CMPT370: Advanced Programming Topics

9 January 2007
CMPT370
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Trinity Western University

- ***cmpt370.seanho.com***
- ***Email sign-up sheet***

Welcome to CMPT 370!

- You are already proficient programmers
- This course is to give you more experience as a programmer with some advanced topics and applications
  - CMPT370 is different every time it's offered
- This semester:
  - Graphical user interfaces: FLTK (~2 wks)
  - Parallel programming: OpenMP (~2.5 wks)
  - Computer graphics: OpenGL (~8 wks)

What's on for today

- Intro / Administration:
  - What I assume of you
  - How you'll be evaluated
  - Principles and policy on group work
  - Development / programming environments
- Overview of this semester's 3 main topics
- An excerpted history of GUIs

What I assume of you

- You don't need hand-holding
  - Lots of docs/tutorials on web: go at it!
- You are proficient in programming
  - At least one language (C, Java, M2, Python, ...)
  - Can pick up C++ in the next two weeks
  - Not required to be a wizard in OO / templates / generic programming
- You are creative and excited to make cool and useful programs!
  - Most labs ask you to design your own task

How you'll be evaluated

- Programming projects (labs) (40%):
  - 5-6 total, about one every other week
  - Usually due on Thursday midnight
  - Lab write-up required (see template)
  - Electronic submission via eCourses:
    - Tarball of the project directory
    - Include C++ sources, Fluid files, executables, data files, lab write-up
- 2 Midterms (15% each), final exam (30%)
  - Midterms: Thu 15Feb, Thu 22Mar

Principles on group work

- Teamwork is great! But it's more complicated.
  - In the working world, you'll always be part of a team, but your role may often change
  - Be flexible to fill all the roles:
    be able to do all the tasks for each lab
- This course is not primarily about team software development (CMPT 386/387), but about advanced programming topics
- Always give credit where credit is due
  - Even just ideas from a conversation

Policy on group work

- In this course, labs are generally individual work:
  - You can talk about the assignment, but
  - You may not copy a classmate's code
  - You may copy snippets from the net, but you must cite where you got it from
  - If you get a good idea from a classmate, give credit in your lab write-up
- But: I'm flexible; if you really want to do a lab as a team, talk to me
  - The scope of the project may need to expand

Development environments

- See the IDE policy sheet for full details
- Officially supported environment:
  - gcc/g++, make, Cygwin on senior lab PCs
  - gcc/g++4, make on carmel (Linux)
  - Plain-text editors (Notepad, nano, vim)
- You may use another environment (MSVC), but:
  - Should use C/C++
  - I need to run your program (Win32/Linux)
  - Parallel lab must be done on carmel
- I'm still flexible; ask me

Your first assignments

- Lab0: FLTK orientation (due next Tues 16Jan)
  - Login to senior lab PCs
  - Get familiar with Cygwin, gcc, make, editors, etc.
  - Follow along with FLTK tutorials
  - Upload a tarball of CubeView to eCourses
- Lab1: FLTK project (due next week Thu 18Jan)
  - Design and implement a cool FLTK program of your own thinking
  - Research and use an advanced FLTK feature
  - Lab write-up required

Topics this semester

- Graphical user interfaces
  - Widgets, valuators, input and output, menus
  - Events and callbacks (FLTK)
  - Signals and slots (Qt)
- Parallel programming
  - Memory models: UMA vs. NUMA, etc.
  - Shared-memory parallelism (OpenMP)
  - Distributed/clusters (MPI)
  - Hybrid models

Topics this semester, cont.

- Lines, curves, Bezier, splines
- Linear/bi/tri interpolation
- Modeling:
  trimeshes: vertex/face tbls, normal, parametric
- Viewing: transforms, perspective projection, homogeneous coords, quaternions
- Lighting:
  shading, diffuse/ambient/specular, materials
- Texture mapping: texcoords, mip-maps
- (Raytracing, global illumination)

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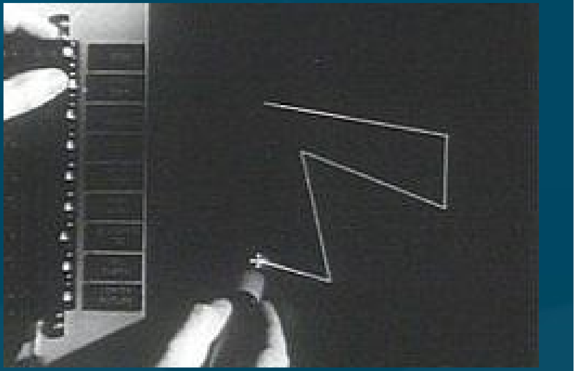
History of graphical user interface

- 1940s-50s: big mainframes, punched cards, mostly number-crunching: text interface
- Some key developments in GUIs:
  - Sutherland's SketchPad (1963)
  - Engelbart's NLS (1968)
  - Xerox PARC: Alto, Smalltalk (1974)
  - Apple Lisa, Mac (1984)
  - MS Windows 1.0 (1985)
- ArsTechnica has an excellent article

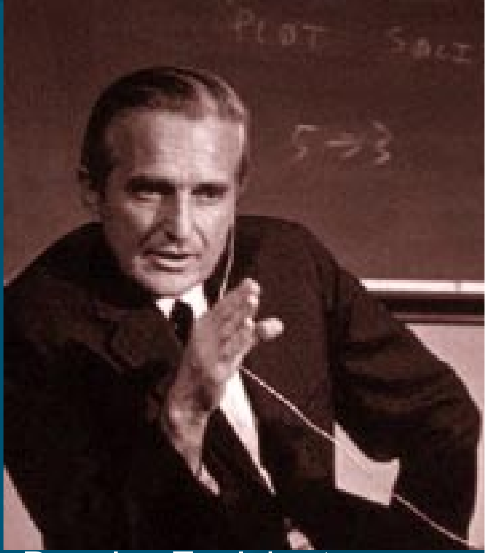
Sutherland's SketchPad (1963)

- Ivan Sutherland
  Ph.D. thesis at MIT
- Used light pen to directly manipulate graphical objects on screen
- Pioneer of computer-aided drafting (CAD):
  - Draw “master” diagram once
  - Instantiate multiple copies, tweak (OO design)
  - Constraint-based system
    (e.g., keep two lines at fixed angle)



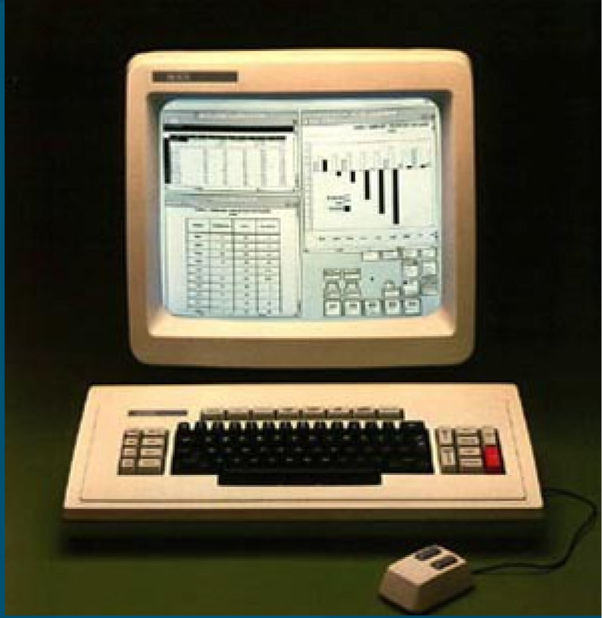
Engelbart's NLS demo (1968)

- NLS (oNLine System) innovations:
  - Mouse
  - Windowing system
  - Collaborative document editing with email, IM, and video conferencing
  - Hyperlinks
  - Chording keyboard



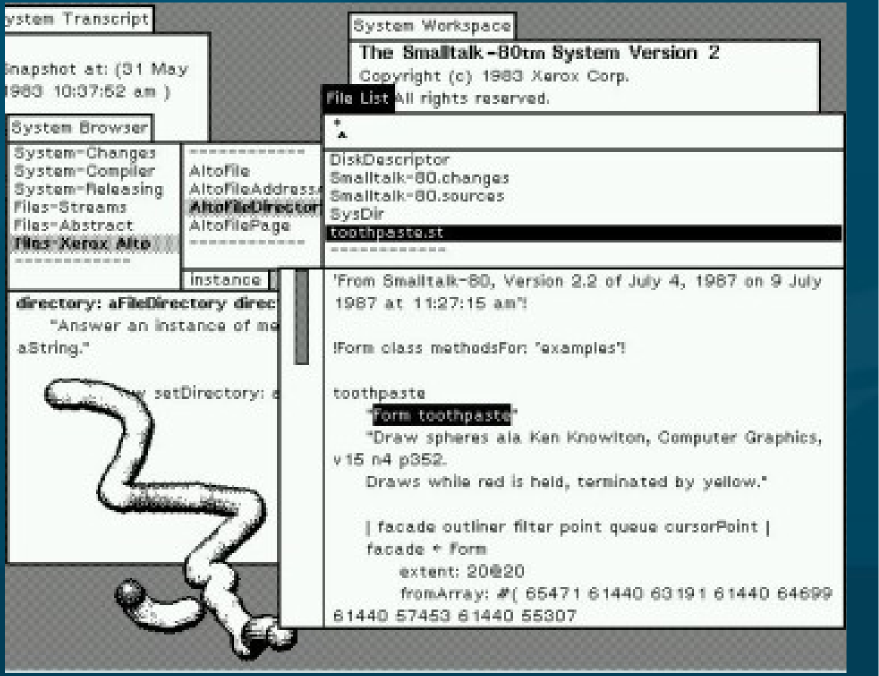
Douglas Englebart,
Stanford Research Inst.

Xerox PARC in the 1970's



Smalltalk
on the Star

- Xerox Palo Alto:
  - Towards “paperless office”
  - Microcomputers: Alto (1973), Star (1981)
  - WIMP model: windows, icons, menus, pointer
  - Desktop
  - Smalltalk (1974):
    - Pure OO language
    - Integrated graphical development
      and runtime environment



```
napshot at: (31 May
1983 10:37:52 am )
```

```
System-Changes
System-Compiler
System-Releasing
Files-Streams
Files-Abstract
Files-Xerox Alto
```

```
AltoFile
AltoFileAddress
AltoFileDirector
AltoFilePage
```

```
directory: aFileDirectory direc
    "Answer an instance of me
aString."

        setDirectory: a
```

The Smalltalk-80tm System Version 2
Copyright (c) 1983 Xerox Corp.
All rights reserved.

```
DiskDescriptor
Smalltalk-80.changes
Smalltalk-80.sources
SysDir
toothpaste.st
```

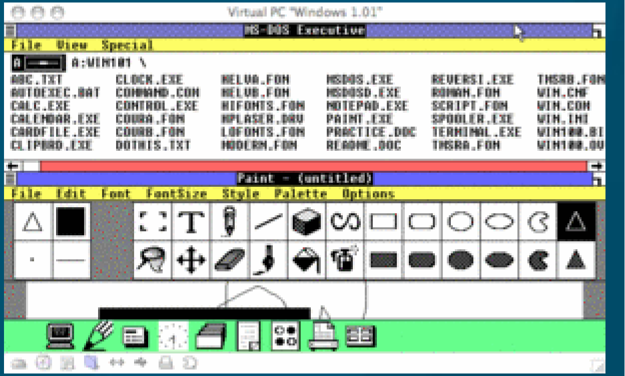
```
'From Smalltalk-80, Version 2.2 of July 4, 1987 on 9 July
1987 at 11:27:15 am'!

!Form class methodsFor: 'examples'!

toothpaste
    "Form toothpaste"
    "Draw spheres ala Ken Knowlton, Computer Graphics,
v15 n4 p352.
    Draws while red is held, terminated by yellow."

    | facade outliner filter point queue cursorPoint |
    facade ← Form
        extent: 20@20
        fromArray: #( 65471 61440 63191 61440 64699
61440 57453 61440 55307
```

Apple in the 1980's

- Lisa (1983):
  - Drag-and-drop
  - Double-click to open/run
- Macintosh (1984):
  - Much cheaper ($2,495 vs. >$10k)
  - Accessible to the public
  - Mass-marketing ad campaign during SuperBowl and 1984 Olympics in L.A.

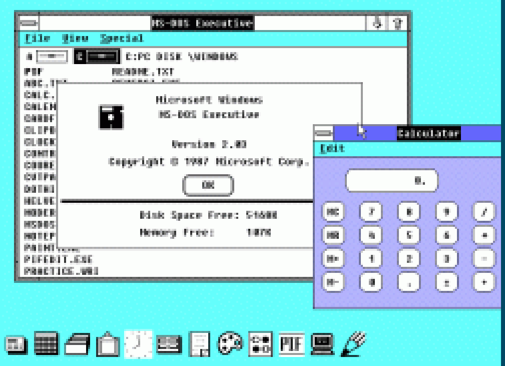
Microsoft Windows (1980's)

- Windows 1.0 (1985):
  - Mostly character-based graphics
  - Tiled windows
  - Popularity dwarfed by Mac


Virtual PC "Windows 1.01"
MS-DOS Executive
File View Special
A:WIN101 \
Paint - (untitled)
File Edit Font FontSize Style Palette Options

```
ABC.TXT        CLOCK.EXE     HELVA.FON     MSDOS.EXE     REVERSI.EXE   TMSRB.FON
AUTOEXEC.BAT   COMMAND.COM   HELVB.FON     MSDOSD.EXE    ROMAN.FON     WIN.CNF
CALC.EXE       CONTROL.EXE   HIFONTS.FON   NOTEPAD.EXE   SCRIPT.FON    WIN.COM
CALENDAR.EXE   COURA.FON     HPLASER.DRV   PAINT.EXE     SPOOLER.EXE   WIN.INI
CARDFILE.EXE   COURB.FON     LOFONTS.FON   PRACTICE.DOC  TERMINAL.EXE  WIN100.BI
CLIPBRD.EXE    DOTHIS.TXT    MODERN.FON    README.DOC    TMSRA.FON     WIN100.OV
```

- Windows 2.0 (1987):
  - Overlapping windows
  - Apple sues MS over “look and feel” (loses)



Microsoft Windows
MS-DOS Executive

Version 2.03

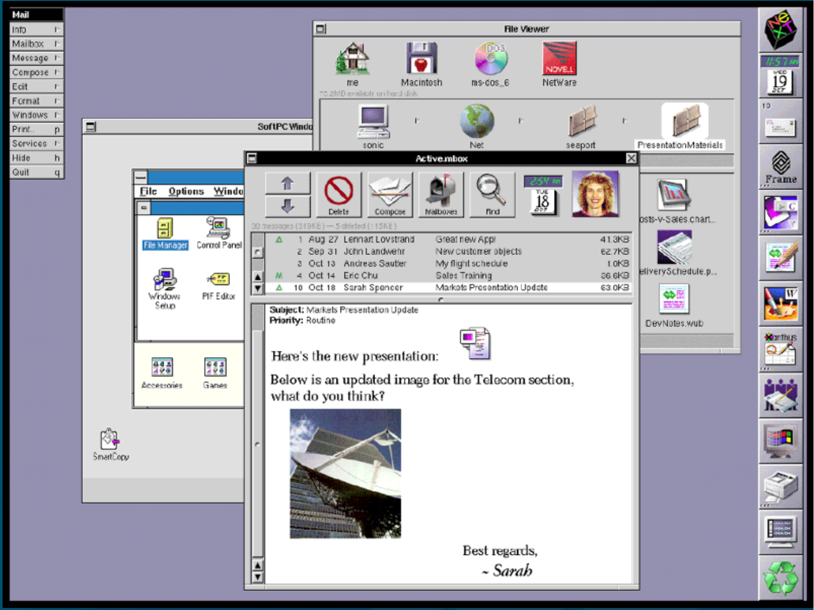
Copyright © 1987 Microsoft Corp.

Disk Space Free: 51600
Memory Free: 107K

- Windows 3.11 (1992), Win95:
  - Looks pretty; wildly popular

Other GUI environments

- GEM (Digital Research) for Atari (1985)
- Amiga Workbench (1985)
- NeXTstep (Steve Jobs) (1988)
  - Pretty, but CPU-intensive
- OS/2 (IBM) (1988):
  - competed with Windows
- Unix X10 (1984), X11 (1987)
  - Network transparency (Xwin32)
  - Multiple libraries on top: Athena, Motif/CDE, OpenLook, KDE/Qt, Gnome/gtk, FLTK



30 messages (319KB) — 5 deleted (115KB)

△	1	Aug 27	Lennart Lovstrand	Great new App!	41.3KB
	2	Sep 31	John Landwehr	New customer objects	62.7KB
	3	Oct 13	Andreas Sautter	My flight schedule	1.0KB
M	4	Oct 14	Eric Chu	Sales Training	36.6KB
△	10	Oct 18	Sarah Spencer	Markets Presentation Update	63.0KB

Subject: Markets Presentation Update
Priority: Routine

Here's the new presentation:

Below is an updated image for the Telecom section, what do you think?

Best regards,
~ Sarah

NeXTstep

OS environment vs. toolkit

- In the past, the only GUI was what was provided by the operating system
- Now, we can write programs that link to various GUI toolkits:
  - Libraries that provide a way to build a GUI program
  - Menus/windows that look just like Windows:
    - Link with MFC or Visual Basic or .NET
  - Other options: FLTK, Qt, wxWindows, gtk, ...
    - Cross-platform: can run on Linux, Mac, etc.

TODO

- Email sign-up sheet
- Brush up on your C++
  - Links at bottom of our IDE policy sheet
- Lab0 due next Tues 16Jan
  - FLTK orientation, tutorials
  - Upload tarball to eCourses by midnight
- Lab1 due next week Thu 18Jan
  - Design + implement your own FLTK program
  - Should be somewhat "useful"