CMPT 370: Advanced Programming

6 January 2009
CMPT370
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Trinity Western University

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 12Feb, Thu 19Mar

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 13Jan)
  - Login to senior lab PCs
  - Get familiar with Cygwin, gcc, make, editors,
  - Follow along with FLTK tutorials
  - Upload a tarball of CubeView to eCourses
- Lab1: FLTK project (due Tues 20Jan)
  - 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
  - The future: CUDA, OpenCL, etc.

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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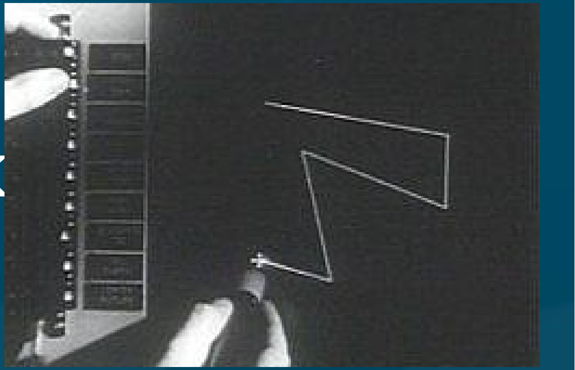
History of graphical user interface

- 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)

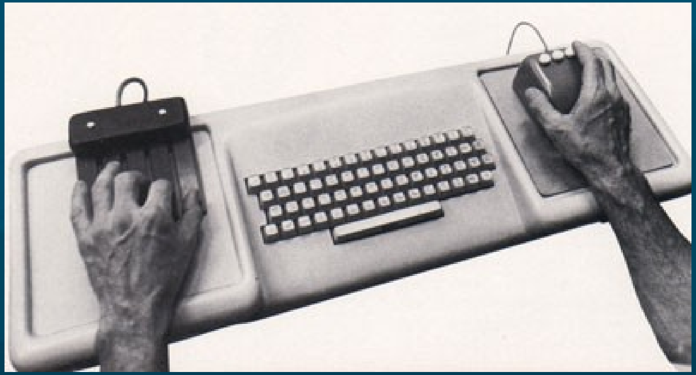
- Ivan Sutherland
  Ph.D. thesis at MIT
- Used light pen to directly manipulate graphical objects on screen
- Pioneer of computer-aided drafting (CAD):
  - Draw "master" diagram once
  - Instantiate multiple copies, tweak (OO design)
  - Constraint-based system
    (e.g., keep two lines at fixed angle)



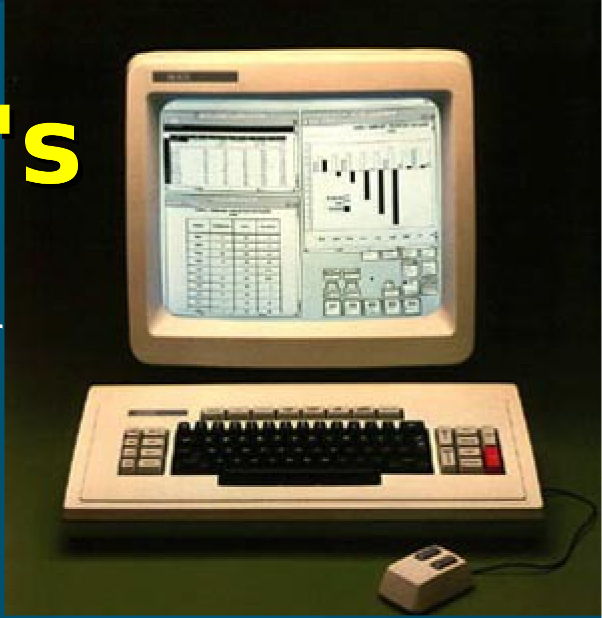
Engelbart's NLS demo (1968)

Douglas Englebart,
Stanford Research Inst.

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

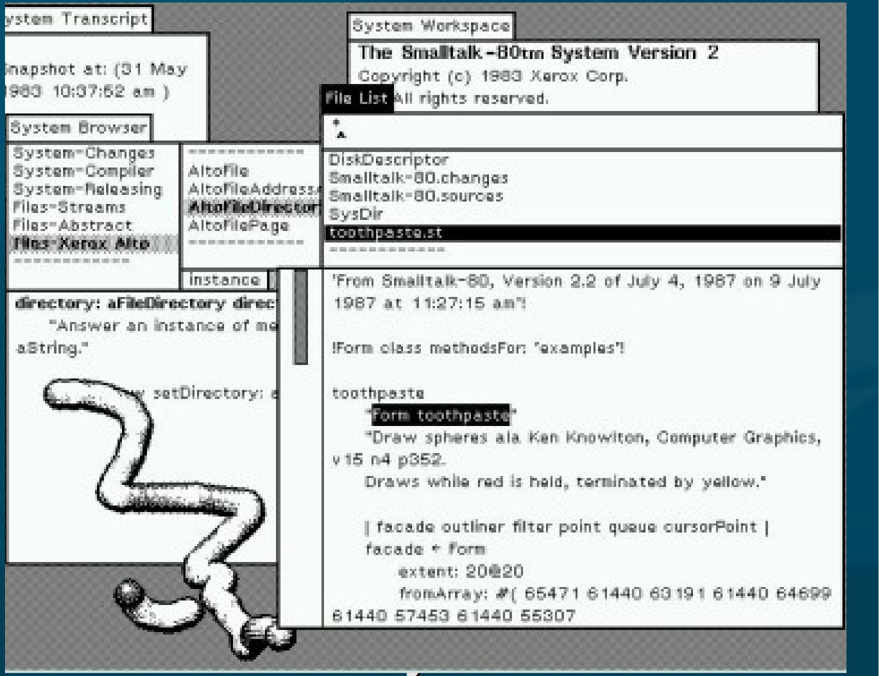


Xerox PARC in the 1970's



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
983 10:37:52 am)

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

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

```
'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,
v 15 n4 p352.
    Draws while red is held, terminated by yellow."

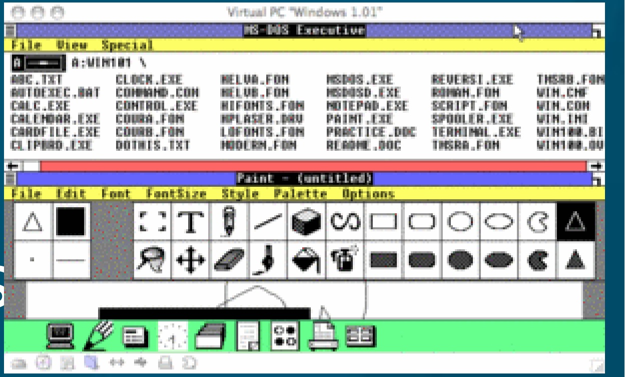
    | facade outliner filter point queue cursorPoint |
    facade ← Form
        extent: 20@20
        fromArray: #( 65471 61440 63191 61440 64699
61440 57453 61440 55307
```

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
- Windows 2.0 (1987):
  - Overlapping windows
  - Apple sues MS over “look and feel” (loses)
- Windows 3.11 (1992), Win95:
  - Looks pretty; wildly popular


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

```
A:WIN101 \
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
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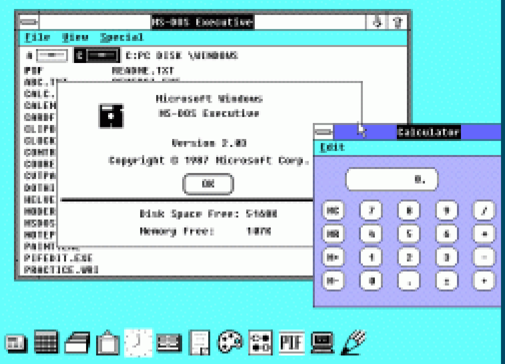


```
C:PC DISK \WINDOWS
PIF             README.TXT
ABC.T
CALC.
CALEN
CARDF
CLIPB
CLOCK
CONTR
COURE
CVTPA
DOTHI
HELVE
MODER
MSDOS
NOTEP
PAINT
PIFEDIT.EXE
PRACTICE.WRI
```

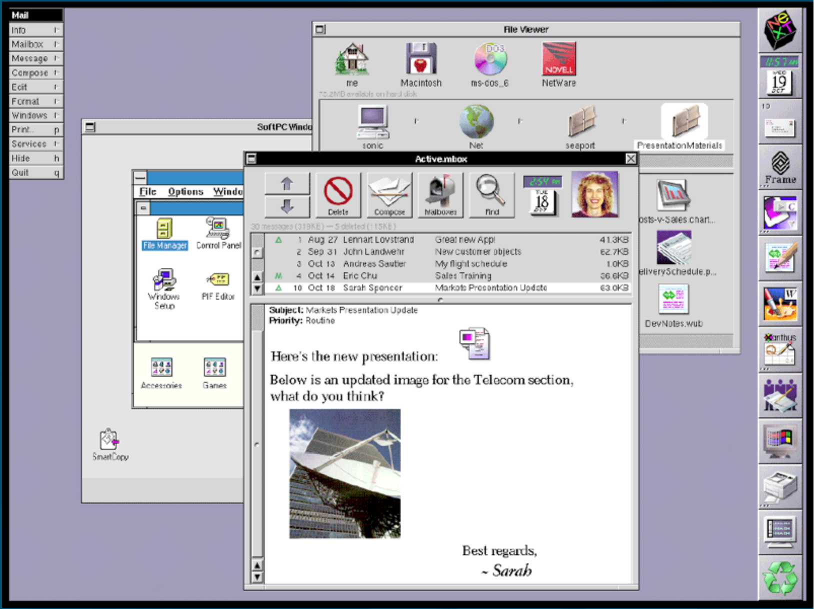
Microsoft Windows
MS-DOS Executive

Version 2.03
Copyright © 1987 Microsoft Corp.

Disk Space Free: 51688
Memory Free: 187K

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 13Jan
  - FLTK orientation, tutorials
  - Upload tarball to myCourses by midnight
- Lab1 due Tues 20Jan
  - Design + implement your own FLTK program
  - Should be somewhat “useful”