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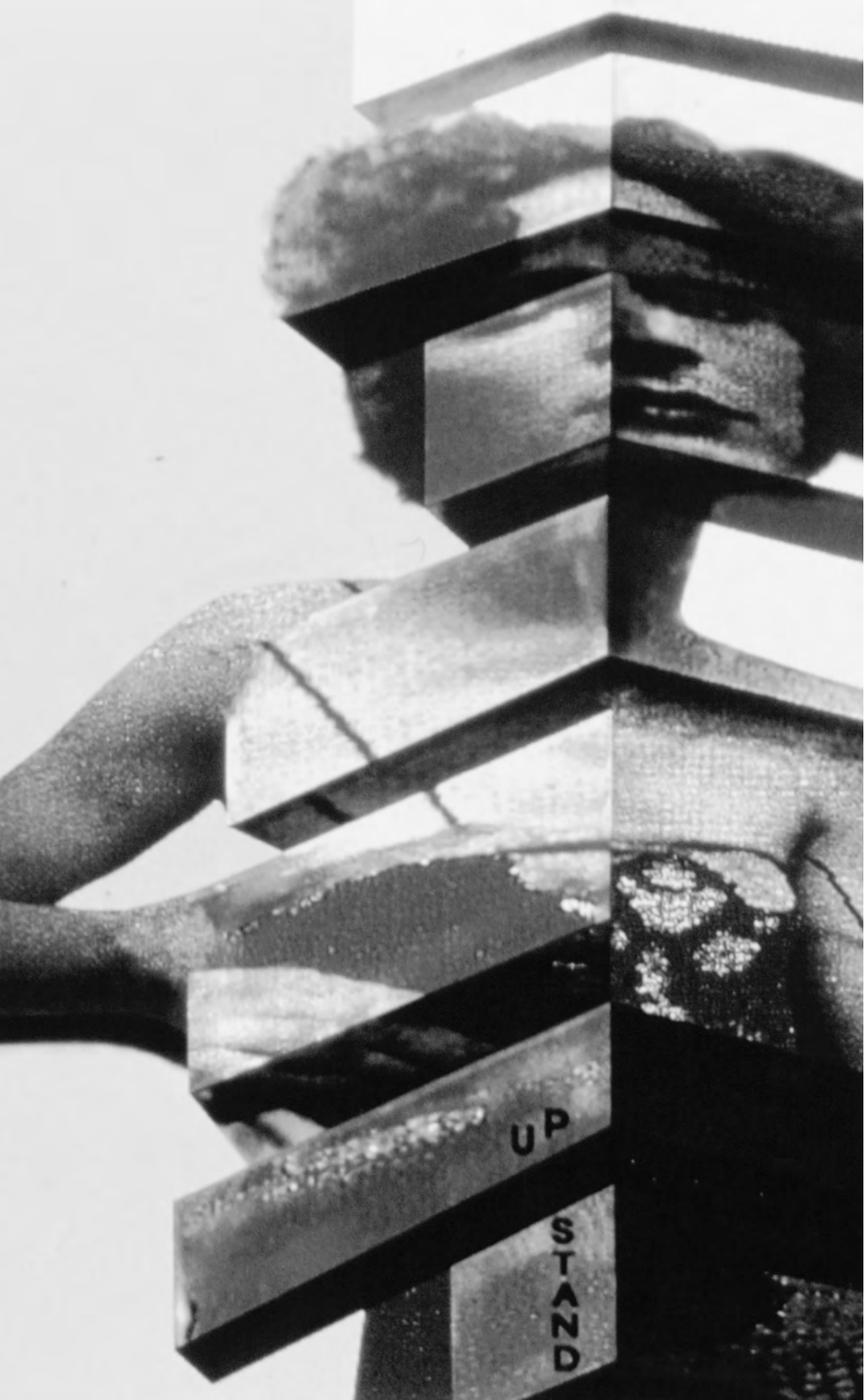
RADICAL SOFTWARE

Women, Art & Computing
1960–1991



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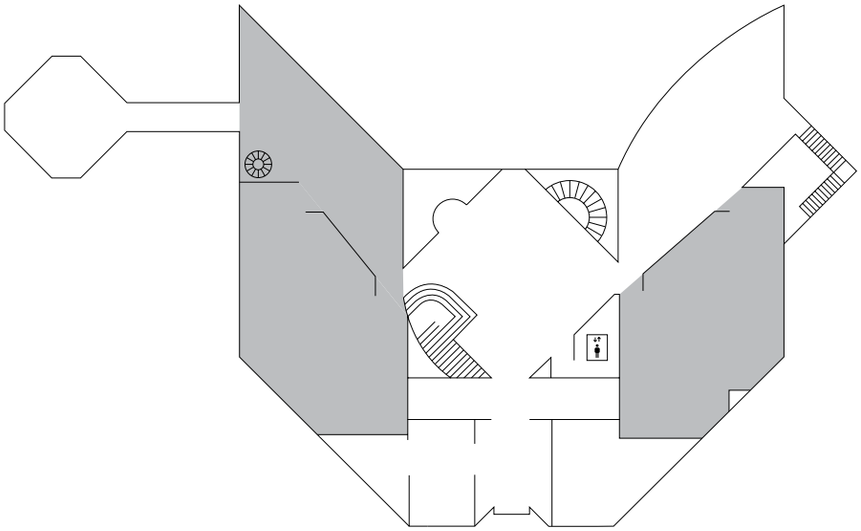


Radical Software
Women, Art & Computing 1960–1991

20.09.2024 — 02.02.2025

Level 0
Galleries and Jardin des Sculptures

Level -1
Auditorium

Guest curator
Michelle Cotton, assisted by Sarah Beaumont

Exhibition Design
Studio Martha Schwindling

Production
David Celli, Paula Fernandes, Jordan Gerber, Richard Goedert,
Matthias Heitbrink, Clara Kremer, Pedro Serrano, Lourindo Soares

The exhibition is organised by Mudam Luxembourg – Musée d'Art Moderne Grand-Duc Jean and Kunsthalle Wien, Vienna.

The artists

Rebecca Allen 1953, Detroit
Elena Asins 1940, Madrid – 2015, Azpirotz, Spain
Colette Stuebe Bangert 1934, Columbus, Ohio
& Charles Jeffries Bangert 1938, Fargo, North Dakota – 2019, Lawrence, Kansas
Gretchen Bender 1951, Seaford, Delaware – 2004, New York
Gudrun Bielz 1954, Linz, Austria
& Ruth Schnell 1956, Feldkirch, Austria
Dara Birnbaum 1946, New York
Inge Borchardt 1935, Stettin, Germany, today Szczecin, Poland
Barbara Buckner 1950, Chicago
Doris Chase 1923 – 2008, Seattle, Washington
Analívia Cordeiro 1954, São Paulo
Betty Danon 1927, Istanbul – 2002, Milan
Hanne Darboven 1941, Munich – 2009, Hamburg
Bia Davou 1932 – 1996, Athens
Agnes Denes 1938, Budapest
VALIE EXPORT 1940, Linz, Austria
Anna Bella Geiger 1933, Rio de Janeiro
Isa Genzken 1948, Bad Oldesloe, Germany
Dominique Gonzalez-Foerster 1965, Strasbourg
Lily Greenham 1924, Vienna – 2001, London
Samia Halaby 1936, Jerusalem
Barbara Hammer 1939, Los Angeles – 2019, New York
Lynn Hershman Leeson 1941, Cleveland, Ohio
Grace C. Hertlein 1924, Chicago – 2015, Chico, California
Channa Horwitz 1932 – 2013, Los Angeles
Irma Hünerfauth 1907, Donaueschingen, Germany – 1998, Kreuth, Germany
Charlotte Johannesson 1943, Malmö
Alison Knowles 1933, New York
Beryl Korot 1945, New York
Katalin Ladik 1942, Novi Sad, Serbia
Ruth Leavitt 1944, St. Paul, Minnesota
Liliane Lijn 1939, New York
Vera Molnár 1924, Budapest – 2023, Paris
Monique Nahas 1940, Paris
& Hervé Huitric 1945, Paris
Katherine Nash 1910 – 1982, Minneapolis, Minnesota
Sonya Rapoport 1923, Brookline, Massachusetts – 2015, Berkeley, California
Deborah Remington 1930, Haddonfield, New Jersey – 2010, Moorestown, New Jersey
Sylvia Roubaud 1941, Munich
Miriam Schapiro 1923, Toronto – 2015, Hampton Bays, New York
Lillian Schwartz 1927, Cincinnati, Ohio
Sonia Sheridan 1925, Newark, Ohio – 2021, Hanover, New Hampshire
Nina Sobell 1947, Patchogue, New York
Barbara T. Smith 1931, Pasadena, California
Tamiko Thiel 1957, Oakland, California
Rosemarie Trockel 1952, Schwerte, Germany
Joan Truckenbrod 1945, Greensboro, North Carolina
Anne-Mie Van Kerckhoven 1951, Antwerp
Ulla Wiggen 1942, Stockholm

The exhibition

During the 1960s and 1970s, artists, musicians, poets, writers and filmmakers experimented with computer technology. Working in collaboration with mathematicians, computer scientists and engineers, they produced the first computer-generated images, music and texts. By the end of the 1970s, computer technology had been applied in a diverse range of artistic contexts, from the production of drawing and painting to filmmaking and performance. Its influence on contemporary art has been far-reaching, spanning several different artistic movements.

Radical Software: Women, Art & Computing 1960–1991 presents work by artists who were amongst the first to use the computer – mainframe and minicomputers – as a tool for artmaking. They are accompanied by other artists who made the computer their subject or worked in a computational way. The exhibition begins with works made in academic or industrial computer labs and ends with others made on the first personal computers in the last years before the World Wide Web made the internet publicly accessible. Set within a period that was also marked by the second wave of feminism, it documents a lesser-known history of the inception of digital art, countering conventional narratives on art and technology by focusing entirely on female figures.

1. Zeros and Ones

The mainframe computers of the 1960s filled entire rooms and the costs involved in building and operating the machines were so high that they tended only to be owned by state agencies, large corporations and academic institutions. In addition, data processing time was much slower and many universities implemented a timesharing system to allow a central computer to be shared by a large number of users who were each given use of the central processor for a fixed period of time. These machines gradually took over many long and tedious calculations that had, since the seventeenth century been performed longhand, on paper by people – often by women – employed as 'computers'.

During the 1960s and 1970s some universities, technical colleges and corporations lent machine time for exhibitions and artistic research, creating the opportunity for a small number of artists to gain access to computers. **Elena Asins**, **Colette Stuebe Bangert** and **Charles Jeffries Bangert**, **Lily Greenham**, **Grace C. Hertlein**, **Ruth Leavitt**, **Vera Molnár**, **Monique Nahas** and **Hervé Huitric**, **Katherine Nash**, **Sylvia Roubaud** and **Joan Truckenbrod** were among the first artists to use computers to produce drawings and prints. Conversely, several scientists including **Inge Borchardt** exhibited their experiments. These pioneers of computer art learned how to use programming languages and sometimes developed their own software. Works were often made without any display or graphical user interface, meaning that artists were unable to see the results until they were printed by a plotter.

For artists such as Asins and Molnár the computer was a means to mechanise the generative or algorithmic art they had previously made by hand. By contrast, others such as **Hanne Darboven**, **Bia Davou** or **Channa Horwitz** produced entire oeuvres of computational works without using machines. For these artists, the handcrafted development and production of systems and their exhaustive execution was fundamental to their work. Here machine-like repetition highlights the mental and physical labour invested in the expansive works on paper by Darboven or the intricate numerical patterns developed by Davou and Horwitz, perhaps unwittingly recalling an era of human computational labour.

Computers were also deployed conceptually or as a tool by artists working across a broad range of media. For instance, **Miriam Schapiro** used the computer to render and rotate preparatory studies for paintings. **Isa Genzken** used one to calculate and plot 1:1 scale linear plans for a series of *Ellipsoid* and *Hyperbolo* sculptures made between 1975 and 1985. Barbara T. Smith generated a series of 3,000 unique 'snowflakes' for a performance in Las Vegas in 1975. **Doris Chase** and **Lillian Schwartz** were among the first artists to use a computer to generate abstract moving images (presented in the auditorium on level -1). Other works, such as those presented here by **Agnes Denes**, **Alison Knowles** or **Liliane Lijn**, variously mechanise or automate part of the creative process in text-based works.

2. Hardware

While some artists adopted the computer as a tool, or focused on its functional behaviour or 'unseen systems', others were inspired by the idea of the machine and by its physical, material aspect and design. From 1963 to 1969 **Ulla Wiggen** produced a series of paintings that directly copy or evoke the integrated circuits used in computers after 1962. Photographs and sound works by **Katalin Ladik** and sculpture by **Irma Hünerfauth** similarly reflect this fascination with the inner workings of machines while the 1960s abstract paintings of **Deborah Remington** can be seen to consider the digital sublime, evoking both the limitless potential and inscrutable complexity of this new era of technology. The exhibition also includes designs from the 1980s by **Tamiko Thiel** for the Connection Machine, the first commercial computer devised to work on simulating intelligence and life.

3. Software

Although the first general-purpose digital computers were built in the 1940s, the theoretical principles on which these machines were based were first described in 1837 by mathematician Charles Babbage. Babbage's concept drew upon a binary system for programming textile looms to weave patterned cloth and the use of punched cards to store the designs invented in 1801 by Joseph Marie Jacquard. The work of Davou, **Charlotte Johannesson**, **Beryl Korot**, **Rosemarie Trockel** and **Joan Truckenbrod** is influenced in various ways by the relationship between computer software and the soft-wares, the commodities, i.e. textiles produced on the loom.

The magazine *Radical Software*, from which this exhibition takes its title, was founded in 1970 by Korot, Phyllis Gershuny (now Phyllis Segura) and Ira Schneider. The introduction to the first issue calls for 'access to information and the means to disseminate it' and for artists and other readers to 'design and implement alternate information structures which transcend and reconfigure the existing ones'. It locates power not in 'hardware' or 'property' but rather in 'software' and 'informational tools' that must be made accessible and 'humanised'.

4. Home Computing

It was Babbage's assistant, **Ada Lovelace**, who recognised that his machine could also be used to process words, images and music in addition to performing numerical calculations. Today Lovelace is widely regarded as the first computer programmer. The video *Ada en ADA* (1989) by **Dominique Gonzalez-Foerster** humorously references this contribution, employing the ADA computer programming language to narrate Ada Lovelace's biographical data.

During the 1970s computers became more affordable, owing to the mass production of microprocessors, ushering in a new era of home computing. Throughout the 1980s they became more accessible to artists who were no longer reliant on technicians and machine time in laboratories. This was especially significant for female artists, who rarely gained access to the labs and often lacked the time and resources to sustain a studio practice. Tina Rivers Ryan explains: 'Faster memory and better screens facilitated real-time interactivity, turning the computer into a device with which one played – a welcome contrast to the early days of computing, when programmers had to manually feed their instructions via punch cards and then wait hours or days for the results. These were also the years that saw the rapid development of new hardware systems for gaming… and even experimental virtual reality (VR) experiences.'

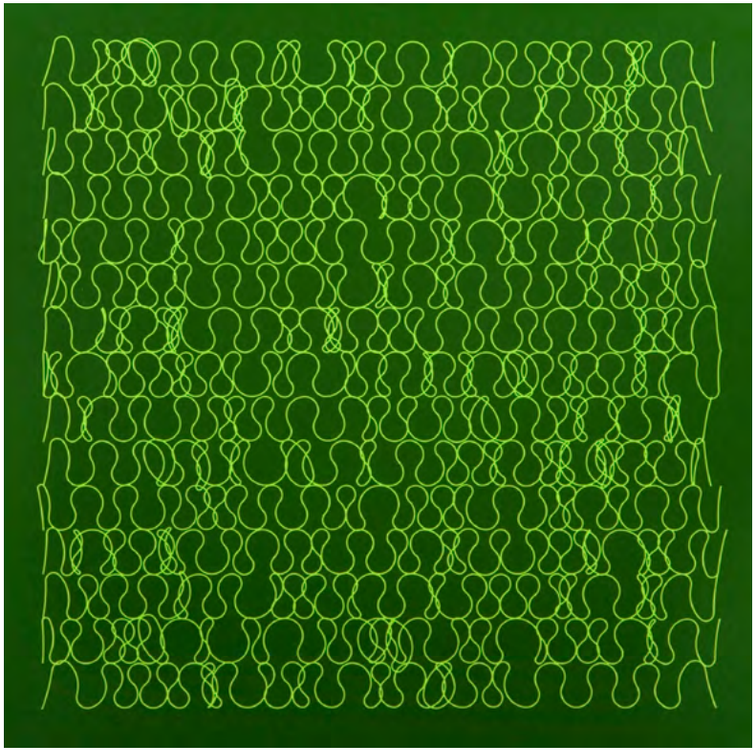
Several works reflect this new era. For example, **Dara Birnbaum**'s video, *Pop-Pop Video: Kojak/Wang* (1980) samples a television advertisement for one of such machine. Similarly, the interactive, participatory work of **Nina Sobell** and **Sonya Rapoport** can be seen in relation to the changes in human-computer interaction and the rise of computer games in popular culture. The works presented here by **Betty Danon**, **Samia Halaby**, **Barbara Hammer** and **Charlotte Johannesson** (a selection of Johannesson's computer graphics are also presented in the Jardin des Sculptures as slide shows) were made on early Apple or Amiga personal computers in their respective homes. While precise, monochromatic, abstract works dominated early computer art, personal computing facilitated a more colourful, figurative and often playful approach that can also be seen in works by **Gretchen Bender**, **Gudrun Bielz** and **Ruth Schnell** and **Barbara Buckner**. These works can also be connected to the burgeoning of 'media art' which was the subject of several major exhibitions and new festivals from the late 1970s.

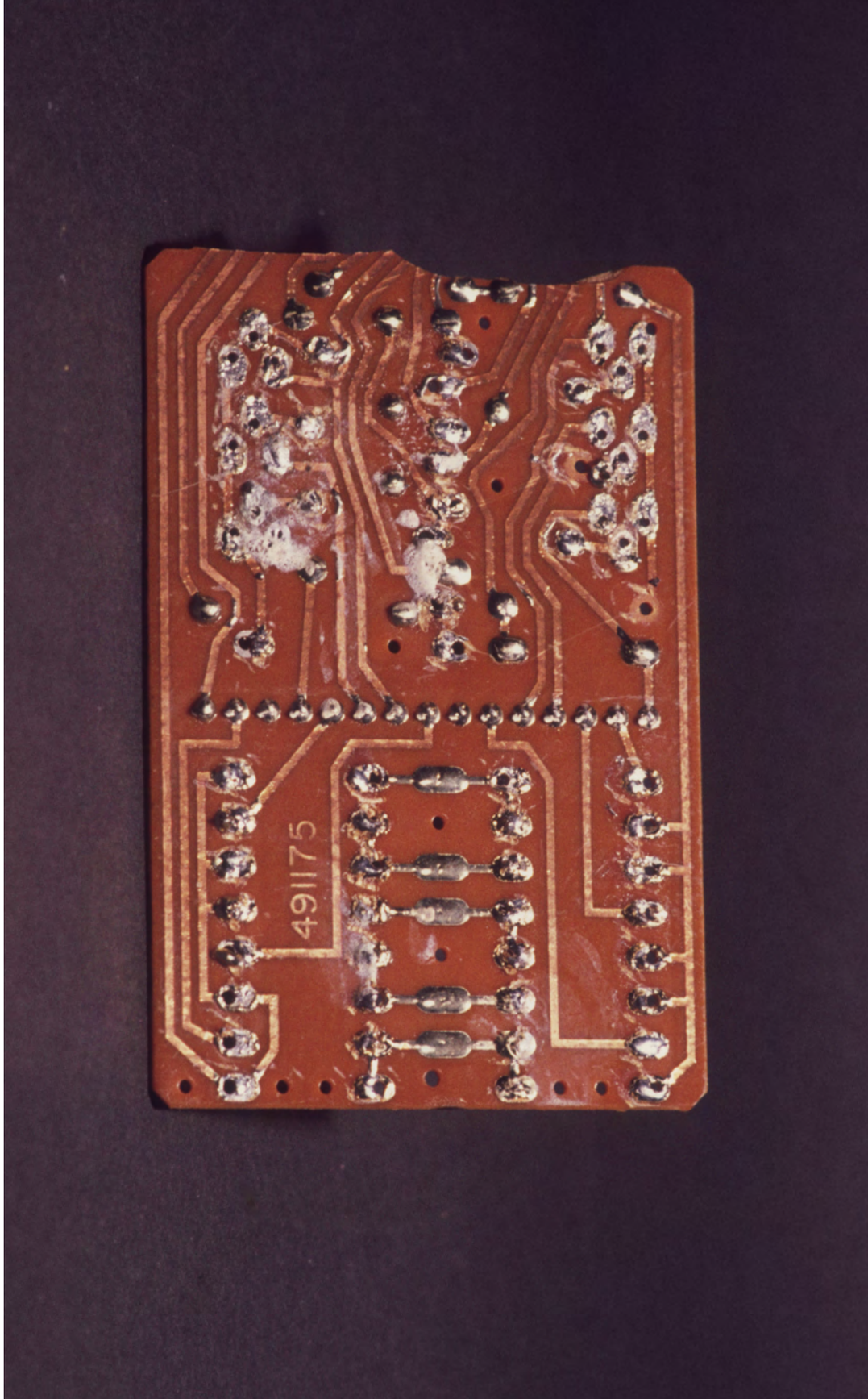
5. I would rather be a cyborg than a goddess

'I would rather be a cyborg than a goddess' wrote Donna Haraway at the end of her influential essay 'A Cyborg Manifesto' (1985). Drawing upon science fiction, Haraway claimed the image of the cyborg (or cybernetic organism) to describe 'a creature in a post-gender world', arguing that 'cyborg imagery can suggest a way out of the maze of dualisms in which we have explained our bodies and our tools to ourselves'. Her 'dream' was 'not of a common language', but of something more plural and mutable. She explained, 'it means both building and destroying machines, identities, categories, relationships, spaces, stories.'

This 'hybrid of machine and organism' continues to inspire countless artworks. *Self Portrait as Another Person* (1965) and *X-Ray Woman* (1966) are two of the earliest cyborgian images produced by **Lynn Hershman Leeson**. They appear together with **Irma Hünerfauth's** *Augen und Glocke* [Eyes and Bell, 1970] and works that **Anne-Mie Van Kerckoven** produced with computers at the Laboratory of Artificial Intelligence in Brussels in the late 1980s. Also presented here are self-portraits that **VALIE EXPORT**, **Anna Bella Geiger** and **Sonia Sheridan** made using the computer (in 1989, 1969 and 1985 respectively) and **Analívia Cordeiro**'s computer dance *M 3x3* (1973) in which the movements of the dancer and camera were synchronised by the computer. Finally, **Rebecca Allen**'s *Swimmer* (1981), was the first three-dimensional animation of a female body. Her earlier piece, *Girl Lifts Skirt* (1974) was intended as a humorous and confrontational riposte to the absence of female bodies and female perspectives in the digital sphere.

Collapsing social, economic and political realities with fiction, Haraway anticipated the cultural impact of technologies such as the internet, virtual reality and smartphones in subsequent decades in the image of the cyborg. She argued: 'The cyborg is a kind of disassembled and reassembled, post-modern collective and personal self. This is the self feminists must code.'

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I'm NO
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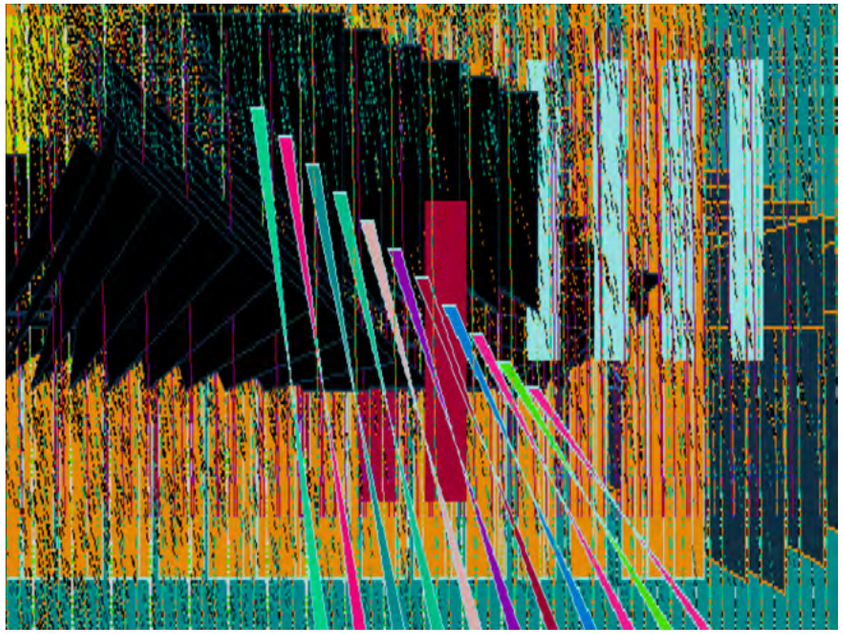
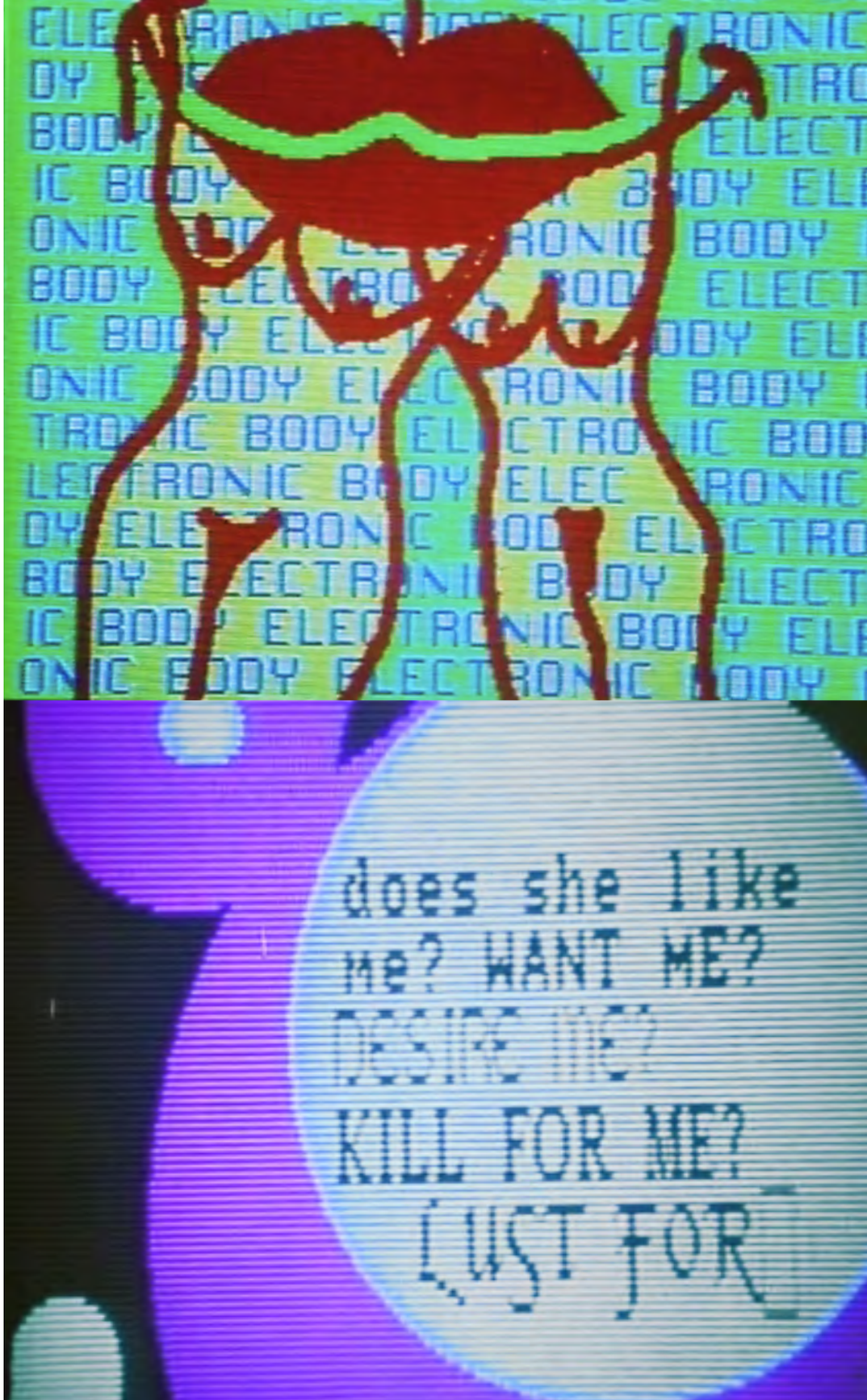



1983


does she like
me? WANT ME?
DESIRE ME?
KILL FOR ME?
LUST FOR


THE COMPUTER PLACE
LONDON ENGLAND

Radical Software: A Timeline*

1613 The first written use of the term ‘computer’ describes a person who performs mathematical calculations.

1843 Ada Lovelace translates L. F. Menabrea’s *Notions sur la machine analytique de M. Charles Babbage* into English, which describes the Analytical Engine Babbage conceived in 1834. Lovelace’s translation is accompanied by extensive notes in which she elaborates on the revolutionary potential of the machine. ‘Note G’ is subsequently referred to as the first algorithm written for a computer with Lovelace regarded as the first computer programmer.

1919 At University College London, computer Eleanor Pairman produces the first volume of *Tables of the Digamma and Trigamma Functions* for the *Tracts for Computers* series edited by mathematician Karl Pearson. The series is intended as a ‘textbook for the use of computers’.

1935 The US National Advisory Committee for Aeronautics (NACA) hires a group of five women to work as a computer pool at the Langley Memorial Aeronautical Laboratory. Virginia Tucker is among the first recruited. By 1946, she supervises a team that has trained around four hundred women as computers.

1942 Actor Hedy Lamarr and avant-garde composer George Antheil receive a patent for frequency hopping. The invention became fundamental to the subsequent development of Wi-Fi, Bluetooth and GPS technology.

1943 A set of computers known as the Colossus is developed by code-breakers at the British Government Code and Cypher School at Bletchley Park in Buckinghamshire. Seventy-five percent of the workforce are women.

Dorothy Hoover, Lessie Hunter, Kathaleen Land, Miriam D. Mann, Kathryn Peddrew and Dorothy Vaughan are the first African American women recruited by NACA to work as computers. Enforced segregation separates them from their white colleagues and they become known as the ‘West Area Computers’ (or ‘Colored Computers’).

1944 Mathematician and US Navy rear admiral Grace Hopper is assigned to work on the Mark I computer at Harvard University. Hopper writes the first computer manual, which is published in 1946 as *A Manual of Operation for the Automatic Sequence Controlled Calculator*, but receives only partial credit for her work.

It is estimated that about half of the computer workforce in the United States are women. One contractor of the Applied Mathematics Panel, a division of the National Defense Research Committee, uses the term ‘kilogirl’ to refer to one thousand hours of female computational labour.

1946 ENIAC (Electronic Numerical Integrator and Computer) becomes the first programmable, fully electronic general-purpose digital computer. A team of six women – Frances Bilas, Frances Elizabeth 'Betty' Holberton, Betty Jean Bartik, Ruth Lichterman, Kathleen 'Kay' McNulty and Marlyn Wescoff – program the machine. They become known as the 'ENIAC Six'.

1948 In the new Computation Centre at the University of Toronto Beatrice Worsley builds a differential analyser analogue computer using parts from the construction toy, Meccano.

1949 Worsley writes the program for the first calculation on the EDSAC (Electronic Delay Storage Automatic Calculator).

1951 Betty Holberton creates the Sort-Merge Generator for the UNIVAC (Universal Automatic Computer). It is one of the first instances where a computer is used to create a computer program. Holberton also persuaded the engineers at Eckert-Mauchly Computer Corporation to change the UNIVAC's exterior from black to beige, a colour that would define the first generation of desktop computers.

1960 Mathematician Katherine Johnson co-authors a paper on the calculations for placing a spacecraft in orbit. She is the first woman in her division to be credited as an author on a NASA report. Johnson co-authors a further twenty-five reports during her career.

Mathematician Melba Roy Mouton begins working at NASA. She heads a group of computers responsible for Project Echo, the first passive communications satellite experiment.

The CAB 500 (Calculatrice Automatique Binaire 500) is released by the SEA in France. Computer scientist Alice Recoque is part of the design team.

1961 The exhibition *nove tendencije* [New Tendencies] is presented at the Gallery of Contemporary Art in Zagreb. Over the next twelve years, computer art gradually becomes a prominent part of this series of exhibitions and symposiums.

In Hamburg, physicist Inge Borchardt is hired by DESY (Deutches Elektronen-Synchrotron) to program the analogue computer EAI 231R. She subsequently produces a series of drawings on the computer, which are exhibited in the Kleine Musikhalle in 1966.

1963 *The Feminine Mystique*, by writer and activist Betty Friedan, is published on 19 February, and subsequently becomes a bestseller. The book becomes a catalyst for second-wave feminism.

In May, the world's first exhibition of algorithmically generated computer art opens at the Spartan Bookstore of San Jose State University. It was organised by Joan Shogren, secretary of the Chemistry Department, together with assistant professor of chemistry Ralph James Fessenden and graduate student Jim Larson.

1964 At the University of Pittsburgh, choreographer Jeanne Hays Beaman and software designer Paul Le Vasseur program an IBM 7070 to create random choreographic sequences for dancers to interpret.

1965 Programmer Mary Allen Wilkes designs the software for the LINC (Laboratory Instrument Computer), a twelve-bit transistorised computer considered to be one of the earliest minicomputers.

The Museum of Modern Art, New York, presents *The Responsive Eye*. Comprising 123 works, the exhibition surveys recent developments in art, including op art and 'programmatic art'. A press release refers to artists speaking of their works as 'information' and their compositional arrangement as 'programming'. The list of ninety-nine artists includes Sue Fuller, Gego (Gertrud Goldschmidt), **Lily Greenham**, Agnes Martin, Bridget Riley and Clara Skinner.

Margaret Hamilton begins writing and testing software for the Apollo mission computers at the Massachusetts Institute of Technology Confidential Instrument Development Laboratory. During this time, Hamilton introduces the now widely used term 'software engineering' to 'legitimise software development as an engineering discipline'. NASA's Apollo Guidance Computer is eventually used by astronauts to land the Apollo 11 spaceflight mission on the moon in 1969.

1967 The April issue of *Cosmopolitan* magazine features the article 'The Computer Girls' illustrated with images of IBM Systems engineer Ann Richardson at work.

Fluxus artists **Alison Knowles** and Dick Higgins host a series of workshops on FORTRAN at their home in the Chelsea neighbourhood of Manhattan. Composer James Tenney leads the workshops for his hosts and artists including Jackson Mac Low, Max Neuhaus, Nam June Paik and Steve Reich.

Vera Molnár and artists who were previously part of GRAV (Groupe de Recherche d'Art Visuel) establish the group Art et Informatique at the Institut d'Esthétique et des Sciences de l'Art in Paris.

1968 A series of exhibitions address artists' experiments with computers:
On 2 August, *Cybernetic Serendipity: The Computer and the Arts* opens at the Institute of Contemporary Arts, London. Curated by Jasia Reichardt, it presents works by forty-three artists including Jeanne H. Beaman, **Alison Knowles** and **Ulla Wiggen**, as well as experiments by eighty-seven engineers, computer scientists and mathematicians.

On 3–4 August, *tendencije 4* opens with the first in a series of symposia titled 'Computers and Visual Research'. The event at the Museum of Contemporary Art in Zagreb is accompanied by four exhibitions where computer-generated works are presented alongside examples of constructive and kinetic art. The nove tendencije movement launches the journal *Bit International* the same year.

In November, *The Machine as Seen at the End of the Mechanical Age* (curated by Pontus Hultén) opens at the Museum of Modern Art, New York. **Lillian Schwartz** is one of five women included in a show of more than ninety artists. Through Leon Harmon, Schwartz gains an introduction to Bell Laboratories and begins to work with computers, producing her first computer-generated film the following year. Her collaboration with Bell Labs continues until 2002.

The Centro de Cálculo (Computation Centre) de la Universidad de Madrid acquires two IBM computers. Artists and scientists are encouraged to collaborate via a series of seminars and exhibitions. Soledad Sevilla and **Elena Asins** are among the artists attending.

1969 Gallerist Käthe Schröder curates *Computerkunst – On the Eve of Tomorrow* for Kubus Hannover, which opens in October. Eighteen artists and collectives are featured in an all-male artist list.

Jean E. Sammet's *Programming Languages: History and Fundamentals* is published. The book covers 120 programming languages and becomes a widely used and enduring resource.

The Groupe Art et Informatique de Vincennes (GAIV) is formed by members of the computer science, arts and music departments at the Centre universitaire de Vincennes, Paris. The founders of the group, architect Sonia Charalambides and artists Jean-Claude Halgand and **Hervé Huitric**, are joined by **Monique Nahas** and others later in the year.

1970 Computer-generated works are presented at the 35th Biennale di Venezia. Other significant exhibitions that year include *Information* at the Museum of Modern Art, New York (curated by Kynaston McShine), and *Software – Information Technology: Its New Meaning for Art* at the Jewish Museum, New York (curated by Jack Burnham). **Agnes Denes** and **Sonia Sheridan** are among the artists featured.

The first issue of the periodical *Radical Software* is published by **Beryl Korot**, Phyllis Gershuny (now Phyllis Segura) and Ira Schneider. Over the next four years, eleven issues are published.

Sonia Sheridan establishes the Generative Systems course at the School of the Art Institute of Chicago.

1971 The Intel 4004 becomes Intel's first central processing unit (CPU) and the first commercially produced microprocessor. Its underlying architecture is later attributed to an unnamed woman from Nara Women's University in Japan.

Jasia Reichardt publishes both *The Computer in Art* and *Cybernetics, Art and Ideas*. Herbert W. Franke's *Computergraphik – Computerkunst* is also published this year. It reproduces works by **Colette** and **Charles Jeffries Bangert**, Susan Casey, **Grace C. Hertlein**, **Alison Knowles**, **Ruth Leavitt**, **Vera Molnár** and **Lillian Schwartz** among others.

At Bell Laboratories, mathematician Erna Schneider Hoover is awarded a software patent for a computerised switching system for telephone calls to replace switchboards.

1972 *Computer Art* opens at the National Gallery of Modern Art at the Jaipur House in New Delhi. Organised in collaboration with IBM India, it comprises works by more than twenty European and American artists, including **Katherine Nash**.

At the Stanford Research Institute in Menlo Park, California, information scientist Elizabeth Jocelyn 'Jake' Feinler produces the *Resource Handbook* for the first demonstration of ARPANET (Advanced Research Projects Agency Network). Created by the US Department of Defense, this decentralised national network of computers, connected by telephone lines and used exclusively by the defence and scientific communities, becomes the technical foundation for the internet. In the following years, Feinler and her team create the WHOIS directory and develop the concept of simple-text file format domains based on the physical address of the computer. They oversee the Host Naming Registry until 1989.

Pamela Hardt-English negotiates the donation of an SDS-940 computer from TransAmerica Leasing Corporation to Project One, an informal community aspiring to 'make technology accessible to people'. This computer network connects San Francisco's countercultures, prefiguring the internet.

1973 The first *International Computer Arts Festival* is held at The Kitchen in New York in April. The programme includes computer-generated films by artists **Doris Chase** and **Lillian Schwartz** and a performance by **Alison Knowles**.

In June, *tendencije 5* is presented at the Gallery of Contemporary Art in Zagreb. The exhibition includes three sections devoted to constructive and computer visual research and conceptual art. The list of thirty-six artists includes **Grace C. Hertlein**, **Monique Nahas** and **Lillian Schwartz**.

In October, *Ordinateur et création artistique*, organised by the French computer company SESA (Software et engineering des systèmes d'informatique et d'automatique) is held at Espace Cardin in Paris, presenting works by members of the GAIV such as **Monique Nahas** and **Hervé Huitric** and by **Vera Molnár**.

1974 Jean E. Sammet serves as the first female president of the New York-based Association for Computing Machinery. She holds the position until 1976.

1975 The cover of the August issue of *Computers and People* (formerly *Computers and Automation*) reproduces an image by **Lillian Schwartz**. Edited by **Grace C. Hertlein**, the issue including the thirteenth annual computer art exhibition features the work of forty-one artists, including **Analívia Cordeiro**, Barbara Dwyer, **Hertlein**, **Ruth Leavitt**, **Vera Molnár**, **Monique Nahas**, Katy Owens and Soledad Sevilla.

The thirteenth issue of the French magazine *IBM-Informatique* focuses on the relationship between the visual arts and the computer. It includes contributions by **Grace C. Hertlein** and Jasia Reichardt, and is illustrated with works by **Vera Molnár**, **Monique Nahas**, **Sylvia Roubaud** and **Lillian Schwartz** among others.

1976 In February, the first issue of *Computer Graphics and Art*, the 'magazine of interdisciplinary computer graphics for graphics people and computer artists' is published. Edited by **Grace C. Hertlein**, twelve issues are produced until it ends in November 1978.

Artist **Ruth Leavitt** publishes *Artist and Computer*, featuring contributions from thirty-five artists including **Colette and Charles J. Bangert**, Karen Huff, **Vera Molnár**, Ann Murray, Patsy Scala and **Lillian Schwartz**.

1977 NASA launches its interstellar Voyager 1 mission with codes written by several women, including Barbara Paulson and Susan Finley.

1978 The Centre Pompidou, Paris, presents *Conception assistée par ordinateur* [Creation assisted by computer], an exhibition including works by **Monique Nahas** and **Vera Molnár** among others.

A team led by Gladys West demonstrates that satellites can be used to observe oceanic data while working on the US experiment, Seasat. Throughout the 1980s, West continues to program an IBM 7030 stretch computer to deliver increasingly accurate calculations for the earth's surface, which are ultimately used to determine the orbit of the Global Positioning System (GPS).

1979 The Centre culturel suédois in Paris presents works by **Monique Nahas** and **Vera Molnár** in the exhibition *L'artiste et l'ordinateur* [The Artist and the Computer].

Grace C. Hertlein, who works as an associate professor of computer science at California State University, Chico, opens a large exhibition of computer art *Cybernetic Symbiosis* at the Lawrence Hall of Science, University of California, Berkeley.

The first Ars Electronica festival, devoted to connections between art, technology and society, is held in Linz, Austria.

1980 Roberta Williams designs the video game *Mystery House*. Programmed by her husband, Ken Willams, it is one of the first video games to combine text and images.

1981 Darcy Gerbarg initiates the first art exhibition organised alongside SIGGRAPH's (Special Interest Group on Computer Graphics and Interactive Techniques) annual conference. Opening in August, *Computer Culture Art Show '81* includes works by **Rebecca Allen**, **Colette** and **Charles Jeffries Bangert**, Joanne P. Culver, Darcy Gerbarg, **Ruth Leavitt**, Laura Scholl, **Lillian Schwartz** and **Joan Truckenbrod**.

In Malmö, artists **Charlotte** and **Sture Johannesson** create the Digital Theatre, Scandinavia's first digital arts laboratory.

1982 Graphic designer Susan Kare produces a series of hand-drawn icons and typefaces for Apple Computer Inc..

Video game designer Carol Shaw develops *River Raid* for the Atari Video Computer System. It becomes one of the best-selling games of 1983.

1983 In January, *Time* magazine devotes its annual 'Man of the Year' issue to the personal computer, naming the PC the 'Machine of the Year'.

In December, the Musée d'art moderne de la Ville de Paris presents *Electra : L'électricité et l'électronique dans l'art au XX^e siècle* [Electra: Electricity and electronics in the art of the twentieth century]. Curated by Frank Popper, it includes computer-generated works by artists **Colette** and **Charles Jeffries Bangert**, **Hervé Huitric** and **Monique Nahas**, **Vera Molnár**, **Lillian Schwartz**, **Sonia Sheridan**, **Joan Truckenbrod** and Jane Veeder among others.

1984 In January, the WISE (Women into Science and Engineering) campaign is established in the United Kingdom to encourage women to study science and engineering.

Apple Computer Inc. releases the first Macintosh computer with Susan Kare's iconic graphic user interface.

Joan Shogren, Dennis Fregger and Mike Mathis design the first computer clip art. It is released for Macintosh computers under the brand ClickArt.

1985 Commodore International releases the first Amiga personal computer. Andy Warhol appears onstage at the launch at Lincoln Center in New York to demonstrate its ProPaint program by making a live portrait of Debbie Harry.

The first ARM (Advanced RISC Machines) processor, co-designed by computer scientist Sophie Wilson, is produced. Developed by Acorn Computers, it is used in ninety-five percent of smartphones by 2012.

The Connection Machine CM-1, developed by the Thinking Machines Corporation, becomes the first commercial supercomputer. Artist **Tamiko Thiel**, then a recent graduate with a degree in mechanical engineering, leads the design teams of the CM-1 and CM-2 (1987).

'A Cyborg Manifesto' by Donna Haraway is first published in the *Socialist Review*.

1986 Judith Malloy produces *Bad Information*, inviting users of the WELL virtual community to contribute entries to an interactive database.

Rebecca Allen creates 3D graphic sequences for Kraftwerk's 'Musique Non Stop' music video.

1987 Computer scientist Anita Borg creates Systers, an international electronic mailing list for women involved in technical aspects of computing. It is the first worldwide community for women working in the field of computer science.

1990 In September, the exhibition *Information Art: Diagramming Microchips* opens at the Museum of Modern Art, New York.

1991 The process to make the World Wide Web accessible to the public begins.

Artist collective VNS Matrix is founded in Adelaide, Australia, by Josephine Starrs, Julianne Pierce, Francesca da Rimini and Virginia Barratt. They circulate the text 'A Cyberfeminst Manifesto for the 21st Century' both in print and online. It is one of the first uses of the term 'cyberfeminism'.

* A more comprehensive timeline is available in the exhibition catalogue.

Public programme

Curator tour

30.10.2024 | 18:00 – 18:45 | FR
04.12.2024 | 18:00 – 18:45 | EN
With Sarah Beaumont

Lunchtime at Mudam

27.09.2024 | 12:30 – 13:30
01.11.2024 | 12:30 – 13:30

Overwrite, decode, collectivise Mudam Talk with Sylvia Eckermann and Viviane Kübler

13.11.2024 | 18:30 – 20:00 | EN

2×2 Dialogues: Radical Software

30.11.2024 | 14:00 – 16:00
In collaboration with Mir wëllen iech ons Heemecht weisen asbl

Pixel Weavers

12.12.2024 | 14:30 – 16:30 | Age 6-12
31.12.2024 | 14:30 – 16:30 | Age 6-12

Drop in! Videowave

26.10 – 03.11.2024 | 10:00 – 18:00
Every working day during the holidays
Every weekend between school holidays | 10:00 – 18:00

21.12.2024 – 05.01.2025 | 10:00 – 18:00
Every working day during the Christmas holidays

Performance *Shoe Field: Our Fate is on Our Shoes*

29.01.2025 | 18:00 – 21:00
01 + 02.02.2025 | 10:00 – 18:00

Images

Cover

Lillian F. Schwartz at Bell Laboratories, Murray Hill, New Jersey, 1974
© 2024 The Henry Ford

Inside cover

VALIE EXPORT, *Stand Up. Sit Down* (detail), 1989
Courtesy of the artist

Image pages

Monique Nahas, *Cubes*, 1973
Courtesy of the ZKM – Zentrum für Kunst und Medien Karlsruhe

Sylvia Roubaud, *Connection of points by arc sequences*, 1972
Courtesy of the artist | Photo: Franz Kimmel | ADAGP, Paris, 2024

Katalin Ladik, *Genesis 01*, 1975
Courtesy of the acb Gallery of Contemporary Art, Budapest

Charlotte Johannesson, *I'm NO ANGEL*, 1972–73/2017
Courtesy of the artist and Hollybush Gardens, London | Photo: Andy Keate

Dara Birnbaum, *Pop-Pop Video: Kojak/Wang*, 1980
Courtesy of Dara Birnbaum and Electronic Arts Intermix (EAI), New York

Samia Hallaby, *Bird Dog 6*, 1987
Courtesy of the artist and Sfeir Semler Gallery, Beirut & Hamburg

Charlotte Johannesson, *Untitled*, 1981–85
Courtesy of the artist and Hollybush Gardens, London

Sonya Rapoport, *Shoe-Field Printouts: Folio Five, Page 2*, 1986
Courtesy of the Estate of Sonya Rapoport

Barbara Hammer, *No No Nooky T.V.*, 1987
Courtesy of the Estate of Barbara Hammer and KOW, Berlin

Anna Bella Geiger, *Self-Portrait*, 1969
Courtesy of the artist and Mendes Wood DM, São Paulo, Brussels, Paris, New York
© Photo: Pauline Assathiany

Sonia Sheridan, *Sonia in Time*, 1985
Courtesy of the Daniel Langlois Foundation Collection of the Cinémathèque Québécoise Sonia Landy Sheridan fonds

Lynn Hershman Leeson, *Self Portait as Another Person*, 1965
Private collection
Courtesy of the artist; Altman Siegel, San Francisco and Bridget Donahue, New York

Mudam Team

Pascal Aubert, Sarah Beaumont, Sandra Biwer, Geoffroy Braibant, David Celli, Alice Champion, Diane Durinck, Zuzana Fabianova, Clarisse Fahrtmann, Marie-Noëlle Farcy, Paula Fernandes, Clara Froumenty, Christophe Gallois, Jordan Gerber, Richard Goedert, Matthias Heitbrink, Christine Henry, Juliette Hesse, Olivier Hoffmann, Camille d'Huart, Julie Jephos, Germain Kerschen, Yousra Khalis, Julie Kohn, Clara Kremer, Deborah Lambolez, Laurence Le Gal, Vanessa Lecomte, Nathalie Lesure, Carine Lilliu, Ioanna Madenoglu, Frédéric Maraud, Tawfik Matine El Din, António Mendes, Laura Mescolini, Mélanie Meyer, Barbara Neiseler, Florence Ostende, Markus Pilgram, Clémentine Proby, Boris Reiland, Susana Rodrigues, Alexandre Sequeira, Pedro Serrano, Elodie Simonian, Lourindo Soares, Bettina Steinbrügge, Vere Van Gool, Sam Wirtz, Ana Wiscour.

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Luxemburger Wort

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