Introduction to Z_n with AdditiveGroup package

```
<< AdditiveGroupMinimal`
```

```
MakeMinimalGroup[6]
```

```
Estimated time is: 0.00031104 seconds.

Computation time: 0. seconds.
```

```
Zn
```

```
{0, 1, 2, 3, 4, 5}
```

```
Subgroups[]
```

```
{{0, 1, 2, 3, 4, 5}, {0, 2, 4}, {0, 3}, {0}}
```

```
Sns
```

```
{{0, 1, 2, 3, 4, 5}, {0, 2, 4}, {0, 3}, {0}}
```

```
{3⊕4, 5⊕5, 0⊕5}(*addition*)
```

```
{1, 4, 5}
```

```
{3¯, 5¯, 0¯}(*inverser*)
```

```
{3, 1, 0}
```

```
{4⊕3¯, 2¯⊕2, 3¯⊕3¯}
```

```
{1, 0, 0}
```

```
Names["AdditiveGroupMinimal`*"]
```

```
{AdditiveGroupMinimalPackage, CayleyTable, ElementOrder, ElementOrders,
 InstanceSubgroups, MakeMinimalGroup, MakeMinimalGroupInstance, N0,
 N1, Sns, SubgroupGenerators, Subgroups, SubgroupsAndGenerator, Zn}
```

```
{N0, N1}(* gruppens ordning och antal undergrupper *)
```

```
{6, 4}
```

```
SubgroupGenerators[]
```

```
{0, 1, 2, 3}
```

```
G0 = MakeMinimalGroupInstance[12];(*G0 kontext med separat grupp*)
```

```
Estimated time is: 0.00124416 seconds.

Computation time: 0. seconds.
```

```
G0⟦1⟧
```

```
{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11}
```

```
G0⟦5⟧(*dess undergrupper*)
```

```
{{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11},
 {0, 2, 4, 6, 8, 10}, {0, 3, 6, 9}, {0, 4, 8}, {0, 6}, {0}}
```

```
Sns(*huvudgruppen kvar att utforska*)
```

```
{{0, 1, 2, 3, 4, 5}, {0, 2, 4}, {0, 3}, {0}}
```

```
<< AdditiveGroupBasics`
```

```
Names["AdditiveGroupBasics`*"]
```

```
{AdditiveGroupBasicsPackage, Containment, ContainmentGenerators,
 ContainmentHierarchy, ContainmentHierarchyNonTrivial, ContainmentIndexes,
 ContainmentIndexesHierarchy, ContainmentIndexesHierarchyNonTrivial,
 ContainmentIndexesNonTrivial, ContainmentMatrix, ContainmentNonTrivial,
 ContainmentSizes, GeneratorsAndOrder, HasseDiagram,
 NonUnitMinimalSubgroupGenerators, SubgroupOrders, ZeroMeetingSubgroups, Zeros}
```

```
MakeMinimalGroup[12]
```

```
Estimated time is: 0.00124416 seconds.

Computation time: 0. seconds.
```

```
SubgroupsAndGenerator[]
```

```
<|0 → {0}, 1 → {0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11},
 2 → {0, 2, 4, 6, 8, 10}, 3 → {0, 3, 6, 9}, 4 → {0, 4, 8}, 6 → {0, 6}|>
```

```
SubgroupOrders[]
```

```
{1, 2, 3, 4, 6}
```

```
SubgroupGenerators[]
```

```
{0, 1, 2, 3, 4, 6}
```

```
GeneratorsAndOrder[]
```

```
<|0 → 1, 1 → 12, 2 → 6, 3 → 4, 4 → 3, 6 → 2|>
```

```
ZeroMeetingSubgroups[] // Column(*undergrupper som bara har enheten 0 gemensamt*)
```

```
{{0, 3, 6, 9}, {0, 4, 8}}
{{0, 4, 8}, {0, 6}}
```

```
Subgroups[] // Column
```

```
{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11}
{0, 2, 4, 6, 8, 10}
{0, 3, 6, 9}
{0, 4, 8}
{0, 6}
{0}
```

```
Sns[[4]]
```

```
{0, 4, 8}
```

```
Containment[4] // Column (*undergrupper som innehåller den fjärde undergruppen*)
```

```
{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11}
{0, 2, 4, 6, 8, 10}
{0, 4, 8}
```

```
<< AdditiveGroup`
```

```
MakeMinimalGroup[6]
```

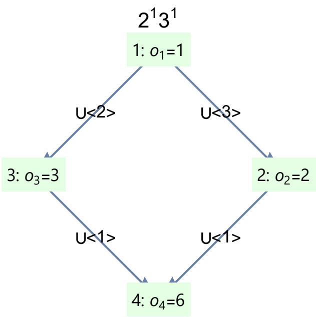
```
Estimated time is: 0.00031104 seconds.

Computation time: 0. seconds.
```

```
SubgroupsAndGenerator[]
```

```
<|0 → {0}, 1 → {0, 1, 2, 3, 4, 5}, 2 → {0, 2, 4}, 3 → {0, 3}|>
```

```
HasseGraphEdges[] (*sambandet mellan undergrupper m.a.p. inklusion*)
```




```
G1 = AdditivePermutationGroup[]; (*mathematica representation*)
```

```
{GroupOrder[G1], N0}
```

```
{6, 6}
```

```
{Sns⟦3⟧, "+", Sns⟦2⟧, "=", Sns⟦3⟧ ⊕ Sns⟦2⟧} (* addition är polymorf till undergrupper *)
```

```
{{0, 3}, +, {0, 2, 4}, =, {0, 1, 2, 3, 4, 5}}
```

```
SubgroupProducts[] // MatrixForm (*all parvisa produkter*)
```

$$\begin{pmatrix} \{0,1,2,3,4,5\} & \{0,1,2,3,4,5\} & \{0,1,2,3,4,5\} & \{0,1,2,3,4,5\} \\ \{0,1,2,3,4,5\} & \{0,2,4\} & \{0,1,2,3,4,5\} & \{0,2,4\} \\ \{0,1,2,3,4,5\} & \{0,1,2,3,4,5\} & \{0,3\} & \{0,3\} \\ \{0,1,2,3,4,5\} & \{0,2,4\} & \{0,3\} & \{0\} \end{pmatrix}$$

```
SubgroupProducing[3] // Grid (*indikerar undergruppspar vars produkt är den tredje*)
```

```
0 0 0 0
0 0 0 0
0 0 1 1
0 0 1 0
```

```
Names["AdditiveGroup`*"]
```

```
{AdditiveGroupPackage, AdditivePermutationGroup, AdditivePermutationSubgroups,
 AggregatedSubgroupProducing, ContainmentAndComplement,
 ContainmentAndComplementNonTrivial, ContainmentIndexesFromGeneratorNonTrivial,
 CyclesList, CyclesMap, DivergerMatrix, DivergerMatrixBool, DivergerPairs,
 GeneratorSpan, HasseGraph, HasseGraphEdges, HasseWeb, HasseWebGraphEdges,
 InnerAut, NonEntanglingPaths, NonEntanglingPathsIndexed, PartitioningSubgroups,
 Permutation, SubgroupIntersections, SubgroupOrder, SubgroupProducing,
 SubgroupProductBoundaries, SubgroupProductBoundary, SubgroupProducts,
 SubgroupSymmetricDiffs, SubsettingPaths, SubsettingPathsContainmentIndexes,
 SubsettingPathsIndexes, vtxpnl$6219, WholeGroupProducts, ZeroMeetFactorisation}
```