

## The Octadecayotton (12 Dimensions)

*who'll be there when i'm gone?*

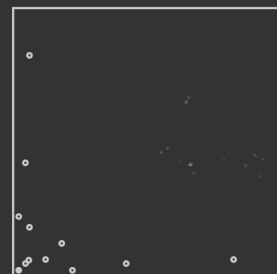
By default 9 dimensions is used, but multiple Octadecayottons or mod settings can change it.

The 4096 spheres will start moving, resembling the rotations of a 12-dimensional cube. 3 rotations are shown, followed by a brief pause before starting over.



### Identifying Dimensions

- There are 12 dimensions: X, Y, Z, W, V, U, R, S, T, O, P, and Q. Each axis can either be positive, or negative.
- Any positive axis points to the right (+X), up (+Z), and/or towards (+Y) the viewer when viewed from the front.
- Any negative axis points to the left (-X), down (-Z), and/or away (-Y) the viewer when viewed from the front.
- Any given sphere has 12 neighbours, which are all 1 of each of the 12 axes, either positively or negatively.
- To the diagram to the right shows an example of a sphere's 12 neighbours as seen from the front. The unfilled spheres are neighbours of the filled sphere.
- In reading order (left-to-right then top-to-bottom), the spheres are O, S, Z, V, W, P, U, Q, T, R, Y (stacked on top of the filled sphere), and X.
- In this example, going from the filled sphere to any unfilled is a positive axis, while going from an unfilled sphere to the filled sphere is a negative axis.



### Identifying Rotations

- Look at 2 spheres that are neighbours (note down their initial axis that connects them together) and watch them transform.
- If these 2 spheres are now neighboured from a different axis, that implies a rotation. Record the new axis that they transformed into, and repeat this process starting with the new axis until the first initial axis is reached.
- For any negative initial axis, invert both the initial and new axis. (positive -> negative, negative -> positive)

Identifying Rotations (...continued)

- When the first initial axis has been reached, start from the bottom of the list, and working your way up; append all the new axes to a separate list.
- The resulting list is called a subrotation. In a given rotation there can be multiple simultaneous subrotations happening at the same time.

Primary Values

- All rotations and subrotations have a primary value. Within each subrotation, create a list of every possible pair of axes from itself and the next axis. (including the last and first axis as a pair\*)
- If the subrotation contains exactly 1 axis, ignore the above rule and make only 1 pair, consisting of the axis repeated twice.
- For each pair, get the value from the table, using the first letter as the row and the second letter as the column.
- If 1 of the 2 axes are negative, multiply the pair's result with -1.

\* Even with 2 axes, this rule still applies. For example, subrotation +R-T gives +R-T and -T+R.

	X	Y	Z	W	V	U	R	S	T	O	P	Q	
X	1	2	5	1	8	8	1	5	2	1	2	5	X
Y	2	3	6	2	9	9	2	6	3	2	3	6	Y
Z	9	1	4	9	7	7	9	4	1	9	1	4	Z
W	1	2	5	1	8	8	1	5	2	1	2	5	W
V	2	3	6	2	9	9	2	6	3	2	3	6	V
U	9	1	4	9	7	7	9	4	1	9	1	4	U
R	1	2	5	1	8	8	1	5	2	1	2	5	R
S	2	3	6	2	9	9	2	6	3	2	3	6	S
T	9	1	4	9	7	7	9	4	1	9	1	4	T
O	1	2	5	1	8	8	1	5	2	1	2	5	O
P	2	3	6	2	9	9	2	6	3	2	3	6	P
Q	9	1	4	9	7	7	9	4	1	9	1	4	Q
	X	Y	Z	W	V	U	R	S	T	O	P	Q	

## Primary Values (...continued)

- The absolute sum of all pairs on all subrotations is the primary value of that rotation. Later in this manual, whenever  $p_1$ ,  $p_2$ , or  $p_3$  is mentioned, it refers to the primary value of the 1<sup>st</sup>, 2<sup>nd</sup>, and 3<sup>rd</sup> rotation respectively.

## The Anchor Sphere

- Create 4 codes, named  $a_0$ ,  $a_1$ ,  $a_2$ , and  $a_3$ , each starting with the value "000000000000".  $a_{1-3}$  represent rotations 1-3.
- Subtract the largest number equal or less than  $p_1$  found in "Decimal  $\leftrightarrow$  Binary" from it, then set  $a_1$ 's Xth digit from the left to 1, where X is the position obtained from that same number that was subtracted with. Keep subtracting and setting digits to 1 until  $p_1$  is 0.
- Repeat the above step using  $p_2$  and  $a_2$ , as well as  $p_3$  and  $a_3$ .

Decimal $\leftrightarrow$ Binary												
Subtract	2048	1024	512	256	128	64	32	16	8	4	2	1
Position	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>	6 <sup>th</sup>	7 <sup>th</sup>	8 <sup>th</sup>	9 <sup>th</sup>	10 <sup>th</sup>	11 <sup>th</sup>	12 <sup>th</sup>

- Look at  $a_1$  and its rotation, for each axis, invert the number's position (0  $\rightarrow$  1, 1  $\rightarrow$  0) according to this the table below.
- Repeat this for  $a_2$  and  $a_3$ , then set  $a_0$  based on these 3 conditions:
- If the 7<sup>th</sup> digit of  $a_1$  is 1, set the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, and 4<sup>th</sup> digits of  $a_0$  to 1.
- If the 7<sup>th</sup> digit of  $a_2$  is 1, set the 5<sup>th</sup>, 6<sup>th</sup>, 7<sup>th</sup>, and 8<sup>th</sup> digits of  $a_0$  to 1.
- If the 7<sup>th</sup> digit of  $a_3$  is 1, set the 9<sup>th</sup>, 10<sup>th</sup>, 11<sup>th</sup>, and 12<sup>th</sup> digits of  $a_0$  to 1.

Axis $\leftrightarrow$ Position												
+Axis	+X	+Y	+Z	+W	+V	+U	+R	+S	+T	+O	+P	+Q
-Axis	-Q	-P	-O	-T	-S	-R	-U	-V	-W	-Z	-Y	-X
Position	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>	6 <sup>th</sup>	7 <sup>th</sup>	8 <sup>th</sup>	9 <sup>th</sup>	10 <sup>th</sup>	11 <sup>th</sup>	12 <sup>th</sup>

## The Anchor Sphere (...continued)

$a_{1-3}$  is now gray code, convert each one to binary:

1. The first binary digit will match the first digit of the gray code.
  2. The next digit is a 1 if the sum of the previous digit of the binary code and the current position's gray code is exactly 1. Otherwise it's 0.
  3. Repeat step 2 until 12 digits are obtained. This is the binary code.
- Starting from  $a_1$ , add the current  $a$  with the previous  $a$ , and then refer to the next  $a$ . Don't carry ( $1+1 \neq 10$ ) and replace 2's with 0's on each step.
  - Replace every 0 with - and every 1 with +. This is now the anchor sequence. Whenever the anchor sphere is mentioned, it refers to the only 1 sphere that matches all positive/negative attributes of the anchor sequence's axes. The position of each character represents what axis they belong to, with the order being "XYZWVURSTOPQ".

## Pausing

- Interact anywhere on the module to pause it. The rotations will stop, and a sound cue is played to indicate that it is ready to be interacted with.
- Each time the module is paused, a random sphere is chosen. This is called the starting sphere. The starting sphere is white.
- The goal is to get the starting sphere to be on the same location as the anchor sphere.

## Navigation

- When the module is interacted with during the seconds digits (modulo 20) being 0-11, an axis is queued. Each submission from 0-11 represents an axis, though order is random.
- 3 axes need to be queued for a valid input. When the timer's seconds digits are 19, 39 or 59, it will try submitting the 3 axes. The queue is cleared if any other number of axes are queued.
- The starting sphere goes to the other side of all 3 axes that were submitted.
- During this submission, all axes can only be submitted up to 2 times.
- This rule can be violated up to four times. The 5<sup>th</sup> time causes a strike.
- When the starting sphere is in the same position as the anchor sphere, submit all 12 axes. The module will strike or solve accordingly.
- Striking the module will unpause the module.