

Artificial Neural Network Architectures
via
Genetic Algorithms
using
Nested Graph Grammars

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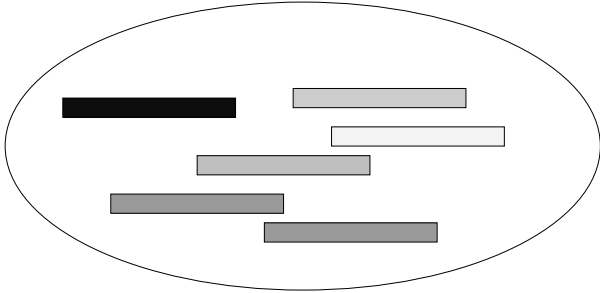
June 2000



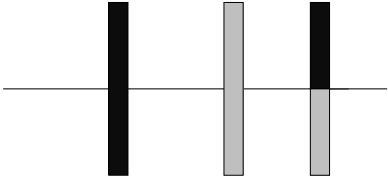
Background

- Montana, Davis 1989
Genetic Algorithms as a Weighting Method
- Miller, Todd, Hedge 1989
Direct Encoding
- Kitano 1990, 1994
Graph Grammars
- Wall 1996
GAlib, MIT

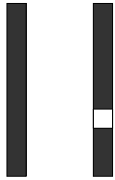
Genetic Algorithms



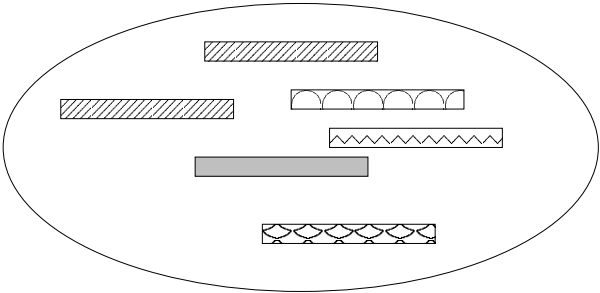
Population



Crossover



Mutation



New Population

Genetic Algorithms as a Weighting Method

- Fixed Network Structure
- Given Training Data
- Find Good Weights
- Use Test Data

Genetic Algorithms to Evolve Network Topologies

Fixed Architectures

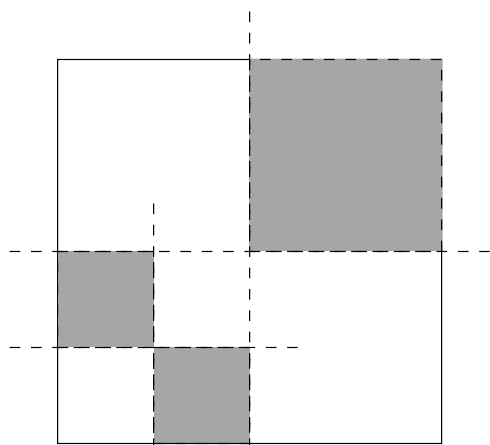
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1	1		1	1	1
1	1		1	1	1
1	1		1	1	1
1	1		1	1	1

0	0		0	0	0
0	0		0	0	0
0	0		0	0	0
0	0		0	0	0
0	0		0	0	0

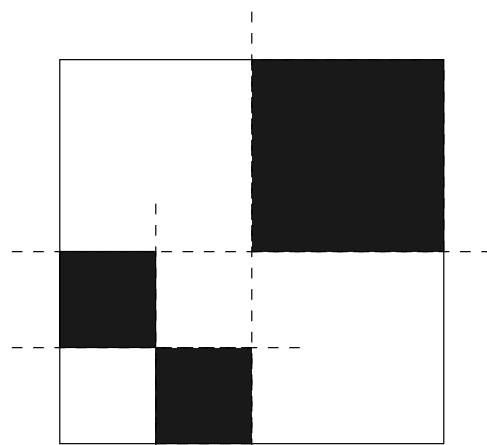
1	1		0	0	0
1	1		0	0	0
1	1		0	0	0
0	0		1	1	1
0	0		1	1	1

0	0		1	1	1
0	0		1	1	1
0	0		1	1	1
1	1		0	0	0
1	1		0	0	0

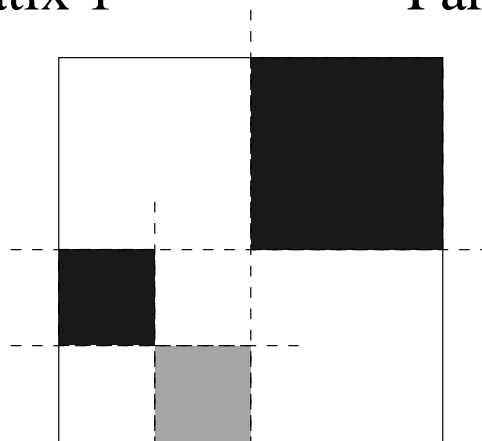
A Scalable Approach



Parent Matix 1



Parent Matrix 2



Child Matrix

A Scalable Approach

Nested Graph Grammar

1. Nonterminal Rules:

$$\mathcal{X} \rightarrow \begin{array}{cc} A & B \\ C & D \end{array}$$

2. Terminal Rules:

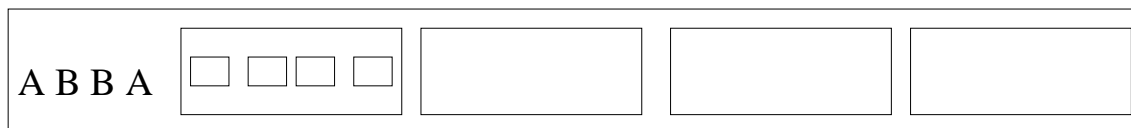
$$\mathcal{X} \rightarrow \begin{array}{cc} \alpha & \beta \\ \gamma & \delta \end{array} \quad \alpha, \beta, \gamma, \delta: 2 \times 2 \text{ binary matrices}$$

Chromosome Representation

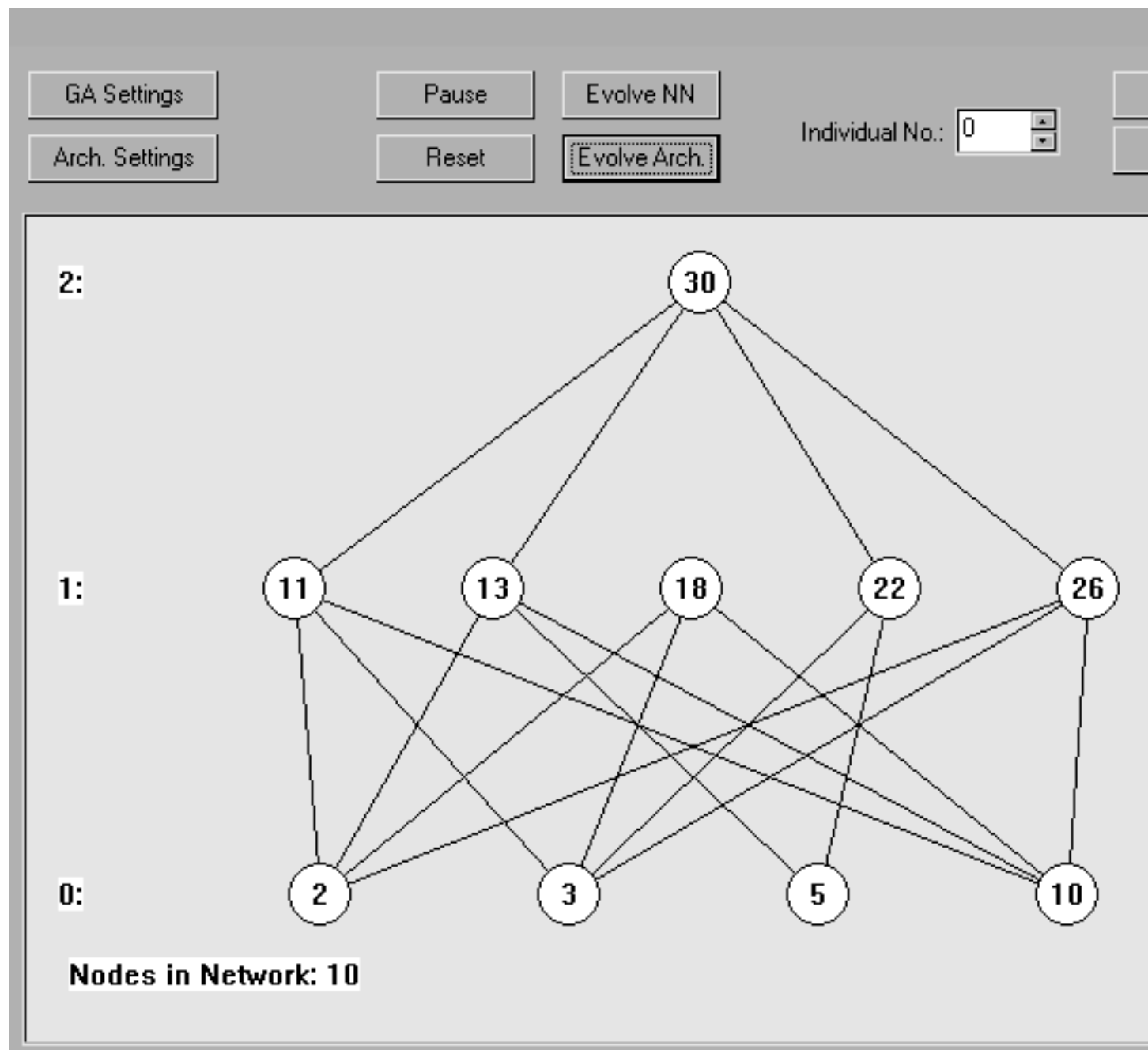
The first four locations in the array hold the starting rule.

The remaining array is divided into four equal sections representing the letters \mathcal{A} , \mathcal{B} , \mathcal{C} , and \mathcal{D}

Recursively, each of these sections is further subdivided in the same manner.



Results continued...



Next...

Consider other Phenotypes....