Generating Permutations

Here is algorithm L for generating all permutations of a set or multiset, from *The Art of Computer Programming, Volume 4A, page 319* by Donald Knuth.

Write the set in ascending order $x_1 \leq x_2 \leq \cdots \leq x_n$. Note that some of these can be equal.

1. Find the largest $j$ such that $x_j < x_{j+1}$.
2. Find the largest $k$ such that $x_j < x_k$.
3. Swap $x_j$ and $x_k$.
4. Reverse all $x_{j+1}, \ldots, x_n$.

For example consider $1, 2, 2, 3$

(1) $j = 3, k = 4$, swap the (second) 2 and 3: $1, 2, 3, 2$. There is no reversing to do.
(2) $j = 2, k = 3$, swap the (first) 2 and the 3 to get $1, 3, 2, 2$, then reverse 2, 2 to (still) get $1, 3, 2, 2$.
(3) $j = 1, k = 4$, swap 1 and the (second) 2, to get $2, 3, 2, 1$, then reverse the last 3: $2, 1, 2, 3$.
(4) $j = 3, k = 4$: swap the last two: $2, 1, 3, 2$.
(5) $j = 2, 4$, swap 1, 2, to get $2, 2, 3, 1$, reverse the last two: $2, 2, 1, 3$.

Final result:

1223 1232 1322 2123 2132 2213 2231 2312 2321 3122 3212 3221 3221.

A trivial example: $1112$. You get: $1121, 1211, 2111$. 