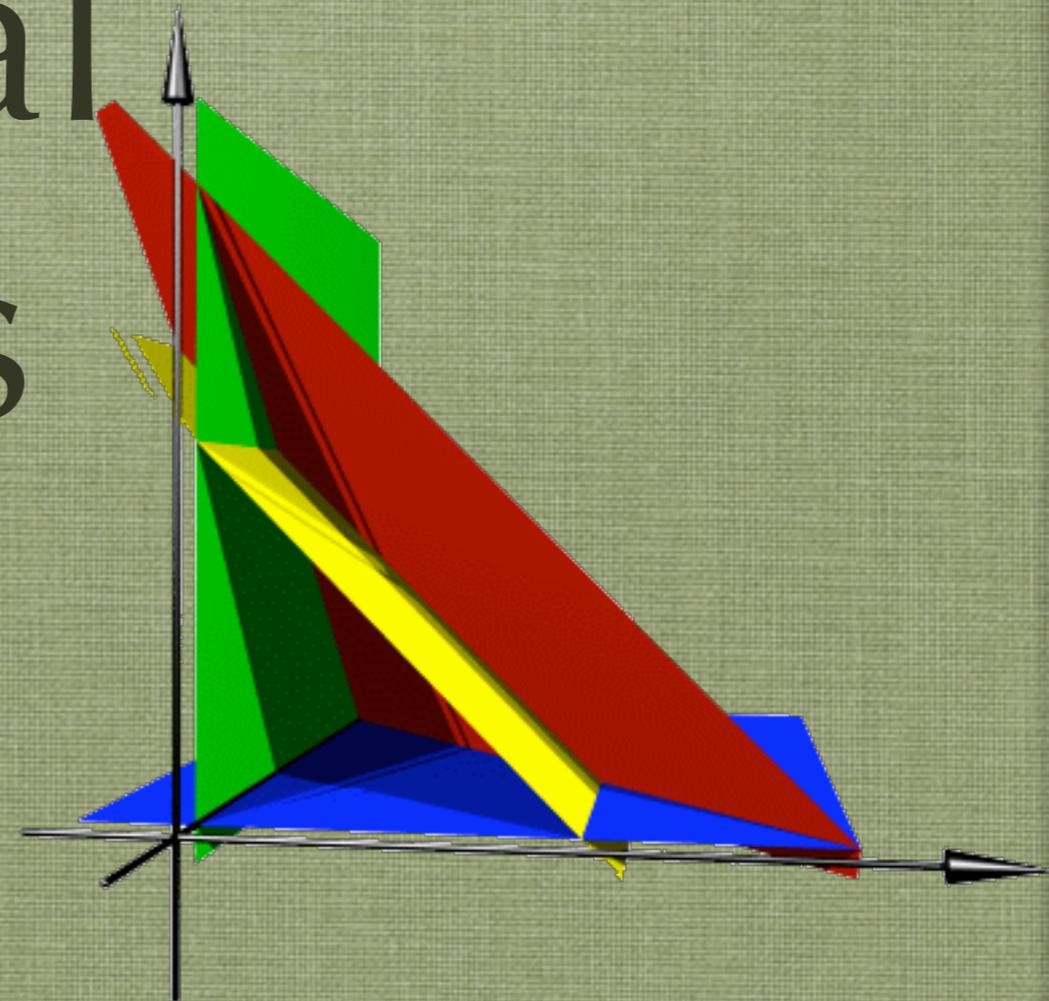


Welcome to
Math21b
Linear Algebra and
Differential
equations

Fall 2003
Oliver Knill



Organisation



Our coordinates:

Oliver Knill

Sci Center 434

knill@math.harvard.edu

Izzett Coskun

Sci Center 333b

coskun@math.harvard.edu

About myself:

I grew up in Switzerland.
Here are some pictures....







Back to business:

You find most of the course information
online at

<http://www.courses.fas.harvard.edu/~math21b>

The handout is a snapshot of the syllabus

Exam Dates:

- 1 Midterm: Wed, Oct 22, 7:30
- 2 Midterm: Wed: Nov 19, 7:30
- Final Exam: To be scheduled by registrar.

Grading Scheme:

20% M1 First midterm

20% M2 Second midterm

20% HW Homework

40% Final

Working on
problems
is extremely
important.
Therefore:

Tough Homework Policy



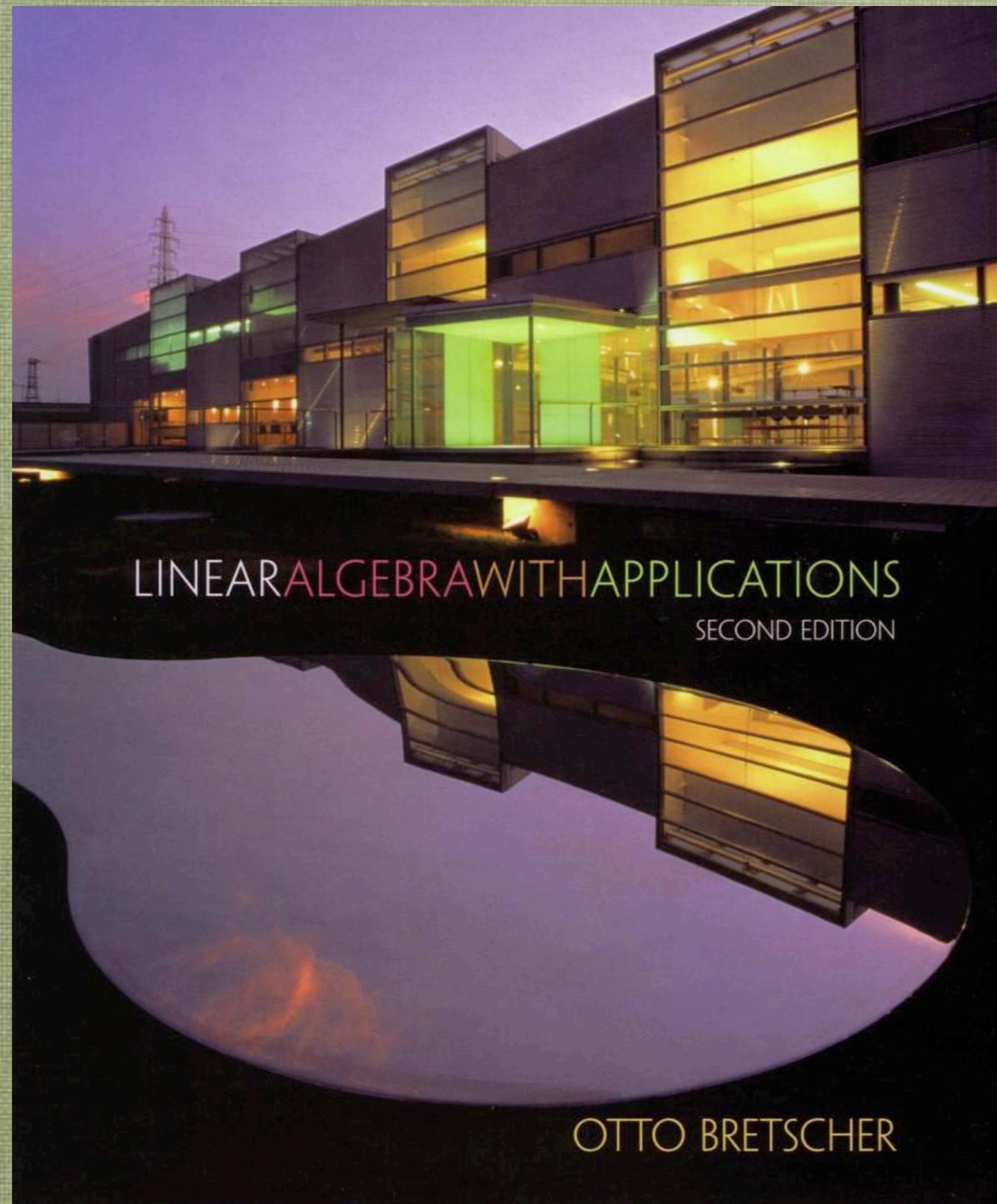
**NO HOMEWORK
EXTENSIONS**

But:



*We delete the 2
lowest AW scores
and solutions will
be posted early!*

Textbook



Otto Bretscher,
Linear Algebra with
Applications

Second Edition

Available in Coop

Covered Topics



Chapters covered in this course, (see syllabus, for more details)

Covered Topics I

- 1: Linear Equations
- 2: Linear Transformations
- 3: Linear Subspaces
- 4: Dimension
- 5: Orthogonality
- 6: Determinants
- 7: Eigensystems

Covered Topics II

8: Diagonalisation

9: Stability

10: Differential equations

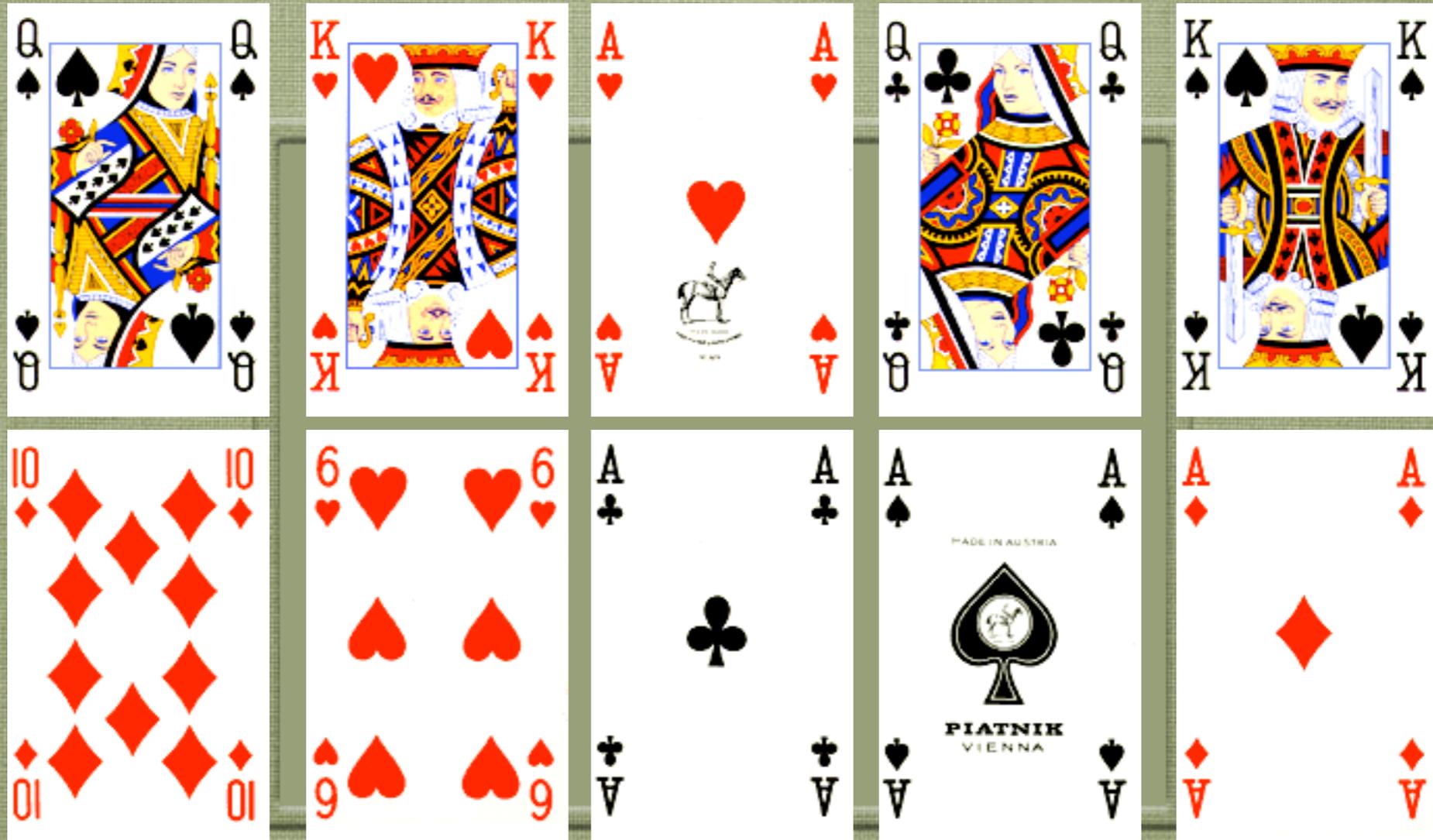
11: Function Spaces

12: Fourier Theory

13: PDE's

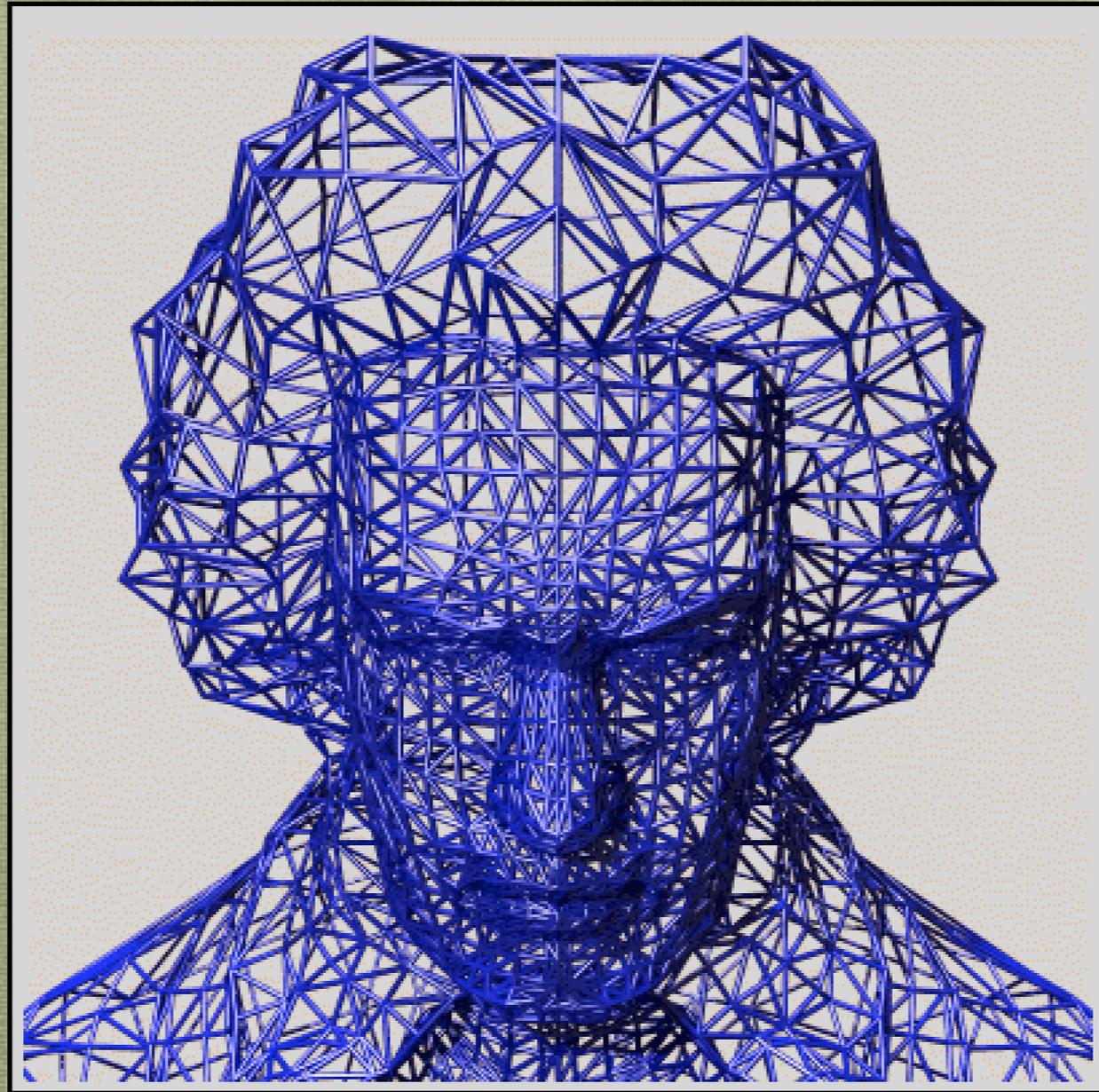
Where is linear
algebra
used?

Statistics



For example: covariance matrix, data fitting,

Computergraphics

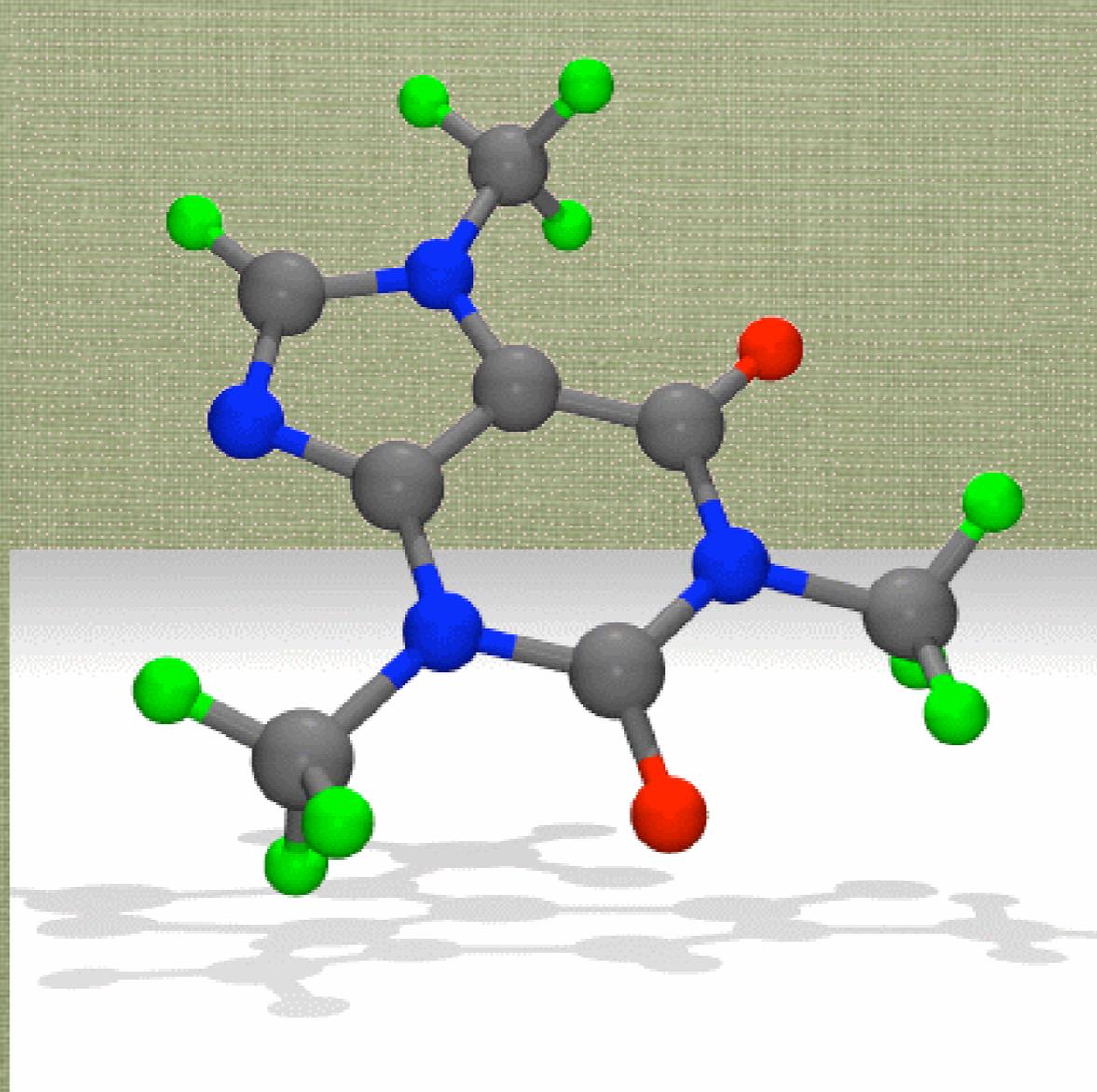


Linear transformations

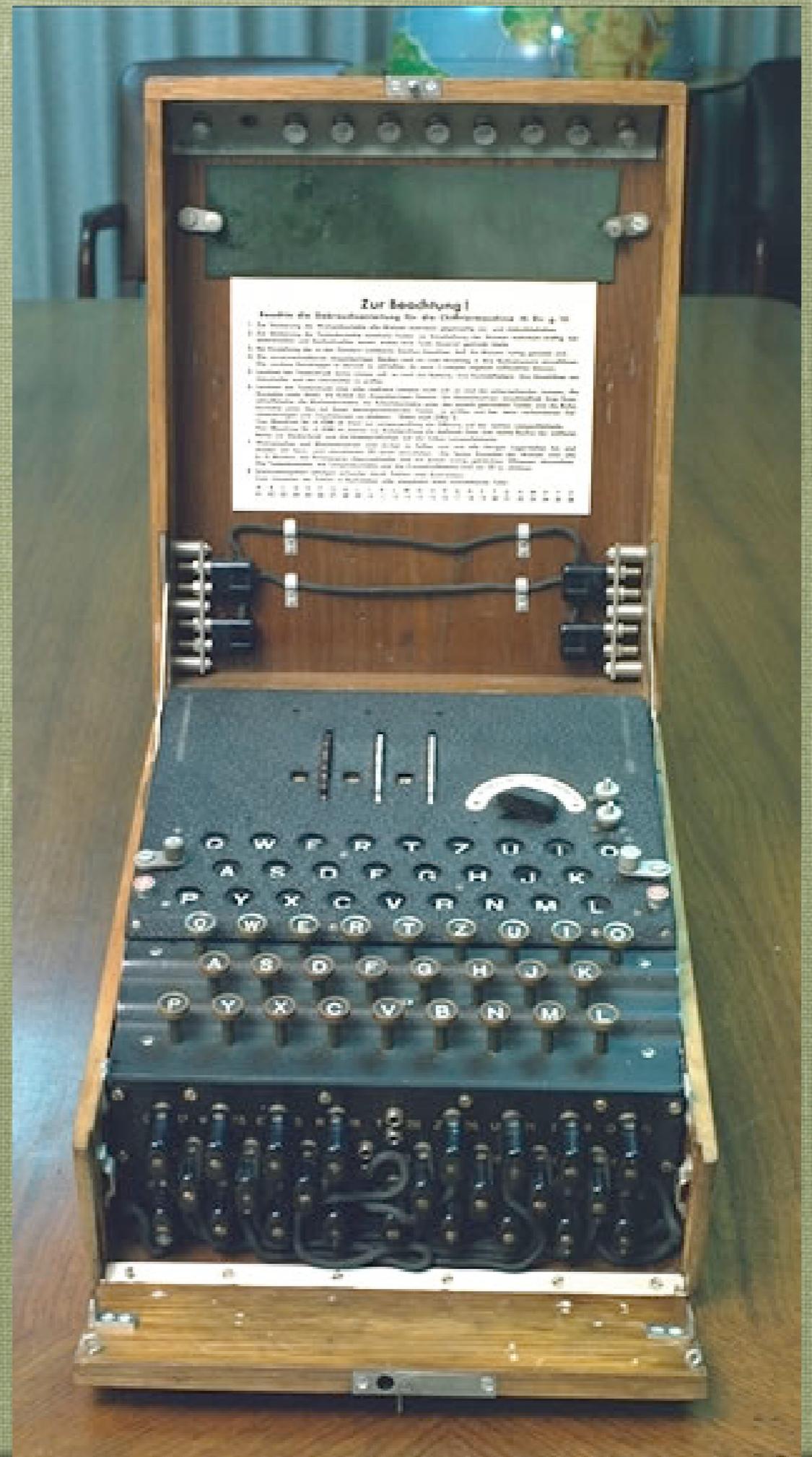
Mechanics/Stability



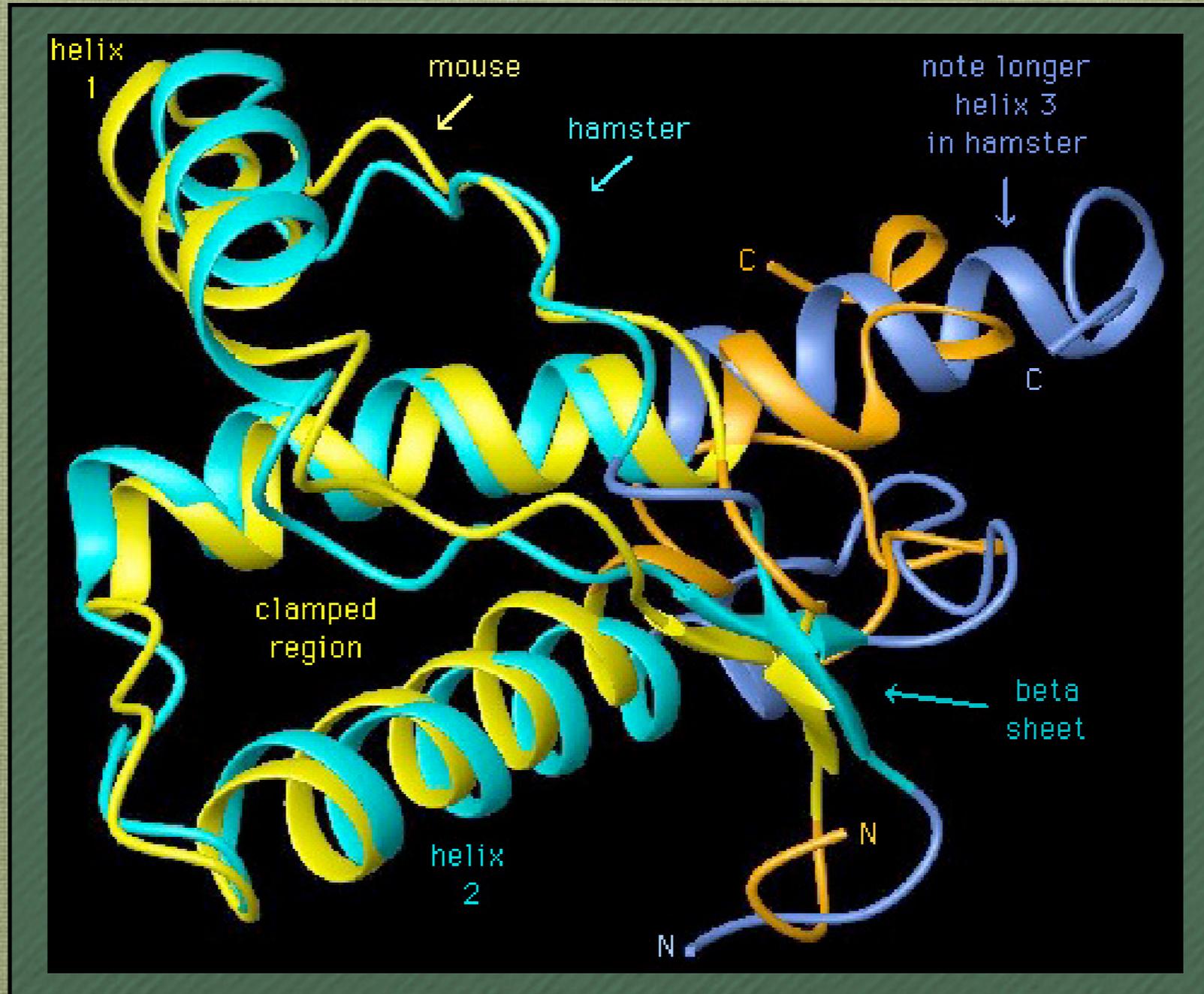
Chemistry



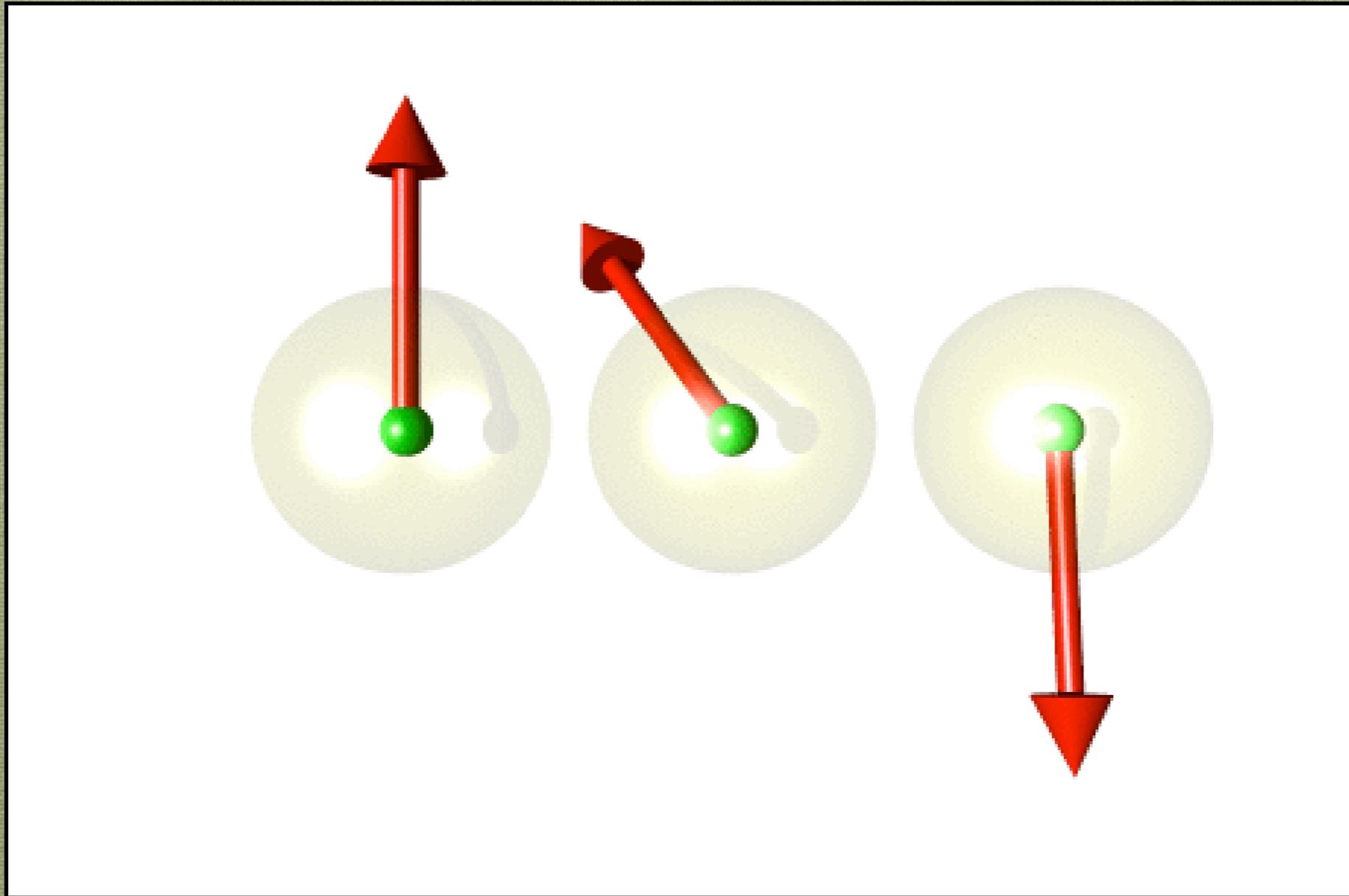
Codes Number theory



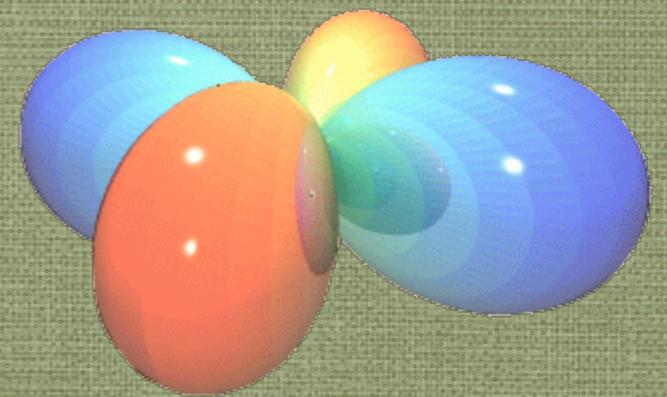
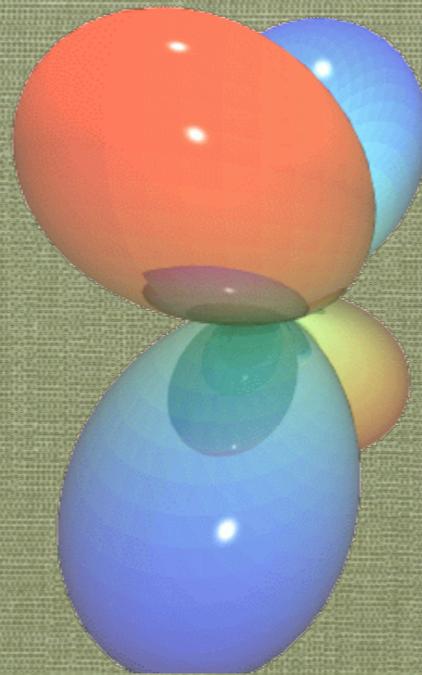
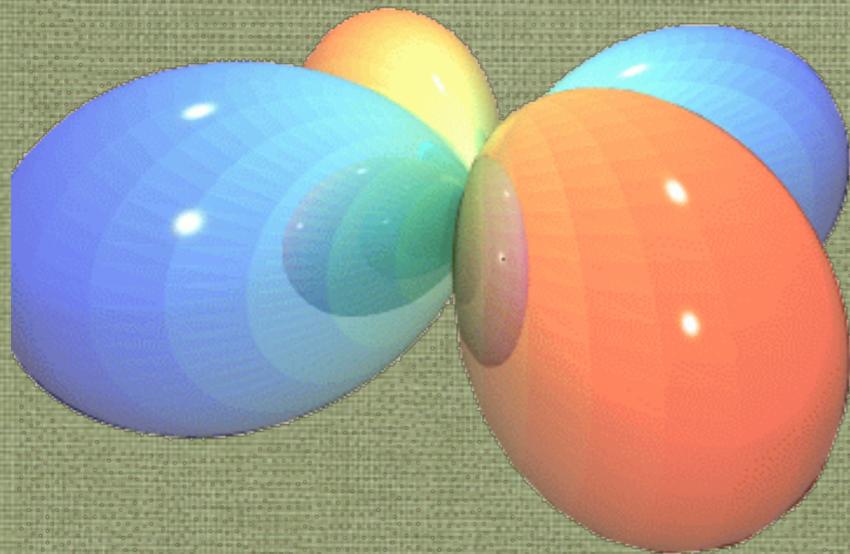
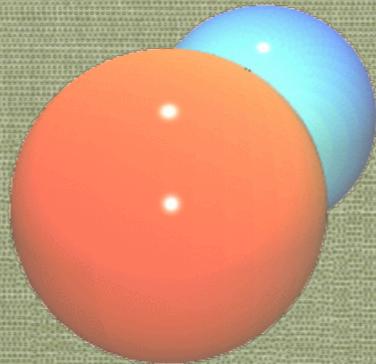
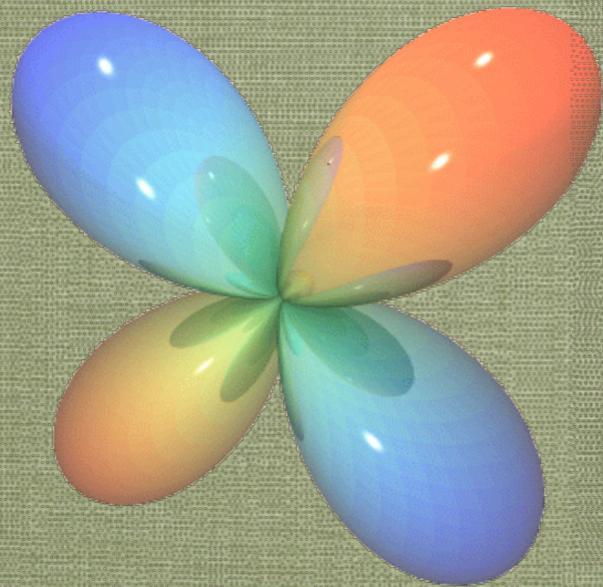
Biology



Quantum Computing



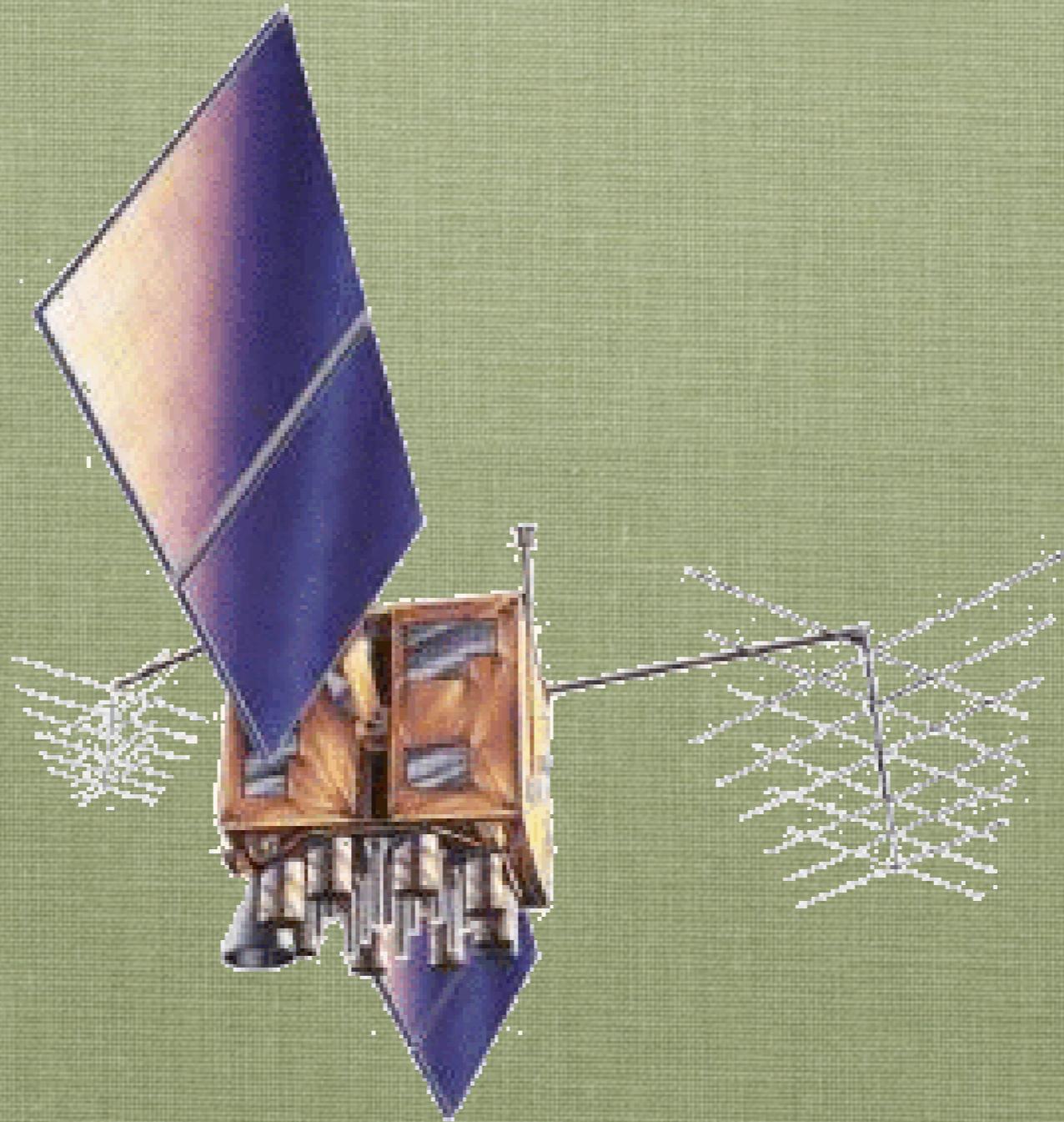
Quantum Mechanics



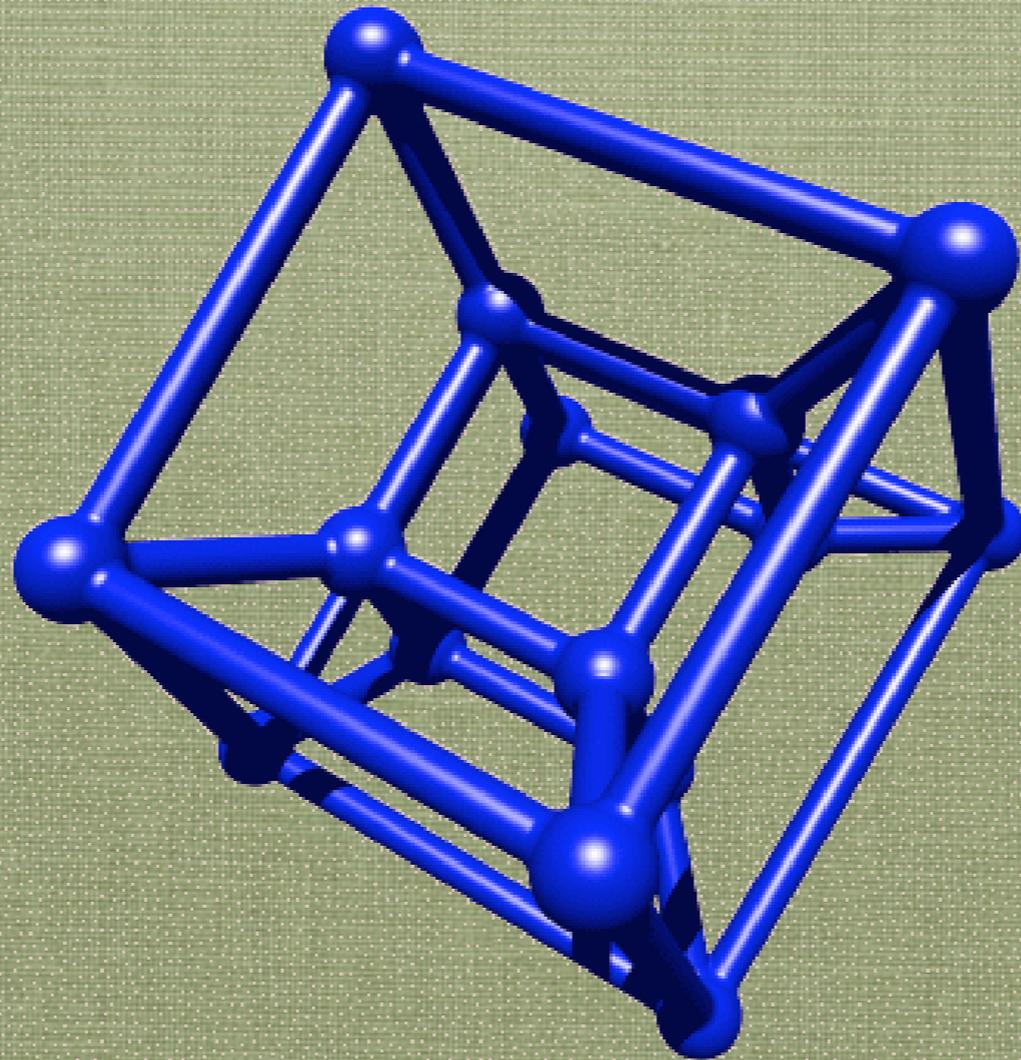
Partial Differential equations



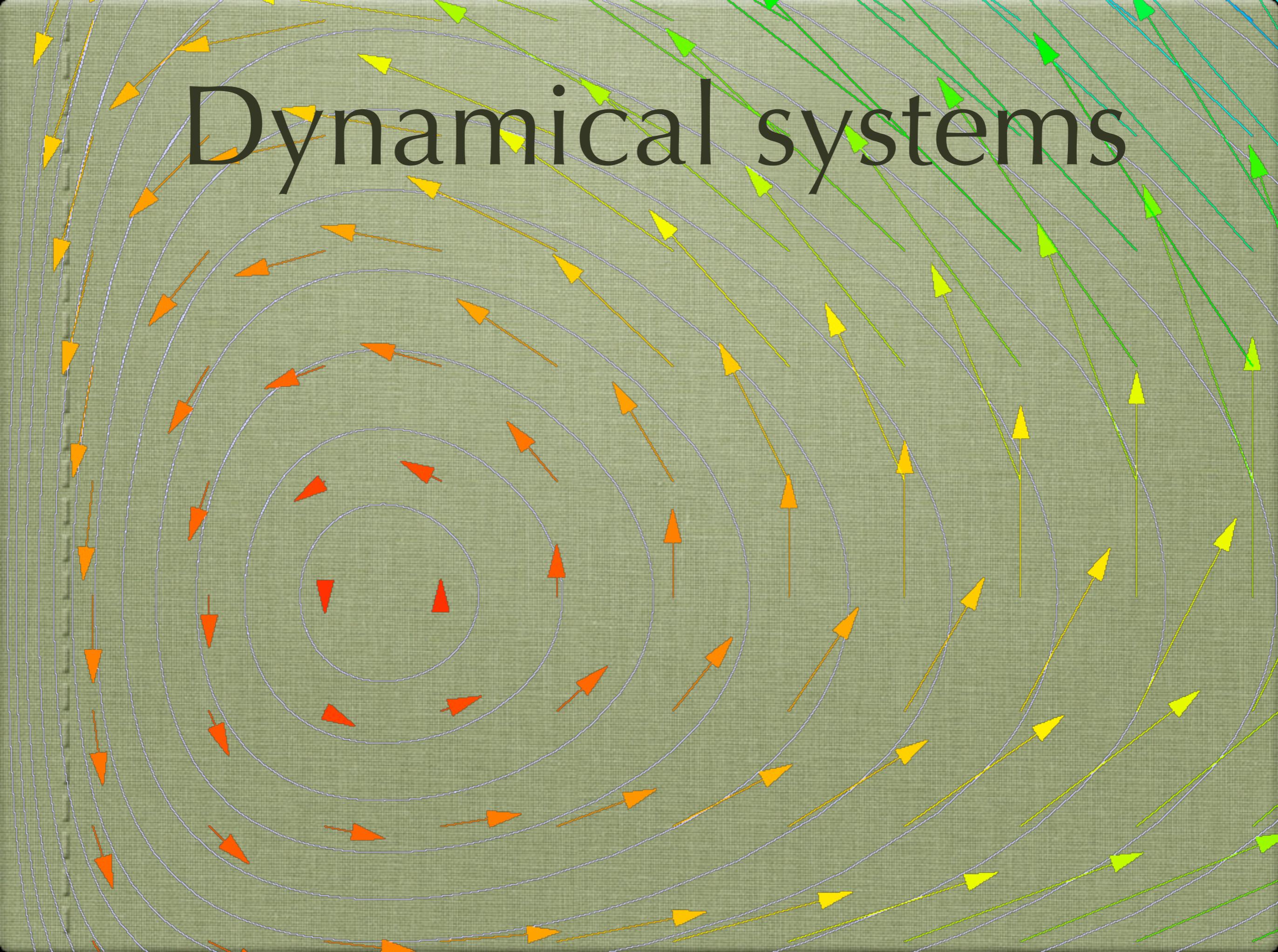
Error Correction



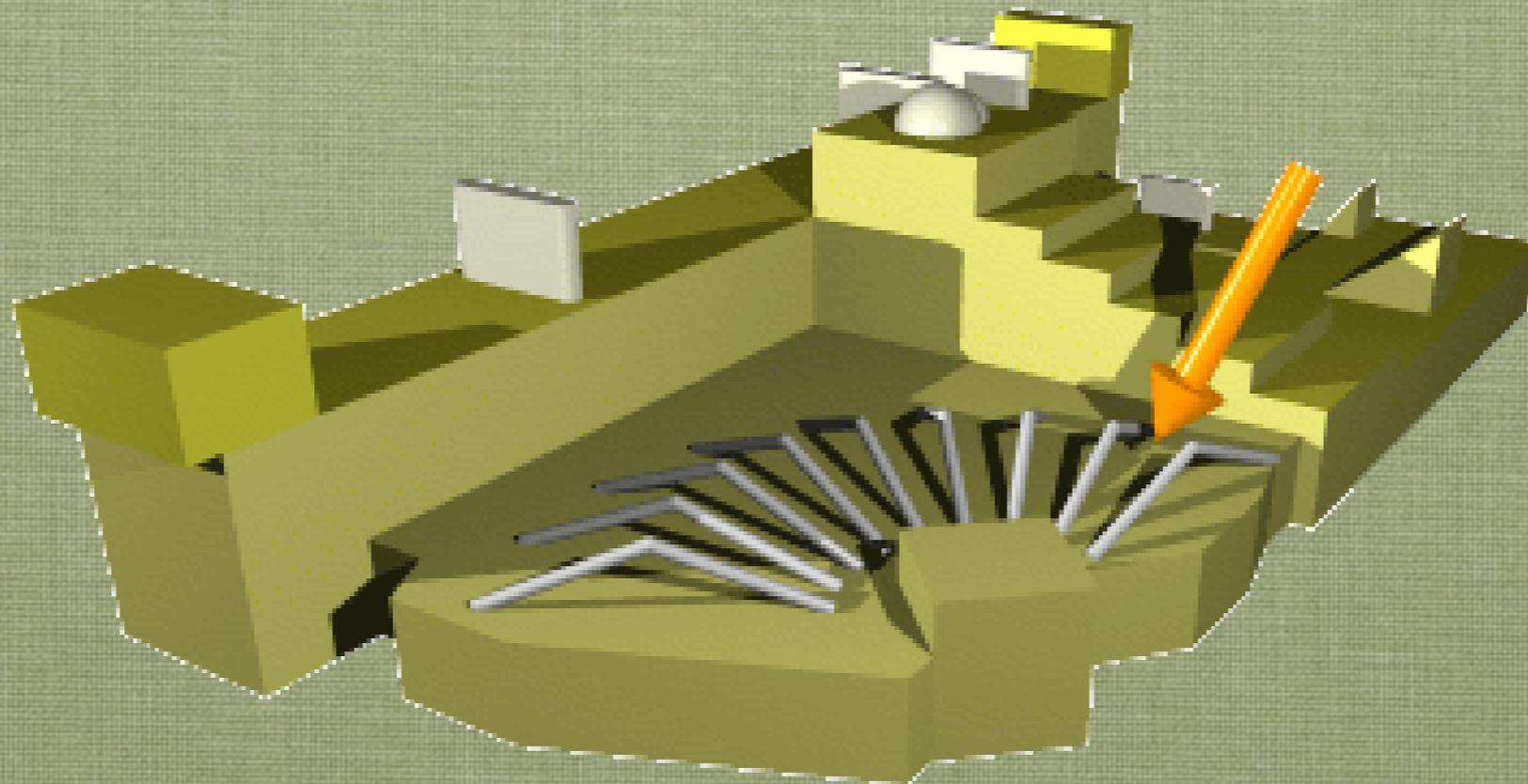
Understanding Higher dimensions



Dynamical systems



2D/3D graphics



Computergames

● Ace (SA)	2
● Drew (SC)	2
● killamajig(DT)	1
● shadow(SA)	1
● Christopher 71	0
● kathy	0
● Night Crawler	0
● Red Bandit	0



A Hatsumon

(Japanese for “asking a question”,

In education used as “hook questions”)

Will Hunting's problem

G is the graph



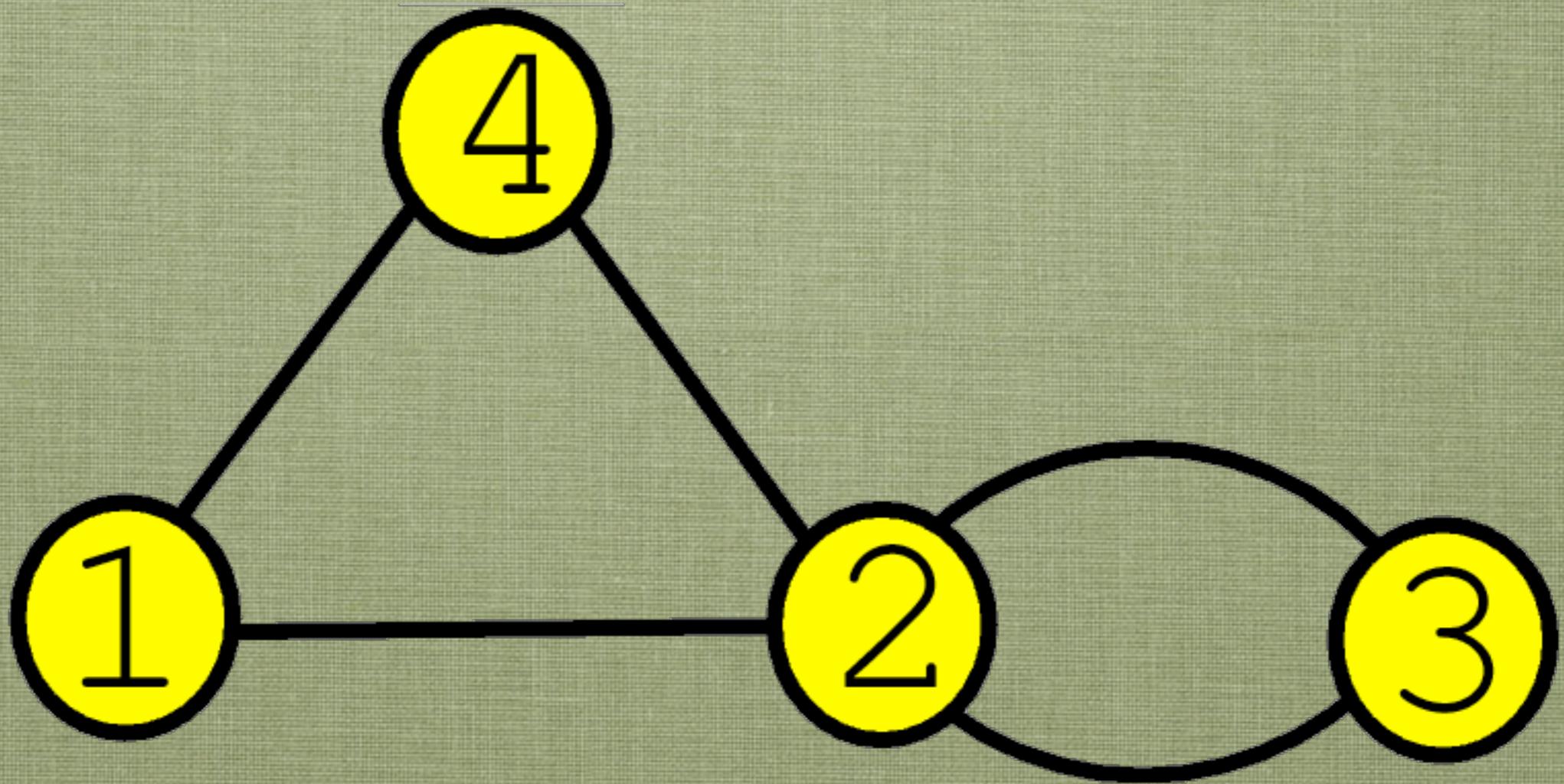
Find 1) the adjacency matrix A

2) the matrix giving the number of 3 step walks

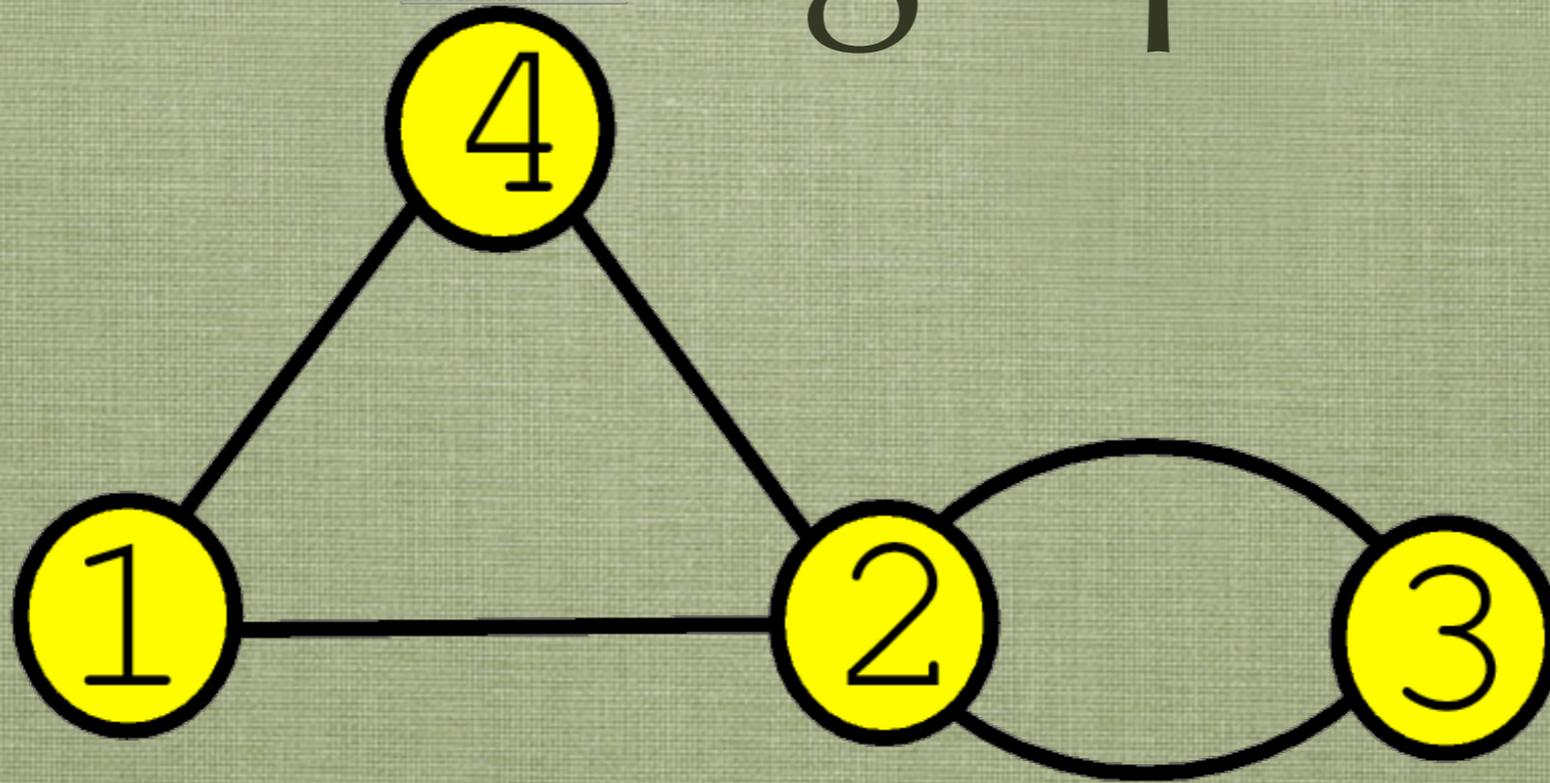
3) the generating function for walks from point 2 \rightarrow 1

4) the generating function for walks from points 1 \rightarrow 3

Will Hunting's problem

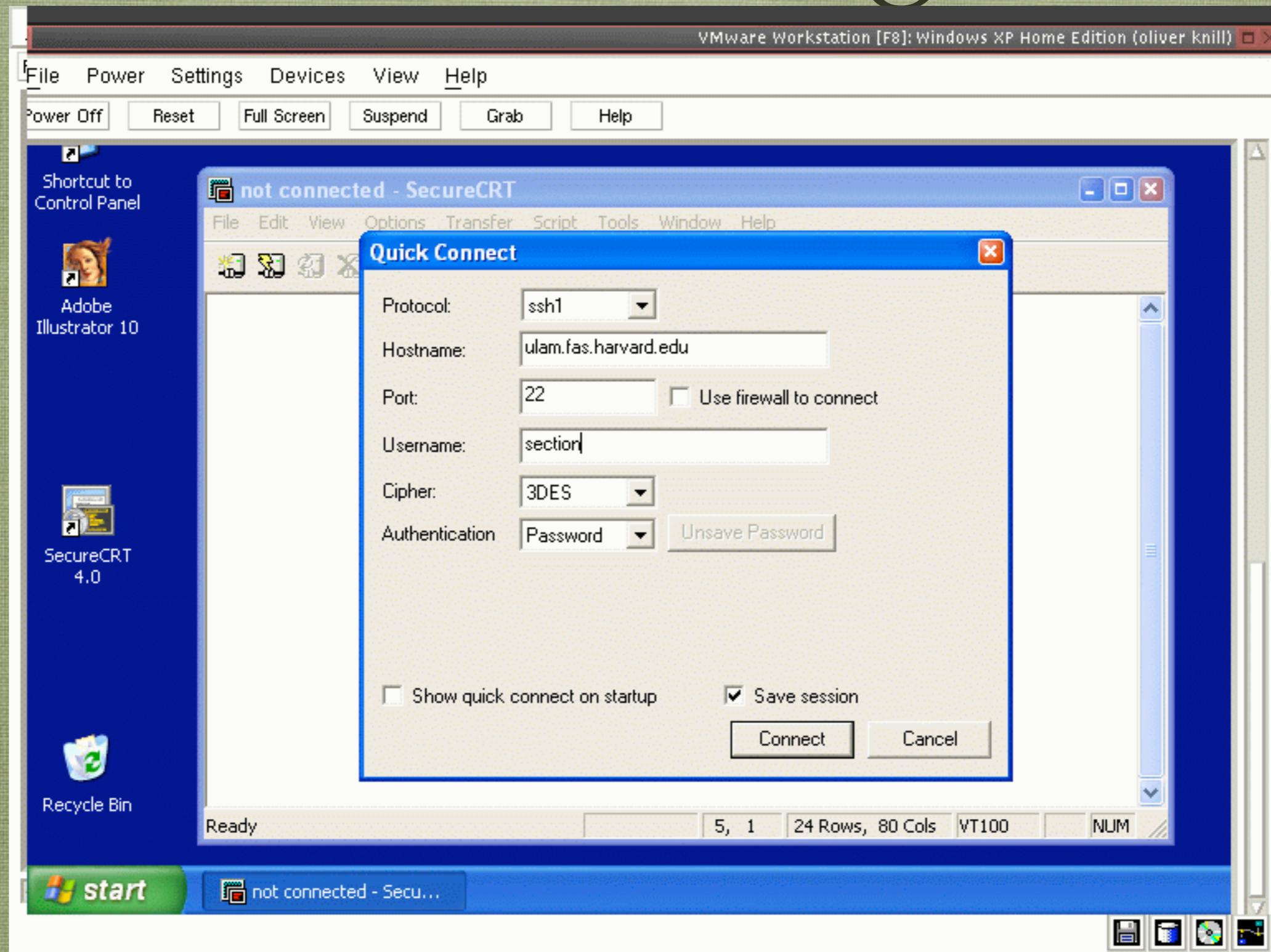


Will Hunting's problem

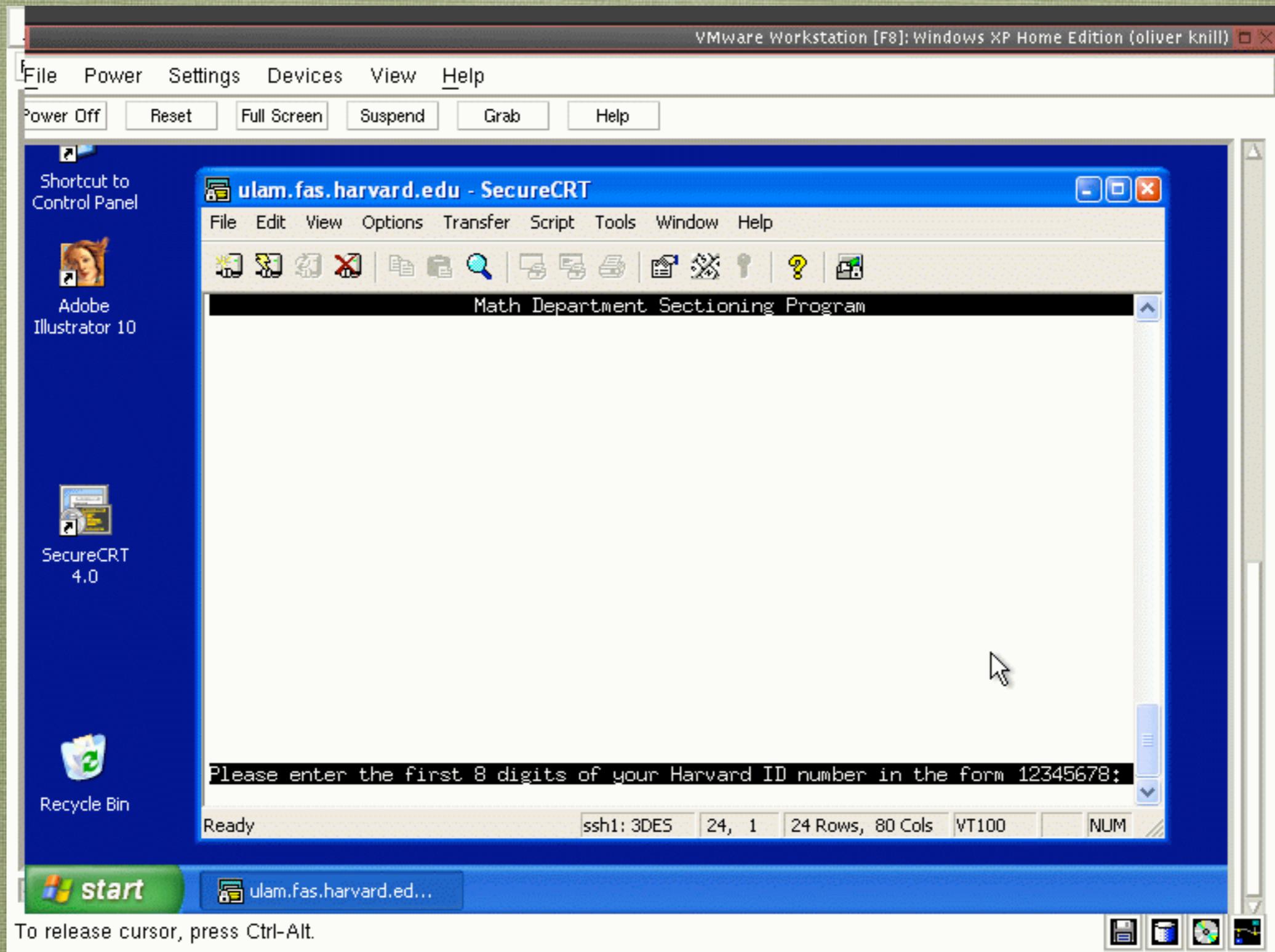


$$L = \begin{bmatrix} 0 & 1 & 0 & 1 \\ 1 & 0 & 2 & 1 \\ 0 & 2 & 0 & 0 \\ 1 & 1 & 0 & 0 \end{bmatrix}$$

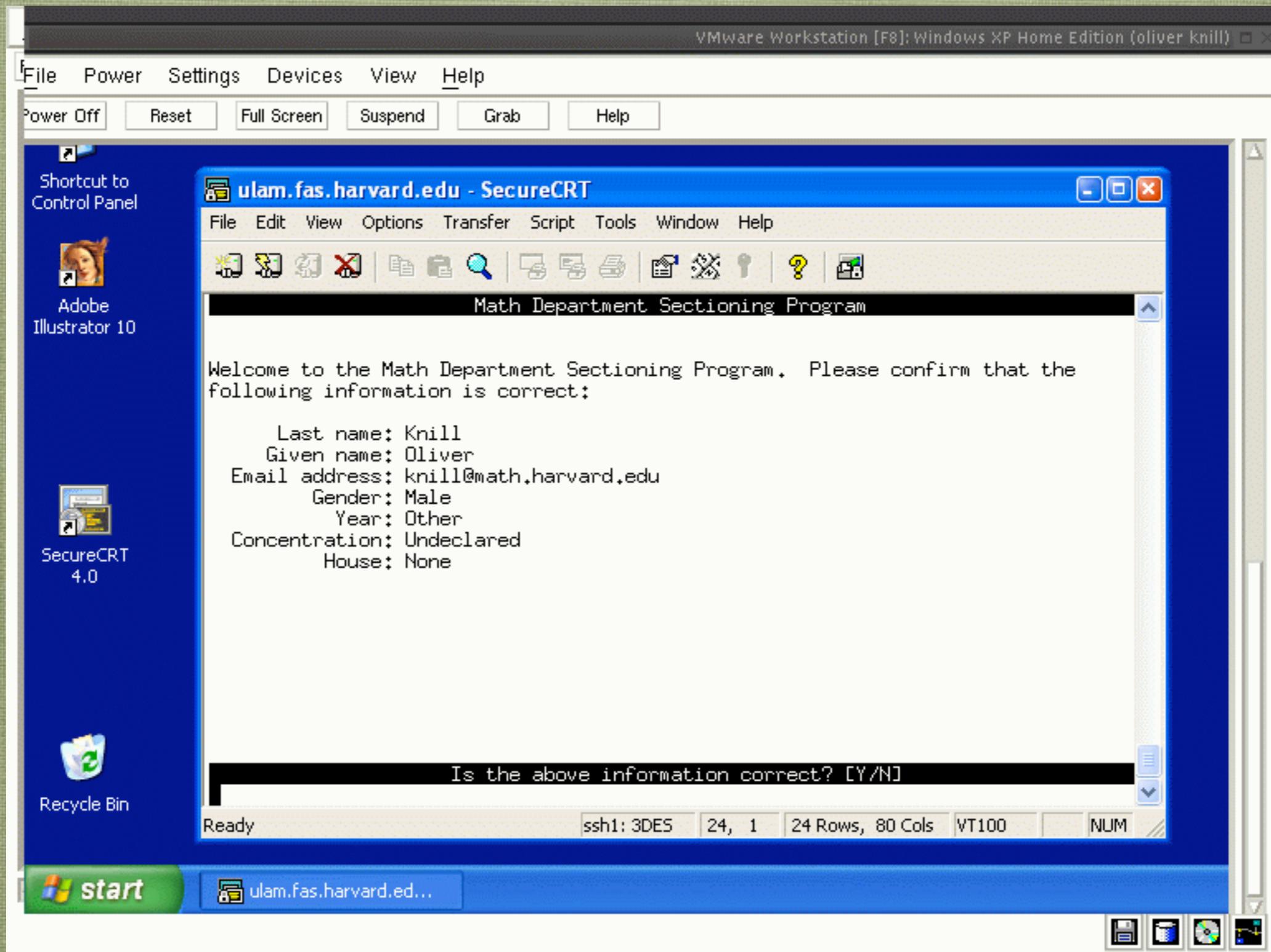
Sectioning I



Sectioning 2



Sectioning 3



Sectioning 4

The image shows a VMware Workstation window titled "VMware Workstation [F8]: Windows XP Home Edition (oliver knill)". The desktop environment is Windows XP, with a taskbar at the bottom showing the Start button and an open window for "ulam.fas.harvard.ed...".

The main focus is a SecureCRT terminal window titled "ulam.fas.harvard.edu - SecureCRT". The terminal displays the following text:

```
Math Department Sectioning Program
Select a Course

Math 1a Calculus, Series and Differential Equations
Math 1b Calculus, Series and Differential Equations
Math 21a Multivariable calculus
Math 21b Linear Algebra with Applications
Math Xb Introduction to Functions and Calculus
```

The terminal window has a menu bar (File, Edit, View, Options, Transfer, Script, Tools, Window, Help) and a toolbar with various icons. At the bottom of the terminal window, there are navigation and search shortcuts: **Esc** Back, **Enter** Select, **Prev**, **Next**, **Space** NextPage, **PrevPage**, and **Search**. The status bar at the bottom of the terminal shows "Ready", "ssh1: 3DES", "6, 78", "24 Rows, 80 Cols", "VT100", and "NUM".

On the Windows XP desktop, there are several icons: "Shortcut to Control Panel", "Adobe Illustrator 10", "SecureCRT 4.0", and "Recycle Bin". The VMware interface includes a menu bar (File, Power, Settings, Devices, View, Help) and a toolbar with buttons for "Power Off", "Reset", "Full Screen", "Suspend", "Grab", and "Help".

To release cursor, press Ctrl-Alt.

Sectioning 5

The screenshot shows a Windows XP desktop environment. The desktop background is blue with several icons: 'Shortcut to Control Panel', 'Adobe Illustrator 10', 'SecureCRT 4.0', and 'Recycle Bin'. A taskbar at the bottom features the 'start' button and an open window for 'ulam.fas.harvard.ed...'. The system tray contains icons for network, volume, and power.

The main focus is a SecureCRT terminal window titled 'ulam.fas.harvard.edu - SecureCRT'. The terminal displays the following text:

```
Math Department Sectioning Program
Please select your section choices in order of preference. Type D when done.

0: MWF 9-10 Physics (w/suff enrollmen [1 section]
1: MWF 10-11 (w/suff enrollment) [1 section]
2: MWF 10-11 BioChem (w/suff enrollmen [1 section]
3: MWF 11-12 [1 section]
4: TTh 10-11: [1 section]
5: TTh 11:30- [1 section]
```

Below the list, a status bar shows keyboard shortcuts: **None**, **Enter** De/Select, **Prev**, **Text**, **PageUp**, **Space** PageDown, and **Search**. The terminal status bar at the bottom indicates 'Ready', 'ssh1: 3DES', '4, 77', '24 Rows, 80 Cols', 'VT100', and 'NUM'. A mouse cursor is visible over the terminal area.

At the bottom of the screen, a message reads: 'To release cursor, press Ctrl-Alt.'

Tonight at 7 PM, Room 507

Preview/Review

Tips how to succeed in this course
Review and discussion of some
topics relevant for this course.