Arthur Lee Samuel

The pioneer of AI

(1901 - 1990)

Loïc Rouaud
11/06/2024

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- Bell Laboratories (career start)
- ILLIAC project
- The first checker program (IBM 701)
- Innovative machine learning techniques
- Min max search
- Alpha-beta pruning
- The techniques Samuel pioneered
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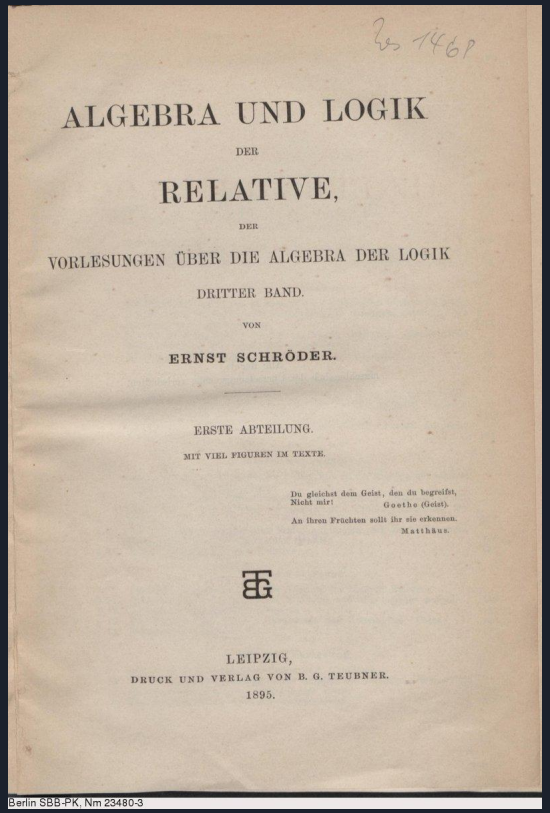
Intro



ALGEBRA UND LOGIK

DER

RELATIVE,

DER

VORLESUNGEN ÜBER DIE ALGEBRA DER LOGIK

DRITTER BAND.

VON

ERNST SCHRÖDER.

ERSTE ABTEILUNG.

MIT VIEL FIGUREN IM TEXTE.

Du gleichst dem Geist, den du begreifst,
Nicht mir! Goethe (Geist).

An ihren Früchten sollt ihr sie erkennen.
Matthäus.

LEIPZIG,
DRUCK UND VERLAG VON B. G. TEUBNER.
1895.

Berlin SBB-PK, Nm 23480-3

From 1890 to 1905

Comprehensive reference to symbolic logic

Youth & Education

Born on December 5, 1901 in Emporia, Kansas

1926

Master degree in Electrical Engineering MIT

Bell Laboratories (career start)

1928

The Gas-Discharge Transmit-Receive Switch

By A. L. SAMUEL, J. W. CLARK and W. W. MUMFORD

THE gas-discharge transmit-receive switch has become an accepted part of every modern radar set. Indeed, without such a device, an efficient single-antenna micro-wave radar would be nearly impossible. Many of the early radar sets made in this country employed separate antennae for the transmitter and receiver. The advantages of single antenna operation are so apparent as hardly to require discussion. The saving in space or, if the same space is to be occupied, the increase in gain and directivity of a large single antenna is, of course, apparent. But even more important, perhaps, is the tremendous simplification in tracking offered by a single antenna, particularly where a very rapid complex scanning motion is desired.

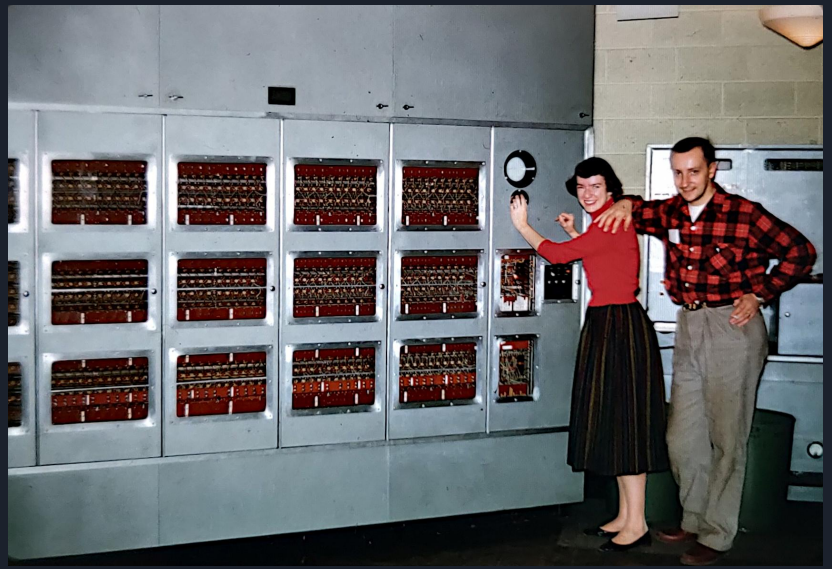
en.wikipedia.org/wiki/Bells_Labs

463 West Street in New York City

ILLIAC project

1946

Professor of Electrical Engineering
University of Illinois

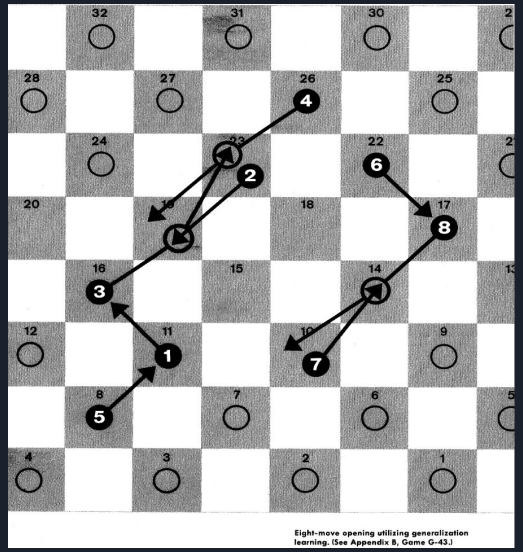


Design one of the first electronic Computers
ILLIAC = **ILL**inois **A**utomatic **C**omputer

The first checker program (IBM 701)

1949

IBM's Poughkeepsie Laboratory, NY



Checkers

The advantage

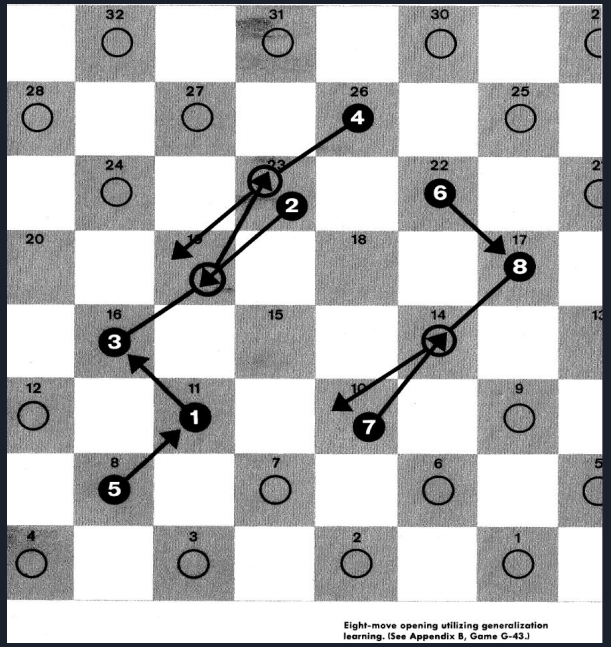
Checker players have access to many volumes of annotated games

Good moves vs bad one

A. L. Samuel, IBM journal

The first checker program

1949



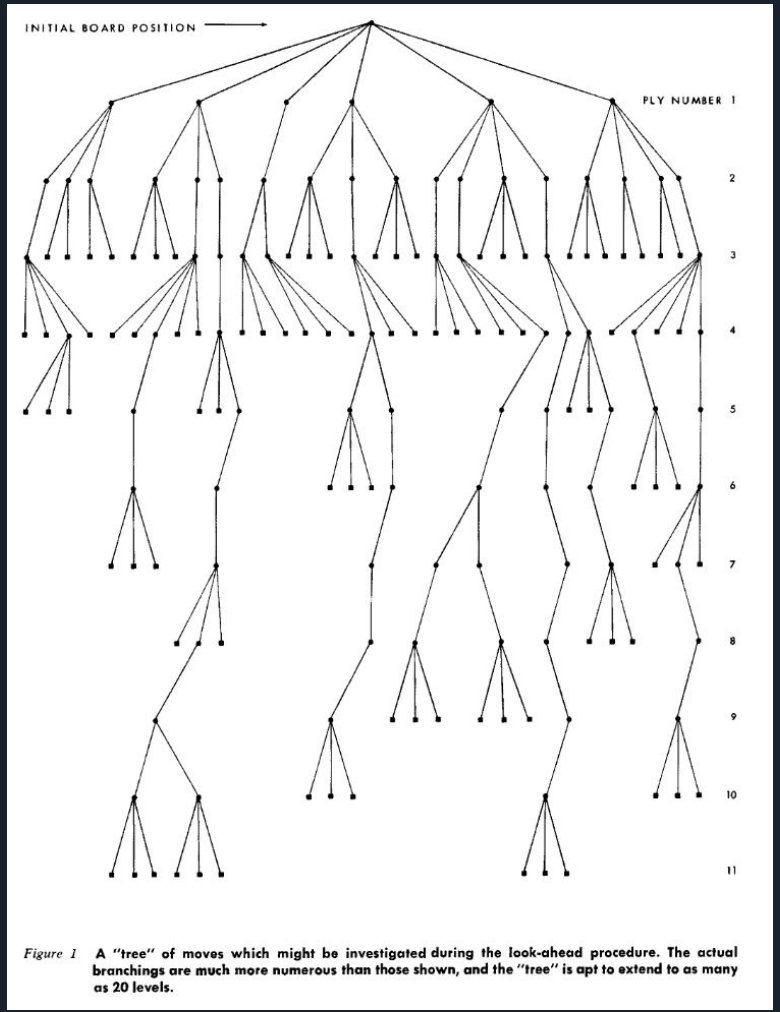
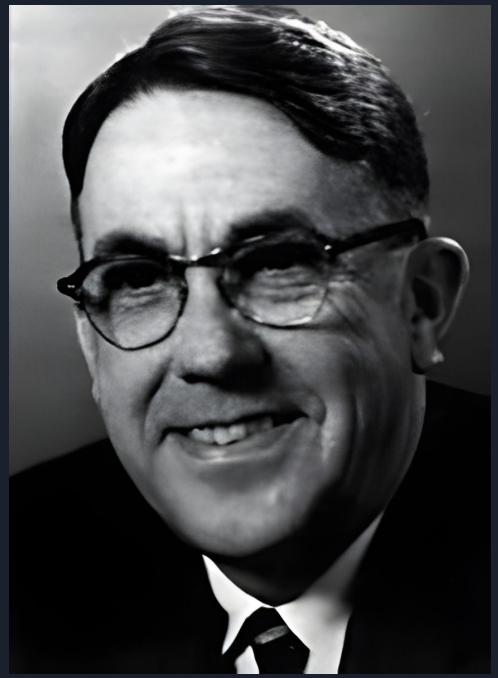


Figure 1 **A "tree" of moves which might be investigated during the look-ahead procedure. The actual branchings are much more numerous than those shown, and the "tree" is apt to extend to as many as 20 levels.**

A. L. Samuel, IBM journal


ARTIFICIAL INTELLIGENCE HAS BECOME SO SMART THAT IT CAN NOW BEAT US AT OUR OWN GAMES.
[Dheya Ghaleb and Midjourney AI]

Machine learning



“Field of study that gives computers the ability to learn without being explicitly programmed.”

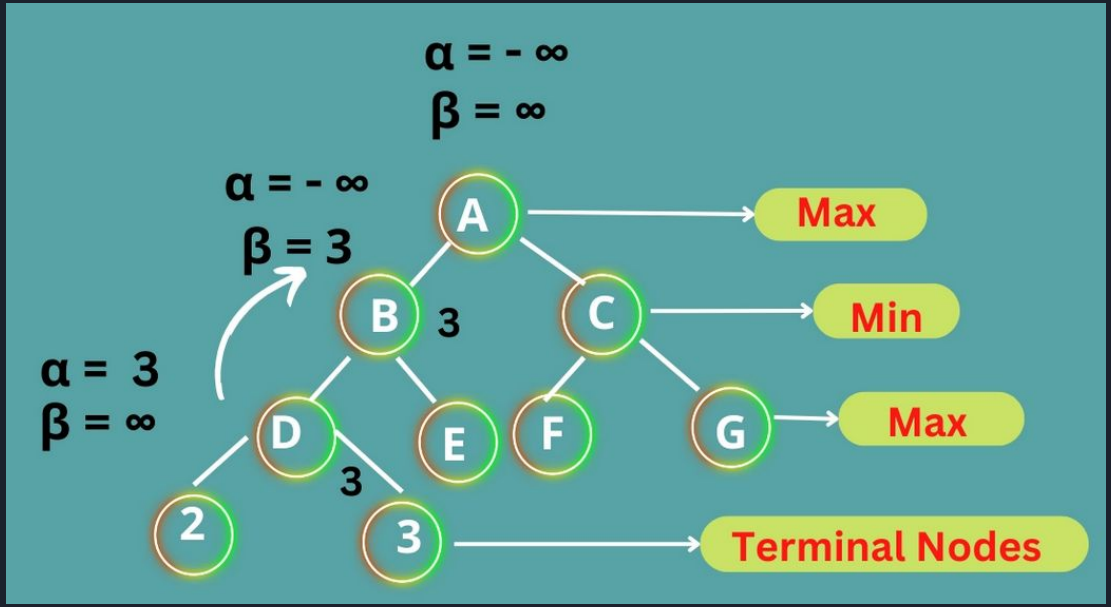
Innovative machine learning techniques

Rote learning
Storage of previously-seen board positions along with their eventual outcomes

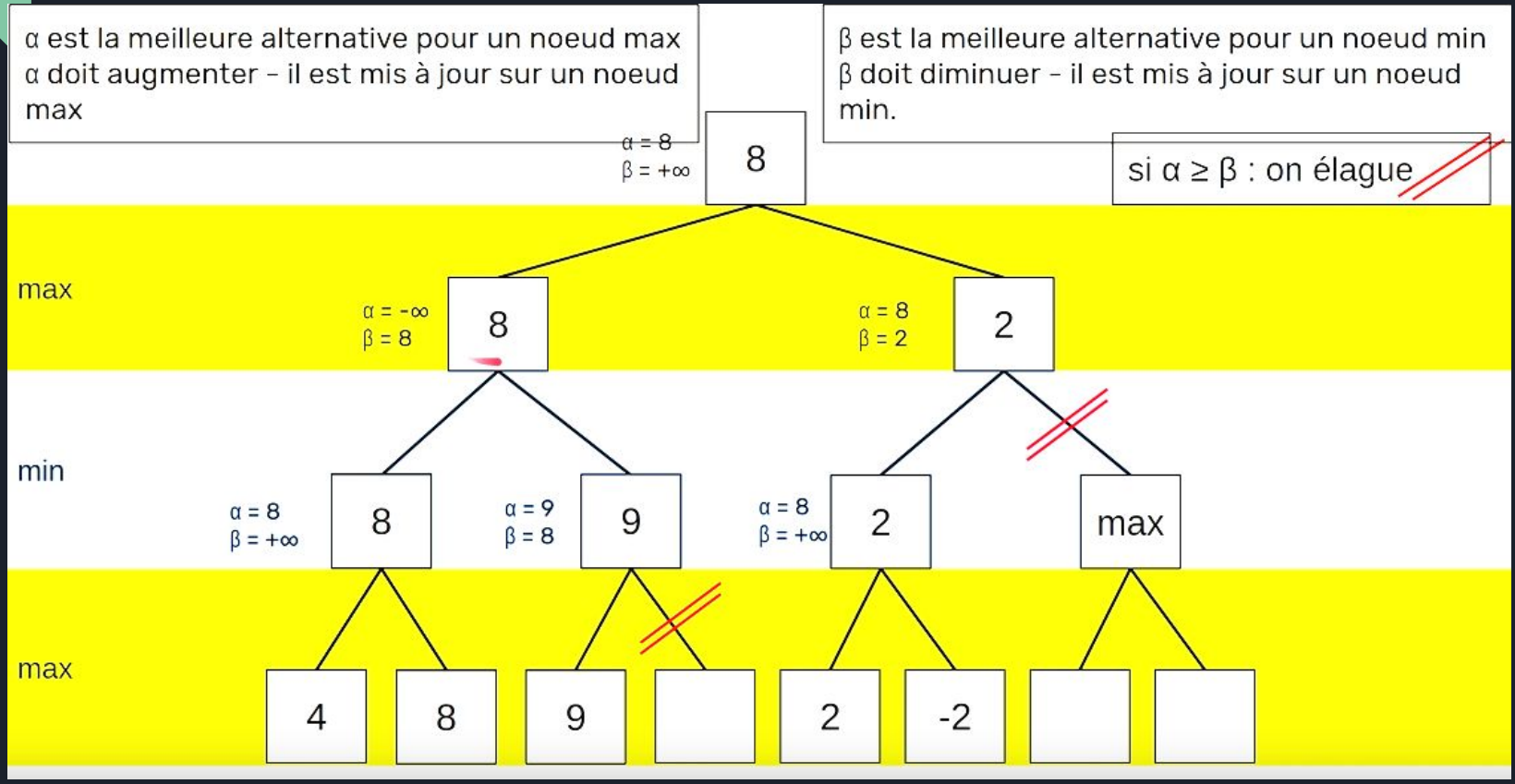
Generalization learning
Refinement of its evaluation function after each game to better reflect the factors that led to victory or defeat

Min max search

This **technique** allow the program to **discard unproming branches of the game tree** ⇒ dramatically **sped** up its search



Alpha-beta pruning



Alpha-beta pruning

```
def alphabeta(node, depth, α, β, maximizingPlayer):
    if depth = 0 or node is a terminal node:
        return the heuristic value of node
    if maximizingPlayer:
        v = -∞
        for each child of node:
            v = max(v, alphabeta(child, depth - 1, α, β, FALSE))
            α = max(α, v)
            if β ≤ α:
                break # β cut-off
        return v
    else:
        v = +∞
        for each child of node:
            v = min(v, alphabeta(child, depth - 1, α, β, TRUE))
            β = min(β, v)
            if β ≤ α:
                break # α cut-off
        return v
```

Python

A modern implementation of alpha-beta pruning in Python (Source: Wikipedia)

The techniques Samuel pioneered

Generalization learning

Alpha-beta pruning → Deep blue chess supercomputer (1989 - 1997)

Minimax search → Google DeepMind‘s AlphaGo (2016)

Self-play → DeepMind‘s AlphaZero masters chess (2017) with reinforcement learning like Samuel technique with modern deep learning techniques

More details on Arthur Samuel

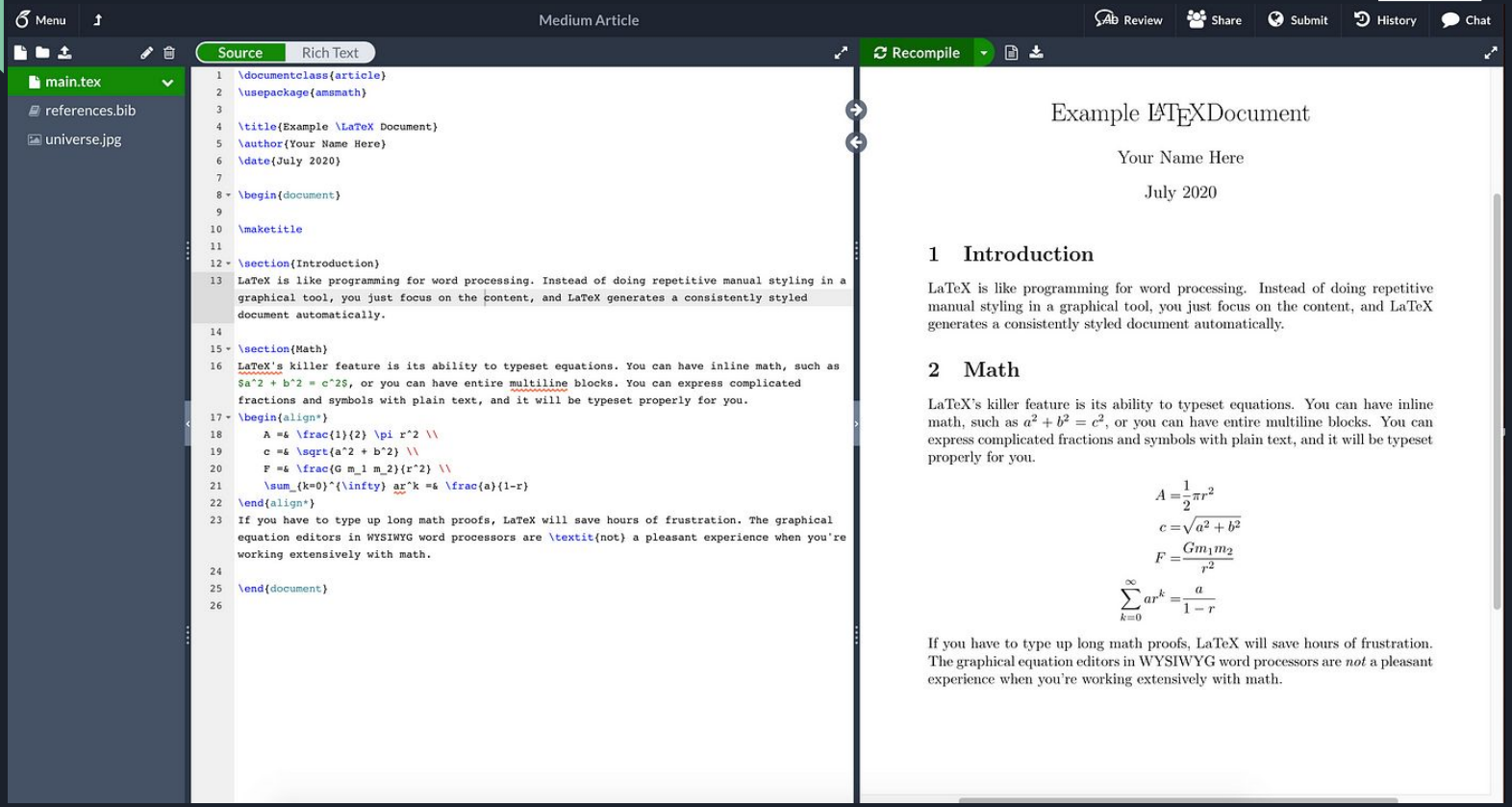
Played a large role in IBM → Zurich lab (Nobel Prize)

Teached at the Stanford University as a Lecturer and Research Associate (1966)

Worked on speech recognition (DARPA)

Contributed LaTeX typesetting system (86)

Contribution to LaTeX




I'M SORRY, DAVE,
I'M AFRAID
I CAN'T DO THAT.
TODAY, SUCCESS IN GAMING HAS LED US TO CHATGPT. THE BOT IS SO EERILY HUMAN, IT MAKES YOU WONDER IF A.I. WILL EVER HAVE A MIND OF ITS OWN.
[Dheya Ghaleb and Midjourney AI]


Thank You
for your attention

Bibliography

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Alpha beta pruning :
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