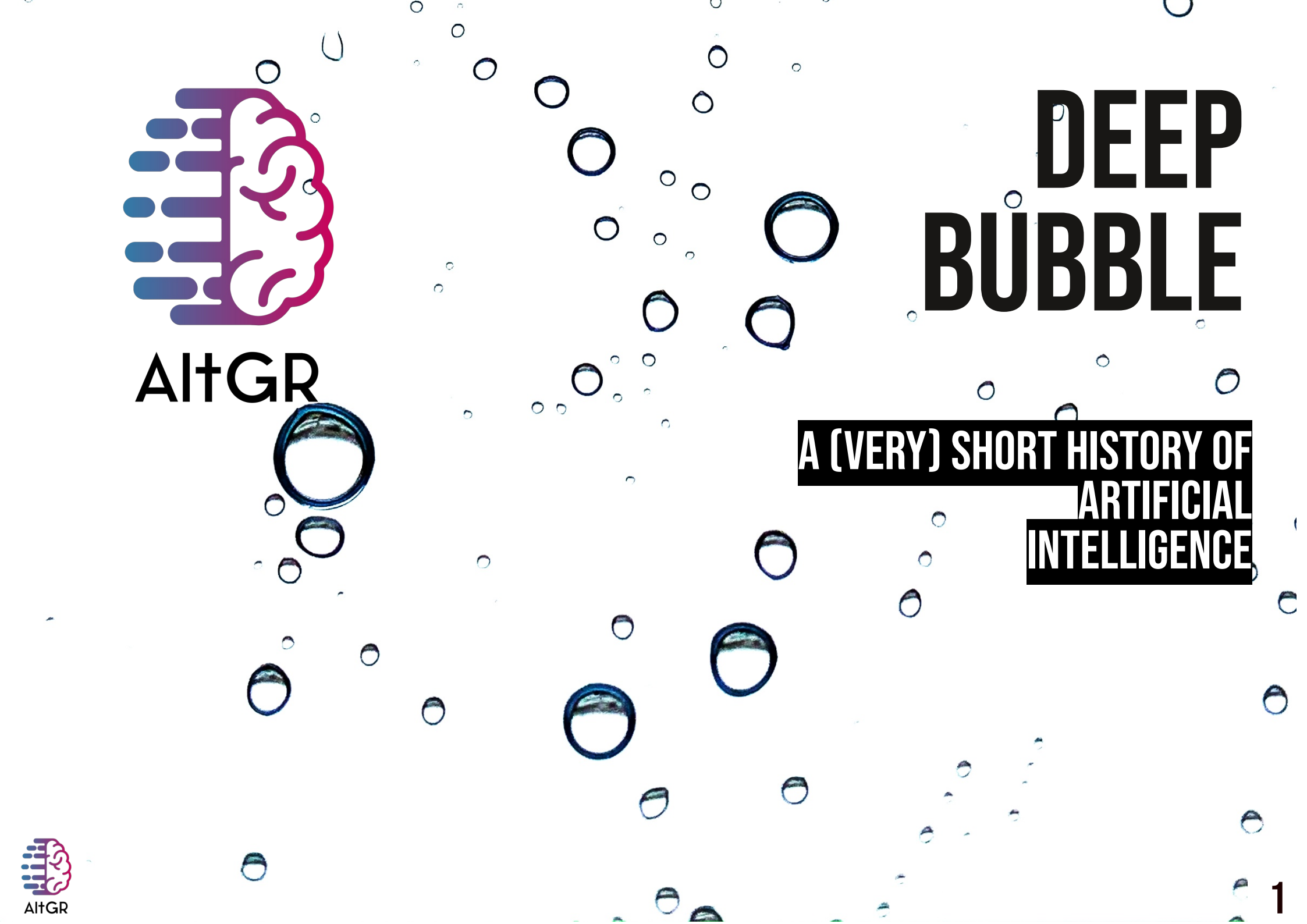


AltGR

DEEP BUBBLE

A (VERY) SHORT HISTORY OF ARTIFICIAL INTELLIGENCE

<1956

AltGR

The New York Times

NEW ELECTRONIC COMPUTER LEARNS BY DOING

WASHINGTON, July. 7 -

Company revealed the embryo of an electronic computer today that it expects will be able to walk, talk, see, write, reproduce itself and be conscious of its existence.

[...]

The $2,000,000 computer learned to differentiate between right and left after fifty attempts

[...]

It is expected to be finished in about a year at a cost of $100,000.

Scientists said the machine would be the first device to think as the human brain

[...]

A thinking machines that will be able to read and write.

[...]

it will be able to recognize people and call out their names and instantly translate speech in one language to speech or writing in another language, it was predicted.

Scientist said [it] would be the first non-living mechanism "capable of receiving, recognizing and identifying its surroundings without any human training or control.

[...]

As do human beings, it will make mistakes at first, but will grow wiser as it gains experience, he said.

[...]

The "brain" is designed to remember images and information it has perceived itself.

AltGR

The New York Times

NEW NAVY DEVICE LEARNS BY DOING

Psychologist Shows Embryo of Computer Designed to Read and Grow Wiser

WASHINGTON, July 7 (UPI) —The Navy revealed the embryo of an electronic computer today that it expects will be able to walk, talk, see, write, reproduce itself and be conscious of its existence.

The embryo—the Weather Bureau's $2,000,000 "704" computer—learned to differentiate between right and left after fifty attempts in the Navy's demonstration for newsmen.

The service said it would use this principle to build the first of its Perceptron thinking machines that will be able to read and write. It is expected to be finished in about a year at a cost of $100,000.

Dr. Frank Rosenblatt, designer of the Perceptron, conducted the demonstration. He said the machine would be the first device to think as the human brain. As do human beings, Perceptron will make mistakes at first, but will grow wiser as it gains experience, he said.

Dr. Rosenblatt, a research psychologist at the Cornell Aeronautical Laboratory, Buffalo, said Perceptrons might be fired to the planets as mechanical space explorers.

Without Human Controls

The Navy said the perceptron would be the first non-living mechanism "capable of receiving, recognizing and identifying its surroundings without any human training or control."

The "brain" is designed to remember images and information it has perceived itself. Ordinary computers remember only what is fed into them on punch cards or magnetic tape.

Later Perceptrons will be able to recognize people and call out their names and instantly translate speech in one language to speech or writing in another language, it was predicted.

Mr. Rosenblatt said in principle it would be possible to build brains that could reproduce themselves on an assembly line and which would be conscious of their existence.

In today's demonstration, the "704" was fed two cards, one with squares marked on the left side and the other with squares on the right side.

Learns by Doing

In the first [illegible] trials, the machine made no distinction between them. Then it started registering a "1" for the left squares and a "0" for the right squares.

Dr. Rosenblatt said he could explain why the machine learned only in highly technical terms. But he said the computer had undergone a "self-induced change in the wiring diagram."

The first Perceptron will have about 1,000 electronic "association cells" receiving electrical impulses from an eye-like scanning device with 400 photo-cells. The human brain has 10,000,000,000 responsive cells, including 100,000,000 connections with the eyes.

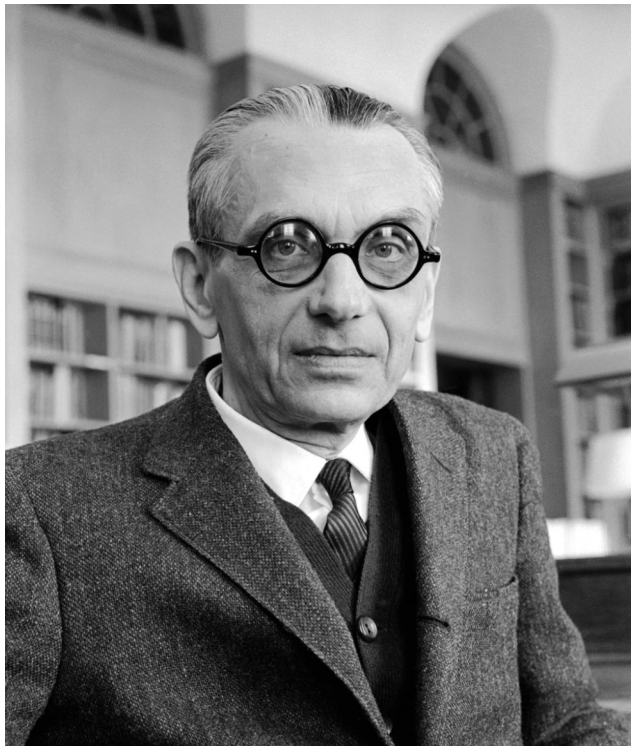
1958

AltGR

EARLY DAYS OF ARTIFICIAL INTELLIGENCE (AND COMPUTER SCIENCE)

< 1956

ADA LOVELACE
(1843)



KURT GÖDEL
(1970S ?)

ALAN TURING
(1938)

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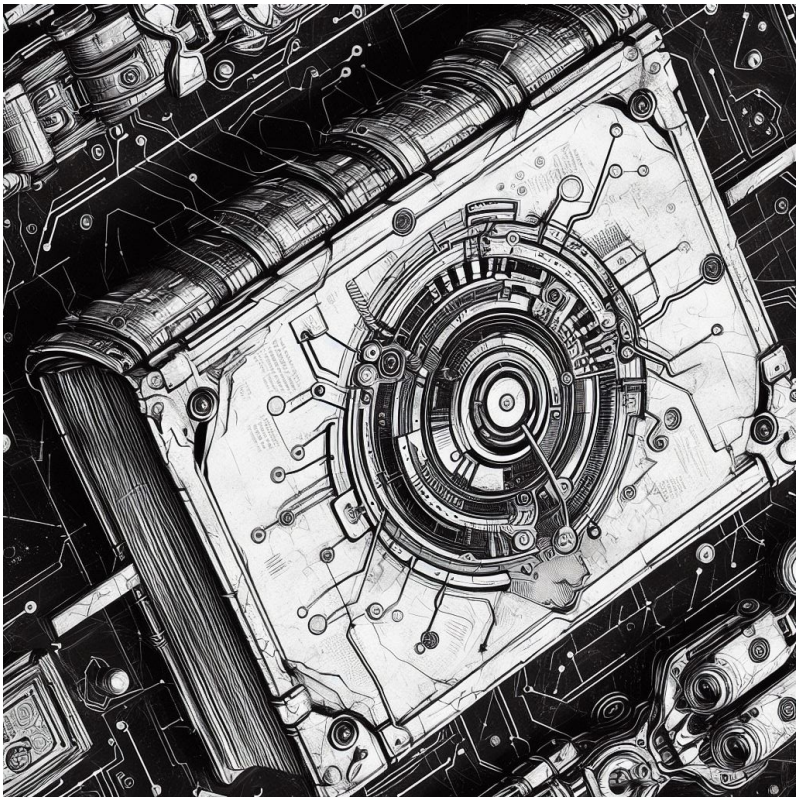
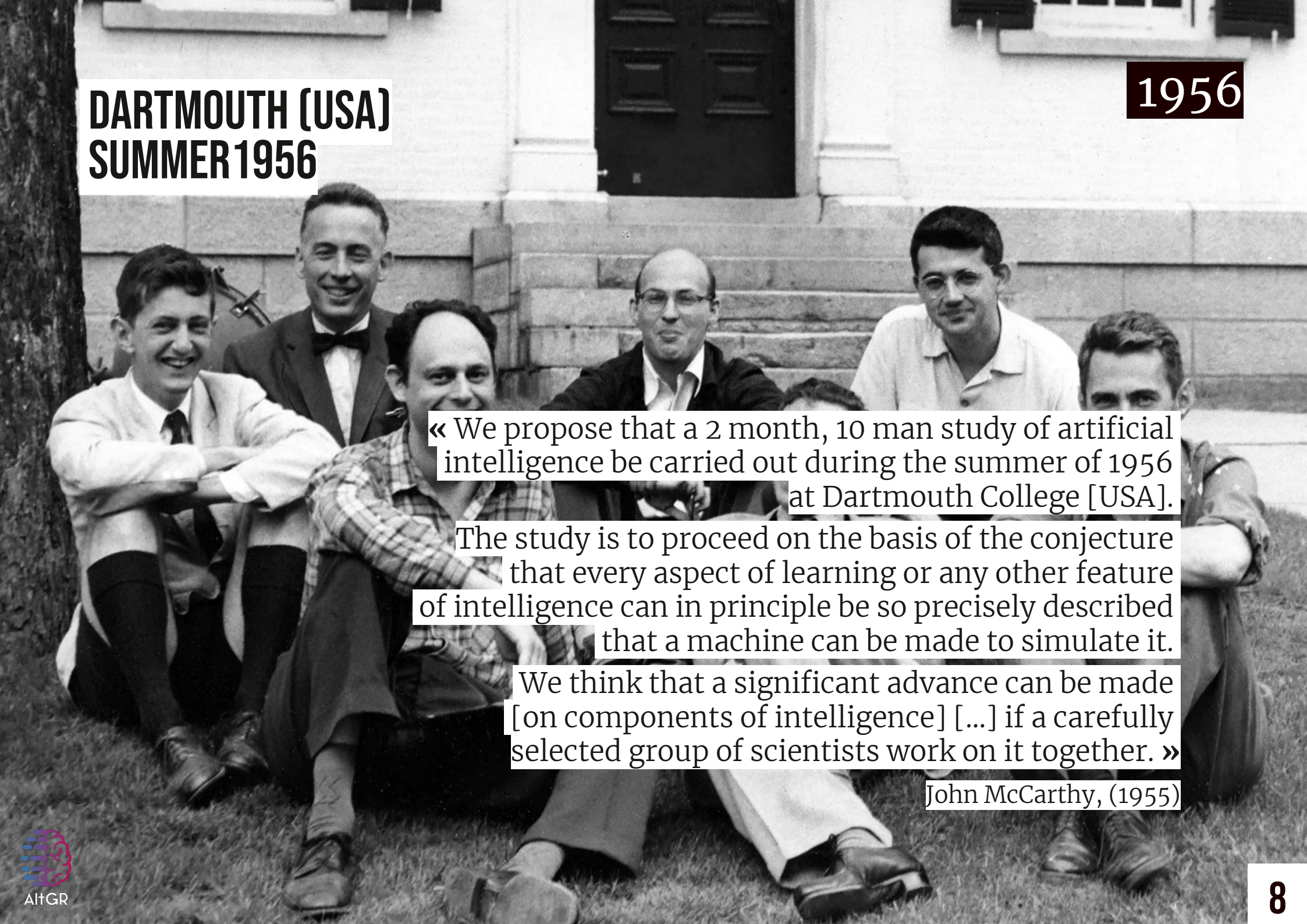
GOLDEN AGE



GOLDEN AGE OF (SYMBOLIC) ARTIFICIAL INTELLIGENCE

1956-1970

AltGR



DARTMOUTH (USA) SUMMER 1956

1956

« We propose that a 2 month, 10 man study of artificial intelligence be carried out during the summer of 1956 at Dartmouth College [USA].

The study is to proceed on the basis of the conjecture that every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it.

We think that a significant advance can be made [on components of intelligence] [...] if a carefully selected group of scientists work on it together. »

John McCarthy, (1955)

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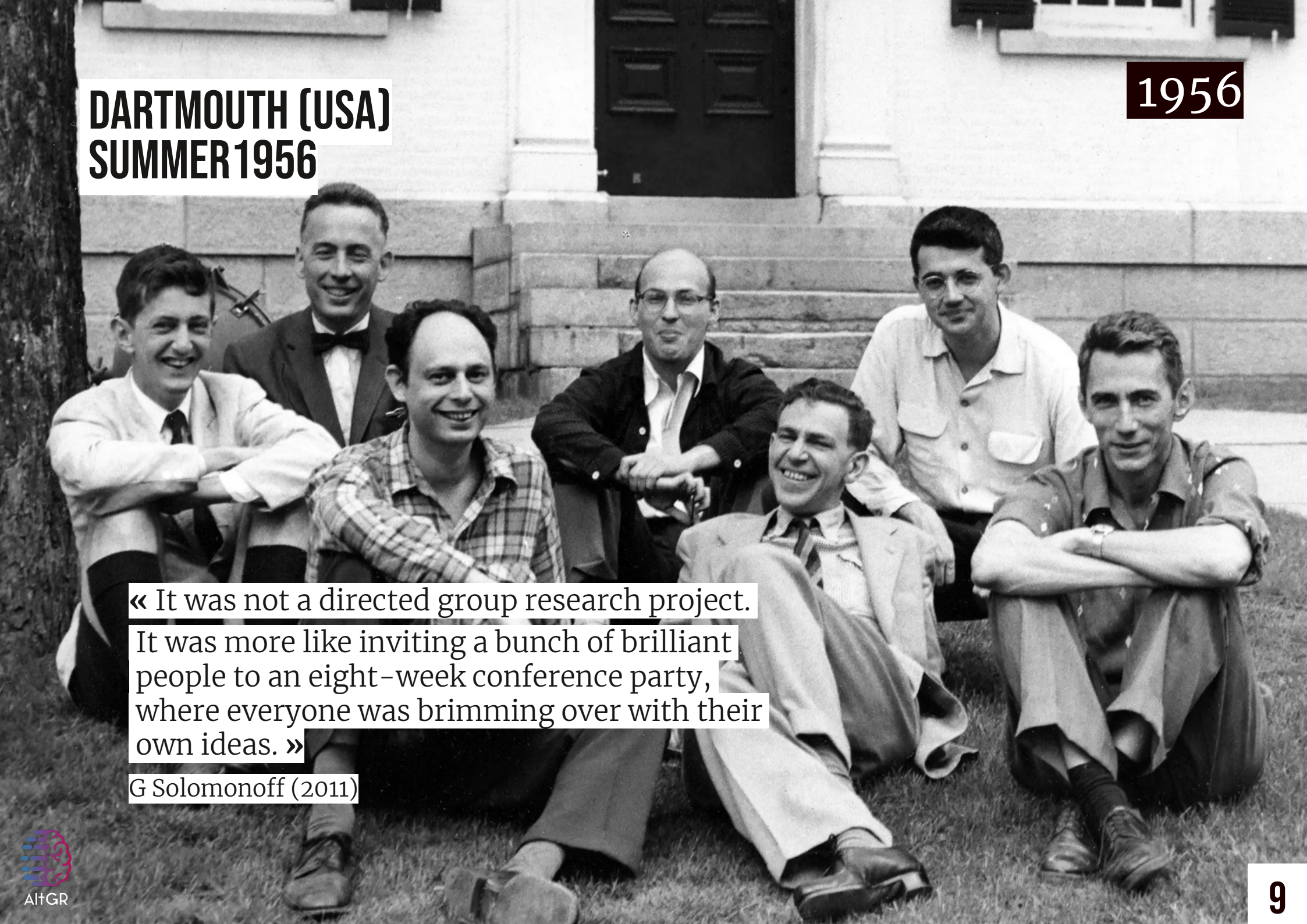


DARTMOUTH (USA) SUMMER 1956

1956

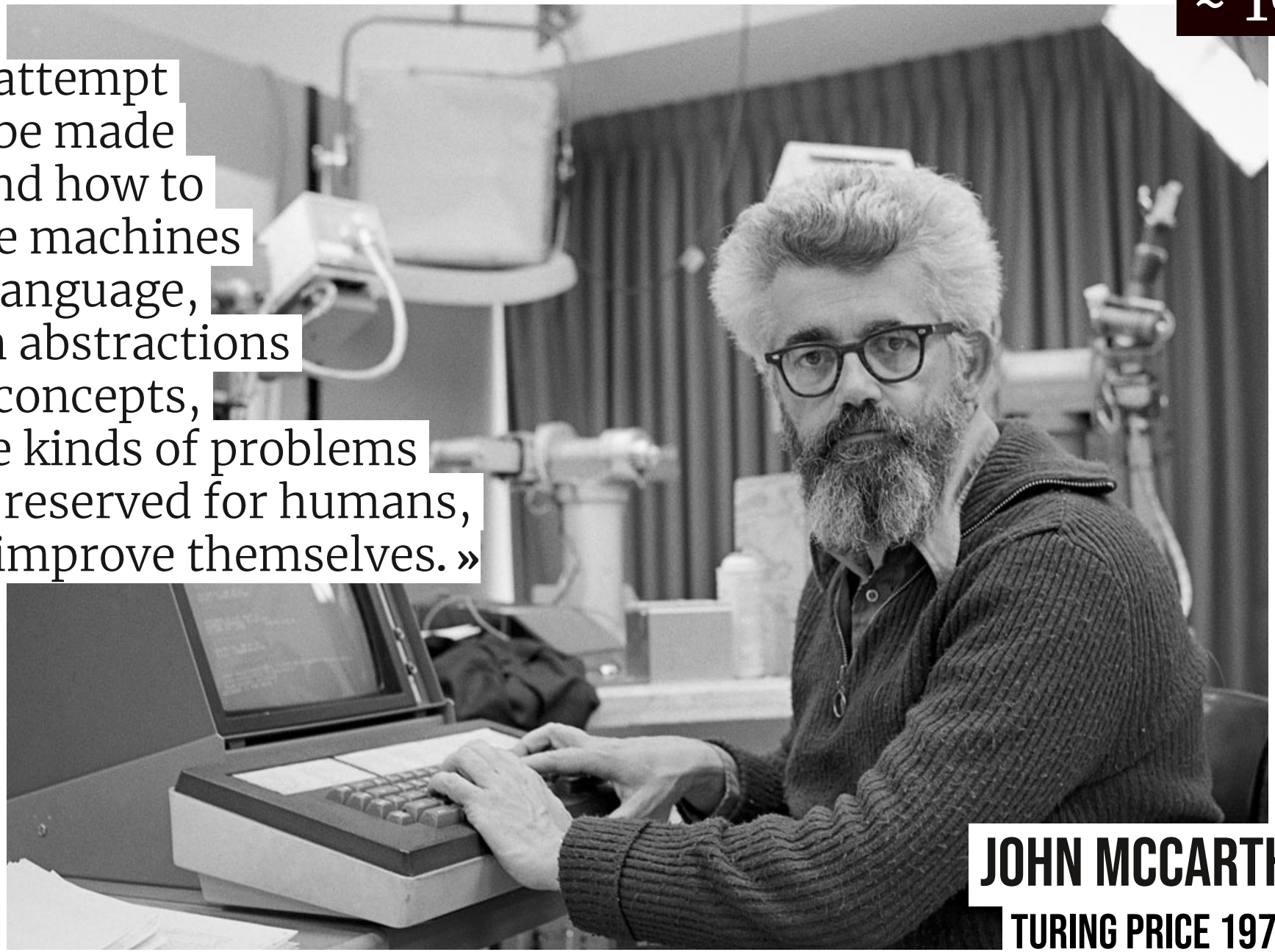
« It was not a directed group research project. It was more like inviting a bunch of brilliant people to an eight-week conference party, where everyone was brimming over with their own ideas. »

G Solomonoff (2011)

AltGR

~ 1956

« An attempt
will be made
to find how to
make machines
use language,
form abstractions
and concepts,
solve kinds of problems
now reserved for humans,
and improve themselves. »



JOHN MCCARTHY

TURING PRICE 1971

AltGR

1967

« For the present purpose the artificial intelligence problem is taken to be that of making a machine behave in ways that would be called intelligent if a human were so behaving. »

JOHN MCCARTHY

TURING PRICE, 1971

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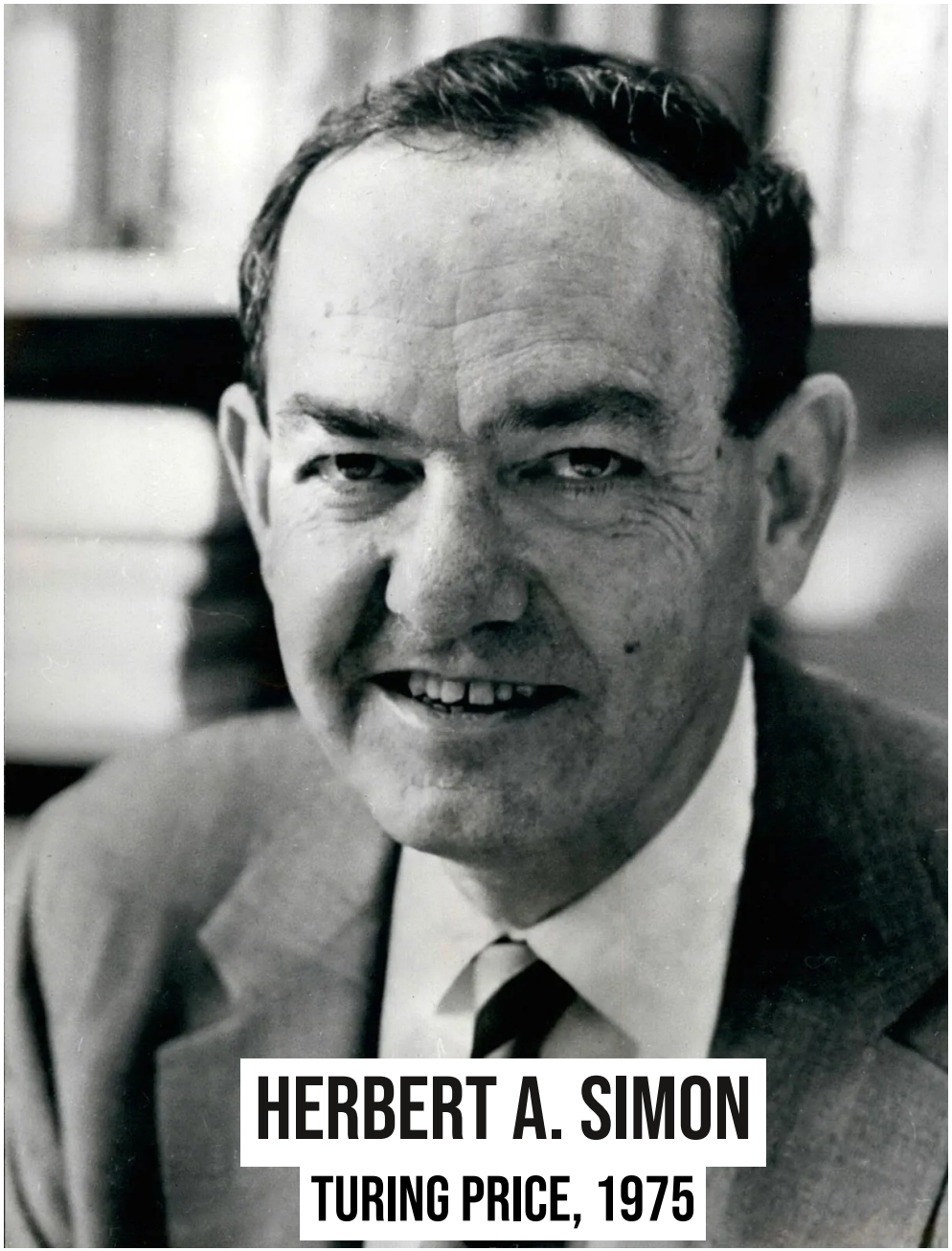


HERBERT A. SIMON

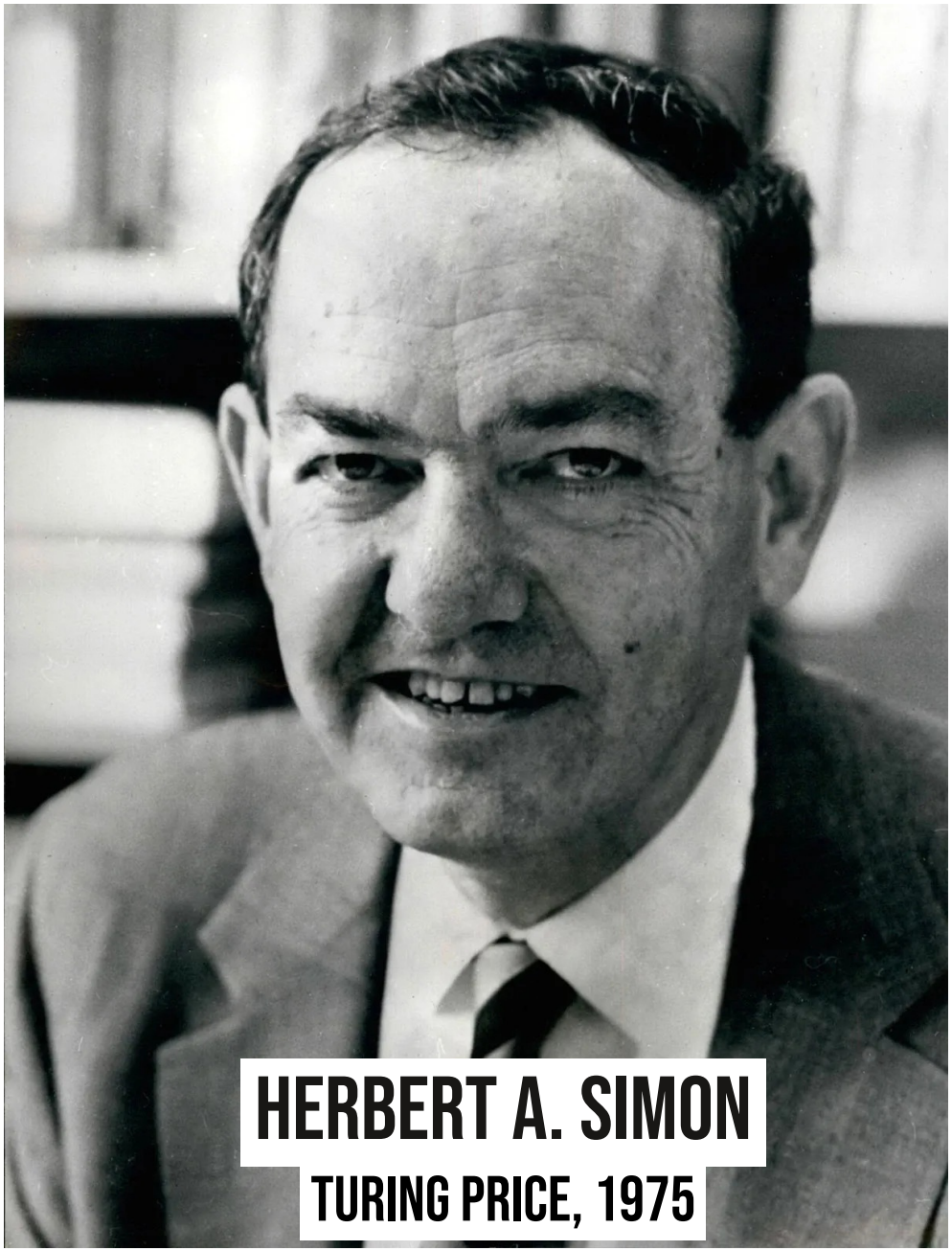
TURING PRICE, 1975

« It is not my aim to surprise or shock you [...].

But the simplest way I can summarize is to say that there are now in the world machines that think, that learn and that create. Moreover, their ability to do these things is going to increase rapidly until—in a visible future—the range of problems they can handle will be coextensive with the range to which the human mind has been applied. »

AltGR

1958

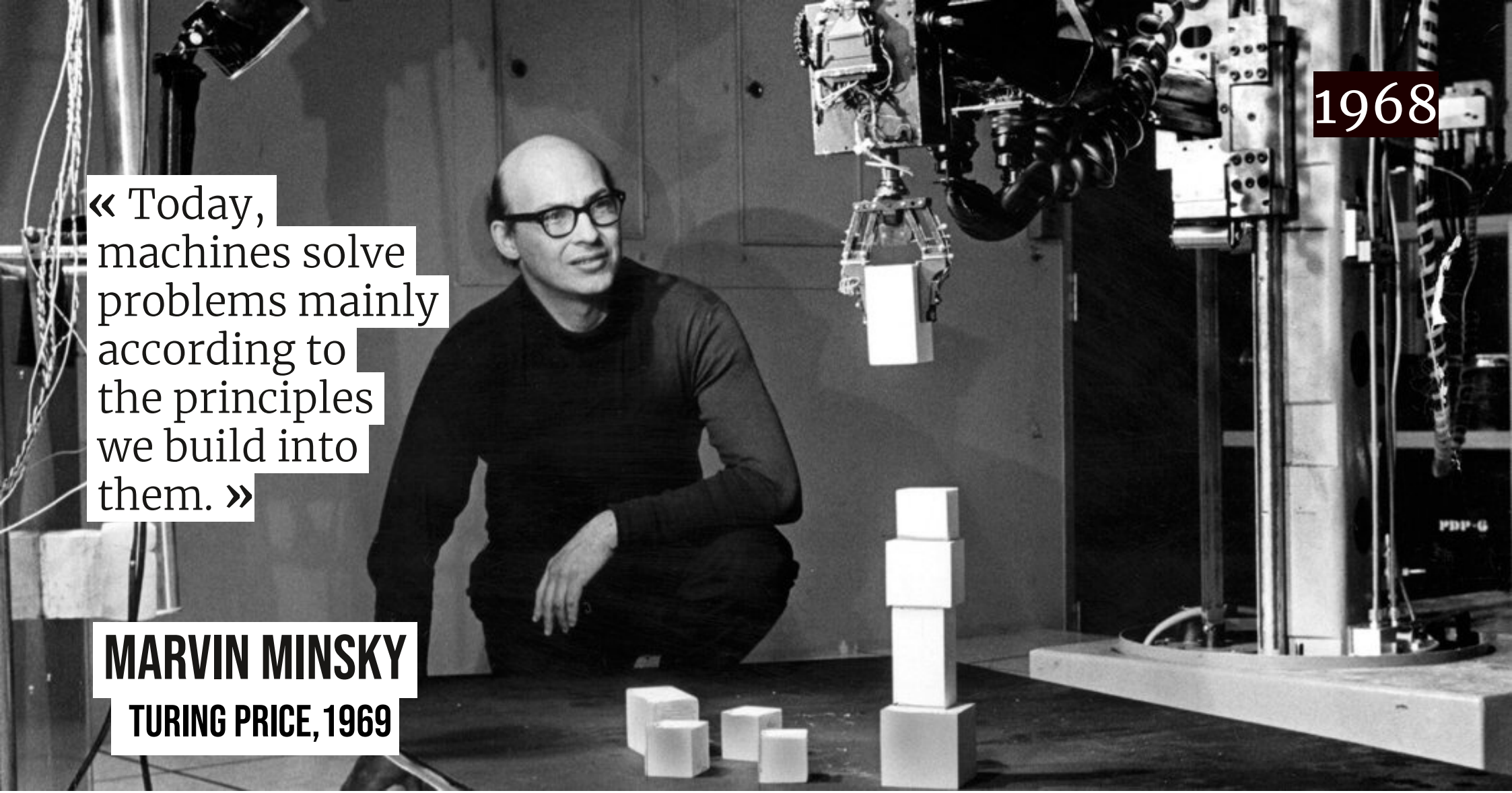


« That within ten years a digital computer will be the world's chess champion, unless the rules bar it from competition.

That within ten years a digital computer will discover and prove an important new mathematical theorem.

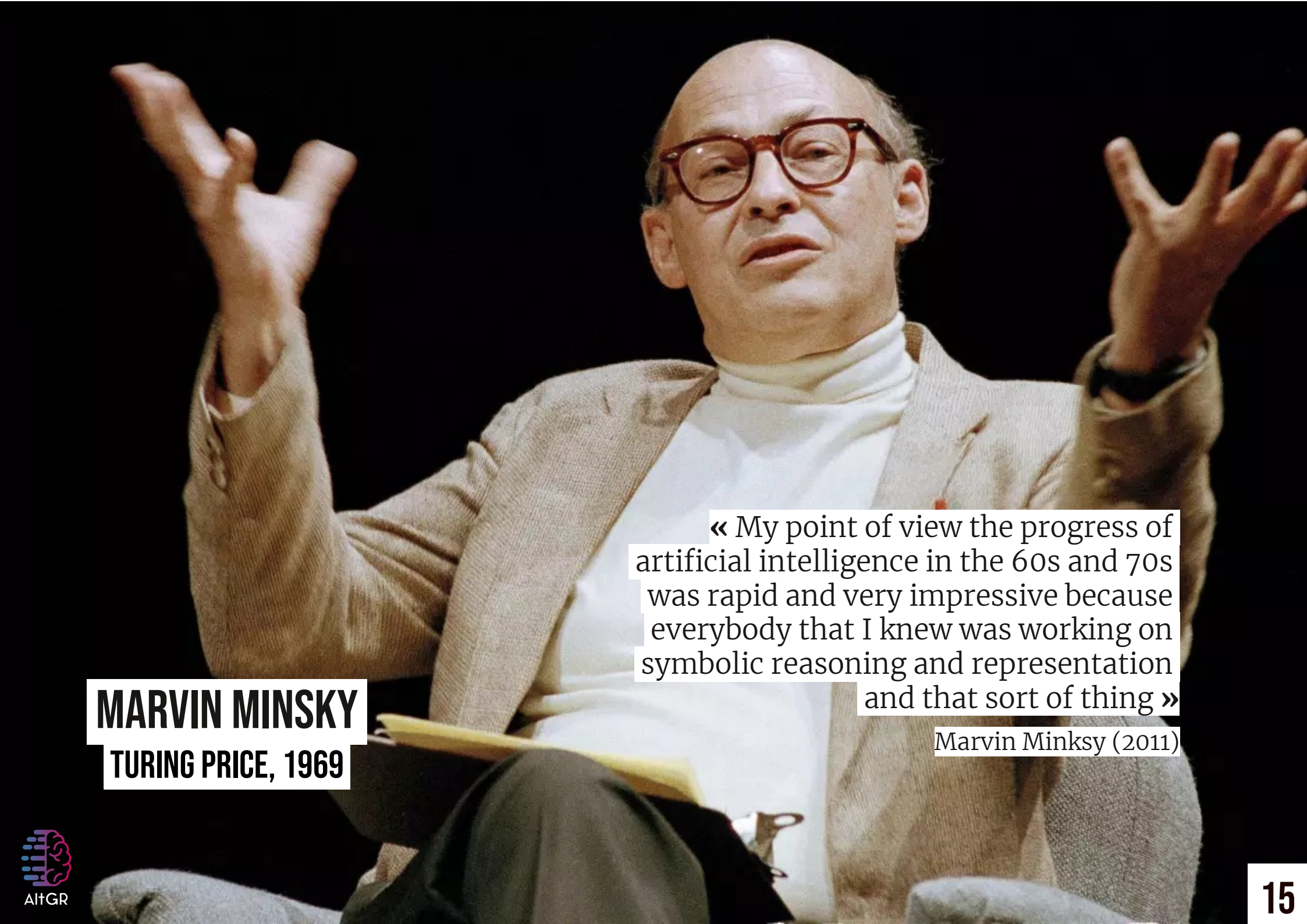
That within ten years most theories in psychology will take the form of computer programs, or of qualitative statements about the characteristics of computer programs. »

AltGR



« Before long, we may learn how to set them to work upon the very special problem of improving their own capacity to solve problems. Once a certain threshold is passed, this could lead to a spiral of acceleration and it may be hard to perfect a reliable “governor” to restrain it. ».

AltGR



MARVIN MINSKY

TURING PRICE, 1969

« My point of view the progress of artificial intelligence in the 60s and 70s was rapid and very impressive because everybody that I knew was working on symbolic reasoning and representation and that sort of thing »

Marvin Minksy (2011)

AltGR

1956-1970

LOGIC THEORIST
GENERAL PROBLEM SOLVER
NEWELL, SIMON & SHAW

SHRDLU
WINOGRAD

ELIZA
WEIZENBAUM

SHAKEY
STANFORD RESEARCH INSTITUTE

PERCEPTRON
ROSENBLATT

LISP
MCCARTHY, RUSSELL & MIT LAB

PROLOG
COLMERAUER, ROUSSEL (1972)

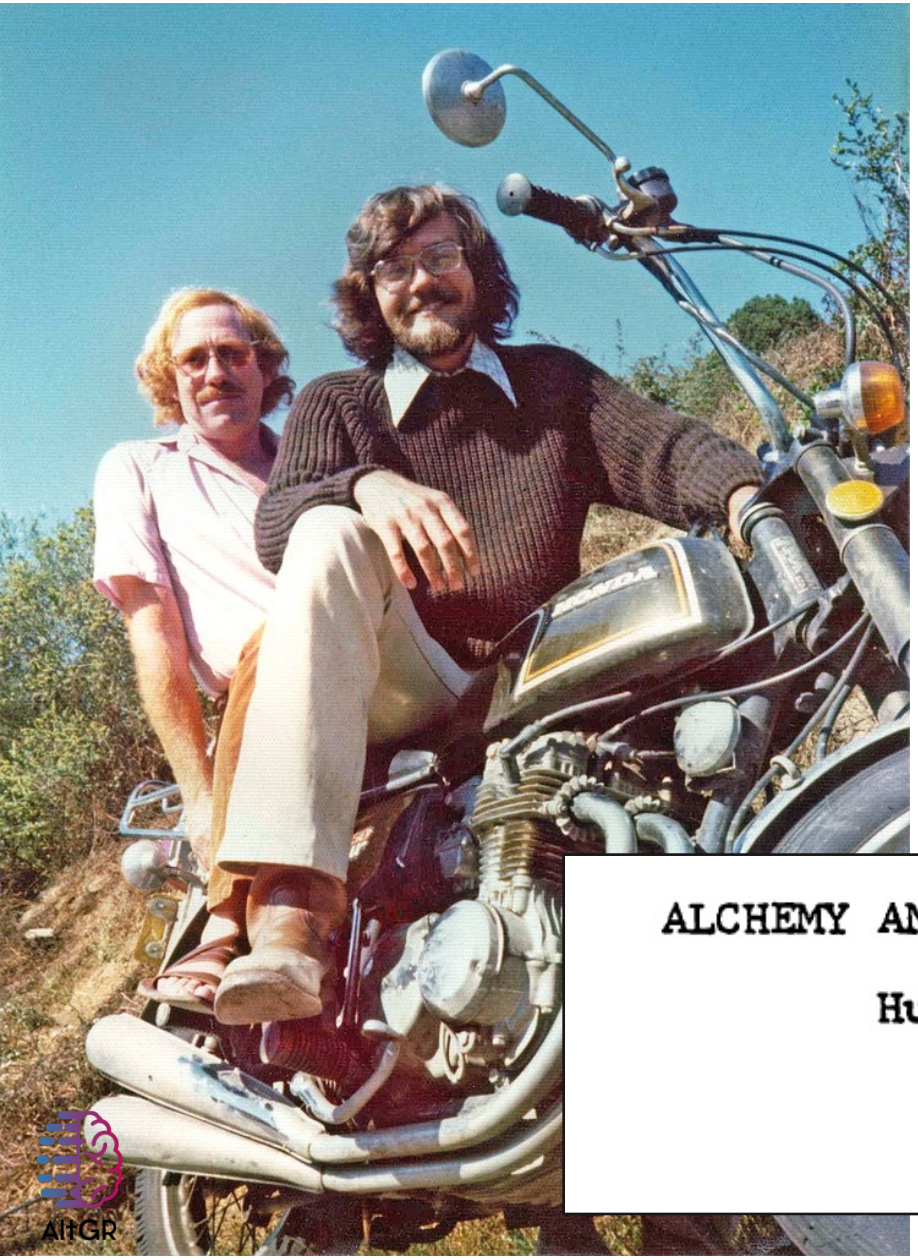
AltGR

WINTER

AltGR

HARSH CRITICS ON THE DOMAIN

1970s



Part I Artificial Intelligence

A general survey by Sir James Lighthill FRS
Lucasian Professor of Applied Mathematics,
Cambridge University. July 1972.

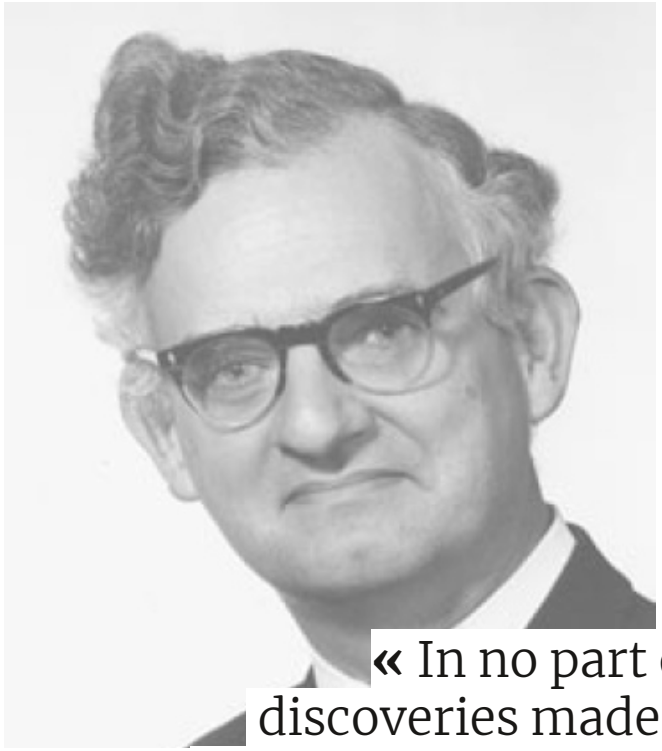
ALCHEMY AND ARTIFICIAL INTELLIGENCE

Hubert L. Dreyfus

December 1965

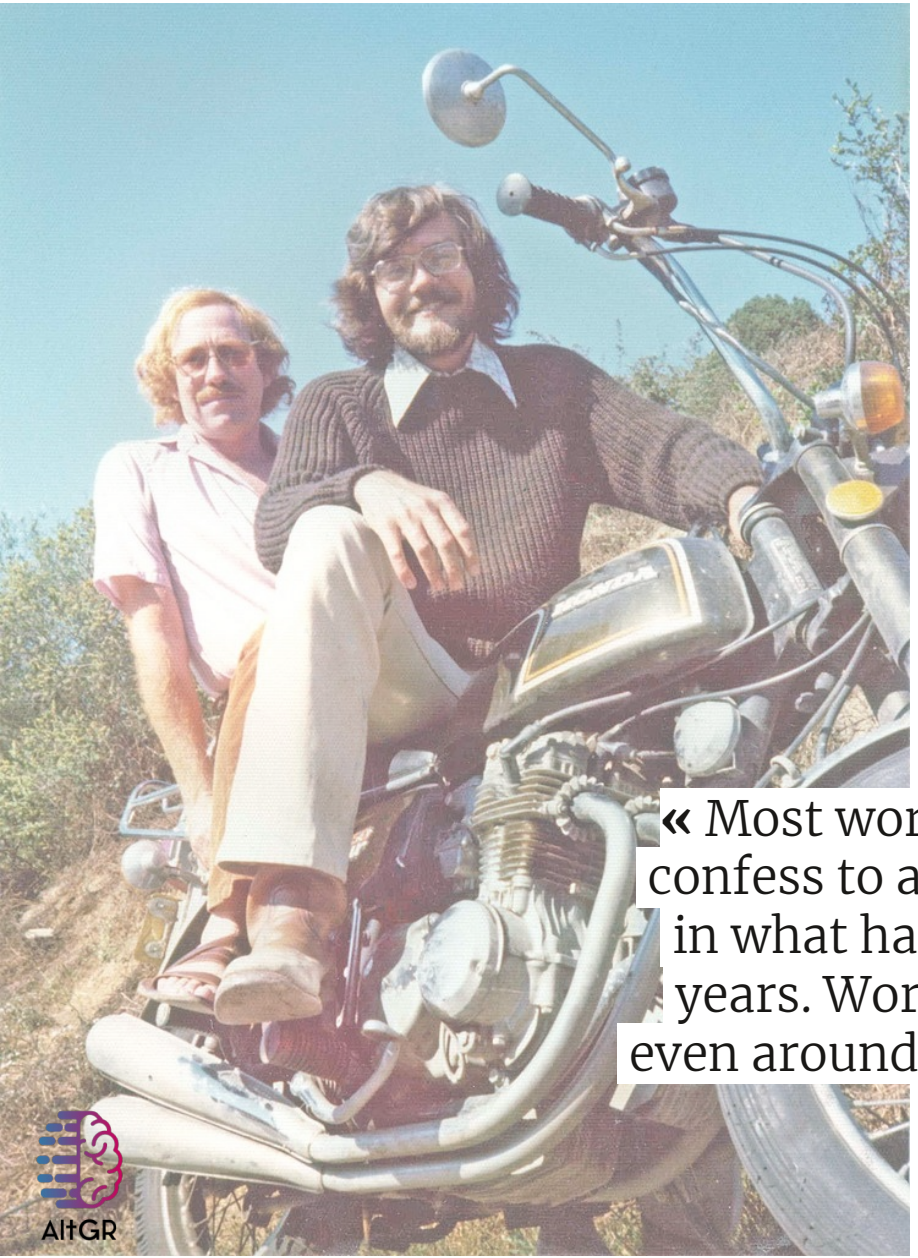
AItGR

~1970s



« In no part of the field have the discoveries made so far produced the major impact that was then promised. »

J. Lighthill (1973)



« Most workers in AI research and in related fields confess to a pronounced feeling of disappointment in what has been achieved in the past twenty-five years. Workers entered the field around 1950, and even around 1960, with high hopes that are very far from having been realised in 1972. »

J. Lighthill (1973)

AltGR

DID MINSKY AND PAPERT KILL NEURAL NETS ?

~1969

Marvin Minsky and Seymour Papert

Perceptrons

An Introduction to Computational Geometry

AltGR

DID MINSKY AND PAPERT KILL NEURAL NETS ?

1969

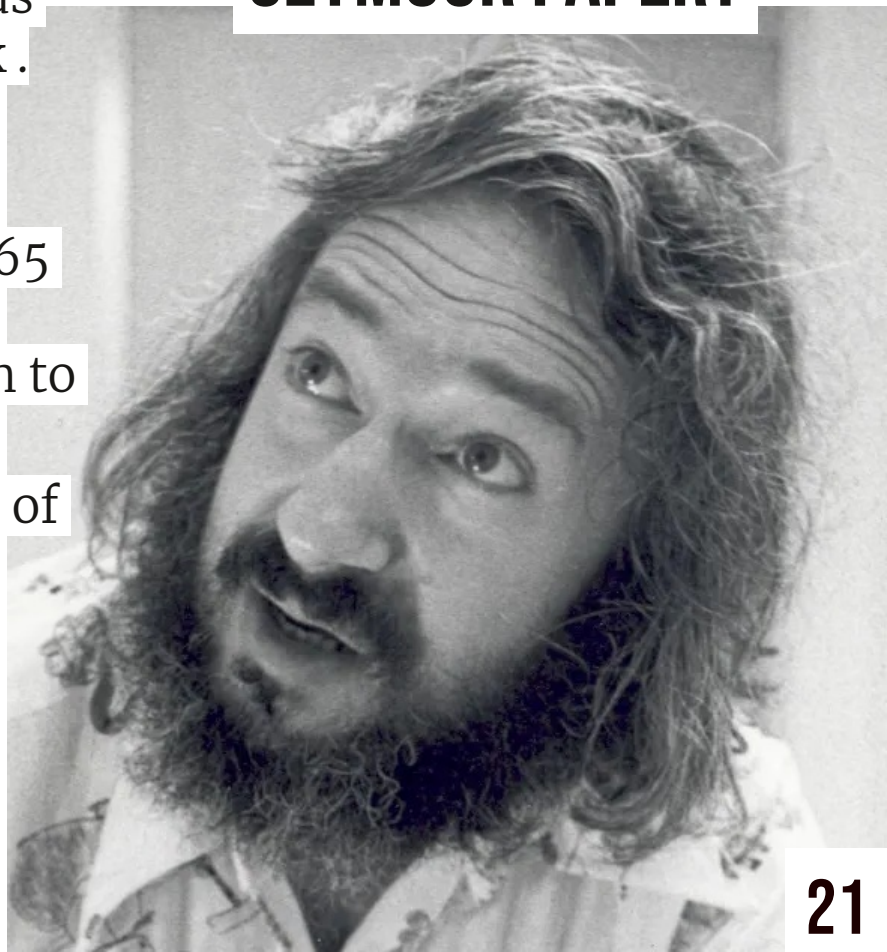
« In the late 1950s, after Rosenblatt's work, there was a great wave of neural network research activity [called perceptrons at the time]. There were maybe thousands of projects in the early 1960s, after Rosenblatt's work .

For example Stanford Research Institute had a good project. But nothing happened.

The machines were very limited. So I would say by 1965 people were getting worried. They were trying to get money to build bigger machines, but they didn't seem to be going anywhere.

That's when Papert and I tried to work out the theory of what was possible for the machines without loops [feedforward perceptrons]. »

SEYMOUR PAPERT



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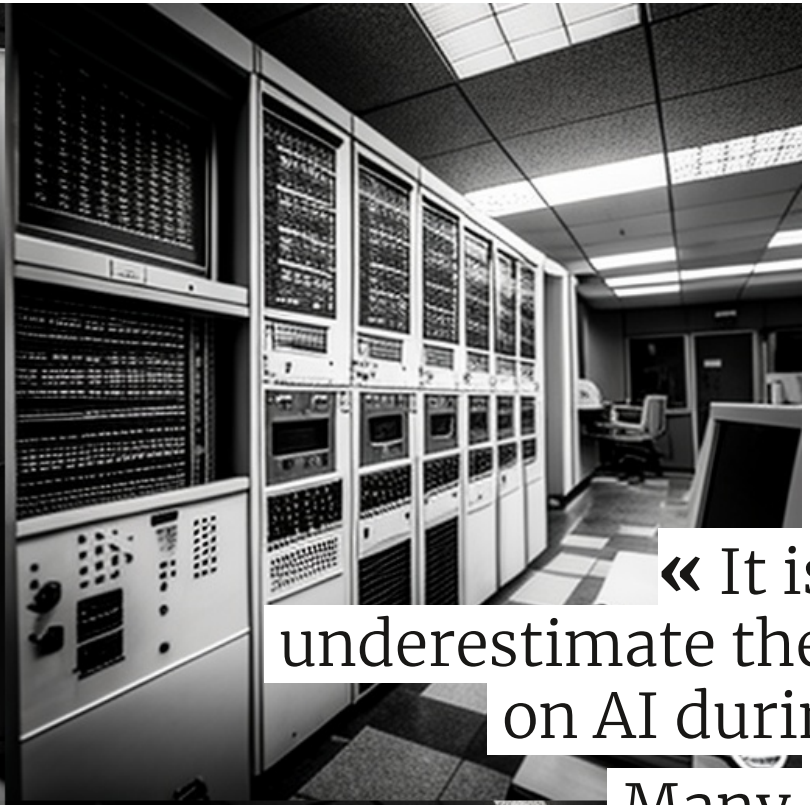
DID MINSKY AND PAPERT KILL NEURAL NETS ?

1969

« What I would like to emphasize here is that the main points of Minsky and Papert's arguments against the perceptron were well known by the mid-1960s, and that those arguments had had a critical effect on neural network research by then. »

M. Olazaran (1993)

AltGR



~1970-80s

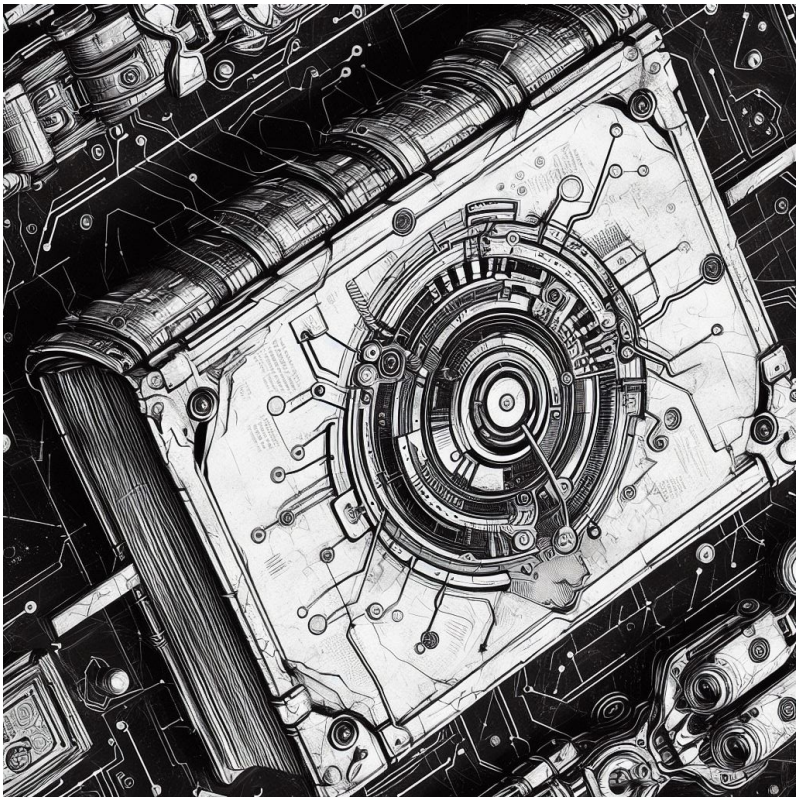
THE FIRST WINTER

« It is important not to underestimate the damage inflicted on AI during the mid-1970s. Many academics started to treat AI as a pseudoscience —the field has really only recently recovered from the reputational damage it suffered during the AI winter. »

M Wooldridge (2021)

AltGR

REVIVAL[S]

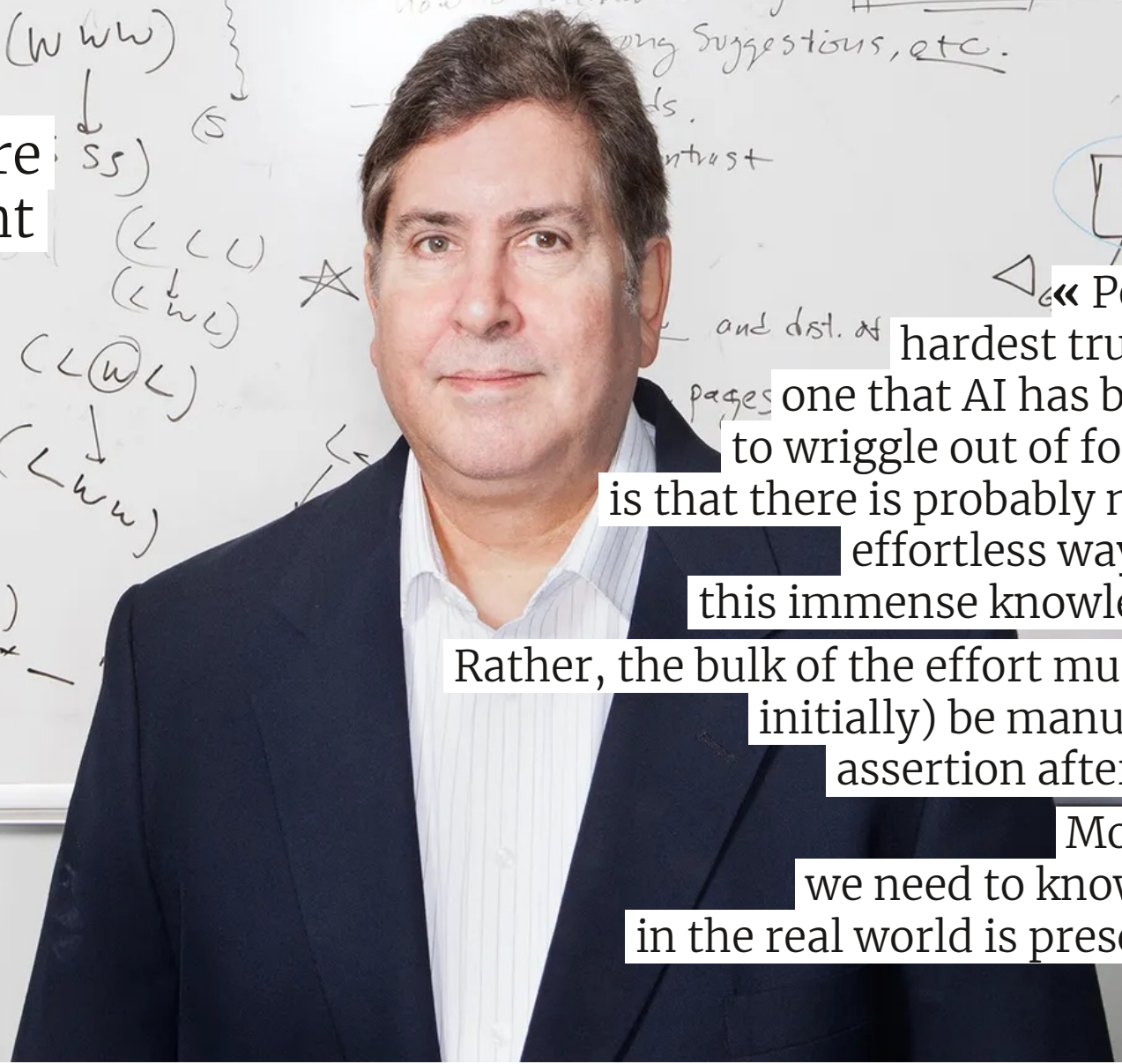


SPRING OF KNOWLEDGE

1980s

« If only there were a Secret Ingredient for intelligence - the Maxwell's Equations of Thought. »

DOUGLAS LENAT



« Perhaps the hardest truth to face, one that AI has been trying to wriggle out of for 34 years, is that there is probably no elegant, effortless way to obtain this immense knowledge base..

Rather, the bulk of the effort must (at least initially) be manual entry of assertion after assertion

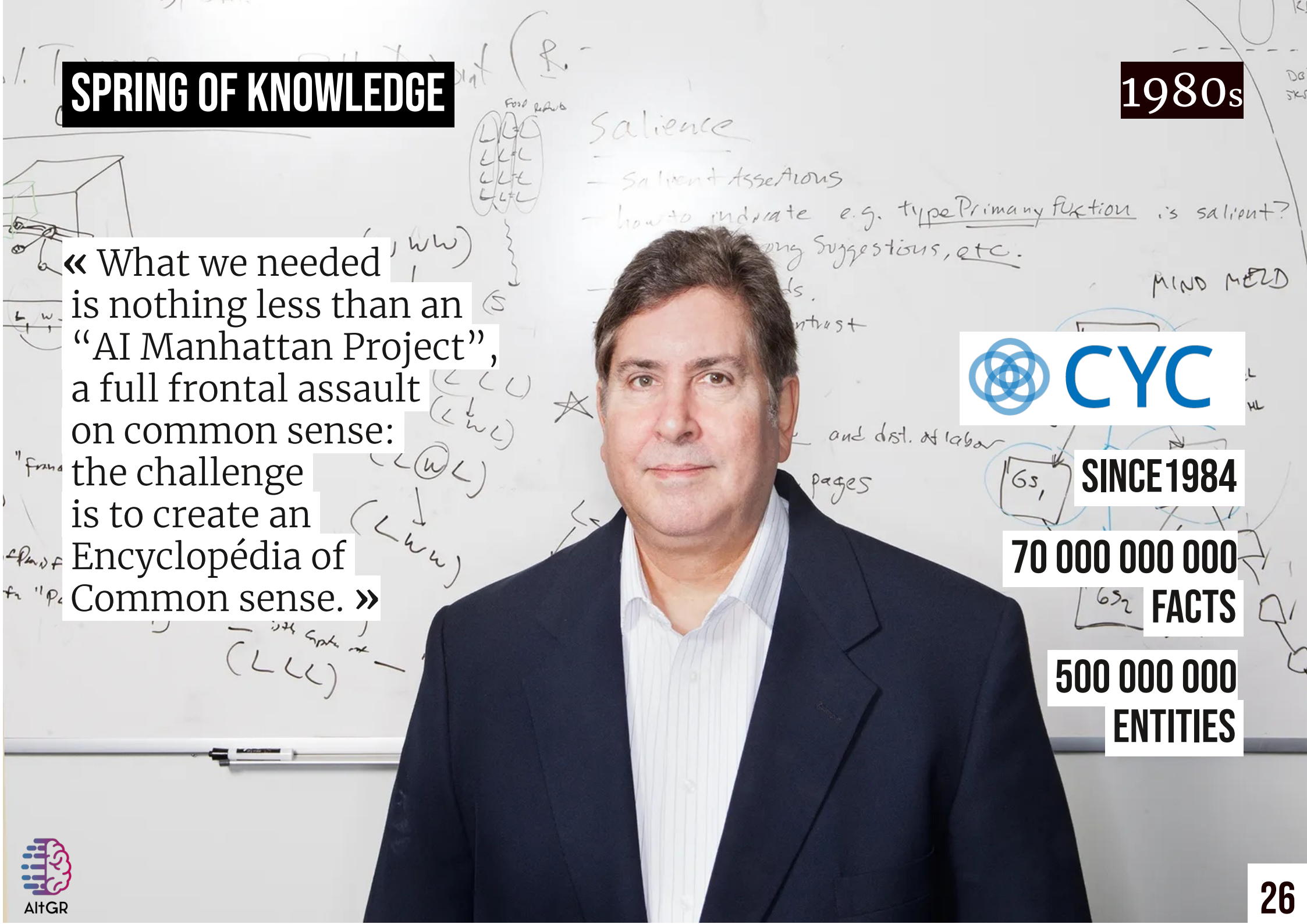
Most of what we need to know to get by in the real world is prescientific. »

AltGR

SPRING OF KNOWLEDGE

1980s

« What we needed is nothing less than an "AI Manhattan Project", a full frontal assault on common sense: the challenge is to create an Encyclopédia of Common sense. »



CYC

SINCE 1984

70 000 000 000 FACTS

500 000 000 ENTITIES

AltGR

SPRING OF KNOWLEDGE

1980s

CYC

« The field might well benefit if CYC were systematicallydescribed and evaluated.

If CYC has solved some significant fraction of commonsense reasoning, then it is critical to know that, both as a useful tool, and as a starting point for further research.

If CYC has run into difficulties, it would be useful to learn from the mistakes that were made.

If CYC is entirely useless, then researchers can at least stop worrying about whether they are reinventing the wheel. »

Gary Marcus (2015)

AltGR

EXPERT SYSTEMS

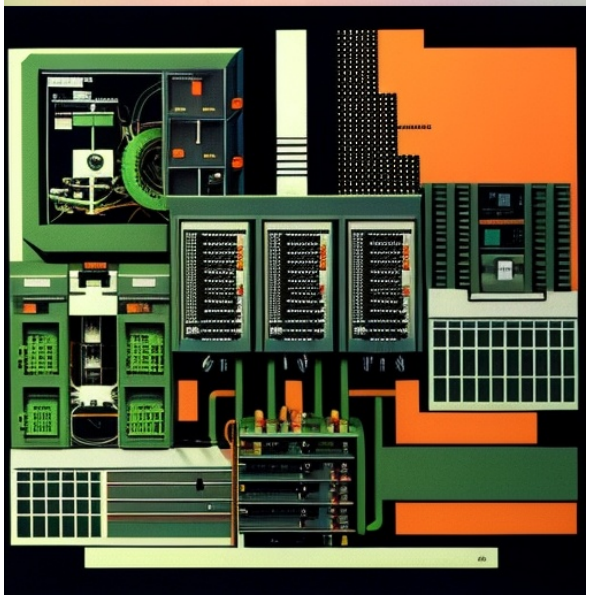
~1970s +80s

DENDRAL
=DYNAMIC ENVIRONMENT FOR DEDUCING REASONING AND LEARNING
HELP ORGANIC CHEMISTS IN IDENTIFYING UNKNOWN ORGANIC MOLECULES

MYCIN
IDENTIFY BACTERIA CAUSING SEVERE INFECTIONS

R1/XCON
=EXPERT CONFIGURER (DEC)
AUTOMATICALLY SELECTING THE COMPUTER SYSTEM COMPONENTS BASED ON THE CUSTOMER'S REQUIREMENTS

SOAR
=SUCCESS ORIENTED ACHIEVEMENT REALIZED
COGNITIVE ARCHITECTURE AND COMPUTATIONAL BLOCKS FOR GENERAL INTELLIGENT AGENTS



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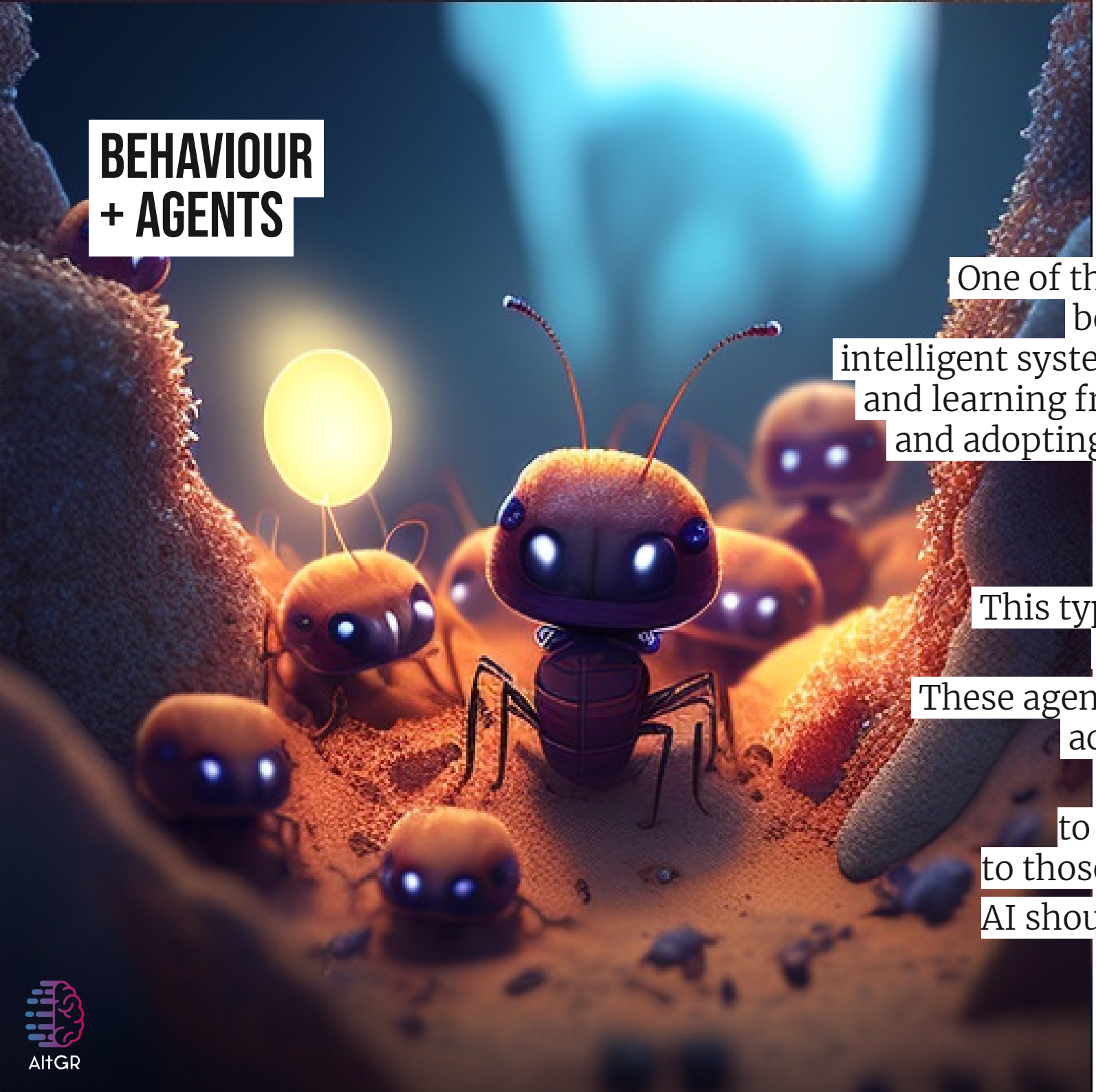


BEHAVIOUR + AGENTS

1990s

One of the primary objectives of behavioral AI is to create intelligent systems capable of adapting and learning from their environment, and adopting behaviors appropriate to a given situation.

This type of AI is used today to create software agents.

These agents are intended to work actively with us or for us.

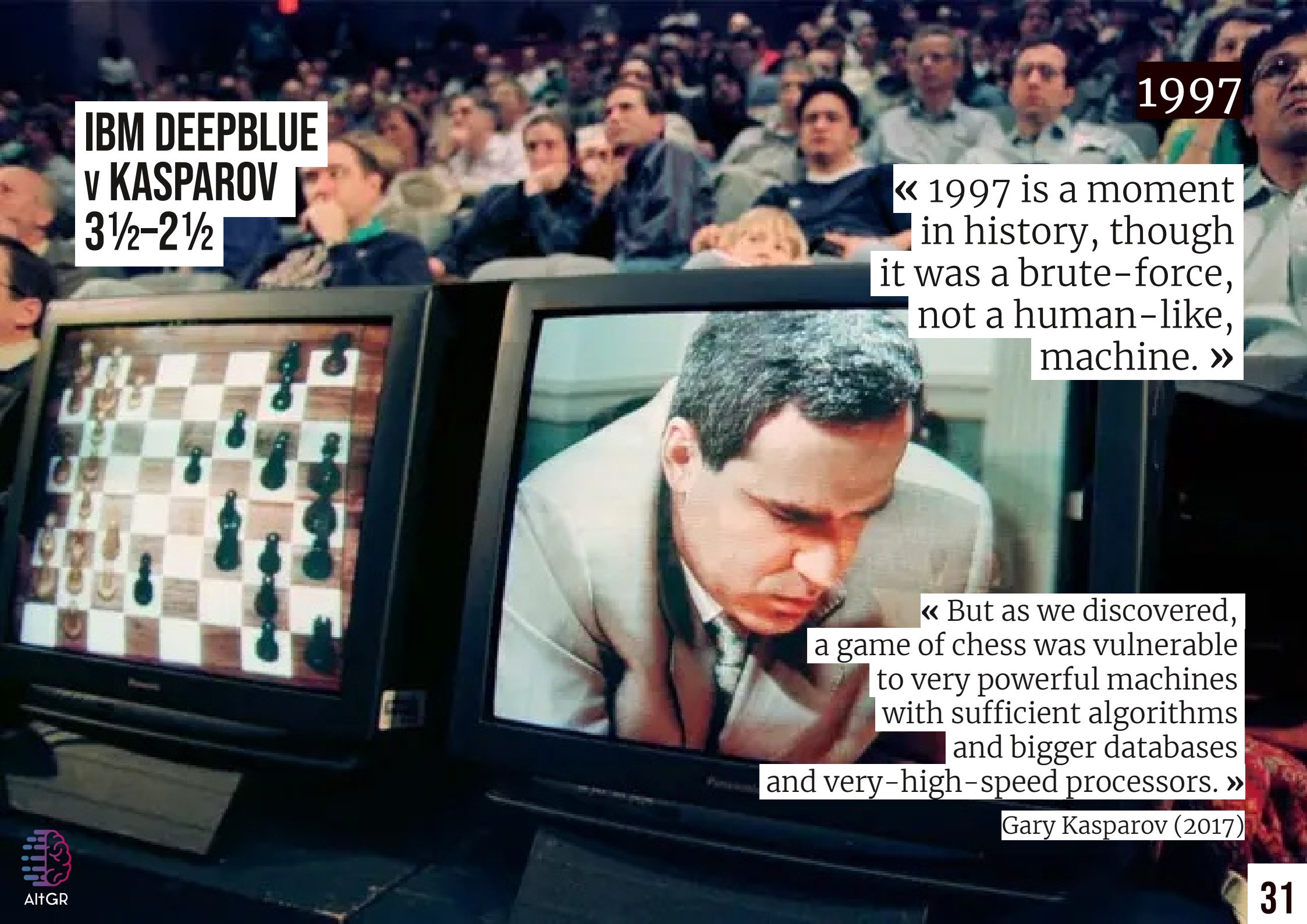
AI no longer needs to make choices identical to those a human would make.

AI should make better choices.

AltGR

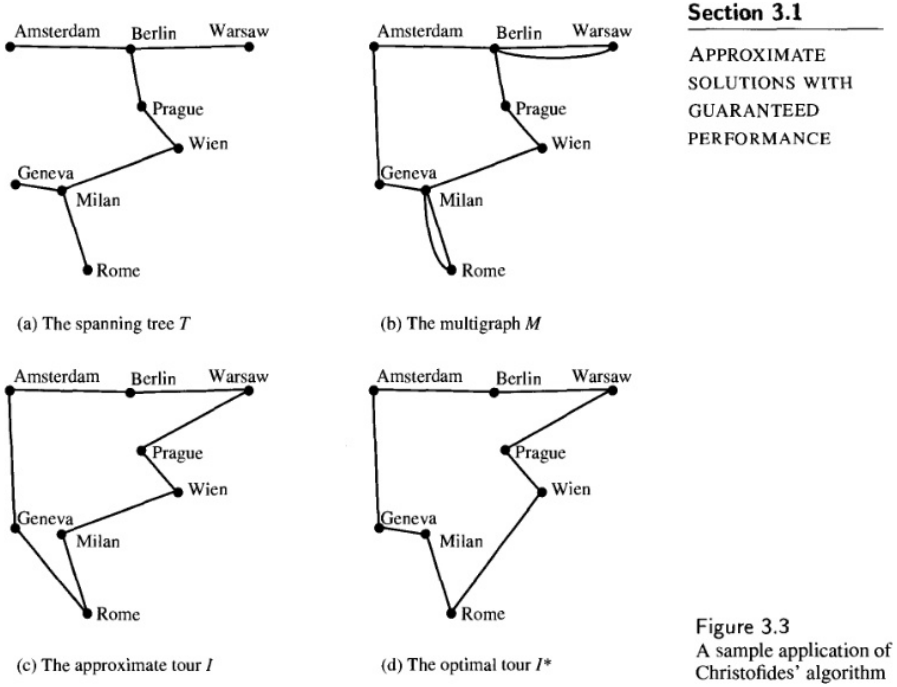
SUCCESSES

AltGR


IBM DEEPBLUE
v KASPAROV
3½–2½
1997
« 1997 is a moment in history, though it was a brute-force, not a human-like, machine. »
« But as we discovered, a game of chess was vulnerable to very powerful machines with sufficient algorithms and bigger databases and very-high-speed processors. »
Gary Kasparov (2017)

SAT SOLVERS OR THE PROBLEM OF BOOLEAN SATISFIABILITY

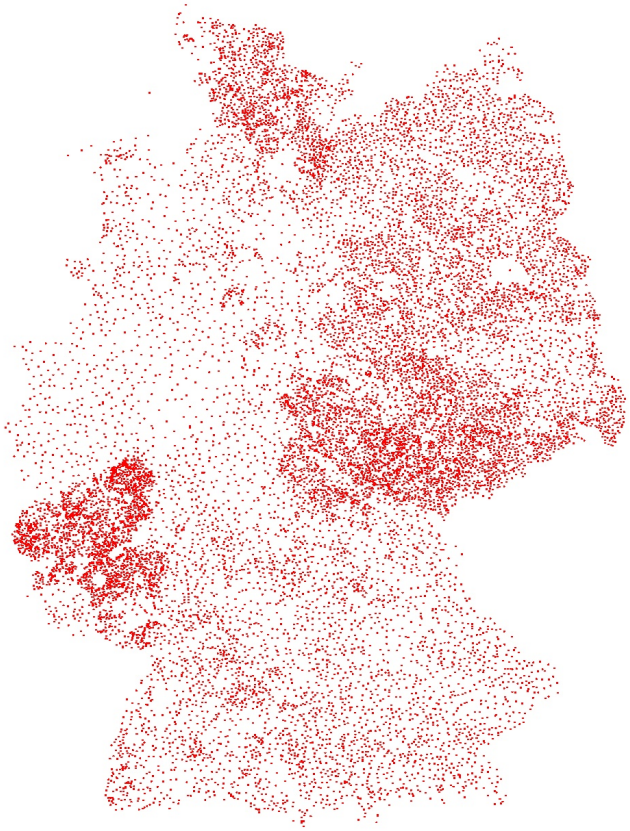
1990s



Section 3.1

APPROXIMATE SOLUTIONS WITH GUARANTEED PERFORMANCE

Figure 3.3
A sample application of Christofides' algorithm

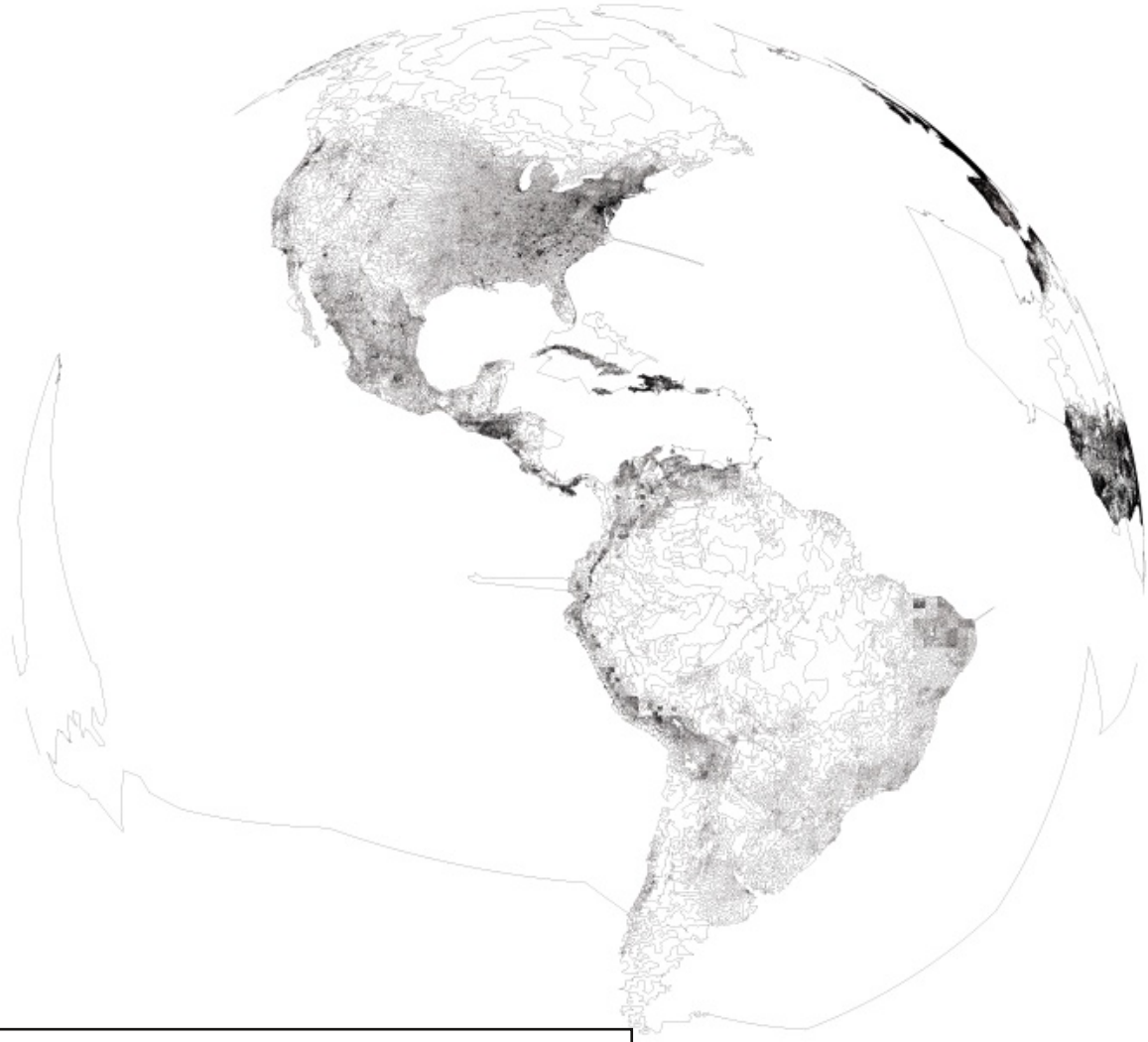


15112 cities, Germany
(TSPLIB, 2001)

AltGR

SAT SOLVERS OR THE PROBLEM OF BOOLEAN SATISFIABILITY

2021



1 904 711 cities
(*LKH heuristic algorithm*, 2021)

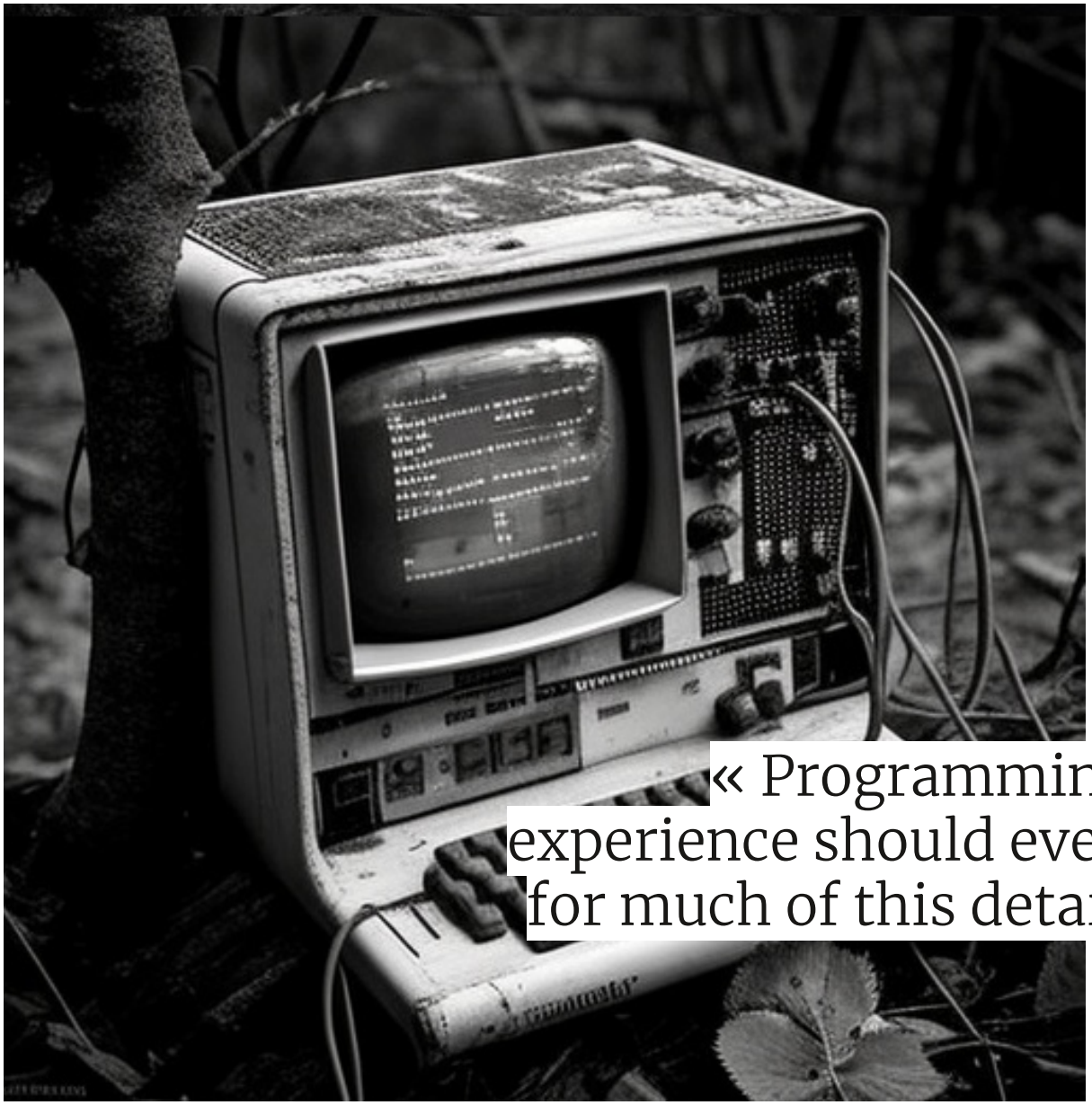
https://www.math.uwaterloo.ca/tsp/world/

AltGR

FOCUS

AltGR

1950s->...

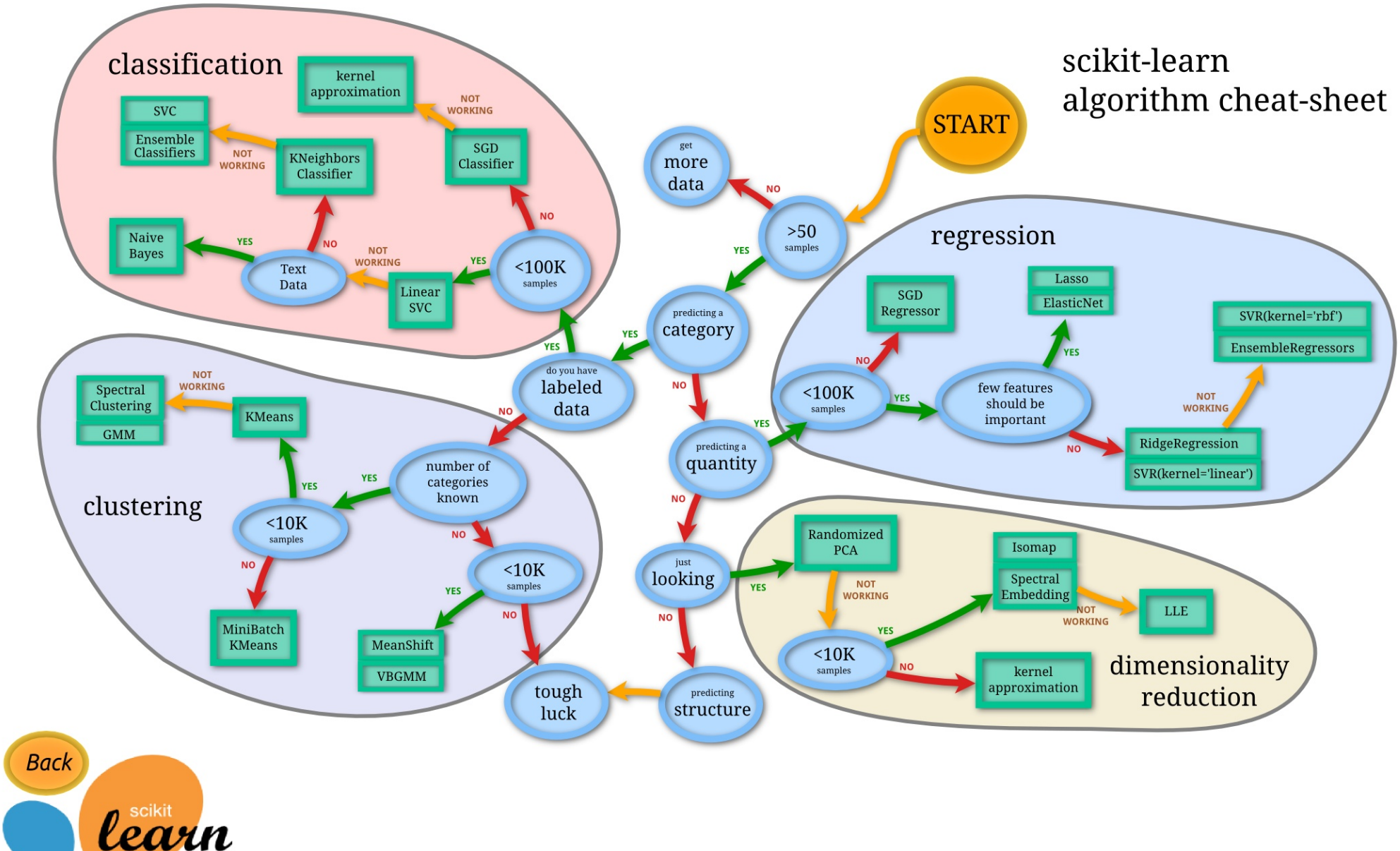


MACHINE LEARNING IS PART OF ARTIFICIAL INTELLIGENCE

« Programming computers to learn from experience should eventually eliminate the need for much of this detailed programming effort. »

Arthur L. Samuel (1959)

AltGR


scikit-learn
algorithm cheat-sheet
START
classification
kernel approximation
NOT WORKING
SVC
Ensemble Classifiers
NOT WORKING
KNeighbors Classifier
SGD Classifier
NO
Naive Bayes
YES
NO
Text Data
NOT WORKING
Linear SVC
YES
<100K samples
NO
get more data
NO
>50 samples
YES
regression
SGD Regressor
Lasso
ElasticNet
SVR(kernel='rbf')
EnsembleRegressors
NO
YES
<100K samples
YES
few features should be important
NOT WORKING
NO
RidgeRegression
SVR(kernel='linear')
predicting a category
YES
NO
do you have labeled data
YES
NO
predicting a quantity
YES
NO
clustering
Spectral Clustering
GMM
NOT WORKING
KMeans
YES
number of categories known
YES
<10K samples
NO
NO
MiniBatch KMeans
<10K samples
YES
NO
MeanShift
VBGMM
just looking
YES
NO
Randomized PCA
NOT WORKING
Isomap
Spectral Embedding
NOT WORKING
LLE
YES
<10K samples
NO
kernel approximation
dimensionality reduction
tough luck
predicting structure
Back
scikit learn

FROM NEURAL NETS TO DEEP LEARNING

« [...] artificial neural networks are made up of many interconnected units, each one capable of computing only one thing [...]

[they] learned to recognize letters without being explicitly taught [and] were puffed enthusiastically in the 1960s newspapers. »

Margaret Boden (2016)

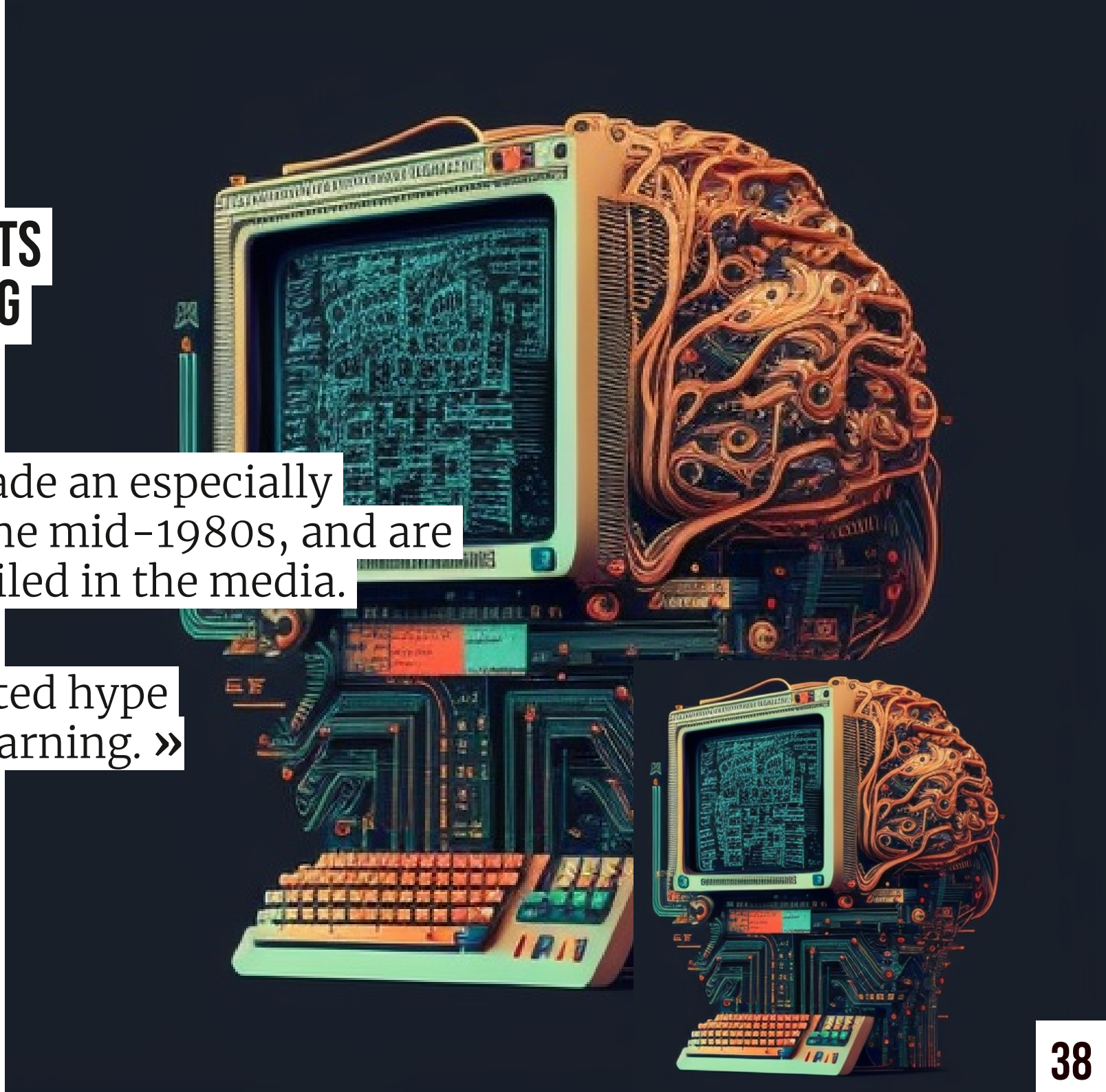
AltGR

FROM NEURAL NETS TO DEEP LEARNING

« Neural nets made an especially noisy splash in the mid-1980s, and are still regularly hailed in the media.

The most recent neural nets-related hype concerns deep learning. »

Margaret Boden (2016)



AltGR

FROM NEURAL NETS TO DEEP LEARNING

« By the 1980s, [neural nets] seemed to be not just a dead end but actually dead. Almost all the research funding had gone into symbolic AI instead. »

(2016)

MARGARET BODEN

OBE FBA

AItGR

DES RÉSEAUX DE NEURONES À L'APPRENTISSAGE PROFOND

« L'apprentissage profond a été initié, en fait, dans les années 1980.

C'est passionnant [...] il permet enfin aux réseaux de neurones de traiter la hiérarchie.

Depuis le début des années 1980, les connexionnistes se sont efforcés de représenter la hiérarchie [...] avec un succès limité.

Mais le domaine n'a explosé que plus récemment, lorsque Hinton a fourni une méthode efficace permettant aux réseaux multicouches de découvrir des relations sur de nombreux niveaux. »

(2016)

MARGARET BODEN

OBE FBA

AltGR

DEEP BUBBLE

AltGR

FROM NEURAL NETS TO DEEP LEARNING

GEOFFREY HINTON

TURING PRICE, 2018

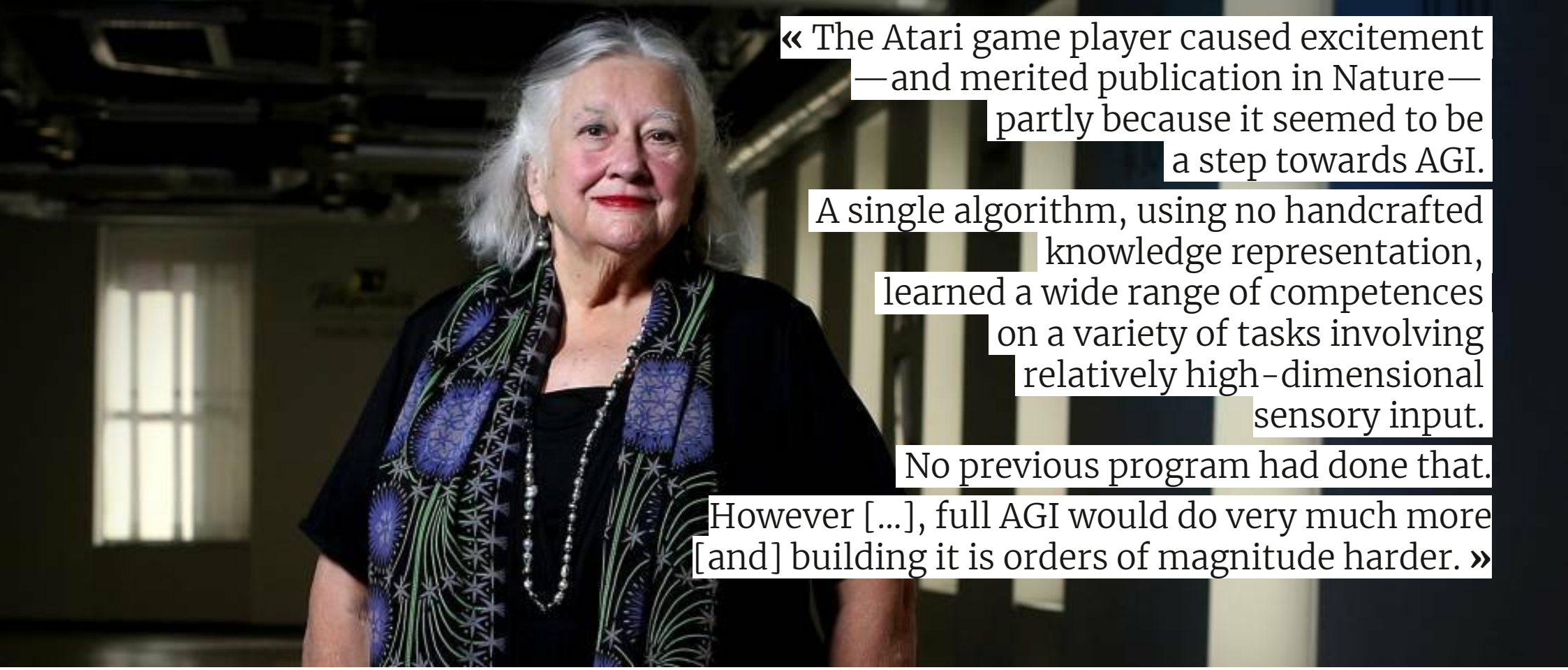
« Our results show that a large, deep convolutional neural network [AlexNet] is capable of achieving recordbreaking results on a highly challenging dataset using purely supervised learning. »

Geoffrey Hinton (2012)

« Finally, we show that our method achieves better performance than an expert human player on **Breakout**, **Enduro** and **Pong** and it achieves close to human performance on **Beam Rider**.

The games **Q*bert**, **Seaquest**, **Space Invaders**, on which we are far from human performance, are more challenging because they require the network to find a strategy that extends over long time scales. »

DeepMind (2013)



« The Atari game player caused excitement —and merited publication in Nature— partly because it seemed to be a step towards AGI.

A single algorithm, using no handcrafted knowledge representation, learned a wide range of competences on a variety of tasks involving relatively high-dimensional sensory input.

No previous program had done that.

However [...], full AGI would do very much more [and] building it is orders of magnitude harder. »

« Deep learning isn't the answer.

Its aficionados admit that
"*new paradigms are needed*"
to combine it with complex reasoning
scholarly code for "*we haven't got a clue*". »

MARGARET BODEN
OBE FBA

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« Most AI researchers abandoned that early hope [of AGI], turning instead to multifarious narrowly defined tasks —often with spectacular success. »

(2016)

« Compared with the brain, neural nets are too neat, too simple, too few and too dry. »

(2016)

MARGARET BODEN

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CONCLUSION

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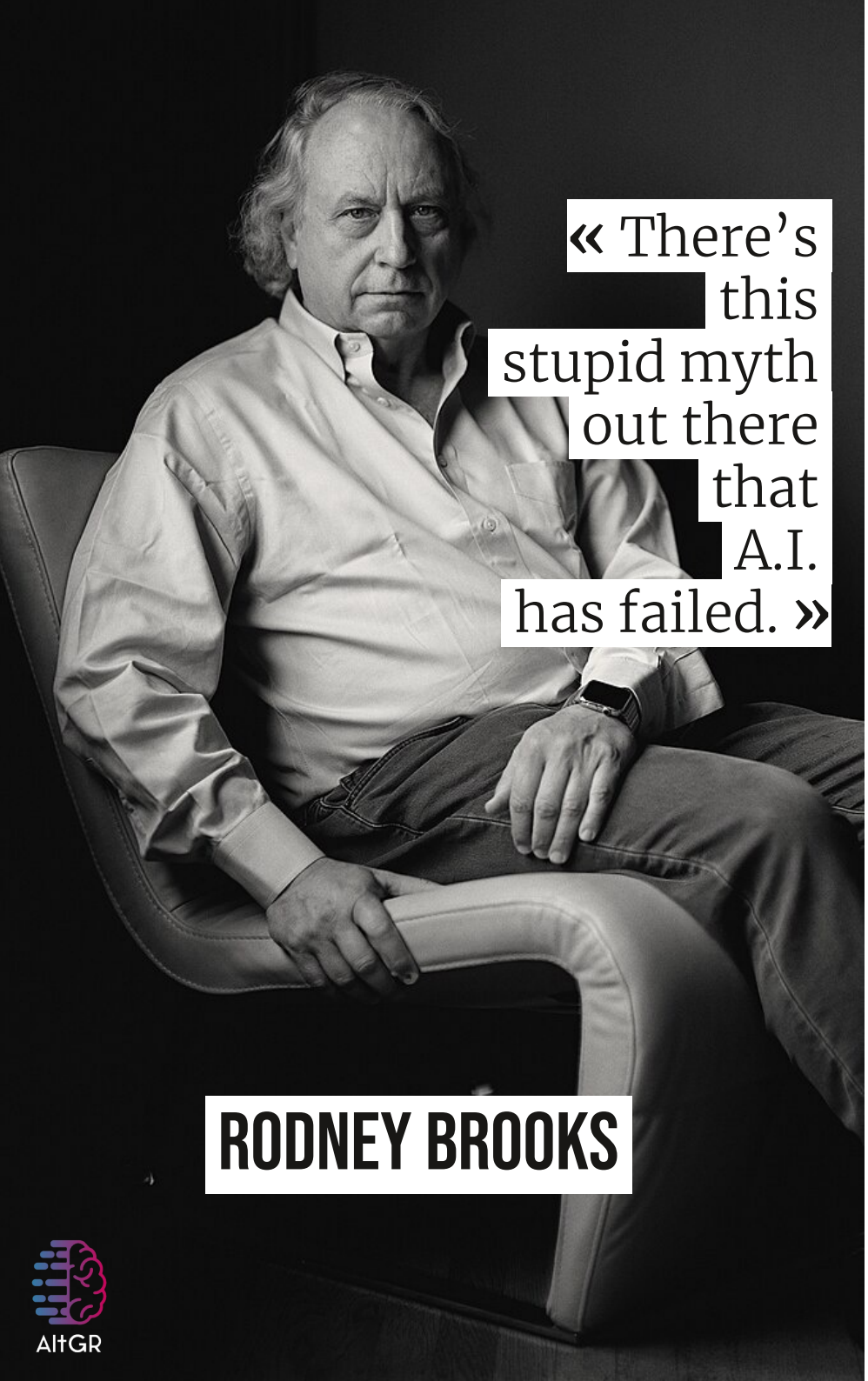


« But A.I. is everywhere around you every second of the day.

People just don't notice it.

You've got A.I. systems in cars, tuning the parameters of the fuel injection systems.

When you land in an airplane, your gate gets chosen by an A.I. scheduling system.

Every time you use a piece of Microsoft software, you've got an A.I. system trying to figure out what you're doing, like writing a letter, and it does a pretty damned good job.

Every time you see a movie with computer-generated characters, they're all little A.I. characters behaving as a group.

Every time you play a video game, you're playing against an A.I. system. »

(2022)

CONVERSATIONNAL AGENTS EXISTED 50 YEARS BEFORE CHATGPT

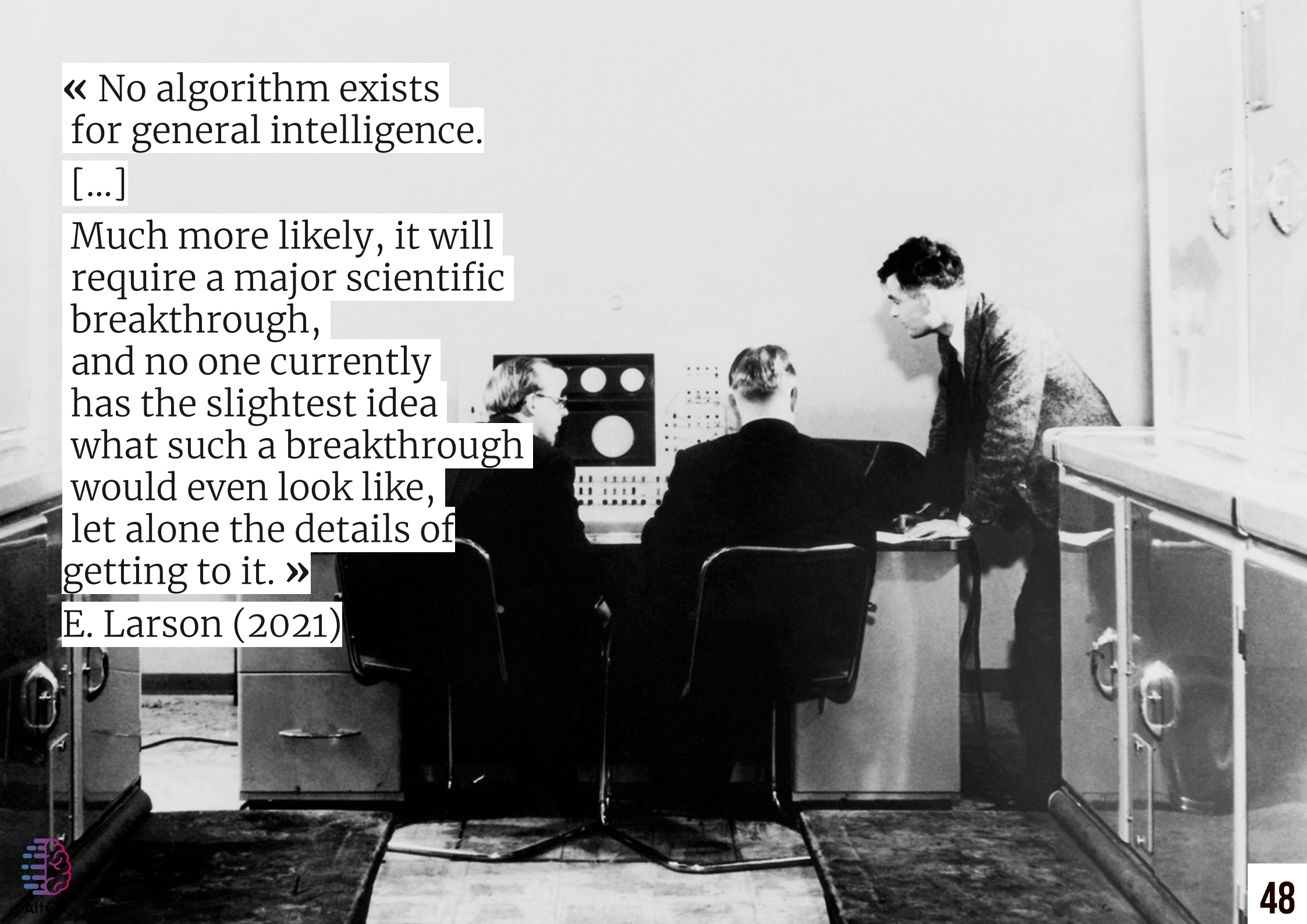
« What I had not realized is that extremely short exposures to a relatively simple computer program could induce powerful delusional thinking in quite normal people. »

Weizenbaum (1976)

```
Welcome to
                EEEEEE  LL      IIII   ZZZZZZ   AAAAA
                EE      LL       II       ZZ   AA   AA
                EEEEE   LL       II     ZZZ    AAAAAAA
                EE      LL       II    ZZ      AA   AA
                EEEEEE  LLLLLL  IIII ZZZZZZ    AA   AA

  Eliza is a mock Rogerian psychotherapist.
  The original program was described by Joseph Weizenbaum in 1966.
  This implementation by Norbert Landsteiner 2005.


ELIZA: Is something troubling you ?
YOU:   Men are all alike.
ELIZA: What is the connection, do you suppose ?
YOU:   They're always bugging us about something or other.
ELIZA: Can you think of a specific example ?
YOU:   Well, my boyfriend made me come here.
ELIZA: Is it important to you that your boyfriend made you come here ?
YOU:   He says I'm depressed much of the time.
ELIZA: I am sorry to hear that you are depressed.
YOU:   It's true. I am unhappy.
ELIZA: Can you explain what made you unhappy ?
YOU:
```



« No algorithm exists for general intelligence.

[...]

Much more likely, it will require a major scientific breakthrough, and no one currently has the slightest idea what such a breakthrough would even look like, let alone the details of getting to it. »

E. Larson (2021)

REFERENCES

Images on pages 2, 17, 23, 24, 28, 29, 30, 34, 35, 37, 41 and 45
were generated by programs (**DALL·E**, **MidJourney**).

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