Dihedral Group of Order 8 (D_4)

```
> restart;
```

We load the GroupTheory package;

```
> with(GroupTheory);
```

```
[ <|> , AbelianInvariants, AllPerfectGroups, AllSmallGroups, AllTransitiveGroups, Alt,
  AlternatingGroup, AreConjugate, AreIsomorphic, BabyMonster, CayleyGraph, CayleyTable,
  CayleyTableGroup, Center, Centraliser, Centralizer, Centre, ComplexProduct, ConjugacyClass,
  ConjugacyClasses, Conjugator, ConwayGroup, Core, CustomGroup, CycleIndexPolynomial,
  CyclicGroup, Degree, DerivedLength, DerivedSeries, DerivedSubgroup, DicyclicGroup,
  DihedralGroup, DirectProduct, DrawCayleyTable, DrawSubgroupLattice, ElementOrder,
  ElementaryGroup, Elements, Embedding, ExceptionalGroup, Exponent, FPGroup, Factor,
  FischerGroup, FittingSubgroup, FrattiniSubgroup, FreeGroup, GL, GaloisGroup,
  GeneralLinearGroup, GeneralOrthogonalGroup, GeneralUnitaryGroup, Generators, Group,
  GroupOrder, HaradaNortonGroup, HeldGroup, HigmanSimsGroup, Hypercenter, Hypercentre,
  IdentifySmallGroup, Index, Intersection, IsAbelian, IsAlternating, IsCommutative, IsCyclic,
  IsElementary, IsFinite, IsNilpotent, IsNormal, IsPerfect, IsPrimitive, IsRegular, IsSimple, IsSoluble,
  IsSolvable, IsSubgroup, IsSymmetric, IsTransitive, JankoGroup, Labels, LeftCoset, LeftCosets,
  LowerCentralSeries, LyonsGroup, MathieuGroup, McLaughlinGroup, MetacyclicGroup, Monster,
  NilpotencyClass, NilpotentResidual, NonRedundantGenerators, NormalClosure, Normaliser,
  NormaliserSubgroup, NormalizerSubgroup, NumGroups, NumPerfectGroups,
  NumTransitiveGroups, ONanGroup, Operations, Orbit, Orbits, OrthogonalGroup, PCore, PGL,
  PGU, PSL, PSU, PSp, PerfectGroup, PermApply, PermCommutator, PermConjugate,
  PermCycleType, PermDegree, PermFixed, PermInverse, PermLeftQuotient, PermOrder,
  PermParity, PermPower, PermProduct, PermRightQuotient, PermSupport, PermutationGroup,
  PresentationComplexity, ProjectiveGeneralLinearGroup, ProjectiveGeneralUnitaryGroup,
  ProjectiveSpecialLinearGroup, ProjectiveSpecialUnitaryGroup, ProjectiveSymplecticGroup,
  QuaternionGroup, RandomElement, Relators, RightCoset, RightCosets, RubiksCubeGroup,
  RudvalisGroup, SL, SearchSmallGroups, SearchTransitiveGroups, Simplify, SmallGroup,
  SolubleResidual, SolvableResidual, SpecialLinearGroup, SpecialOrthogonalGroup,
  SpecialUnitaryGroup, Stabiliser, Stabilizer, Subgroup, SubgroupLattice, SubgroupMembership,
  Supergroup, SuzukiGroup, SylowSubgroup, Symm, SymmetricGroup, SymplecticGroup,
  ThompsonGroup, TitsGroup, TransitiveGroup, TrivialGroup, UpperCentralSeries ]
```

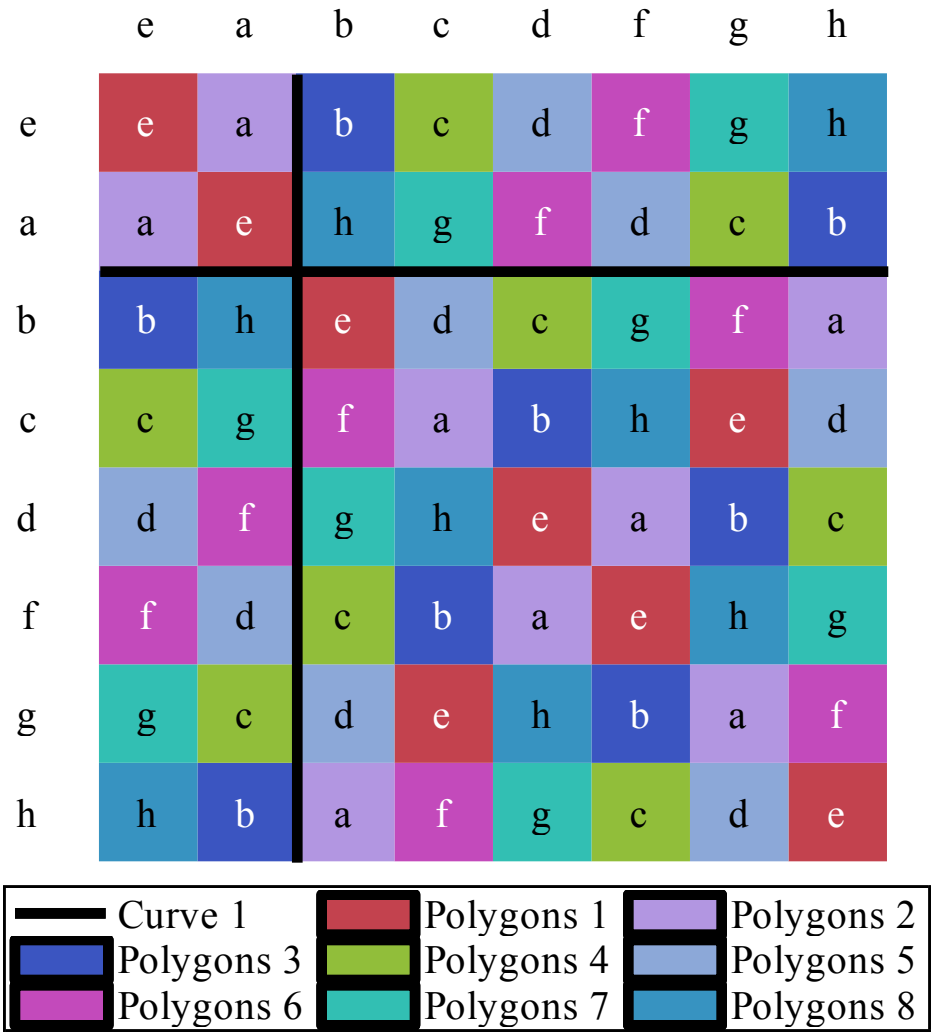
We ask for the dihedral group of order 8 (in general, of order $2 \cdot n$), the group of symmetries ot the square (in general, of a n-sided regular polygon.

```
> G:=DihedralGroup(4);
```

$$G := D_4$$

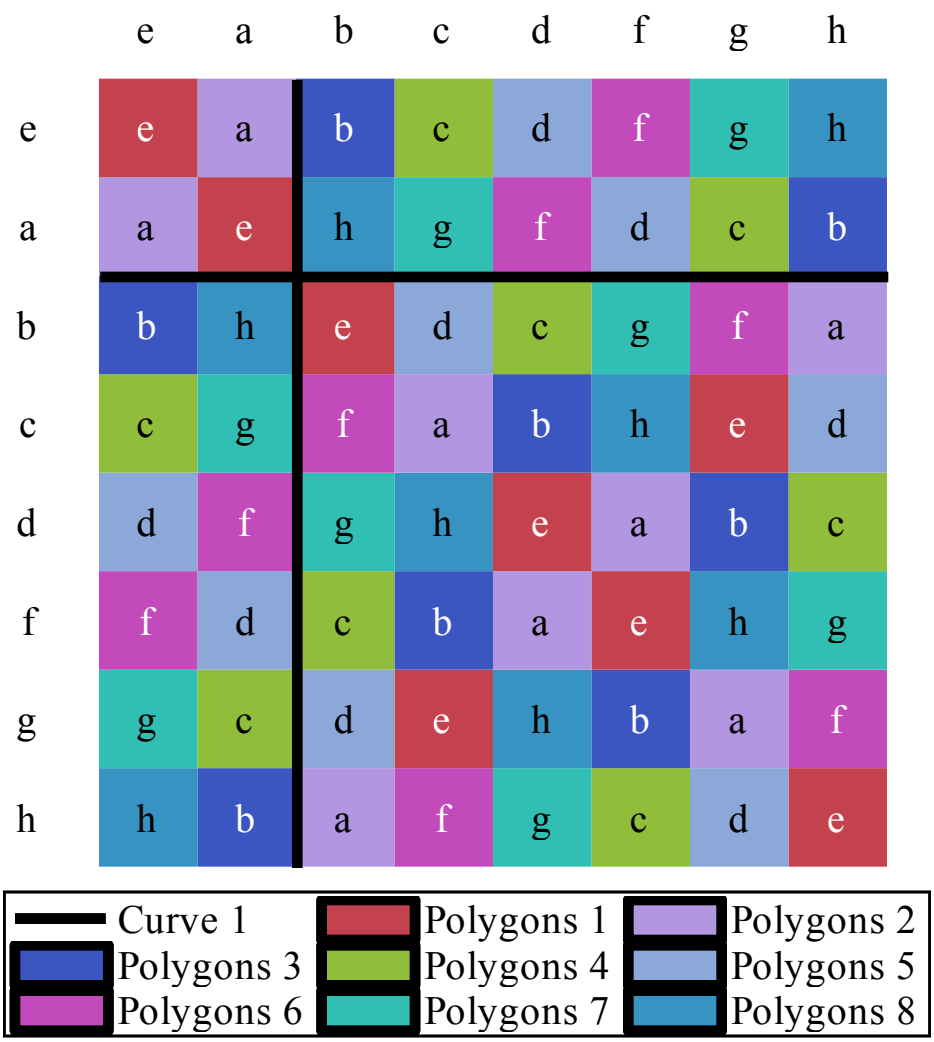
We find a Cayley or operations table for the group.

```
> DrawCayleyTable(G);
```



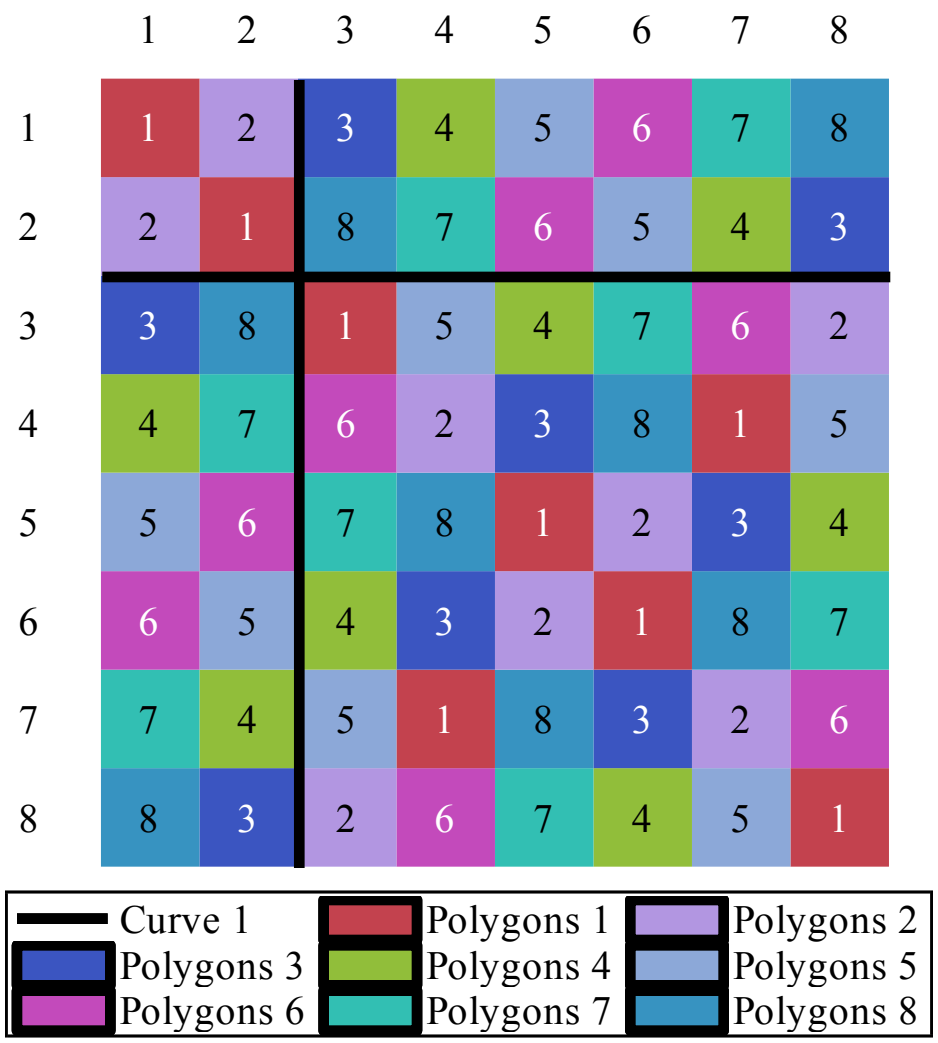
We get the same table from the following.

```
> DrawCayleyTable(G,labels=letters);
```



But we can also get this.

```
> DrawCayleyTable(G,labels=numbers);
```


1 2 3 4 5 6 7 8
1 1 2 3 4 5 6 7 8
2 2 1 8 7 6 5 4 3
3 3 8 1 5 4 7 6 2
4 4 7 6 2 3 8 1 5
5 5 6 7 8 1 2 3 4
6 6 5 4 3 2 1 8 7
7 7 4 5 1 8 3 2 6
8 8 3 2 6 7 4 5 1
Curve 1
Polygons 1
Polygons 2
Polygons 3
Polygons 4
Polygons 5
Polygons 6
Polygons 7
Polygons 8