





Ivan E. Sutherland

Ivan Edward Sutherland was born in 1938 in Hastings, Nebraska. He was born there because he wanted to be with his mother. What follows is a story of Ivan's life, told to me directly from his mouth, and sometimes mine.

He is oftentimes considered to be the father of computer graphics.

RICHTER BLOCKS

Richter blocks played a significant role in how Ivan learned to think. He did not read until the third grade, but developed a highly sensitive visual language as a result of playing with these blocks. Each block part fits into certain architectural configurations with other parts; their relations, though variable, have constraints.

BLUEPRINTS

When Ivan was in grade school, each pupil had to cover their school-owned textbooks. Ivan's mother was thrifty, so Ivan's textbooks were covered with blueprints his father had discarded instead of store-bought covers.

During class, if his mind wandered, he would stare at his blueprints on the book covers and try to figure out what the diagrams meant. Ivan did not like to draw on paper because the eraser left ugly marks. He would have much preferred an interface that did not become messy so easily.

FRANKEN, THE MECHANICAL MOUSE

Anne Sutherland, their mother, took young Ivan and Bert to a Math Teacher's conference. There, the brothers met Edmund C. Berkeley, one of the founders of the Association for Computing Machinery. Bert and Ivan worked for Berkeley during high school.



Ivan Sutherland as an undergraduate at Carnegie Tech, courtesy University Archives

Berkeley supported them in building a maze similar to the work of Claude Shannon, then a scientist at Bell Labs. Shannon had built a mechanical mouse that would fidget its way through a maze until it reached its goal. It would remember the path it had chosen in future trials. Ivan and Bert created a mouse they called "Franken", named after Frankenstein.

BELL LABS

Early on, Ivan had an opportunity to visit Bell Laboratories with Bert. A young Ivan accompanied Bert and Claude Shannon on a tour of the lab.

Shannon initially considered Bert to be the subject of the visit, but towards the end, young Ivan worked up the courage to ask Shannon questions about his method and work. Shannon later remarked, that at that point he came to the realization that "there were two of them"...

ELECTRIC ANIMALS

In 1958, when Ivan was a senior at Carnegie Tech, he co-published an article with his brother, Bert, and Malcolm G. Mugglin in Computers and Automation. Titled "An Electro-Mechanical Model of Simple Animals", the article begins:

"OUR SUBJECT lies in a novel and relatively unexplored field: to make a machine that mimics some of the characteristics of living things."¹

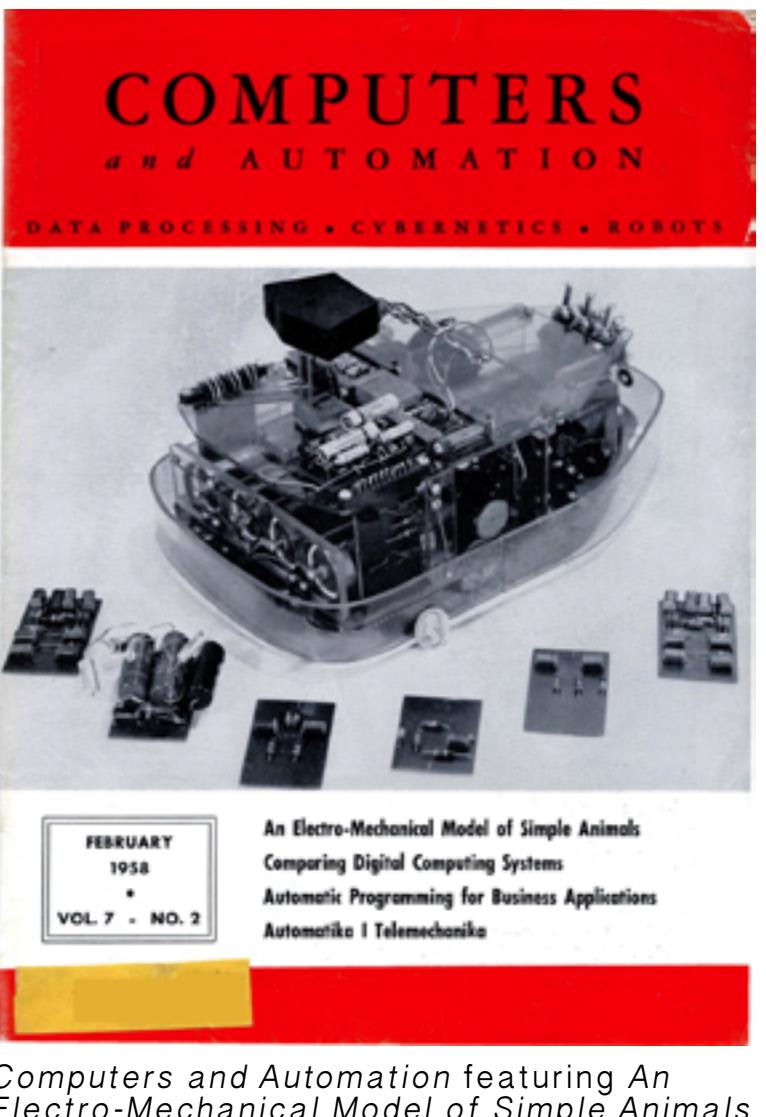
The subject of the article was "Machina versatilis", a robot Ivan and his brother had been designing since high school, one of the first cybernetic animals to utilize transistors.

Machina versatilis was able to "chase lights, squeal appealingly when it bumped something, and attempt to avoid obstacles".

MIT

Ivan graduated from Carnegie Tech with a Bachelor's degree in 1959.

The same year, Ivan married Marcia, his first wife, who had grown up in Pittsburgh. Ivan chose to attend Caltech for graduate school, in order to take his bride as far away from his new mother-in-law as possible. Ivan and Marcia moved to California, where they lived a block away from the route of the Rose Parade.



In January, during Ivan's first year at Caltech, Marvin Minsky and Oliver Selfridge from MIT came for a visit. During a large luncheon at the Atheneum, they told Ivan about the developing field of "computing" at MIT. Ivan held a National Science Foundation Fellowship that could be applied anywhere, so he transferred to MIT the following fall.



Ivan at the TX-2

Claude Shannon, Marvin Minsky, and Steven Coons were on his Thesis Committee at MIT. Shannon remembered the much younger Ivan who had visited him, 10 years earlier.

The TX-2 Computer was developed at MIT Lincoln labs in 1958. It had a 7" CRT display with a resolution of 1024x1024 pixels. Designed by Wesley A. Clark, at the time it was the most powerful computer in the world.

There was no such thing as a mouse, so the TX-2 used a light pen to interact with the screen.

At the end of the summer of 1960, Ivan approached Wesley Clark at the Lincoln Laboratory. Ivan wanted to see if he could use the TX-2 for experiments with drawing. Clark said yes.

Wesley Clark later said of this encounter that he "had built the machine for Ivan, but didn't know it at the time"...

SKETCHPAD

On the TX-2, Ivan created the first real-time graphics display system in the universe, Sketchpad.

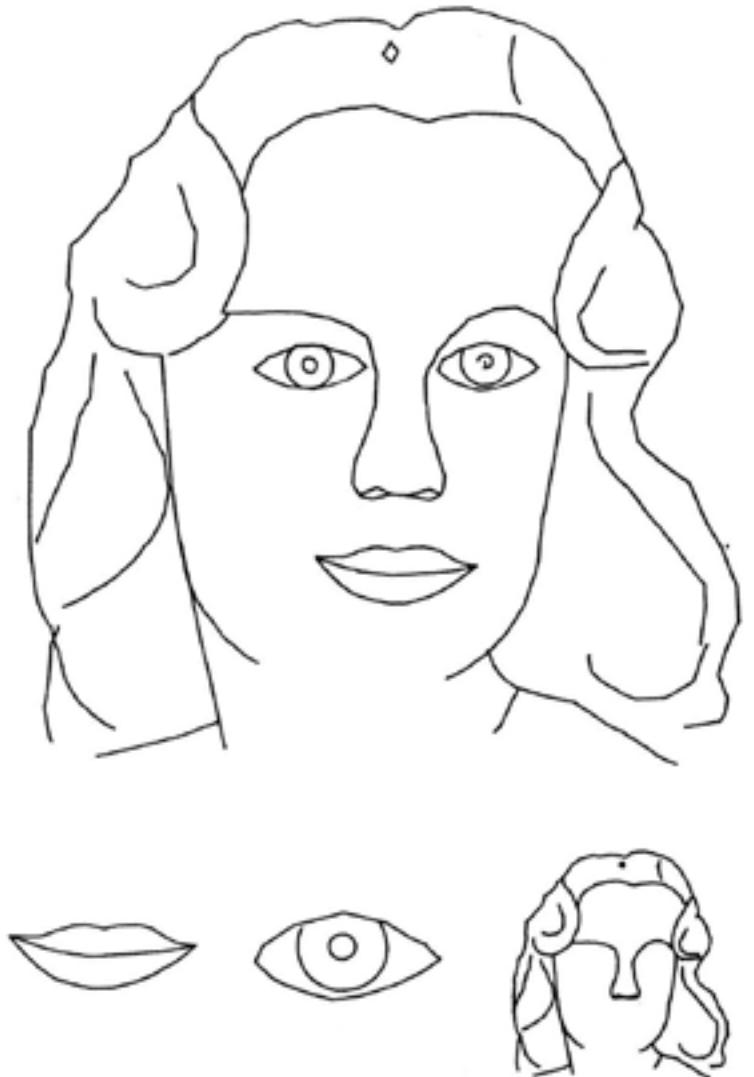


FIGURE 9.9.
GIRL TRACED FROM PHOTOGRAPH

"Girl traced from photograph", Ivan Sutherland, 1963

The display of "INK" on the screen provided a way for the light pen to start tracking. When the light pen touched "INK", the computer would begin tracking the pen position and "INK" would vanish. You could then begin to draw straight lines onto the screen from the light pen. Upon seeing the straight lines, Ivan's advisor, Claude Shannon, said "I think you should do circles."

In creating circles and lines, he ran into a problem. The computer has to figure out what is not on the screen and eliminate it, while still retaining its relations on the screen. He named this process clipping. When using Sketchpad, a user could set up constraints and relationships between segments and arcs, or combine horizontal and vertical lines into various shapes. You could bring in a copy of another picture as an "instance". You could reduce, magnify, rotate and place shapes.

Sketchpad simultaneously introduced the concept of a "window", the concept of "clipping", the ability to zoom, rotate, and duplicate polygonal shapes, the concept of drag and drop, the concept of copying and pasting, constraint specification, and "rubber banding"

It was magic.

Ivan finished with a Ph.D from MIT in 1963.

HARVARD AND VIRTUAL REALITY

After military service, Ivan arrived as an associate professor at Harvard University in 1965.



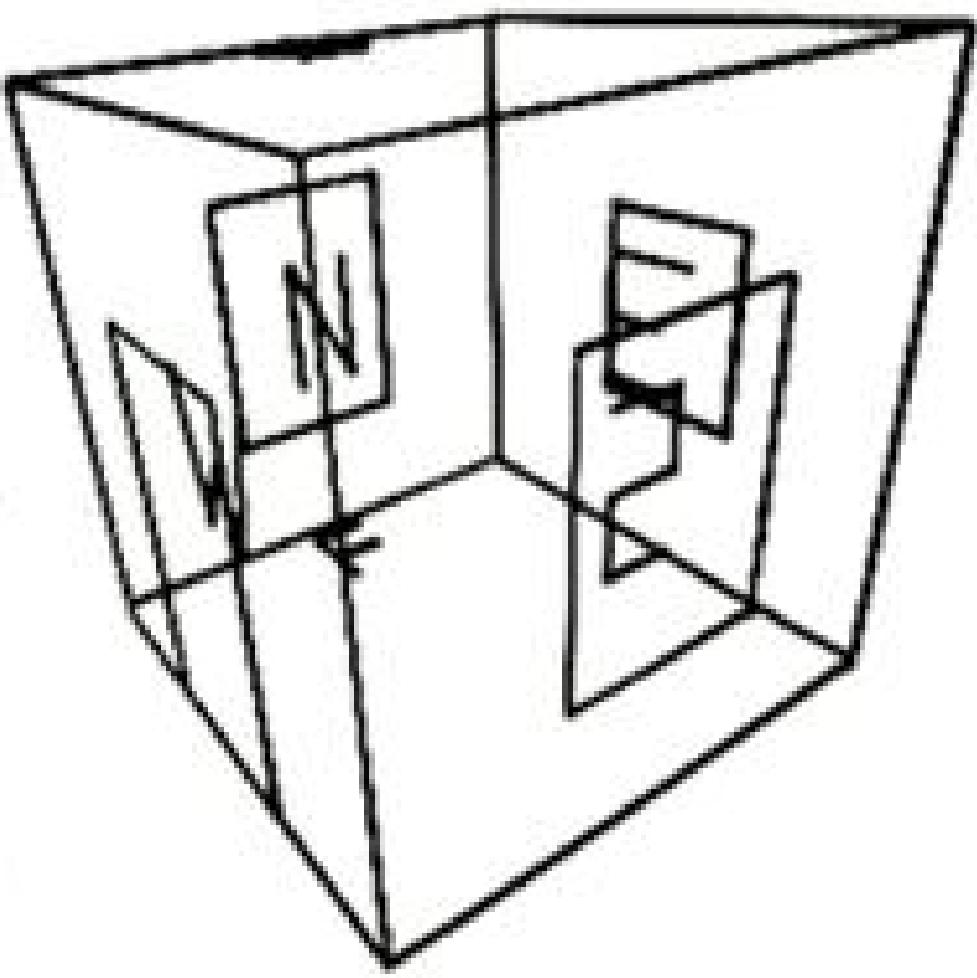
The first head mounted display

Ivan had previously visited Bell Helicopter in Fort Worth, TX, where a "head mounted display" was in use to help aid a helicopter pilot land at night. A camera was mounted on the roof of the laboratory, where two people were playing catch. An observer in the lab could see this from a live feed, because the camera on the roof turned when the observer turned his head.

At one point, a player threw the ball at the camera. The observer ducked. The observer clearly thought he was where the camera was. Ivan thought, instead of a camera, why don't we use a computer?

He worked with a small group, including graduate student and future long term collaborator, Bob Sproull, on a head-mounted display they named "The Sword of Damocles". This refers to the Greek myth of Damocles, whose momentary good fortune was beset by a large sword, suspended over his head by a horse hair – the impending doom present in all abundance.

The display, whose position was measured by a mechanical connection from the ceiling, could rotate with the viewer. Half-silvered mirrors in the display imposed both the images generated by the computer and objects in the room into one view.



The first simulation was a geometric cube floating in the room with the viewer. Each wall of the cube was labeled with its orientation, N/S/E/W. The floor and ceiling were labeled respectively.



David C. Evans

EVANS & SUTHERLAND

In 1968, while still at Harvard, Ivan cofounded a computer graphics company with David C. Evans, Evans & Sutherland. The idea came up while out at a restaurant in Phoenix, Arizona. Ivan moved out to Utah to be near David.

UNIVERSITY OF UTAH

Ivan also started teaching at the University of Utah in 1968, where he taught until 1974. The department at Utah was too small to cover a comprehensive computer science program, so they focused on the burgeoning field of Computer Graphics. This was a wise choice, as it resulted in the first class of students who developed and championed the discipline. Students at the time included:

CLASS

Bui Tuong Phong

developer of the Phong shading method

Henri Gouraud

developer of Gouraud smooth shading

Frank Crow

developer of antialiasing algorithms

Edwin Catmull

co-founder of Pixar, President of Disney

John Warnock co-founder of Adobe

Jim Clark,

founder of Silicon Graphics, Inc.

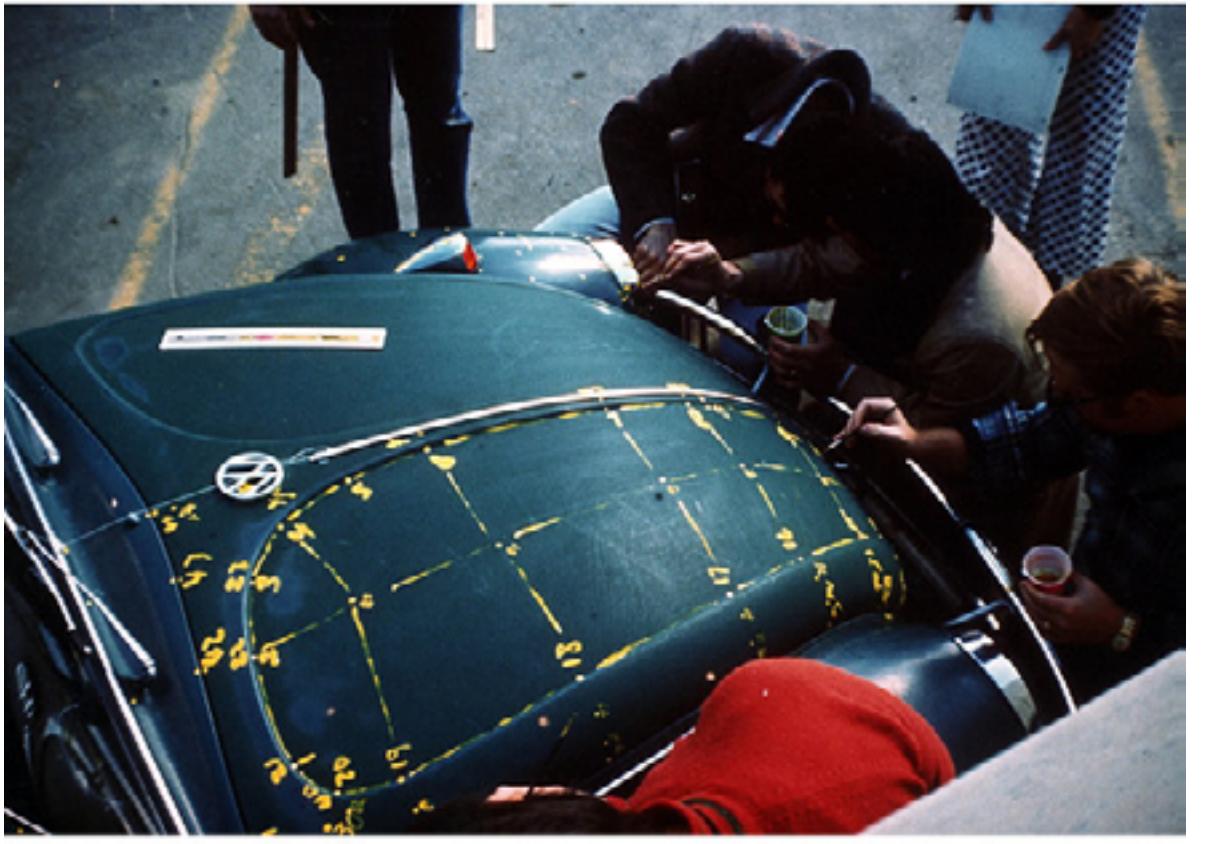


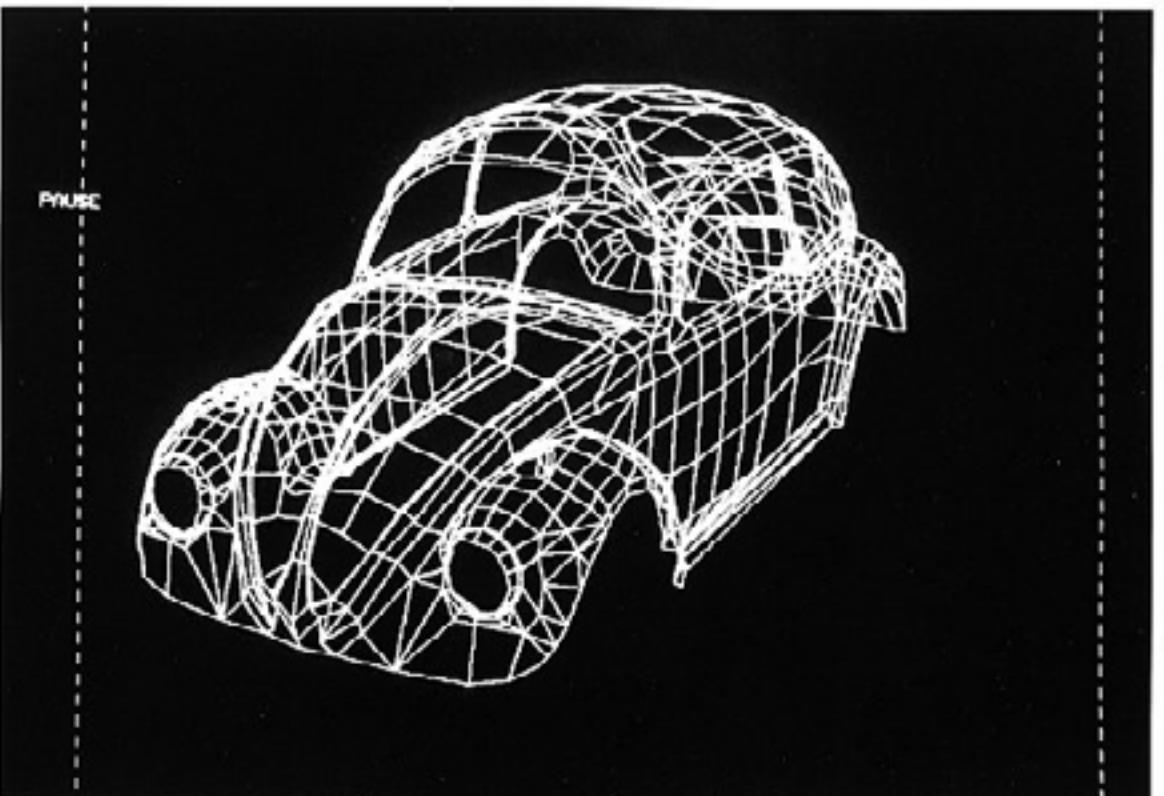
Image from the University of Utah, taping Ivan's Volkswagen Beetle to make a 3D model

Ivan had the idea that they could measure objects in order to make computer models of them. Ivan brought a whole bunch of yardsticks, tape measures, yellow watercolor paints, strings, carpentering levels and squares to class one day.

This picture shows several students measuring the polygonal faces of Ivan's Volkswagen Beetle, mapping out the planes to find the coordinates. The class also experimented with photogrammetry, taking numerous photographs from multiple angles of an object as references for 3D models.

Evans and Sutherland received a contract to make graphics "of naval interest." Ivan asked his student, Danny Cohen, to add an airplane to a rendering they made of an Aircraft Carrier. Danny added Snoopy on his Sopwith Camel, doing a barrel roll over the model of a nuclear carrier.

Ivan thought this picture much funnier than the Admirals who later saw it.



The 3D model produced from Ivan's Volkswagen Beetle