Cube Synthesizer 3

Introduction

CubeSynthesizer3 is a computer program written in Excel VBA that can be used to find algorithms for animated 3x3x3 calendar and picture cubes. These are solved for a *single* face out of six to display pictures or patterns on a selected front face.

A way of solving a single face is first to move a center to the front by rotating the cube and then to solve the front face row by row. By twisting and rotating some parts of the cube, it is possible to move selected facelets from any face to the front face. Note that each letter, number or symbol on a solved face should have the right orientation, i.e. should generally be oriented North (0°).

Maneuvers used for twisting and rotating parts of a cube are coded as a series of letters called an *algorithm*. An algorithm is then a code for a sequence of moves used to change the state of a cube from an *initial* (unsolved) state to a *final* (solved) state.

The initial state of a cube is given by a particular layout of letters, numbers and symbols shown on the cube texture whereas the final state is given by what we would like to see displayed on a selected front face. This is where we would need a software tool for automatically generating an algorithm to set the cube to a user-selected final state. This is what is called synthesis, which is just the reverse of analysis. and the software tool to do this is called a Synthesizer. The Synthesizer input data is the final state data. Basic algorithms extracted from a previously generated DataBase are used to change the state of each front face facelet from an initial to a final state. Synthesized algorithms are then simply basic algorithms that have been concatenated.

Scalability

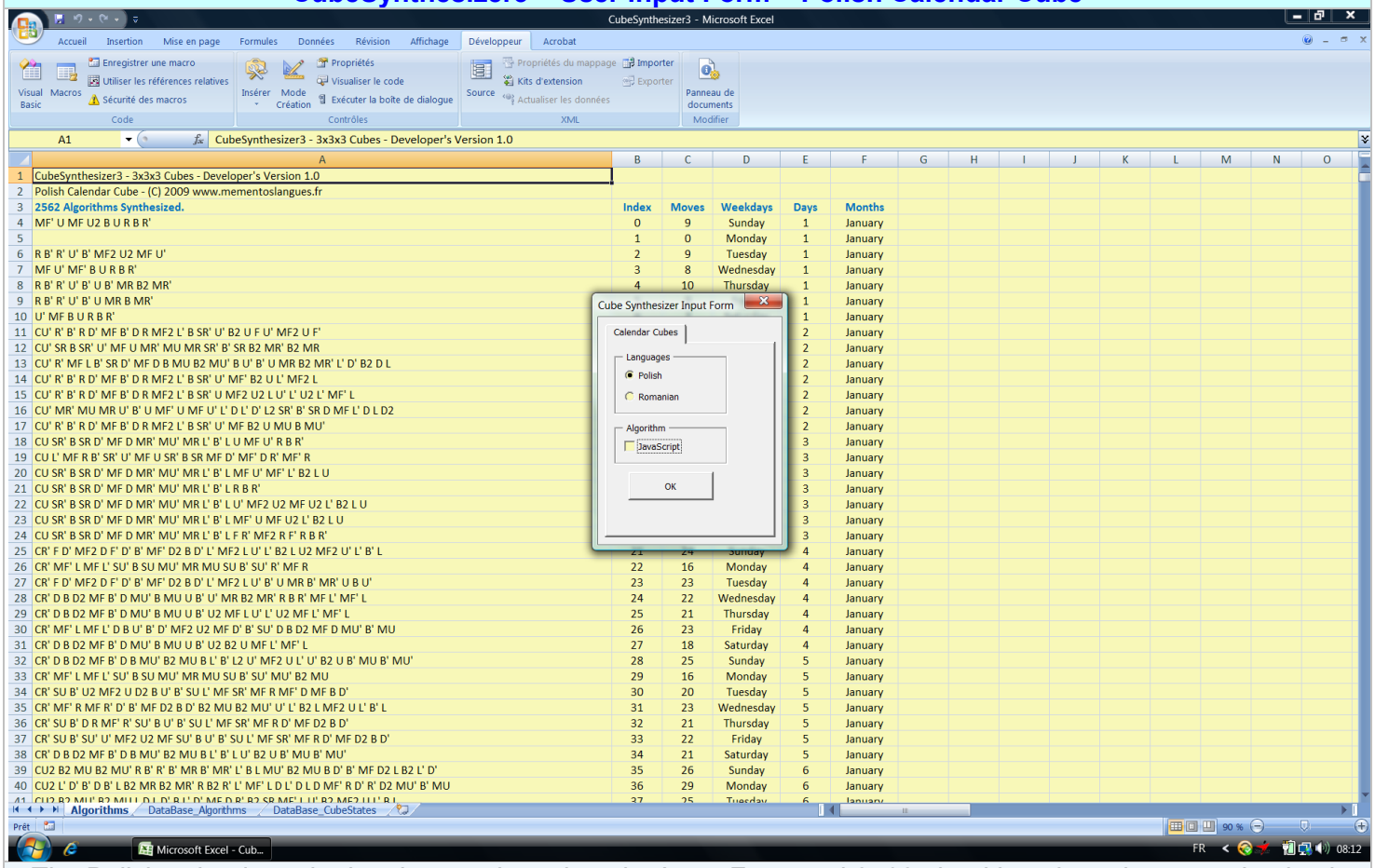
All **CubeSynthesizer3** core subroutines are N-scalable, ie. can be re-used for *any* higher order cube simply by updating the 'cubeOrder' variable.

CubeSynthesizer3 – 3x3x3 Cube Examples		
		
Numbered Cube	Polish Calendar Cube	Romanian Calendar Cube

Download CubeSynthesizer3 – Microsoft Excel 2007
http://www.mementoslangues.fr/CubeDesign/CubeSynthesizer/CubeSynthesizer3.xlsm
Type **Ctrl + Shift + S** to start the program and **Ctrl + Break** to stop it if execution time is too long.

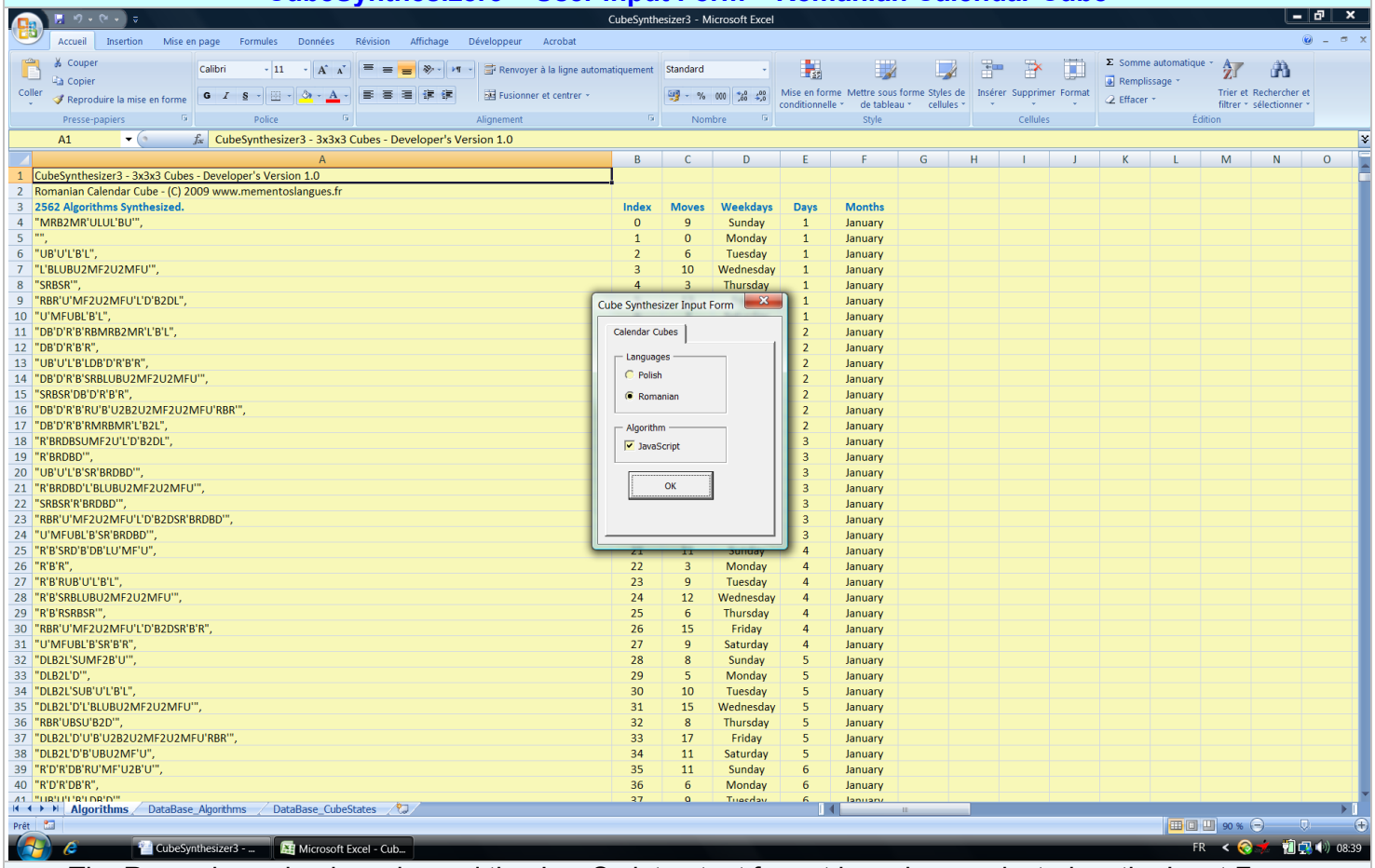
User Input Form

CubeSynthesizer3 – User Input Form – Polish Calendar Cube



The Polish calendar cube has been selected on the Input Form and 2562 algorithms have been synthesized.

CubeSynthesizer3 – User Input Form – Romanian Calendar Cube



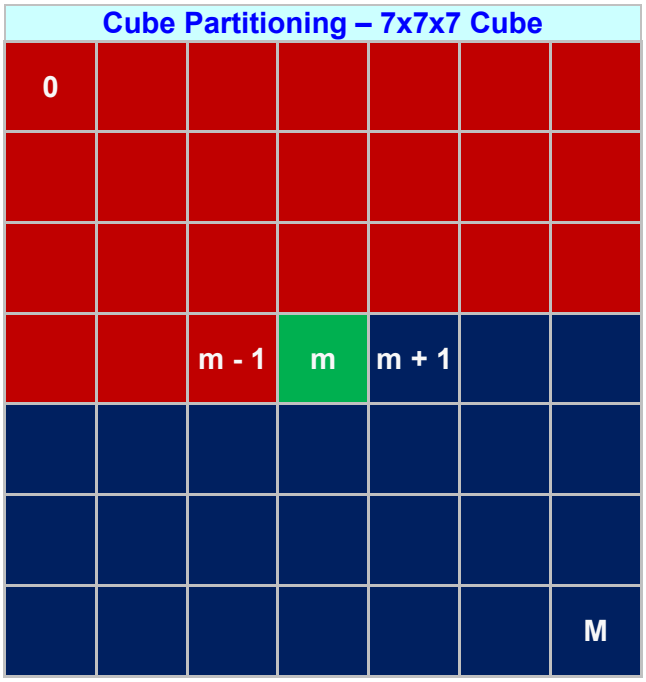
The Romanian calendar cube and the JavaScript output format have been selected on the Input Form.

Algorithm Length Optimization

A center facelet is moved to the front face simply by rotating the cube. All other facelets are individually moved to the front face, using algorithms that will not modify other facelets of the front face. This means that facelets can just be moved to the front face in any order. By dividing the front face in 3 parts A, B and C, half algorithms for parts A and B can be concatenated in just 8 different ways to give the fewest move compound algorithm.

The cube front face is divided into 3 parts:

- Part A: facelets numbered from 0 to m
- Part B: facelets numbered from m + 1 to M
- Part C: center facelet with number m



Front Face Center Number – m							
3	5	7	N (odd)	4	6	8	N (even)
4	12	24	$(N^2 – 1)/2$	5	14	27	$(N^2 – N – 2)/2$
$M = N^2 – 1$							

Half Algorithm Combinations					
Half Algorithms	Start	Stop	Step	Combinations	Index
(A→)	0	m - 1	+1	(A→) (B→)	0
(B→)	m + 1	M	+1	(B→) (A→)	1
(A→)	0	m - 1	+1	(A→) (←B)	2
(←B)	M	m + 1	-1	(←B) (A→)	3
(←A)	m - 1	0	-1	(←A) (B→)	4
(B→)	m + 1	M	+1	(B→) (←A)	5
(←A)	m - 1	0	-1	(←A) (←B)	6
(←B)	M	m + 1	-1	(←B) (←A)	7

DataBase Algorithms – 3x3x3 Cubes

A DataBase of 240 basic algorithms has been generated for 3x3x3 cubes using AlgorithmFinder3. The algorithm indexing is based on a new cube numbering scheme, where facelets are numbered according to the group they are in.

DataBase Algorithms – 3x3x3 Cubes	
Algorithms	**Index**
	0
CF	1
CF2	2
CF'	3
CU	4
CU CF	5
CU' CR2	6
CU CF'	7
CR'	8
CU CR'	9
CU2 CR'	10
CU' CR'	11
CU'	12
CU' CF	13
CU' CF2	14
CU' CF'	15
CR	16
CU' CR	17
CU2 CR	18
CU CR	19
CU2	20
CU2 CF	21
CR2	22
CU2 CF'	23
	24
MU' MR' MF MU MR	25
MU' MF' MU2 MF' MU'	26
MU' MR MF' MU MR'	27
	28
U R MF' R' U'	29
D' U' MF2 U D	30
L U MF U' L'	31
U R MF R' U'	32
	33
D' R' MF' R D	34
L' R' MF2 R L	35
D' U' MF2 U D	36
D' R' MF R D	37
	38
D L MF' L' D'	39
L U MF' U' L'	40
L' R' MF2 R L	41
D L MF L' D'	42
	43
	44
D B U' B' SU	45
D' U' B2 D U	46
L' B' R B SR'	47
U' B' D B SU	48
	49
L B R' B' SR	50
D U B2 D' U'	51

D' U' B2 D U	52
R' B' L B SR	53
	54
U B D' B' SU'	55
R B L' B' SR'	56
D U B2 D' U'	57
D' B' U B SU'	58
	59
MU MR' MU' MR	60
MR' MF MR	61
MF' MU MF' MU'	62
MR MF' MR'	63
MF U' MF' U	64
MR B MR'	65
U MF2 U'	66
U R' MF2 R U'	67
F D' MF2 D F'	68
R' MF R	69
F' U MF2 U' F	70
R' MF2 R2 MF R'	71
D' MF2 D	72
MR' B' MR	73
MF' D MF D'	74
D' R MF2 R' D	75
L' MF' L	76
B' MU B' MU'	77
L MF L'	78
MR' MU MR	79
R B R'	80
B U' B' U	81
R' B' R2 B2 R'	82
U' B U R B R'	83
B' D B D'	84
R' B' R	85
D B' D' R' B' R	86
R B R2 B2 R	87
D' B2 D	88
L B' L'	89
SR' B' SR	90
D' R B2 R' D	91
L' B L	92
U B2 U'	93
U R' B2 R U'	94
SR B SR'	95
MR' MU' MR MU	96
MU' MF MU	97
MF' MR' MF' MR	98
MU MF' MU'	99
U' MF U	100
F' L MF2 L' F	101
U' MF2 U2 MF U'	102
F R' MF2 R F'	103
MU' B' MU	104
MF' R MF R'	105
U R' MF2 R U'	106
R' MF2 R	107
B' MR' B' MR	108
D MF D'	109
MU' MR' MU	110
D' MF' D	111

MU B MU'	112
L MF2 L'	113
L U' MF2 U L'	114
MF L' MF' L	115
U' B' U	116
R B' R' U' B' U	117
U B U2 B2 U	118
B' R B R'	119
D B' D'	120
SU' B' SU	121
U R' B2 R U'	122
R' B2 R	123
L B2 L'	124
L U' B2 U L'	125
SU B SU'	126
D' B D	127
B L' B' L	128
U' B' U2 B2 U'	129
L' B L U B U'	130
U B U'	131
MU' MR' MU MR	132
MR MF MR'	133
MF' MU' MF' MU	134
MR' MF' MR	135
MF' U MF U'	136
L U' MF2 U L'	137
U' MF2 U	138
MR B' MR'	139
R MF R'	140
MR' MU' MR	141
R' MF' R	142
B' MU' B' MU	143
D MF2 D'	144
D L' MF2 L D'	145
MF D' MF' D	146
MR' B MR	147
F' D MF2 D' F	148
L' MF2 L2 MF L'	149
F U' MF2 U F'	150
L' MF L	151
SR B' SR'	152
L U' B2 U L'	153
U' B2 U	154
R B' R'	155
D L' B2 L D'	156
SR' B SR	157
R' B R	158
D B2 D'	159
L' B' L2 B2 L'	160
D' B D L B L'	161
L B L'	162
B D' B' D	163
U B' U' L' B' L	164
L B L2 B2 L	165
B' U B U'	166
L' B' L	167
MR MU' MR' MU	168
MU MF MU'	169
MF' MR MF' MR'	170
MU' MF' MU	171

MU' MR MU	172
U' MF' U	173
B' MR B' MR'	174
U MF U'	175
D' R MF2 R' D	176
MF R' MF' R	177
MU' B MU	178
R MF2 R'	179
D' MF2 D2 MF D'	180
F L' MF2 L F'	181
D' MF D	182
F' R MF2 R' F	183
D L' MF2 L D'	184
L' MF2 L	185
MU B' MU'	186
MF' L MF L'	187
SU' B SU	188
U' B U	189
R B2 R'	190
D' R B2 R' D	191
R' B R D B D'	192
D B D'	193
B R' B' R	194
D' B' D2 B2 D'	195
D B D2 B2 D	196
B' L B L'	197
D' B' D	198
L B' L' D' B' D	199
D L' B2 L D'	200
L' B2 L	201
U B' U'	202
SU B' SU'	203
MR' MF2 MR	204
MU' MR MF MU MR'	205
MU MF2 MU'	206
MU' MR' MF' MU MR	207
MR B2 MR'	208
B' MR B2 MR'	209
B2 MR B2 MR'	210
B MR B2 MR'	211
B' MU' B2 MU	212
B2 MU' B2 MU	213
B MU' B2 MU	214
MU' B2 MU	215
B2 MR' B2 MR	216
B MR' B2 MR	217
MR' B2 MR	218
B' MR' B2 MR	219
B MU B2 MU'	220
MU B2 MU'	221
B' MU B2 MU'	222
B2 MU B2 MU'	223
R D B D' B R'	224
U' L U' L' U2	225
U' L' B' L B' U	226
U' L' B2 L U	227
D L' D L D2	228
R' D' R' D B' R	229
D L B2 L' D'	230
D L B L' B D'	231

D' L' D' L B' D	232
D' L' D2 L D	233
L D L D' B L'	234
D' R D' R' D2	235
L' D' B2 D L	236
U L U L' B U'	237
L' D L' D' L2	238
L' D' B' D B' L	239