The number of sunspots varies over time in a cyclical way
- Sunspot Cycle* discovered by Samuel Schwabe (1843)



* There is some connection between sunspots and extreme weather

MATLAB Examples 1-3

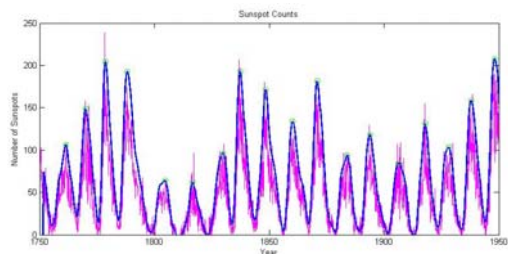
The sunspot data:



How can we determine the length of the sunspot cycle?

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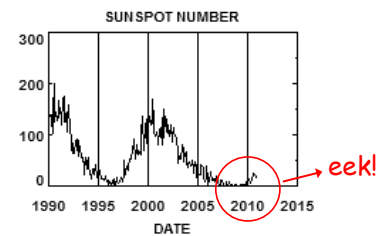
The length of the sunspot cycle: ~ 12 years



Note: virtually no sunspot activity in the years 1650-1700 (Europe's mini ice-age) and we're currently in a low spot in the cycle!

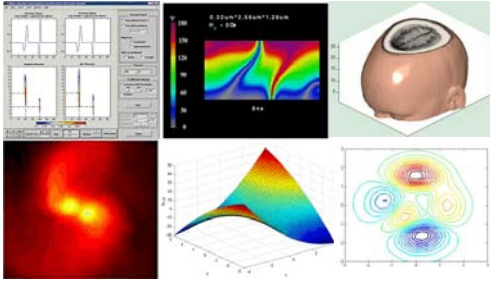
MATLAB Examples 1-5

Recent NASA sunspot data...



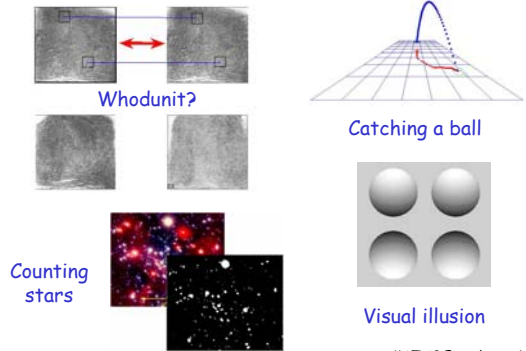
MATLAB Examples 1-6

Visualizing data



MATLAB Examples 1-7

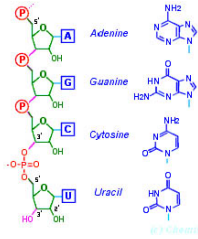
Creating and analyzing images



MATLAB Examples 1-8

Ribonucleic acid

- An **RNA** molecule is a sequence of nucleotides drawn from **Adenine (A)**, **Guanine (G)**, **Cytosine (C)**, and **Uracil (U)**
- Three adjacent nucleotides form a triplet called a **codon** that corresponds to a single **amino acid**
- You'll write a MATLAB program that translates a sequence of RNA nucleotides to an amino-acid sequence:



UANCUAUCUAUCUCCGGUC ... ⇒ Tyr Leu Ser Ile Phe Gln Val

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Searching databases

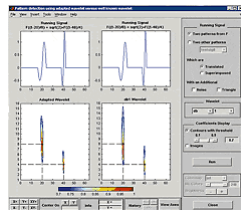
- What is the average cholesterol level for women in their twenties who exercise at least 30 minutes a day?

| | | | | | | | |
|-------------|-----|-----|-----|-----|-----|-----|-----|
| cholesterol | 189 | 239 | 178 | 185 | 251 | 165 | ... |
| age | 25 | 35 | 28 | 40 | 28 | 22 | ... |
| sex | 'm' | 'm' | 'f' | 'm' | 'm' | 'f' | ... |
| exercise | 30 | 15 | 40 | 25 | 15 | 60 | ... |

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Designing GUI's*

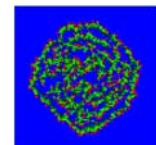
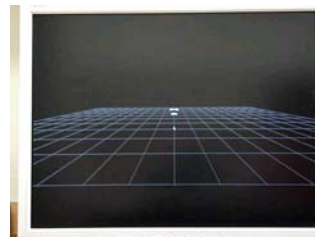
- Graphical User Interfaces** simplify communication with our programs by using text boxes, pop-up windows, buttons, menus, check boxes, sliders, etc.
- We'll use MATLAB's GUI facilities to build our own interactive programs



* Pronounced "gooey"

MATLAB Examples 1-11

Animations & simulations



Simulating the spread of a virus

Perceptual experiments
(Oly Fernando '08)

MATLAB Examples 1-12