Geographical Coordinates & Clock Cube Design

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WebSites	http://www.mementoslangues.fr/	http://www.randelshofer.ch/

Introduction

A **Geographical Coordinates & Clock Cube** is a 3x3x3 **Rubik's Cube** used to display Latitude, Longitude or Time of the day. These are displayed as follows:

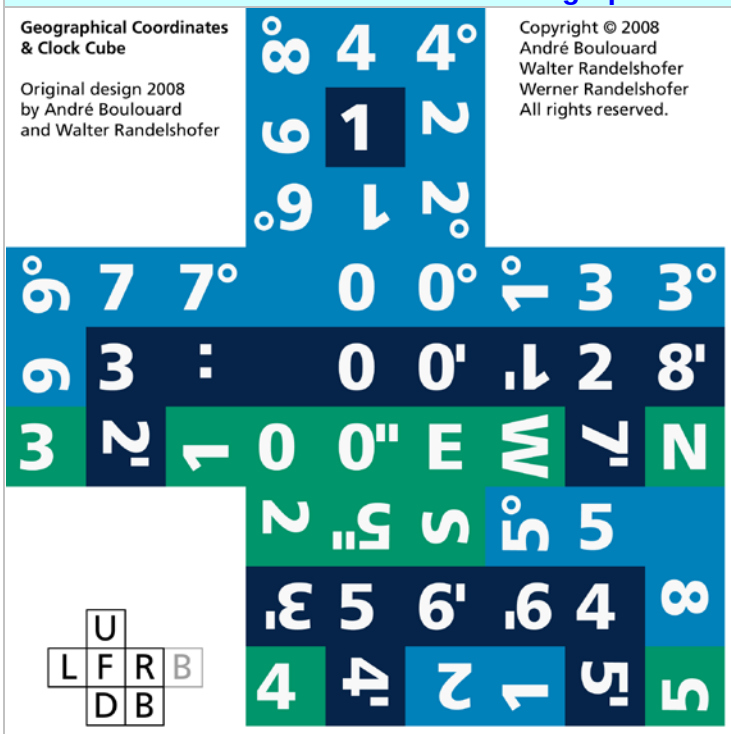
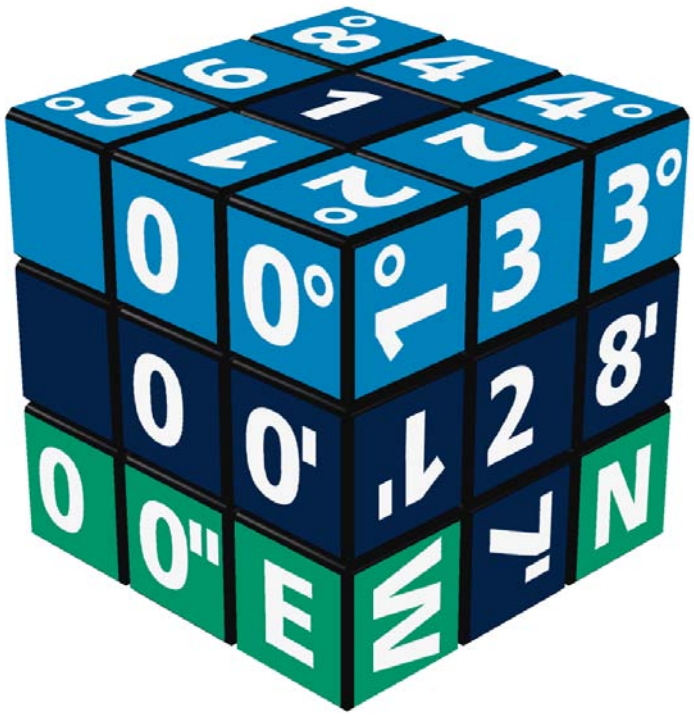
- Latitude: from 00° 00′ 00″ up to 90° 00′ 00″ in 05″ (arc seconds) steps, North (N) or South (S)
- Longitude: from 00° 00′ 00″ up to 180° 00′ 00″ in 05″ (arc seconds) steps, East (E) or West (W)
- Time of the day: from 00:00′ 00″ up to 24:00′ 00″ in 05″ (seconds of time) steps, Summer (S), Winter (W) or English Time (E)
- Arc seconds or seconds of time: 00″, 05″, 10″, 15″, 20″, 25″, 30″, 35″, 40″, 45″, 50″, 55″

A **Geographical Coordinates Cube** or **Geo Cube** is a 3x3x3 **Rubik's Cube** used to display Latitude and Longitude only (see Geo Cube for more details). The Time of the day option is not used for this cube.

Geographical Coordinates – Useful Links	
http://en.wikipedia.org/wiki/Latitude	http://en.wikipedia.org/wiki/Longitude

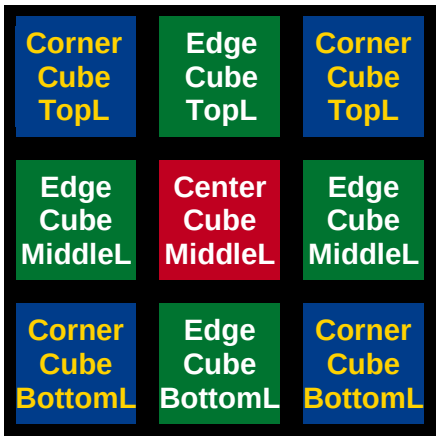
There are **Virtual Cubes** that can be *virtually* rotated and twisted on a computer screen and **Real Cubes** that can only be *physically* rotated and twisted by hand. A **Texture** is laid down on a Virtual Cube whereas real **Stickers** are stuck down on a Real Cube. A Geographical Coordinates & Clock Cube is designed by placing letters and numbers on a texture which is then laid down on a Virtual Cube (see http://www.randelshofer.ch/ for more details). Latitude, longitude and time of the da) can be displayed on a *selected* Cube face by rotating and twisting some parts of the Cube. When this has been achieved, we say that the Cube has been *solved*.

The example below shows the initial state of a **Geographical Coordinates & Clock Cube**, displaying a Longitude of 00° 00′ 00″ E*, which is the Longitude of the Prime Meridian passing through Greenwich, London, England. *Longitude may be either East ('E') or West ('W') when greater than zero, but, in the initial state, letter 'E' may also mean England or GrEenwich.

Virtual Geographical Coordinates & Clock Cube	
	
Geographical Coordinates Cube Texture	Virtual Geographical Coordinates Cube
Download **CubeTwister** from: http://www.randelshofer.ch/	

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
cubie, 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

Geographical Coordinates & Clock Cube Design

Cube Layout

In this design, Latitude, Longitude and Time of the day are displayed as follows:

- Top Layer: degrees (Latitude or Longitude) or hours of Time
- Middle Layer: minutes (Latitude or Longitude or minutes of Time)
- Bottom Layer: seconds (Latitude or Longitude or minutes of Time)

Top Layer Layout

Numbers on the Top Layer are sorted out as follows:

1- 2 **T**op **L**eft numbers on 1 corner cube: **1**, **2**
2- 10 **T**op **C**enter numbers on edge cubes: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9
3- 2 **T**op **R**ight blanks + 10 numbers on corner cubes: 0°, 1°, 2°, 3°, 4°, 5°, 6°, 7°, 8°, 9°, blank_TopLayer, blank_TopLayer

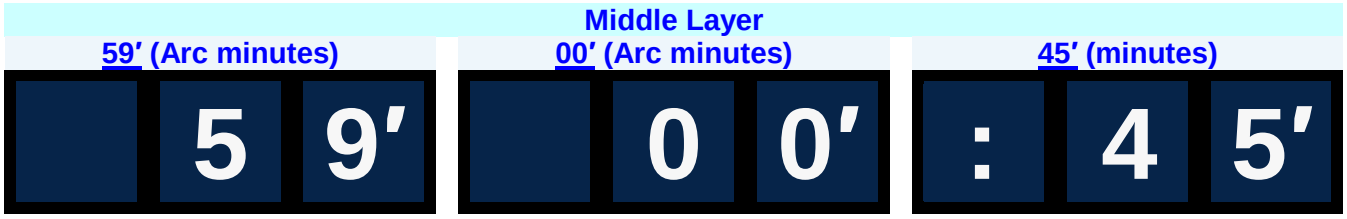
Numbers are now *logically* combined on corner and edge cubes:

1- 5 **T**op **C**enter edge cubes: (0,1), (2,3), (4,5), (6,7), (8,9)
2- 4 **T**op **R**ight corner cubes: (0°,1°,2°), (3°,4°,5°), (6°,7°, blank_TopLayer), (8°,9°, blank_TopLayer)

Note 1: There is always 1 blank_TopLayer that can be used either **T**op **R**ight or **T**op **L**eft on the Top Layer
Note 2: The 2 **T**op **L**eft numbers **1** and **2** are laid on a Bottom Layer corner cube

So, now there are 4 corner and 7 edge cubes left that can be used for the 2 remaining layers.

Middle Layer Layout



Symbols and numbers on the Middle Layer are sorted out as follows:

1- 1 **M**iddle **L**eft symbol + 1 blank on 1 edge cube: :, blank_MiddleLayer
2- 6 **M**iddle **C**enter numbers on center cubes: 0, 1, 2, 3, 4, 5
3- 10 **M**iddle **R**ight numbers on edge cubes: 0′, 1′, 2′, 3′, 4′, 5′, 6′, 7′, 8′, 9′

Symbols and numbers are now *logically* combined on edge cubes:

1- 1 **M**iddle **L**eft edge cube: (:,blank_MiddleLayer)
2- 5 **M**iddle **R**ight edge cubes: (0′,1′), (2′,3′), (4′,5′), (6′,7′), (8′,9′)

Note 4: The Geographical Coordinates mode is selected by displaying a blank **M**iddle **L**eft
Note 5: The Clock mode is selected by displaying character ':' **M**iddle **L**eft

So, now there are 4 corner and 1 edge cube left that can be used for the Bottom Layer.

Bottom Layer Layout

Letters and numbers on the Bottom Layer are sorted out as follows:

1- 6 **B**ottom **L**eft numbers: 0, 1, 2, 3, 4, 5
2- 2 **B**ottom **C**enter numbers on 1 edge cube: 0″, 5″
3- 4 **B**ottom **R**ight letters + 2 **T**op **L**eft numbers **1** and **2** on corner cubes: E, W, S, N, **1**, **2**

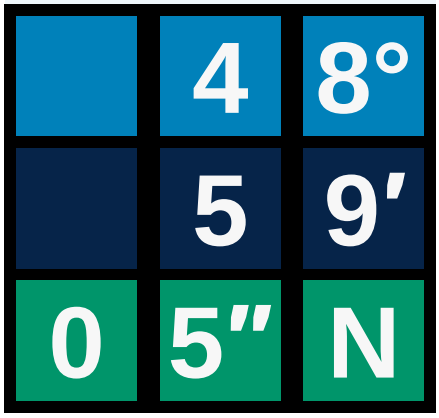
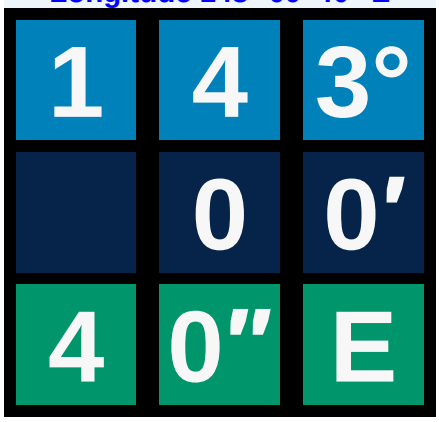
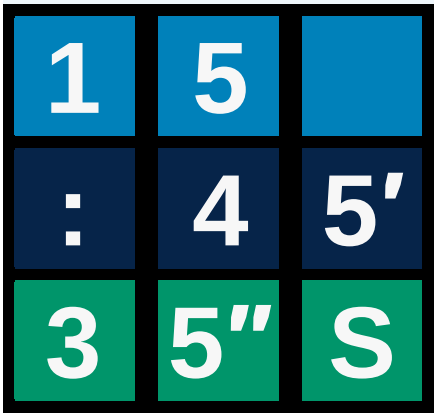
Letters and numbers are now combined on corner and edge cubes:

1- 2 **B**ottom **L**eft corner cube: (0,1,2), (3,4,5)
2- 1 **B**ottom **C**enter edge cube: (0″,5″)
3- 2 **B**ottom **R**ight corner cubes: (E,W,S), (N,**1**, **2**)

Note 6: Number **1** **T**op **L**eft should not be used with letters 'E' and 'W' on the same cube because Longitude varies from 0° up to **1**80° E or W (**DRC**). However, number **1** **T**op **L**eft can be used with letter 'N' or letter 'S' on the same cube because Latitude varies from 0° up to 90° E or W (number **1** not used in that latter case, use a blank_TopLayer instead).
Note 7: Clock mode is selected by displaying character ':' **M**iddle **L**eft. In this case, one out of the three letters 'S', 'W' or 'E' can be displayed **B**ottom **R**ight. Letter 'S' states that it is Summer Time whereas letter 'W' states that it is Winter Time. Letter 'E' would simply mean that this is English Time.

Geographical Coordinates & Clock Cube Layout Table		
Reading from Left to Right		
Top **L**eft – Corner cubes	**T**op **C**enter – Edge cubes	**T**op **R**ight – Corner cubes
1, 2, blank_TL	0, 1, 2, 3, 4, 5, 6, 7, 8, 9	0°, 1°, 2°, 3°, 4°, 5°, 6°, 7°, 8°, 9°, blank_TL
Middle **L**eft – Edge cubes	**M**iddle **C**enter – Center cubes	**M**iddle **R**ight – Edge cubes
:, blank_ML	0, 1, 2, 3, 4, 5	0′, 1′, 2′, 3′, 4′, 5′, 6′, 7′, 8′, 9′
Bottom **L**eft – Corner cubes	**B**ottom **C**enter – Edge cubes	**B**ottom **R**ight – Corner cubes
0,1, 2, 3, 4, 5	0″,5″	E, W, S, N

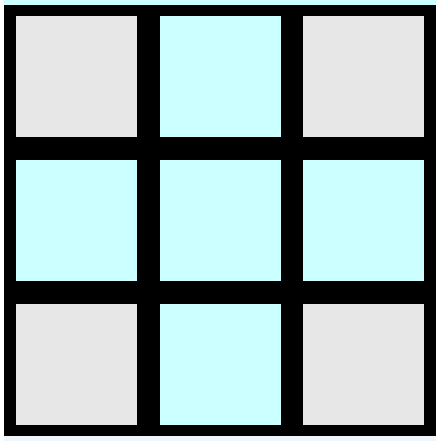
Geographical Coordinates & Clock Cube

Latitude 48° 59′ 05″ N	Longitude 143° 00′ 40″ E	Time 15:45′ 35″ Summer Time
		

Solving a Geographical Coordinates & Clock Cube Step by Step

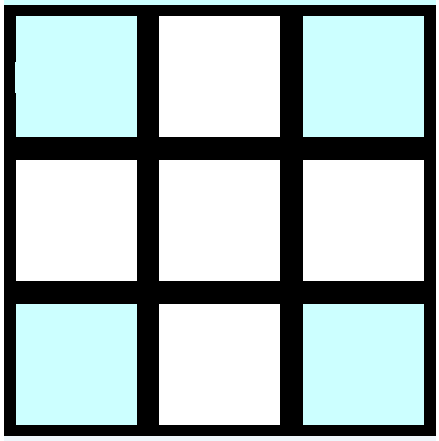
In this example, a step by step solving process is applied to the Geographical Coordinates & Clock Cube, just described before. Note that we only need to solve a *single* Face out of six. We will solve a Face for the latitude of Paris (France): Latitude 48° 51′ 30″ N and Longitude 02° 21′ 10″ E

Solve the Cross First



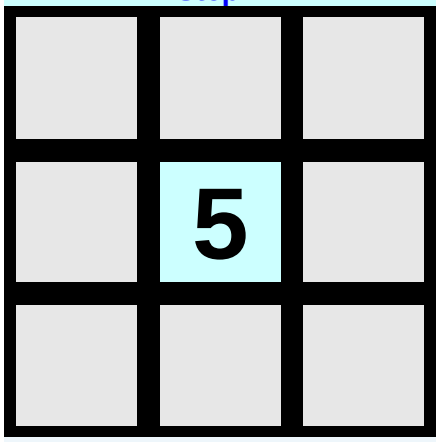
Standard Rubik's Cube Solving

Then Solve the Corner Cubes



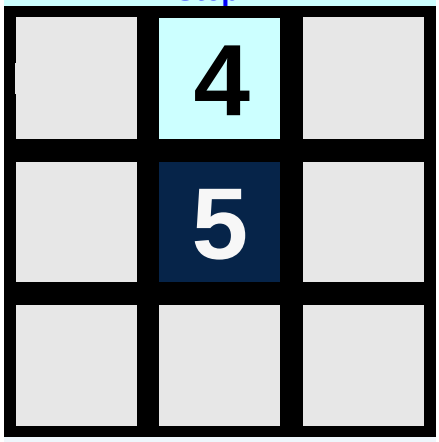
Standard Rubik's Cube Solving

Step 1



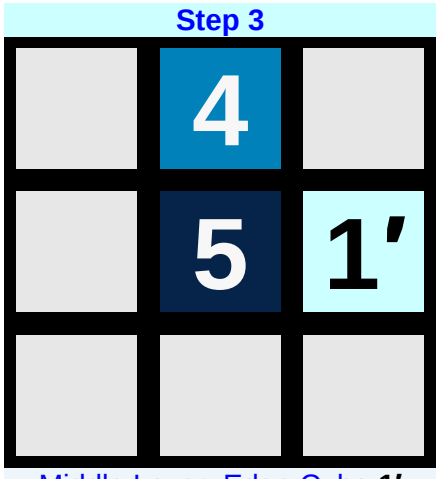
Center **5** on Front Face

Step 2



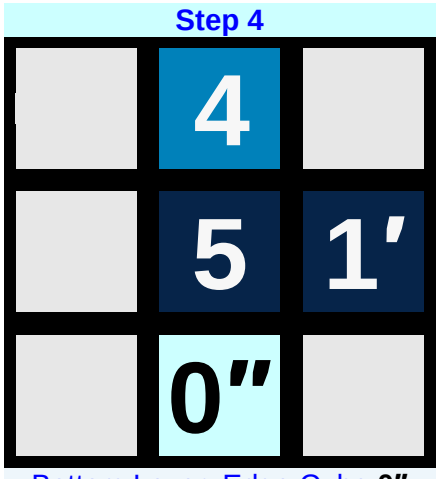
Top Layer: Edge Cube **4**

Step 3



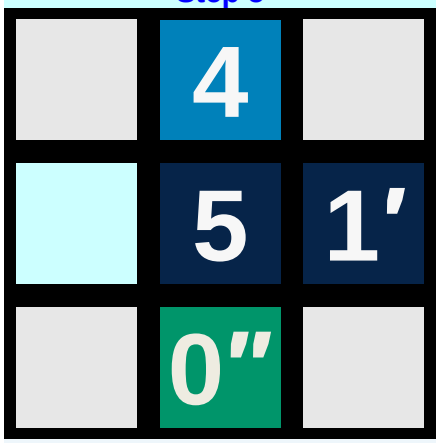
Middle Layer: Edge Cube **1′**

Step 4



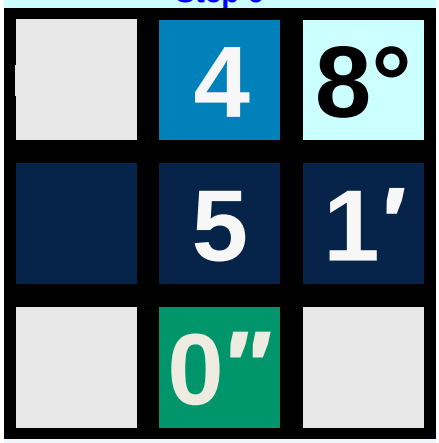
Bottom Layer: Edge Cube **0″**

Step 5



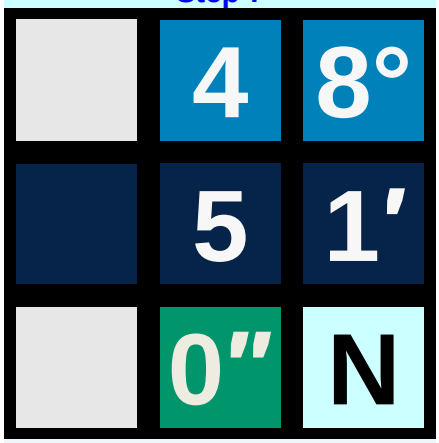
Middle Layer: Edge Cube **Blank**

Step 6



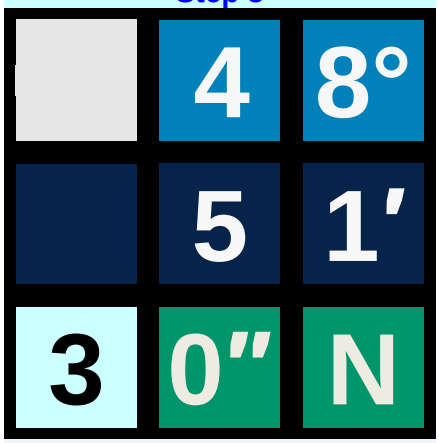
Top Layer: Corner Cube **8°**

Step 7



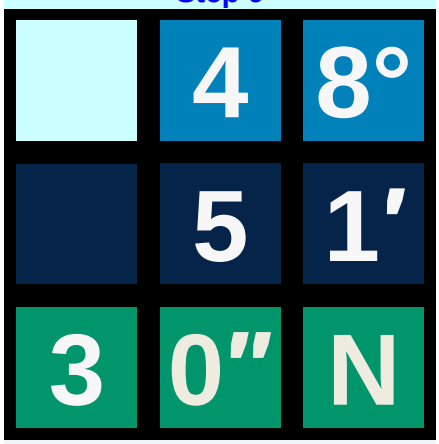
Bottom Layer: Corner Cube **N**

Step 8



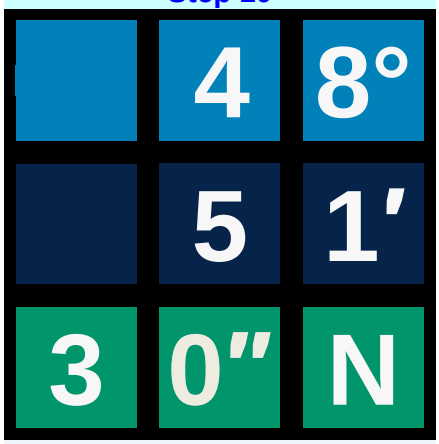
Bottom Layer: Corner Cube **3**

Step 9



Top Layer: Corner Cube **Blank**

Step 10



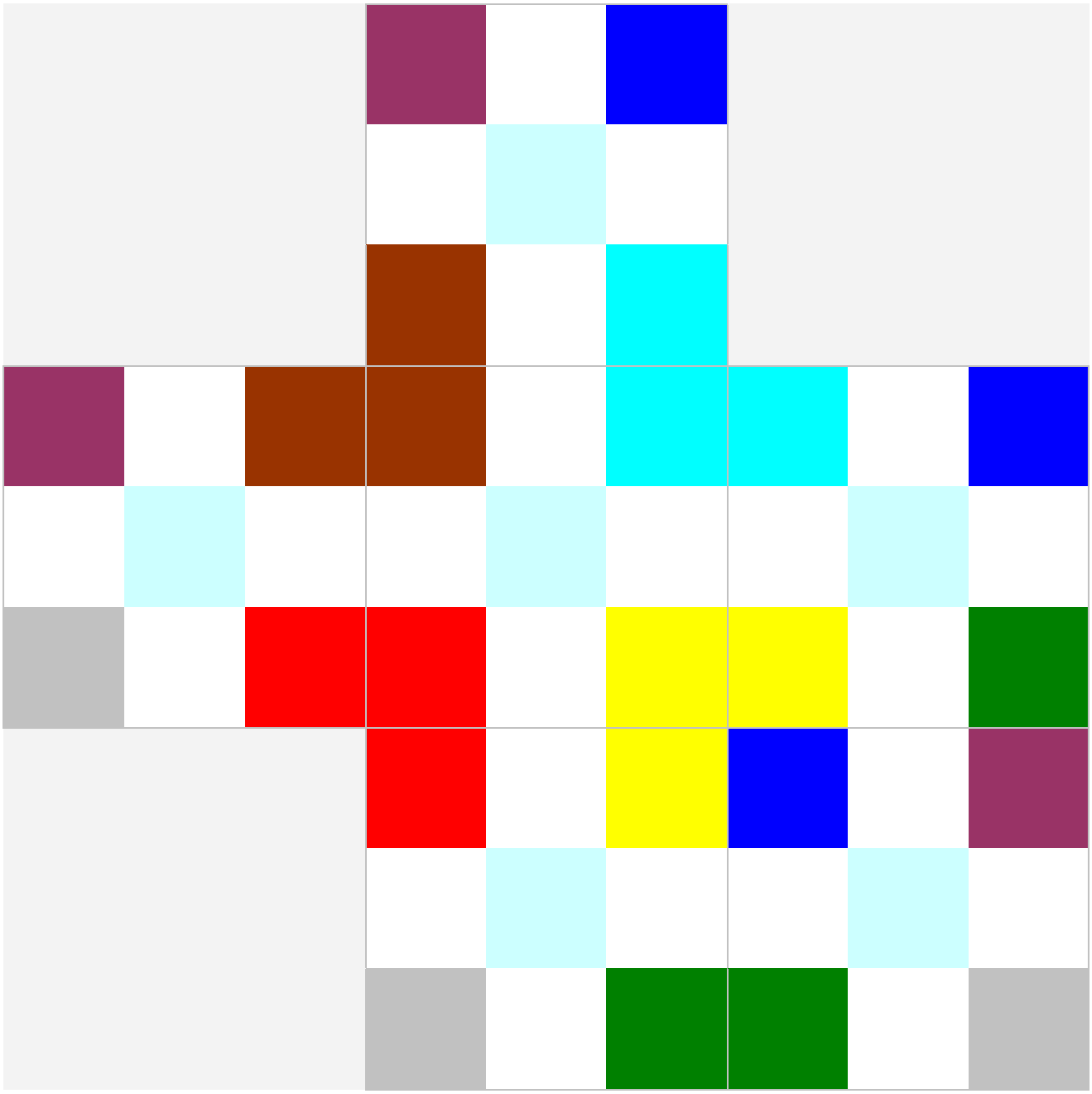
That's it !

Print out this page and fill in the blank faces with *your* data. Then try to design your *own* Cube.

TL	TC	TR
ML	MC	MR
BL	BC	BR

Corner Cubes Final Check

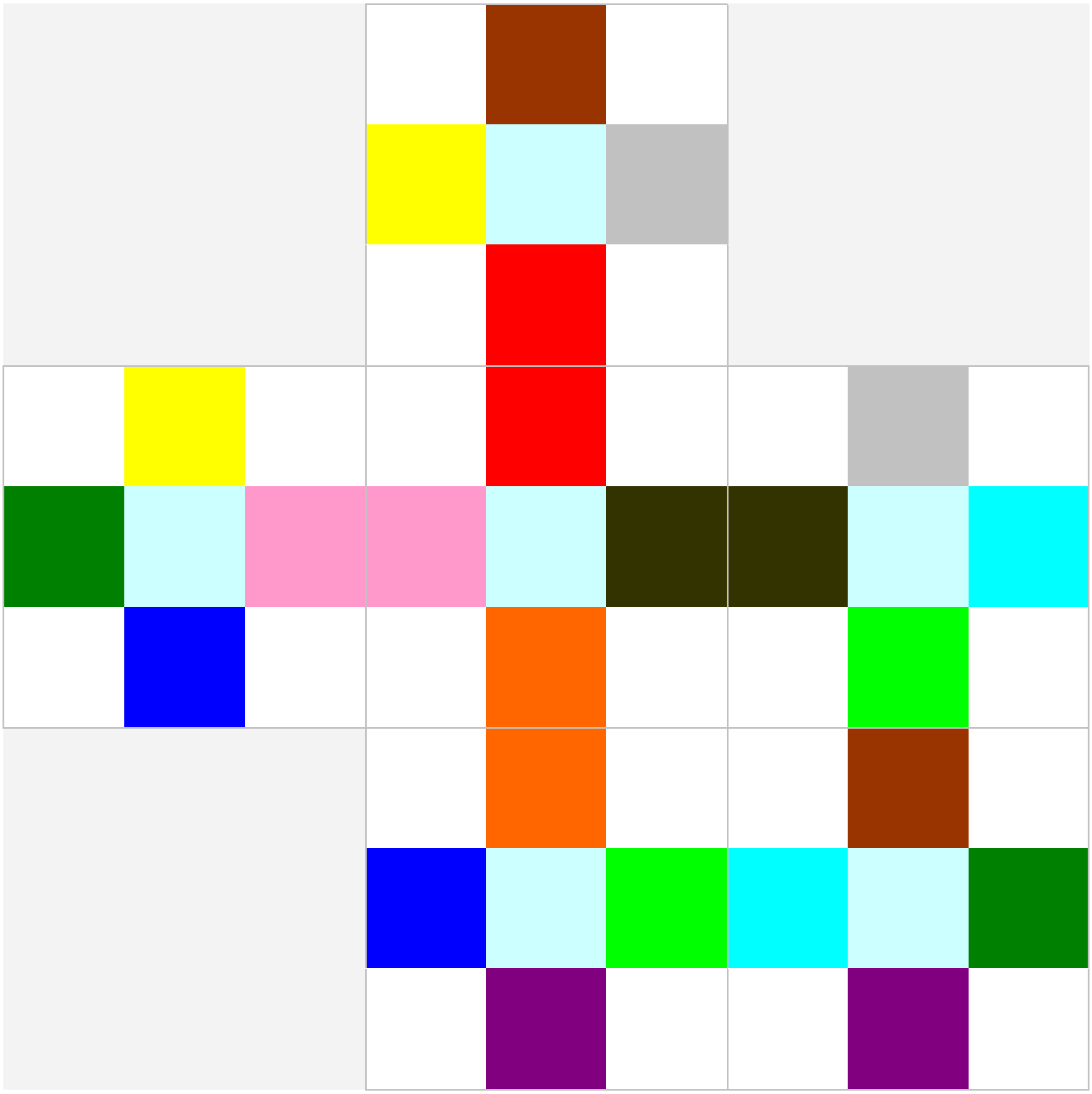
There are 8 Corner Cubes and 3 faces per Corner Cube. In the diagram below, each Corner Cube is displayed in 8 different colours and with the same colour applied to each of its 3 faces. This diagram can be used as a convenient *visual aid* to check Design Rules (DRC).



	Up		
Left	**F**ront	**R**ight	**B**ack
	Down	**B**ack	

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 colours and with the same colour applied to each of its 2 faces. This diagram can be used as a convenient *visual aid* to check Design Rules (DRC).



	Up		
Left	**F**ront	**R**ight	**B**ack
	Down	**B**ack	

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.