HCI-631
Software Architectures for User Interfaces

Vassilis Kostakos

UI Hall of Fame or Shame?

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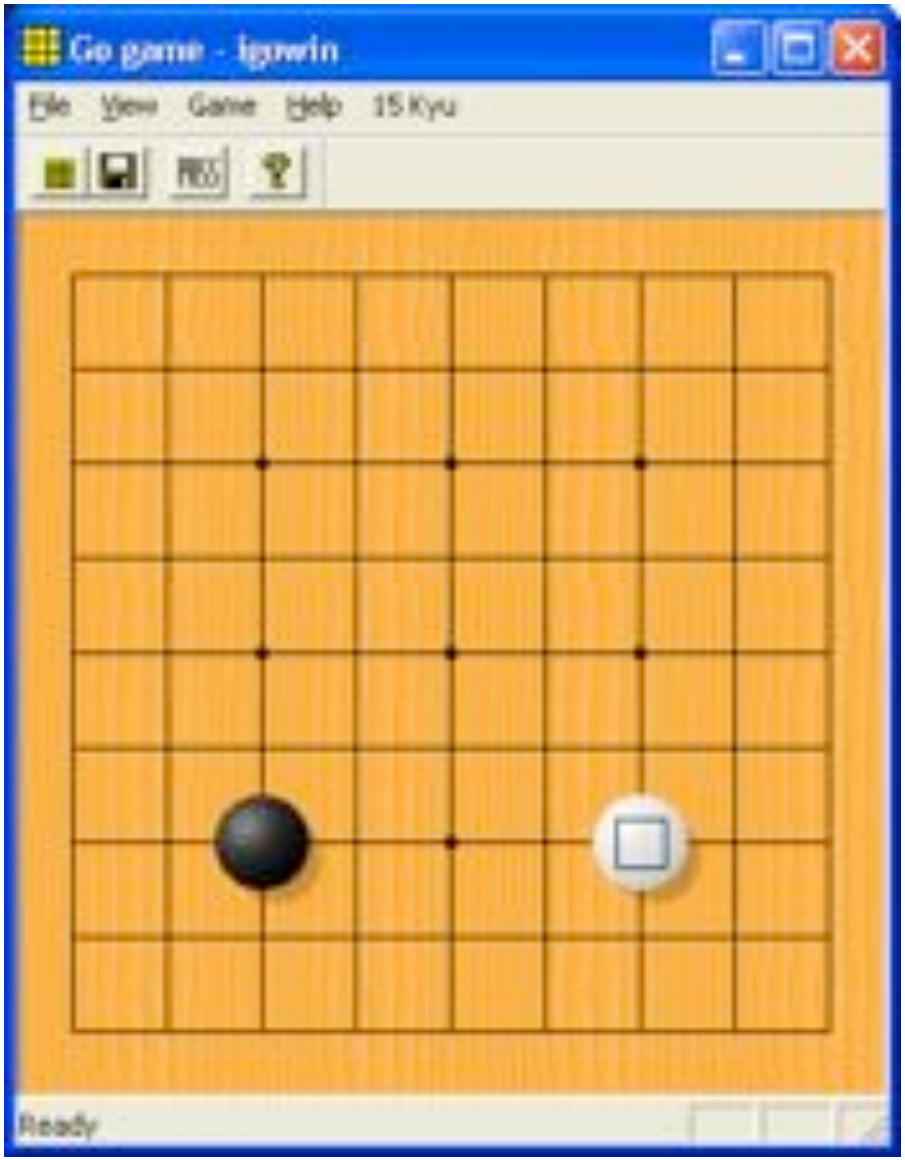
Hall of Fame or Shame?

- IE5 page setup for printing

Who are we?

- Vassilis Kostakos
  - Assistant Professor
  - BA in Computer Science, University of Bath
  - Ph.D. from University of Bath
  - Research interests:
    - HCI and pervasive computing
    - Complex network dynamics

What is This Course About?



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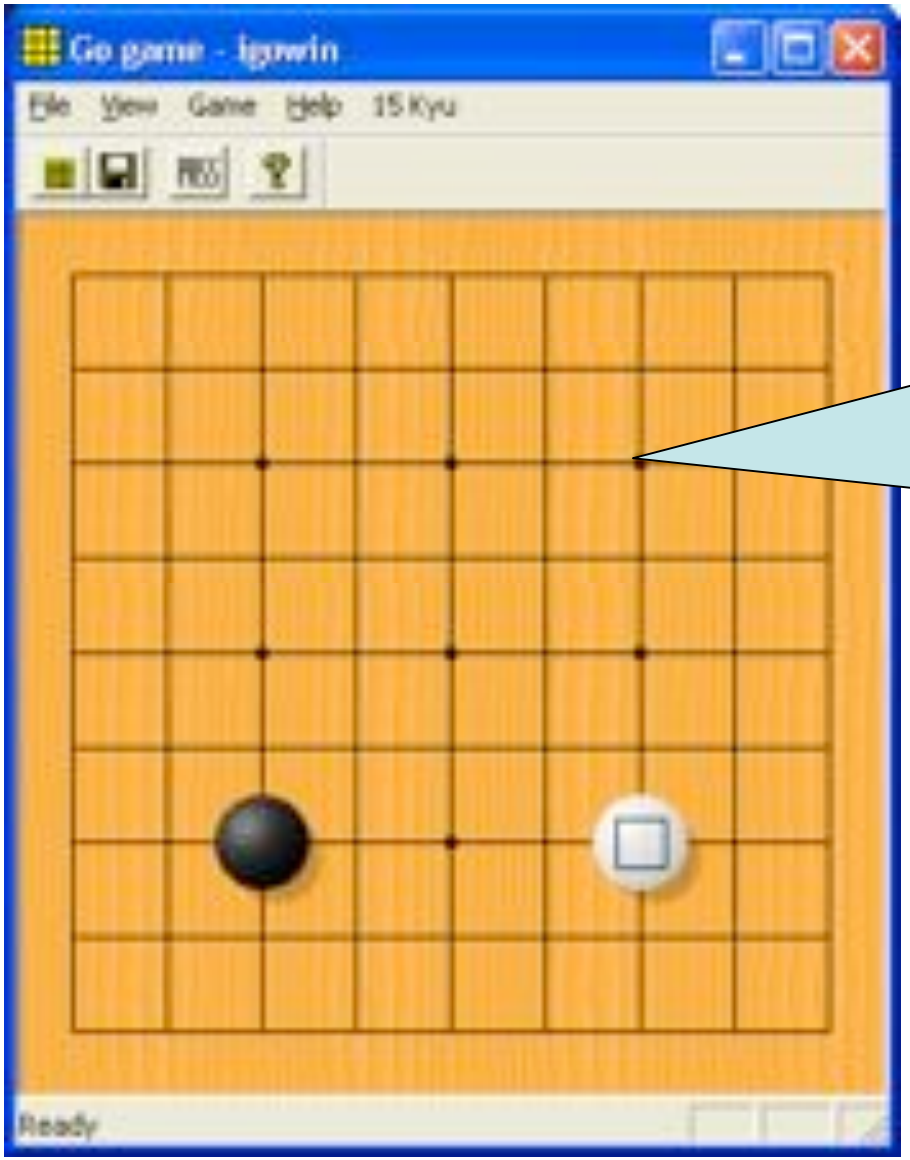
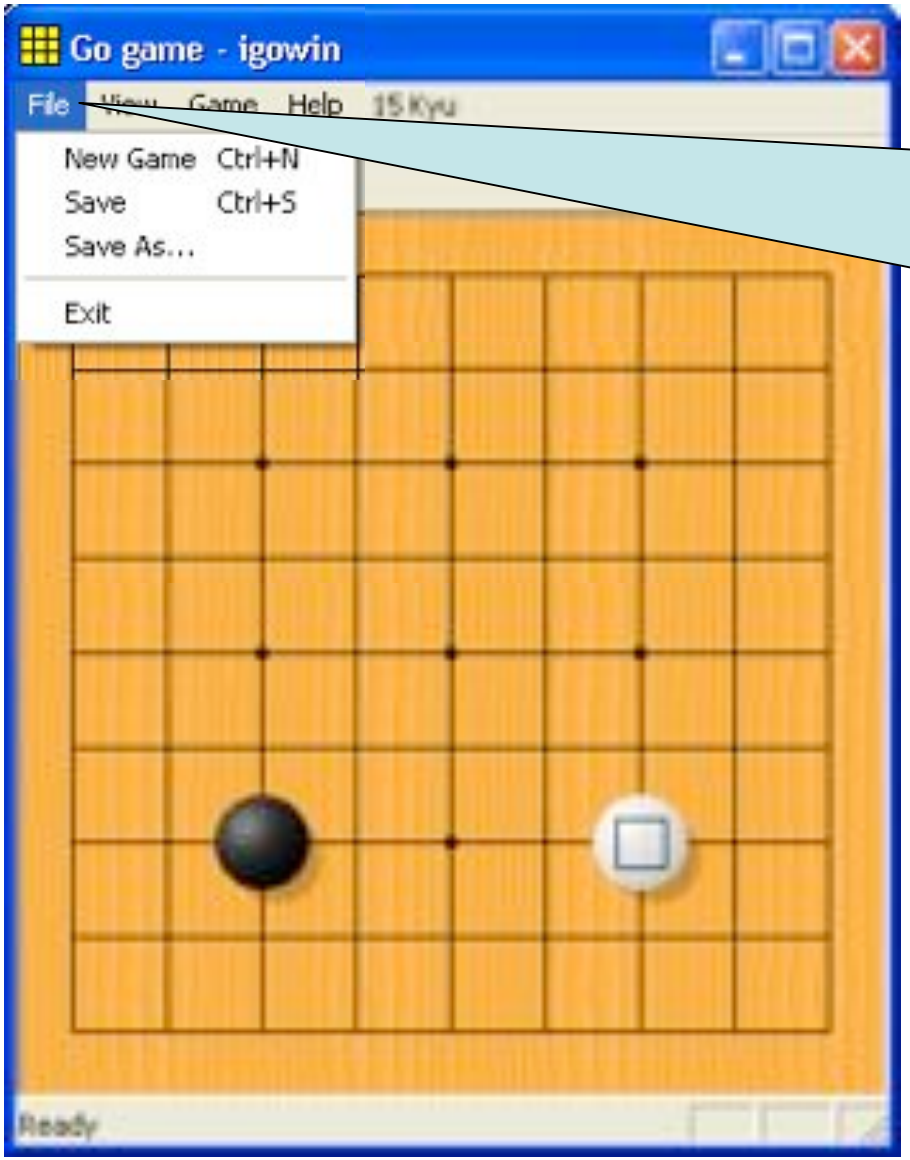


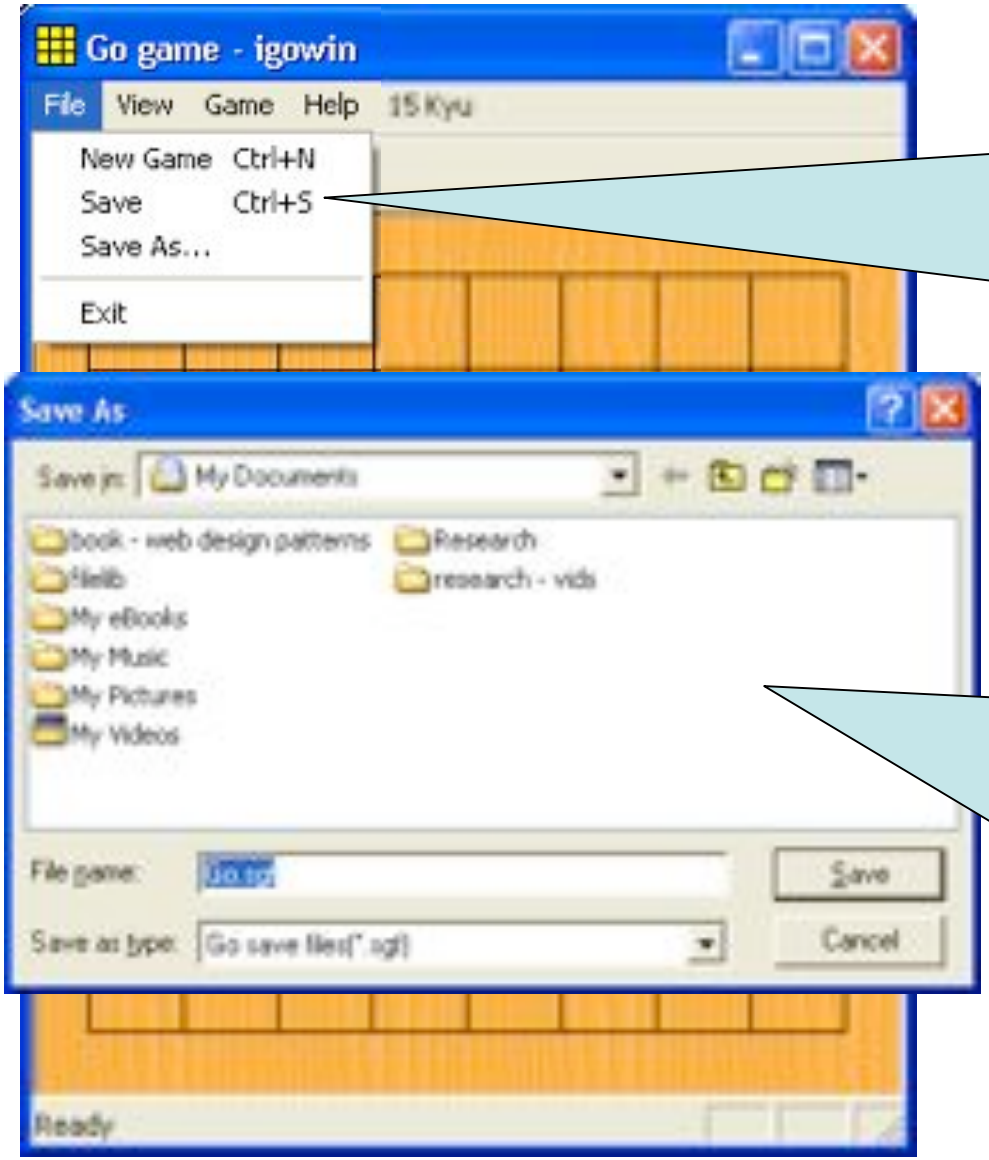
How does the game know to add a piece here if you click here?

What is This Course About?



How does the game know to bring up a menu if you click here (or use the keyboard shortcut)?

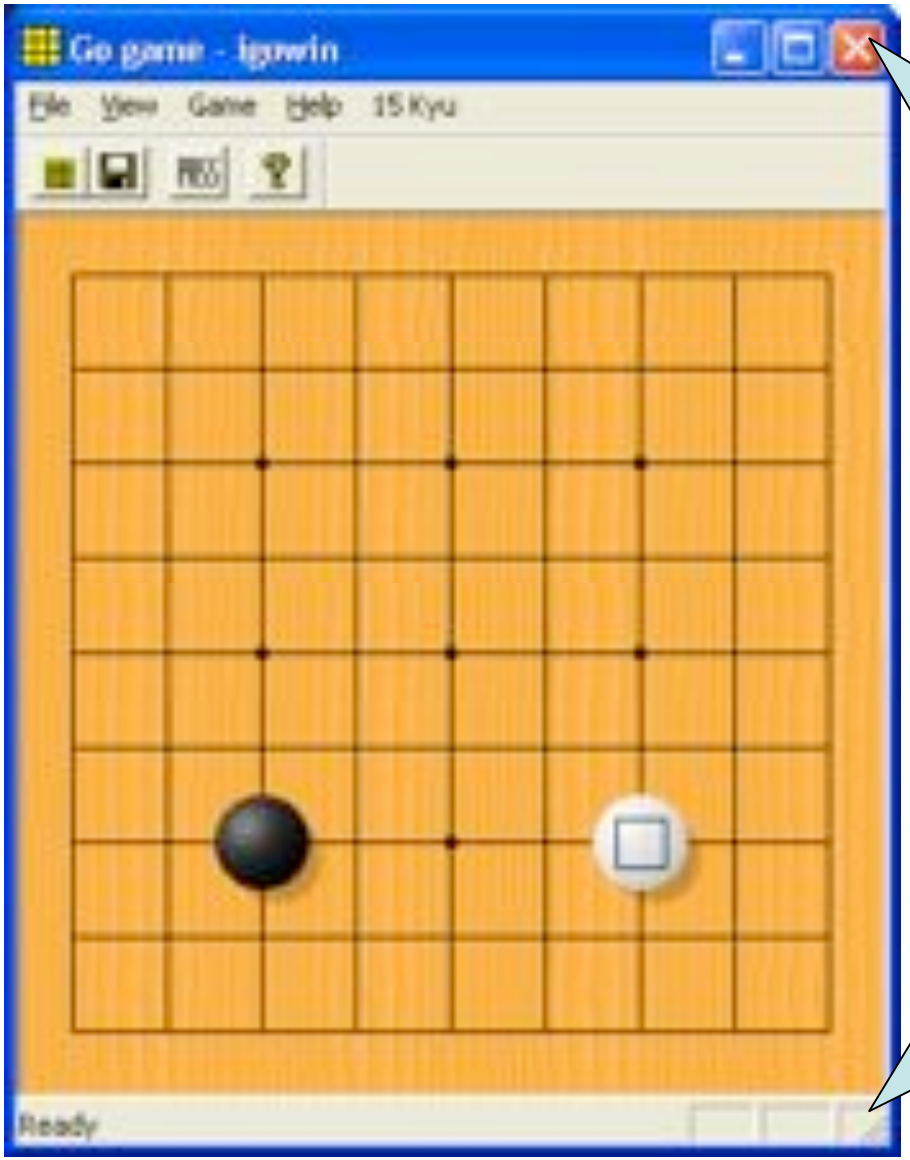
What is This Course About?



How does the game know to bring up the save dialog box if you click on “Save” or hit Ctrl+S?

How does the game know to arrange the save dialog like this?

What is This Course About?



How does the game know to close the window if you click here?

How does the game know to resize if you drag here?

What is This Course About?

- Organizing principles of user interface software
  - How do they work? (or, How to program?)
  - Why they work that way (or, Design rationale?)
    - Ex. How properties of people apply to building systems

- Practice in UI implementation
  - Parts and organization
  - Some practice in implementation

- Advanced techniques for interaction

Course Topics

- GUI desktop
- Web
- History of UIs
- Mobile and pervasive UIs

Course Topics

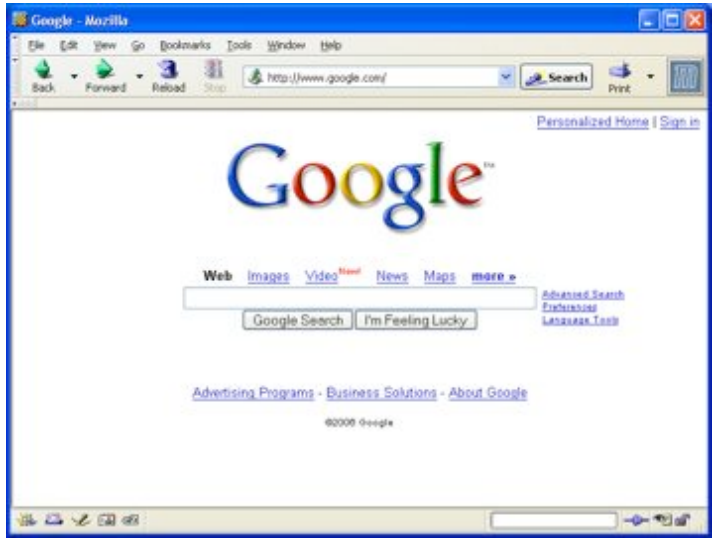
GUI Desktop

- Basic organization of GUIs
  - Main subsystems
  - Output models
  - Input models
- Properties of people
- Interaction techniques

- Evolution of user interface systems
  - Current UI toolkits built on top of ideas from older ones
  - Understanding core principles important for using and implementing

Course Topics
Web

- Basic organization of the Web
  - Key ideas that make it work
  - Competing ideas that didn't work
- Evolution of the Web
  - Web services
  - Semantic web
  - Mashups
  - Social web



Course Topics

History

- How did we get here?
  - Files, folders, mouse, menus, windows?
  - Who were the people that did it?
  - What were the insights and engineering that made it happen?

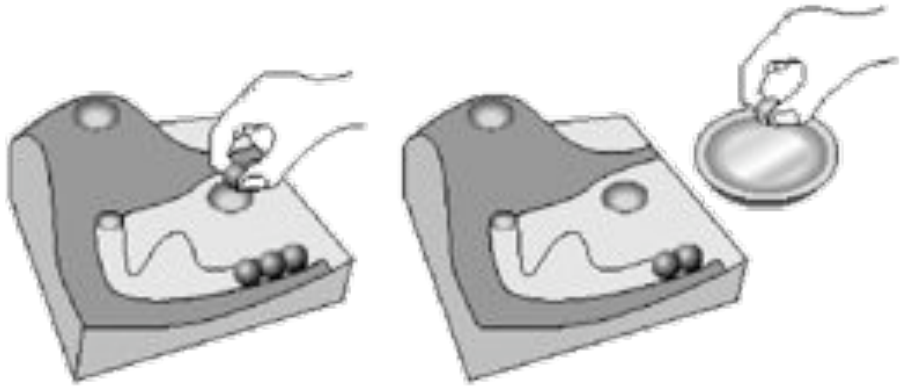
Course Topics

Mobile and Pervasive UIs

- Location-based services

- Multimodal Interaction

- Tangible UIs



Everyone Take Out a Sheet of Paper

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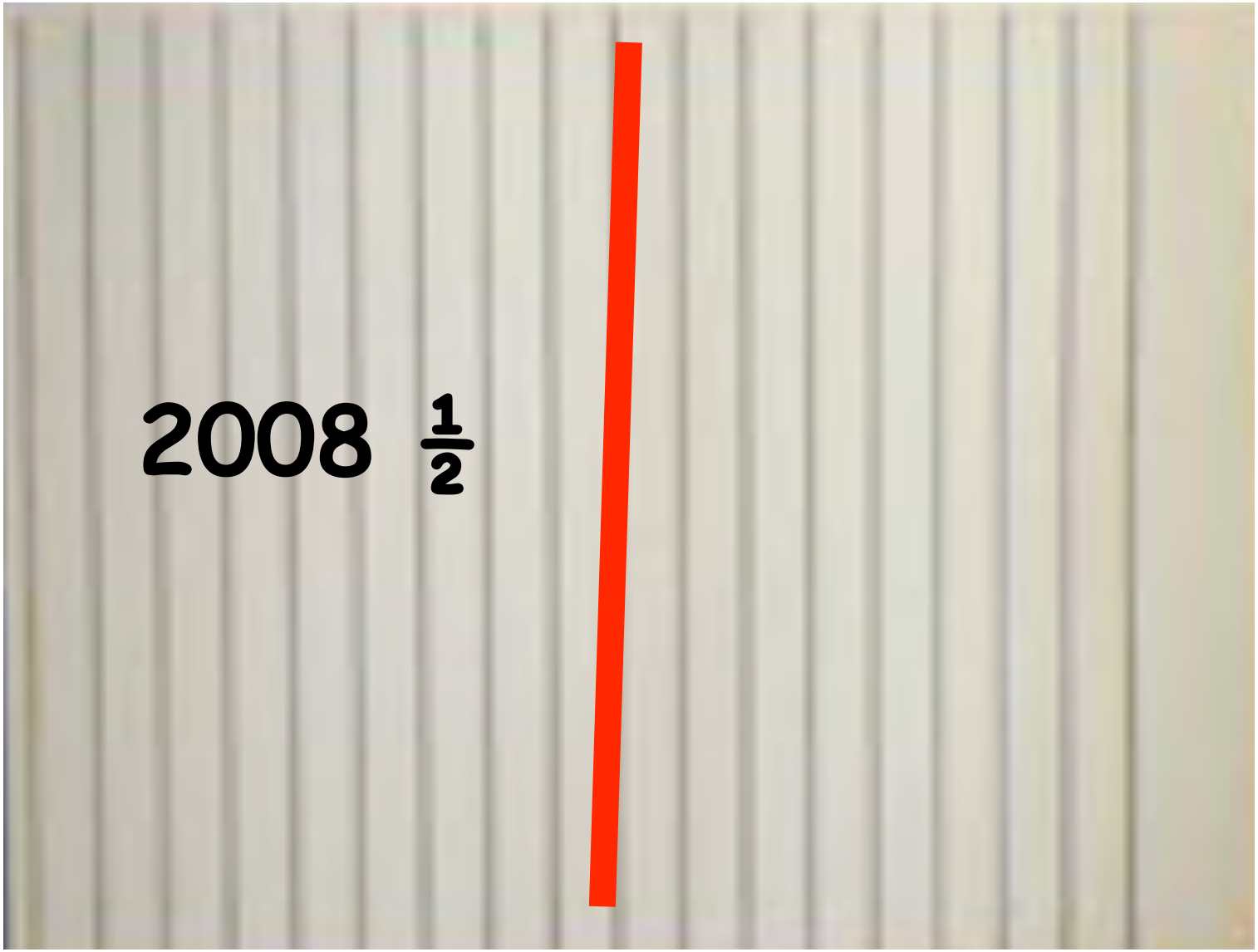

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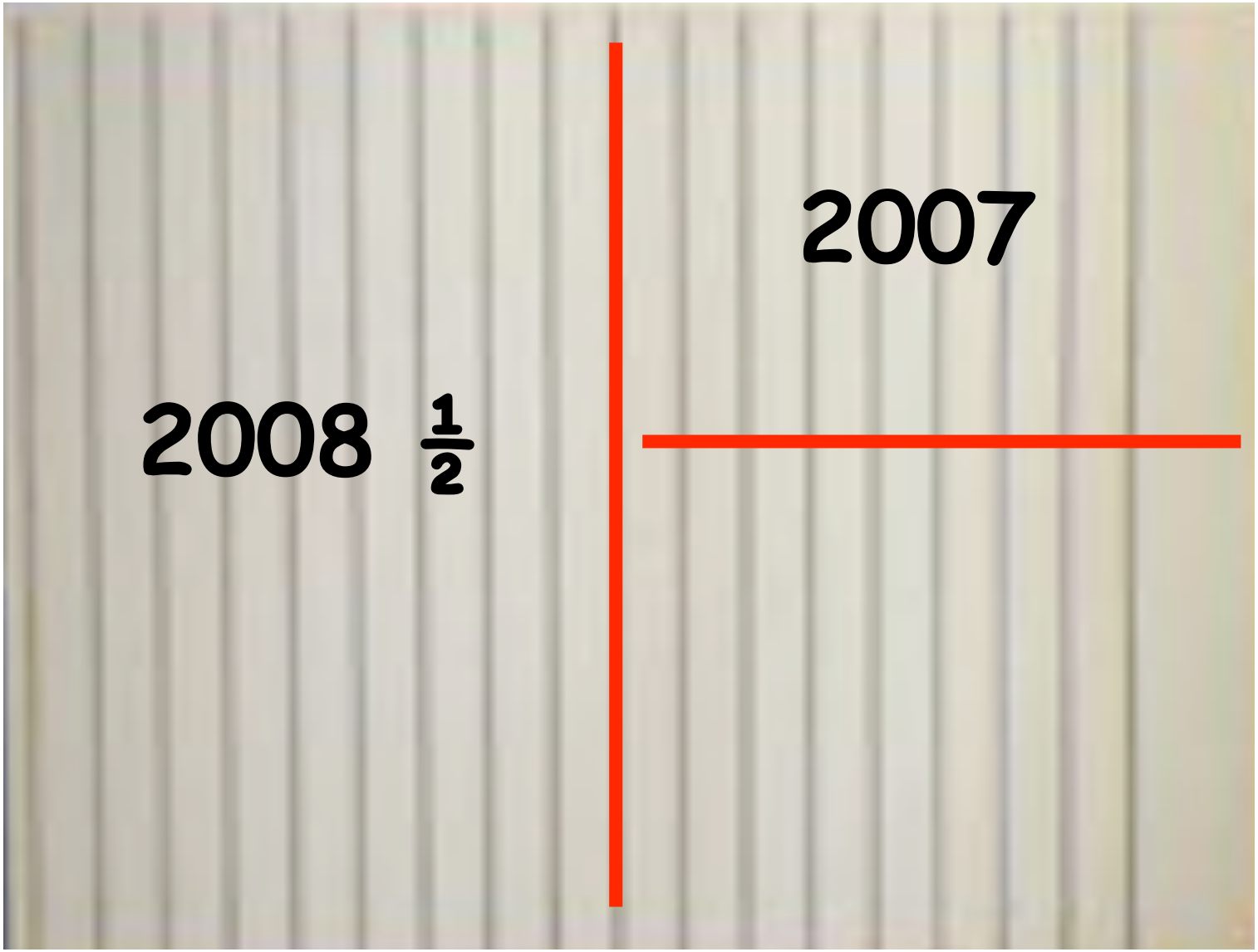

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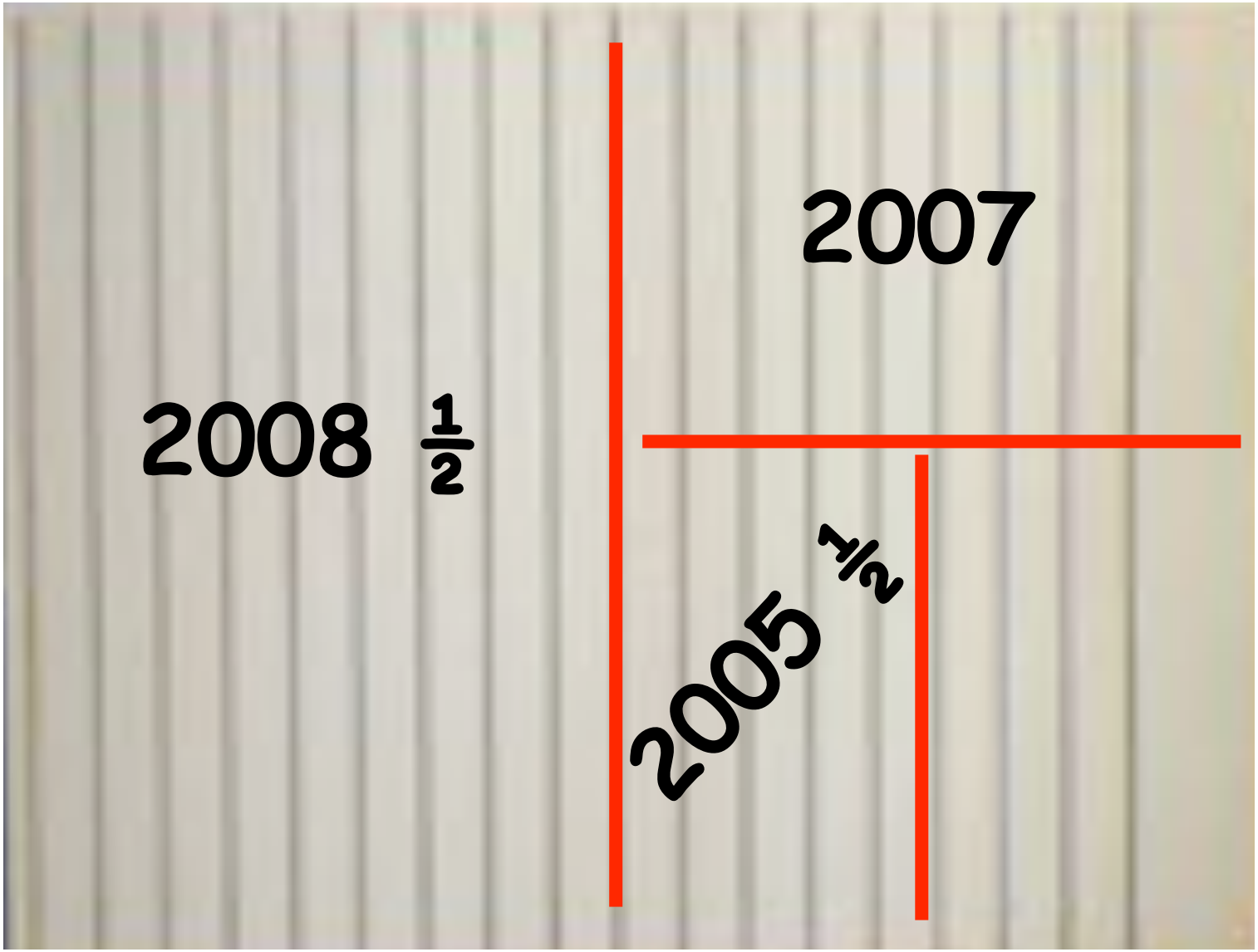

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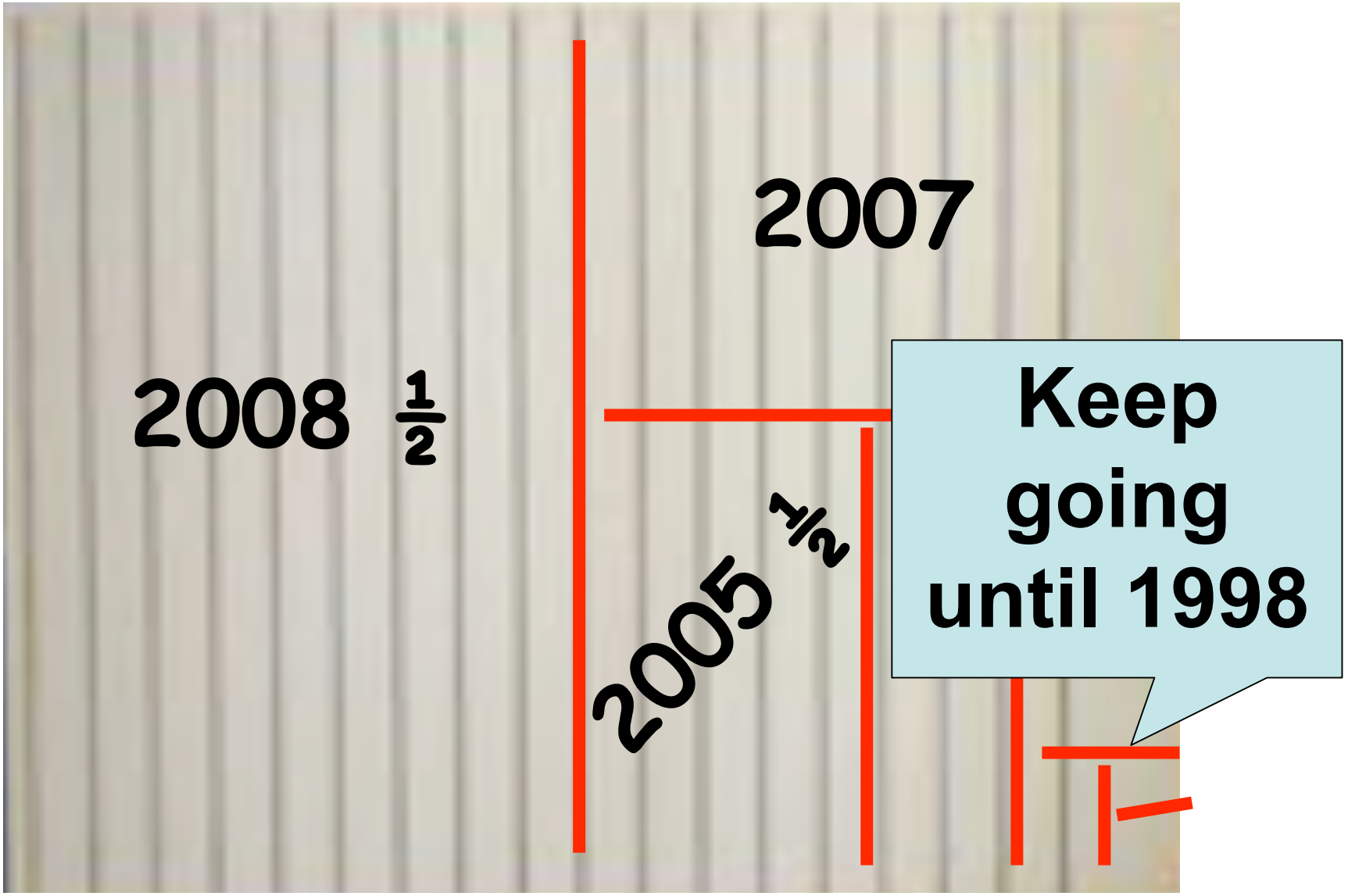

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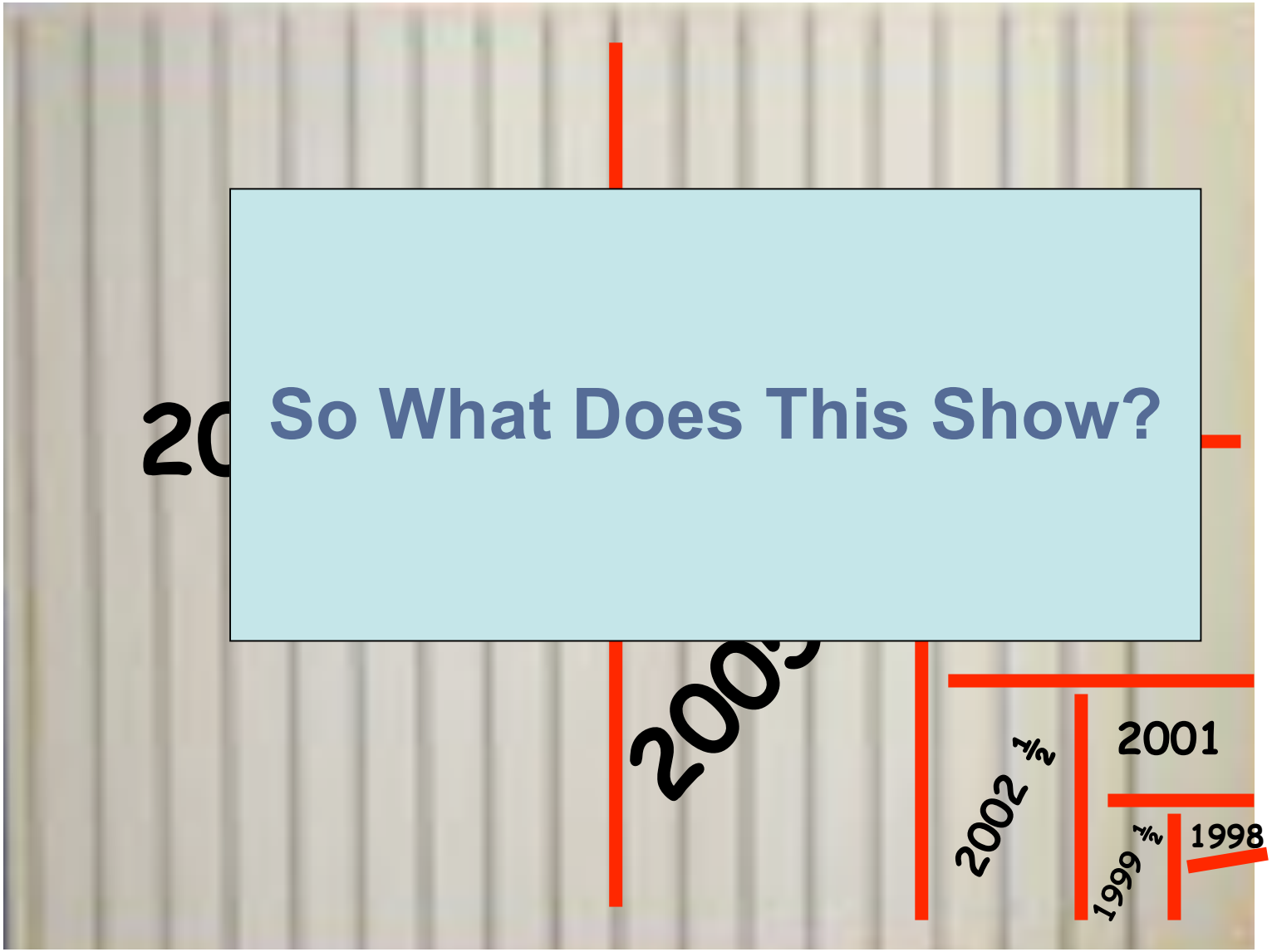
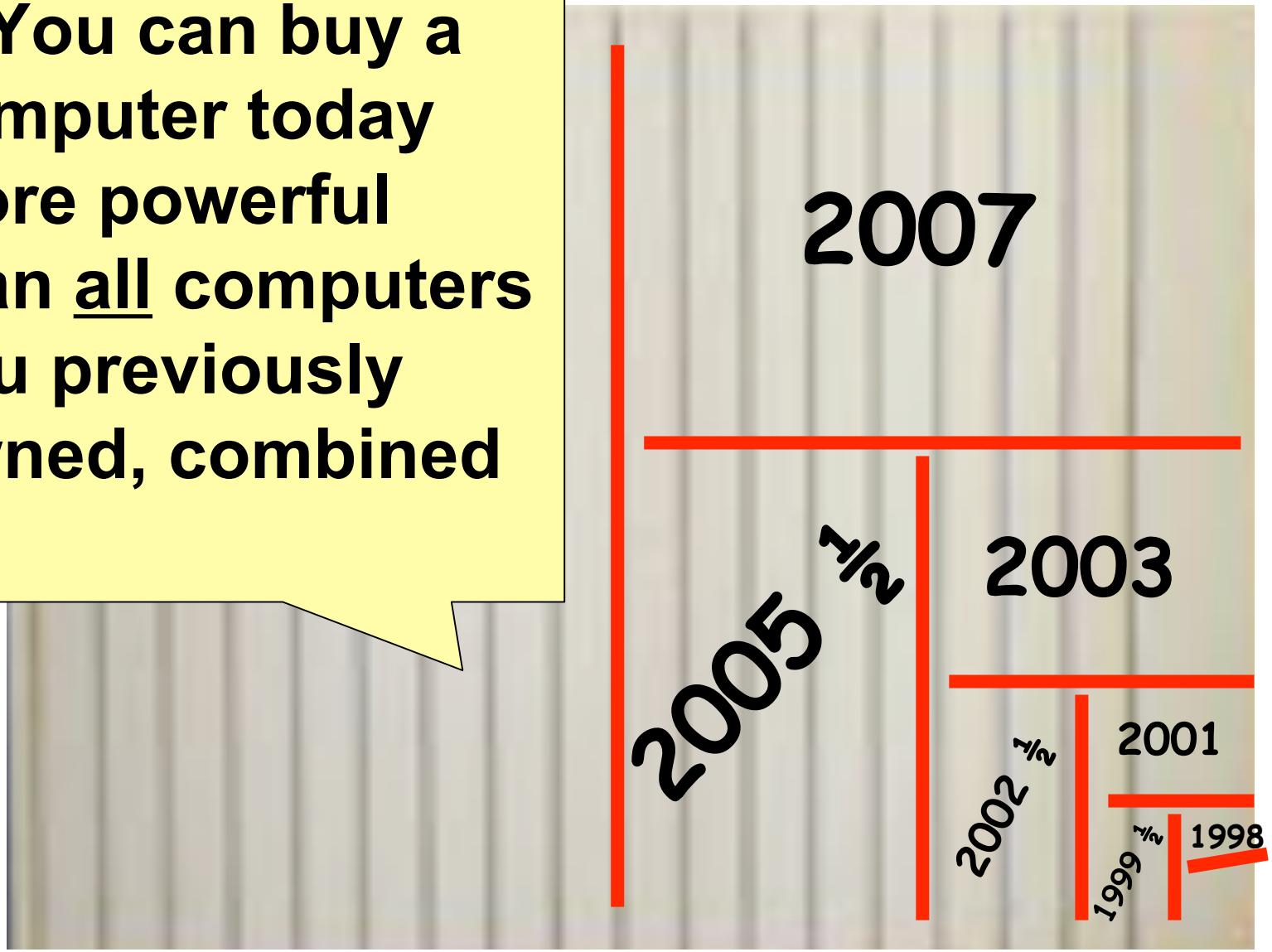


Moore's Law


transistors
MOORE'S LAW
Pentium® 4 Processor
Pentium® III Processor
Pentium® II Processor
Pentium® Processor
486™ DX Processor
386™ Processor
286
8086
8080
8008
4004
100,000,000
10,000,000
1,000,000
100,000
10,000
1000
1970
1975
1980
1985
1990
1995
2000

So What Does This Show?

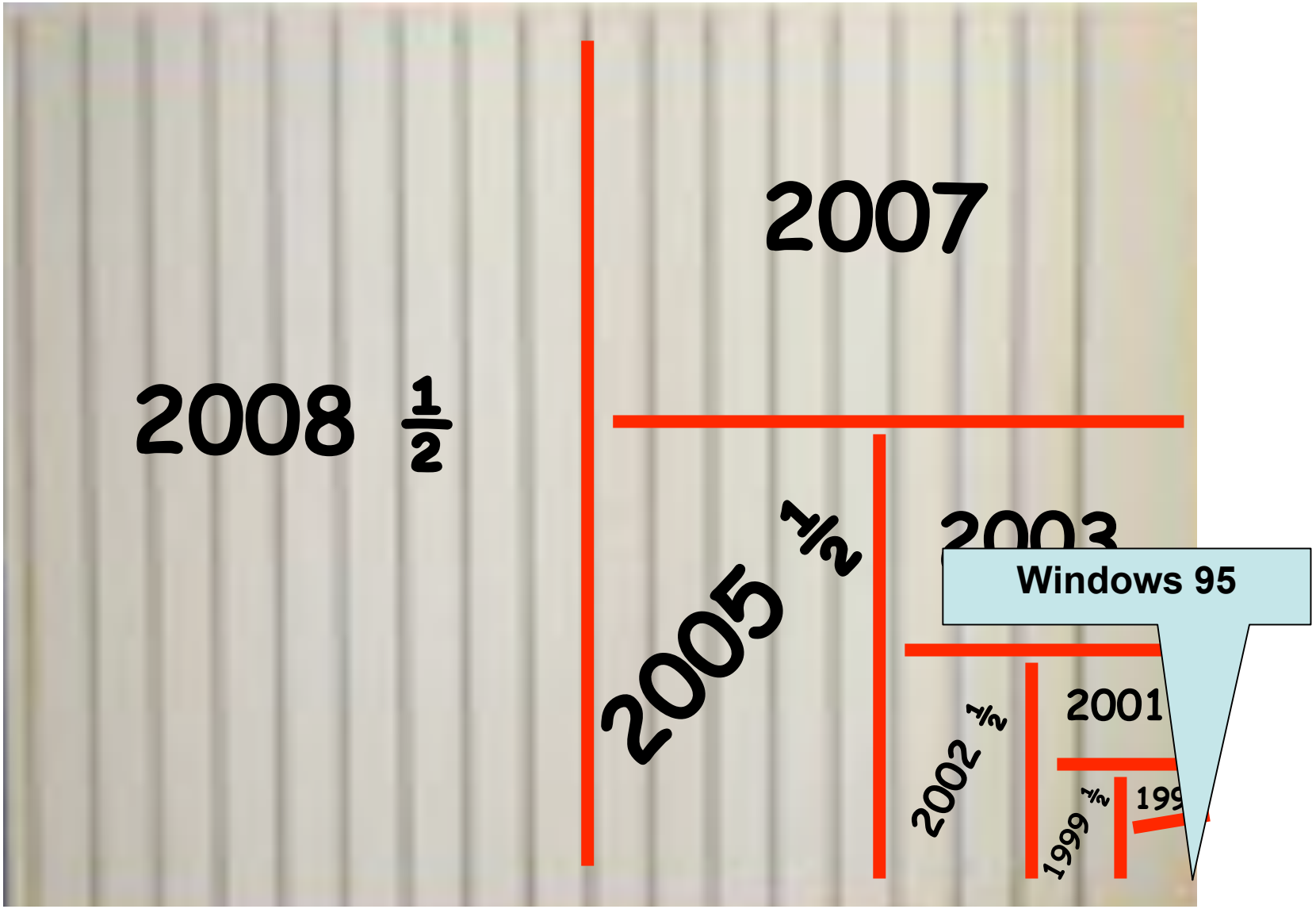
1 You can buy a computer today more powerful than <u>all</u> computers you previously owned, combined



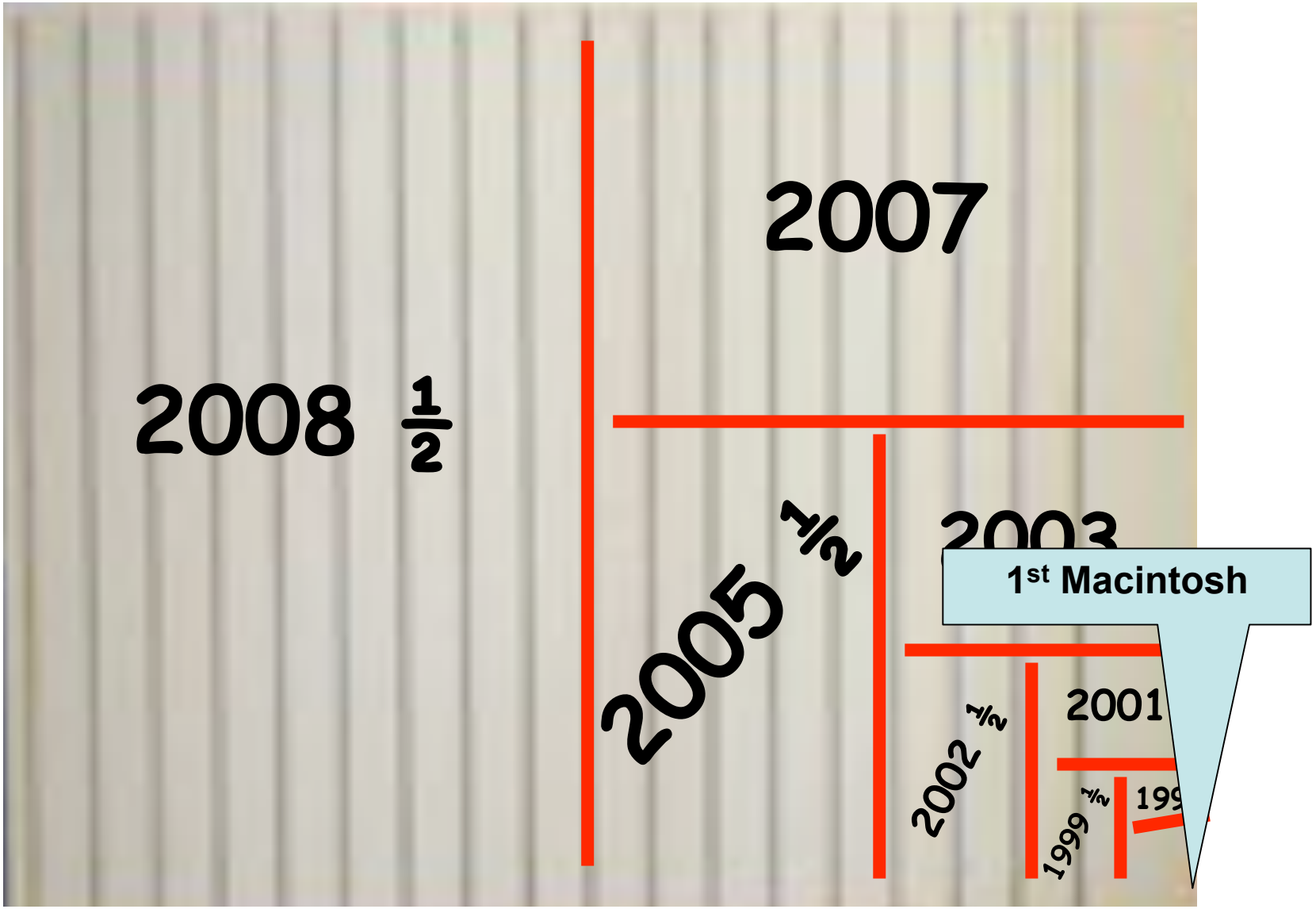
My Old Computers

>

So What Does This Show?

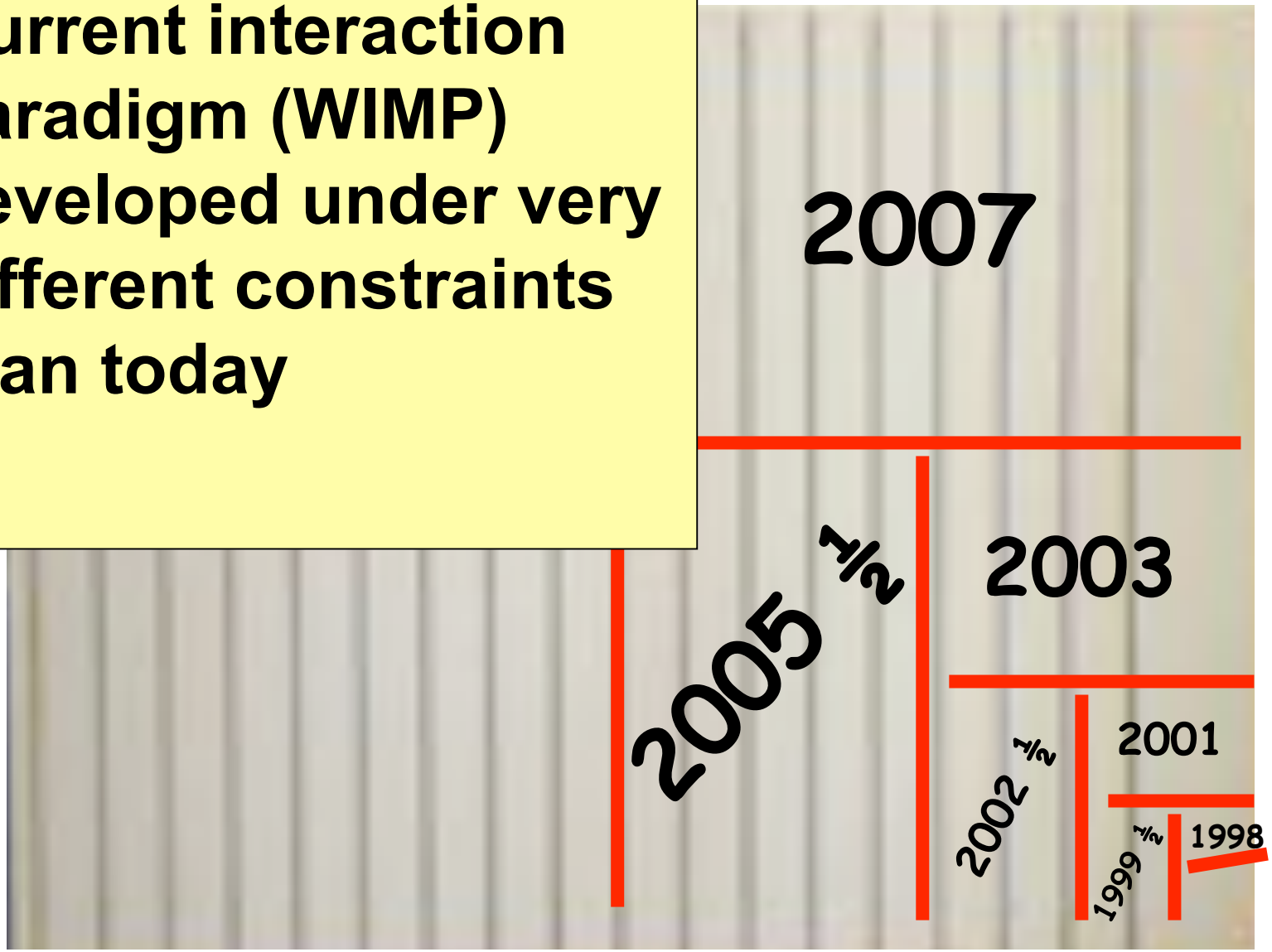


So What Does This Show?



So What Does This Show?

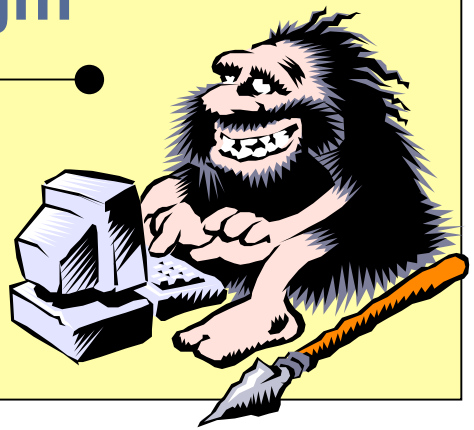
2 **Current interaction paradigm (WIMP) developed under very different constraints than today**



Moore's Law

- Old environment when GUIs developed
  - CPUs slow
  - Storage small
  - Computers bulky
  - Computers expensive
  - Few computers networked, wired
  - No web, not awash in information

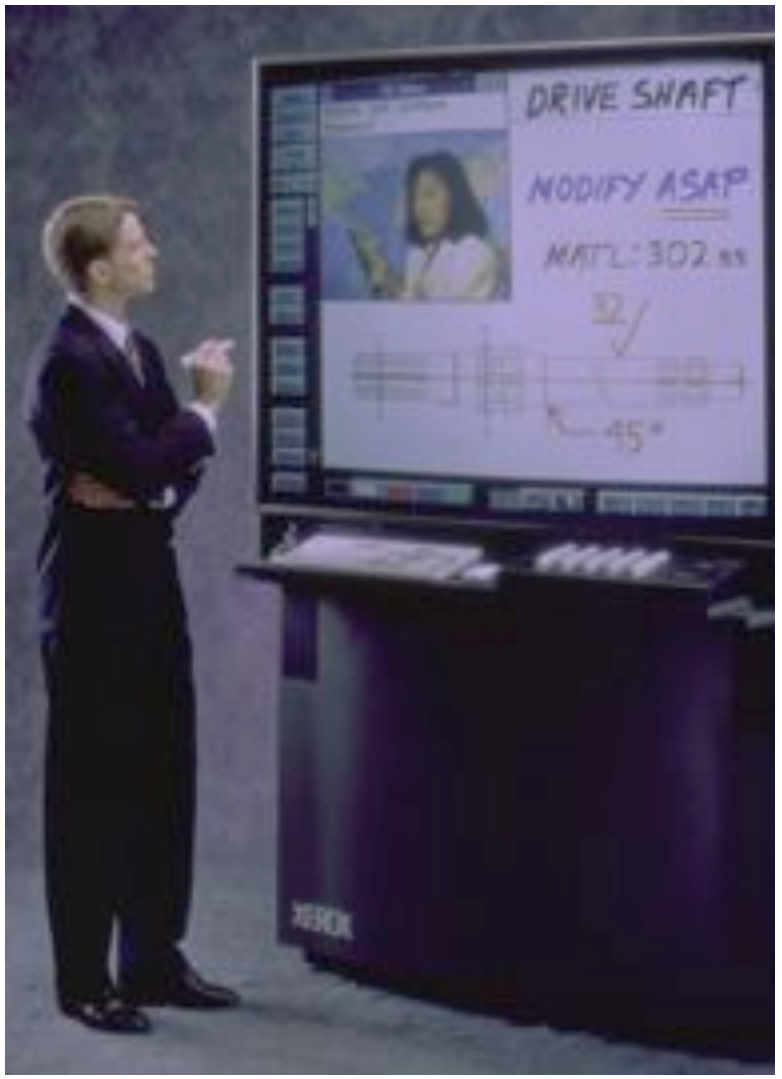
- **Worth re-thinking existing GUI paradigm**
  - Go beyond "point-and-grunt"
- **Worth looking at new opportunities**
  - Lower prices, newer form factors



Why is This Useful?

- A critical time
- Computers are exploding into society
  - Pervasive computing power
  - Small, cheap, powerful
  - ➔Everywhere

Computers Are Appearing Everywhere



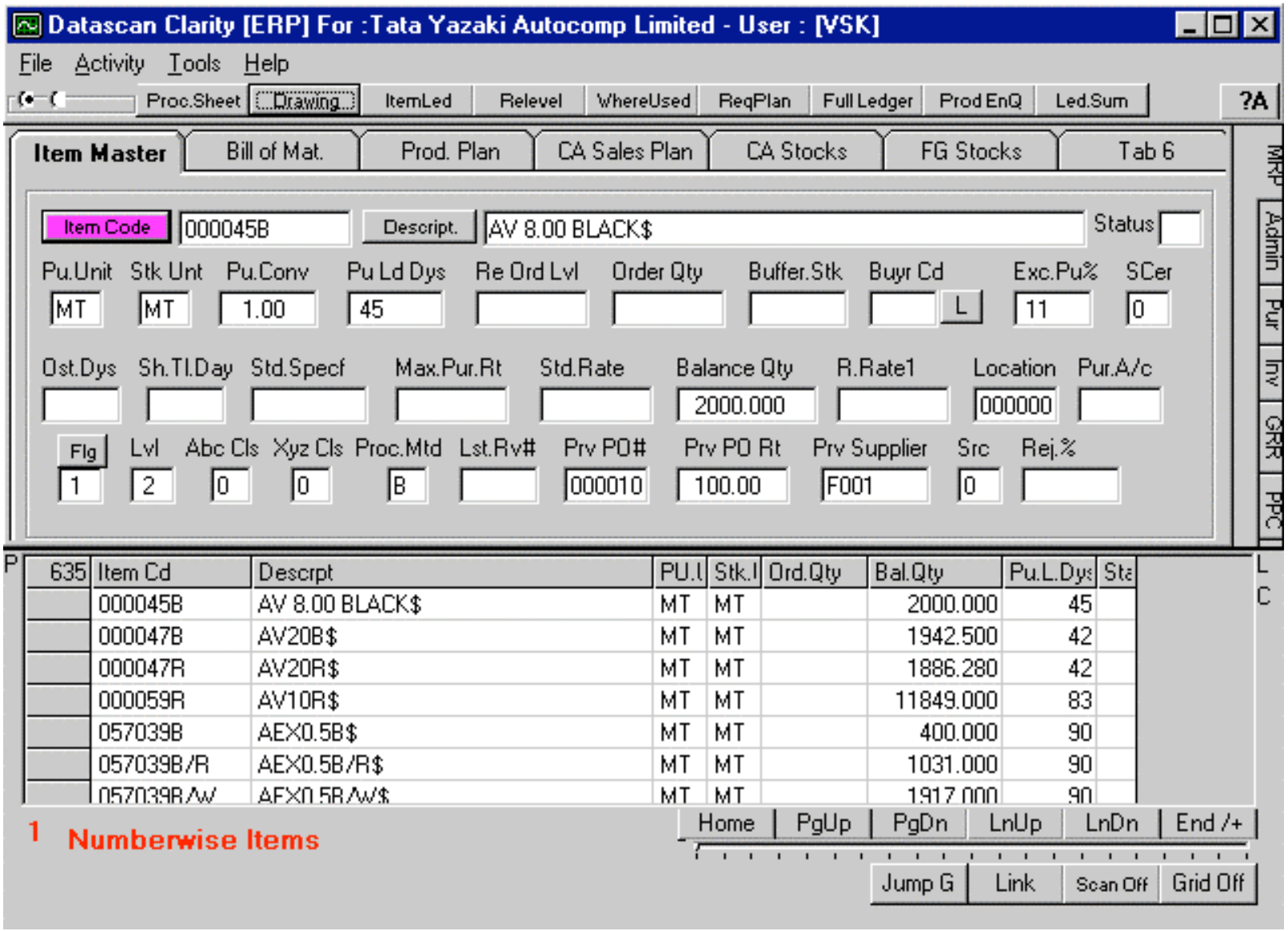
Computers Are Appearing Everywhere

Big Impact on the World

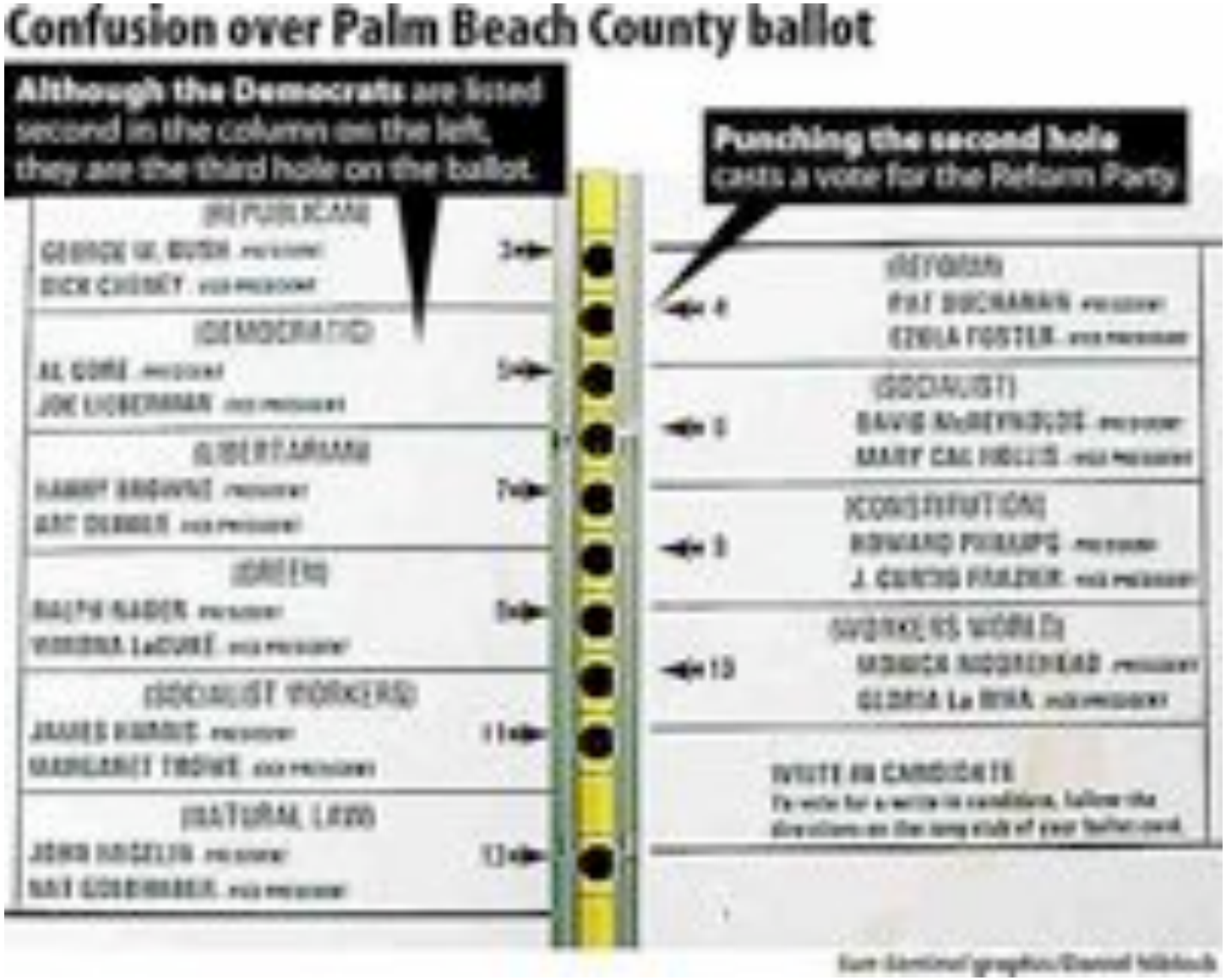
- Large numbers use computers
  - Most Europeans & Americans own computers
  - Majority have internet access (42% broadband)
- No one in our society is not affected in some way by computers

- Short-term, likely you will become developers, project leaders, members of startups
- Person who develops the system has the last word on usability
  - Strong position to advocate for end-users

We Want You to Avoid UIs Like This...



… And This


Confusion over Palm Beach County ballot
Although the Democrats are listed second in the column on the left, they are the third hole on the ballot.
Punching the second hole casts a vote for the Reform Party

…and This.

- Therac-25 (6 accidents 1985-87)
  http://courses.cs.vt.edu/~cs3604/lib/Therac_25/Therac_1.html
  – Repeated in 2000 (5 more deaths)
  http://archives.seattletimes.nwsource.com/cgi-bin/texis/web/vortex/display?slug=radiation14&date=20010614

- Aegis (July 4, 1988)
  – Iranian Airbus shootdown by *Vincennes*
  http://washingtonpost.com/wp-srv/inatl/longterm/flight801/stories/july88crash.htm

- Helios Airways Flight 522 (August 14,2005)
  – 121 dead because a cleaner had moved a switch
  http://en.wikipedia.org/wiki/Helios_Airways_Flight_522

Good Usability is Important

- Long-term, many of you will become managers, CTOs, founders of startups
- Important to know:
  - What the trends are
  - What technologies are out there
  - What the range of possibilities are

Handout & Administrative Details

- Projects
  - Requires strong CS and programming background
- Grading
  - 5 projects 80%
  - Homework 10%
  - Class participation 10%

"Μηδείς αγεωμέτρητος εισίτω"

Handout & Administrative Details

- On-line materials
  - Everything online
  - http://www.hci-uma.org/courses/saui

Important note

- Minimal Java training in class
- If you are not comfortable with Java programming:
  1) Learn
  2) Drop course

- P1 is Java based
- P2 is your choice
- P3 is Java based
- P4 is web-based
- P5 is your choice

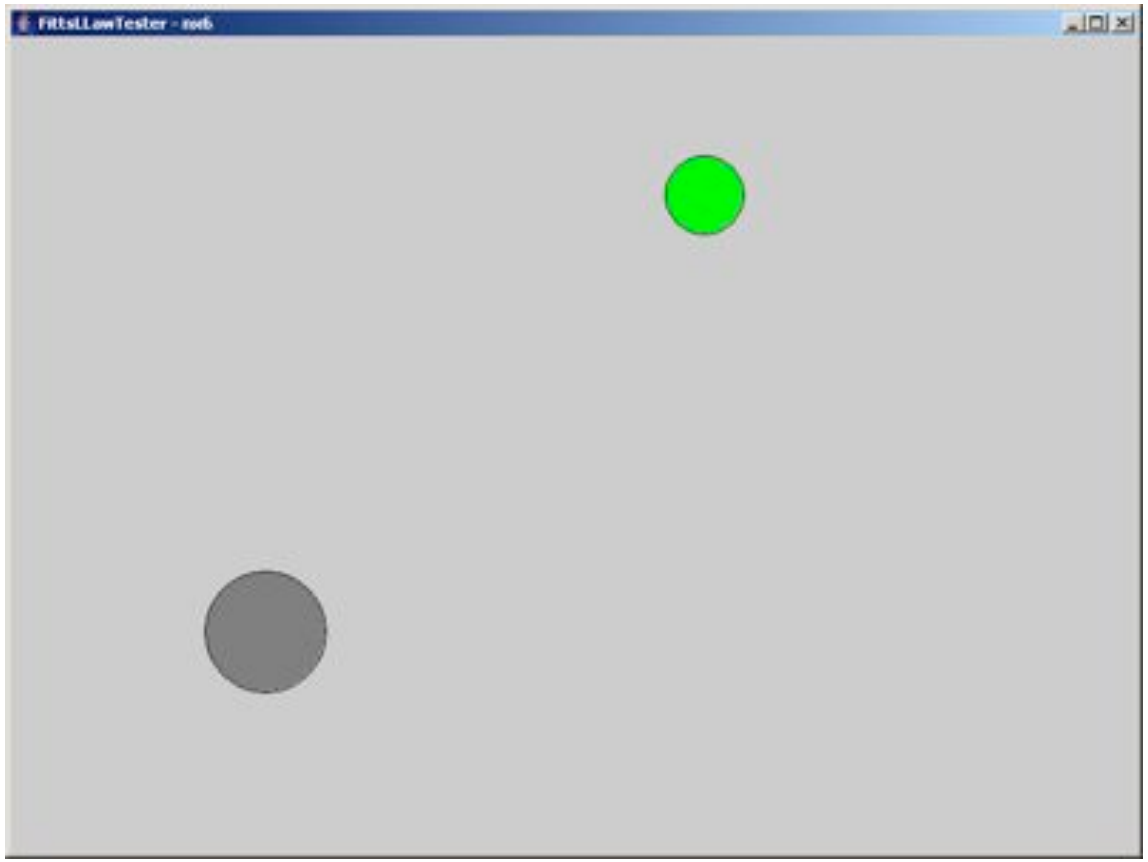
Programming Assignments

- Some assignments are individual
- It's ok to talk with others about assignments
  - Big picture concepts
  - Specific API details
  - Help with debugging (reasonable)
- It's ok to examine open source software
- It's not ok to copy and paste under any circumstances

- In all cases, add a README file documenting what help you got

Assignment #1

- Fitts' Law

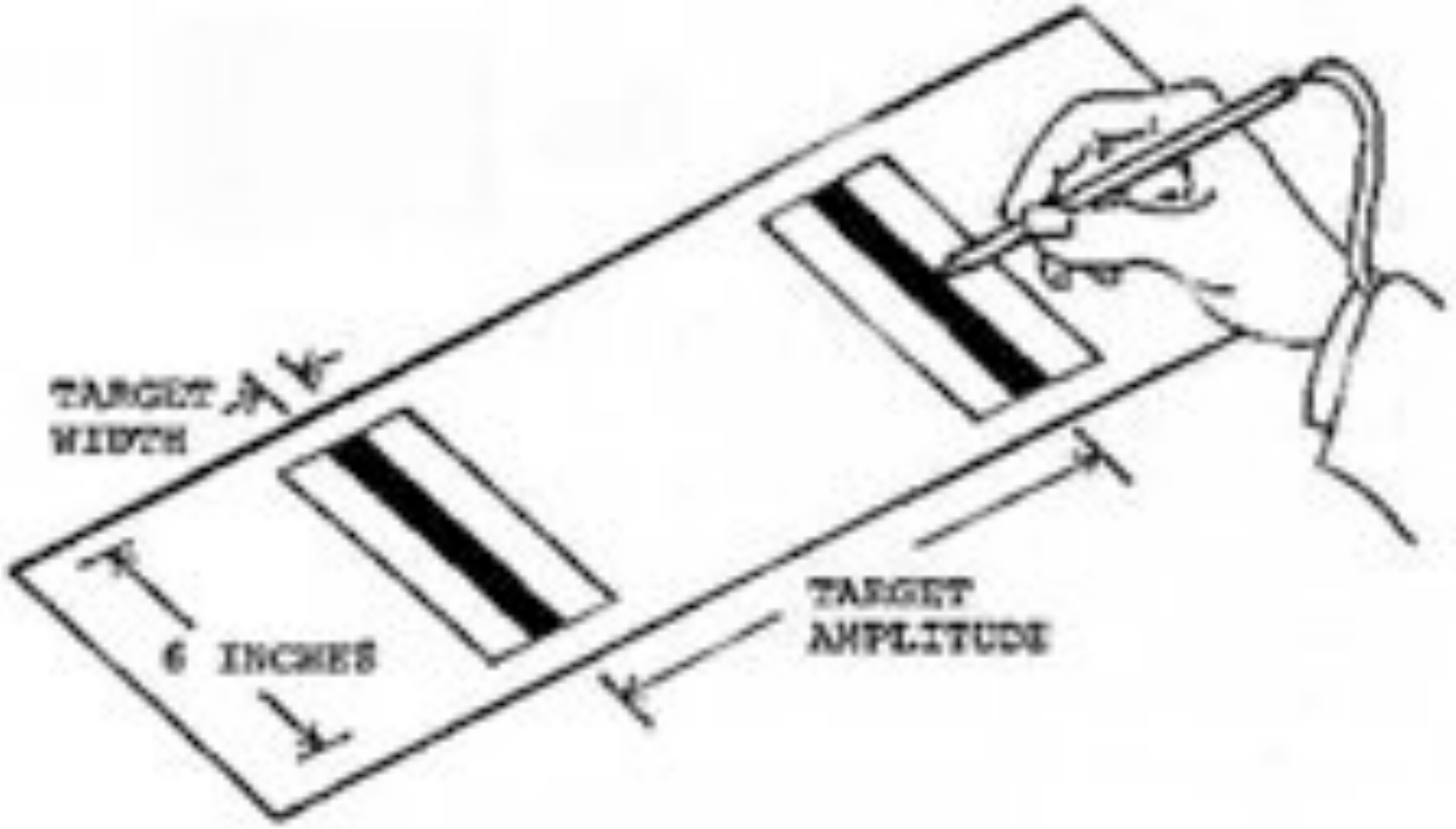


Some Tips

- Download the JDK with the Java source code
  - Very useful for understanding the guts of how it works
  - Can see production code in all its glory and messiness
- Highly recommend Eclipse IDE

  - Though you can use any environment
  - Comes with JVM and JDK source code
- Make sure you use good programming practices
  - You will be graded on this!
- Need to check, Java 1.5 and Mac OS X?

Questions


TARGET
WIDTH
6 INCHES
TARGET
AMPLITUDE

Fitts' Law

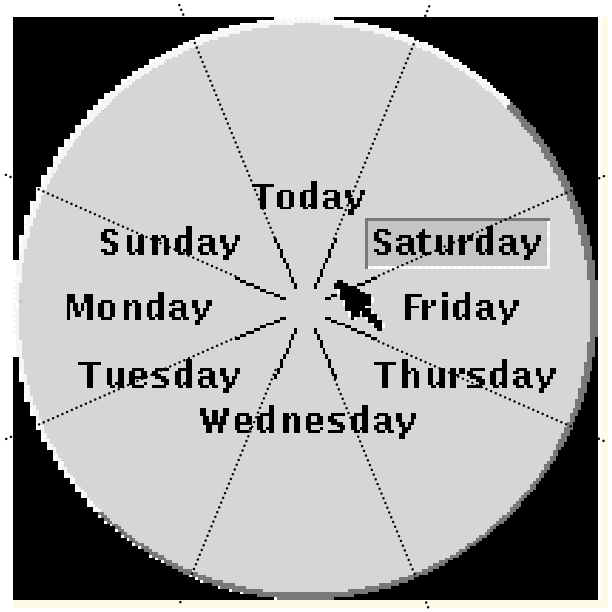
- Fitts' law tells us about difficulty for pointing and selection tasks
- Predicts time to make a movement
  - Moving hand is a series of micro-corrections
  - Time = A + B*$\log_2$(Dist/Size + 1)
  - A and B are empirically derived constants
- Time to move the hand depends only on relative precision required

Fitts' Law Example

Pop-up Linear Menu

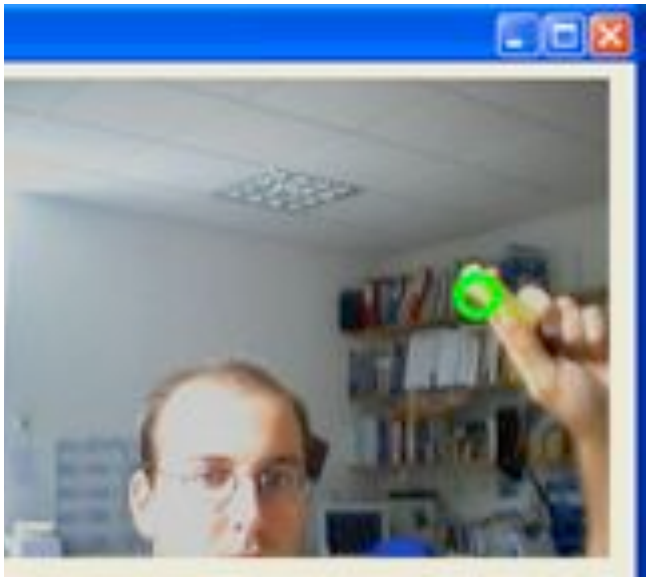
Today
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday

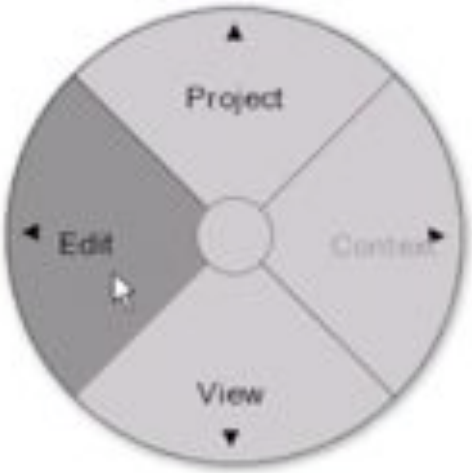
Pop-up Pie Menu



- Which will be faster on average?

Digression – Pie Menus in Practice





Pie menus are example of an *interaction technique*

Digression – Pie Menus in Practice

- If better, why don't we see them much?

- Harder to implement
  - couldn't do non-rectangular things quickly until mid-1990s
  - particularly drawing labels
- Don't scale past a few items
  - No hierarchy
- Unfamiliar to people
- Relatively small overall gain
  - Have to use menus **a lot**
  - Existing menus good enough

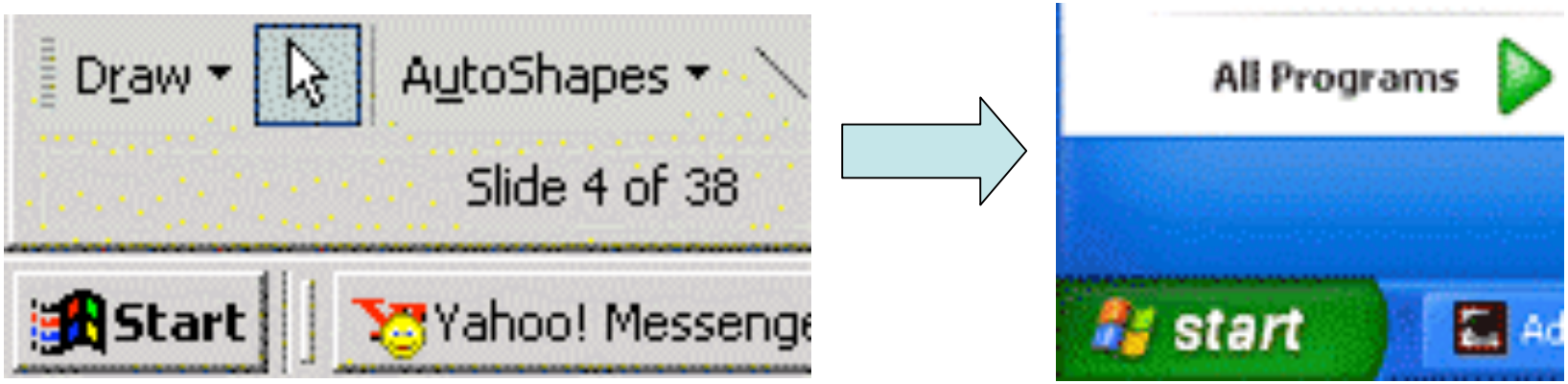
Fitts' law effects

- Windows menus at top of windows, vs. Mac menus at top of screen
  - Interesting Fitts' law effect
    - what is it?

Fitts' law effects

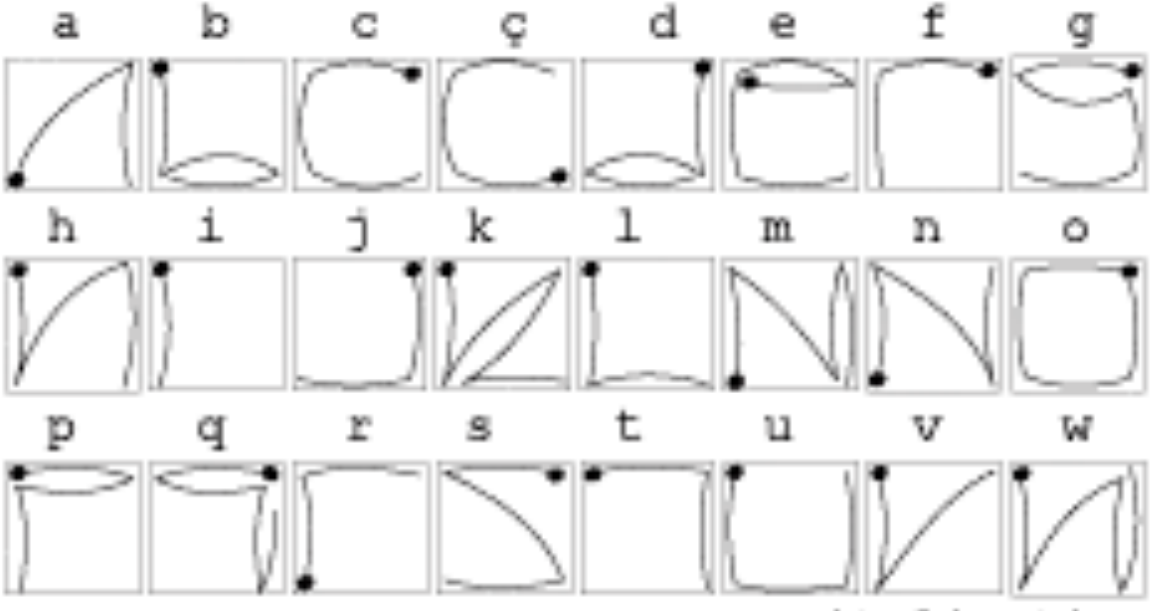
- Windows menus at top of windows, vs. Mac menus at top of screen
  - Interesting Fitts' law effect
    - thin vertical target (dir of move) ➔ high required accuracy
    - hard to pick
    - But both menus are thin vertical targets…
- With menu at top of screen can overshoot by an arbitrary amount
  - Example of a "barrier" technique

Another Fitts' Law Example



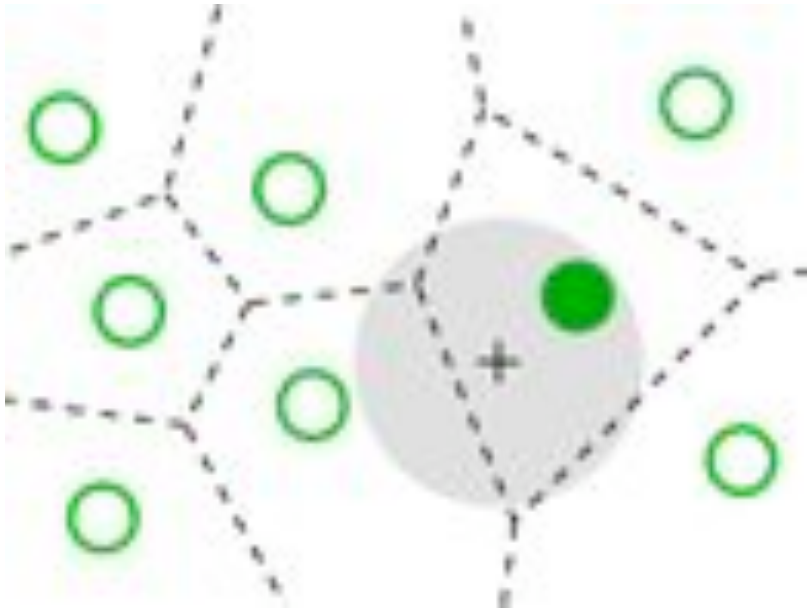
Fitts' Law and Accessibility

- Use a physical overlay and new unistroke alphabet
- Easier for:
  - People with disabilities
  - Mobile users



Fitts' Law and Item Selection

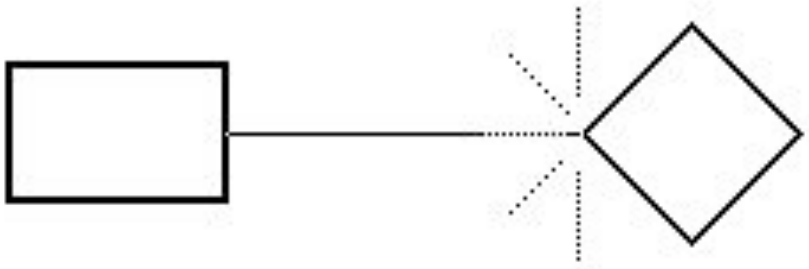
- Fitts' Law depends on distance and size of target
- Bubble cursor cleverly manipulates distance with a "resizable" cursor



Other Ways of Beating Fitts' Law?

- Time = A + B*$\log_2$(Dist/Size + 1)

- Hint: think menus
- Hint: think scroll bars
- Hint: think drawing programs



Questions