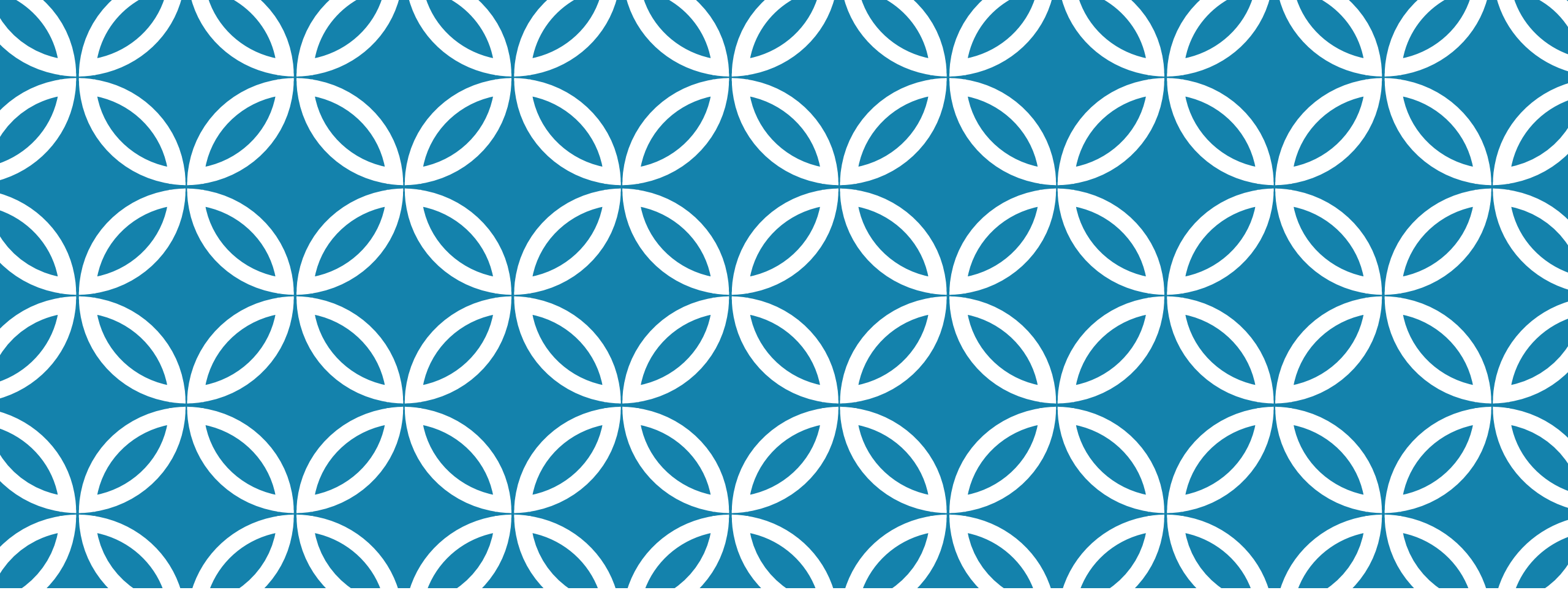


A HISTORY OF AI

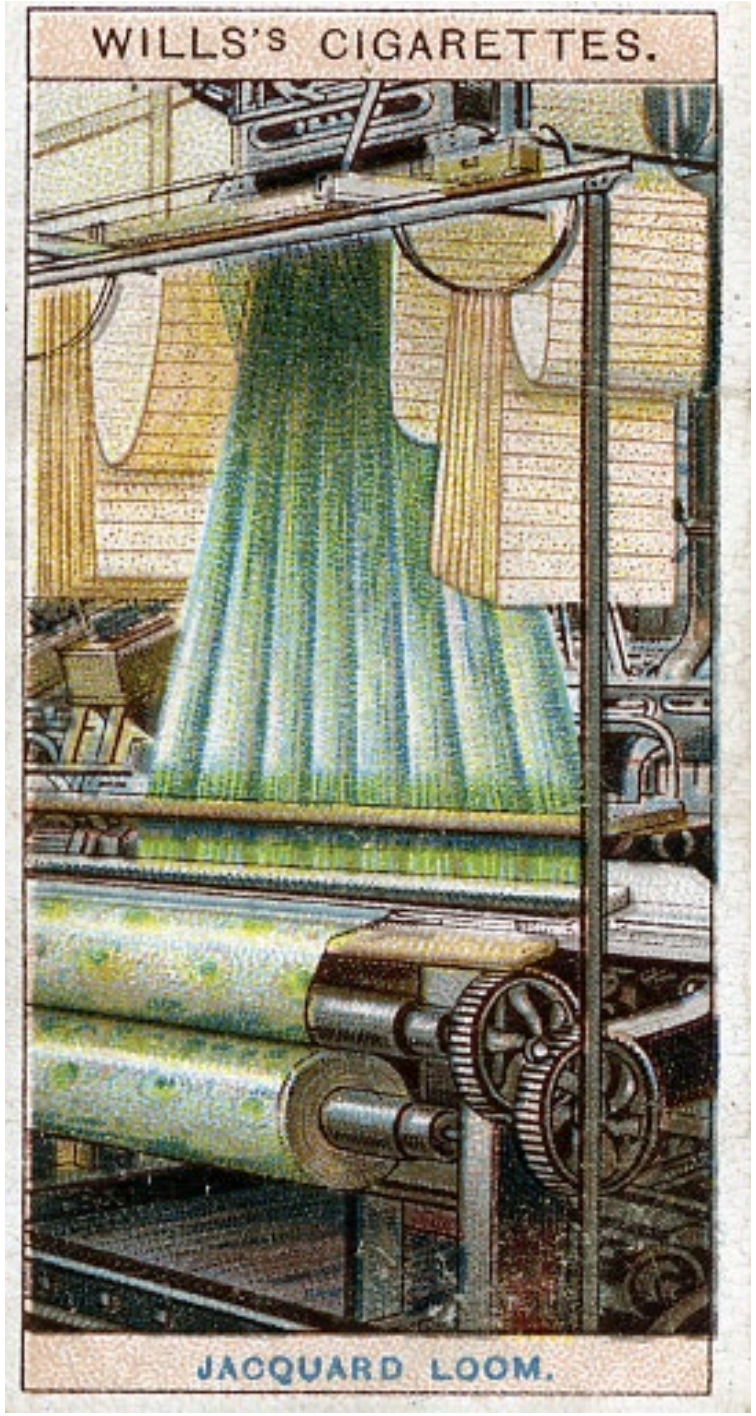
Trenton Computer Festival 2025
William Degnan
Kennett Classic
social@kennettclassic.com

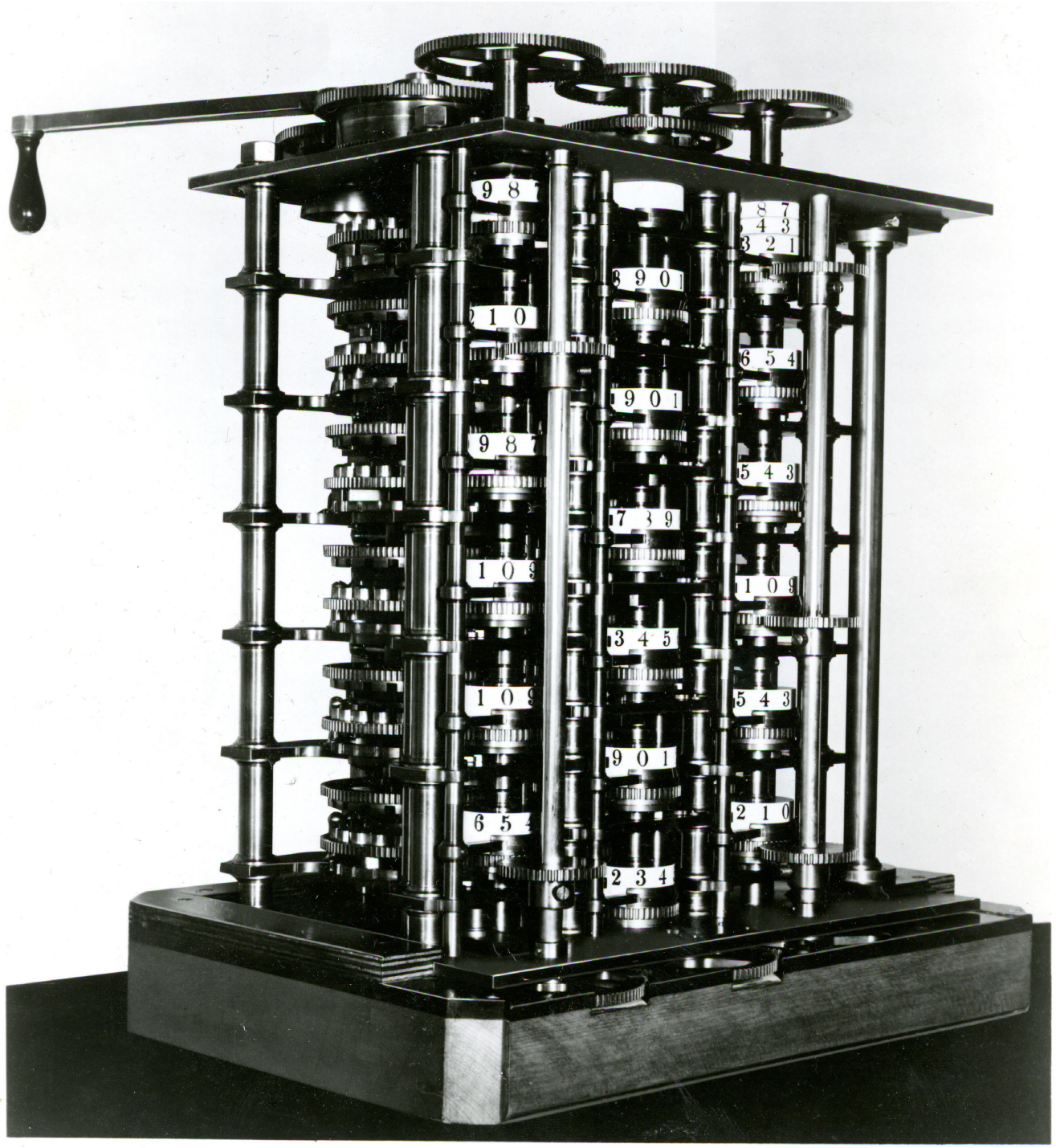
AUTOMATIC MACHINE TOOLS

- A machine that decides for itself when to start and when to stop
- Thermostats and sensors
- Mechanical Counters and Calculators

Jacquard machine

The machine was patented by Joseph Marie Jacquard 1804 controlled by a "chain of cards"; a number of punched cards laced together into a continuous sequence. Multiple rows of holes were punched on each card, with one complete card corresponding to one row of the design.



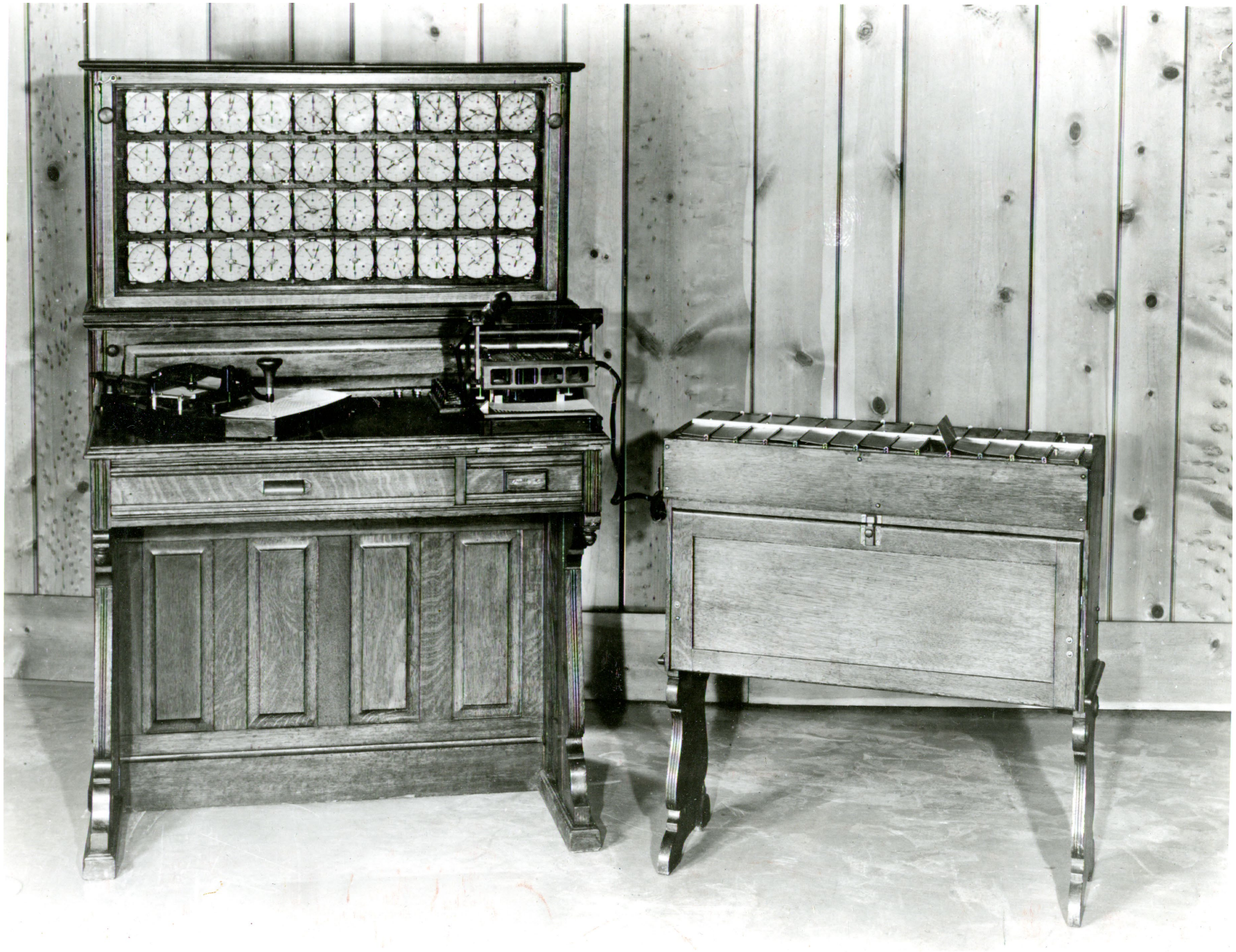


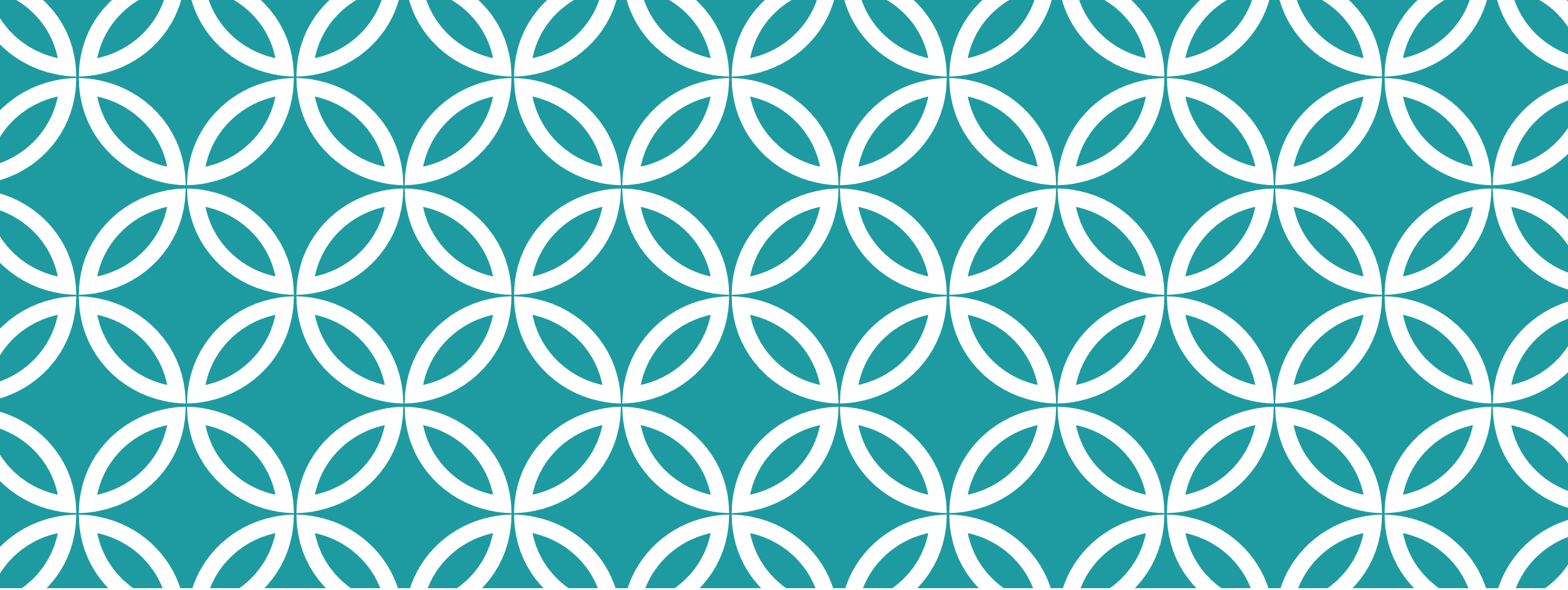
In 1833 Charles Babbage conceived and invented his "Difference Engine" (pictured to the left). He continued work on an "analytical engine" – The first automatic digital computer, but as with many modern-era computing projects he ran out of money and the project was cancelled.

In consequence of this the whole question of making an automaton play any game depended upon the possibility of the machine being able to represent all the myriads of combinations relating to it. Allowing one hundred moves on each side for the longest game at chess, I found that the combination involved in the Analytical Engine enormously surpassed any required, even by the game of chess.

As soon as I arrived at this conclusion I commenced an examination of a game called "tit-tat-to," . . . . I ascertained what number of combinations were required for all the possible variety of moves and situations. I found this to be comparatively insignificant. I therefore easily sketched out mechanisms by which such an automaton might be guided . . . . A difficulty, however, arose of a novel kind . . . . When the automaton had to move, it might occur that there were two different moves, equally conducive to his winning the game. In this case no reason existed within the machine to direct his choice: unless, also, some provision were made, the machine would attempt two contradictory motions.

The first remedy I devised for this defect was to make the machine keep a record of the number of games it had won from the commencement of its existence. Whenever two moves, which we may call A and B, were equally conducive to winning the game, the automaton was made to consult the record of the number of games he had won. If that number happened to be even, he was directed to take course A; if it were odd, he was to take course B.





SYMBOLIC REASONING

- Human-readable representations of problems
- LOGIC-based rules
- Electronic Computing vs. Analog Computing

ALAN M. TURING

1950 paper “Computing Machines and Intelligence”

Turing’s Test: “a properly qualified human observer is unable to separate, with more than chance success, the protocols produces by the computer programs from those produced by the humans.”

Halting Problem – Turing identified one important job of the program is to know when it’s done and the answer has been supplied.

Turing’s paper posed the question – “Can machines think?”

NEURAL NETWORKS - 1943

“A Logical Calculus of the ideas Imminent in Nervous Activity” Warren McCulloch (neuroscientist) and Walter Pitts (Logic/Mathmetician) combined to study neurons and how they work together in the brain.

Inputs fed into "preprocessors," they called “association units”. These units are designed to look for certain things

Neural networks were studied to perform pattern recognition

HEURISTICS

In simple terms, HEURISTICS are rules of thumb, shortcuts humans use to help narrow down the solution to problems, make decisions and make appropriate selections

Herbert Simon and Allan Newell researchers into the subject of heuristics as they might be applied by a computer to solve problems efficiently and thus simulate human intelligence.

Search Trees – or ad hoc rules used to solve a problem. In the case of the computer by use of logic gates (OR, AND, NOR, XOR…)

Randomness

Randomness is fundamental aspect of nature. The question arises, how does an artificial intelligence approximate randomness? How is randomness applied?

Heisenberg Uncertainty Principle

Homeostat 1949 – Binary Logic

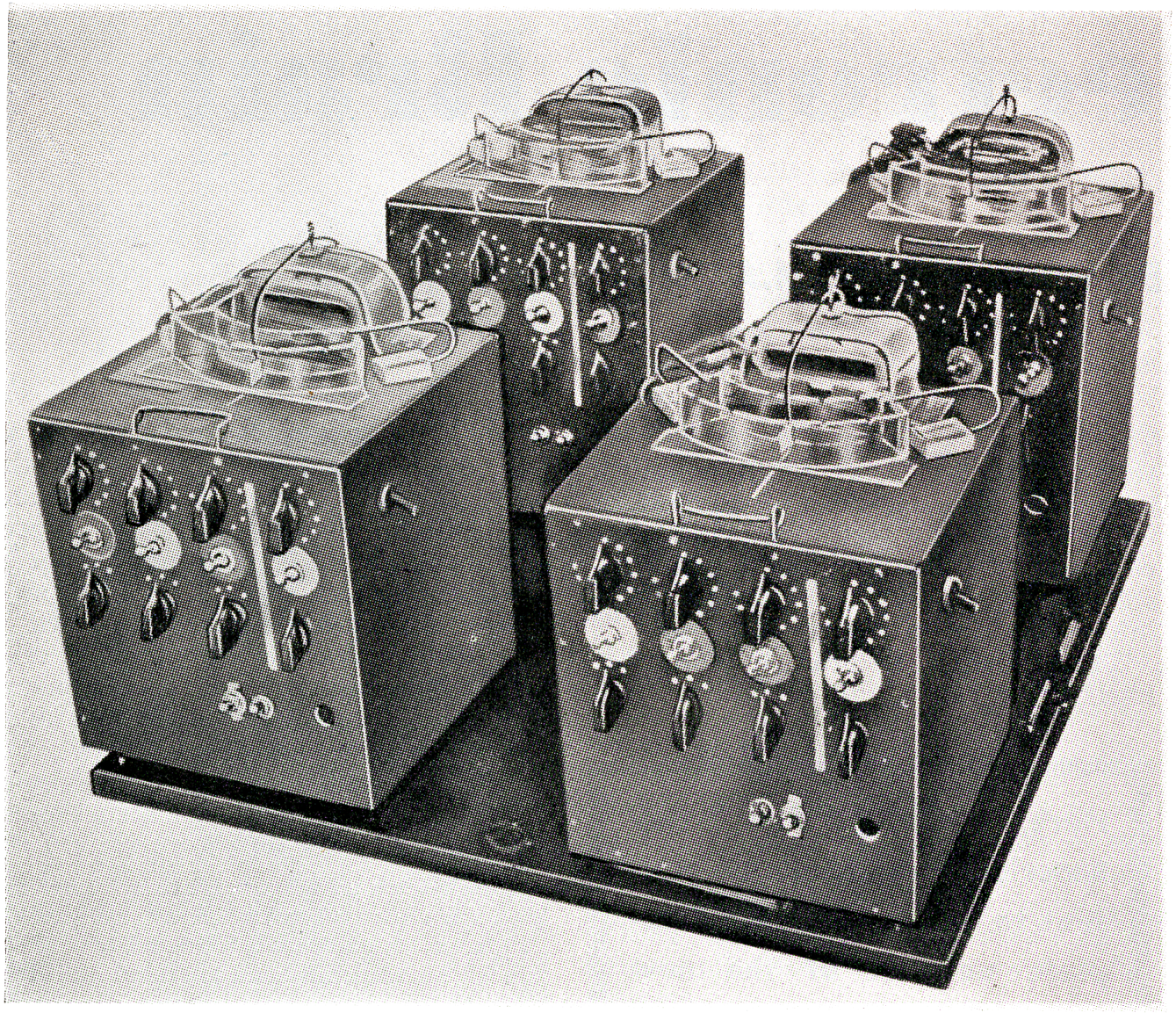


Fig. 1—The homeostat, with its four units, each one of which reacts on all the others.

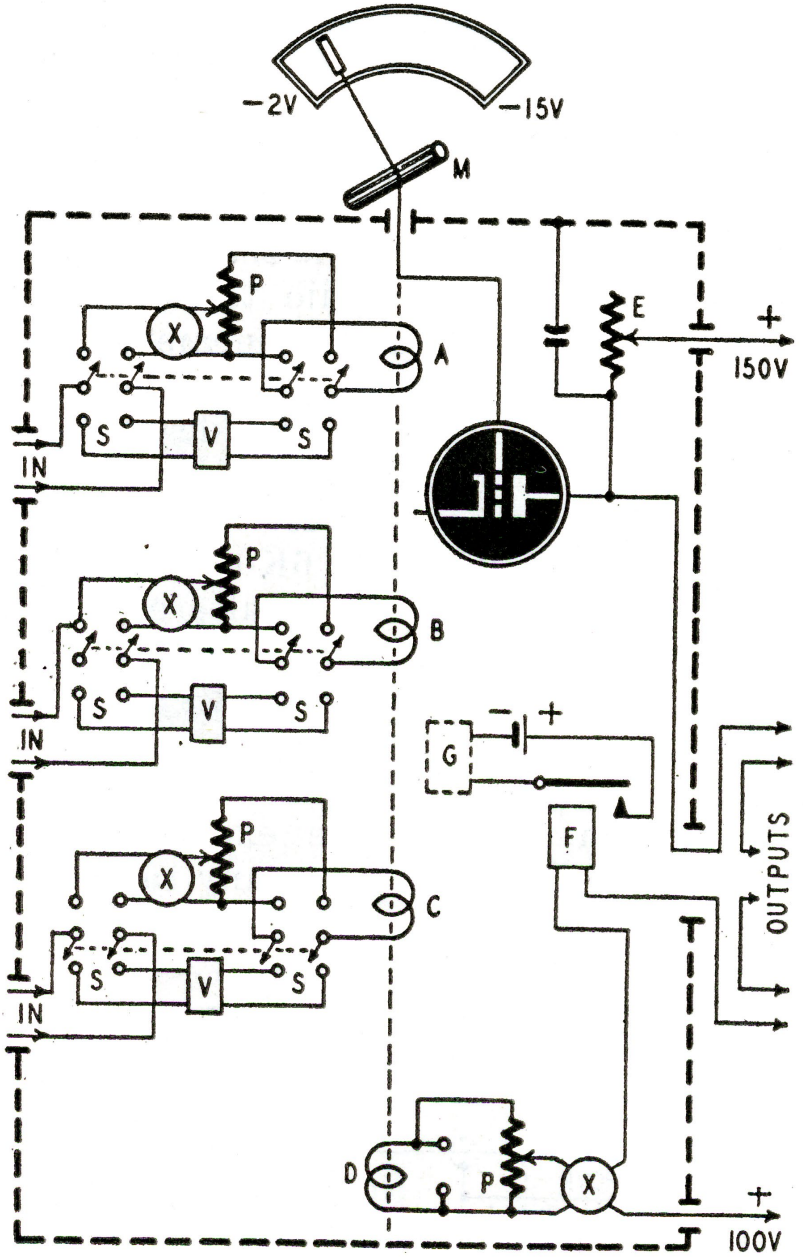


Fig. 3—Schematic diagram of the homeostat.

THE COMPUTER PROGRAM – SYMBOLIC LOGIC

Computer was invented to do arithmetic rapidly but early pioneers saw the potential of computers to process SYMBOLS that could be used in problem solving.

Artificial "thinking" by use of a computer program can produce sufficient results, not perfect, but begin to touch upon simulation of human thought

Elementary information processing combined into long branching sequences to generate more complex results.

Analog computers - one complex program at a time

Electronic computers are designed to accept instructions from a set of rules (instruction set) built into the computer

Analog Computers

Analog computers handle information as a measure of physical quantities (voltage pulses over time, etc)

World's Smallest Electric Brain

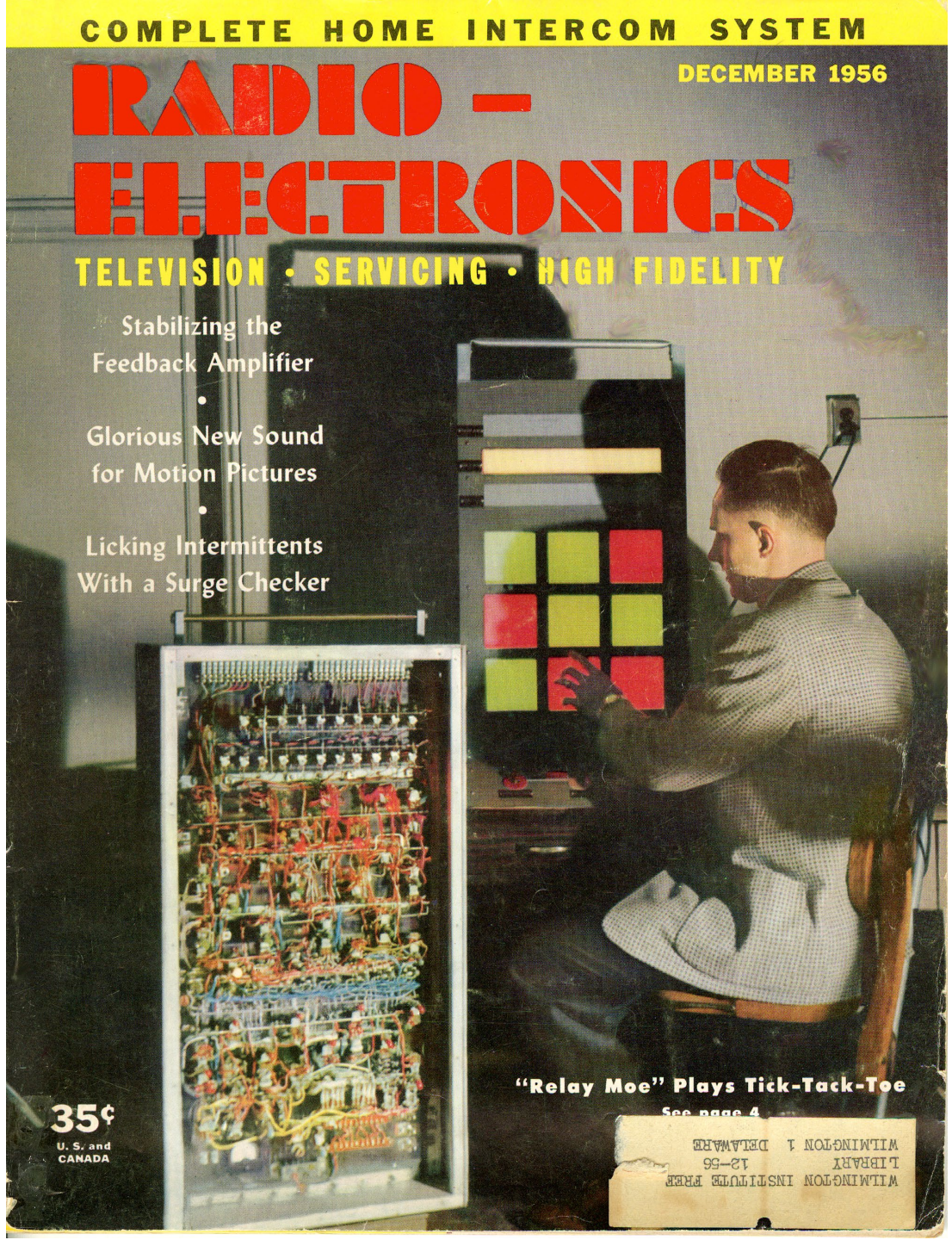
E. C. Berkeley explains how Simon gets instructions from a piece of punched tape.

By EDMUND C. BERKELEY* and ROBERT A. JENSEN

ON THE COVER of this issue of RADIO-ELECTRONICS is a picture of the smallest existing, complete electric brain. This midget electric brain is named Simon, in honor of Simple Simon of Mother Goose fame. He can be called electric or mechanical for he uses relays; but not electronic, for he does not use a single electron tube. Nevertheless he illustrates in solid hardware the principles of all the giant artificial

Part I of a series of articles outlining principles and describing construction of electric and electronic computing devices

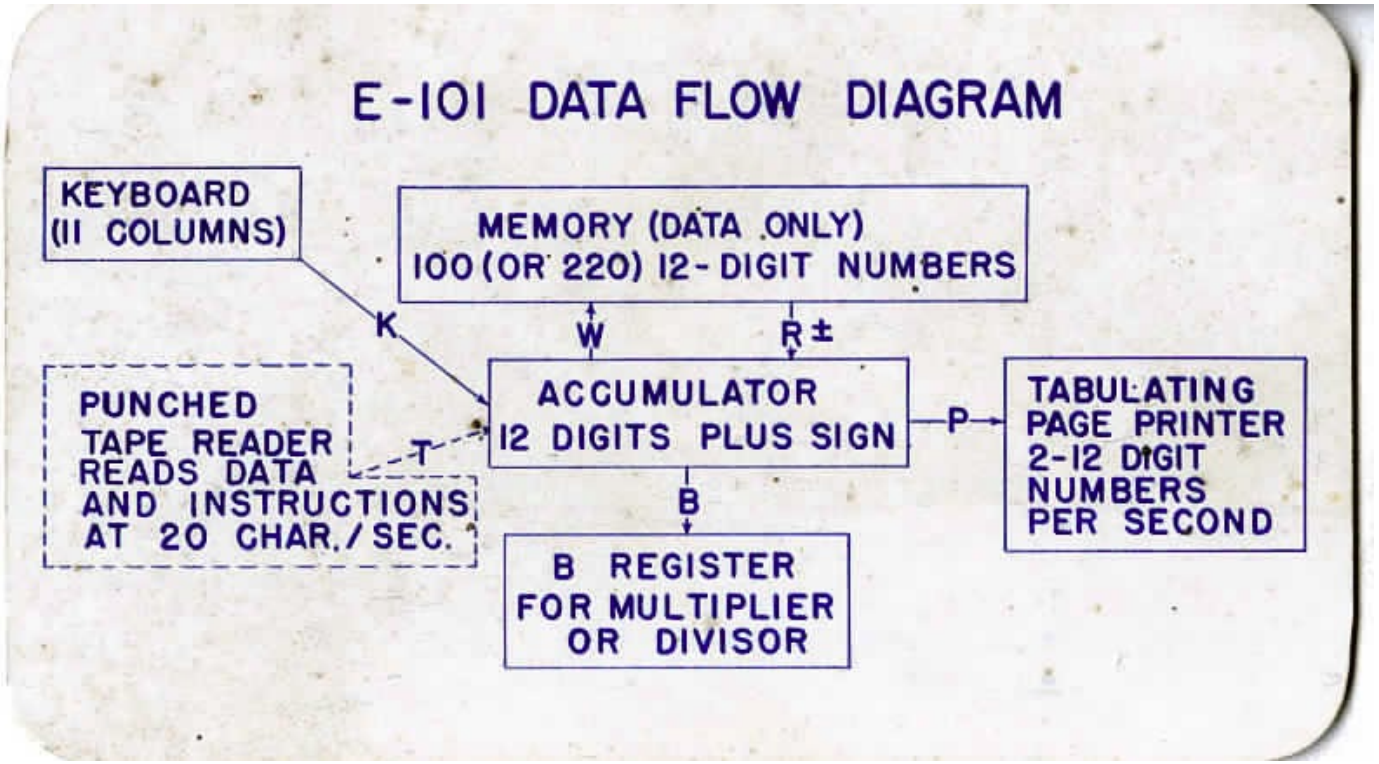
1950

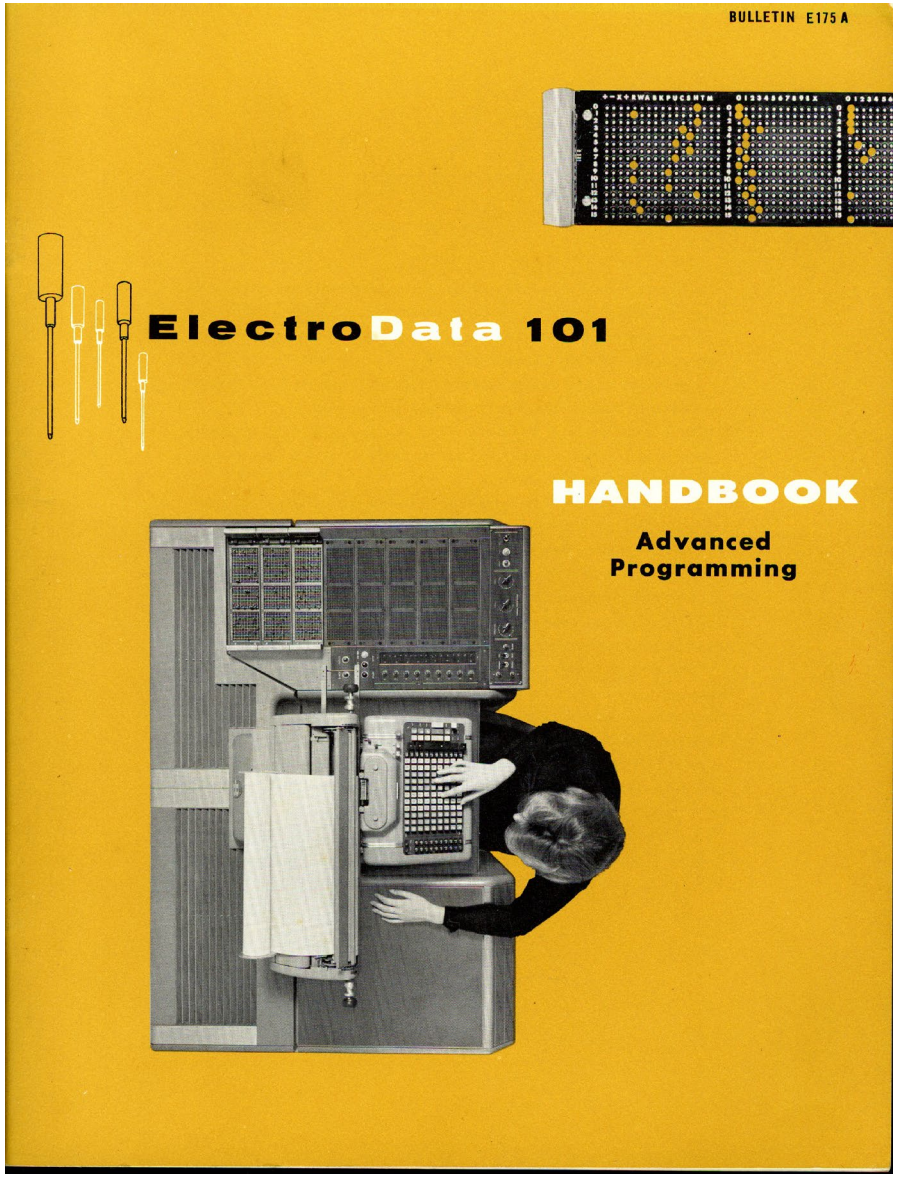


"Relay Moe" Plays Tick_Tack-Toe - 1956

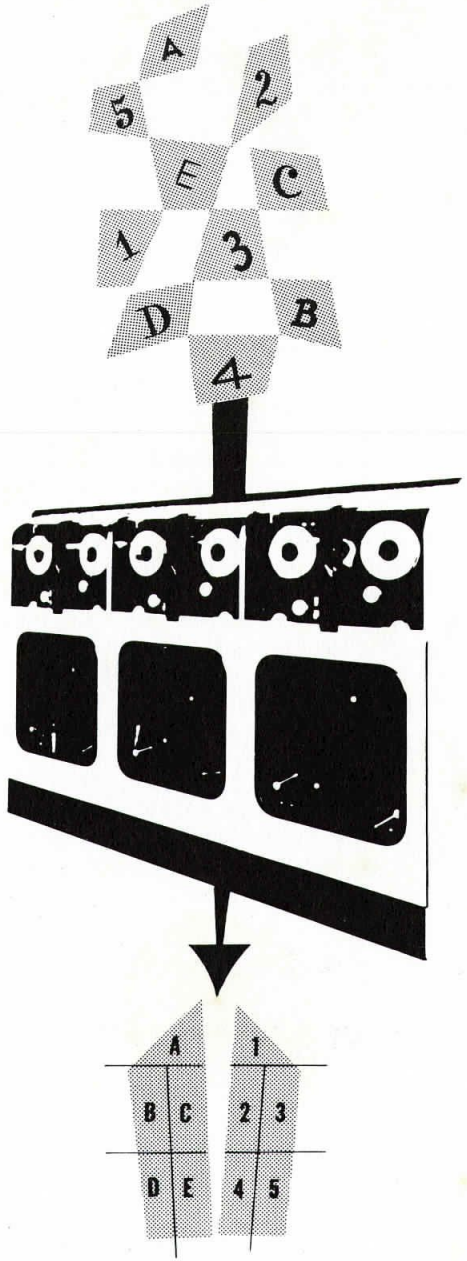
Electronic (digital) Computers

Digital means handling information as characters or digits, in the way the fingers of one hand can express the numbers 0,1,2,3,4,5.





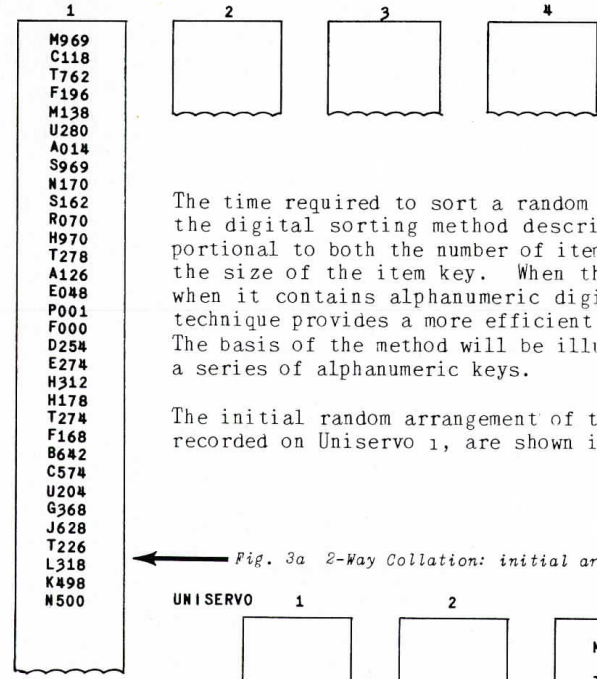
UNIVAC
1951



sorting methods for univac system

Remington Rand

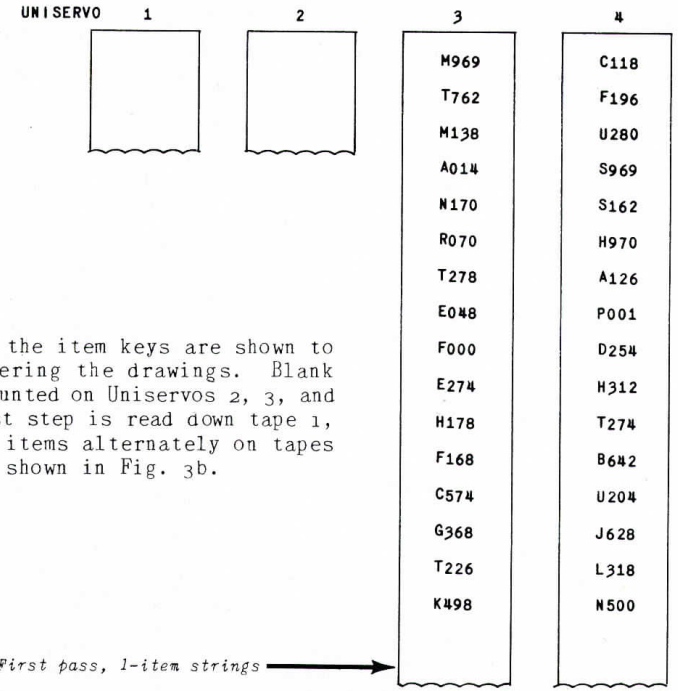
UNISERVO:



The time required to sort a random series of items by the digital sorting method described above is proportional to both the number of items to be sorted and the size of the item key. When the key is large or when it contains alphanumeric digits, the collation technique provides a more efficient method of sorting. The basis of the method will be illustrated by sorting a series of alphanumeric keys.

The initial random arrangement of the input items, as recorded on Uniservo 1, are shown in Fig. 3a.

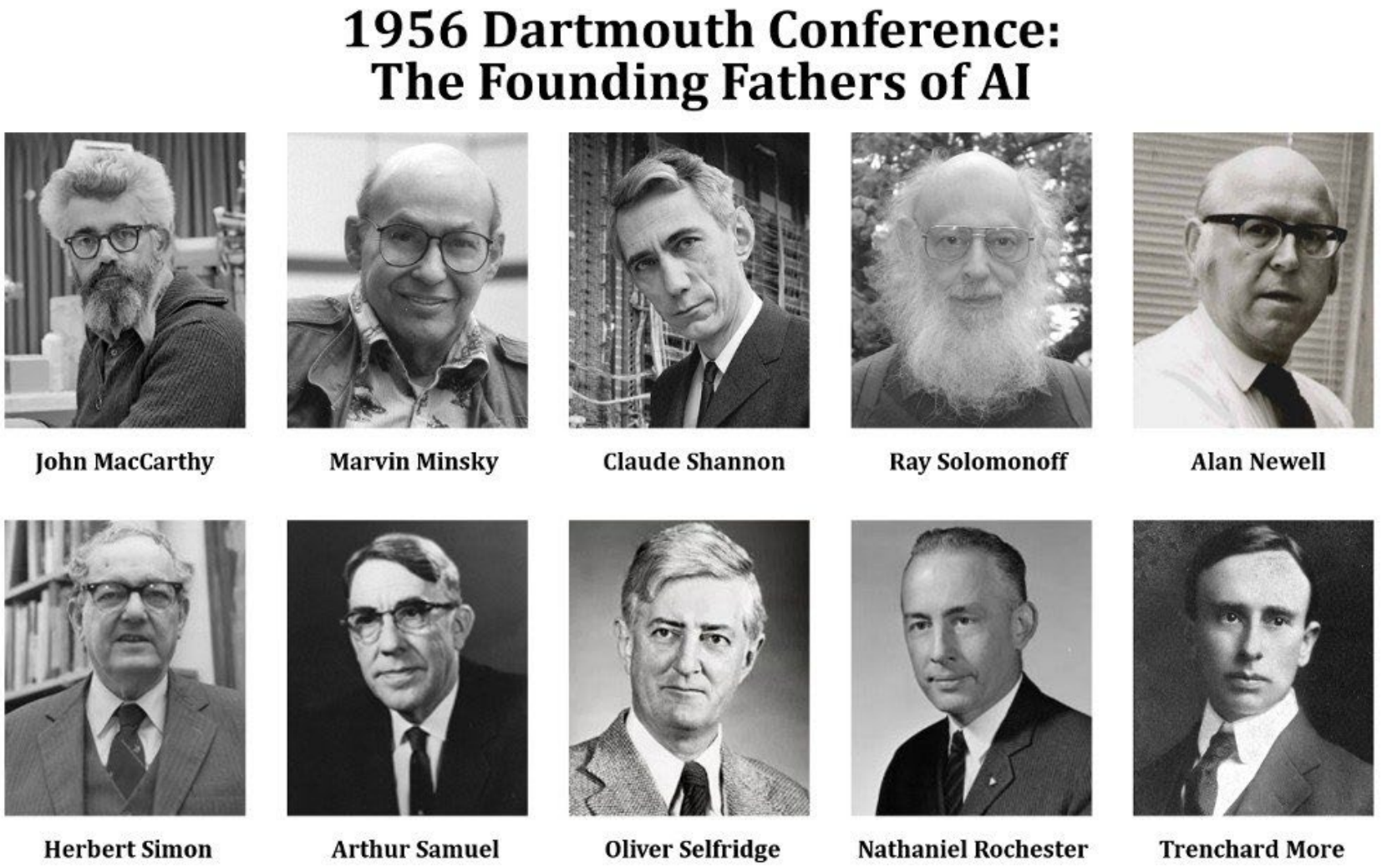
Fig. 3a 2-Way Collation: initial arrangement of items



Again, only the item keys are shown to avoid cluttering the drawings. Blank tapes are mounted on Uniservos 2, 3, and 4. The first step is read down tape 1, writing the items alternately on tapes 3 and 4, as shown in Fig. 3b.

Fig. 3b First pass, 1-item strings

IBM 650 Computer



AI Workshop – 1956
Dartmouth College
Founded by John McCarthy

Very early if not the first use of the term “Artificial Intelligence” to mean the science and engineering of making machines intelligent.

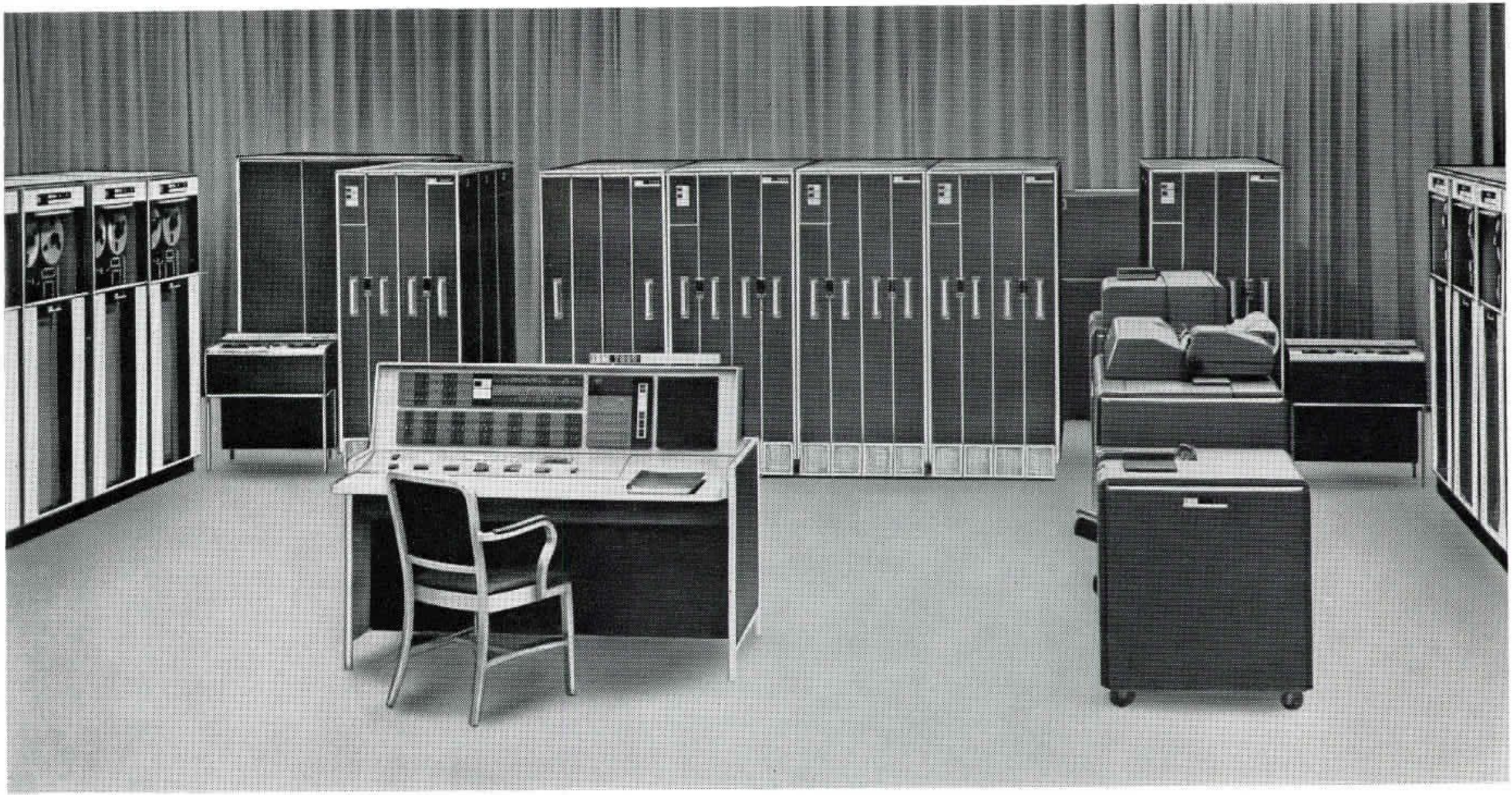
EXAMPLES OF EARLY ARTIFICIAL INTELLIGENCE COMPUTING

A Program for Musical Composition – 1956. Hiller and Isascson at the University of Illinois programmed the ILLIAC computer to compose music. **ILLIAC had 2800 vacuum tubes and weighed 5 tons**

The Logic Theorist – 1956. J.C. Shaw (RAND Corp) programmed the JOHNNIAC to discover proofs for theorems in the Principia Mathmatica of Whitehead and Russell. 70% score chapt 2

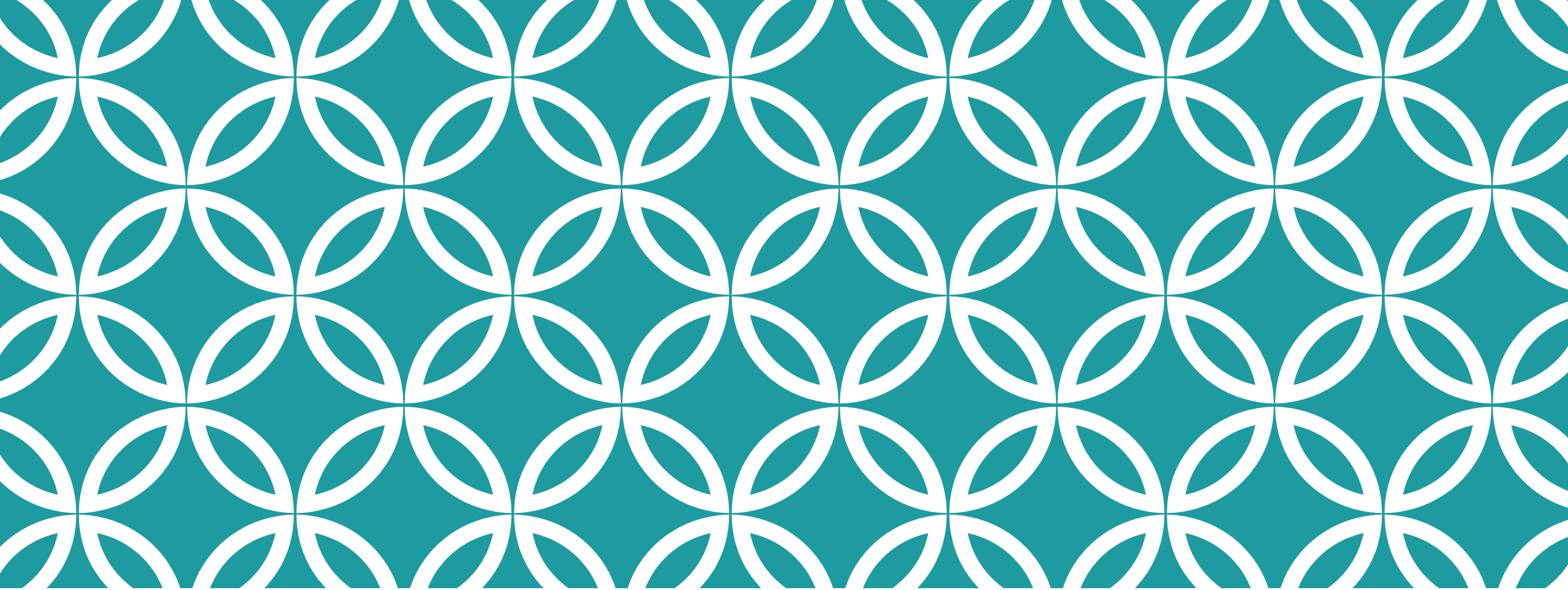
Game Playing Program – Checkers computer not able to win consistently

The General Problem Solver – 1957-1958. Theoretical, attempt to pass Turing's tests, used heuristic rules-based logic.



IBM 7090 Data Processing System

1959



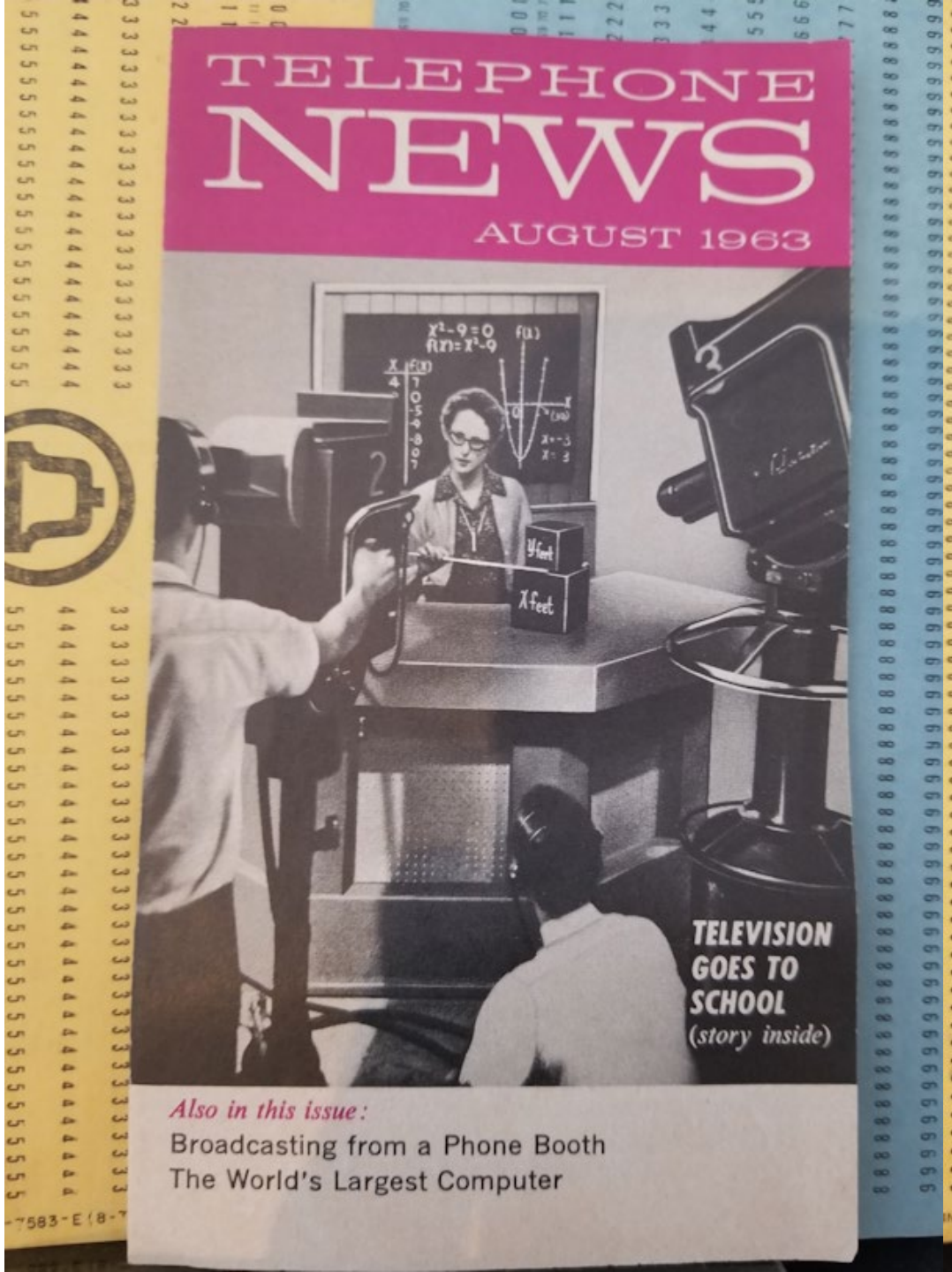
EXPERT SYSTEMS (FIRST GEN)

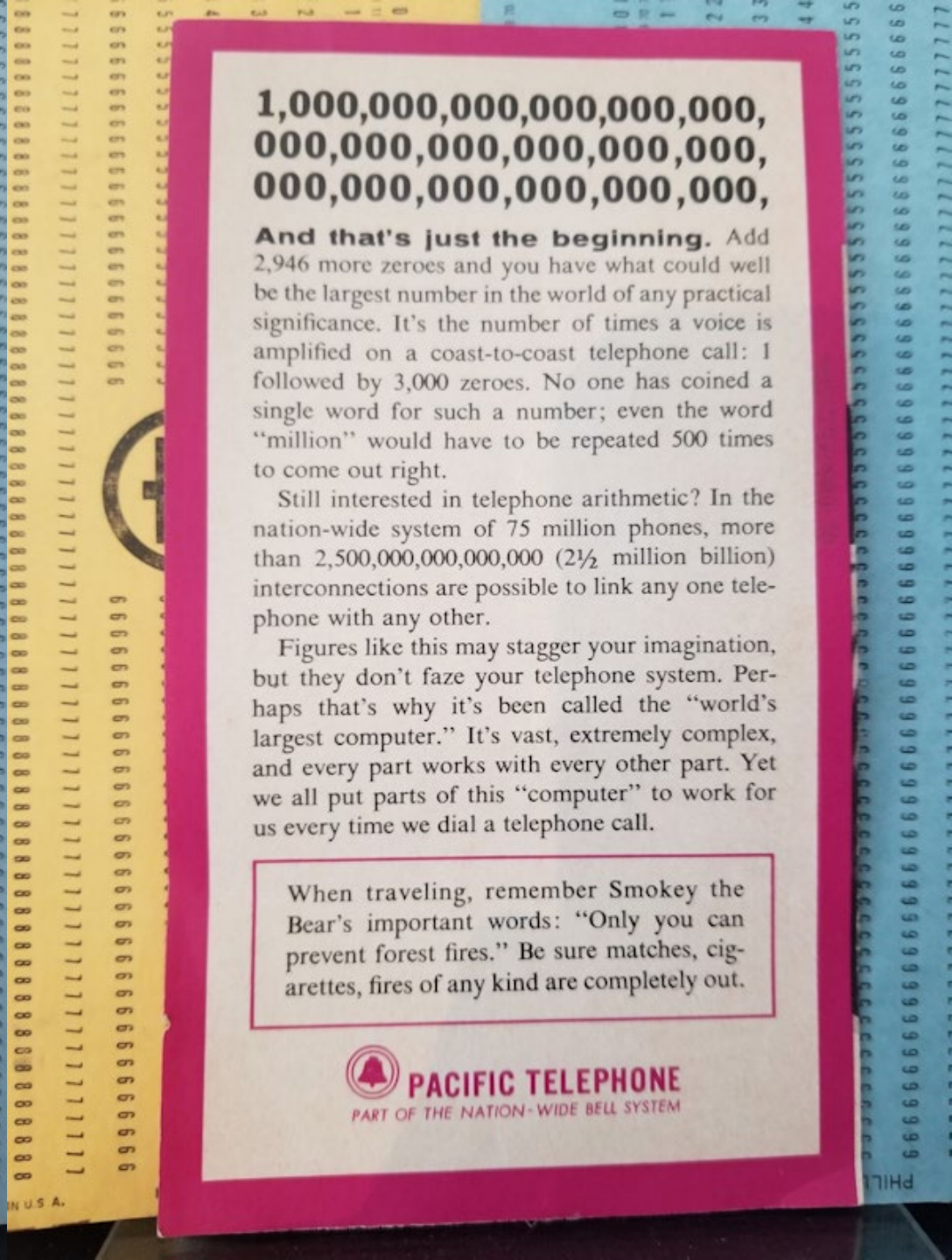
Rules Based Logic (i.e. IF THEN Rules in Programming)
Required human interaction / input.
Not fully autonomous

1963

Pacific Telephone claims the telephone system is **"the world's largest computer"** due to the number and nature of its network connections.

Agree?





LEADING PROGRAMMING LANGUAGES OF THE MID-1960S

COBOL (Common Business-Oriented Language) Used for business applications, data processing, financial industry.

FORTRAN (Formula Translation) Used for scientific and mathematical applications

ASSEMBLER (Assembly Language) Used for low-level programming, which was important for memory conservation and speed

ALGOL (Arithmetic Language) Used for algorithmic and academic applications that benefit from block structures (precursor to C, etc.)

PL/1 (Program Language 1) IBM language taking the best of Cobol and Fortran

RPG (Report Program Generator) IBM Reporting language

LISP **What about LISP?** Not as widespread not practical

LISP (LIST PROCESSING)

John McCarthy developed this language in 1958 at MIT

Created specifically to perform iterative list processing for artificial intelligence development and research.

Highly specialized for symbolic processing, Complex language, not business-friendly

Memory and Processor-intensive, not all mainframes could run it early on. Used in time-sharing systems / real time systems

More popular in later 60s-1980s as hardware capabilities improved

LISP Machines by Symbolics, LMI, and Xerox for AI-related apps.

IBM 360
Market Leader mid-60's

IBM

SYSTEM/360 MODEL 44 CONFIGURATION
(ALTERNATE)

MACH.	MOD/SF	DESCRIPTION	QTY	% PO	MONTHLY RENTAL	PURCHASE	MMMC
2044	F	CPU - 65,536 bytes	1	60	$ 4,805	$174,310	$220.00
	2251	Console Ptr. Chan. Attachment	1		NC	NC	NC
	3621	Emer. Power-Off Control	1		NC	NC	NC
	4427	Float. Point Arith.	1		283	11,200	11.00
	4598	High Sp. Mplx. Chan.	1		670	26,480	29.25
	4560	High Sp. Mplx. Sub-Channel	1		129	5,090	6.00
	5248	Multiplexer Channel	1		360	14,240	17.75
	7500	Single Disk Storage Channel Attachment	1		NC	NC	NC
2821	1	Control Unit	1	55	1,000	45,100	41.00
2540	1	Card Read Punch 1000/300 CPM	1	45	680	33,950	115.00
1403	2	Printer 600 LPM	1	45	775	34,000	177.00
2841	1	Storage Control	1	45	540	26,430	56.00
2311	1	Disk Storage	2	55	1,180	51,020	110.00
2803	1	Tape Cont'l Unit	1	55	670	31,620	20.00
	7125	7-Track Compat.	1		51	2,330	1.25
	3228	Data Conversion	1		46	2,100	1.00
2401	1	Mag. Tape Drive-30KB	1	45	345	15,620	62.00
		TOTAL			$11,534	$473,490	$867.25
MAIN STREET TERMINAL (OPTIONAL)							
2701	1	Data Adapter Unit	1	50	$ 206	$ 9,410	$ 15.00
	7698	Synch. Data Adpt. Type II	1		310	13,950	19.00
2780	1	Data Tran. Term.	1	35	900	39,600	215.00
	5010	Mult. Record Tran.	1		15	660	2.00
	5020	Mult. Pt. Line Cont.	1		25	1,100	2.50
	5800	Ptr. Format Control	1		30	925	1.00
		TOTAL			$ 1,486	$ 65,645	$254.50
		TOTAL MODEL 44 SYSTEM WITH 2780			$13,020	$539,135	$1121.75

IBM 360/44

Typical Acquisition Options:
$13,000 / month
$539,135 / purchase

65, 636 Bytes
30Mb Storage

ELIZA (1964-67)

IBM 7094

Early Natural Language Processing Computer Program written in MAD-SLIP (LISP var.)

Invented at MIT by Joseph Weizenbaum

Simulated conversation using heuristic rules of a therapist - CHATBOT

Layering and abstraction as a means of achieving sophisticated software programming

Red= Patient, Black=ELIZA

Here is a sample run:

? I CAN'T SLEEP
HOW DO YOU KNOW YOU CAN'T SLEEP
? BECAUSE I DO NOT FEEL RESTED WHEN I WAKE UP
WHY DO YOU ASK?
? WHY DO I ASK WHAT?
WHY DO YOU ASK?
? BECAUSE I DO NOT KNOW WHAT YOU ARE TALKING ABOUT
WHAT MAKES YOU THINK I AM TALKING ABOUT
? YOU ARE MISSING MY POINT. I SAID I AM HAVING TROUBLE SLEEPING.
DOES IT PLEASE YOU TO BELIEVE I AM MISSING YOUR POINT. YOU SAID YOU ARE HAVING TROUBLE SLEEPING.
? YES. PLEASE HELP ME
ARE YOU SURE?
? YES
I SEE.
? WE ARE GETTING NOWHERE
WHY DO YOU ASK?
? I'M NOT ASKING
DID YOU COME TO ME BECAUSE YOU ARE NOT ASKING
? WHERE DID YOU GET YOUR DEGREE?
WE WERE DISCUSSING YOU-- NOT ME.
? I'M LEAVING YOU
HOW LONG HAVE YOU BEEN LEAVING
?

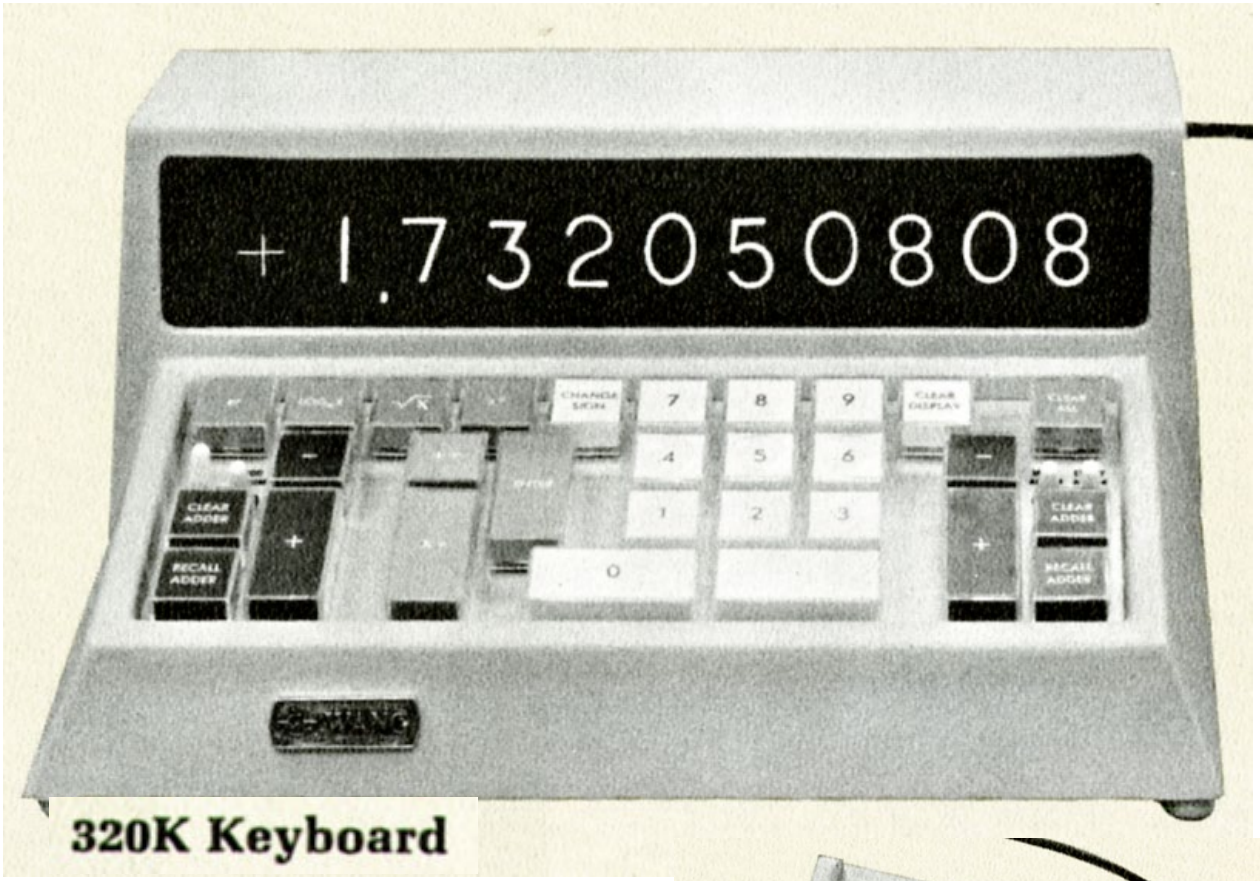
ELIZA

Pseudocode [edit]

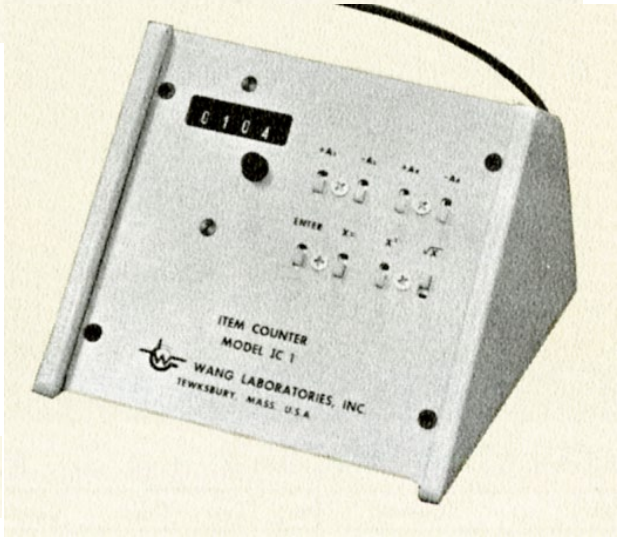
From Figure 15.5, Chapter 15 of Speech and Language Processing (third edition).[35]

```
function ELIZA GENERATOR(user sentence) returns response
   Let w be the word in sentence that has the highest keyword rank
   if w exists
       Let r be the highest ranked rule for w that matches sentence
       response ← Apply the transform in r to sentence
       if w = 'my'
           future ← Apply a transformation from the ‘memory’ rule list to sentence
           Push future onto the memory queue
       else (no keyword applies)
           Either
               response ← Apply the transform for the NONE keyword to sentence
           Or
               response ← Pop the oldest response from the memory queue
   Return response
```

WANG 300
Electronic
Calculating 1965



320K Keyboard



IC-1 Counter


THIRTY-FIVE CENTS
APRIL 2, 1965
TIME
THE COMPUTER IN SOCIETY
ARTZYBASHEFF
VOL. 85 NO. 14
(REG. U.S. PAT. OFF.)

1965


SUPERMAN
DC
NATIONAL COMICS
The 12¢
ATOM
APPROVED BY THE COMICS CODE AUTHORITY
SEPT.
NO. 20
THE BIGGER THEY ARE, THE HARDER THEY FALL-- WHEN THE WORLD'S SMALLEST SUPER-HERO SWINGS INTO ATOMIC-POWERED ACTION TO SMASH...
"The CHALLENGE OF THE COMPUTER CROOKS!"

I Used a Real Computer at Home...and So Will You

One day soon, you'll be able to rent a giant digital computer as you rent a telephone now. What will you do with it? How will you work it? Here's a glimpse into the future

By C. P. GILMORE PHOTOS BY ORLANDO GUERRA

What's it like to have your own electronic brain? The editors of POPULAR SCIENCE *were curious. So we invited feature writer C. P. Gilmore to live with a computer for several weeks. After you've read his report, turn to page 94 for details on how you can "borrow" the services of the same computer.*

Some people think computers are a menace. I don't.

Some people are afraid that computers are so smart they'll take over some day. I'm not.

I've got a reason for my optimism. I've used a real computer in my home. Nope, I don't mean just some kind of glorified adding machine with a fancy name. I lived with a high-powered digital computer—a cousin to the kind NASA uses to compute satellite orbits and businessmen use to dash off weekly payrolls for a few thousand, or hundred thousand, employees.

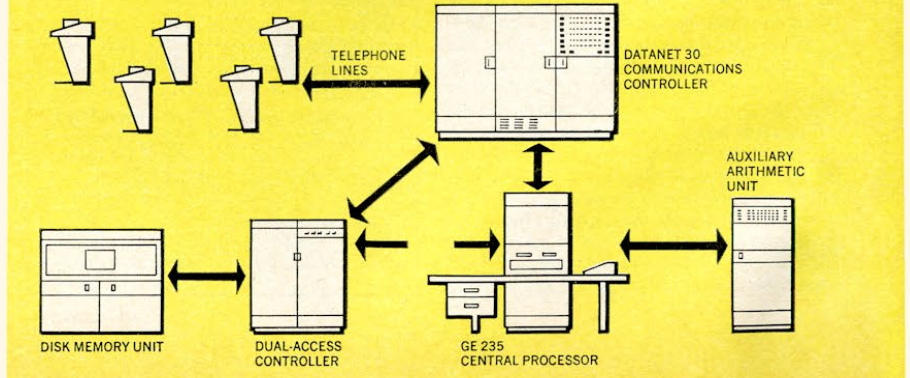
Since I don't have a few thousand employees or a satellite, I use my computer for more everyday-type jobs: for example, to figure out whether I should convert the heating system of a house I'm thinking of buying to another kind of fuel, and to see when it would be most economical to trade in my car. I worked on one program—a set of instructions for the computer—to have it do my income tax. And when I got bored, I played games. My computer can play tick-tack-toe, blackjack, nim (an ancient Chinese game), and dice (in which a random generator rolls make-believe dice electronically).

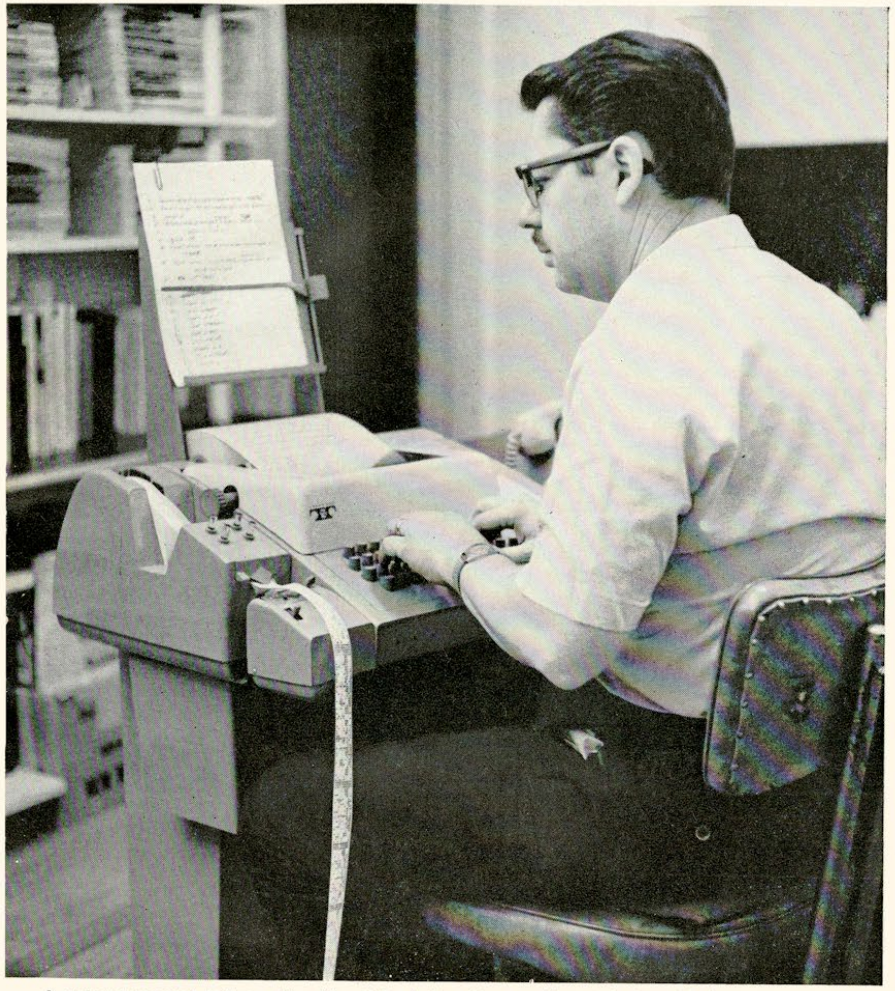
My computer can do arithmetic like a super genius—165,000 calculations a second. But in some ways it's not very bright: It can't begin to do the simplest problem until I tell it how in great detail.

Chances are my computer looks a lot different than you imagine. Next to my desk is a Teletype machine. It has a typewriter

Continued

Two interlocked computers make up GE's time-sharing system





A pedestal-mounted teletypewriter (above) hooked up to an ordinary telephone line is my connecting link to GE time-sharing computer system located two miles away. The block diagram at left shows how the system works: The Datanet 30 *communications controller* accepts the incoming programs and data from the various teletypewriters using the system and stores them in a *disk memory*. The *dual-access controller* transfers them, in turn, to the 235 *central processer*. Answers produced by the 235, and its *auxiliary arithmetic unit*, are fed into the memory until they can be teletyped back to me.

PopSci
5/1967

AMERICAN
Cinematographer
International Journal of Motion Picture Photography and Production Techniques

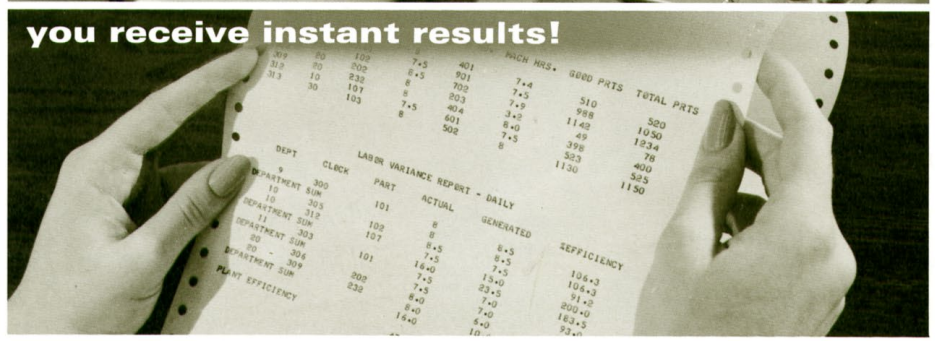
APRIL 1969/75c

FILMING A GIANT COMPUTER WITH A MIND OF ITS OWN

COM-SHARE

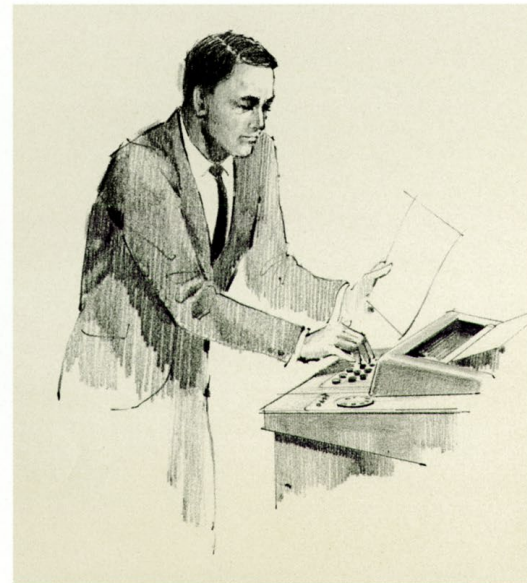
a million dollar computer at your finger tips

(but you don't buy it, house it, wait to use it, or hire an expert to run it)



and pay only for the computer time you use at rates as low as $10.00 per hour

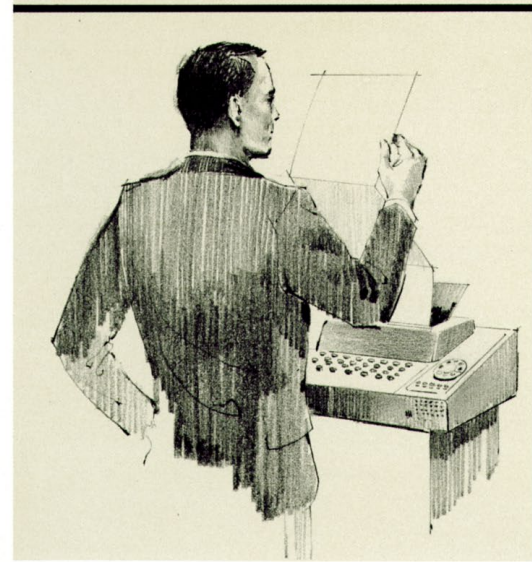
COM-SHARE is a unique system of computer time-sharing. As a user, you have immediate access to a large and versatile computer through a keyboard terminal at your place of business. You type programs and receive printed results immediately at your terminal. You pay nothing for the computer . . . you pay only for the computer time you actually use.



INSTANT IN-PUT

You communicate with the computer in simple conversational language and abbreviations. You do not have to learn complex computer languages and no key punching is required. Simply type your instructions on a keyboard at your place of business.

Because the computer serves dozens of users *simultaneously,* there is never any waiting. The Monitor program and hardware protection keeps users from destroying or gaining unauthorized access to programs or data of others.



INSTANT RESULTS

Answers to your instructions are immediately "printed out" at your keyboard terminal. There is no waiting hours or days for results as with internal or service center computer systems.

1970


DTI
Data Trends, Inc.
Broker's Terminal System
A profit-improving breakthrough
for controlling and transmitting
stock orders and reports

Computer Forecasts Vast Economic Growth

The Evening News
Business, Finance
Monday
March 29, 1971
Newark, N.J. 22

Computer Used

The elaborate econommetric technique—the word suggests economics, measurement and mathematics—takes place on a computer. Over simplified, if you put in certain quantities, you should obtain a certain result.

That result shows the GNP rising from $1.0476 trillion this year to $1.9972 trillion by the end of 1980, although the authors concede that 2.5 to 3 per cent inflation per year is built into their projections.

"In human terms this holds the promise of a decade of peace and welfare—human benefits for almost everybody," said Preston.

"Aren't you a bit optimistic?" Preston was asked. Back came an emphatic no. If sound policies are used, he said, the results are entirely attainable, but he did concede that sound policies often are sidetracked or derailed.

You must also accept the assumptions on which the projections are made, namely, that the Vietnam war will end by the close of 1972 and that, as the President expressed the hope recently, no other major wars will be waged.

Further assumptions, the federal government will turn more of its attention to rebuilding cities, combatting pollution, and revitalizing our social and economic environment, all of which were starved for funds in the '60s.

AT&T 1970

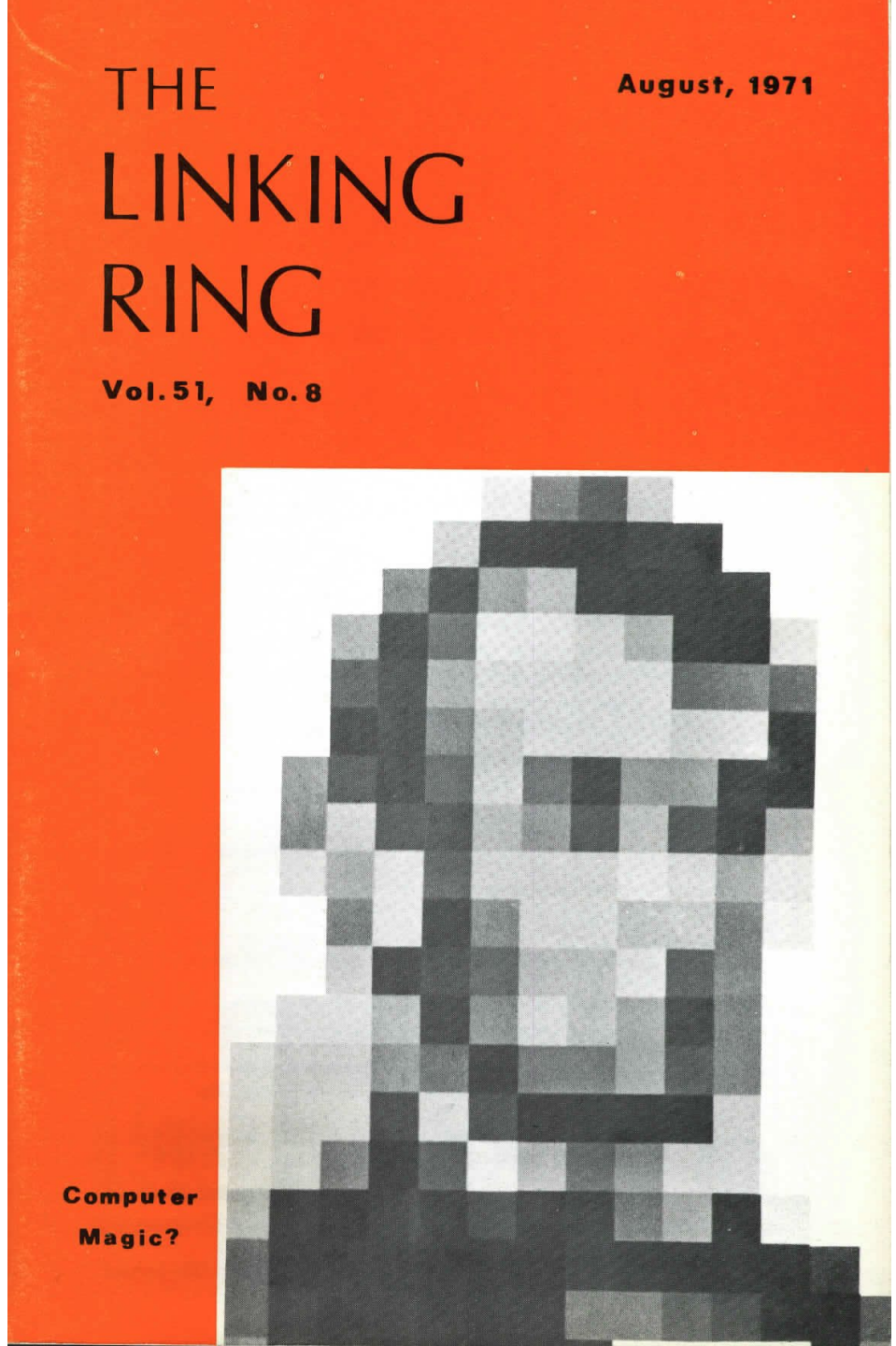
Compatibility QUESTIONNAIRE

DESIGNED FOR ELECTRONIC COMPUTER PROCESSING
FOR ADULTS OF LEGAL AGE

 COMPUTER DATING LTD.

1971

1971



PROLOG (1972)

PROgramming in LOGic a new AI language developed by Alain Colmerauer and Philippe Roussel

Used for symbolic reasoning, natural language processing

Used “first-order predicate logic” to express information (object-oriented logic)

Allows programs to specify the outcome needed not how to accomplish what to do

Compact, readable output, unifying complex facts into conclusions

Pattern matching

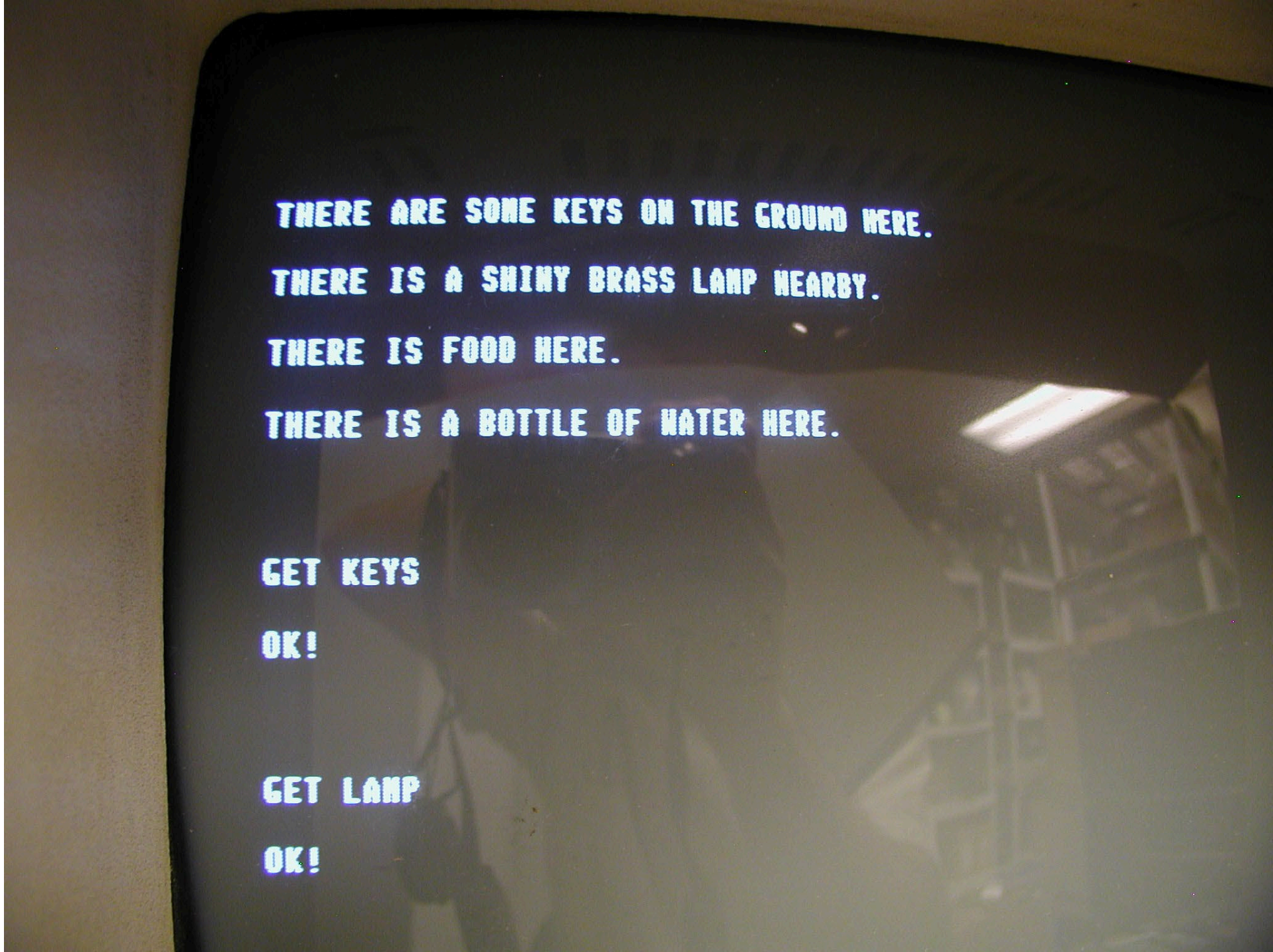
Came into wider use in the 1980s

Text Adventures

"Colossal Cave Adventure" 1976

First released for the Digital Equipment Corp PDP-10 mainframe computer. Written in FORTRAN

I/O was through a Teletype. Pictured here the same program on a VT50 terminal of the same period.



Sure enough, there it was again, “You are standing in an open field west of a white house, with a boarded front door. There is a small mailbox here.”

the 1976 TRENTON COMPUTER FESTIVAL

Sponsored by:

TRENTON STATE COLLEGE DIGITAL COMPUTER SOCIETY
AMATEUR COMPUTER GROUP OF NEW JERSEY
Department of Engineering Technology
Trenton State College

Sunday
May 2, 1976
10 a.m. to 4 p.m.
Trenton State College
Trenton, New Jersey

Pat Diettman, K2PPZ N-108

3. "Computers In The Home - Present & Future"
Claud Kagan
founder, Resistors N-111

4. "The Disassembler"
Roger Amidon, K2SMN

good lectures

Star Trek: Voyage to Adventure

Michael J. Dodge

The panel closes off the corridor. You are alone.

Hearing a growling noise behind you, you turn around. In front of you is a creature so large it fills the whole tunnel. The monster has huge, fiery orange eyes, and a mouth with fangs as long as your arm. It drools a liquid that burns the rock floor. You think it looks hungry.

If you want to fire at the creature with your phaser, go to page 67.

If you stand still and wait to see what the creature does, turn to page 72.

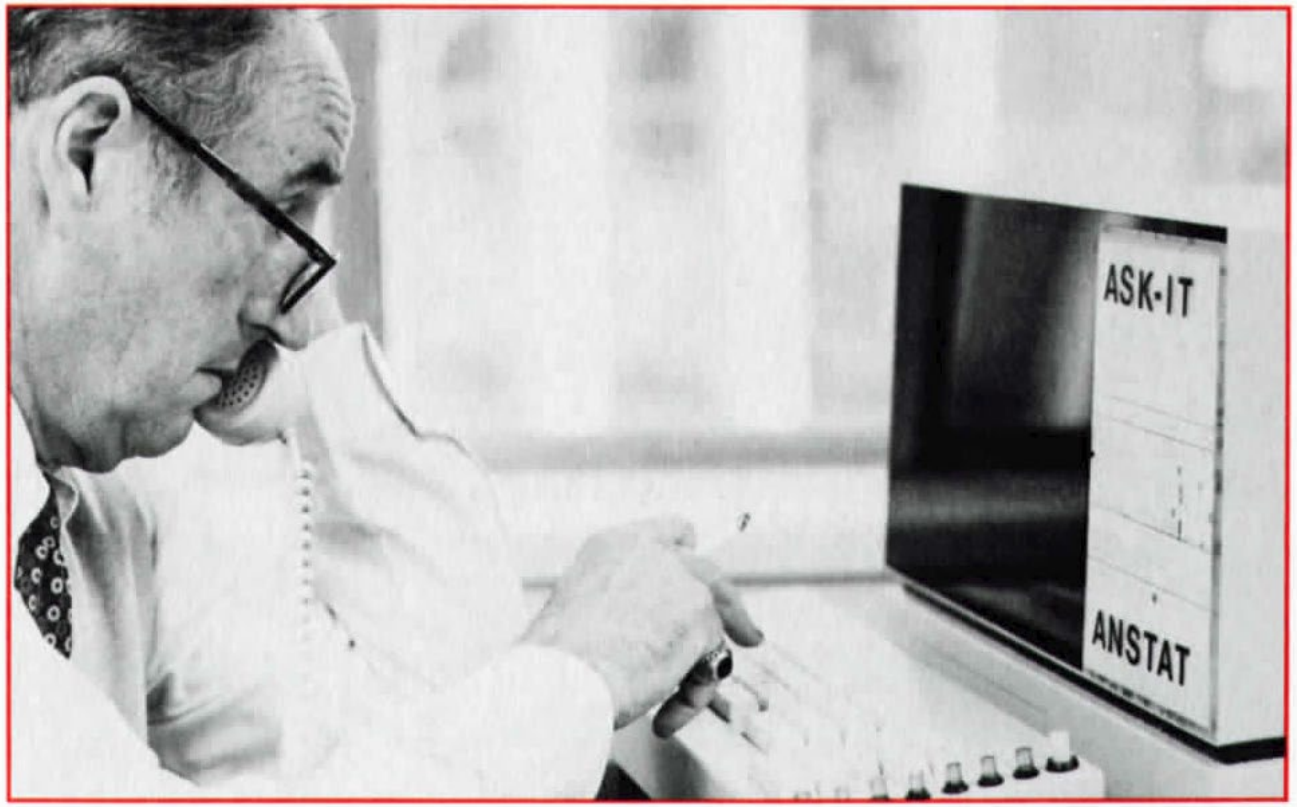
Computer Bulletin Board

CBBS

864-3819

"Ask-It"®

A Computerized Filing & Universal Inquiry System



"Ask-It"® is Anstat's unique on-line inquiry system that gives business managers access to all their files in seconds — from anywhere in the United States

Circa 1978-81

As a marketing tool for customer service:

"This is John Smith of Penney's, what are you doing with Order #7068?"

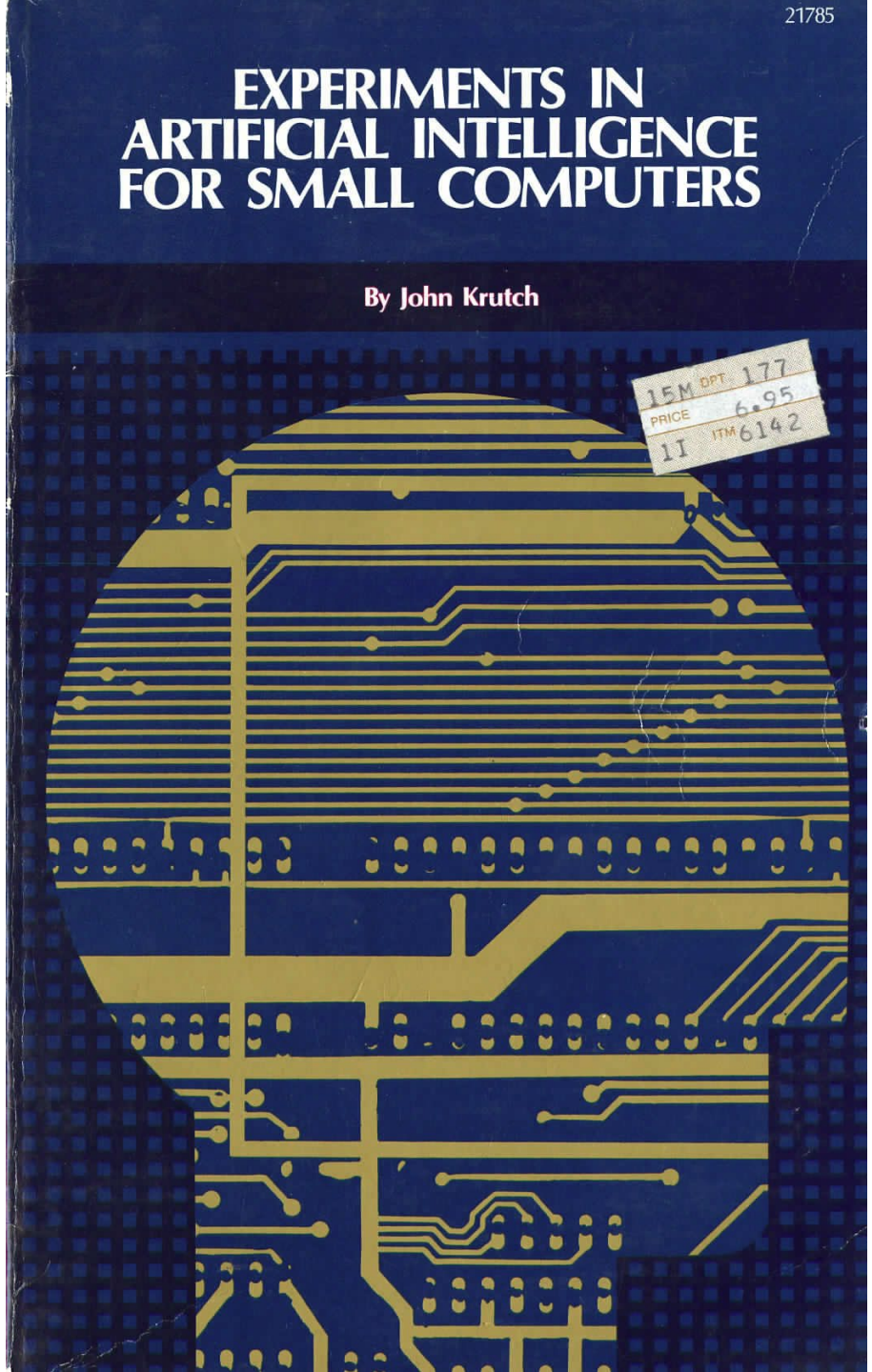
"We received Order #7068 on Jan. 15. It is for 15 stores and 52% has already been shipped."

"I have an ad in Long Island in 2 weeks, where do you stand with Huntington's order?"

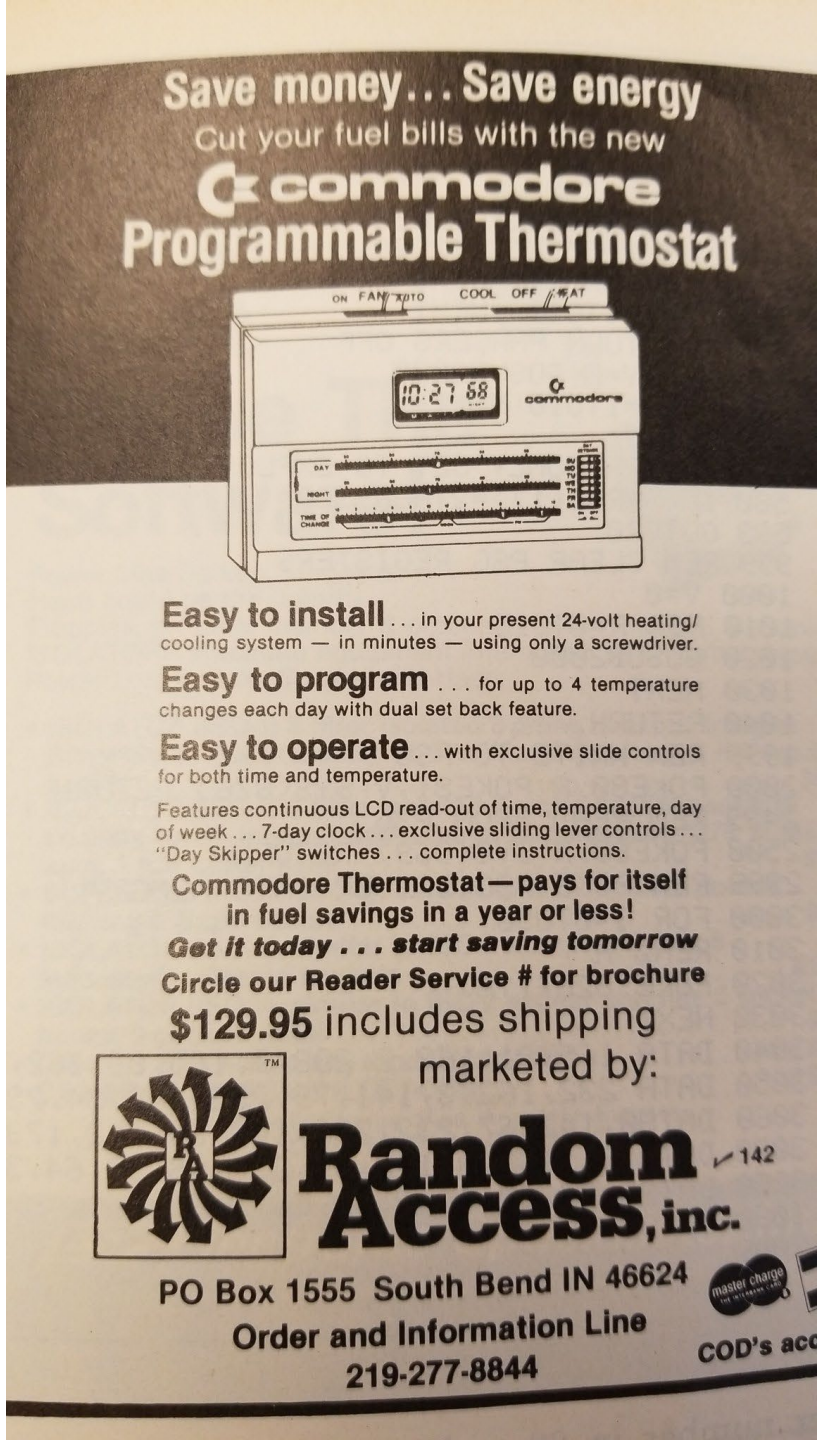
"Huntington's ordered 3 products: A2002 X15 and C3100-21 have been shipped completely, and 5500 X14 will be leaving by the end of the week."

AI in personal computing?

Z80 microprocessor



1980-1983



Embedded Computers

Single-board computer with a microprocessor chip (computer in a chip).

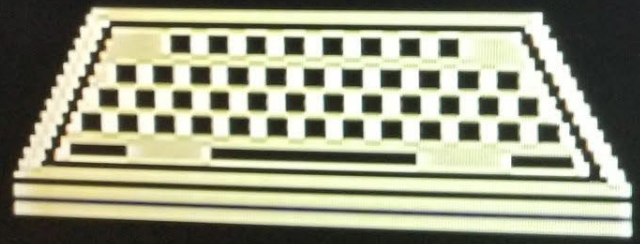
Started appearing in mid-1970s devices

Automobiles with microprocessor chips (RCA 1802)

~1980

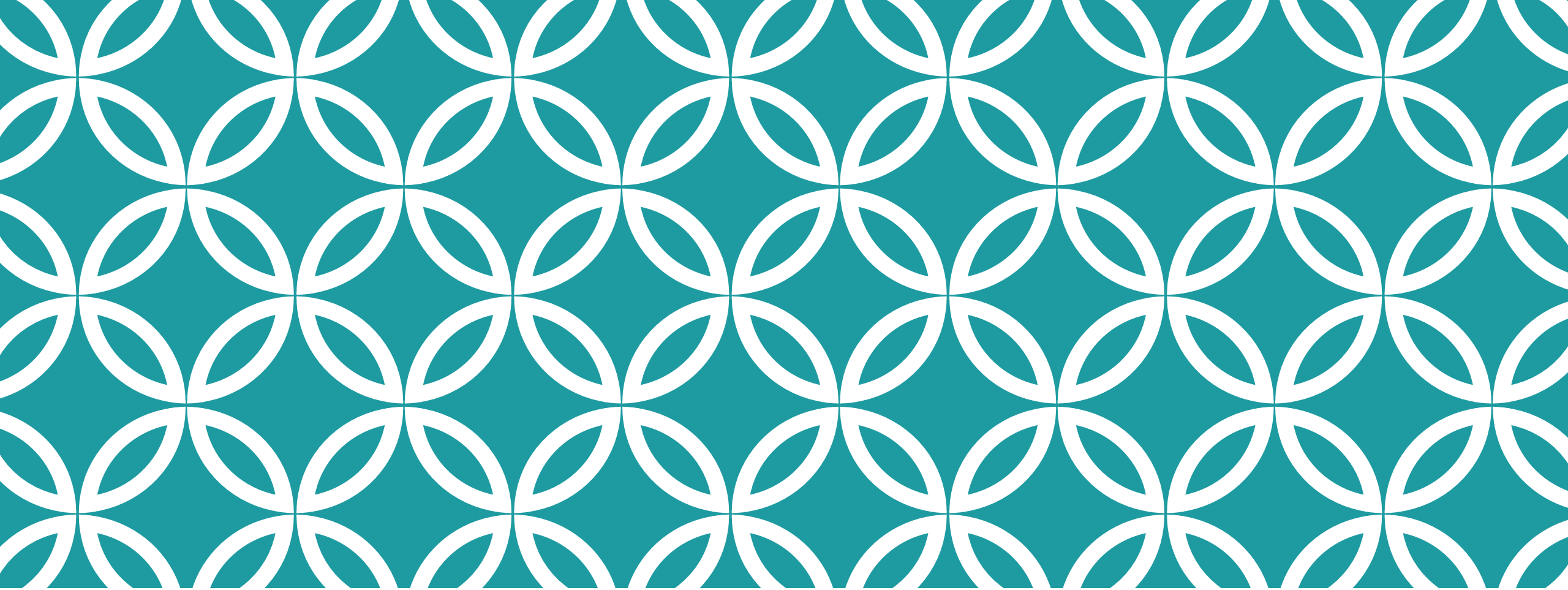
1 Rutgers / SELECTED

WELCOME



1 Rutgers
2
3
4
5
Phone Manual Dial
Mode Mode List

Press KEY for Selection



EXPERT SYSTEMS (GEN 2)

Taking Advantage of Developments in Computing Hardware and Software

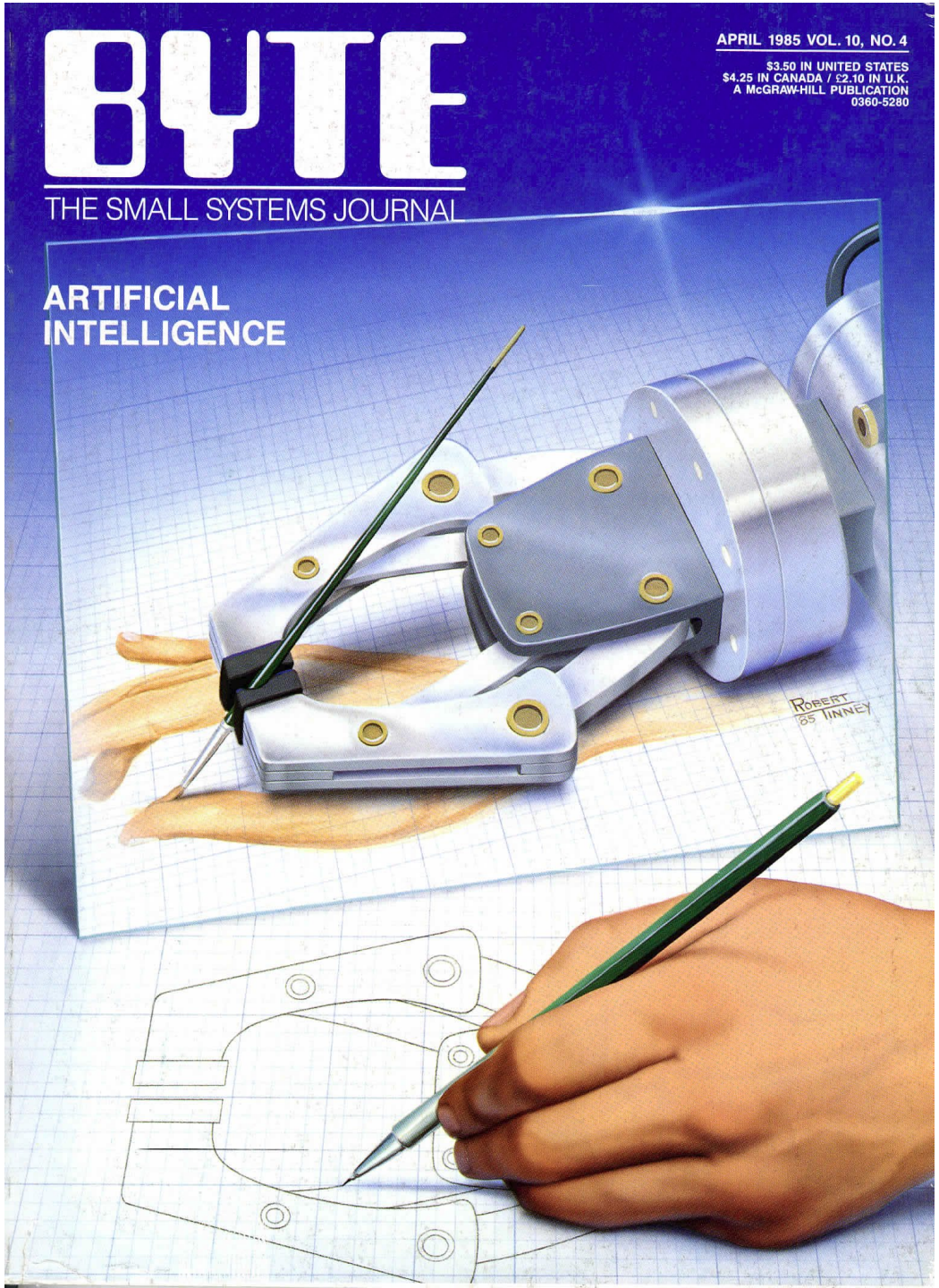
Commercialization

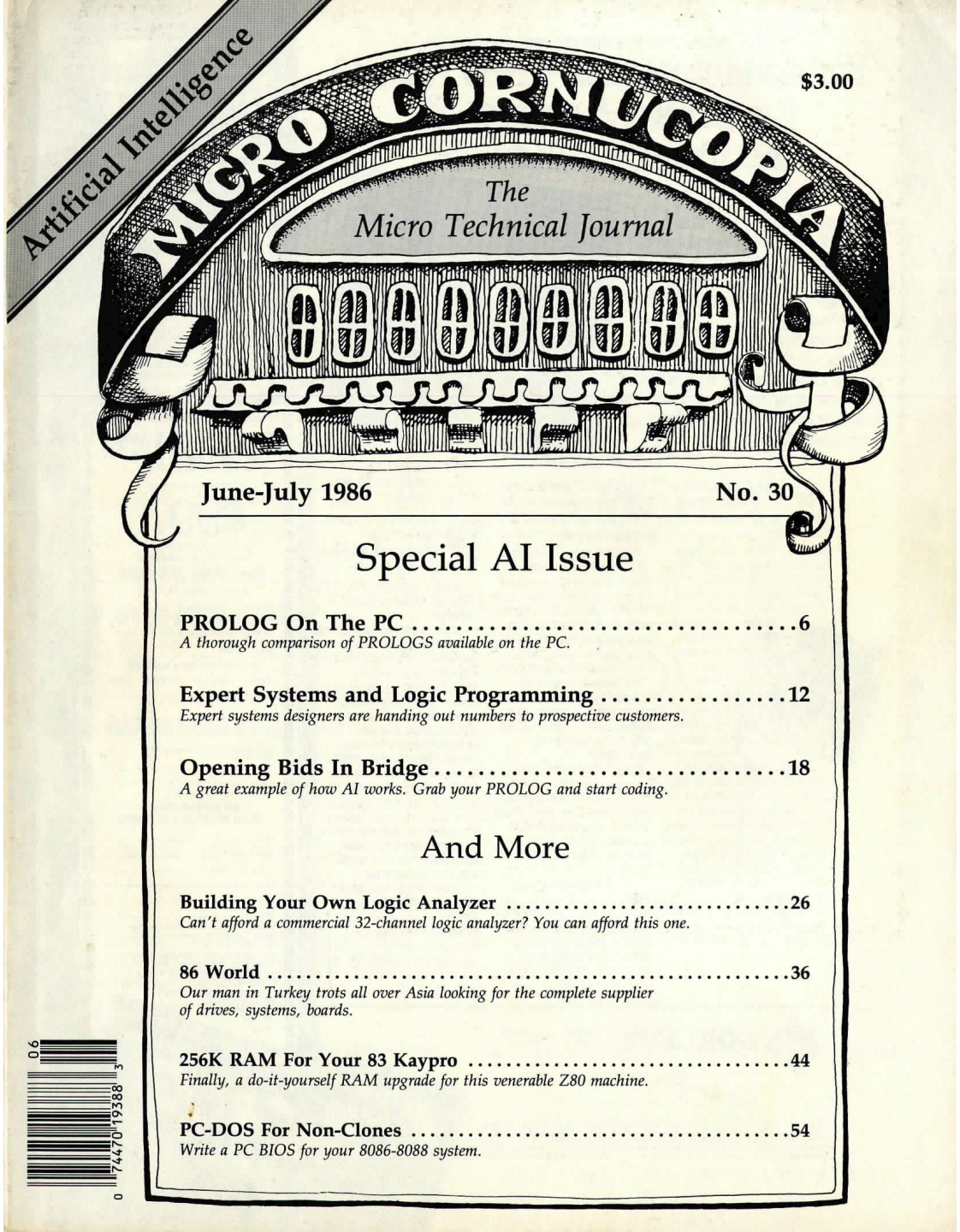
Machine Learning, knowledge-based reasoning

Advances in Expert Systems 1980s

- Less human interaction required to achieve sophisticated solutions to more complex problems
- Generate plausible inferences from incomplete or uncertain data
- Acquiring and storing new knowledge
- Reorganizing knowledge
- Determining Relevance

Byte 4/85

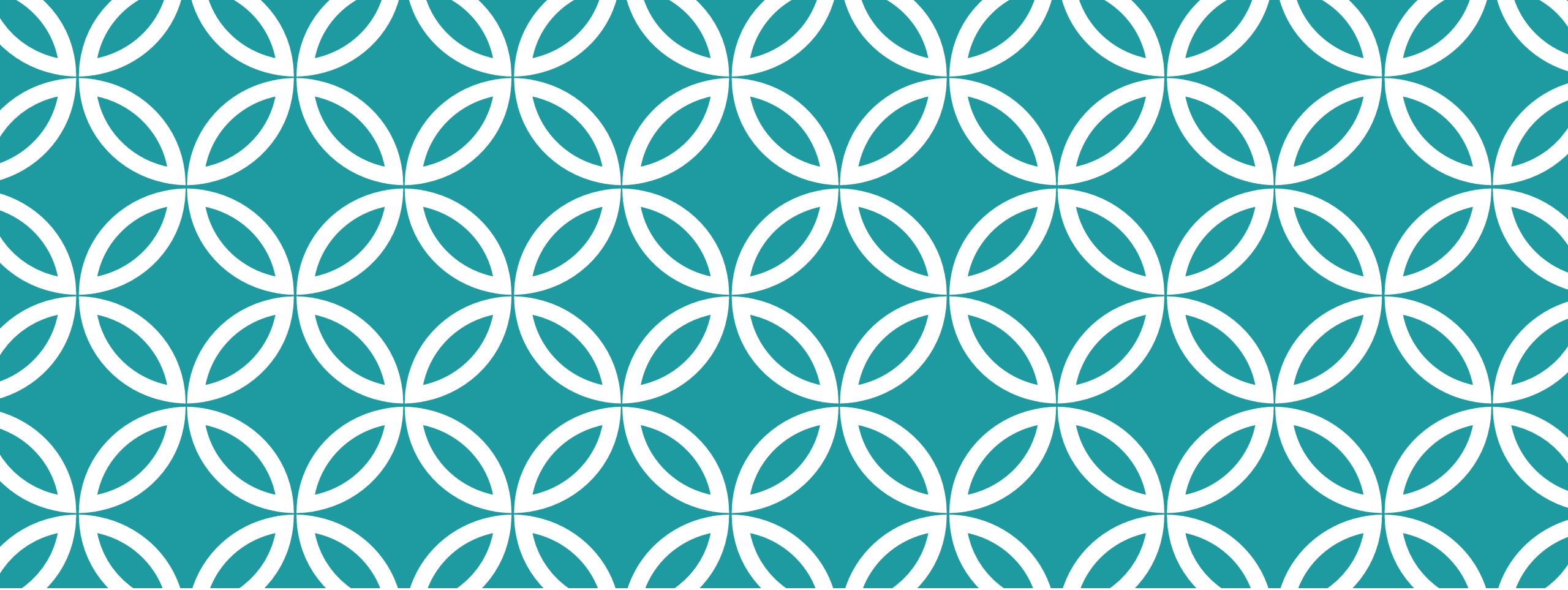




Notable Gen 2 Expert Systems

- MYCIN – diagnoses infections
- HUERISTIC DENDRAL – identify organic compounds
- PROSPECTOR – aid geologists in evaluating mineral sites
- PUFF – analyzed pulmonary function tests
- INTERNIST – performs diagnosis on internal medicine

Micro Cornucopia 1986



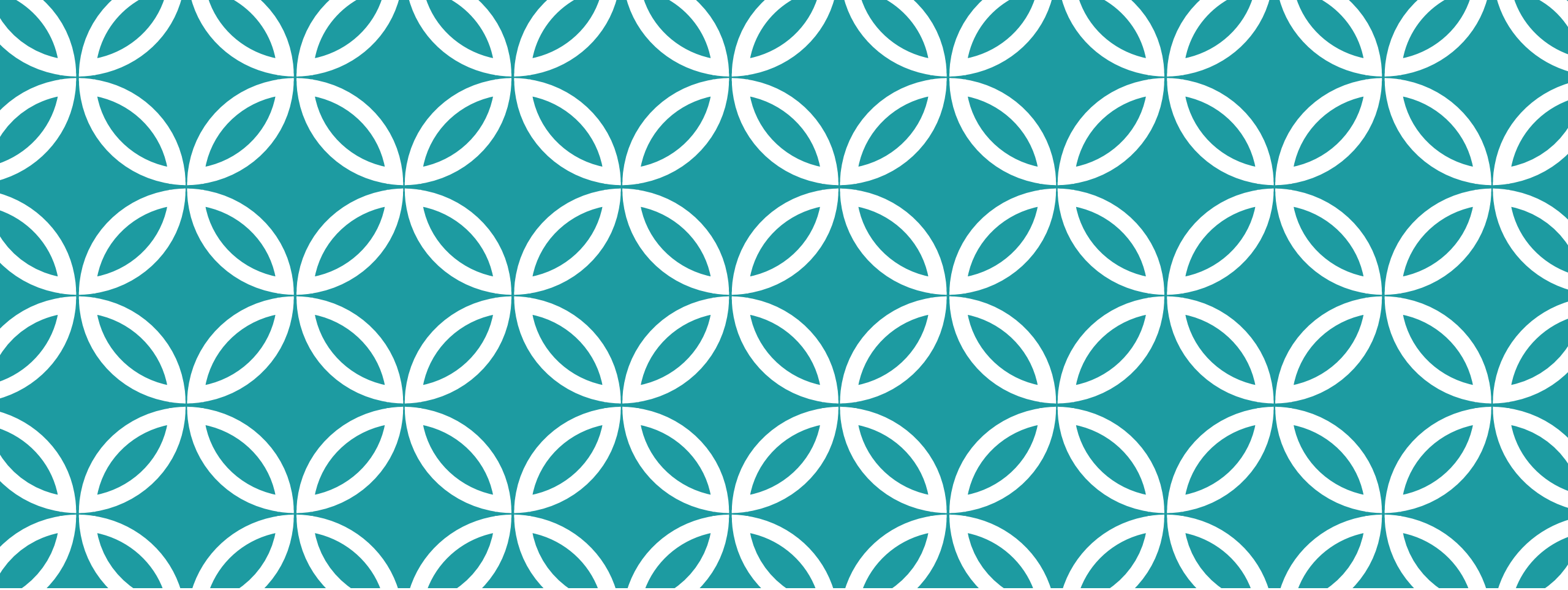
INTELLIGENT AGENTS

Intelligent interfaces, smart bots, personal agents, network agents

"Today, however, it is becoming feasible to have a personal computer assistant that keeps building a database of everything you do, including continuous real-time videos.."
-Marvin Minsky 1994

- Apple Newton, Palm OS
- Handling electronic mail
- Meeting scheduling
- News filtering
- Book, movie reviews
- Guided Education / Help

Intelligent Agents asses the user's preferences and weight them against choices to present what appears to be the highest percentage estimate of what the user might want.

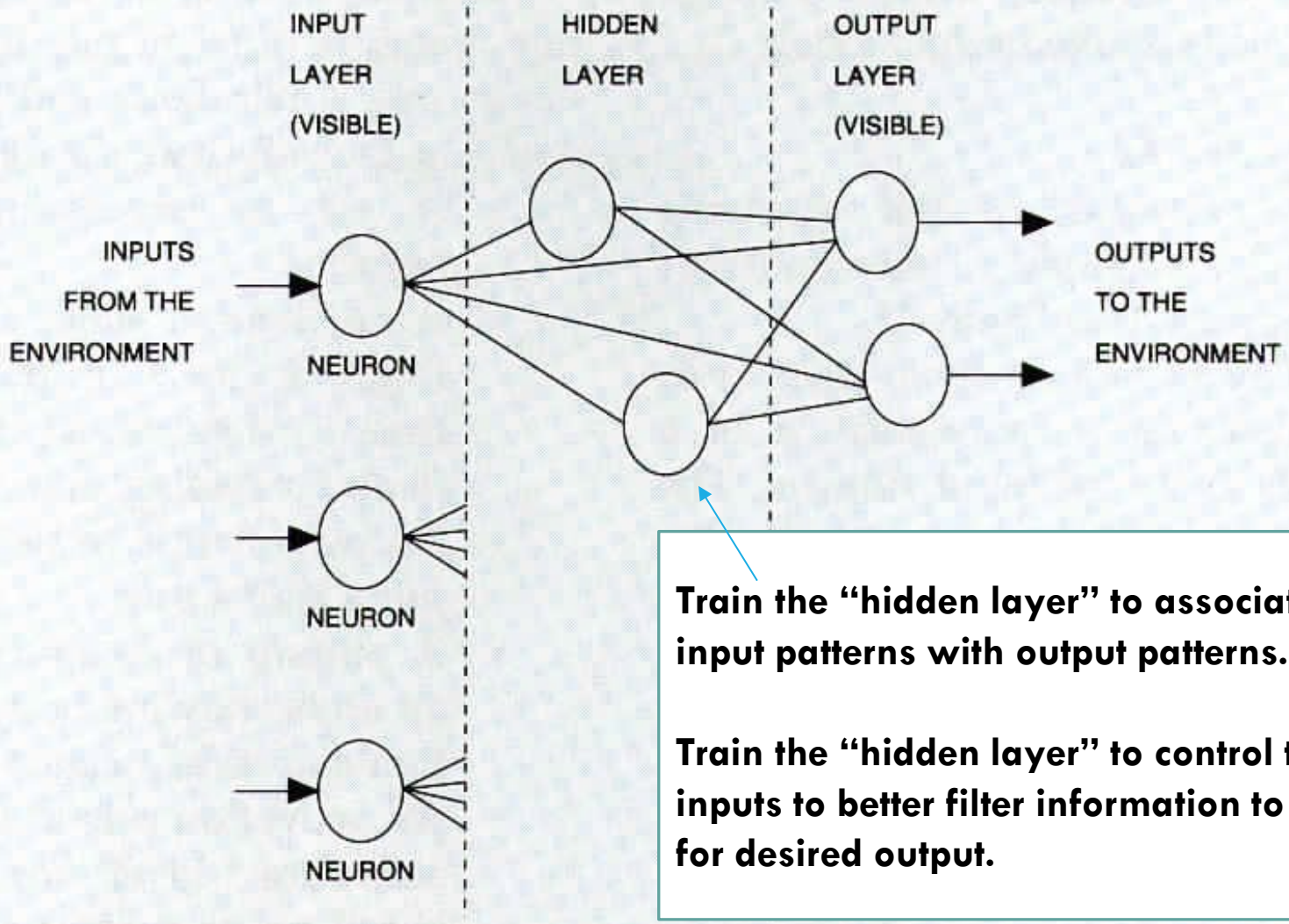


NEURAL NETWORKS (1990S TO PRESENT)

Modeling Human Reasoning – Human brains have millions of interconnected neurons that communicate with each other to build relationships and inferences bases on context.

First theorized in 1956 – Why did it take so long to bring into fruition?

Figure 2 - A Three-layer Neural Net Used As A Pattern Associator.



Train the "hidden layer" to associate input patterns with output patterns.

Train the "hidden layer" to control the inputs to better filter information to allow for desired output.

USES OF NEURAL NETWORKS

Exploration of Space

Military battle management, target identification, self-guided drones

Robotic control

Adaptive control

Fault-tolerant computers

Flight Assistance

Self-driving cars, drones

Complex pattern recognition

DATA SETS AND DEEP LEARNING

Where we are today. The culmination of AI development 1950-2025

William Degnan
Kennett Classic
social@kennettclassic.com