A Compendium of Chinese-Rings-Like Puzzles

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http://puzzles.schwandtner.info/compendium

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Chinese Rings



Interesting puzzle – but:

A whole compendium for one puzzle?

Agenda

- **1.** Introduction Chinese Rings
- 2. Puzzles of Various Kinds in the Compendium
- 3. Definition "CR recursive"
- 4. How to solve these puzzles?
- 5. Number of moves and solution length
- 6. Recent Developments
- 7. Compendium entries

Chinese Rings Variants



SpinOut, Crazy Elephant Dance











Tower of Hanoi Variants



Sliding Piece Puzzles / 2D Burrs











Puzzle "Devices"



Disentanglement Puzzles



Definition: CR recursive puzzles

A CR recursive (or n-ary) puzzle is a puzzle that

- contains m special similar pieces (with $m \ge 1$) and
- the puzzle can be **generalized** to other values of $m \ge 1$ and
- each **special piece** has *n* **different positions** (e.g. 0, ..., n-1, with $n \ge 2$, **Arity** *n*) and
- there is a uniform condition stating that a special piece can only move between some positions if the other special pieces are in certain positions.

Example 1: Chinese Rings

Chinese Rings with 7, 9 rings etc.

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Def CR recursive:
m special pieces
n different positions
generalizable
uniform condition

Example 1: Chinese Rings

Condition to move a ring, the green ring in the following example:

depending on all rings to the left

Def CR recursive:

- m special pieces
- n different positions
- generalizable
- uniform condition:



Example 2: Crazy Elephant Dance



Def CR recursive:
m special pieces
n different positions
generalizable
uniform condition

- 5 Elephants
- Positions 0, 1, 2
- (others: See Markus Götz' Homepage)
- Condition: ?

Example 2: Crazy Elephant Dance



Elephant can move between 0 and 1 if:

All right of it are in position 2

Elephant can move Between 1 and 2 if:

Right neighbor is in position 0 All further right are in position 2



How to Solve?

- Move pieces depending on other pieces positions (uniform condition)
- How to implement solution based on this?

• Recursion!



Recursion Example 2: CR

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Number of Moves – Solution Length

- Number of moves for specific puzzle or as function s(m,n) of parameters m, n.
- Typically with growth like *n*^m

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Chinese Rings:

n=2

s(m,n)=[2<sup>m+1</sup>/3]

moves: 21
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Kugellager: *n=***5** s(m,n)=2***5**^m moves: 1250



Die Welle: *n=***5** s(m,n)=**5**^m-1 moves: 124



Ternary or Binary?

Not always does arity *n* from definition and base of solution length function coincide!

Example:

Crazy Elephant Dance is ternary (*n=3*),

but has solution length $3 \cdot (2^m - 1) - 2 \cdot m$

Why?

Not all configurations are used in the solution of the puzzle: e.g. (0,1,0,0,1)



Recent Developments









Data Contained in Compendium

CR060	Name	Die Welle			
	Designer			Manufacturer	Year
	Jean-Claude Constantin			Jean-Claude Constantin	2010
	Arity	No of pieces	Piece type	Solution length function	Number of moves
	5	3	balls	5 ^{<i>m</i>} —1	124
	Remarks				
	References	[1]			

CR074	Name	Dispersed	GC Lock		
and the second se	Designer			Manufacturer	Year
Namio		Salakhov		Namick Salakhov	2013
000000000	Arity	No of pieces	Piece type	Solution length function	Number of moves
	2	9	Switches		92
	Remarks				
[1] [2] [3] [4]	References	[1], [2]			

	Name	Electro 1	
10000	Designer		

CR014

[1

and the second se	Designer			Manufacturer	Year	
				Tenyo		
	Arity	No of pieces	Piece type	Solution length function	Number of moves	
	3	5	pairs of loops		26	
	Remarks	The second picture shows an unknown variant. Variants: <u>CR030</u> , <u>CR067</u> , <u>CR068</u> , <u>CR069</u> , <u>CR070</u> , <u>CR075</u>				
	References	[1]				



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