EE231002 Introduction to Programming

Lab06. Permutations

Due: Oct. 25, 2019

Given a set of `N` distinct elements, there are `N!` possible permutations to arrange these elements. For example, given the set {3, 2, 1} they can be arranged in the following 6 permutations:

3 2 1
3 1 2
2 3 1
2 1 3
1 3 2
1 2 3

Your assignment is to write a program to generate all possible permutations given the set of `N` integers from 1 to `N` in reverse order. The output should follow the format below.

Assuming the array `A[N]` stores a permutation, the following algorithm generates the next permutation in reverse lexicographic order. The algorithm is based on the one invented by Narayan Pandia of India in 14th century.

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1. Find the largest index `j` such that `A[j] > A[j + 1]`.
   If no such index exists, the permutation is the last permutation.
2. Find the largest index `k` such that `A[j] > A[k]`.
3. Swap `A[j]` with `A[k]`.
4. Reverse the sequence from `A[j + 1]` up to and including the last element `A[N - 1]`.

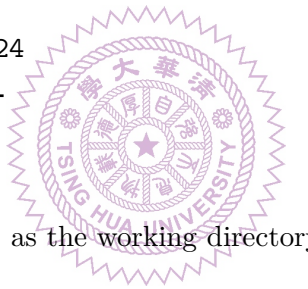
If the array `A` is initialized to {`N`, `N-1`, ⋯ , 1 }, then repeatedly applying the algorithm it would generate all possible permutations. Please implement the algorithm such that all possible permutations are generated in the following format:

Example output (`N = 4`):

```
permutation #1: 4 3 2 1
permutation #2: 4 3 1 2
permutation #3: 4 2 3 1
permutation #4: 4 2 1 3
```

```
permutation #5: 4 1 3 2
permutation #6: 4 1 2 3
permutation #7: 3 4 2 1
permutation #8: 3 4 1 2
permutation #9: 3 2 4 1
permutation #10: 3 2 1 4
permutation #11: 3 1 4 2
permutation #12: 3 1 2 4
permutation #13: 2 4 3 1
permutation #14: 2 4 1 3
permutation #15: 2 3 4 1
permutation #16: 2 3 1 4
permutation #17: 2 1 4 3
permutation #18: 2 1 3 4
permutation #19: 1 4 3 2
permutation #20: 1 4 2 3
permutation #21: 1 3 4 2
permutation #22: 1 3 2 4
permutation #23: 1 2 4 3
permutation #24: 1 2 3 4
  Total number of permutations is 24
```

Notes.



1. Create a directory **lab06** and use it as the working directory.
2. Name your program source file as **lab06.c**.
3. The first few lines of your program should be comments as the following.

   ```
   // EE231002 Lab06. Permutations
   // ID, Name
   // Date:
   ```

4. The number of elements, N, should be defined as a macro as following:

   ```
   #define N 7
   ```

5. After finishing editing your source file, you can execute the following command to compile it,

   ```
   $ gcc lab06.c
   ```

   If no compilation errors, the executable file, **a.out**, should be generated, and you can execute it by typing

   ```
   $ ./a.out
   ```

6. After you finish verifying your program, you can submit your source code by

```
$ ~ee2310/bin/submit lab06 lab06.c
```

If you see a "submitted" message, then you are done. In case you want to check which file and at what time you submitted your labs, you can type in the following command:

```
$ ~ee2310/bin/subrec lab06
```

It will show the last few submission records.