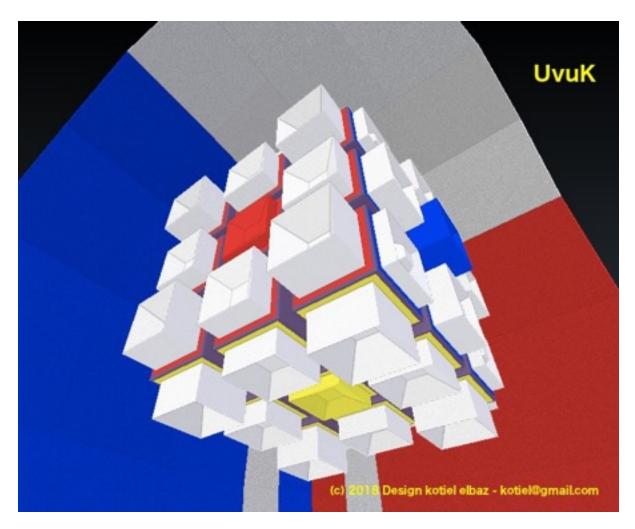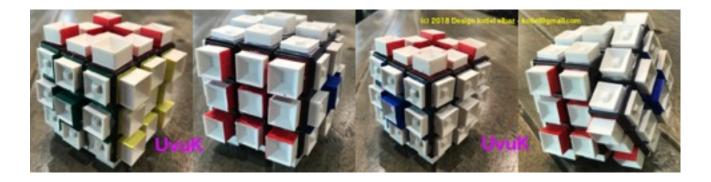# UvuK Cube

Cubignons PiK and LaK

UvuK, enter the third dimension to shake up your thoughts, even with the eyes in your pocket.
The cubignons **PiK** et **LaK**, to feel the colours on your fingers tips.

UvuK, a 3D printer, careless glue, and supernatural painting to enjoy the cubignons **PiK** and **LaK**.

Assemblage

The list

The Cube

The cubignons stand on top of a Rubik'®s cube frame.

- A cube has six sides, each of them with 9 squares
- The nine squares have the same colour
- The central square colour of each side is the reference used for all the colour side
- The cubignon on the central square remain at this position whatever the rotation

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The Cubignon

Le cubignon is a tiny cube to glue on a square of the cube side.
There are two kinds of cubignons
- The cubignon **LaK** is an hollow cavity
- The cubignon **PiK** is an hollow cavity with a knob at its bottom

PiK et **LaK**, both of them are 3D printed in three heights of 3mm, 6mm and 9mm..

Surface of cubignons

Each cube sides own a total of 9 cubignons **PiK** or of 9 cubignons **LaK**.
The outline position of various cubignons heights allows to shape of two surfaces type.

- **THE CONVEX SURFACE**
  - A _central_ small cubignon of height 3mm, the _side_ - between the 4 corners - a medium cubignon of height 6mm and at each _corners_ there is a tall cubignon of height 9mm
- **THE CONCAVE SURFACE**
  - A _central_ tall cubignon of height 9mm, the _side_ - between the 4 corners - medium cubignon of height 6mm and at each _corners_ there is a tall cubignon of height 3mm

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Glue for Cubignon

There is a grand total of 54 3D printed cubignons, the heated glue iron is a practical way to glue the cubignons on the cube.
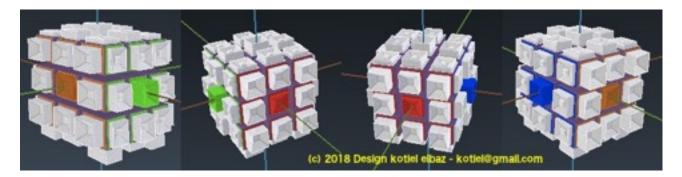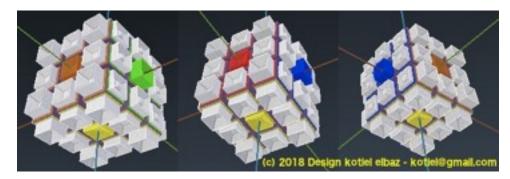

Paint my Cubignon

Some cubignon's side are selected for painting with the colour of the cube center side square :
- The cubignon _central_ : paint all its sides
- The cubignon _corner_ : the both sides located inside toward the central cubignon
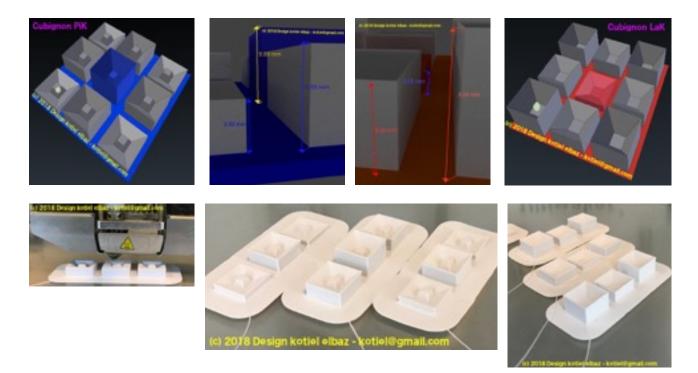- The cubignon _side_ : only the side in front of the central cubignon

Uvuk Cube

Sides vues

Cubignons **PiK** and **Lak**, 3mm, 6mm and 9mm

Uvuk Surface

Concave Side

The center one is a 9mm height.
On the right, left, above and below (cross) from the central cubignon, it's a 6mm height cubignon - 4 of them.
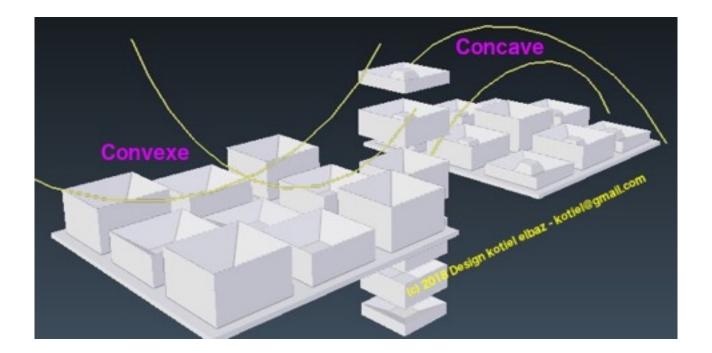On all the 4 corners, the cubignons height is a 3mm.

Convex Side

The center one is a 3mm height.
On the right, left, above and below (cross) from the central cubignon, it's a 6mm height cubignon - 4 of them.
On all the 4 corners, the cubignons height is a 9mm.

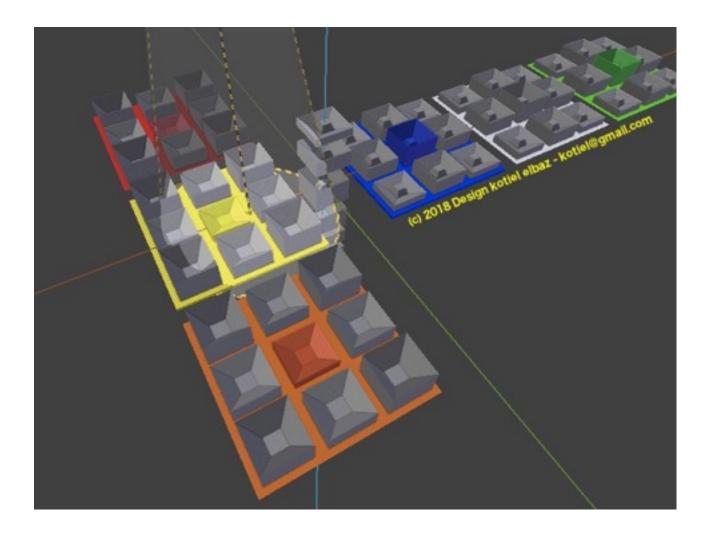## Convex and Concave Surface

Assemblage UvuK

3D prints to build
  - 3 concave surfaces of **PiK** cubignons
  - 3 convex surfaces of **LaK** cubignons

Glue the cubignons to
 - Red, yellow, orange cube sides to form a convex surface of **LaK** cubignons
 - Blue, white and green cube sides to form a concave surface of **PiK** cubignons

Re-do Uvuk

The aim behind **UvuK**, first to be able to move back all the cubignons to their reference position. The cubignons outline over concave and convex surfaces is designed also to be able to put them back using only your fingers tips.
UvuK got 3 concave sides of **PiK** and 3 convex sides of **LaK** :
 - The front side (red) and the back side (orange) are convex of **LaK**
 - The left (green) and the right (blue) are concave of **PiK**
 - The top (white) is concave of **PiK** and the bottom (yellow) is convex of **LaK**

UvuK

Uvuk has 6 sides, each sides are sliced in 9 squares.
Each sides central square is attached to the end of an horizontal axe.
The formula below describes the list of rotation with direction left/right or forward/backward, they allow you step by step to move the cubignons around.
Holding **UvuK** in front of you :
- the front and back sides rotate right and left
- the left and right sides rotate forward or backward
- the top and bottom sides rotate right and left
The start position is a center **LaK** cubignon at the bottom, a center **LaK** cubignon in front and a center **PiK** cubignon on top - same as the red side in front of you.

Central, *Corner*, *Side*

The *corner* : with three squares, each of them belonging to an adjacent **UvuK** sides - 6 of them.
The *side square* : the side square has two cubignons, each of them belonging to an adjacent **UvuK** side - 4 of them per cube side.
A *side square* is between two corners - a cross of 4 cubignons *side square* is around a *central* cubignon.
UvuK, on each of the cube sides, there is a center cubignon **PiK** or **LaK,** of a height 3mm or 9mm.

List of Surfaces

	PiK	LaK	Convex	Concave	Start Position	Rotation direction
Red		LaK	Convex		FRONT	Right/Left
Orange		LaK	Convex		BACK	Right/Left
Blue	PiK			Concave	RIGHT	Forward/Backward
Green	PiK			Concave	LEFT	Forward/Backward
White	PiK			Concave	TOP	Right/Left
Yellow		LaK	Convex		BOTTOM	Right/Left

Exemple : pivot the right side by one step backward : sideRight.backward

The formules

Step I - Top Side

Randomly scramble all the cubignons over **UvuK**.
The following formula help you to put them back to their original position.
For this first step, we arrange the cubignons on a top side.
Actually for the first step, do it on your own - it's a good exercise to train the visual and tactile memory.
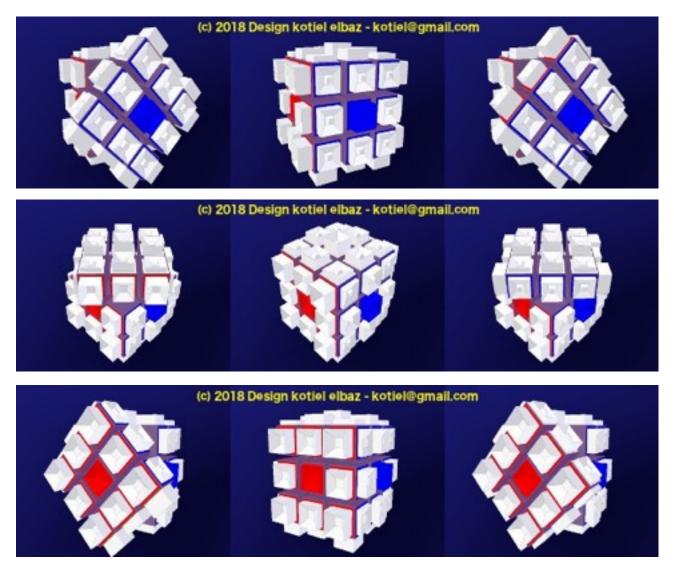
The starting position is with **UvuK** in front of you, a center cubignon **LaK** in front (red), a center cubignon **LaK** at the bottom (yellow) and a center cubignon **PiK** on top (white).

For the first top side :
 - Set the four corners in position - 4 **PiK** 3mm cubignons as it's a concave top side
 - Set the 4 sides square between the four corners - one annoying situation, it's a top cubignon at a position on the bottom side (yellow) - courage, find the solution by yourself
 - As the corners and the sides square are in positions, next is the colour side band around the top side - Use the central cubignon of an adjacent side to know which colour to choose

Step II - Center Row

The **Uvuk** central row has 4 central cubignons and 4 side square cubignons - This formula is used to complete one **UvuK** surface at a time - where the center row belongs.
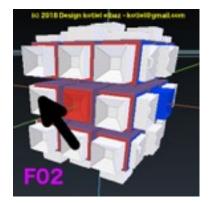
Sometime, a cubignon in position has a wrong orientation. Then, apply F01 or F02 on any bottom cubignons and then use it again (F01 or F02) to move up the correct one in position.
F01 allow you to move one cubignon from the bottom row toward the right, and F02 toward the left middle row.
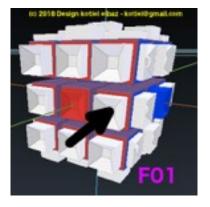
F01 - F02 - Center row

F01 - Cubignon Bottom Row toward Right Central Row

Step 1	Step 2	Step 3	Step 4
sideBottom.left	sideRight.forward	sideBottom.right	sideRight.backward
Step 5	Step 6	Step 7	Step 8
sideBottom.right	sideFront.right	sideBottom.left	sideFront.left

F02 - Cubignon Bottom Row toward Left central Row

Step 1	Step 2	Step 3	Step 4
sideBottom.right	sideLeft.forward	sideBottom.left	sideLeft.backward
Step 5	Step 6	Step 7	Step 8
sideBottom.left	sideFront.left	sideBottom.right	sideFront.right

Please position **Uvuk** sunny side up, the **LaK** convex surface (yellow) on top
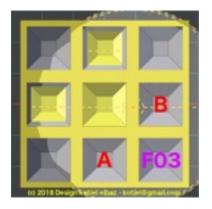
F03 - Position Cross

 A cross like of side square cubignons to position around the central one.
The focus is on the orientation at the top, the side row colour order is done at the next step.

F03 formula is orientating only half of the cross at a time - to achieve it, F03 is done multiple times.

As soon as you get two cubignons orientated on the top, position them at the top left - as on the picture below, then apply F03 again.

F03 - Position cross

Step 1	Step 2	Step 3	Step 4
sideRight.forward	sideTop.left	sideFront.left	sideTop.right
Step 5	Step 6		
sideFront.right	sideRight.backward		

F04 - F05 - Orientation Cross

The top four cubignons around the center are now in position. The formula F04 and F05 aligns their sides row to match their adjacent sides.
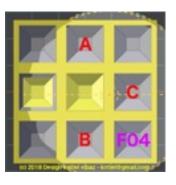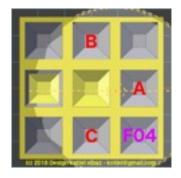The formula F04 and F05 rotates only 3 cubignons at a time - the picture below.

The left cubignon remains in its position after using F04 or F05. Turn only the top **UvuK** side to select a start position - multiple start positions are usually possible, experience helps to select the best right start position. Sometimes, you need to apply F04 or F05 only to get a start position then apply F04 or F05 again.
At the end of this step, a full cross is in position with the sides aligned to their adjacente one.
Learn the formula F04 and F05 by heart ;).

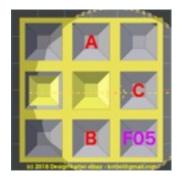## F04 - Circular rotation, top cubignon to the right

Step 1	Step 2	Step 3	Step 4	Step 5
sideRight.backward	sideTop.right	sideRight.forward	sideTop.right	sideRight.backward
Step 6	Step 7	Step 8	Step 9	Step 10
sideTop.right	sideTop.right	sideRight.forward	sideTop.right	sideTop.right

F05 - Circular rotation, the top cubignon to bellow

Step 1	Step 2	Step 3	Step 4	Step 5
sideRight.forward	sideTop.left	sideRight.backward	sideTop.left	sideRight.forward
Step 6	Step 7	Step 8	Step 9	Step 10
sideTop.right	sideTop.right	sideRight.backward	sideTop.right	sideTop.right

F06 - Position Corner

This step moves the corners at their correct position - without turning the top side, first locate if one of the four corners is in the right position. If one is in position, then by orienting **Uvuk,** position the corner at the top left - picture below.
The orientation of the three sides square of the cubignon corner is done with the last next formula.
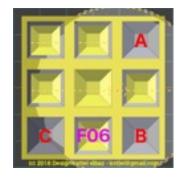
Use the F06 formula to rotate the three remaining corners, as many times as required until all the corners are in their position.
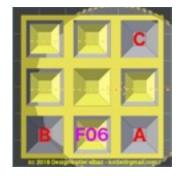
When at the beginning, there is not a single corners in the correct position, then apply F06 until it happens. Once you get one corner in position - the orientation is done at the next step - then oriente **UvuK** to have it at the top left position. Apply F06 again until all the corners are at their correct position.
F06 rotates only the corners A, B and C while the corner on the top left remain in position.

F06 - Circular rotation, corners to the right

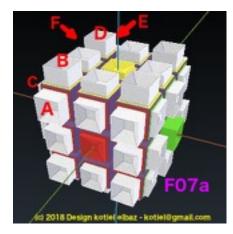| Step 1	Step 2	Step 3	Step 4	Step 5
sideRight.forward	sideLeft.forward	sideTop.right	sideLeft.backward	sideTop.left
Step 6	Step 7	Step 8	Step 9	Step 10
sideRight.backward	sideTop.right	sideLeft.forward	sideTop.left	sideLeft.backward

F07 - Orientation Corners

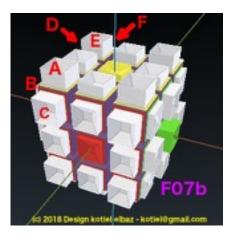Great the last step, the previous formula F04 followed by F05 are re-used.

At this step, the top **UvuK** side has all its sides square cubignons in position, the corners are in position and it only remain the corners' orientation to complete **UvuK** original cubignons positions.
Using the formula F04 followed by the F05, it rotates the position A, B and C of the front side, while at the same time on the backside, the position D, E and F also rotate.
Set on your left, the sides square at corner A/B/C and D/E/F positions before using F04, this by orientating **UvuK,** without turning a cube side.
Once, in position as on F07a picture, apply the previous formula F04 and right away without moving **UvuK** at the end of F04, then apply the steps of the formula F05.
The others corners sides are also moving to their definitive position.

Files list

Blender 3D

UvuK and the cubignons **PiK** et **LaK** models are designed with Blender 3D software.

File name	Content	Created with	Note
uvuk-kte.blend	original 3D cubignons	Blender3D	prototype and design d'**UvuK**
uvuk-lak-3mm.stl	STL file	Blender3D	**UvuK** cubignon **LaK** 3mm
uvuk-lak-6mm.stl	STL file	Blender3D	**UvuK** cubignon **LaK** 6mm
uvuk-lak-9mm.stl	STL file	Blender3D	**UvuK** cubignon **LaK** 9mm
uvuk-pik-3mm.stl	STL file	Blender3D	**UvuK** cubignon **PiK** 3mm
uvuk-pik-6mm.stl	STL file	Blender3D	**UvuK** cubignon **PiK** 6mm
uvuk-pik-9mm.stl	STL file	Blender3D	**UvuK** cubignon **PiK** 9mm
uvuk-ccv-face.stl	STL file	Blender3D	**UvuK** concave **PiK**
uvuk-cvx-face.stl	STL file	Blender3D	**UvuK** convex **LaK**

CURA

The gcode file for the cubignons are generated with the 3D printer software CURA.

File name	Content	Created with	Note
UM2+_uvuk-lak-r01.gcode	gcode file used by 3D Printer	CURA	row of 3 cubignons **LaK** - 1 central of 6mm and 2 of 9mm
UM2+_uvuk-lak-rc01.gcode	gcode file used by 3D Printer	CURA	row central of 3 cubignons **LaK** - 1 central of 3mm and 2 of 6mm
UM2+_uvuk-pik-r01.gcode	gcode file used by 3D Printer	CURA	row of 3 cubignons **PiK** - 1 central of 6mm and 2 of 3mm
UM2+_uvuk-pik-rc01.gcode	gcode file used by 3D Printer	CURA	row central of 3 cubignons **PiK** - 1 central of 9mm and 2 of 6mm

UvuK surface	File name	3D Print one side	3D Print full UvuK
Convex	UM2+_uvuk-lak-r01.gcode	2 instances	6 instances
Convex	UM2+_uvuk-lak-rc01.gcode	1 instance	3 instances
Concave	UM2+_uvuk-pik-r01.gcode	2 instances	6 instances
Concave	UM2+_uvuk-pik-rc01.gcode	1 instance	3 instances

Ambush

- The cubignons are 3D printed on 3 by 3 stand, a scissor is good enough to separate them.

- The default colour for the cubignon is white. However, if more than one drop, it's difficult to find out where to put them back. My choice is to paint only some cubignon's sides.

- To glue the cubignons on the cube, an iron glue is convenient. A fair amount of glue on the cubignon side achieves a good result - a super-glue like is recommended for an intensive **UvuK** usage. More glue means more difficult to remove … also with 54 cubignons to go, watch your mistakes.

- While re-doing **UvuK**, when the cubignons position looks like to be blocking a first formula then use the formula to move it out from a wrong position, and then apply the same or another formula to put back the right cubignon in position.

- At rest, UvuK loves to smile red side in front, and its yellow foot on the ground ;).

Software

Software Blender 3D : blender.org
3D Printer Ultimaker 2+ with software CURA : ultimaker.org

UvuK License

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June, 1st - 2018

Bon Courage,
Kotiel Elbaz

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