In[63]:=
```
<< Combinatorica`
```

Generating permutations

In[64]:=
```
Permutations[3]
```

Out[64]=
```
{{1, 2, 3}, {1, 3, 2}, {2, 1, 3}, {2, 3, 1}, {3, 1, 2}, {3, 2, 1}}
```

In[65]:=
```
Permutations[4]
```

Out[65]=
```
{{1, 2, 3, 4}, {1, 2, 4, 3}, {1, 3, 2, 4}, {1, 3, 4, 2}, {1, 4, 2, 3}, {1, 4, 3, 2},
 {2, 1, 3, 4}, {2, 1, 4, 3}, {2, 3, 1, 4}, {2, 3, 4, 1}, {2, 4, 1, 3}, {2, 4, 3, 1},
 {3, 1, 2, 4}, {3, 1, 4, 2}, {3, 2, 1, 4}, {3, 2, 4, 1}, {3, 4, 1, 2}, {3, 4, 2, 1},
 {4, 1, 2, 3}, {4, 1, 3, 2}, {4, 2, 1, 3}, {4, 2, 3, 1}, {4, 3, 1, 2}, {4, 3, 2, 1}}
```

In[66]:=
```
Permute[{A, B, C, D}, Permutations[3]]
```

Out[66]=
```
{{A, B, C}, {A, C, B}, {B, A, C}, {B, C, A}, {C, A, B}, {C, B, A}}
```

In[67]:=
```
MinimumChangePermutations[{x, y, z}]
```

Out[67]=
```
{{x, y, z}, {y, x, z}, {z, x, y}, {x, z, y}, {y, z, x}, {z, y, x}}
```

In[68]:=
```
Table[RandomPermutation[2], {10}]
```

Out[68]=
```
{{1, 2}, {2, 1}, {1, 2}, {1, 2}, {2, 1}, {2, 1}, {1, 2}, {2, 1}, {2, 1}, {2, 1}}
```

In[69]:=
```
Permute[{a, b, c, d, e}, {5, 3, 2, 1, 4}]
```

Out[69]=
```
{e, c, b, a, d}
```

In[70]:=
```
Permute[Permute[{a, b, c, d, e}, {1, 5, 4, 2, 3}], {4, 5, 1, 3, 2}]
```

Out[70]=
```
{b, c, a, d, e}
```

In[71]:=
```
LexicographicPermutations[3]
```

Out[71]=
```
{{1, 2, 3}, {1, 3, 2}, {2, 1, 3}, {2, 3, 1}, {3, 1, 2}, {3, 2, 1}}
```

In[72]:=
```
Permutations[3]
```

Out[72]=
```
{{1, 2, 3}, {1, 3, 2}, {2, 1, 3}, {2, 3, 1}, {3, 1, 2}, {3, 2, 1}}
```

In[73]:=
```
Clear[P, Q, R, S]; LexicographicPermutations[{P, Q, R, S}]
```

Out[73]=
```
{{P, Q, R, S}, {P, Q, S, R}, {P, R, Q, S}, {P, R, S, Q}, {P, S, Q, R}, {P, S, R, Q},
 {Q, P, R, S}, {Q, P, S, R}, {Q, R, P, S}, {Q, R, S, P}, {Q, S, P, R}, {Q, S, R, P},
 {R, P, Q, S}, {R, P, S, Q}, {R, Q, P, S}, {R, Q, S, P}, {R, S, P, Q}, {R, S, Q, P},
 {S, P, Q, R}, {S, P, R, Q}, {S, Q, P, R}, {S, Q, R, P}, {S, R, P, Q}, {S, R, Q, P}}
```

LexicographicPermutations is slower than Permutations.

In[74]:=
```
Permutations[{1, 1, 2}]
```

Out[74]=
```
{{1, 1, 2}, {1, 2, 1}, {2, 1, 1}}
```

In[75]:=
```
LexicographicPermutations[{1, 1, 2}]
```
Out[75]=
```
{{1, 1, 2}, {1, 2, 1}, {1, 1, 2}, {1, 2, 1}, {2, 1, 1}, {2, 1, 1}}
```

Permutations deals with multisets corectly, while LexicographicPermutations does not.

Ranking and Unranking permutations

In[76]:=
```
RankPermutation[{1, 2, 3}]
```
Out[76]=
```
0
```

In[77]:=
```
RankPermutation[{5, 1, 3, 2, 4}]
```
Out[77]=
```
98
```

In[78]:=
```
RankPermutation[{5, 1, 3, 4, 2}]
```
Out[78]=
```
99
```

```
RankPermutation[{2, 3, 1, 5, 4}]
```
```
31
```

In[79]:=
```
RankPermutation[{5, 4, 3, 2, 1}]
```
Out[79]=
```
119
```

In[80]:=
```
UnrankPermutation[3, {1, 2, 3}]
```
Out[80]=
```
{2, 3, 1}
```

In[81]:=
```
UnrankPermutation[3, {3, 2, 1}]
```
Out[81]=
```
{2, 1, 3}
```

In[82]:=
```
RankPermutation /@ Permutations[{1, 2, 3, 4}]
```
Out[82]=
```
{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23}
```

In[83]:=
```
NextPermutation[{1, 2, 3}]
```
Out[83]=
```
{1, 3, 2}
```

In[84]:=
```
NextPermutation[{5, 1, 3, 2, 4}]
```
Out[84]=
```
{5, 1, 3, 4, 2}
```

In[85]:=
```
NextPermutation[{5, 4, 3, 2, 1}]
```
Out[85]=
```
{1, 2, 3, 4, 5}
```

In[86]:=
```
Range[5]
```
Out[86]=
```
{1, 2, 3, 4, 5}
```

In[87]:=
```
Reverse[%]
```
Out[87]=
```
{5, 4, 3, 2, 1}
```

In[88]:=
```
NextPermutation[%](*NextPermutation[Reverse[Range[5]]]*)
```
Out[88]=
```
{1, 2, 3, 4, 5}
```

In[89]:=
```
UnrankPermutation[2, Range[3]]
```
Out[89]=
```
{2, 1, 3}
```

In[90]:=
```
Table[UnrankPermutation[n, Range[3]], {n, 0, 5}]
```
Out[90]=
```
{{1, 2, 3}, {1, 3, 2}, {2, 1, 3}, {2, 3, 1}, {3, 1, 2}, {3, 2, 1}}
```

In[91]:=
```
Table[UnrankPermutation[n, Range[3]], {n, 0, 9}]
```
Out[91]=
```
{{1, 2, 3}, {1, 3, 2}, {2, 1, 3}, {2, 3, 1},
 {3, 1, 2}, {3, 2, 1}, {1, 2, 3}, {1, 3, 2}, {2, 1, 3}, {2, 3, 1}}
```

In[92]:=
```
Map[RankPermutation, Permutations[{1, 2, 3, 4}]]
```
Out[92]=
```
{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23}
```

Generating subsets

In[93]:=
```
Subsets[{1, 2, 3}]
```
Out[93]=
```
{{}, {1}, {2}, {3}, {1, 2}, {1, 3}, {2, 3}, {1, 2, 3}}
```

In[94]:=
```
LexicographicSubsets[{1, 2, 3}]
```
Out[94]=
```
{{}, {1}, {1, 2}, {1, 2, 3}, {1, 3}, {2}, {2, 3}, {3}}
```

In[95]:=
```
Subsets[{1, 2, 3}, 2]
```
Out[95]=
```
{{}, {1}, {2}, {3}, {1, 2}, {1, 3}, {2, 3}}
```

In[96]:=
```
KSubsets[{1, 2, 3}, 2]
```
Out[96]=
```
{{1, 2}, {1, 3}, {2, 3}}
```

In[97]:=
```
KSubsets[{1, 2, 3, 4, 5}, 3]
```
Out[97]=
```
{{1, 2, 3}, {1, 2, 4}, {1, 2, 5}, {1, 3, 4},
 {1, 3, 5}, {1, 4, 5}, {2, 3, 4}, {2, 3, 5}, {2, 4, 5}, {3, 4, 5}}
```

In the following we generate 13 lexicographically consecutive subsets of [a, b, c, d, e, f] starting with [a, b, d, f].

In[98]:=
```
Clear[a, b, c, d, e, f];
NestList[NextLexicographicSubset[{a, b, c, d, e, f}, #] &, {a, b, d, f}, 13]
```
Out[98]=
```
{{a, b, d, f}, {a, b, e}, {a, b, e, f}, {a, b, f}, {a, c}, {a, c, d}, {a, c, d, e},
 {a, c, d, e, f}, {a, c, d, f}, {a, c, e}, {a, c, e, f}, {a, c, f}, {a, d}, {a, d, e}}
```

In[99]:=
```
Clear[a, b, c, d]; BinarySubsets[{a, b, c, d}]
```
Out[99]=
```
{{}, {d}, {c}, {c, d}, {b}, {b, d}, {b, c}, {b, c, d}, {a},
 {a, d}, {a, c}, {a, c, d}, {a, b}, {a, b, d}, {a, b, c}, {a, b, c, d}}
```

In[100]:=
```
NestList[NextBinarySubset[{a, b, c, d}, #] &, {}, 15]
```
Out[100]=
```
{{}, {d}, {c}, {c, d}, {b}, {b, d}, {b, c}, {b, c, d}, {a},
 {a, d}, {a, c}, {a, c, d}, {a, b}, {a, b, d}, {a, b, c}, {a, b, c, d}}
```

n is taken modulo the number of subsets, therefor one can use any positive or negative number to specify the rank of a subset.

In[101]:=
```
UnrankBinarySubset[-10, {a, b, c, d}]
```
Out[101]=
```
{b, c}
```

In[102]:=
```
UnrankSubset[2, {a, b, c, d}]
```
Out[102]=
```
{b}
```

In[103]:=
```
UnrankSubset[0, {a, b, c, d}]
```
Out[103]=
```
{}
```

In[104]:=
```
Table[UnrankSubset[n, {a, b, c, d}], {n, 0, 15}]
```
Out[104]=
```
{{}, {a}, {b}, {c}, {d}, {a, b}, {a, c}, {a, d}, {b, c}, {b, d},
 {c, d}, {a, b, c}, {a, b, d}, {a, c, d}, {b, c, d}, {a, b, c, d}}
```

In[105]:=
```
Subsets[{1, 2, 3}]
```
Out[105]=
```
{{}, {1}, {2}, {3}, {1, 2}, {1, 3}, {2, 3}, {1, 2, 3}}
```

In[106]:=
```
LexicographicSubsets[{1, 2, 3}]
```
Out[106]=
```
{{}, {1}, {1, 2}, {1, 2, 3}, {1, 3}, {2}, {2, 3}, {3}}
```

In[107]:=
```
RankSubset[{1, 2, 3}, {2}]
```
Out[107]=
```
2
```

In[108]:=
```
RankSubset[{1, 2, 3}, {1, 2}]
```
Out[108]=
```
4
```

In[109]:=
```
RankKSubset[{2}, {1, 2, 3}]
```
Out[109]=
```
1
```

In[110]:=
```
NextSubset[{1, 2, 3}, {2}]
```
Out[110]=
```
{3}
```

In[111]:=
```
NextSubset[{1, 2, 3}, {1, 3}]
```
Out[111]=
```
{2, 3}
```

In[112]:= **UnrankSubset[3, {1, 2, 3}]**

Out[112]= {3}

In[113]:= **UnrankSubset[2, {1, 2, 3}]**

Out[113]= {2}