Sketchpad

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A Man-Machine Graphical Communication System

- Developed by Ivan Sutherland at MIT in the 1960s
- Introduced as conversation between humans and computers
An Example of Sketchpad in Use

http://www.youtube.com/watch?v=mOZqRJzE8xg
Basic Elements Observed

- Use of sub-pictures: Pictures once drawn can be used to make more complex pictures, which in turn can be used to draw more complex pictures.
- Constraints: Vertical, horizontal, parallel, perpendicular, attach points, upright symbols, relate symbols.
- Definition copying: Combination of operations.
Intended Uses of Sketchpad

- Library of drawings
- Scientific and engineering visualization
- Circuit design and simulation
- Repetitive drawings (sounds similar to first point)
Architecture – Ring Structure

- Elements stored in blocks: strings of pointers to elements
- Elements found by accessing the block to which they belong and following the links
- Formed a circular linked list of elements
- Operations on these blocks were elementary (all done using MACRO instructions):
  - Insertion
  - Deletion
  - Sorting
The Light Pen (Lightsaber? Pen mightier than sword etc.)

- Light pen must be “inked up” to establish tracking, and moved really fast across screen to end tracking
- Use of phrases throughout text to describe things for which we have words today – eg. “Display spot” for “pixel”
- Objects within 1/8th inch of pen center were considered; established an area of influence for light pen
- Bringing pen close to an element gives it a pseudo-position
Display Generation

- Use of TX-2 computer; displays 100K “display spots”/second (a computer with 64k memory, 36-bit word-size)
- Digits and text, used for legends, typed in by keyboard. Accommodated up to 36 characters/line
- Buffering and interlacing done for smoother display
- Each display spot described by 36 (20 for co-ordinates, 16 for address in ring structure) bits in memory
- Allowed magnification of up to 2000 times
- This involves solving problems such as
Edge Detection

- Knowing what is to be displayed
- Knowing how much is to be displayed
- Considered a non-trivial problem
Use of Recursive Functions

- A Good Idea (capitalized on purpose) because it allowed use of generic functions over and over to do:
  - Expansion of Instances: Sub-pictures within sub-pictures within sub-pictures ad infinitum
  - Recursive Deletion
  - Recursive Merging
Building a Drawing

- Involves recursive use of picture parts and constraints
- Actually copying a definition picture is slightly complicated (by modern standards)
- Requires “designated attachers (not a word)” that are part of the object
- Instances are different from definition pictures: all the parts of an instance are drawn together and get deleted together
How Constraints are Satisfied

- Also entered into system in the form of a block
- Consists of a subroutine that finds how much error enters the system (there’s always an error) because of applying the constraint
- This can be done by one-pass method, or “reliable but slow method of relaxation”
- One-pass method: the short story
  - Find drawing variable with fewest (or very few) constraints and evaluate it
  - Plug value into variable with next fewest numbers and evaluate it
  - Repeat
Examples of Sketchpad usage during testing

- Patterns
- Linkages
- Dimension Lines
- Bridges
- Electrical Circuit Diagrams
- Artistic Drawings
One Thesis, Many Ideas

- Graphical User Interface
- Graphics
- Computer Assisted Drawing/Computer Aided Drawing
- Object-Oriented Programming
Sketchpad Demo Videos

- http://www.youtube.com/watch?v=mOZqRJzE8xg
- http://www.youtube.com/watch?v=USyoT_Ha_bA&feature=related
- http://www.youtube.com/watch?v=BKM3CmRqK2o&feature=related
Thank you