

Analog Clock Cube Design

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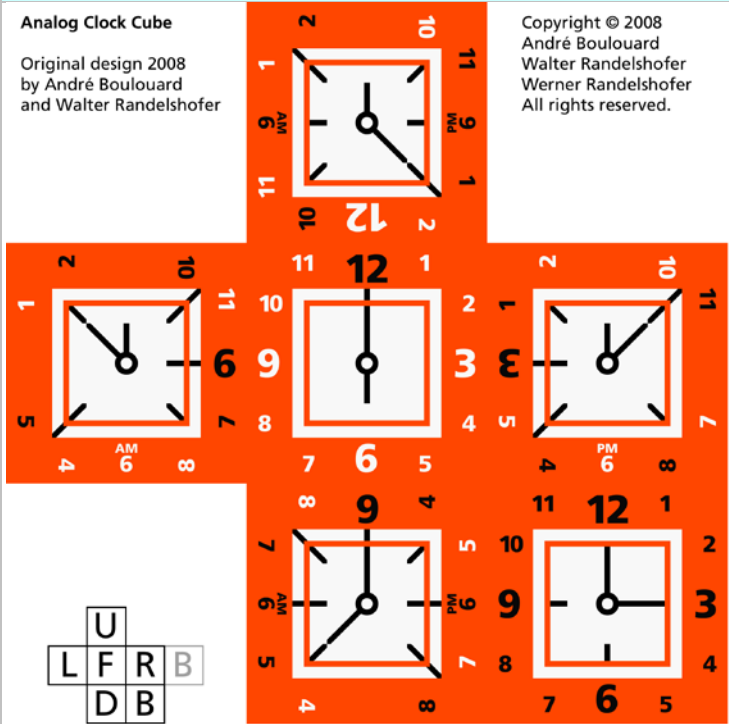
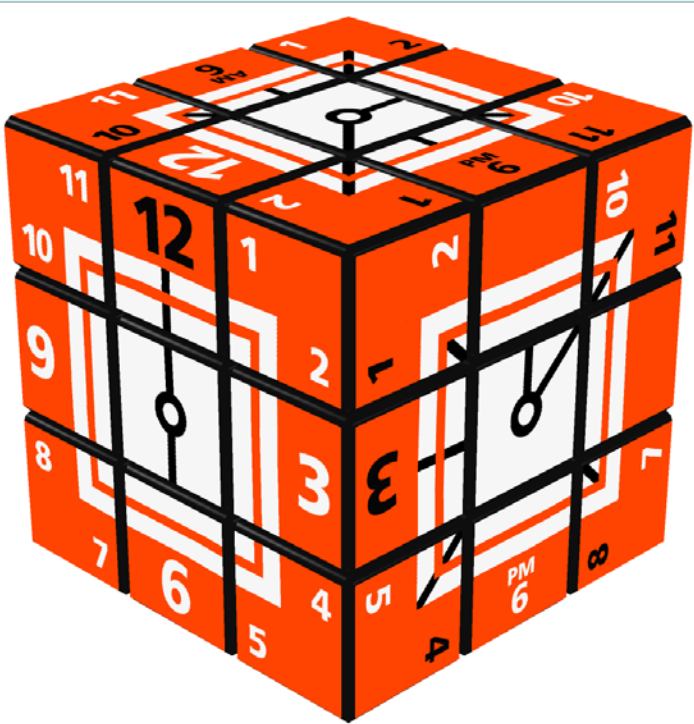
Designers	André Boulouard	Walter and Werner Randelshofer
WebSites	http://www.mementoslangues.fr/	http://www.randelshofer.ch/

Introduction

An **Analog Clock Cube** is a 3x3x3 **Rubik's Cube** used for indicating time. Analog clocks usually indicate time using angles. The most common clock face uses a fixed numbered dial and moving hand(s). It usually has a circular scale of 12 hours, which can also serve as a scale of 60 minutes if the clock has a second hand.

Clock – Useful Links	
http://en.wikipedia.org/wiki/Clock	http://en.wikipedia.org/wiki/Clock_face
http://en.wikipedia.org/wiki/24_hour_analog_dial	http://en.wikipedia.org/wiki/Watch

There are **Virtual Cubes** that can be *virtually* rotated and twisted on a computer screen and **Real Cubes** that can only be *physically* rotated and twisted by hand. A **Texture** is laid down on a Virtual Cube whereas real **Stickers** are stuck down on a Real Cube. An Analog Clock Cube is designed by placing numbers and hands on a texture which is then laid down on a Virtual Cube (see <http://www.randelshofer.ch/> for more details). The following example shows the *initial* state of the Cube (12:00) where all hands are lined up with number '12'.

Analog Clock Cube	
Analog Clock Cube Original design 2008 by André Boulouard and Walter Randelshofer 	Copyright © 2008 André Boulouard Walter Randelshofer Werner Randelshofer All rights reserved. 
Analog Clock Cube Texture	Virtual Analog Clock Cube
Download CubeTwister from: http://www.randelshofer.ch/	

Analog Clock Cube Features

Designing a 3-hand analog clock that works on a 3x3x3 Rubik's Cube is a *real* challenge, as there are only 6 center facelets available. There are clearly not enough center facelets available for displaying *all* possible hand combinations, but by selecting the most common combinations a solution can be arrived at. The solution found here consists first in splitting hands in 2 parts and second in using each corner facelet to display 2 numbers. There are 3 hands on the Clock Cube: hour, minute and second. Each hand is split into 2 parts, one part (body) on a center cube and the other part (arrow) on a corner or an edge. The clock can work in 2 modes, Clock or Timer. In Clock mode, the AM/PM time of the day can be displayed every 5 minutes for 3, 6, 9 and 12 o'clock and every 15 minutes for 1, 2, 4, 5, 7, 8, 10 and 11 o'clock. In Timer mode the second hand can tick every 15 seconds.

Examples of Analog Clocks

The most common clock face has 3 hands:

- 1 hour hand
- 1 minute hand
- 1 second hand

Analog Clocks



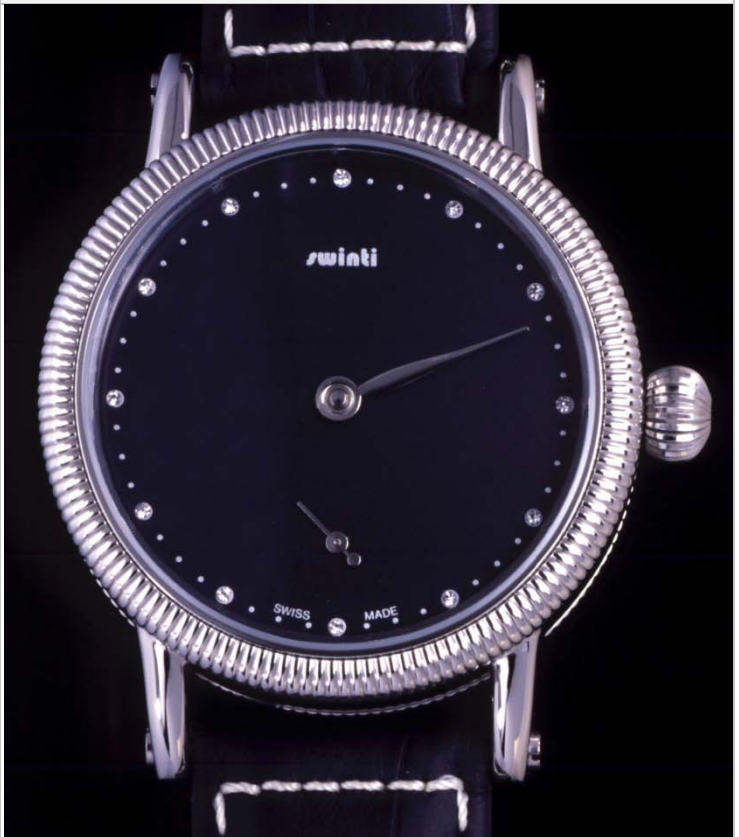
A wall clock, with 3 dials and 5 hands



Two-hand Wristwatch



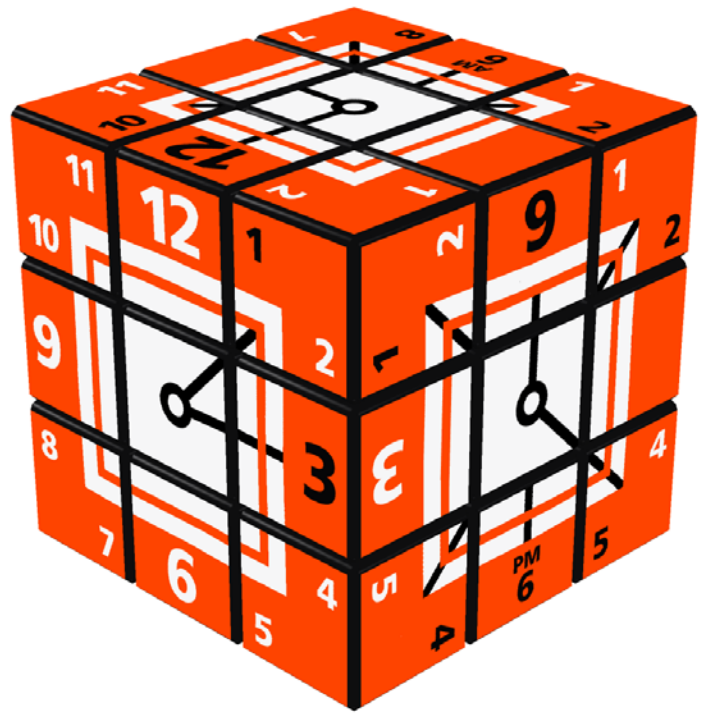
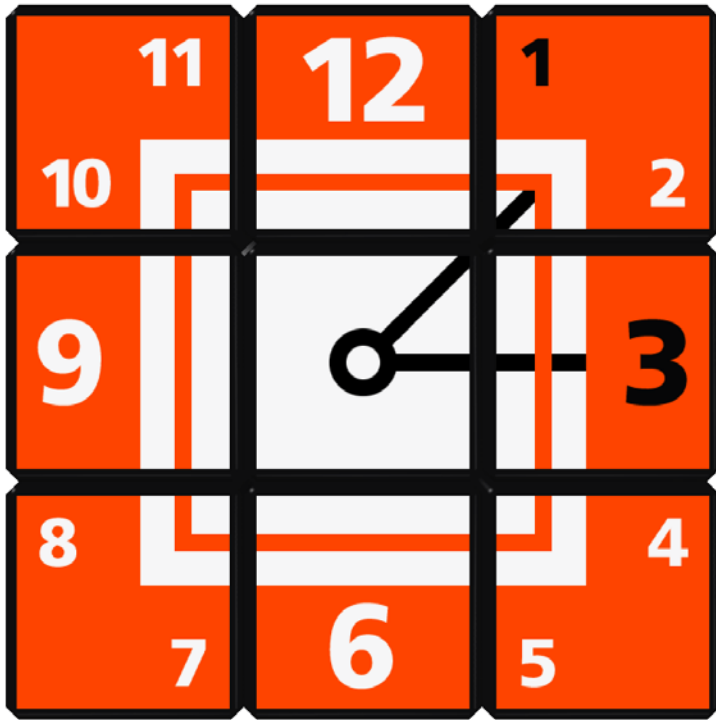
Rubik's Clock



One-Hand Wristwatch

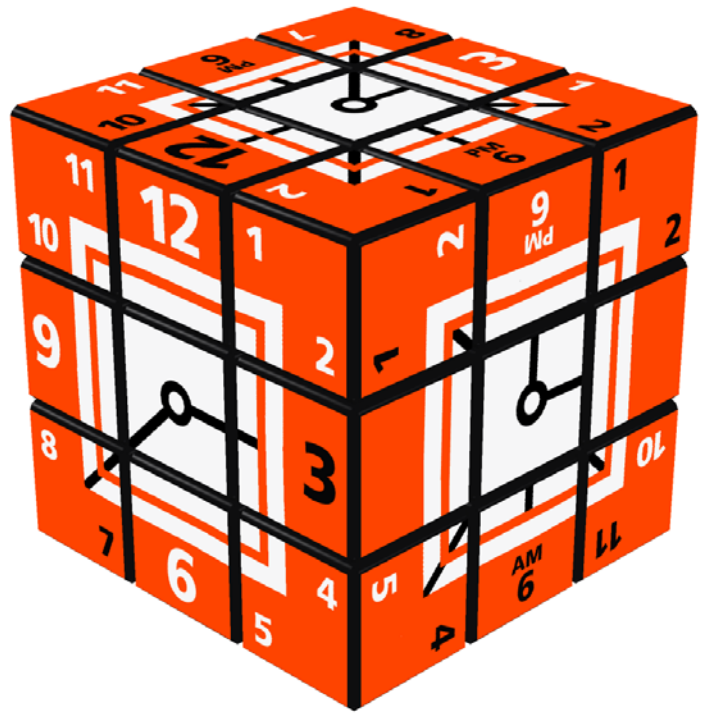
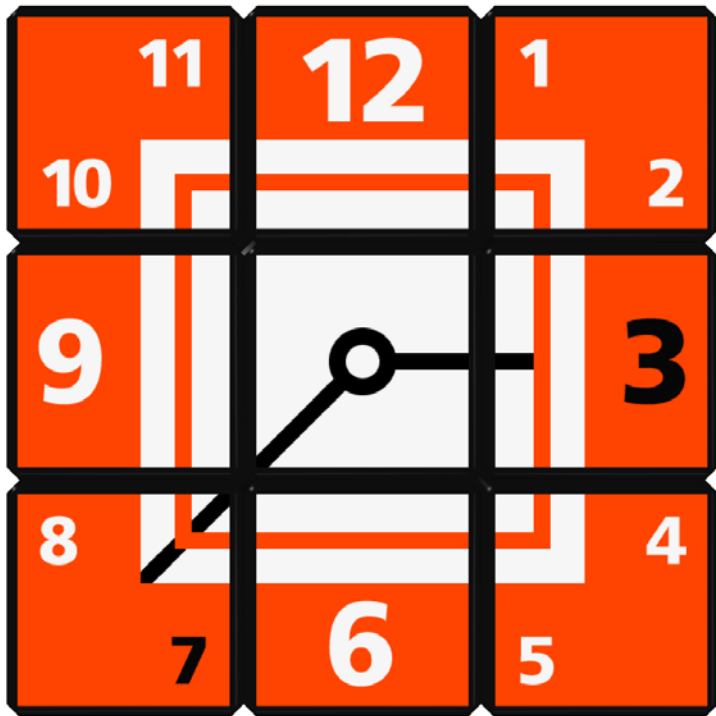
Examples of Analog Clock Cube Synthesized Algorithms

Analog Clock Cube Synthesized Algorithms



Synthesized Algorithm (1:15)

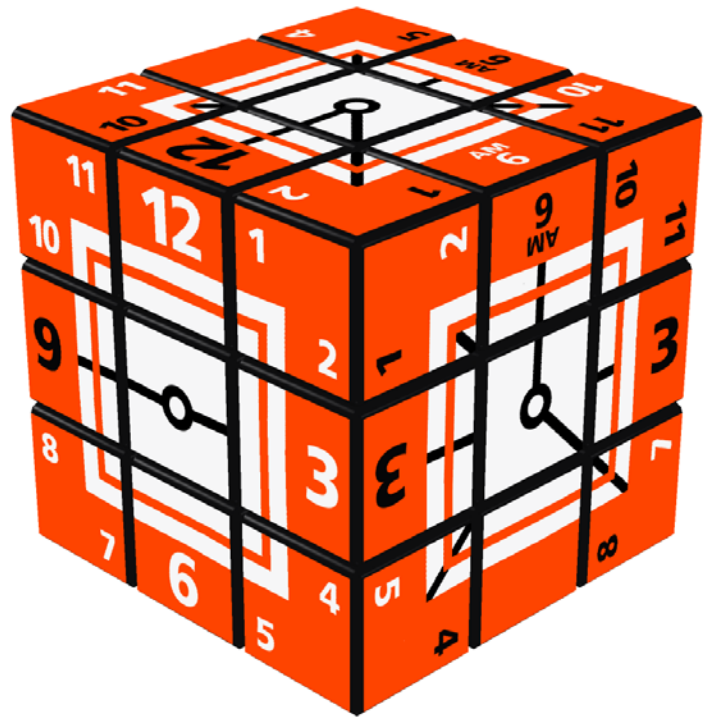
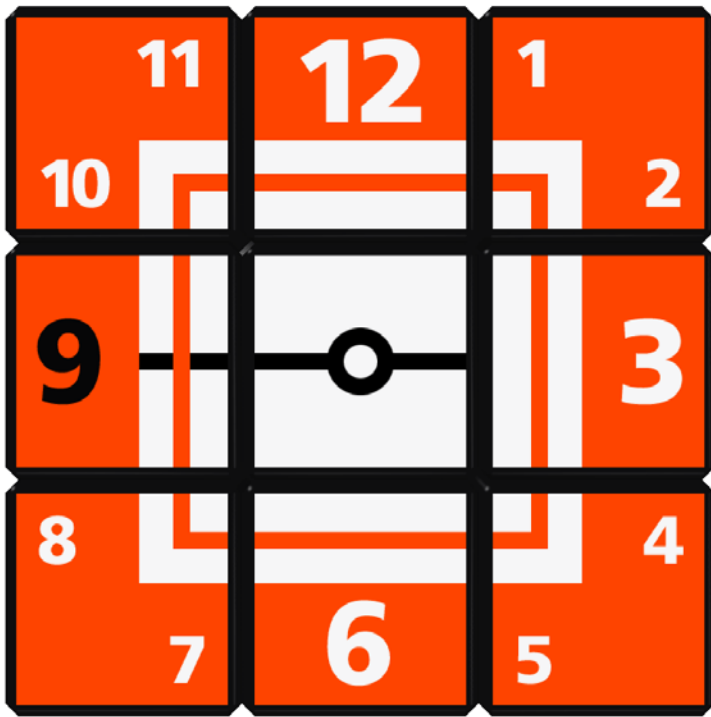
CF CR' R2 U B R2 L B D' L' D' L' B L R B2 R2 B R



Synthesized Algorithm (3:35)

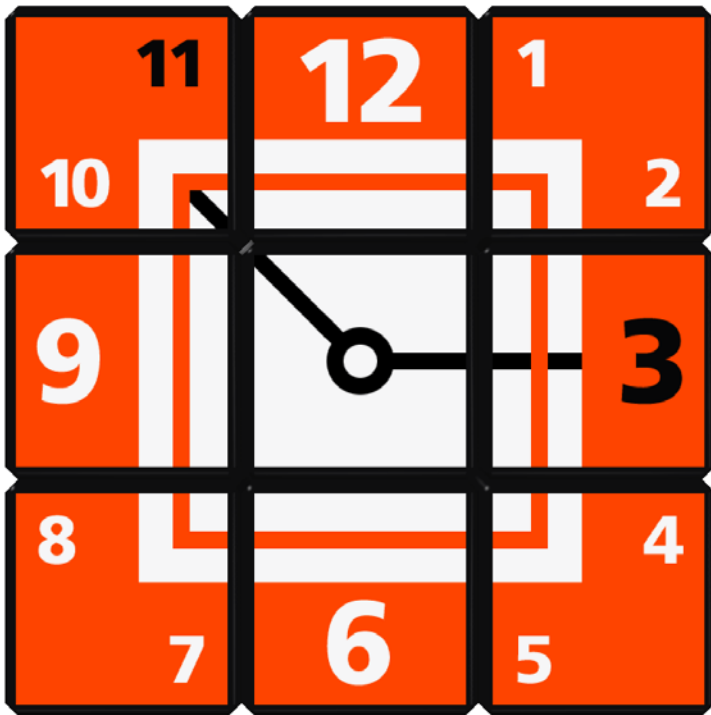
CF CU L2 B' U2 L' B D' R L2 D B' U' L U B2 U B' U' L' B2 L D' B D2 B2 D' R' B2 R B R B' R'

Analog Clock Cube Synthesized Algorithms



Synthesized Algorithm (9:45)

CF R U D2 B R2 L2 B L' D2 L' B L2 B L' U' B U L R' B R L'



Synthesized Algorithm (11:15)

CF CU' B U2 R U' B2 U D2 U B U' L2 U B2 U' B U' B U R B2 R' B' D' B D L B2 L'

Analog Clock Cube Design

In this design, a hand is composed of 2 parts:

- 1- 1 part (body) on a center cube
- 2- 1 part (arrow) on a corner or edge cube

By doing so, we ensure that a minimum step of 15 minutes can be displayed for a full 12-hour cycle.

There are 2 different arrows on corner cubes and 4 corners without any arrow.:

- 1- 1 arrow for the (short) hour hand
- 2- 1 arrow for the (long) minute hand

Corner cubes can then display:

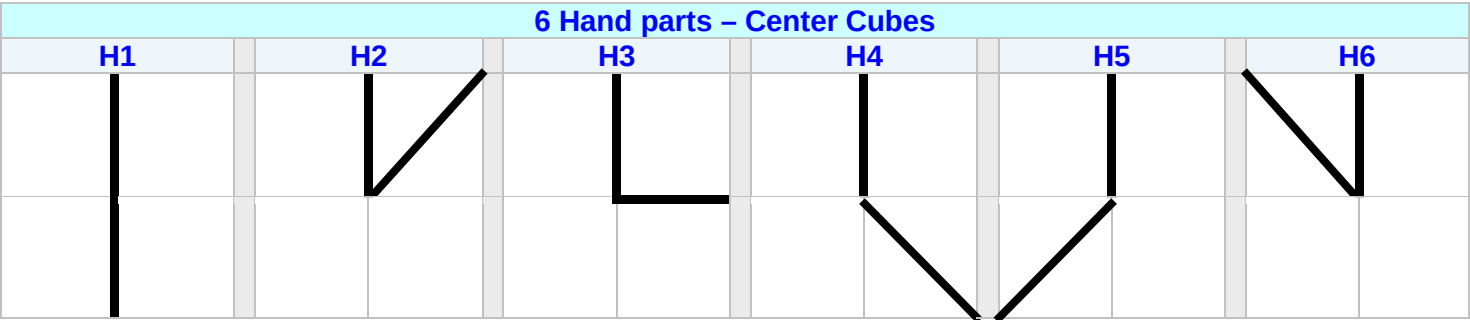
- 1- **Top Right:** '1' + '2' + hour arrow, '1' + '2' + hour arrow, '1' + '2' + minute arrow, '1' + '2' + minute arrow, '1' + '2' (without any arrow)
- 2- **Bottom Right:** '4' + '5' + hour arrow, '4' + '5' + hour arrow, '4' + '5' + minute arrow, '4' + '5' + minute arrow, '4' + '5' (without any arrow)
- 3- **Bottom Left:** '7' + '8' + hour arrow, '7' + '8' + hour arrow, '7' + '8' + minute arrow, '7' + '8' + minute arrow, '7' + '8' (without any arrow)
- 4- **Top Left:** '10' + '11' + hour arrow, '10' + '11' + hour arrow, '10' + '11' + minute arrow, '10' + '11' + minute arrow, '10' + '11' (without any arrow)

There are also 2 different arrows on edge cubes and 4 edges without any arrow:

- 1- 1 arrow for the (short) hour hand
- 2- 1 arrow for the (long) minute hand

Corner cubes can then display:

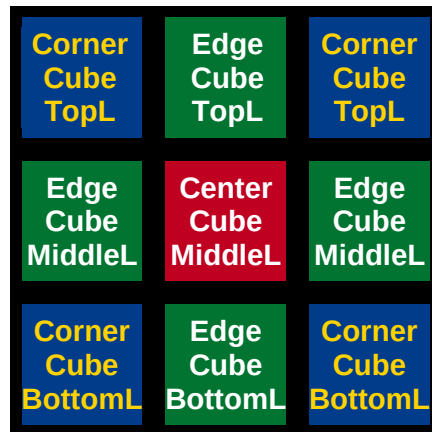
- 1- **Top Center:** '3' + hour arrow, '3' + minute arrow, '3' (without any arrow)
- 2- **Middle Right:** '6' + hour arrow, '6' + minute arrow, '6' (without any arrow)
- 3- **Bottom Center:** '9' + hour arrow, '9' + minute arrow, '9' (without any arrow)
- 4- **Middle Left:** '12' + hour arrow, '12' + minute arrow, '12' (without any arrow)



Indexed Hours:Minutes displayed on the Cube											
1	2	3	4	5	6	7	8	9	10	11	12
0:00	0:05	0:10	0:15	0:20	0:25	0:30	0:35	0:40	0:45	0:50	0:55
13	14	15	16	17	18	19	20	21	22	23	24
1:00	1:00	1:00	1:15	1:15	1:15	1:30	1:30	1:30	1:45	1:45	1:45
25	26	27	28	29	30	31	32	33	34	35	36
2:00	2:00	2:00	2:15	2:15	2:15	2:30	2:30	2:30	2:45	2:45	2:45
37	38	39	40	41	42	43	44	45	46	47	48
3:00	3:05	3:10	3:15	3:20	3:25	3:30	3:35	3:40	3:45	3:50	3:55
49	50	51	52	53	54	55	56	57	58	59	60
4:00	4:00	4:00	4:15	4:15	4:15	4:30	4:30	4:30	4:45	4:45	4:45
61	62	63	64	65	66	67	68	69	70	71	72
5:00	5:00	5:00	5:15	5:15	5:15	5:30	5:30	5:30	5:45	5:45	5:45
73	74	75	76	77	78	79	80	81	82	83	84
6:00	6:05	6:10	6:15	6:20	6:25	6:30	6:35	6:40	6:45	6:50	6:55
85	86	87	88	89	90	91	92	93	94	95	96
7:00	7:00	7:00	7:15	7:15	7:15	7:30	7:30	7:30	7:45	7:45	7:45
97	98	99	100	101	102	103	104	105	106	107	108
8:00	8:00	8:00	8:15	8:15	8:15	8:30	8:30	8:30	8:45	8:45	8:45
109	110	111	112	113	114	115	116	117	118	119	120
9:00	9:05	9:10	9:15	9:20	9:25	9:30	9:35	9:40	9:45	9:50	9:55
121	122	123	124	125	126	127	128	129	130	131	132
10:00	10:00	10:00	10:15	10:15	10:15	10:30	10:30	10:30	10:45	10:45	10:45
133	134	135	136	137	138	139	140	141	142	143	144
11:00	11:00	11:00	11:15	11:15	11:15	11:30	11:30	11:30	11:45	11:45	11:45

Terminology

In a 3x3x3 **Rubik's Cube**, there are 8 *Corner Cubes*, 12 *Edge Cubes*, 6 *Center Cubes* and 6 *Cube Faces*. There are also 4 Corner Cube faces, 4 Edge Cube faces and 1 Center Cube face *per Cube Face*, as shown below.



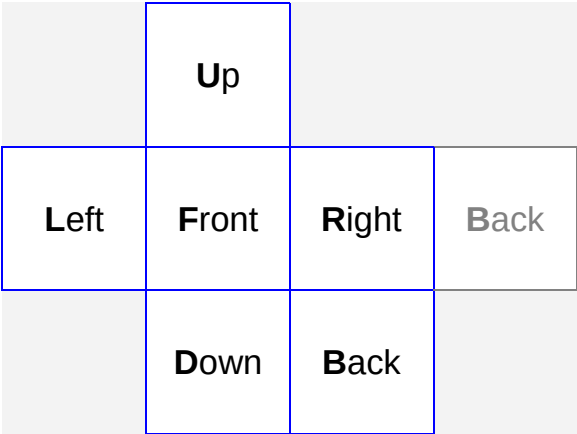
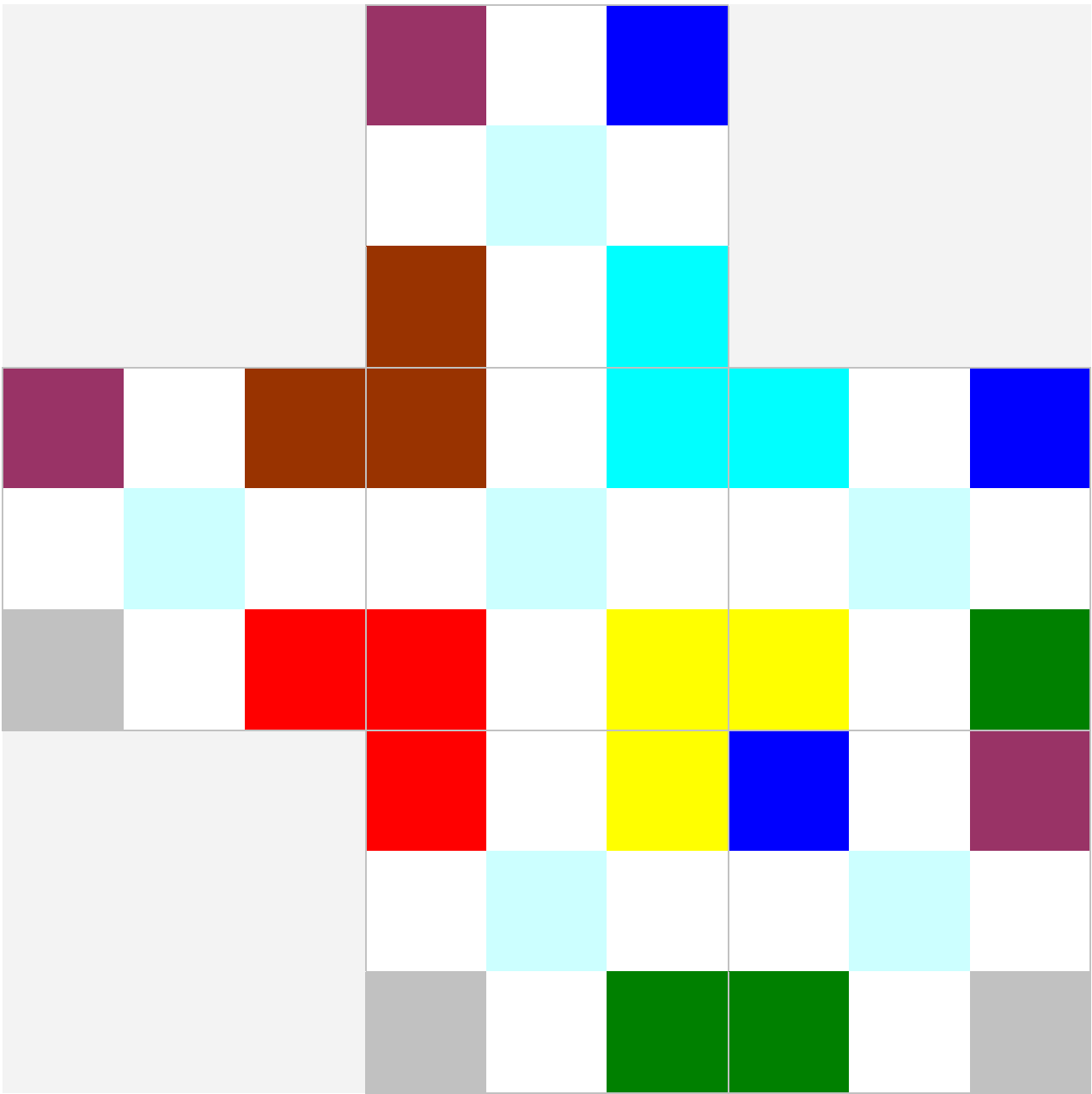
There are 1 face per Center Cube, 2 faces per Edge Cube and 3 faces per Corner Cube.

There are also 3 horizontal *Layers* called *Top*, *Middle* and *Bottom Layers*.

Cube Lexicon		
English	Français	Deutsch
Cube	Cube	Würfel
cube, cube	cube, petit cube	Würfelteil, Teil des Würfels
face	face	Seite, Seitenfläche
front face	face avant	vordere Seite, vorne
back face	face arrière	hintere Seite, hinten
left face	face gauche	linke Seite, links
right face	face droite	rechte Seite, rechts
top face	face supérieure	obere Seite, oben
bottom face	face inférieure	untere Seite, unten
sticker	étiquette (autocollante), plaquette	Kleber, Farbkleber
tile	tuile, plaquette	Plättchen, Farbplättchen
center cube, center	cube central, centre	Mittelwürfel, Mittelstein, Mitte
edge cube, edge	cube-arête, arête	Kantenwürfel, Kantenstein, Kante
corner cube, corner	cube de coin, coin	Eckwürfel, Eckstein, Ecke
layer	couronne	Schicht, Scheibe
top layer	couronne supérieure	obere Schicht, obere Scheibe
middle layer	couronne intermédiaire	mittlere Schicht, mittlere Scheibe, Mittelschicht, Mittelscheibe
bottom layer	couronne inférieure	untere Schicht, untere Scheibe
orientation, direction	orientation	Orientierung
to solve	résoudre	lösen, zusammen drehen
to twist	pivoter	drehen
to rotate	tourner, effectuer une rotation	drehen
clockwise	dans le sens horaire	im Uhrzeigersinn
anticlockwise, counter-clockwise	dans le sens anti-horaire	im Gegenuhrzeigersinn

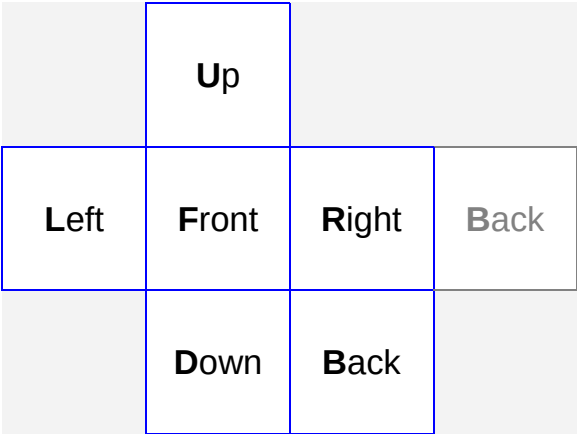
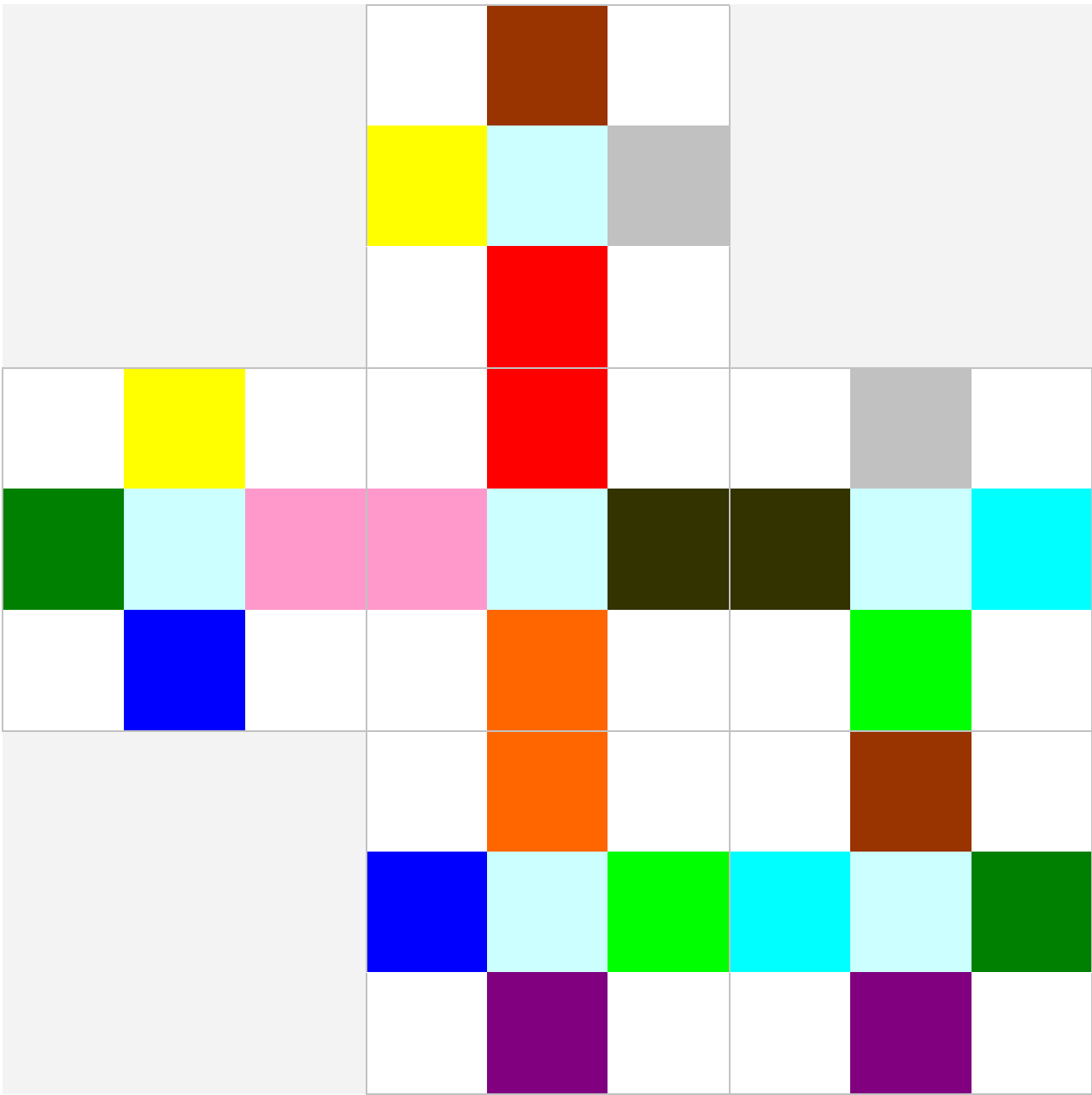
Corner Cubes Final Check

There are 8 Corner Cubes and 3 faces per Corner Cube. In the diagram below, each Corner Cube is displayed in 8 different colors and with the same color applied to each of its 3 faces. This diagram can be used as a convenient *visual aid* to check Design Rules (DRC).



Edge Cubes Final Check

There are 12 Edge Cubes and 2 faces per Edge Cube. In the diagram below, each Edge Cube is displayed in 12 different colors and with the same color applied to each of its 2 faces. This diagram can be used as a convenient *visual aid* to check Design Rules (DRC).



Texture Template

This is a texture template that can be printed out and used for writing down numbers and letters by hand *prior to* texture design. All is needed are pencil, rubber...and time.

