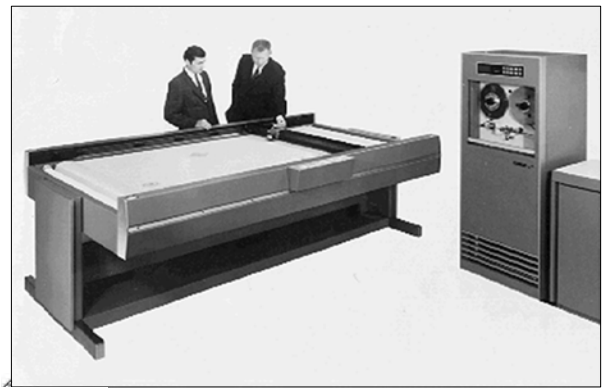
MIT

Luiz Velho
IMPA

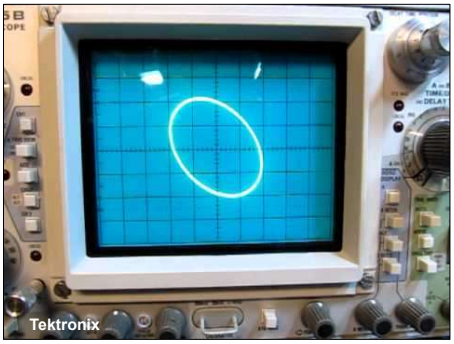
The Birth of Graphics Devices

The 1950s

- Pen Plotters
- Computer-controlled oscilloscopes



Calcomp



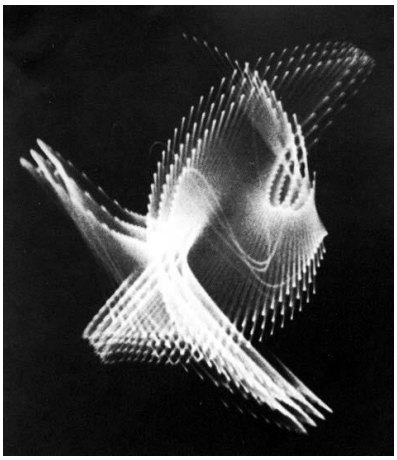
The 1960s

- Ivan Sutherland's SketchPad project
- Interaction
- Vector displays

The Early MIT Years

First Graphic Image

- 1950: The first graphic images are created by Ben Laposky using an oscilloscope to generate waveform artwork produced by manipulating the analog electronic beams.



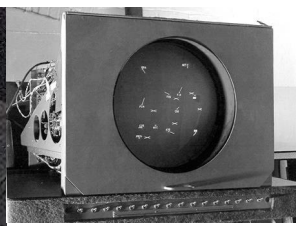
Whirlwind

- 1951: Designed to support military preparedness, **Jay Forrester and Robert Everett** of the Massachusetts Institute of Technology **(MIT)** produce the ***Whirlwind***, a mainframe computer with a CRT to plot blips representing incoming aircrafts based on radar-gathered data.

SAGE

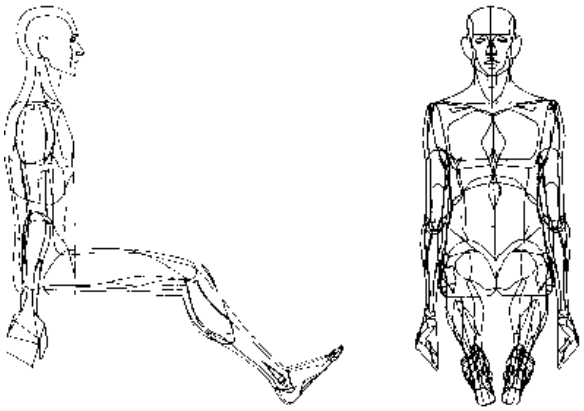
- 1955: Direct descendant of the Whirlwind, the SAGE (Semi-Automatic Ground Equipment) air defense system is designed by **Bert Sutherland** at **MIT**. It uses **simple vector graphics** to display on analog CRTs radar images with a wireframe outline of the region being scanned, as well as the **first light pen** as an input device that operators would use to pinpoint planes flying over regions of the United States. It becomes a key part of the US missile defense system.

SAGE demonstrated pioneering solutions to the problem of the user interface. The system displayed extremely large amounts of information to its operators using the then-new cathode ray tube; operators could then obtain additional information on aircraft tracks by selecting them with a light gun. Similar techniques are still in use today.



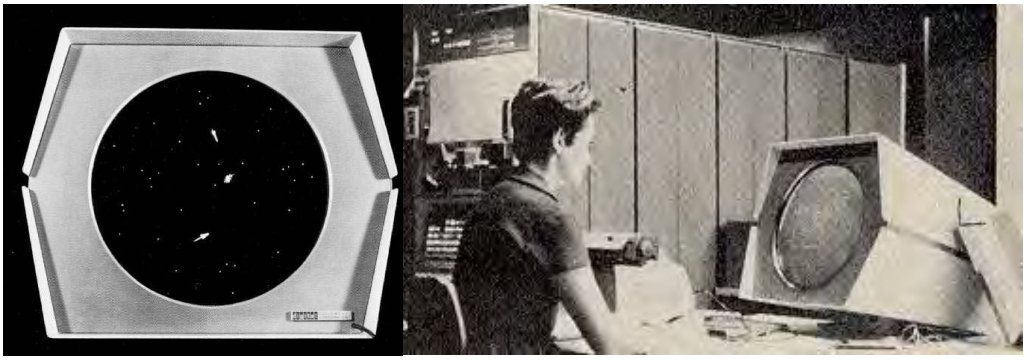
We Have a Name

- 1960: The **term "computer graphics"** is coined by **William A. Fetter at Boeing** to describe the new design methods for his human factors cockpit simulations. Two years later, he will create the "First Man" digital human for cockpit studies.



Spacewar

- 1961: ***Spacewar***, the first video game, is developed by **MIT** student **Steve Russell** for the DEC PDP-1 minicomputer.



Who is Ivan Sutherland

A Man with a Vision

- Computer-Aided Design
  - Sketchpad, 1962
- Virtual and Augmented Reality
  - Head Mounted 3D Display, 1965
- Academic Think Tank
  - Utah Program in Graphics, 1968
- Visual Simulation
  - Evans and Sutherland, 1968

Sketchpad

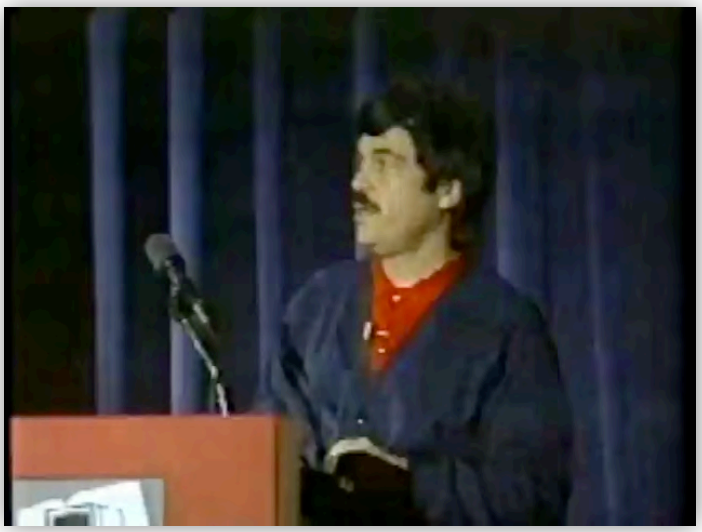
The 1st CAD System

- 1963: For his doctoral thesis at MIT, **Ivan Sutherland** develops **Sketchpad**, the first **Computer-Aided Drafting and Design** (CADD) package allowing shapes to be interactively drawn on a vector-based display monitor using a **light pen input device** wired into the computer. The light pen uses a small photoelectric cell in its tip to emit an electronic pulse when the pen “sees” the electron beam.

The Sketchpad System

- Interactive 2D Computer Graphics
  - MIT Ph.D. Dissertation
  - Lincoln Lab TX-2 computer / Light Pen
- Master Instance Coupling
  - Object-Oriented Programming
- Geometric Constraint Maintenance

The System in Action

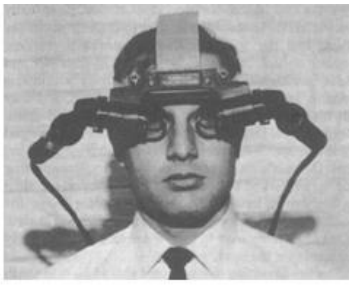


- Demo by Alan Kay

The Sword of Damocles

The First HMD

- 1966: **Ivan Sutherland** creates the first **head-mounted display**, the *Sword of Damocles*, which displays separate wireframe images, allowing depth perception.



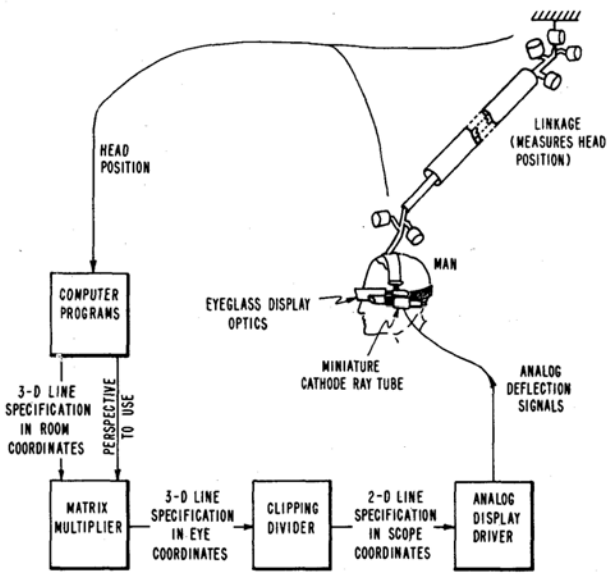
Hardware Prototype

- MIT Lincoln Lab

HMD

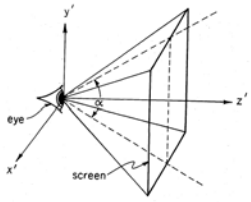
The Sword

System's Components

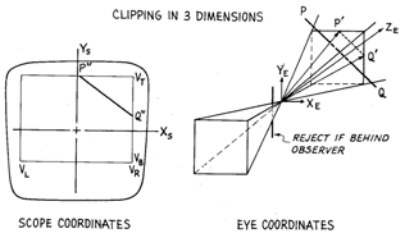


Software Architecture

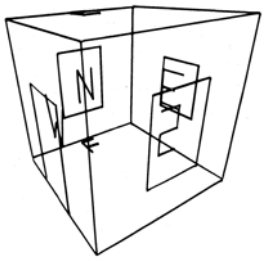
- The Inception of 3D Graphics



Virtual Camera



Viewing Transformations



3D Display

Room with a View

- First Demo @ Lincoln Lab

Camelot

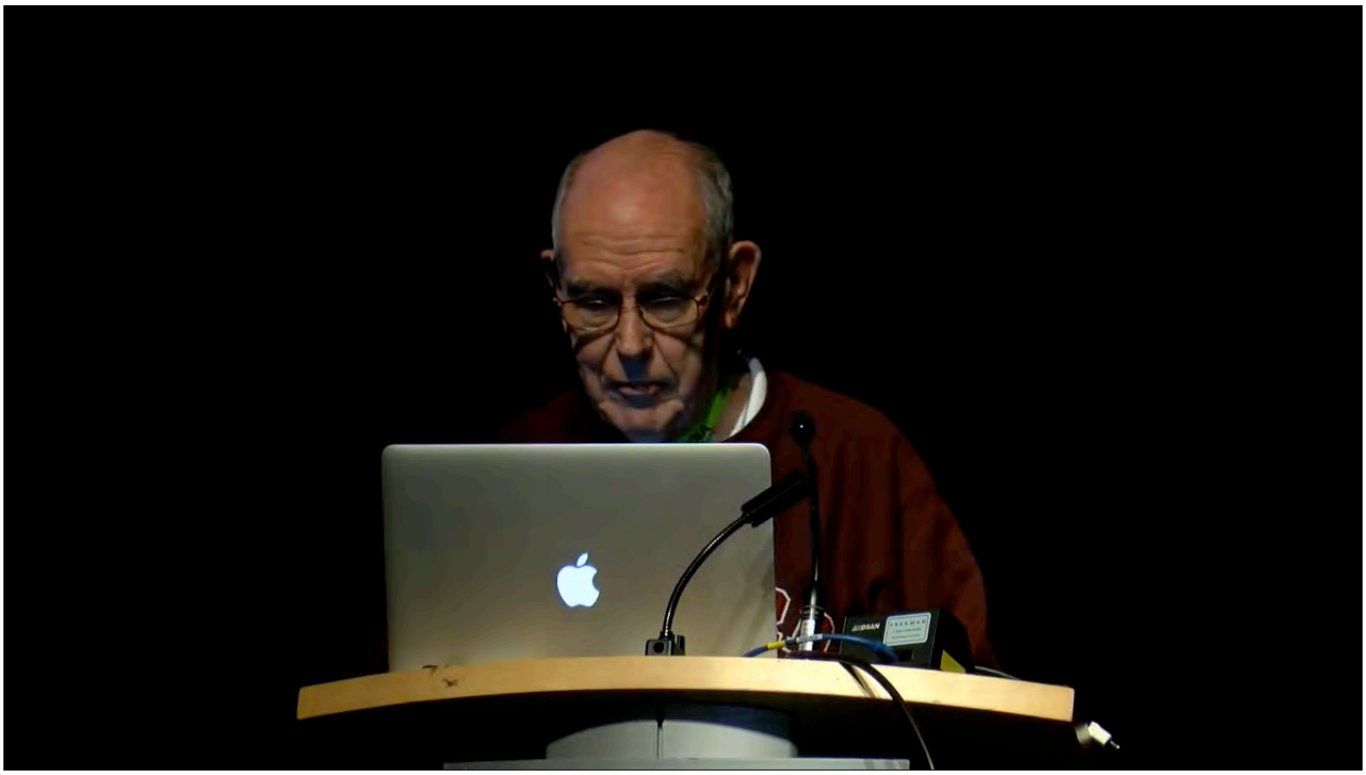
Evans & Sutherland

- 1967: **MIT**'s **Center for Advanced Visual Studies** is founded by Gyorgy Kepes.

- 1968: **Dave Evans** joins the computer science department at the **University of Utah** and forms a CG group. **Sutherland** also joins the University of Utah.

- 1968: Frustrated by the lack of graphics hardware available, **Evans & Sutherland** then found their own company.

The Godfather of VR



Sutherland's VR Vision

*"Don't think of that thing as a **screen**;*
*think of it as a **window**.*
*Through that **window**, one looks into a **virtual world**."*

Looking into the Future

Sutherland VR Challenge

- Complete **Immersion** in Virtual World
- Eye and Body **Tracking**
- Image Generation produces a World that **Looks Real**
- User **Directly Manipulates** Virtual Objects
- Computer Maintains World Model in **Real Time**
- Virtual World **Sounds Real**, **Feels Real**

Challenges of Requirements

- System
  - Display: Resolution, Color, Stereo, Field-of-View
  - Sound: Spatial
  - Haptics: Touch, Pressure, Heat-Flow
- Modeling the Virtual World
  - Geometry, Texture, Color
  - Illumination, Optics, Physics

Watch @ Home

- Utah Graphics in the Bay Area

group gathering
(kool & the gang meeting)