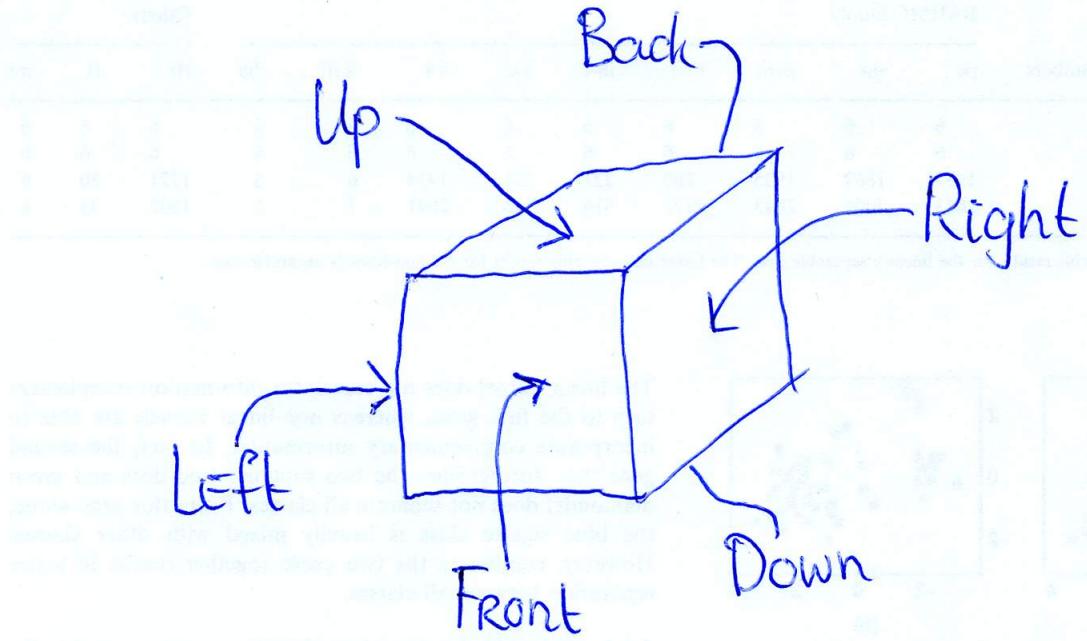


Sides of the Cube



Rotations

For determining the direction of a rotation, we use mathematical orientation:



Positive Rotation



Negative Rotation

Rotations

A rotation has form S_j^i .

- Here S is a surface, so $S \in \{L, R, U, D, F, B\}$
- i specifies the amount of rotation.
 - $i=1$: go degrees in positive direction, when looking onto the surface
 - $i=-1$: go degrees in negative direction when looking onto the surface
 - $i=2$: 180° degrees. (Direction does not matter.)
- j specifies the layer being rotated.
 - $j=1$ is the surface itself.
 - $j=2$ is the second layer below the surface,

Abbreviations

With all the other rotation methods and the 3D coordinate system abbreviations we've talked about so far, we can combine them to make our code more compact and easier to work with.

- When $i=1$, we omit i .

S_j is the same as S_j^1

- We combine rotations with the same S and i . If $j_1 \neq j_2$, then

$S_{j_1}^i \cdot S_{j_2}^i$ is the same as S_{j_1, j_2}^i .

(You don't need to implement the abbreviations.)

With all the other rotation methods and the 3D coordinate system abbreviations we've talked about so far, we can combine them to make our code more compact and easier to work with.

matrix-vector multiplication is a common operation in linear algebra. It's often used in computer graphics to transform vertices from one coordinate system to another.

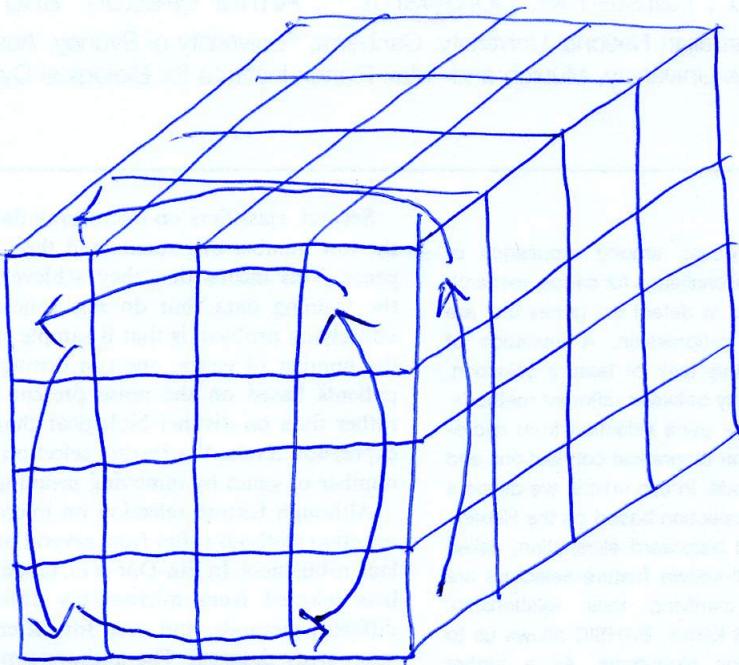
$$\text{matrix-vector multiplication}$$

matrix-vector multiplication is a common operation in linear algebra. It's often used in computer graphics to transform vertices from one coordinate system to another.

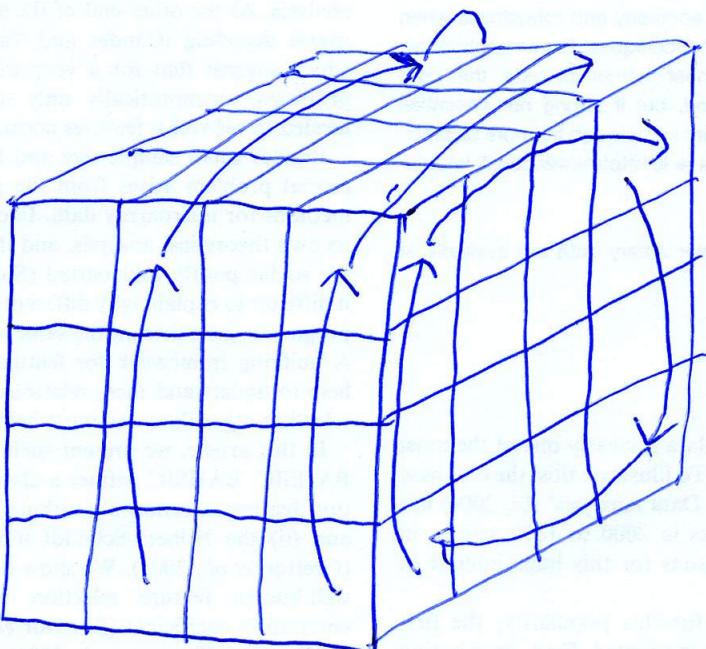
Examples (In 4-cube)

(4)

$F^1:$



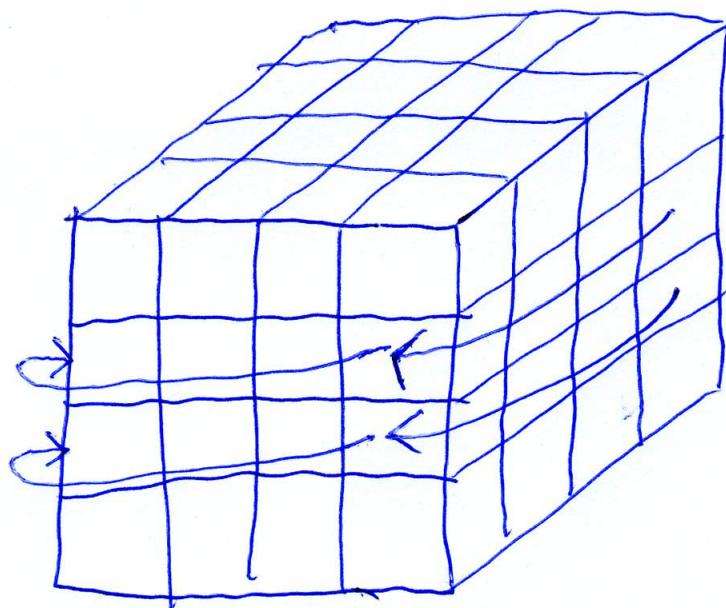
$R_{13}^{-1}:$



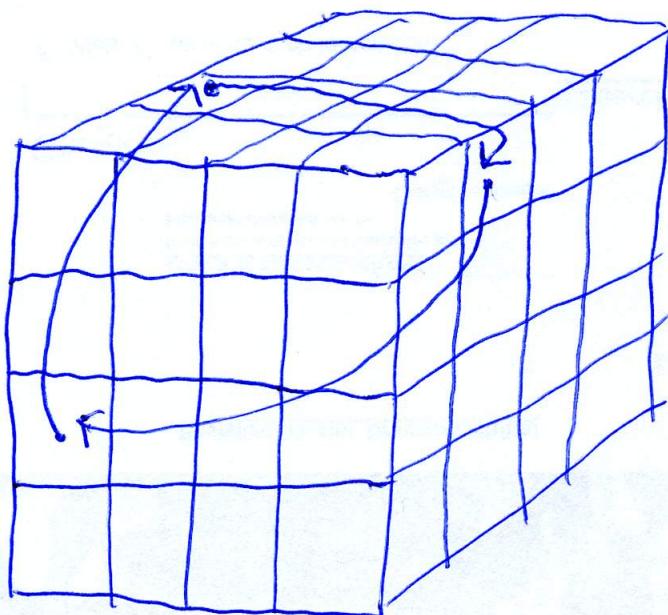
(5)

Examples

$D_{2,3} \circ$



$L_{1,3} \circ U \circ L_3^{-1} \circ U^{-1} \circ L_1^{-1} \circ U \circ L_3 \circ U^{-1} \circ L_3^{-1}$



The cube implementation

