I have many proceedings and reports from my time at the Harvard Laboratory for Computer Graphics and Spatial Analysis from 1973 to 1978. Here are photos of the covers, often including the list of papers in each volume.

This material ought to be made publicly available; suggestions are welcome.

—

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An Advanced Study Symposium on Topological Data Structures for Geographic Information Systems
October 16th. through 21st., 1977 Conference Chairman: Allan H. Schmidt

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BOUILLÉ, François	Structural Cartographic Data and Spatial Processes with the Hypergraph-Based Data Structure
COOK, Bruce G.	The Structural and Algorithmic Basis of a Geographic Data Base
COOKE, Donald F.	Dime Variants for Curvilinear Networks
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THOMAS, A. L. — Data Structures for Modelling Polygonal and Polyhedral Objects

WAUGH, Thomas C. — A Parameter Driven Language for Use in Application Systems

WHITE, Marvin — The Cost of Topological File Access

WOOD, Peter M. — Interactive Display of Polygonal Data

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COMPUTER ASSISTED CARTOGRAPHY
AND
GEOGRAPHIC INFORMATION
PROCESSING
HOPE AND REALISM
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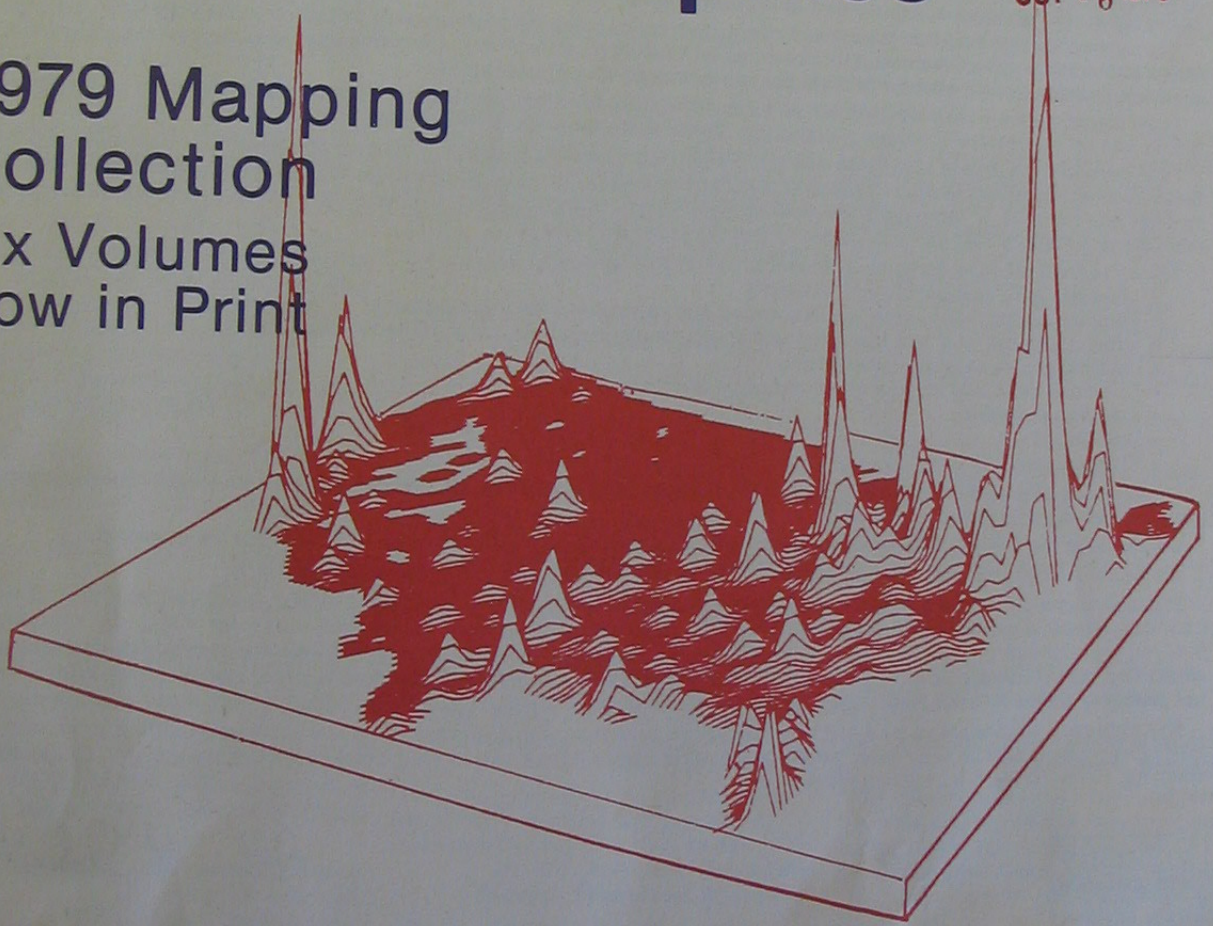

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PROPOSAL SUBMITTED TO

THE DEFENSE ADVANCED RESEARCH PROJECTS AGENCY

ARPA TERRAIN DATA BASE MAPPING SYSTEM
CONCEPT, DEFINITION AND SYSTEMS REQUIREMENTS

June 1977

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Proposal Submitted to

The Defense Advanced Research Projects Agency

ARPA Terrain Database Structure

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April 1978

COPY 2

The TOPAZ Allocation Model

by Eric Teicholz and Helvio Mation
Laboratory for Computer Graphics
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Graduate School of Design
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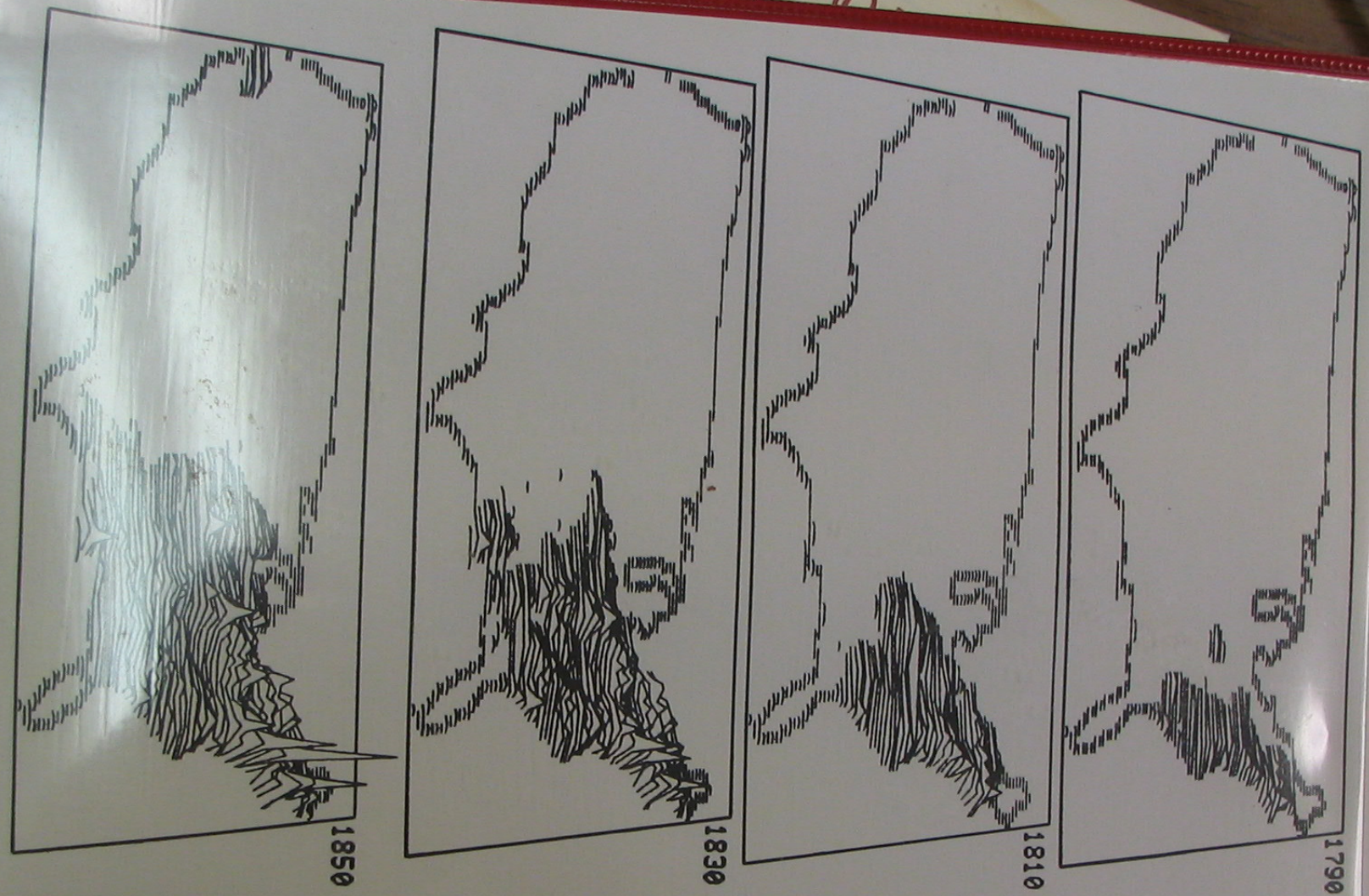
July 1978



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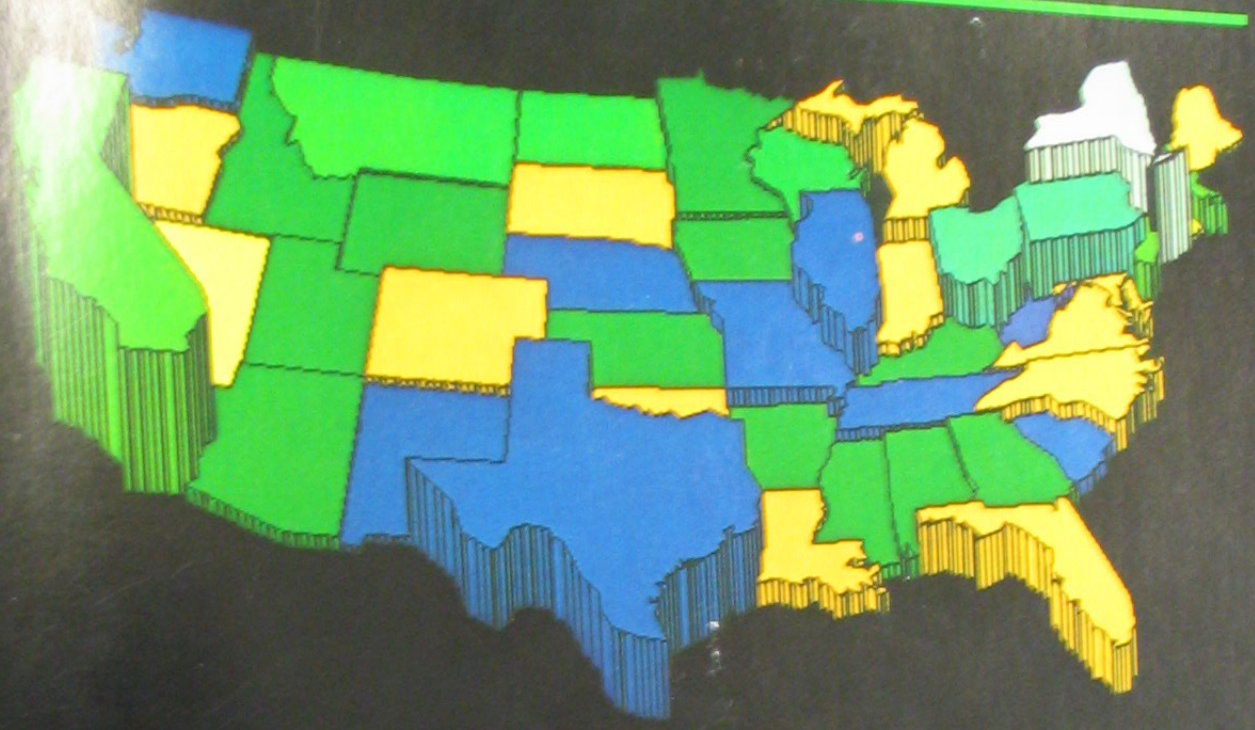

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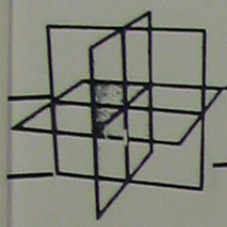
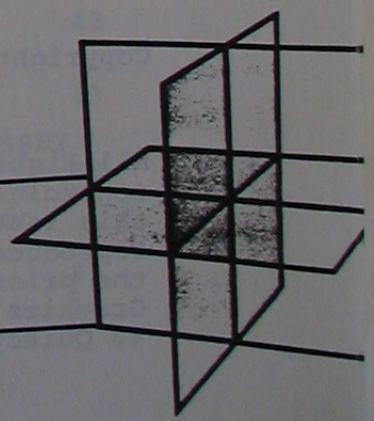


CURRENT RESEARCH AT THE LABORATORY FOR COMPUTER GRAPHICS AND SPATIAL ANALYSIS

Compiled by GEOFFREY DUTTON

September 1980



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Premier Issue — July 1979

THE HARVARD NEWSLETTER ON COMPUTER GRAPHICS

news/trends insights perspective opportunities

TOP-OF-THE-WIRE

A NEW CONTENDER IN PLOTTERS

Earlier this year, French pen plotter manufacturer, Benson, S.A., acquired Varian Associates' electrostatic printer/plotter graphics product line, and now the rationale behind the acquisition is unfolding. Benson holds a 50% market share in Europe with a product line that includes incremental plotters and interpolated drawing plotters priced from $7,000 to $22,000. These products for the first time ever will be manufactured and marketed in the U.S. by the combined company, called Benson-Varian, Inc., located in Mountain View, Calif. "This marks our strong entry into the U.S. hardcopy graphics marketplace," declares Gene Mourier, Benson S.A. founder and president.

AN ALTERNATIVE TO HOLOGRAPHIC DISPLAY?

The 3-M Co. has devised an unusual way to view objects in three dimensions that conceivably offers an alternative to holography technology. The technique ntails overlaying as many as 100 sheets of 3-M's new two mil polyester film that has a 99% light transmissivity. When stacked in this way, two-dimensional cross-sectional drawings can be visualized in a 3-D graphics format. 3-M seeks applications for its new technology; anyone interested may contact *D. Rappa, Marketing Manager, Central Research Laboratories, 3-M Center, St. Paul, MN 55101. (612) 733–1110.*

YOUTHFUL ENTREPRENEURS MAKE THEIR MARK IN COMPUTER GRAPHICS

Some youthful tigers, still in their mid-20's and outside the computer graphics establishment, are doing quite a business making computer graphics a happy hunting ground. Their products attest to the interesting market opportunities being opened up in the field – opportunities that The Harvard Newsletter will closely monitor.

Taking the West Coast first, Digital Engineering, Inc., Sacramento, Calif., will chalk up some $1 million to $2 million in sales this year on its RETRO-GRAPHICS printed circuit board. The device converts the Lear Siegler terminal (ADM-3A) into a graphics station having a 60 Hz refresh rate and a 512 x 250 resolution. A simple plug connection between the board and the terminal results in a Tektronix 4046 and 4010 raster

(Continued on page 3)

COMPUTER GRAPHICS VS. DATA COMMUNICATIONS

The Harvard Newsletter has turned up some startling –and welcome–statistics: Annual shipments of computer graphics systems by OEMs about equal shipments of data communication systems. This appears to be somewhat remarkable, considering the overwhelming attention given to data comm vs. computer graphics. In any case, the source for the statistical finding is a recently-published "Directory of Systems Houses and Minicomputer OEMs" by Sentry Publishing Co. The directory covers about 40% of the total OEM minicomputer market.

An analysis of the directory data finds that 32,208 computer graphics systems were shipped in 1978 vs. 32,378 datacom systems. Here's a break down on the computer graphics category:

Application	Number of Systems
Graphics, image, display control	16,352
Plotting, drafting, mapping	12,389
Computer-aided design	3,467

The numbers may be conservative. Yet, other systems that conceivably may incorporate a graphics capability are omitted from the tabulation. These include management information systems, with 8,337 shipped in 1978; process and supervisory control, numbering 28,747 systems; and medical diagnosis, 6,548 systems.

In addition, the directory finds computer graphics to rank among the top five applications having the best (highest) ratio of systems shipped per supplier. At 112 systems shipped per supplier, computer graphics represents a "little noticed, or overlooked opportunity area," the directory says.

More information on the 347 page loose-leaf directory is available from *William Gannon, Sentry Publishing Co., 5 Kane Industrial Dr., Hudson, MA 01749.*

COLOR HARD COPY: THE BARRIERS BEGIN TO FALL

Recent equipment introductions by four vendors now enable user choice in an area long seen as a stumbling block to the growth of computer graphics: quality color hard copy. The units, driven directly from CPUs, graphic terminals, or tape drives, produce a variety of formats–photographic prints, 35mm slides, transparencies, and plain paper copies. They also vary

(Continued on page 2)

SAMPLE ISSUE

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Volume 1, No. 3 — September 1979

THE HARVARD NEWSLETTER ON COMPUTER GRAPHICS

news/trends insights perspective opportunities

TOP-OF-THE-WIRE

MORE INTERACTIVE POWER TO THE TEK 4054

To improve "graphics interactivity," Tektronix, Inc. introduces the "Dynamic Graphics Option 30" for use on its 4054 DVST terminals. The new option, consisting of a field-installed circuit board, stores graphic elements in a separate memory which operates independently of the main processor's read/write memory. This can speed up a CRT's refresh rate 100-fold, TEK claims.

The board contains a proprietary microprocessor and 32K bytes of memory. It enables 4054 users to create and manipulate graphics as complex as a 1,000 vector object—in addition to points and lines. Simultaneously, the 4054 main memory can be calculating, storing, and retrieving data from mass storage, and even controlling peripherals. With the new option, the model 4054 "becomes a powerful combination of refresh and stored graphics," is the way Tektronix puts it.

Tektronix envisions its new option to be especially useful in design engineering—circuit schematics, facilities layout, architecture and landscape design, city planning, and PERT charts. Here, complex displays are built up from standard symbols or components.

The option costs $2500 (the 4054 base price is $16,500). Contact: *Marketing Communications Dept., M.S. 63-635, P.O. Box 500, Beaverton, Oregon 97077. (503) 644–0161.*

NOW, COLOR HARD COPY FROM MATRIX CORP.

Just a few weeks ago, Dunn Instruments formally introduced a camera that makes hard copy—color prints and 35mm slides—directly from a color graphics terminal (Harvard Newsletter — July 1979). Now, Matrix Corp., an American Stock Exchange-listed company, introduces both a machine (model 2000) that does essentially the same job, but costing about $1,000 less, and another, unique version (model 3000/4000) that turns out multiple images:

- As many as 25 different images on a single 8-in. x 10-in. sheet of Polaroid film.
- A microfiche format that holds 92 images.

"The system ideally lends itself to archival mass storage," says Ivan Volent, executive vice president of

(Continued on page 3)

A CG FIRST: COLOR WITH PASCAL

Ramtek Corp. introduces what it says is the first color graphics system able to be programmed in Pascal. The 6114 colorgraphic computer, which also can be programmed in assembly language, is capable of stand-alone applications or operation with a host computer. It includes a Z-80 central processor operating at 4 MHz with 64K bytes of memory, floppy disk controller, 250K-byte single density floppy disk drive, and the Pascal operating system. Refresh memory on the 6114 is 256 x 320, with 240 x 320 displayable pixels; the display generates eight standard colors.

The 6114 costs $12,000; a companion monochrome system that can be upgraded to color costs $11,000. Optional interfaces include RS-232 communications, color printer/plotter, black/white printer, and graphics tablet. Contact *Beverly Toms, Ramtek Corp., 2211 Lawson Lane, Santa Clara, CA 95050. (408) 988–2211.*

GRAPHICS TO BE ADDED TO SANDERS' WORD PROCESSING PRINTER

An ingenious dot matrix printer by R. C. Sanders Technology Systems, Inc. will soon have full graphics capability. The company is at the final stages of developing a software interface package, scheduled for release on October 1. It will enable high quality black and white graphics from a host computer to be downloaded to the Sanders' so-called Media 12/7 printer. Resolution in the x-axis will be one mil (0.001-in.); in the y-direction, 3.5 mil (0.0035-in.).

"That's state-of-the-art performance for a dot matrix impact printer of our type," says Robert Ingalls, product manager. Applications would be in phototypesetting, also to program ideographic images, such as Chinese characters. The graphics can also be used to create signatures, letterheads, and logos. Via software control, a user can mix images and text on the same page.

The unqiue Media 12/7 design delivers both draft quality printing at high speeds and letter quality printing at low speeds by varying the number of passes (dot density) made by the machine. Currently, the printer can do limited graphics by means of images that are programmed and stored internally in the printer's typefont data base. The new interface, however, will "significantly boost" the printer's graphics capability and flexibility, Ingalls says. No

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TOP-OF-THE-WIRE

ISC HITS TEKTRONIX WITH A $22 MILLION LAW SUIT

A few years ago, an upstart company with headquarters in a suburban Georgia home startled the computer world with a barrage of full-page, full-color advertisements for what was then an extraordinarily low-cost color graphic CRT terminal. That company, Intelligent Systems Corp., now a multi-million dollar operation, headquartered in Norcross, GA, is once again churning up the CG world.

This time, ISC has filed a $22 million law suit against Tektronix, charging that Tek "wrongfully appropriated" proprietary ISC circuitry for use in its 4027 terminal. As a result, ISC has incurred damages amounting to $3 million, says the documents filed in Atlanta federal court. Because of a monopoly charge, ISC is requesting punitive damages triple that of the actual loss and amounting to an additional $10 million. ISC also seeks to enjoin Tektronix from producing or selling 4027 terminals.

ISC, whose primary market focus is in business and process control applications, manufactures desktop computers and graphic terminals that incorporate color CRT displays. ISC allegations concern convergence circuitry used to "mix" the three primary colors on a display screen. Tektronix, whose legal rebuttal is expected to be filed within two weeks, says, "the claims are without merit."

DIGRAPH MOVES INTO THE MARKETPLACE

After nearly six man (person)-years of development and test effort, the Univ. of Colorado Computing Center has begun a "low key thrust" to market worldwide its CG software, dubbed Digraph (**D**evice **I**ndependent **Gra**phics from **FORTRAN**). Existing test sites for Digraph — an integrated collection of more than 200 subroutines — include an Amdahl system at the Univ. of Michigan and a PDP-11/70 at the Univ. of New Hampshire, according to James R. Warner, head of the Digraph group, a non-profit auxiliary enterprise of the Univ. of Colorado Computing Center.

Digraph functions, designed to be compatible with ACM/SIGGRAPH Core Systems Standards, include

(Continued on page 3)

CG IN RAILROAD ENGINEERING

A symposium to "identify the potential" of computer graphics in railroad engineering will be held on Oct. 16-17, 1979, in Atlanta, GA, sponsored by the American Railway Engineering Association. The program will present user experience with computer graphics, according to symposium spokesman R. F. Tuve. It will also provide guidelines on equipment acquisition and implementation, he adds. Tuve is manager, quality control engineering, for *Southern Railway System in Atlanta, GA 30303. Telephone (404) 529-1313.*

A CAD TRAINER SYSTEM AT LESS THAN $10,000

A standalone computer-aided design system, developed at Texas A&M Univ. as a "low-cost" CAD trainer, costs less than $9,000 for the hardware and $300-a-year for the software based on BASIC and licensed from Texas A&M. The system configuration can include "almost any microcomputer" that supports multiple RS-232 ports, multiple mini-floppies having both data and program storage, and 48K bytes of RAM; the Texas A&M version incorporates a Houston Instrument plotter and digitizer and a Lear-Siegler ADM-3 terminal modified to handle graphics.

The system, developed under an NSF grant, supports a wide range of functions. A part, entered into it via the digitizer, terminal, or keyboard can be manipulated — rotated, scaled, and displayed in multiple views — via software instruction and then plotted as an isometric, axonometric, perspective, oblique, or orthographic representation.

Also supported are graphing routines, limited manufacturing cost analysis, and limited linkage analysis. In addition, a 2-D input sketch routine is available to support the digitizer; a 3-D version is under development.

Contact: *John T. Demel, Engineering Design Graphics Dept., Texas A&M Univ., College Station, TX 77843. (713) 845–1633.*

A MESSAGE TO READERS

With this issue, *The Harvard Newsletter on Computer Graphics* commences a twice-a-month publishing frequency, making this publication the most timely of all specialized publications covering the computer graphics and related application fields. Until now, as a monthly, you have seen the Newsletter as eight pages of tightly-written and fact-filled text; now each issue

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TOP-OF-THE-WIRE

SPACE LAB EXPERIMENTS: A CG BONANZA?

CG equipment vendors and service firms, especially those in image processing, should be aware of a potential — and prestigious — market bonanza opened up by the Spacelab/Shuttle flights to begin in 1983. NASA recently selected 33 U.S.-sponsored and seven foreign-sponsored scientific investigations pertaining to astronomy, upper atmospheric physics, space plasma physics, solar physics, and high energy astrophysics. The U.S. probes alone will entail expenditures of $100 million, and now is the time to prepare to become a chosen supplier. Much of the money will go for data collection, processing, and analyses that are likely to require CG equipment and support services.

Participating in the program are 16 universities, four private organizations, and seven government agencies who were chosen from 200 applicants. A list that includes the principal investigators along with their affiliations and experiments is available from *Joe McRoberts, NASA, Washington, D.C. 20546. (202) 755–3680.* Alternatively, the *Harvard Newsletter* will send a copy to subscribers who write, *enclosing a stamped, self-addressed envelope.*

A GRAPHICS INTERFACE FOR CROMEMCO COMPUTERS

Cromemco Inc. jumps into the computer graphics arena with a two-board interface that imparts color graphics capability to its computer systems. Resolution is 756 x 484 points from a 12K- or 48K-byte memory that has direct CPU access. Each display pixel is mapped from one bit or one nybble (4 bits) of display memory, under software control. In a nybble-mapped mode, any 16 of 4,096 colors — or, in black and white applications, 16 shades of gray — can be displayed. The three separate analog output signals, besides driving the monitor's red, green, and blue guns, can be used in black and white applications to drive three separate monochromatic monitors, thereby enabling three different pictures to be displayed simultaneously.

Price on the interface is $595; an optional 16K byte two-port memory card that provides 48K bytes of display memory costs $795 each. *Cromemco, Inc., 280 Bernardo Ave., Mountain View, CA 94043. (413) 964–7400.*

NBS OBSOLETES SYMBOL

The National Bureau of Standards has obsoleted the familiar SYMBOL plotting program with a new FORTRAN subroutine as a way to generate alpha-numeric characters on vector plotters. Now, a user who is working with both text and graphics has a much richer choice in options. He or she can choose from among six styles of alphabetic characters — including Greek, Roman, and italic — as well as three styles of numerals for generating text and from among 22 symbols to do the graphic plotting. In addition, the new software contains 48 special mathematical symbols.

A listing of the subroutine costs $2.30 from the *Supt. of Documents, U.S. Government Printing Office, Washington, D.C. 20402* (Order SD 003-003-01921-6). A magnetic tape version costs $100 from the *Office of Standard Reference Data, National Bureau of Standards, Washington, D.C. 20234.*

COLOR RASTER DISPLAYS GET ANOTHER CONTENDER

With all the myriad color raster displays coming on the scene, the market for this type of CG equipment had better mushroom just as the forecasters project . . . or else! The latest newcomer, Applied Dynamics International, at first blush might appear to be a frail 13-year-old, $7 million Ann Arbor (Mich.)-based company newly embarked on some fast CG bucks. But ADI, which recently formed a CG division, is also a subsidiary of the Holland-based $3 billion conglomerate Internatio Muller. Moreover, its entry product in the color display derby is the "Light 50" intelligent terminal, built around the TI 9900 16-bit microcomputer. ADI, itself, did not develop the Light 50, which competes against Ramtek, Aydin, Chromatics, Grinnell, Genisco, and other OEM units, but rather the company outbid Vector General to acquire the manufacturing and marketing rights from Child, Inc., an R&D firm located in Kansas City. In the process, ADI also hired away Richard L. Davison from Vector General, making him the new division's general manager and an ADI vice president.

Light 50 features multiple video outputs for RGB or composite video as well as sync and subcarrier, and accommodates as many as four independent image outputs with an image space up to 2K bytes of run-length encoded information and 512 x 512 bytes of windowing. Scrolling and scaling are included in the basic hardware, and overlaying is provided for text

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IBM MOVES FULL FORCE INTO BUSINESS COMPUTER GRAPHICS

Industry Leader "Blesses" Color As A Basic Tool

In recent years, IBM Corp. has wet its toes in computer graphics, primarily with high end products and with less than total commitment. Last month, however, the industry giant made its long-awaited, major move into graphics by announcing raster scan color graphics terminals, companion hard-copy printers, and, most important, the software necessary to convert reams of data spewn out by its computers into easy-to- understand color pie charts, bar graphs, linear plots, and other data presentation formats.

Computer graphics consultant Carl Machover, based in White Plains, N.Y., interprets the IBM move in this way: "IBM has now taken a position on color . . . on graphic CRTs . . . and on computer graphics itself. Its equipment operates in a standard business environment, using IBM-provided software support!" Machover has always thought that business graphics would take hold someday, but that such growth could not come "without a push from IBM." Says Machover: "IBM has now provided that push!"

IBM's new CG product line-up includes:

● **3279 TERMINALS:** Two 14-in. color displays, designated 3279, compatible with IBM 370 and 4300 mainframe computers, and, pending program software still under development, indirectly compatible with IBM's new 8100 series computers via other IBM attachments.

Actually, IBM has announced four versions of the 3279 color terminal, but only two models — 2B and 3B — support graphic displays; the other two can handle only color alphanumerics. That's because the graphics models *only* support a prerequisite hardware feature — namely six symbol sets, each containing 190-user defined shapes and symbols, that enable a user to create mathematical signs, special type fonts, and the seven different formats used in the presentation graphics, such as bar graphs, pie charts, and linear plots.

The low-end terminal (model 2B) displays 24 lines of 80 alphanumeric characters (1920 characters total) in any of four different base colors — red, green, blue, and white — plus yellow, pink, and turquoise. The high-end model (3B) has 32 lines, or 2560 characters as well as the seven-color capability.

Screen resolution on the 3279 is 9 dots wide x 12 dots high for each character block, or 275,000 individually addressable points on the 32-line, 14-in. screen. "Not bad," consultant Machover comments, referring to the acceptable picture quality attainable with such resolution.

Prices on the 3279 terminals come in at the mid-range level, way above the $1500, or so, barebones pricing on Intelligent Systems Corp. units and far less than the $20,000 price level on the much higher resolution, wider screen, and more sophisticated Genisco, Ramtek, and Aydin top-of-the-line units. The 24-line-screen, seven color model 2B, including keyboard and the full programmable symbol capability, costs about $6,250. The rental rate is $175-a-month; and a two-year lease, $148-a-month. The 32-line, seven-color model 3B costs about $6,600 when purchased outright; its rental rate is $185-a-month; and a two-year lease nets out to $157-a-month or thereabouts.

● **3287 PRINTERS:** The IBM announcement also includes 10 x 8 dot matrix printers, intended as companions to the 3279 CG terminals for generating color hard copy. A low-end model 1C operates at 80 cps, the model 2C at 120 cps (but only 80 cps maximum when doing graphics, it should be noted). Color printing, moreover, slows each model considerably. A line in four colors prints out at an effective rate less than 20 cps, with a full screen printout taking a minimum of two minutes, according to Newsletter estimates.

The rate is comparable with the Trilog color printer that was introduced last summer (*Harvard Newsletter* — July 1979). The IBM printer, however, is more complex because of a significant design difference. In the Trilog Colorplot 100, based on a Printronix printer, the length of ribbon is split into three equal parts, each containing a reverse primary color that enables different hues and tones to be created, based on the pattern of color dots put down. All colors can be rendered in just three passes of the page through the printer.

The 3287, on the other hand, uses a multi-track ribbon design, with each of the four colors running as a thin strip along the ribbon length. Thus, for each line, a separate pass is necessary to put down each color, and only these four colors; no other hues or tones are available. The extended colors on the high-end 3279 terminal —

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TOP-OF-THE-WIRE

A MARKET STUDY FOCUSES ON NEXT FIVE YEARS

A multi-client study on computer graphics markets over the next five years, now underway by International Data Corp., refers to CG as a high growth $500 million market (1980) and one marked by merger and acquisition activity. The study, to be completed Jan. 25, 1980, concentrates on CAD/CAM and business graphics. It also covers software and service firms, leasing, and user attitudes, among other aspects, says project manager Neil Kleinman, IDC's West Coast director.

The study entails two parts:

- A market analysis and forecast segment, costing $4,500.
- A segment on end user applications and plans, also costing $4,500.

Sponsors receive a final report plus a formal presentation on the findings. To obtain a study proposal, contact *Neil Kleinman, IDC, 1541 Westwood Blvd., Los Angeles, CA 90024. (213) 477-3578.*

A CG SOCIETY FORMS; D.C. TO BE FIRST CONFERENCE SITE

On July 24, 1979, a National Computer Graphics Association (NCGA) was incorporated in Delaware, resulting from a dissatisfaction with an alleged academic orientation of the Special Interest Group on Computer Graphics (SIGGRAPH) of the Assoc. for Computing Machinery. Now, as one of the new society's initial activities, the 1st Annual NCGA Conference and Exhibit will be held in Washington, D.C., June 16-18, 1980. The theme: "Progress and Productivity in Computer Graphics." SIGGRAPH, of course, sponsors its own very successful conference and exhibit to be held in Seattle in July, 1980 (Harvard Newsletter — Oct. 19).

According to NCGA by-laws, the society aims to: provide a common forum for vendors and users to exchange views; increase the awareness of computer graphics among CG user management; increase productivity in the U.S.; establish CG standards; and serve as a national information resource. Individual membership costs $25 a year; sustaining organizational membership, $1,000 a year; and patron members, an initial $10,000 and then $1,000 each year thereafter. To date, three patron members are on board, with two more scheduled to sign up; the society goal is to have 12 patrons.

The Harvard Newsletter will monitor NCGA progress and activities, of course. In the meantime, details on membership can be obtained from NCGA President, Dr. Stephen Levine, 841 Katrina St., Livermore, Calif. 94550.

For information on the 1980 NCGA Conference, contact *Caby C. Smith, Conference Director, P.O. Box 9046, Alexandria, VA 22304. (202) 523—5169.*

DYNAGRAPHIC SUCCESS LEADS TO IMLAC EXPANSION

Imlac Corp., the commercial CG subsidiary of Hazeltine Corp., announces a 17,500 sq.-ft. plant expansion that will increase manufacturing space by 50 percent. The new building was made necessary by the success of the DYNAGRAPHIC interactive CG terminal introduced about 1½ years ago, according to David A. Luther, CG product marketing manager at Imlac that employs 200 people. DYNAGRAPHIC now accounts for 50 percent of Imlac sales.

COMPUTER SLIDE-MAKING GETS ANOTHER CONTENDER

Xerox Corp. recently announced that it will market the Mathematical Applications Group, Inc. MAGIslide system through its network of 42 Xerox Reproduction Centers around the country. And, now, Integrated Software Systems Corp. (ISSCO) announces a 35 mm. color slide-making service called ISSCOslides.

ISSCO's customer base, however, is confined to users of DISSPLA and TEL-A-GRAF software that automatically convert raw data into charts and graphs. This software can be licensed or is available through selected time-sharing services. Unlike the Xerox approach, which uses the dial-up telephone lines between a remote slide-

COMING IN JANUARY

A Special Insight Report:
What Digital Equipment Corp. Is Up To In Computer Graphics.

COMING IN FEBRUARY

A Special Insight Report:
How Leading Venture Capitalists View Computer Graphics.

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TOP-OF-THE-WIRE

CALCOMP TO MARKET DUNN CG HARD COPY CAMERA OUTSIDE U.S.

Dunn Instruments, Inc., San Francisco, appoints California Computer Products, Inc. exclusive international distributor of the Dunn model 631 color graphics hard copy camera to be sold under the CalComp name as the model 31. The camera, introduced last summer, makes photographs and slides from raster scan graphics terminals via electronic signal interception as opposed to the traditional, comparatively low resolution technique of filming the display screen itself. (Newsletter - July '79)

CalComp, it is worth noting, will be merged into Sanders Associates, Inc., pending the outcome of a CalComp stockholder's meeting to be held this month. (Newsletter - Nov. 16, '79)

DICOMED ELECTS HUELSKOETTER PRESIDENT

Wayne R. Huelskoetter becomes president of Minneapolis-based Dicomed Corp., manufacturer of graphic COM (computer-onto-microfilm) systems. Huelskoetter, a Dicomed founder, previously responsible for sales and marketing, will attempt to turn-around the $3 million-a-year (est. 1979 sales) company that has lost money in seven of the ten years since its founding in 1969. Co-founder Richard H. Hilden, former president and Dicomed's technological visionary, resigned in August. (Newsletter - Sept.)

PLASMA DISPLAY'S LARGE SCREEN OFFERS NEW USER APPEAL

Plasma panel displays are precluded from use in many applications because of their small size screens (8.5-in. x 8.5-in. max) and limited 512 x 512 resolution. But, now, computer terminals incorporating plasma displays that increase the screen size available by a factor of four have come on the market. The largest screen size—22-in. x 22-in. with 100 pixels per inch—"means that the one million bit resolution plasma display is here!" exclaims Robert Czajkowski assistant vice president at San Diego-based Science Applications, Inc., manufacturer of the plasma terminal.

Think tank Mitre Corp.'s Edward McLaughlin observed a recent demonstration of a 17-in. x 17-in. version at his

(Continued on page 4, column 1.)

ENGLAND TO BE SITE OF "CG '80" CONFERENCE AND EXHIBIT

Here is yet another computer graphics conference and exhibit to be held in 1980—this one in Birmingham, England, Aug. 12 thru 14. The conference reportedly will cover the universe of computer graphics subjects, including hardware, software, applications, standards, and so on; in addition it will feature an "animation festival" on computer-generated films.

The meeting's sponsor, Uxbridge, England-based Online, Ltd., "anticipates that approximately 40 suppliers" will take booth space in what the firm dubs "Computer Graphics '80"—a sequel to its CG '70 held a decade ago. Registration fee: approx. $450, plus value added tax. For details, contact: Paula Stockham, Online, Ltd., Cleveland Rd., Uxbridge, UB8 2DD. Phone: (0895)39262.

IMLAC FORMS A CG DIV., APPOINTS LEN SACON AS GM

At Needham Heights (Mass.)-based Imlac Corp., computer graphics terminal sales account for at least 80 percent of the total revenues of this Hazeltine Corp. subsidiary. To accommodate ambitious CG plans that include a 10-fold increase in terminal shipments over the next few years, Imlac establishes a Computer Graphics Division, with Len Sacon, an Imlac 10-year veteran and also an Adage alumnus, appointed general manager to head up the new operating unit. The division consolidates the once disparate and unwieldy activities of marketing, product planning, and engineering and software development into a single, more streamlined operation, Sacon says. About a year ago, Imlac also formed a graphic arts division.

TEKTRONIX YEAR END: PART I: YOU WIN SOME

A flurry of CG developments marked this year end at Tektronix, Inc., Beaverton, Oregon. On the win side, graphics display vendor Intelligent Systems Corp., Norcorss, Georgia, dropped its $22 million law suit against Tek. And, in another coup, Tek announced a novel, first-of-its-kind arrangement that links Tek's 4692 video hard copy unit to the Digital Equipment Corp. MINC laboratory computer system.

On the downbeat side, however, Tek withdrew its turn-

(Continued on page 3, column 1.)

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TOP-OF-THE-WIRE

DISSPLA IMPLEMENTED AS A FIRMWARE PRODUCT

Ian Hirschsohn co-founded San Diego (Calif.)-based Integrated Software Systems Corp. in the late 1960s following his development of DISSPLA software that converts numerical data bases into charts, graphs, and other visual formats. Hirschsohn also became ISSCO president. But, then, in May 1978, he exchanged his 49 per cent ISSCO equity holding for royalties on DISSPLA sales and the rights to implement DISSPLA as a combined hardware/software product (firmware).

Now, more than a year and some $500,000 later, Hirschsohn recently demonstrated the outcome of his labor — a 48-bit ''Personal Graphics Mainframe'' (PGM), about microwave oven size, that plugs into a wall socket, and enables a user to run DISSPLA functions apart from a host mainframe. ''It definitely works!'' exclaims Hans Lindbloom at the Naval Weapons Center in China Lake, Calif. Lindbloom had conducted a week-long trial on-site, prior to ordering the unit to be used to generate a mag tape encoded with management reporting illustrations.

Hirschsohn has also sold PGM units to the Zytron Graphics Systems subsidiary of the National CSS, a Dun and Bradstreet, Inc., division. Zytron plans to set up graphics ''service centers'' in various cities, housing a PGM in each of two facilities initially. These remote PGMs, in turn, will be linked via the NCSS time-sharing net to a third PGM located at Zytron's Sunnyvale headquarters, where hard copy graphics are produced. (More on Zytron in a forthcoming Newsletter.)

PGM is no ''sissy'' achievement. DISSPLA's 40,000 Fortran statements entail some 400 statements per vector. Put another way, some four million Fortran statements must be executed to generate a typical camera-ready plot, employing elaborate fonts, dot-dash lines, and other attractive features. Indeed, DISSPLA taxes the memory and computation resources of even large mainframes. Nevertheless, Hirschsohn has packed his PGM onto four PC boards, along with a 29M byte disk, and 400K bytes of processor memory, and in a unit that weighs 84 lbs. ''I fly the PGM

(Cont.'d on page 3.)

MEGATEK READIES SOFTWARE PACKAGE

San Diego-based Megatek Corp., which has carved out a strong hardware identity, will move into a different, but related, business area: packaged CG software. The company, reportedly, will offer a ''highly interactive'' computer graphics package, comprising a set of SIGGRAPH core standard Fortran subroutines, that will be device-independent. Formal announcement, however, is a few months away.

RAMTEK AND MATRIX SIGN OEM ACCORD

In September, Matrix Corp. announced a color CG hard copy camera (Newsletter - Sept., '79). Now, the Northvale, N.J.-based company announces its first OEM agreement, with terminal maker Ramtek Corp., who will market the camera under its own name.

Matrix' production rate is now 50 units a month. The medical imaging product company has also set up a distributor and rep network employing four people to oversee it, with an international sales manager yet to be hired. Within two years, Matrix' CG product line is expected to generate the company's lion share of revenues, now accounted for by its medical imaging equipment.

TV WEATHER NEWS TO TEST CG USE

Next month, computer graphics will have a chance to become a television star when Los Angeles' KNXT-TV launches a two-month experiment in applying CG techniques to TV weather news. The system, based on a Chromatics terminal, will be supplied by Santa Monica (Calif.)-based Xiphias Div. of Computer Graphics, Inc., which also developed the software.

Peter Black, formerly a TV journalist who is ardent that CG has a big future in TV news, founded Xiphias with financial backing from Films, Inc. Board Chairman Charles Benton. The privately-owned, Wilmette (Ill.) company distributes 16-mm. film, and Benton, himself, was chairman of the White House Conference on Libraries and Information Systems, held in November.

Success of the pilot program could lead to a welter of new CG opportunities. Black is optimistic that his initial weather application will be expanded to include sports, politics, and

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TOP-OF-THE-WIRE

A 4096 x 4096 VECTOR REFRESH TERMINAL

Some years ago, Autographics, Inc., founders developed an interactive graphics nesting and grading system for the apparel industry and licensed it to Hughes Aircraft Co., which has since installed some 125 systems worldwide. Last year, Autographics sold out entirely to Hughes and put the proceeds, in part, to the formation of a ''graphics systems house.''

Now the firm, Vector Automation, announces its first product — the Graphicus-80 vector refresh intelligent graphics terminal, having 4096 x 4096 resolution and able to draw 66,000 vectors, up to 0.1 inch in size. ''This capability puts us in the same markets as those served by Megatek and Sanders,'' says Phillip A. Adams, marketing vice president.

The 21-inch Graphicus-80 incorporates a firmware processor having 32K bytes of memory (expandable to 256K bytes), full ASCII keyboard, RS-232 serial interface, and built-in diagnostics. Quantity one price is $24,500; OEM discounts can go to 30% for large quantities. Contact: Phillip A. Adams, vice president - marketing, Vector Automation, Village of Cross Keys, Baltimore, MD 21210. (301)323-1212.

IMAGING SCIENCES INSTITUTE ESTABLISHED AT POLYTECHNIC INSTITUTE

Impetus toward progress in computer graphics now comes from the Polytechnic Institute of New York, with the announcement that the Brooklyn-based technical college is establishing an Institute of Image Sciences. The Institute will research new methods and techniques of image processing, reports Polytechnic President Dr. George Bugliarello, ''to anticipate forthcoming changes in photography, document copy, electronic books, and the like—in general, all the processes used to capture, transmit, store, retrieve, and reproduce information ultimately presented in visual form.''

Bugliarello explains the rationale behind the new Institute, which will be funded by a ''major gift'' from Polychrome Corp. Board Chairman Gregory Halperin. ''Few American universities have programs in the science and technology of the production of images,'' he says, and ''none offers a program sufficiently broad to encompass all processes used in imaging science.'' As part of the plan, Polytechnic Institute will develop a graduate course in imaging science. Standard engineering courses are to be augmented by new topics dealing with the chemical properties of materials used in imaging, electronic display devices, lasers, facsimile and image transmission, and photocomposition. Short courses and seminars in these disciplines will also be offered.

A Laboratory of Imaging Sciences, also to be set up, will focus on three research areas initially: (1) Photothoretic spectroscopy, a new process that employs lasers to form images on paper developed by Polytechnic Professor Steven Arnold; (2) The relationship of polymers to image-producing processes; and (3) Non-optical imaging techniques, such as tomography. Institute location: 33 Jay St., Brooklyn, NY 11201. (212)643-5000.

FORMER U.S. SECRETARY OF TREASURY JOINS INDUSTRIAL DATA TERMINALS BOARD

Without fanfare, Industrial Data Terminals Corp. appears to be positioning itself on all fronts to capture booming computer graphics markets. On the financial and business front, William Simon, former Secretary of the Treasury under Pres. Richard Nixon, joins IDT's board, having reportedly made a ''six figure investment'' in IDT. Also, IDT recently received $1.2 million from a venture capital group, led by Allstate Insurance Co. which, itself, anted up $800,000.

In other moves, IDT announced late last year a tripling of plant facility to 28,000 sq. ft. The privately-owned company also expects revenues to nearly triple in 1980 (HN - Dec. 7, '79). As a final touch, IDT also introduces the first in a new line of color monitors (Page 2).

A PORTABLE TERMINAL THAT DOES GRAPHICS

The Harvard Newsletter has already noted the trend by manufacturers to give alphanumeric printers a graphics capability (HN - Oct. 19, '79). Now, that same trend reaches into the domain of the portable terminal, namely, the 17-lb. Execuport 4000G that can generate time plots,

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Volume 2, No. 4 - February 22, 1980

THE HARVARD NEWSLETTER ON COMPUTER GRAPHICS

news/trends insights perspective opportunities

TOP-OF-THE-WIRE

Raster Scan Color Graphics To Debut From Digital Equipment Corp.

Look for raster scan color graphics from Digital Equipment Corp. to debut in March with deliveries to start in the autumn. Though official DEC policy remains "mum's the word," DEC salesmen were briefed on the new graphics options in January; moreover, selected OEM vendors and others have been treated to demonstrations for some time by DEC's Computer Special Systems Group in Merrimac, N.H., the DEC unit responsible for the new raster products. Some consultants, also, are aware of the specifications, and from all of these sources, the Harvard Newsletter has pieced together this preliminary report to be updated following the release of official product details.

Nomenclature for the raster scan options is another DEC-style linguistic nightmare — hold your breath — the VSV11/VS11. The VS11 signifies UNIBUS (PDP-11 and VAX-11/780) plug compatibility; the VSV11 denotes LSI-11 bus compatibility. Either graphics option entails three PC boards:

(1) Video sync generator.

(2) Image processor whose graphics instruction set is based on the DEC VT11 refresh graphics terminal, having vector, point, and bit map modes, among other functions.

(3) Image memory, or video frame buffer, able to generate static graphics in 16 colors (512 x 512 x 4 bit interlaced) or dynamic graphics, also in 16 colors or shades of gray (512 x 256 x 4 bit non-interlaced).

A barebones VSV11 configuration with a joy stick cursor will cost about $5,000; for the VS11, $6,000, which includes an additional PC board necessary for tying into the UNIBUS. A top-of-the-line package, incorporating two memory boards to achieve full graphics performance and a 19-in. color monitor (supplied by Hitachi), will cost $14,000. Prices on intermediate-level systems having a 12-in. black and white VT-100 graphics terminal will range between $7,500 and $9,000.

As for software, the initial offerings will be very limited — namely, handlers to support some versions of the RSX-11 and VAX/VMS operating systems. High-level

(Continued on page 3, column 1.)

Visionary Solar Intl. Scheme Leads to a $5 Million Budget

One of the most ambitious and far-reaching CG programs yet to be undertaken is underway at International Harvester's Solar Turbines Group in San Diego, Calif. It aims to automate "everything from the engineering conceptual process to production on the shop floor," says Victor Muglia, Solar's resident CG visionary, officially titled manager — distributed computing. As a result, Muglia's in-house Technical Systems and Services Support section expects to expend some $5 million on CG/CAD/CAM hardware, software, systems and services over the next few years. This will include 22 graphics terminals to serve some 150 engineers, plus another 15 CG terminals that will stand on the manufacturing shop floor. Says Muglia: "We are currently at a systems definition stage."

Pressed onward by top management interest, Muglia is scheduled to make systems recommendations in April and to begin implementation in November. "What we want is

(Continued on page 3, column 2.)

Major Computer Animation Studio Underway in California

In less than five years, Dr. Edwin E. Catmull transformed a pioneering CG vision into what is now one of the world's foremost computer animation laboratories located at the New York Institute of Technology. Here in Old Westbury on New York's Long Island peninsula is housed some $3 million worth of computer graphics and related equipment — six animation stations, Dicomed color film recorder, VAX 11/780 computer, and 22 frame buffers — not including software. (More on this Laboratory in a forthcoming Newsletter.)

Now, the 35-year-old CG trailblazer, who also wrote TWEEN character animation software, has relocated to the Far West, lured away by George Lucas of Star Wars movie fame to join his Lucasfilm, Ltd., production company in San Anselmo, Calif., across from the Golden Gate Bridge. Reached at home, Catmull told the Harvard Newsletter of his new charge by Lucas to create a state-of-the-art commercial movie studio that will do film and sound editing and create special effects — all via computer techniques. Says Catmull: "The studio will be up and running in about two

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THE HARVARD NEWSLETTER ON COMPUTER GRAPHICS

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TOP-OF-THE-WIRE

OEM CG Market Expanded By A Third In 1979

Computer graphics systems shipped by original equipment manufacturers and independent systems houses in 1979 increased by nearly one-third over prior year shipments, according to the "Directory of Systems Houses and Minicomputer OEMs," published by Sentry Publishing Co.

The just-issued 1980 edition breaks down systems shipments by application, as follows:

	1978	1979
Computer-Aided Design	3,467	10,127
Graphics, Image, Display Control	16,352	27,467
Plotting, Drafting, Mapping	12,389	14,264
TOTAL	32,208	51,858

Though the absolute totals result in a gain in 1979 greater than one third (actually 40%), the numbers need to be adjusted because the 1978 reported data represent 40 per cent of the total market while the 1979 data represent 50 per cent, according to directory publisher William Gannon, who adds: "The large samples offer statistical reliability and projectability."

The data, based on replies from 1,300 OEMs and systems houses to a questionnaire sent out by Sentry, also show an expanding interest in graphics markets, as follows:

No. of OEMs Shipping CG Systems

	1978	1979
Computer-Aided Design	60	86
Graphics, Image, Display Control	149	191
Plotting, Drafting, Mapping	103	127

The results are even more varied, however, when viewed by that all important ratio, systems shipped per supplier,

(Continued on page 3, column 2.)

End Users Gain Another Turnkey Source

End users who require intelligent graphics display systems for use in image processing, signal processing, event simulation, and other specialized scientific activities now have another turnkey source to turn to — First Computer Corp., a large, independent Digital Equipment Corp. distributor and systems integrator. The Ann Arbor (Mich.)-based company has entered into "a million dollar" agreement to purchase and market the LIGHT 50 color display generators made by Applied Dynamics International, also based in Ann Arbor (HN - Oct. 19, '79). First Computer will integrate the LIGHT 50 — which offers hardware scroll, zoom and video look-up table, RGB, and NSTC outputs, among other features — into complete graphics systems, using Floating Point Systems array processors and DEC LSI-11 computers. Contact: Jerome Martin, Pres., First Computer Corp., 825 N. Cass Ave., Westmont, IL 60559. (312)920-1050.

A VAX Interface for the E&S Picture System

Evans & Sutherland develops an interface to provide a native mode, Unibus link between its MultiPicture ICG System and the Digital Equipment Corp. VAX 11/780 computer. Existing PDP-11-based graphics programs need only to be compiled onto the VAX, according to E&S.

Polaroid Corp. Forms A Computer Graphics Unit

With its consumer business battered by inflation, instant camera and film producer Polaroid Corp. is driving hard to step up industrial product sales. One offshoot is the formation of a computer graphics division, headed by Morris L. Samit, a Summagraphics Corp. co-founder who, by the way, got the Polaroid post following a story about this Wharton School graduate in the Harvard Newsletter (Dec. 7, '79).

Samit's unit will market Type 808 Polacolor film, whose biggest use is currently in photographic portraiture, as a hard copy CG medium. Polaroid expects CG to become a big market, because of the recent advent of color hard camera equipment from Northvale, (N.J.)-based Matrix Corp. and San Francisco-based Dunn Instruments Corp. These cameras intercept the electronic signal in graphics displays to generate photo quality prints, slides, and transparencies. (For product descriptions, see HN - July '79 and Sept. '79.)

More Moves By CDC Into CAD/CAM

Control Data Corp. signs an OEM agreement to market Sanders Associates' Graphics 7 vector refresh terminal under the CDC logo and to be designated Digigraphics 795.

(Continued on page 4, column 2.)

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New promise of computer graphics

Hirotaka Takeuchi and Allan H. Schmidt

Reprinted from

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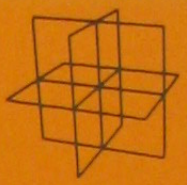

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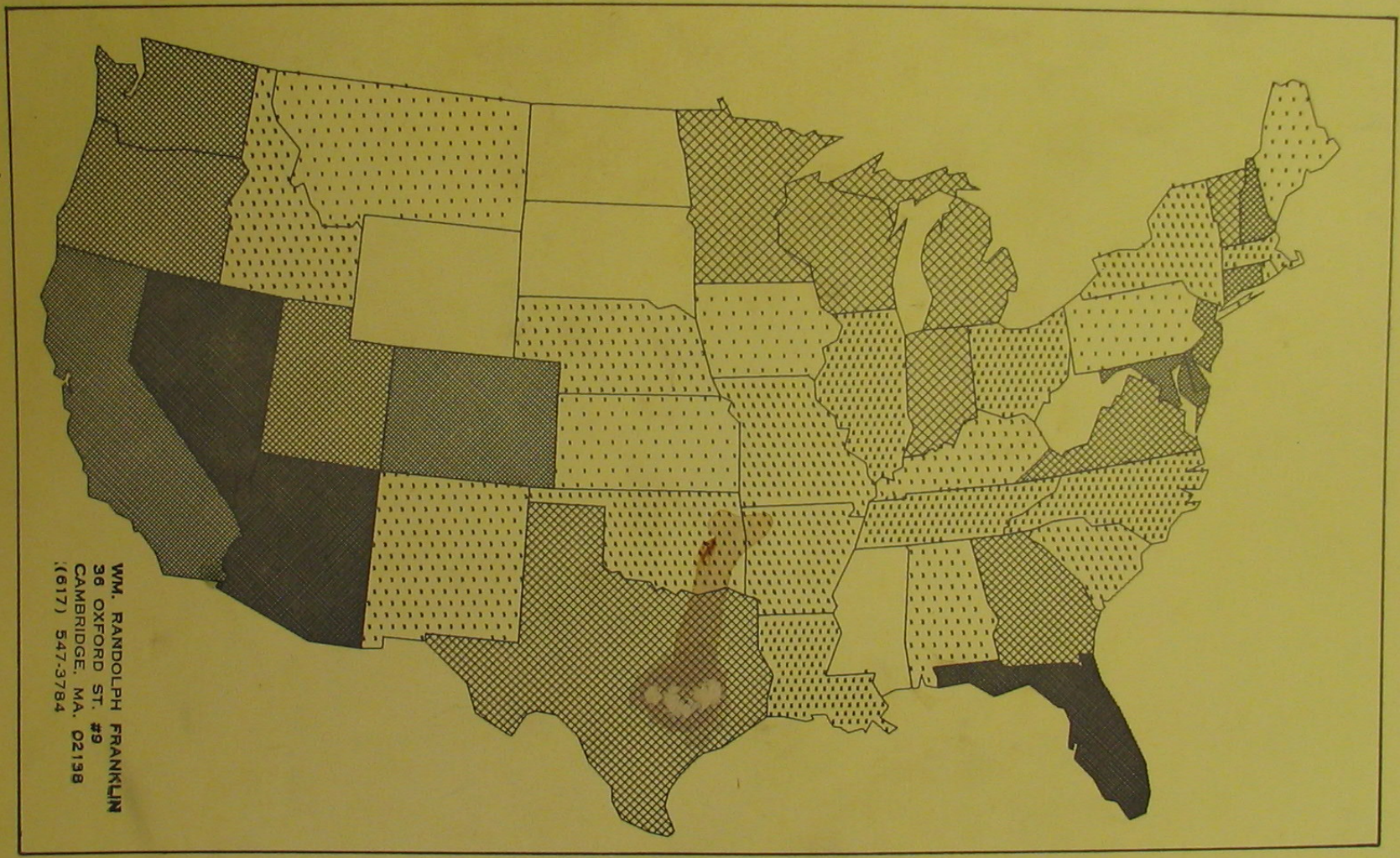

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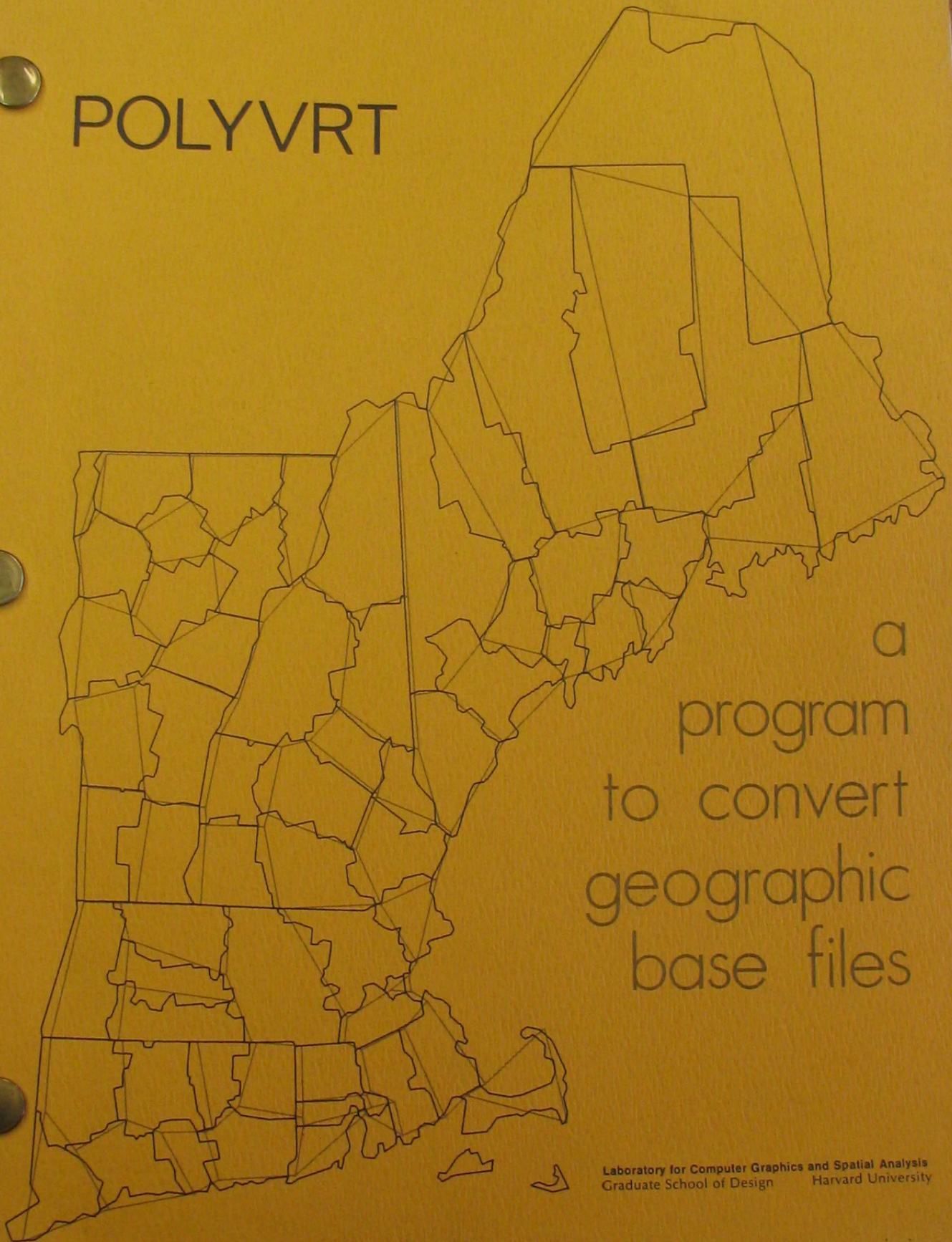

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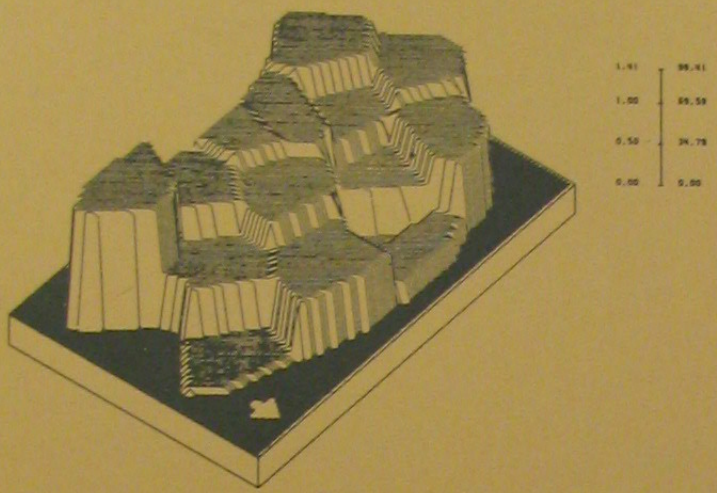

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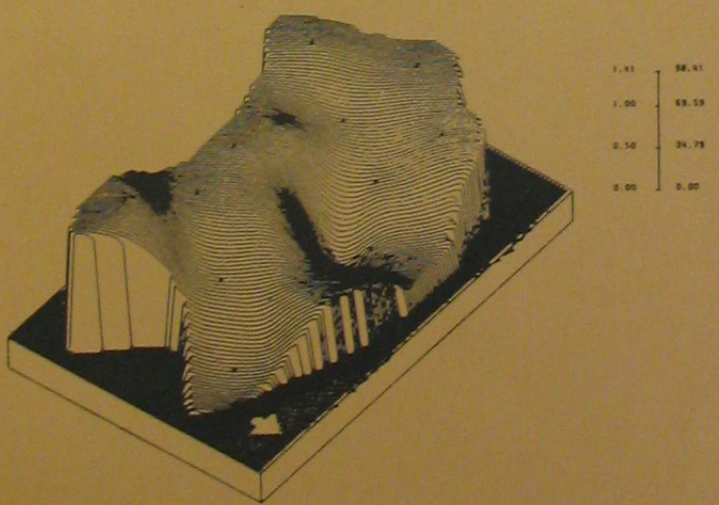

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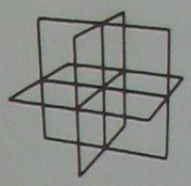

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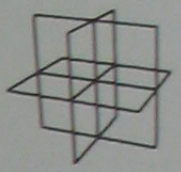

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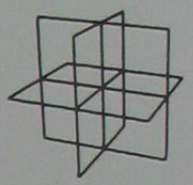

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FOR

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August 1977

Eric Teicholz, Principal Investigator
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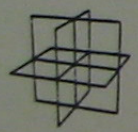

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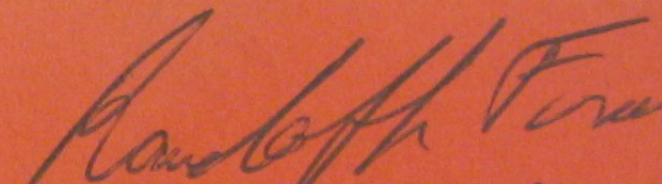

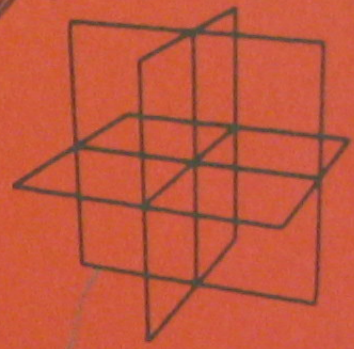

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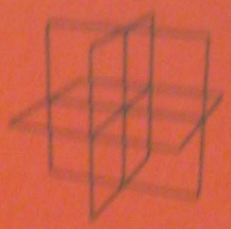

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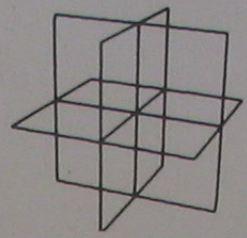

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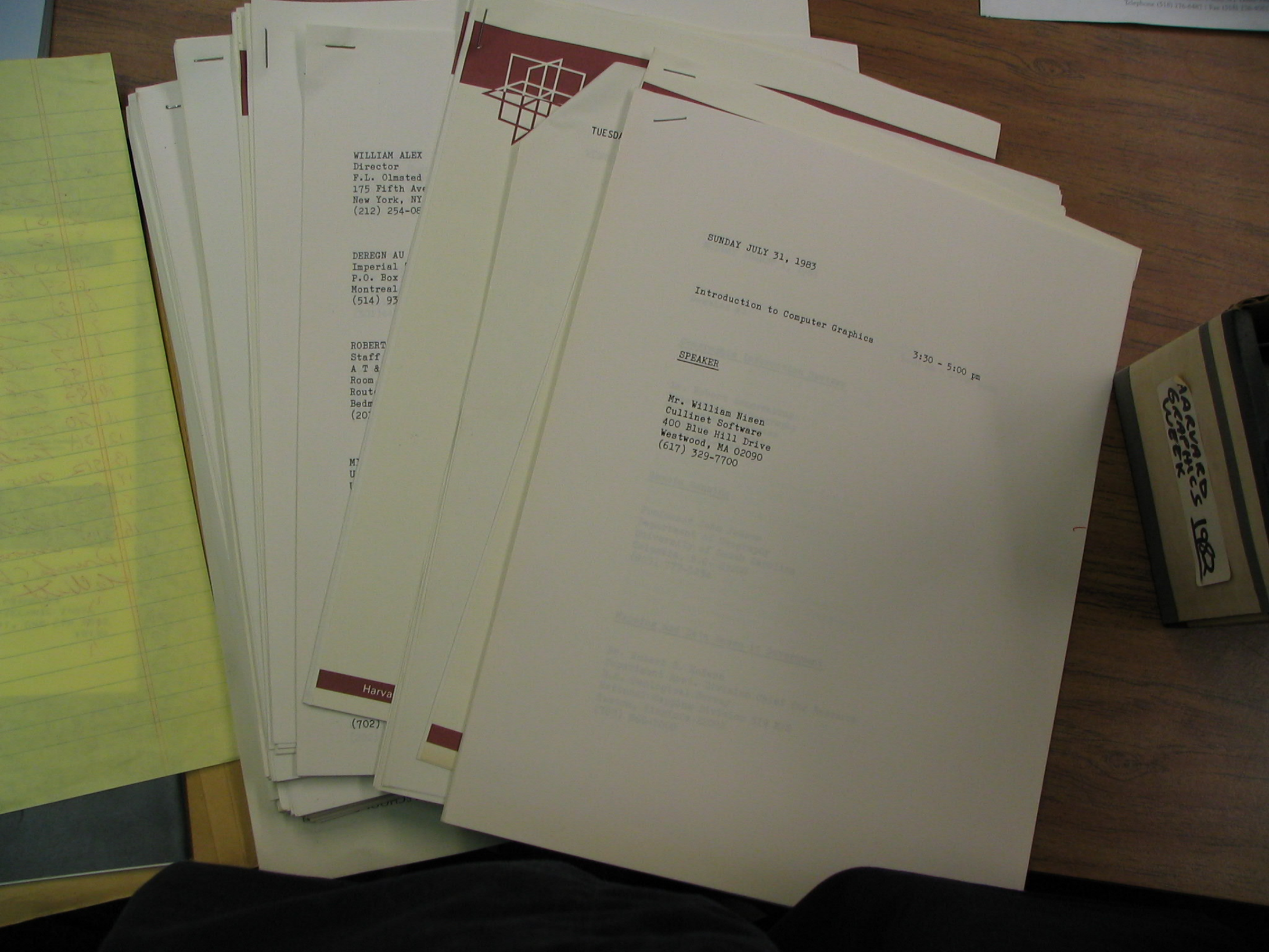
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HARVARD GRAPHICS WEEK 1982

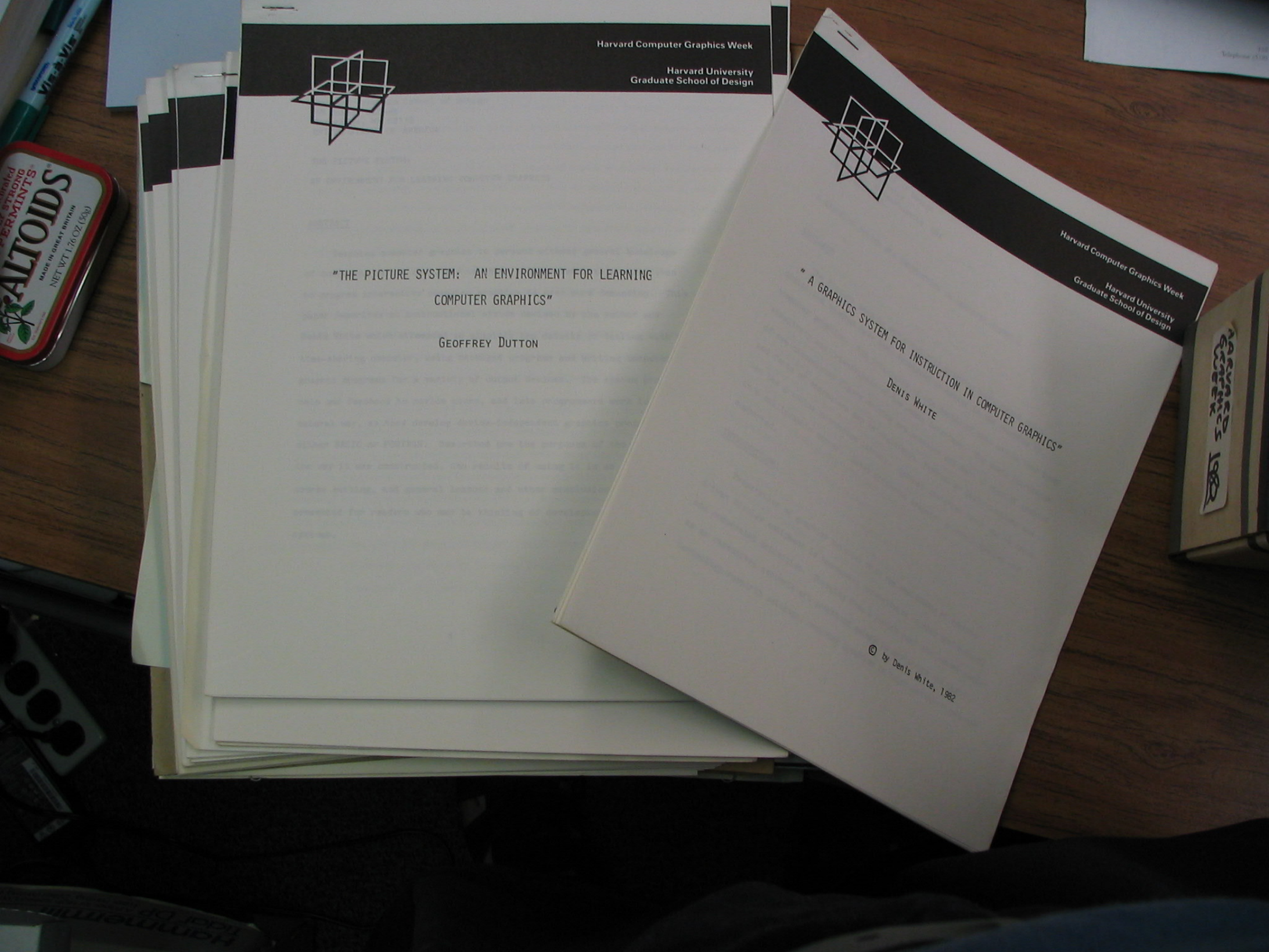
Harvard Computer Graphics Week 1982

An International Users' Conference
focusing on
Computer Mapping, Image Processing,
Graphic Communication and
Information Resources

Harvard University, Graduate School of Design
Laboratory for Computer Graphics
and Spatial Analysis

July 25-30, 1982

Hyatt Regency Hotel, Cambridge, Massachusetts


Harvard Computer Graphics Week
Harvard University
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"THE PICTURE SYSTEM: AN ENVIRONMENT FOR LEARNING COMPUTER GRAPHICS"
GEOFFREY DUTTON
Harvard Computer Graphics Week
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"A GRAPHICS SYSTEM FOR INSTRUCTION IN COMPUTER GRAPHICS"
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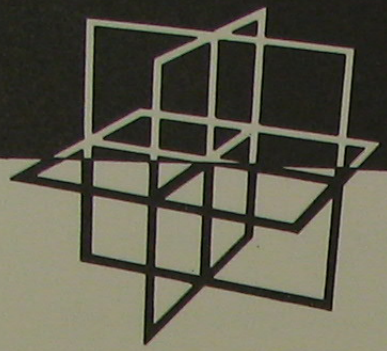

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"ESTIMATING THE ERROR OF CATEGORICAL MAPS"

NICHOLAS R. CHRISMAN