Linguistic Geometry: Adversarial Reasoning for Real Life Problems

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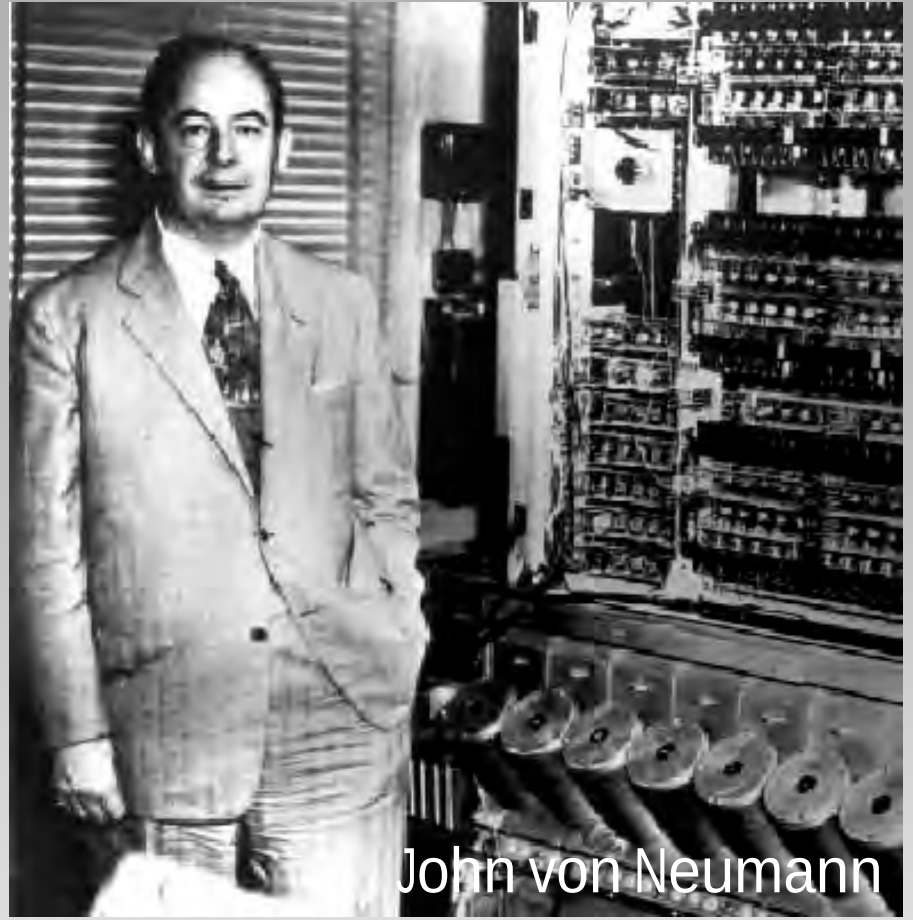
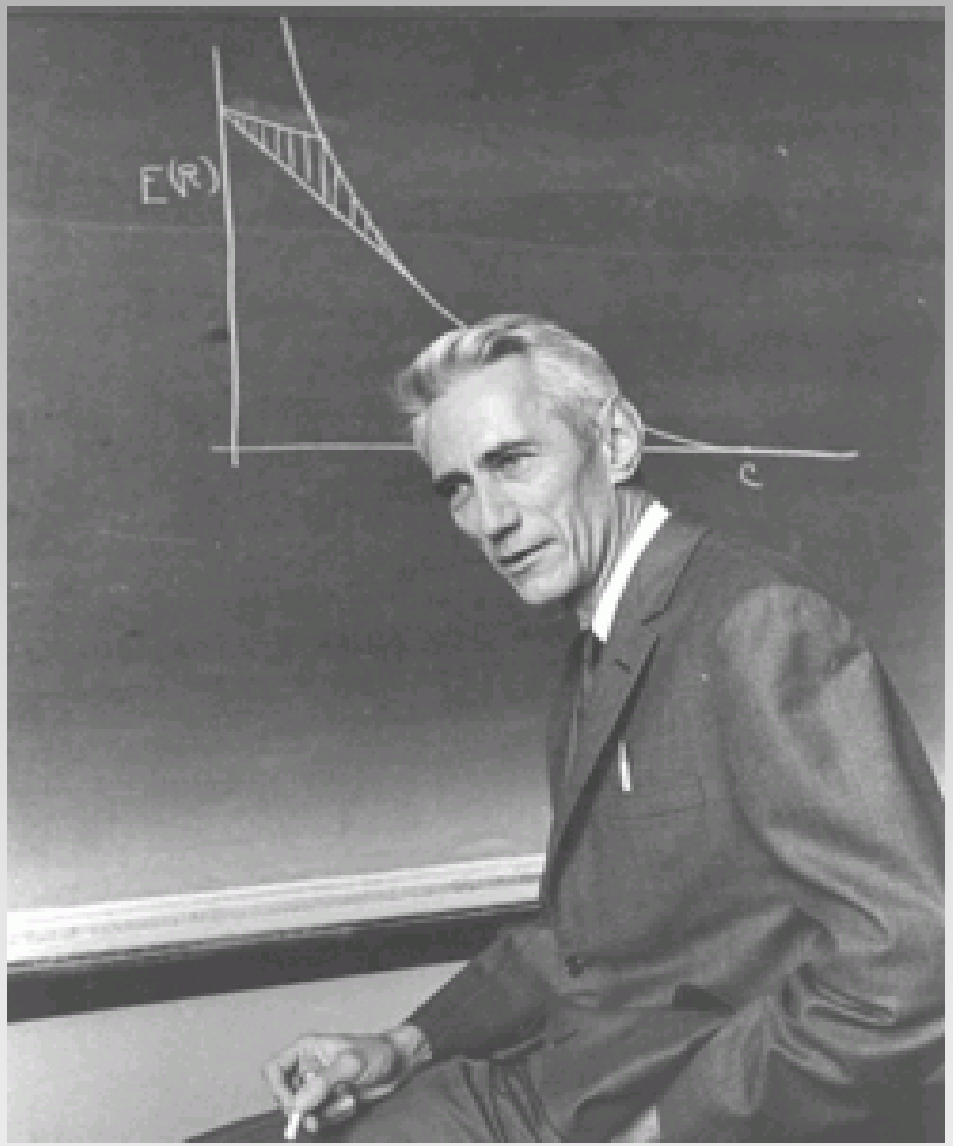
University of Colorado Denver, USA
STILMAN Advanced Strategies, USA



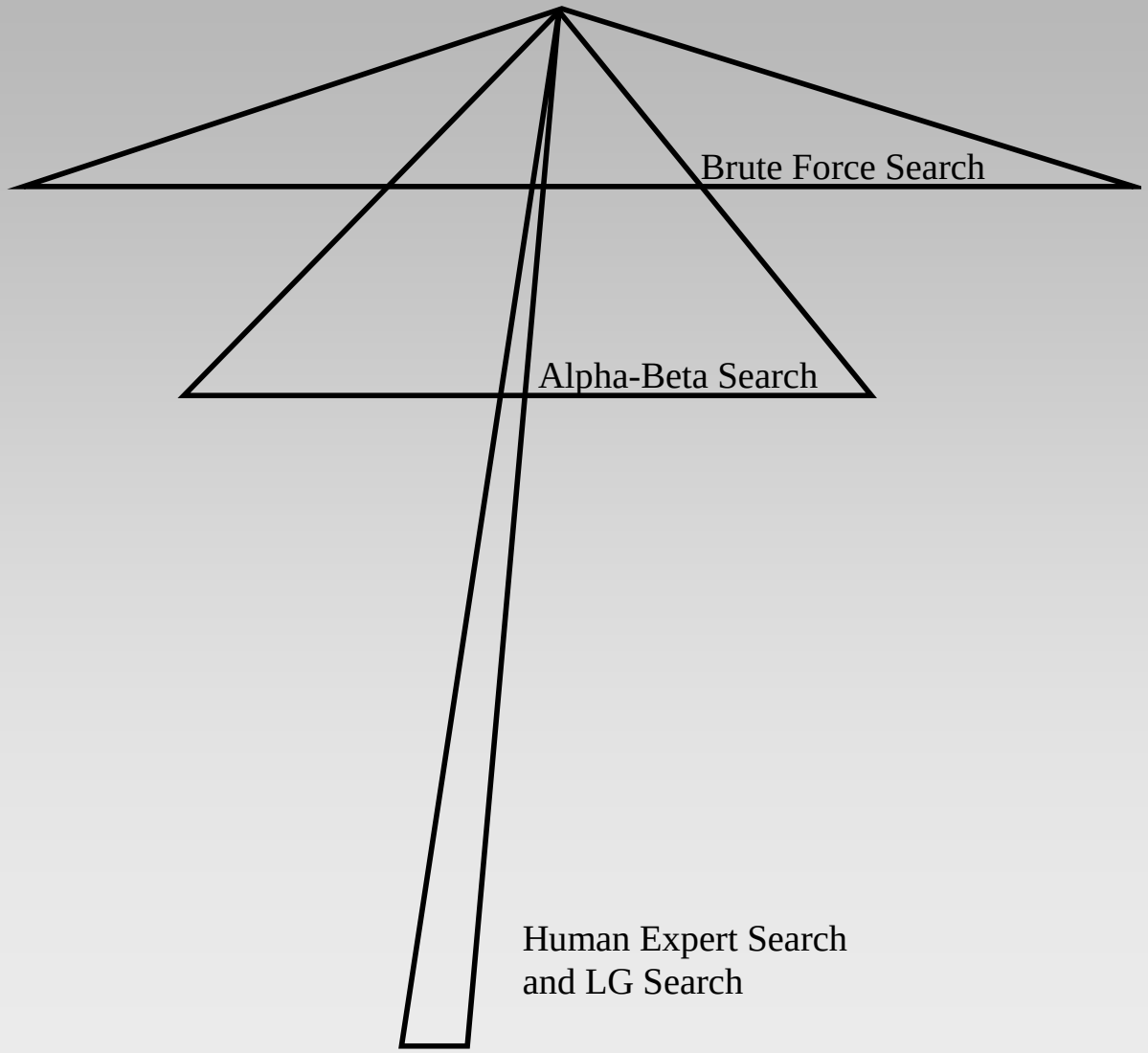
What is Linguistic Geometry?

Claude Shannon

1950



A Comparison of Searches for the same processing time



1997

Rematch
Garry Kasparov
vs
Deep Blue

Facts	Garry Kasparov	IBM's Deep Blue
Height:	5'10"	6'5"
Weight:	176 lbs.	1.4 tons
Age:	34 years	4 years
Birthplace:	Azerbaijan	Yorktown, NY
# Processors:	100B Neurons	32 P2SC Processors
Moves/Second:	2	200 million
Power Source:	electrical/chemical	electrical
Next Career:	champion	none

Chess World Champions

Mikhail Botvinnik

1911 - 1995
6th World Champion
1948 - 1957, 1958 - 1960, 1961 - 1963

Mikhail Botvinnik
"To Achieve the Goal"

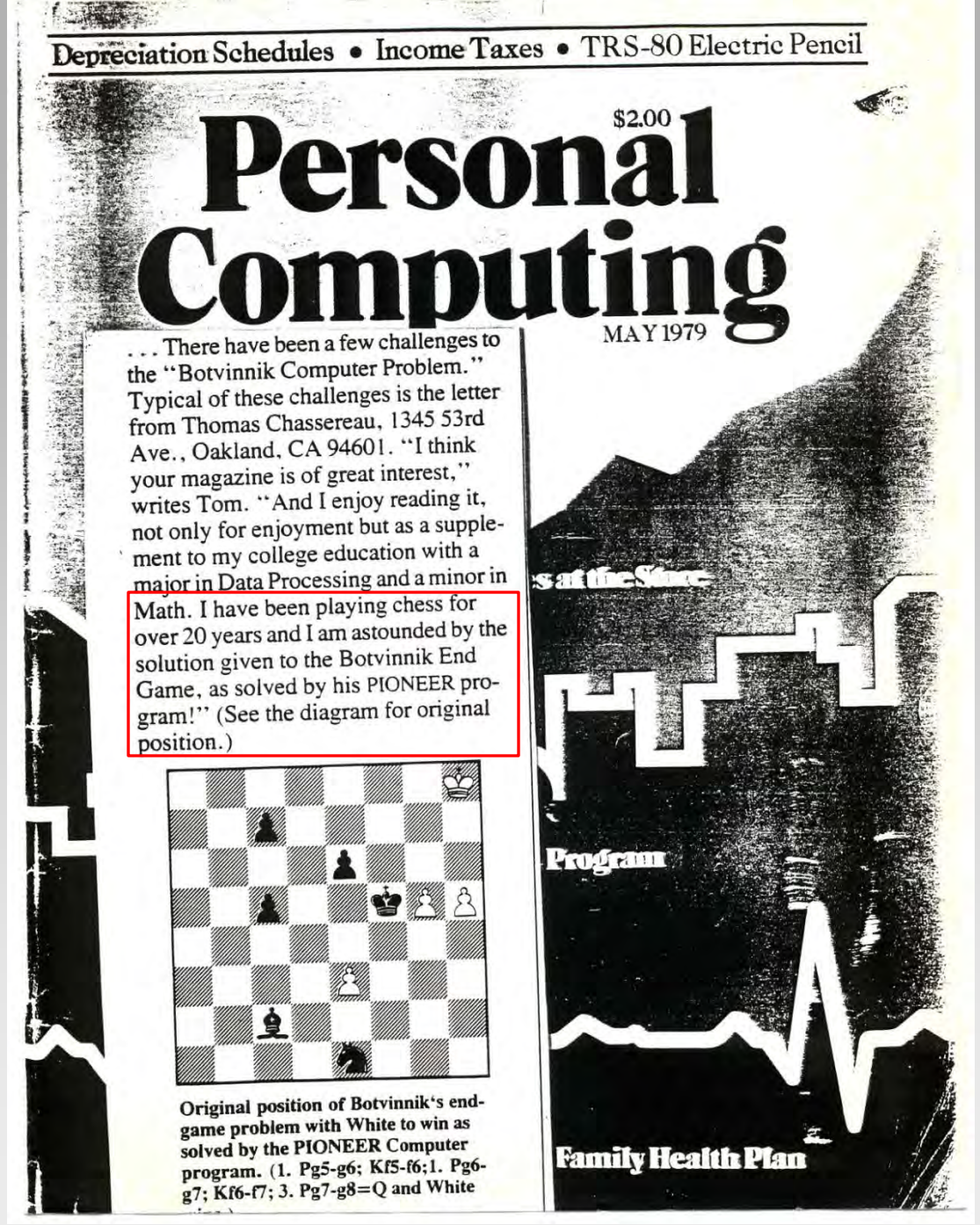
1972

Moscow State University

1972

M. Botvinnik

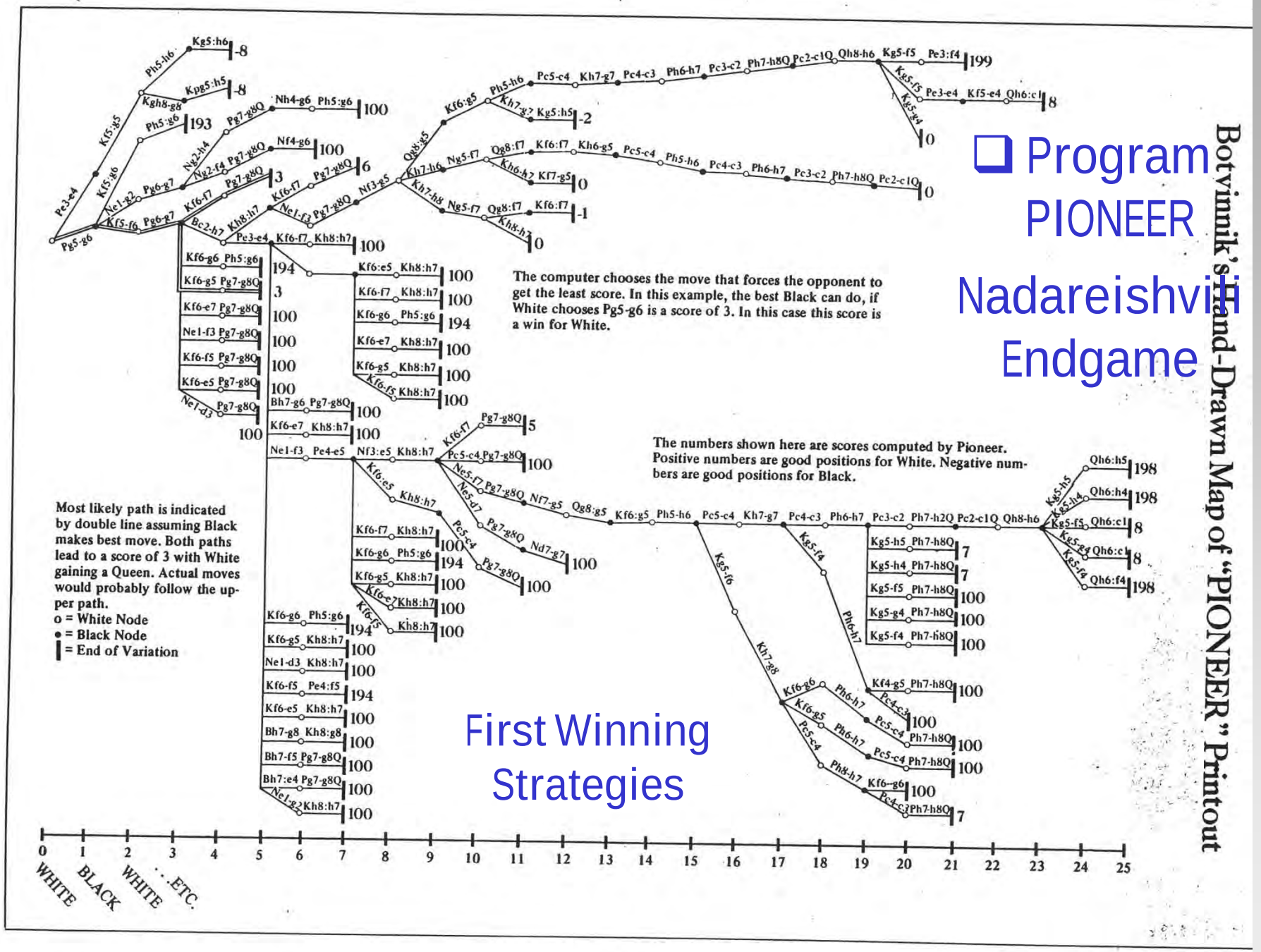
A Flow Chart of
The Algorithm for
Playing Chess

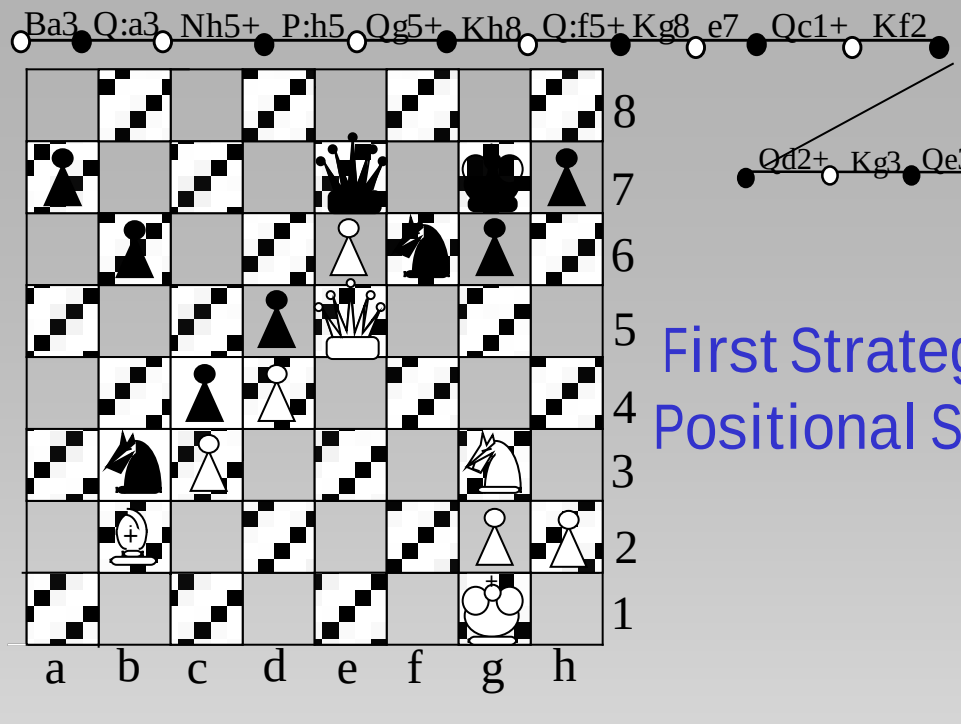


1977

- Program PIONEER

Nadareishvili Endgame


Botvinnik's Hand-Drawn Map of "PIONEER" Printout
Program PIONEER
Nadareishvili Endgame
First Winning Strategies
The computer chooses the move that forces the opponent to get the least score. In this example, the best Black can do, if White chooses Pg5-g6 is a score of 3. In this case this score is a win for White.
The numbers shown here are scores computed by Pioneer. Positive numbers are good positions for White. Negative numbers are good positions for Black.
Most likely path is indicated by double line assuming Black makes best move. Both paths lead to a score of 3 with White gaining a Queen. Actual moves would probably follow the upper path.
o = White Node
• = Black Node
| = End of Variation
0 WHITE
1 BLACK
2 WHITE
3 . . . ETC.
4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

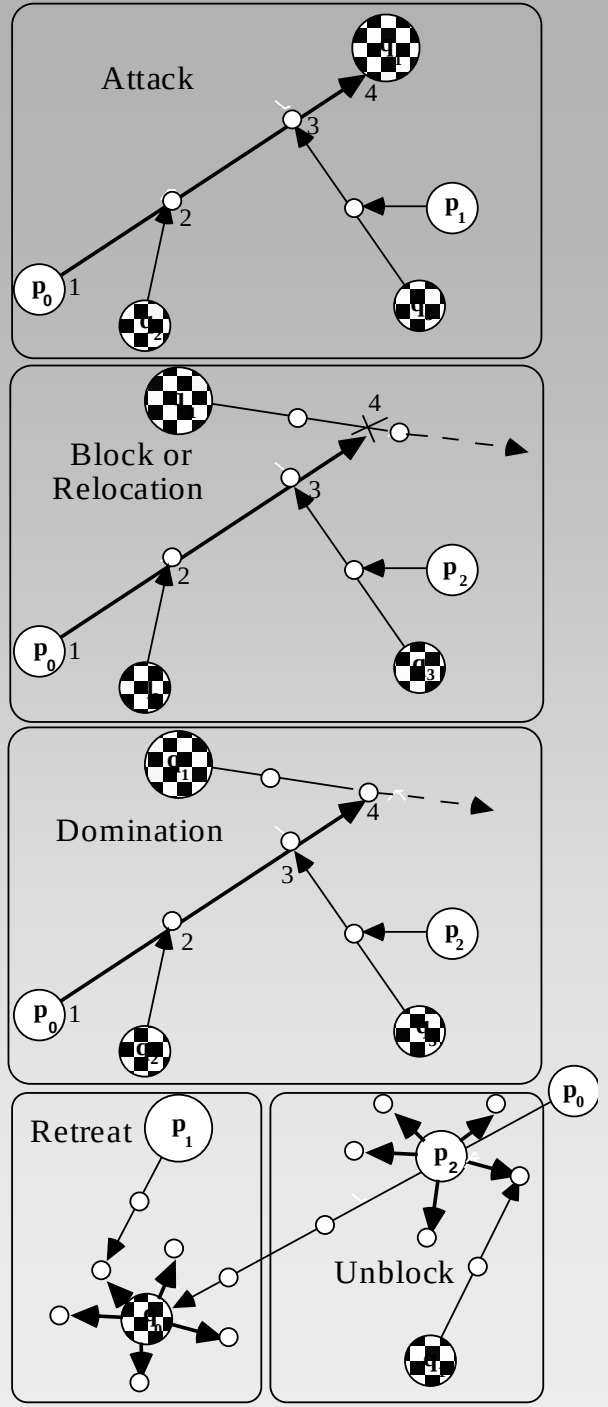


1980

First Strategies with Positional Sacrifices

Moscow, USSR

Program PIONEER



❑ Zones

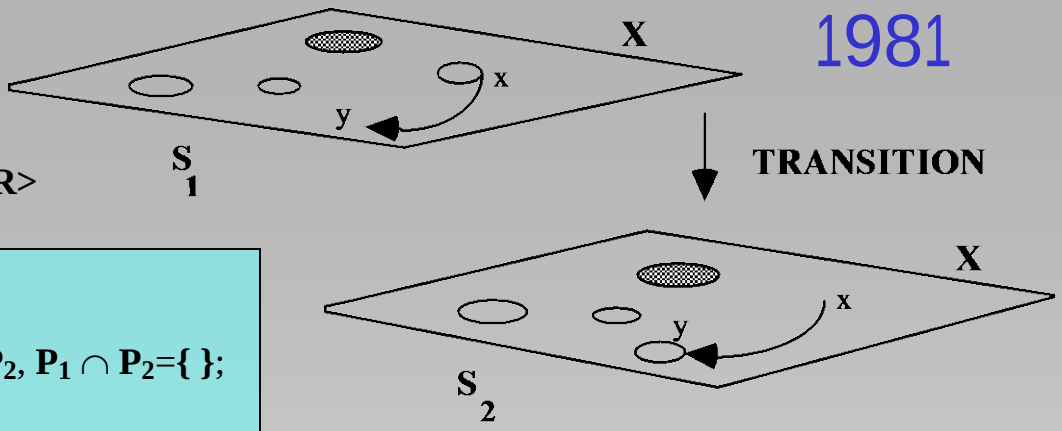
Types of Zones

Abstract Board Games

1981

An Abstract Board Game
is the following eight-tuple

$< X, P, R_p, \{ON\}, v, S_i, S_t, TR>$

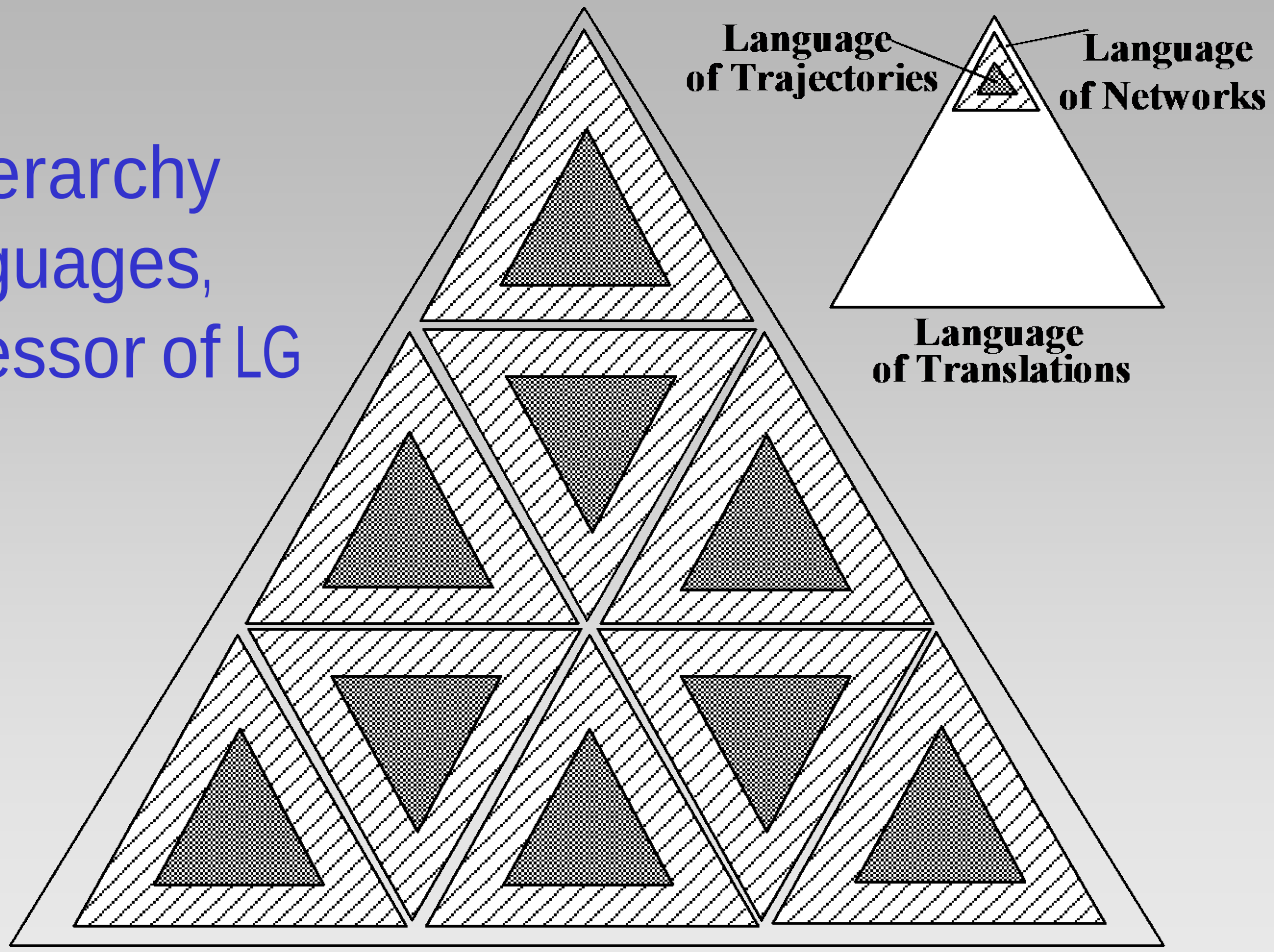


$X = \{x_i\}$	is a finite set of ***points***;
$P = \{p_i\}$	is a finite set of ***elements***; $P=P_1 \cup P_2$, $P_1 \cap P_2=\{\ \}$;
$R_p(x, y)$	is a family of binary relations of ***reachability*** in X ($x \in X$, $y \in Y$, $p \in P$); y is ***reachable*** from x for p;
$ON(p) = x$	is a partial function of ***placement*** of elements P into X;
$v > 0$	is a real function, $v(p_i)$ are the ***values*** of elements;
S_i	is a set of ***initial*** states of the system, a certain set of formulas $\{ON(p_i)=x_i\}$;
S_t	is a set ***target*** states of the system (as S_i);
TR	is a set of operators **TRANSITION(p, x, y)** for transition of the system from one state to another described as follows

precondition: $(ON(p) = x) \wedge R_p(x, y)$
delete: $ON(p) = x$
add: $ON(p) = y$

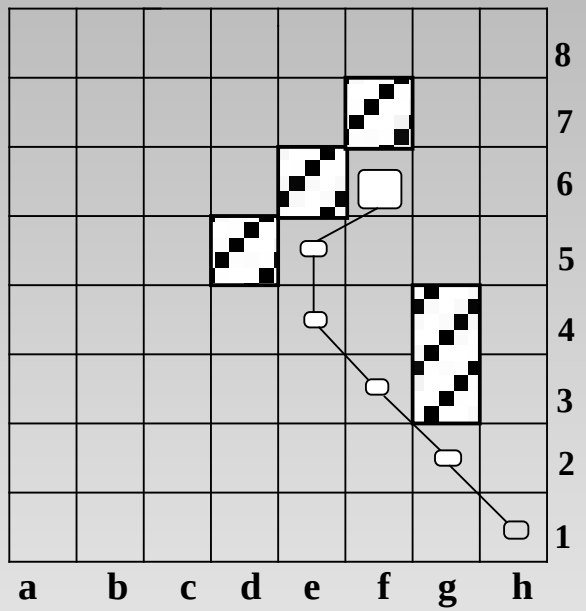
1981-
1985

First Hierarchy
of Languages,
a predecessor of LG



1981

a(f6)***a***(e5)***a***(e4)***a***(f3)***a***(g2)***a***(h1)

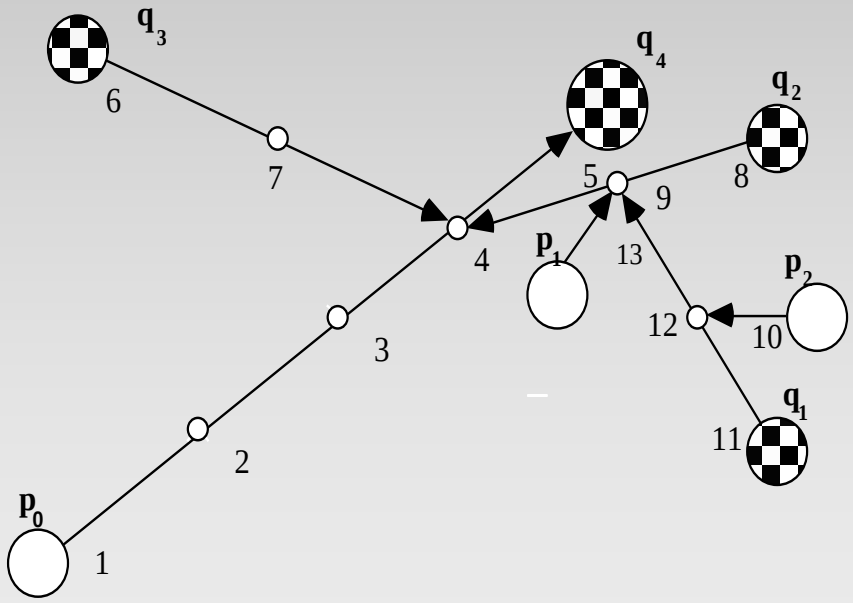


Language of Trajectories

1982

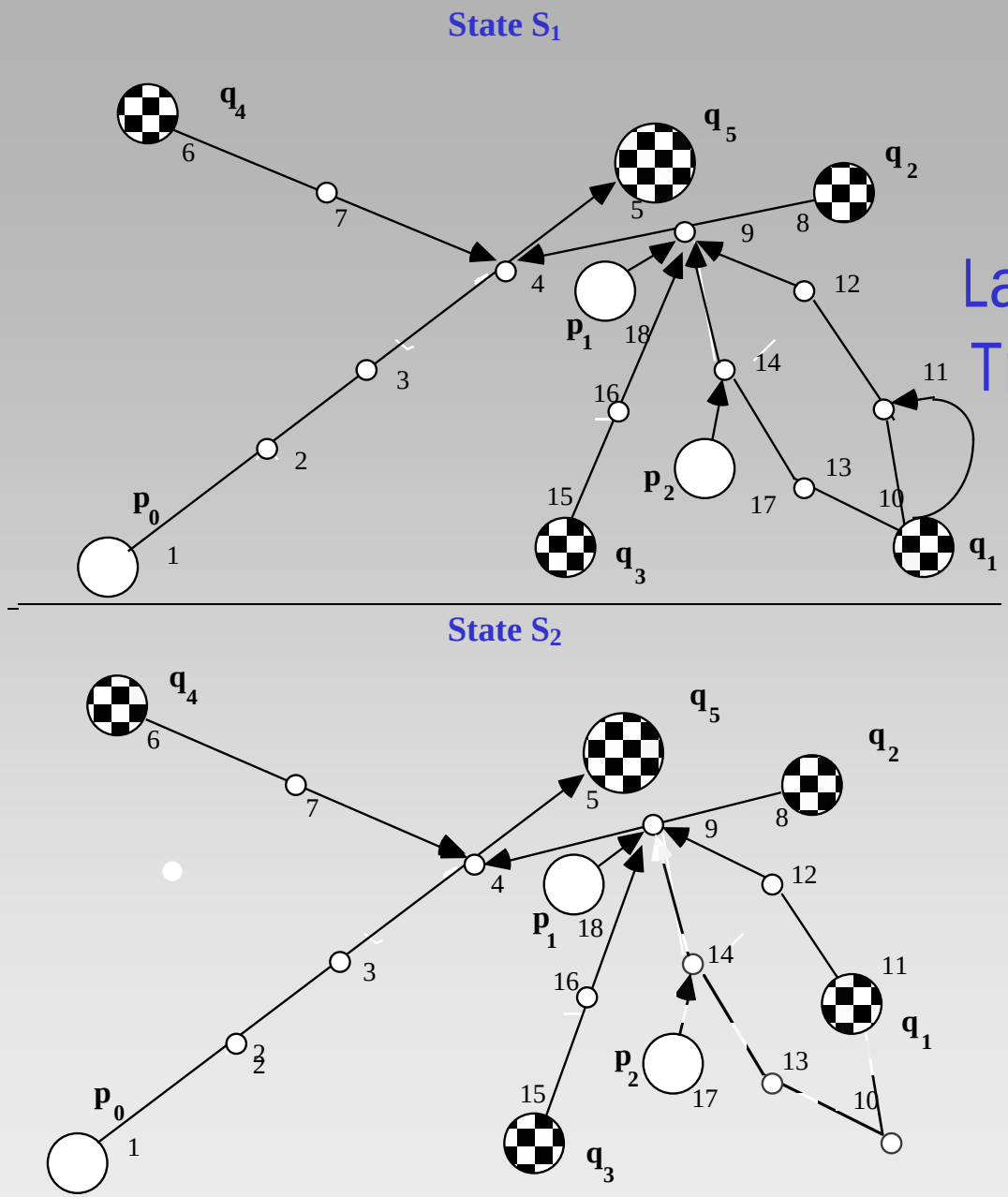
$$Z = \boldsymbol{t}(p_o, \boldsymbol{a}(1)\boldsymbol{a}(2)\boldsymbol{a}(3)\boldsymbol{a}(4)\boldsymbol{a}(5), 5)\boldsymbol{t}(q_3, \boldsymbol{a}(6)\boldsymbol{a}(7)\boldsymbol{a}(4), 4)$$
$$\boldsymbol{t}(q_2, \boldsymbol{a}(8)\boldsymbol{a}(9)\boldsymbol{a}(4), 4)\boldsymbol{t}(p_1, \boldsymbol{a}(13)\boldsymbol{a}(9), 3)$$
$$\boldsymbol{t}(q_1, \boldsymbol{a}(11)\boldsymbol{a}(12)\boldsymbol{a}(9), 3)\boldsymbol{t}(p_2, \boldsymbol{a}(10)\boldsymbol{a}(12), 2)$$

Language of Networks (Zones)



1982

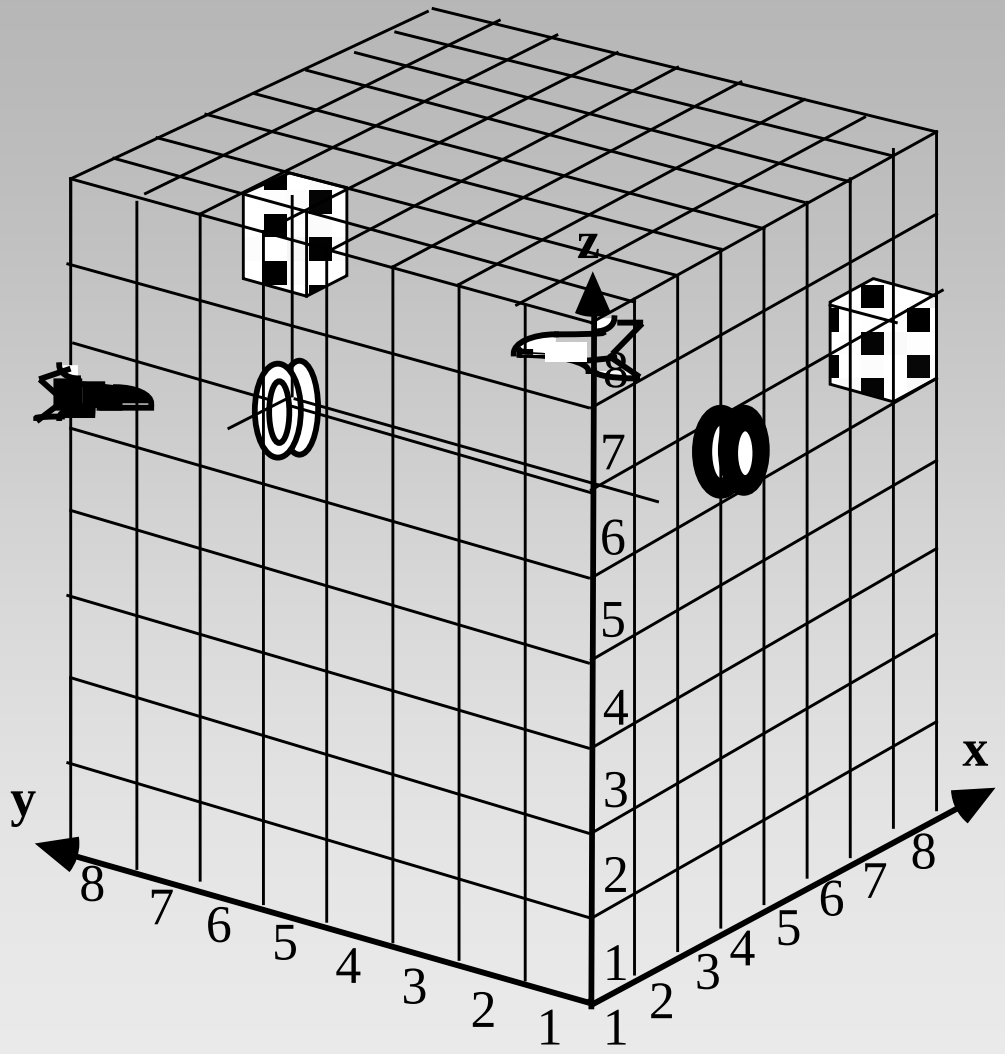
Language of Translations




1990-91
McGill University

From 2D to 3D Models

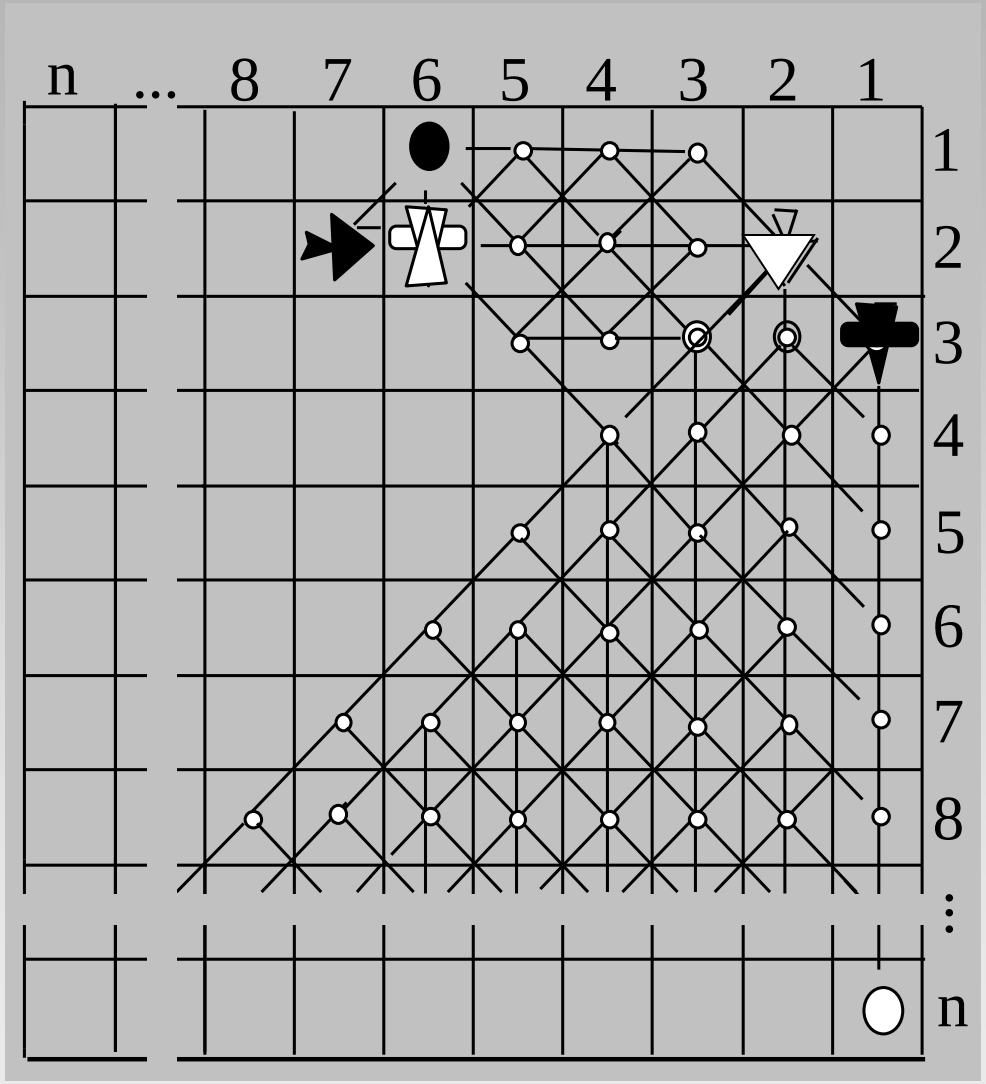
1993



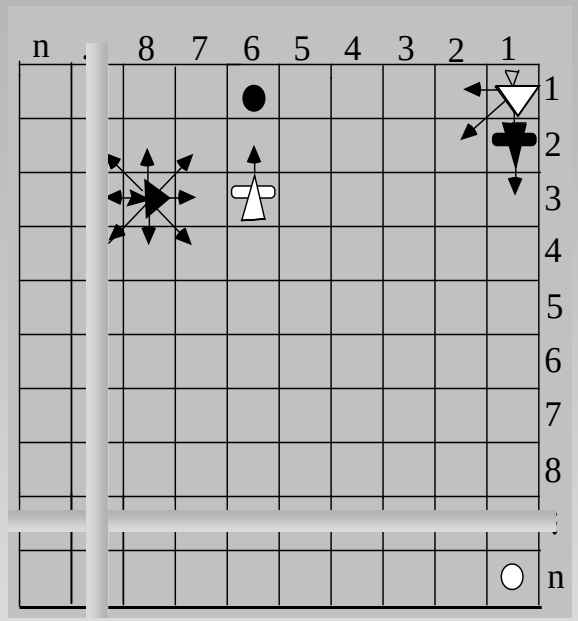
First
3D Board

From Limited to n×n Variable Size District

1995

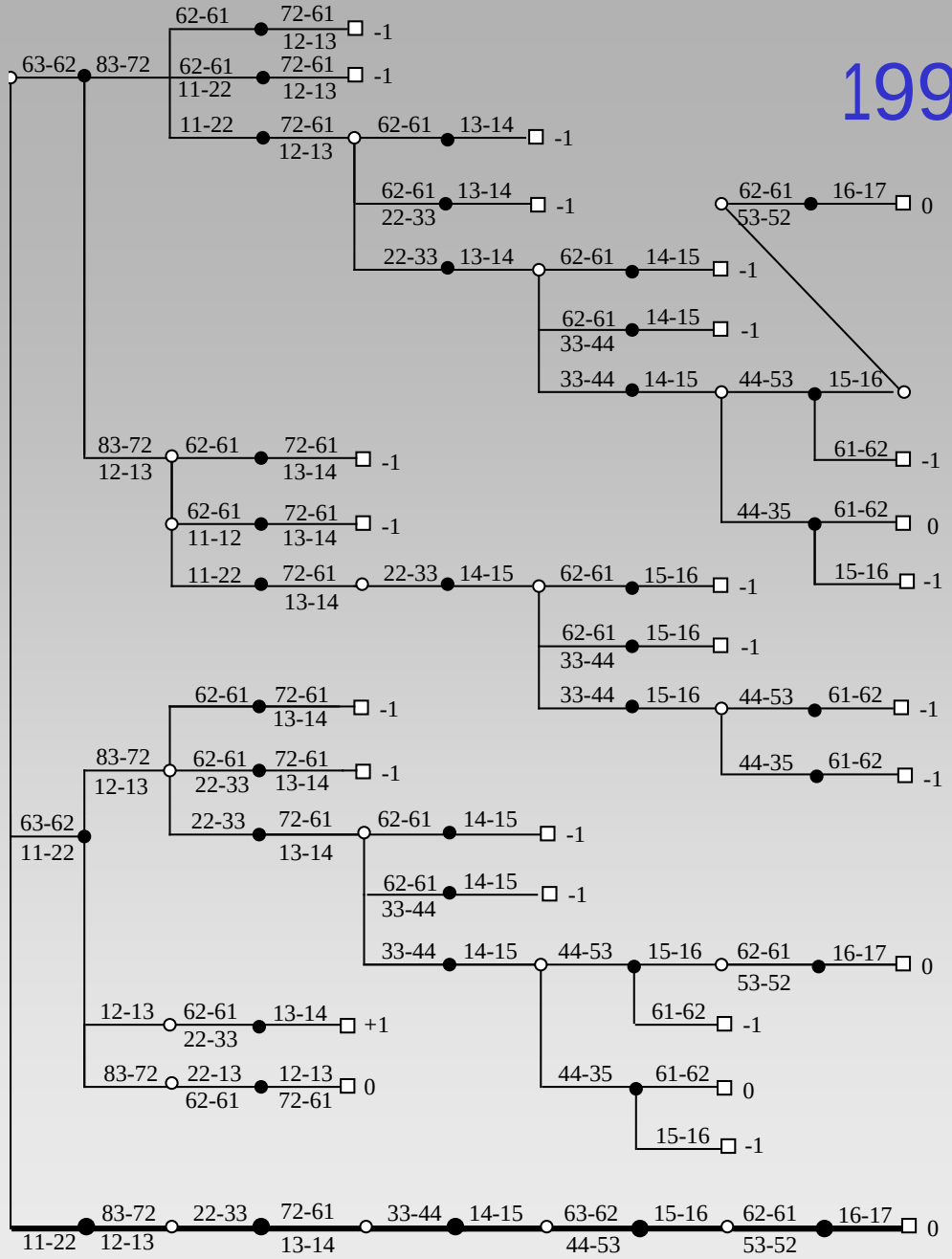


First
n*×*n Board



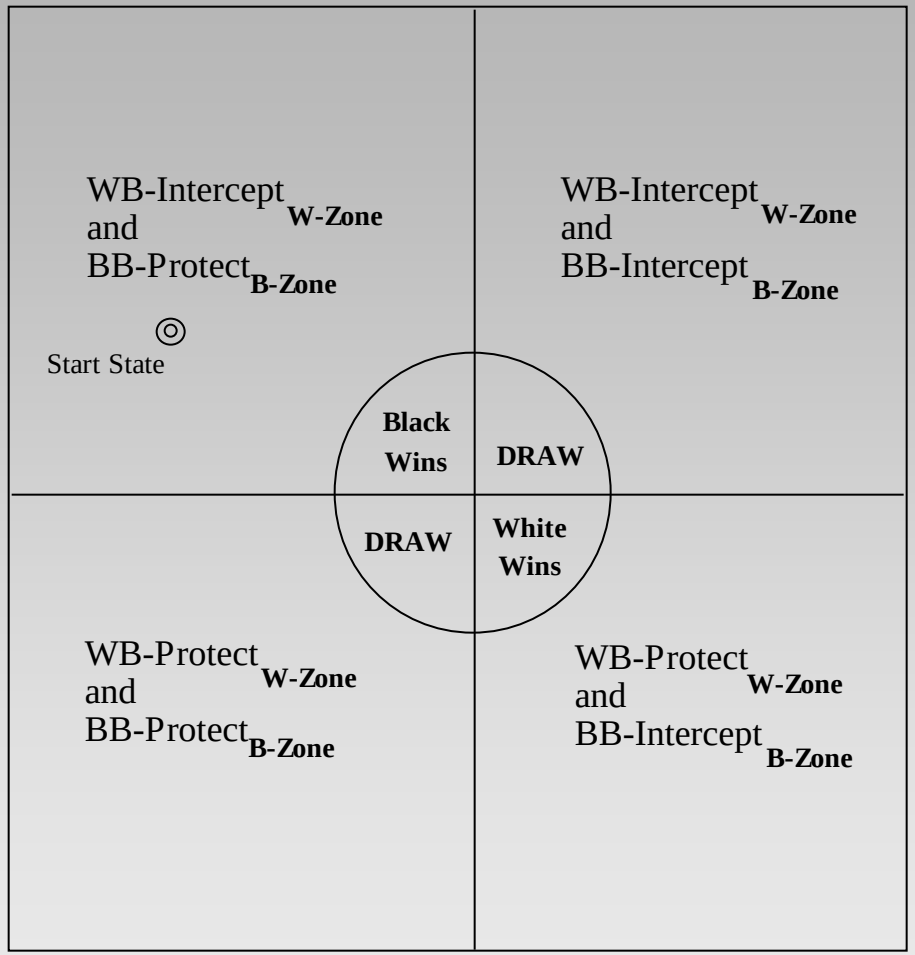
First Concurrent Strategies

1995

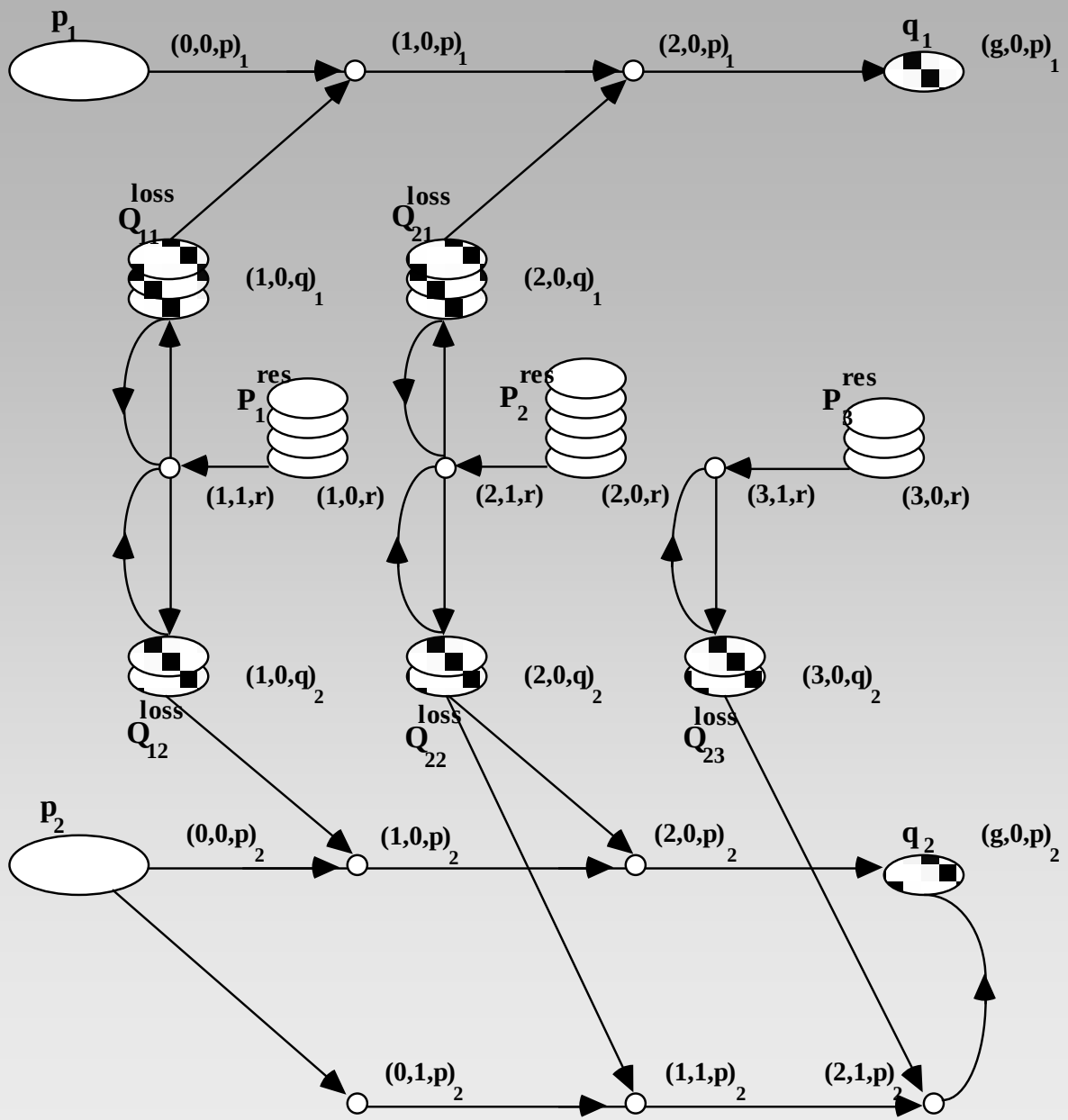


Experiments with State Space Chart: NO-Search Approach

1996



First Proof of Strategies Optimality

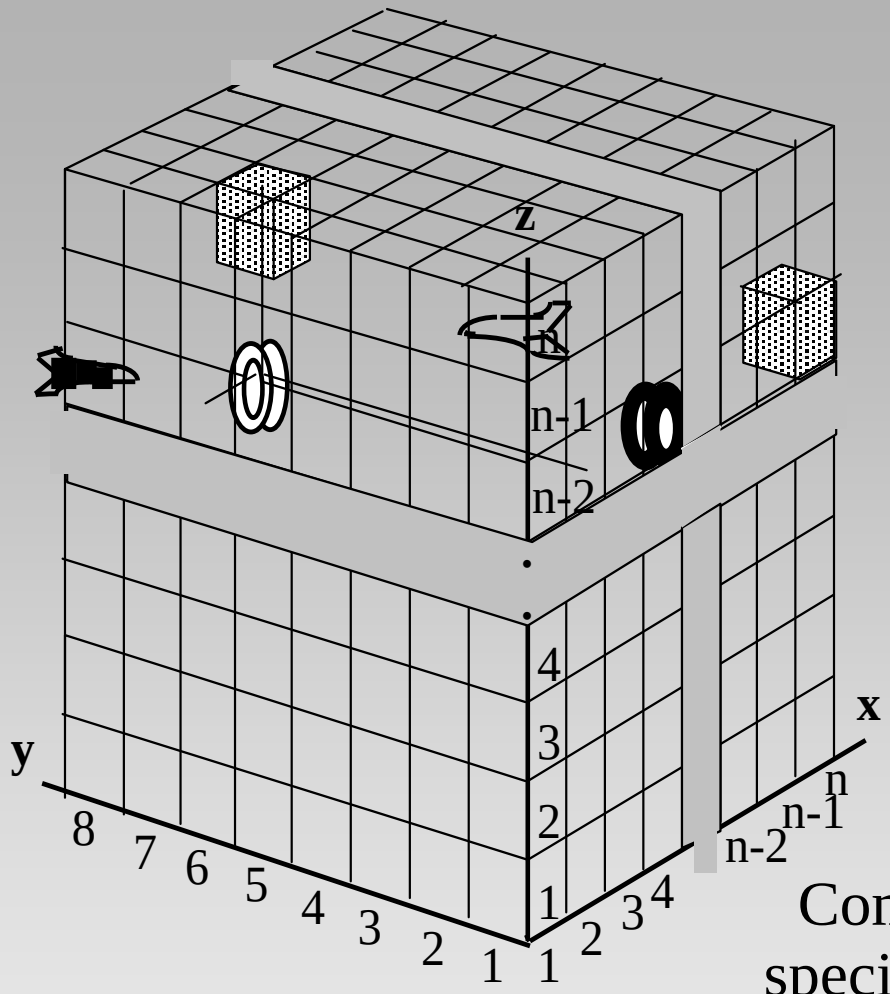


1997

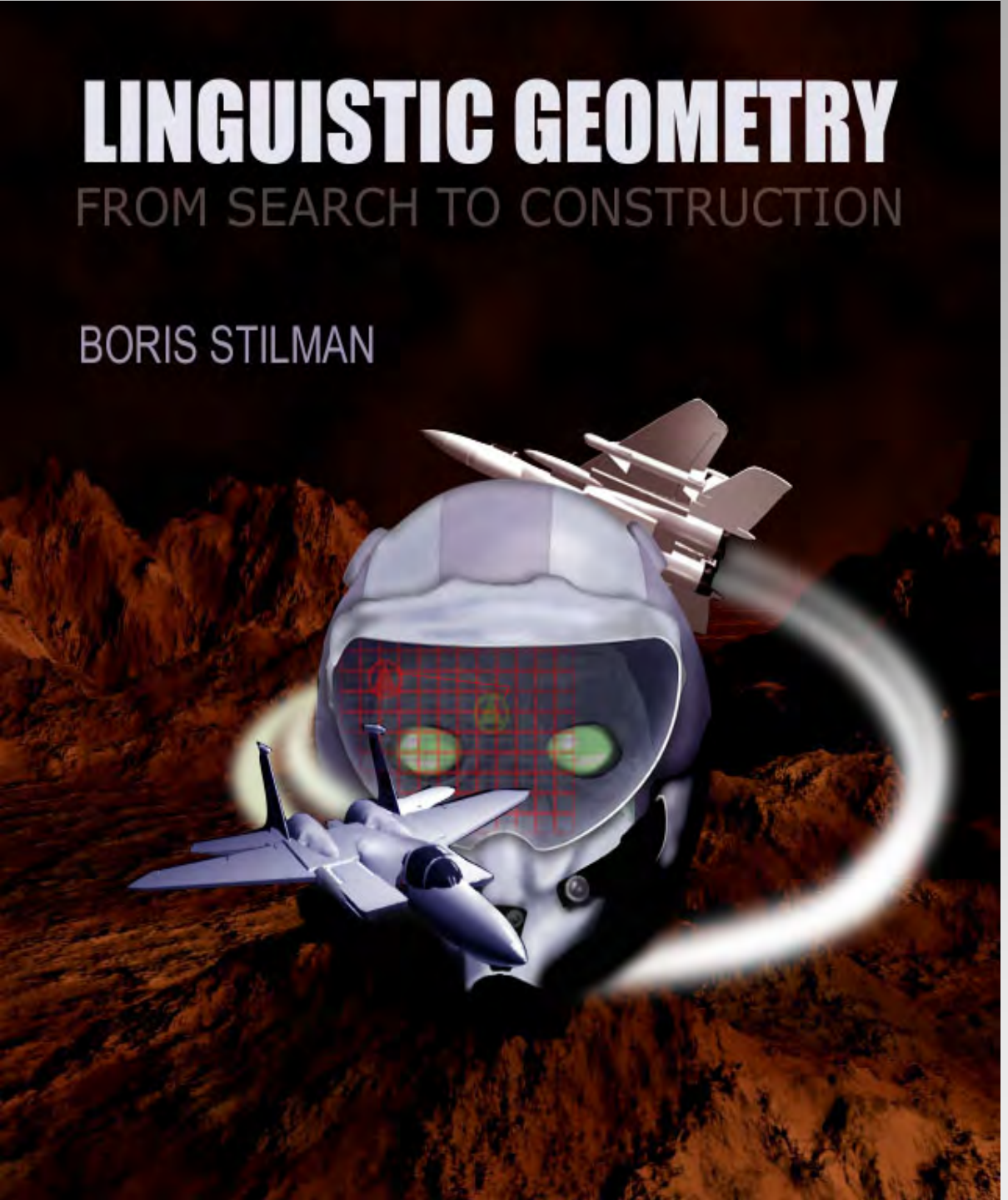
First Artificial Enemy in LG

1999

First Proof of Polynomial Run Time



Computational complexity of the specific classes of abstract board games is **polynomial** with respect to the length of the input.



Manuscript finished in 1999

Published in 2000

- Linguistic Geometry **(**LG**)** is a new type of game theory;
- LG replaces search by construction, making the games computationally tractable.

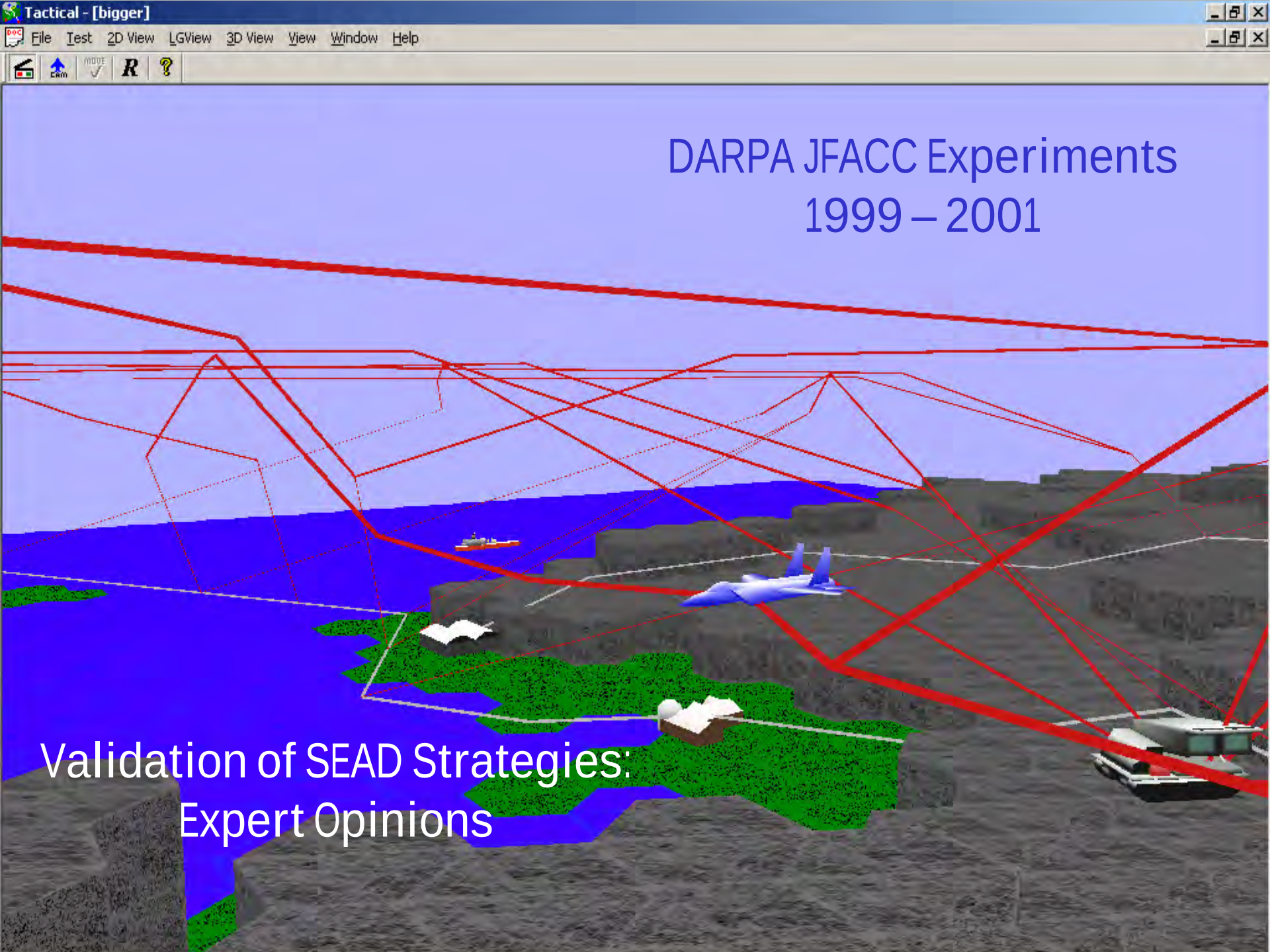
1999

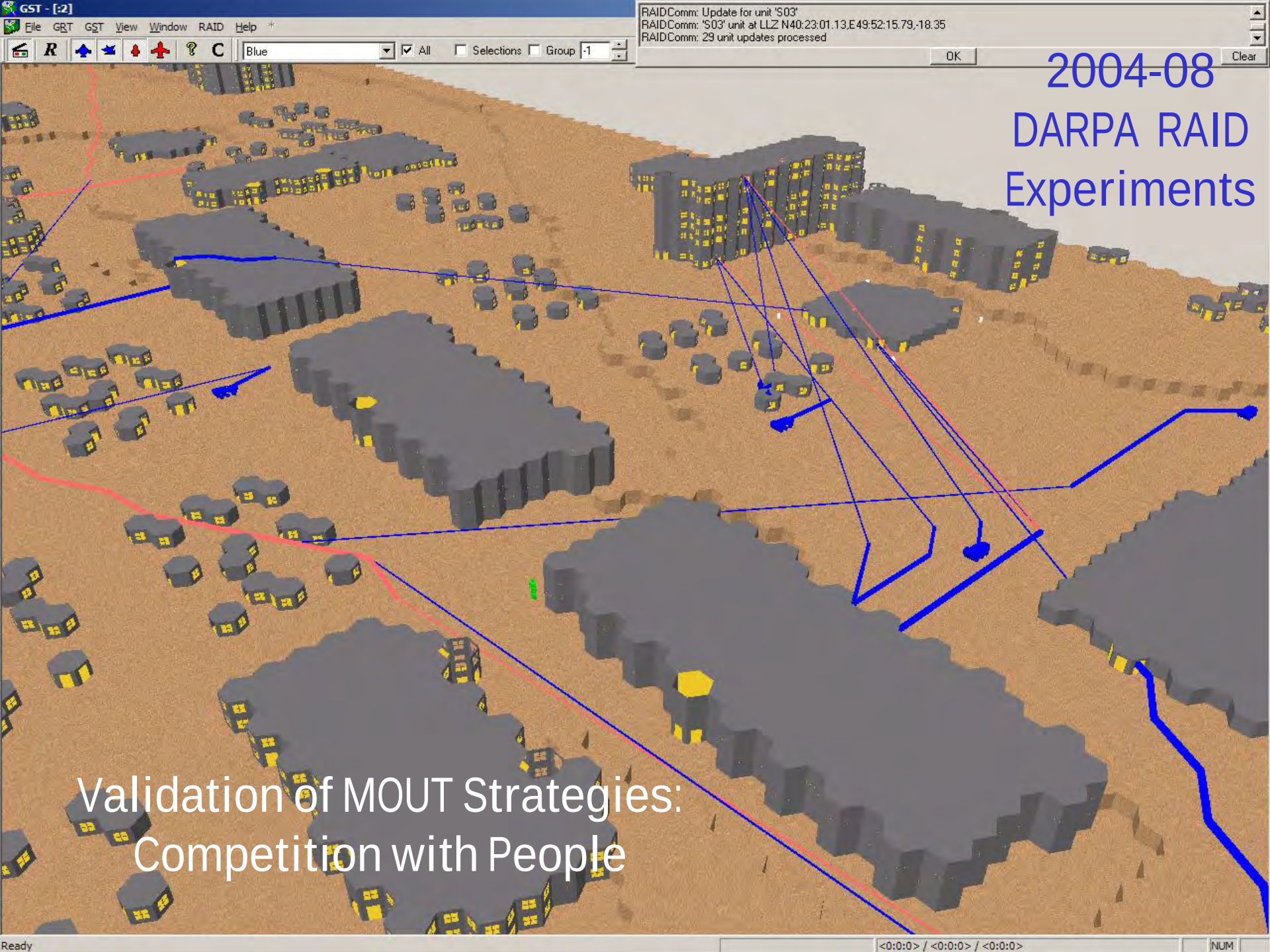
STILMAN
advanced strategies

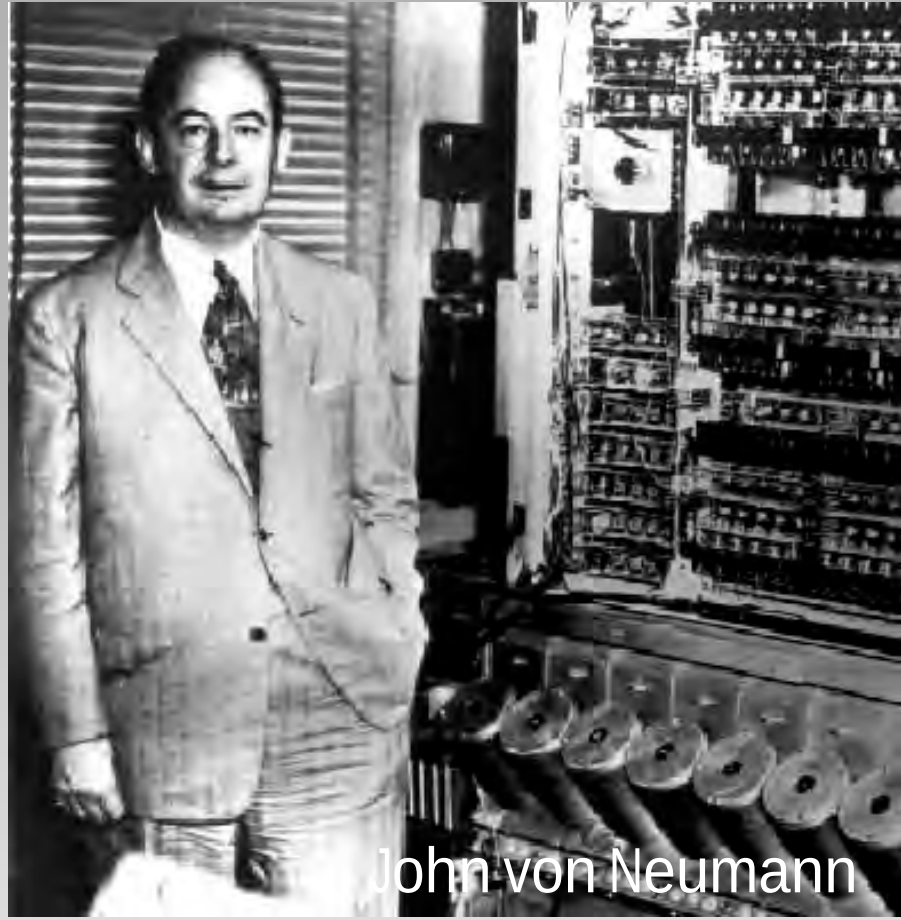
www.stilman-strategies.com

9/9/99

Denver, CO

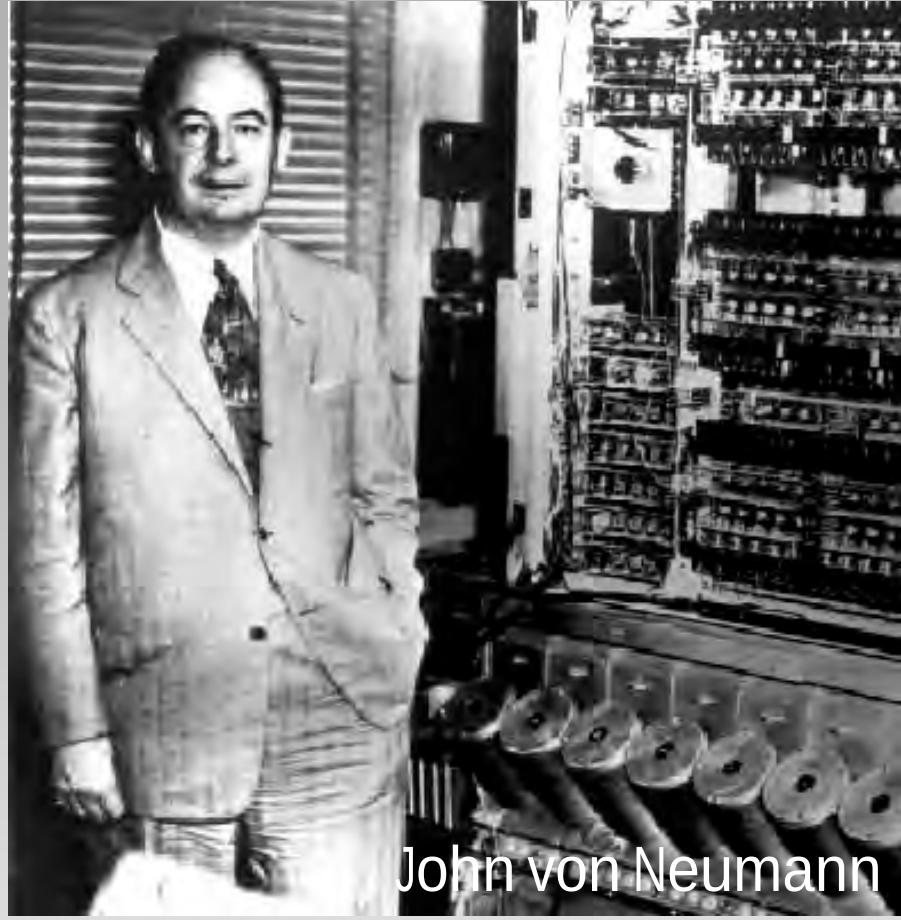

Tactical - [bigger]
File Test 2D View LGView 3D View View Window Help
DARPA JFACC Experiments
1999 – 2001
Validation of SEAD Strategies:
Expert Opinions


GST - [:2]
File GRT GST View Window RAID Help
Blue
All
Selections
Group
-1
RAIDComm: Update for unit 'S03'
RAIDComm: 'S03' unit at LLZ N40:23:01.13,E49:52:15.79,-18.35
RAIDComm: 29 unit updates processed
OK
Clear
2004-08
DARPA RAID
Experiments
Validation of MOUT Strategies:
Competition with People
Ready
<0:0:0> / <0:0:0> / <0:0:0>
NUM



What is Linguistic Geometry?

- Chess Masters' Problem Solving
- Search Reduction Techniques
- Subclass of Gaming Problems of Polynomial Complexity
- No-Search Paradigm for Decision Making: "From Search to Construction"
- OR maybe, it is something else . . .



It appears that LG is a model of human thinking about conflict resolution, a warfighting model at the level of superintelligence . . .