Evolutionary Computation for Cognitive Complexity Reduction

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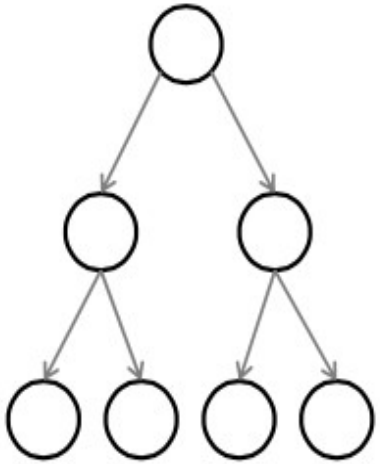
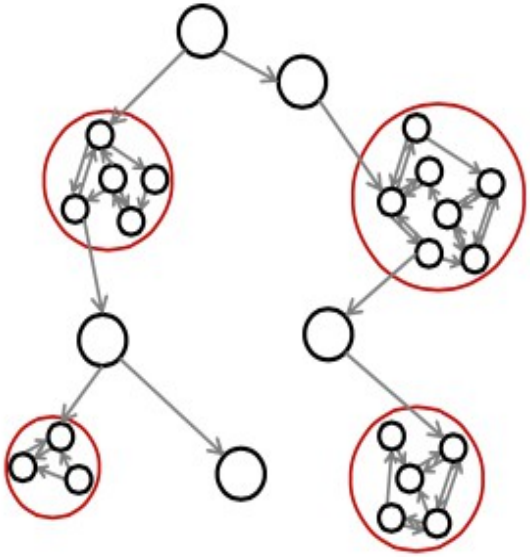
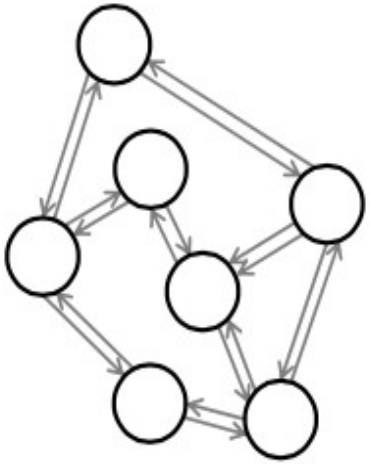
Three System Structure Types

Organizing Properties of Symmetry

Asymmetric	Nonsymmetric	Symmetric
Hierarchy	Combined Hierarchy & Network	Network
		
• Use logic rules to discover structure in an efficient manner • Analyze structure	• Apply lattice and set partitioning rules to identify components • Apply other techniques as needed	• Analyze for highest value configuration • Filter out controlling structure • Analyze structure

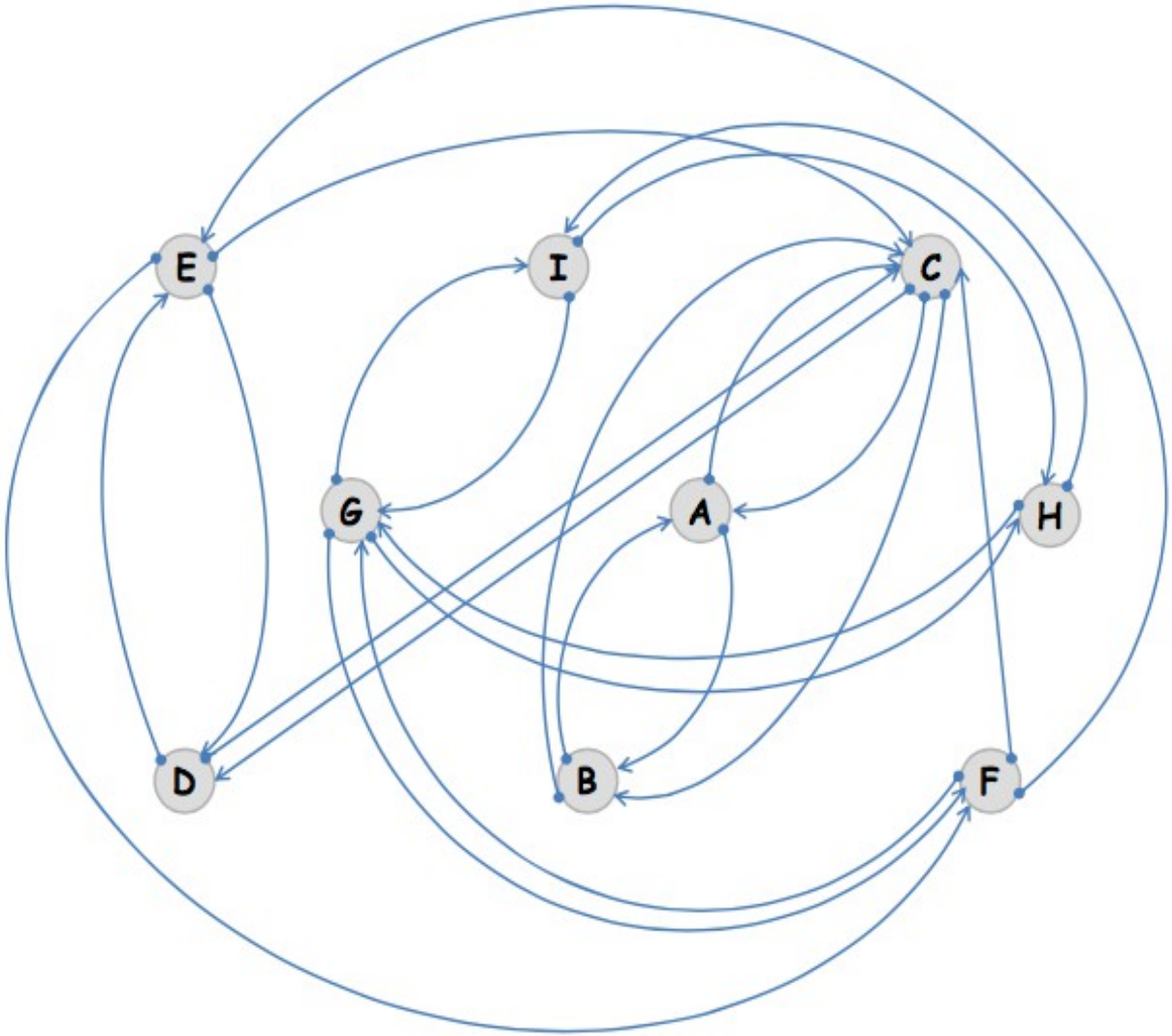
Logical Relation Properties

Hi-Level Logical Characteristics of Three Dyadic Relations - v1.1

Reflexivity *Involves one individual*	*Symmetry* *Involves two individuals*	*Transitivity* *Involves three (or more) individuals*
Reflexive A relation, R, is reflexive iff any individual that enters into the relation bears R to itself. *Identical with; Divisible by	**Symmetric** If any individual bears the relation to a second individual, then the second bears it to the first. *Touching	**Transitive** If any individual bears this relation to a second and the second bears it to a third, then the first bears it to the third. *Greater than; North of; Included in
Irreflexive A relation, R, is irreflexive iff no individual bears R to itself. *Stand next to; Father of	**Asymmetric** A relation, R, is asymmetrical iff, if any individual bears R to a second, then the second does not bear R to the first. *North of; Heavier than; Child of	**Intransitive** A relation, R, is intransitive iff, if any individual bears R to a second and the second bears R to a third, then the first does not bear R to the third. *Father of; 2" taller than
Nonreflexive A relation which is neither reflexive nor irreflexive is nonreflexive. *Respecting; Killing	**Nonsymmetric** A relation which is neither symmetrical nor asymmetrical is nonsymmetric. *Likes; Seeing	**Nontransitive** A relation which is neither transitive nor intransitive is nontransitive. *Admiring; Fearing

*Examples

Logical Properties?



Discover Order

Disordered System Configuration

E	0	1	0	0	0	1	0	1
0	I	0	1	0	1	0	0	0
0	0	C	0	1	0	1	1	0
0	1	0	G	0	1	0	0	1
0	0	1	0	A	0	0	1	0
0	1	0	1	0	H	0	0	0
1	0	1	0	0	0	D	0	0
0	0	1	0	1	0	0	B	0
1	0	1	1	0	0	0	0	F

Ordered System Configuration

A	1	1	0	0	0	0	0	0
1	B	1	0	0	0	0	0	0
1	1	C	1	0	0	0	0	0
0	0	1	D	1	0	0	0	0
0	0	1	1	E	1	0	0	0
0	0	1	0	1	F	1	0	0
0	0	0	0	0	1	G	1	1
0	0	0	0	0	0	1	H	1
0	0	0	0	0	0	1	1	I

Initial Configuration

```
[[0, 0, 1, 0, 0, 0, 1, 0, 1],
 [0, 0, 0, 1, 0, 1, 0, 0, 0],
 [0, 0, 0, 0, 1, 0, 0, 1, 0],
 [0, 1, 0, 0, 0, 1, 0, 0, 1],
 [0, 0, 1, 0, 0, 0, 0, 1, 0],
 [0, 1, 0, 1, 0, 0, 0, 0, 0],
 [1, 0, 1, 0, 0, 0, 0, 0, 0],
 [0, 0, 1, 0, 1, 0, 0, 0, 0],
 [1, 0, 1, 1, 0, 0, 0, 0, 0]]
```

```
[[0, 1, 2, 3, 4, 5, 6, 7, 8],
 [1, 0, 1, 2, 3, 4, 5, 6, 7],
 [2, 1, 0, 1, 2, 3, 4, 5, 6],
 [3, 2, 1, 0, 1, 2, 3, 4, 5],
 [4, 3, 2, 1, 0, 1, 2, 3, 4],
 [5, 4, 3, 2, 1, 0, 1, 2, 3],
 [6, 5, 4, 3, 2, 1, 0, 1, 2],
 [7, 6, 5, 4, 3, 2, 1, 0, 1],
 [8, 7, 6, 5, 4, 3, 2, 1, 0]]
```

Value = 87

Candidate Configurations

```
[[0, 1, 1, 0, 0, 0, 0, 0, 0],
 [1, 0, 1, 0, 0, 0, 0, 0, 0],
 [1, 1, 0, 0, 0, 0, 0, 0, 0],
 [0, 1, 0, 0, 1, 1, 0, 0, 0],
 [0, 1, 0, 1, 0, 0, 0, 1, 0],
 [0, 1, 0, 1, 0, 0, 0, 0, 0],
 [0, 0, 0, 0, 0, 0, 0, 1, 1],
 [0, 0, 0, 0, 1, 0, 1, 0, 1],
 [0, 0, 0, 0, 0, 0, 1, 1, 0]]
```

Value = 37

```
[[0, 1, 1, 0, 0, 0, 0, 0, 0],
 [1, 0, 1, 0, 0, 0, 0, 0, 0],
 [1, 1, 0, 0, 0, 0, 0, 0, 0],
 [0, 0, 1, 0, 0, 1, 0, 0, 0],
 [0, 0, 1, 0, 0, 1, 1, 0, 0],
 [0, 0, 1, 1, 1, 0, 0, 0, 0],
 [0, 0, 0, 0, 1, 0, 0, 1, 1],
 [0, 0, 0, 0, 0, 0, 1, 0, 1],
 [0, 0, 0, 0, 0, 0, 1, 1, 0]]
```

Value = 32

Candidate Configurations

```
[[0, 1, 1, 0, 0, 0, 0, 0, 0],
 [1, 0, 1, 0, 0, 0, 0, 0, 0],
 [1, 1, 0, 0, 0, 0, 0, 0, 0],
 [0, 0, 1, 0, 1, 0, 0, 0, 0],
 [0, 0, 1, 1, 0, 1, 0, 0, 0],
 [0, 0, 1, 0, 1, 0, 1, 0, 0],
 [0, 0, 0, 0, 0, 1, 0, 1, 1],
 [0, 0, 0, 0, 0, 0, 1, 0, 1],
 [0, 0, 0, 0, 0, 0, 1, 1, 0]]
```

Value = 28

```
[[0, 1, 1, 0, 0, 0, 0, 0, 0],
 [1, 0, 1, 0, 0, 0, 0, 0, 0],
 [1, 1, 0, 0, 1, 0, 0, 0, 0],
 [0, 0, 0, 0, 1, 1, 1, 0, 0],
 [0, 0, 1, 1, 0, 0, 1, 0, 0],
 [0, 0, 0, 1, 0, 0, 1, 0, 0],
 [0, 0, 0, 0, 0, 0, 0, 1, 1],
 [0, 0, 0, 0, 0, 0, 1, 0, 1],
 [0, 0, 0, 0, 0, 0, 1, 1, 0]]
```

Value = 32

Show Me The Code

Github Repository

https://github.com/jjs0sbw/EvoCom

General Information and Background

http://systemsconcept.org/