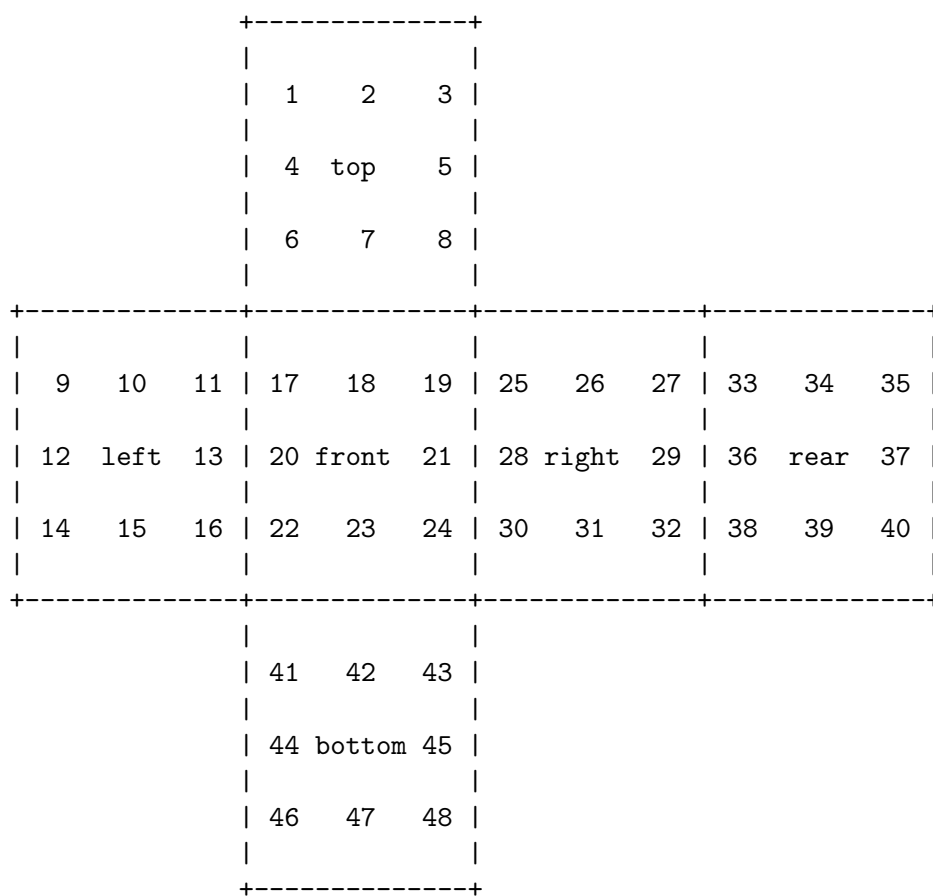


GAP session: Rubik's cube

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Number the faces of the Rubik's cube:



$$\begin{aligned}
d &= (25, 27, 32, 30)(26, 29, 31, 28)(3, 38, 43, 19)(5, 36, 45, 21)(8, 33, 48, 24), \\
e &= (33, 35, 40, 38)(34, 37, 39, 36)(3, 9, 46, 32)(2, 12, 47, 29)(1, 14, 48, 27), \\
f &= (41, 43, 48, 46)(42, 45, 47, 44)(14, 22, 30, 38)(15, 23, 31, 39)(16, 24, 32, 40)
\end{aligned}$$

Exercise 1: Define the permutation group C defined by $\langle a, b, c, d, e, f \rangle$ in GAP.

Exercise 2: How many elements does C have?

(Try $\text{Size}(C)$)

Exercise 3: Is it possible to turn one corner in C ?

(For example, try $(6, 11, 17)$ in C .)

Exercise 3: Is it possible to flip one edge in C ?

(For example, try $(7, 18)$ in C .)

Exercise 4: How does C act on corners (or edges)?

(One corner is $[6, 11, 17]$. Get the other corners via $\text{Orbit}(C, [6, 11, 17], \text{OnSets})$. Now investigate the action on them using $\text{ActionHomomorphism}$. Similar for edges.)

Exercise 5: What can you say about the 2×2 -cube and the 4×4 -cube?