

## AP COMPUTER SCIENCE B – PERMUTATIONS

The number of permutations of  $b$  distinct objects taken  $n$  at a time is

$${}_bP_n = \frac{b!}{(b-n)!} \quad (1)$$

A good way to construct a list of permutations is to count in base  $b$ , which is what class `CountInBase.java` does. Run program `TestCountInBase` (which uses classes `CountInBase` and `BN`) with (base)  $b = 3$  and (number of digits)  $n = 3$ . File `3_count_3.txt` will be created. It contains

```
000 001 002 010 011 012 020 021 022
100 101 102 110 111 112 120 121 122
200 201 202 210 211 212 220 221 222
```

(2)

which are the three-digit numbers (front-padded with zeros) counting from 0 to 222 in base 3. Note that the 6 permutations of 3 things taken 3 at a time, *i.e.*,

```
012 021 102 120 201 210
```

are contained in the list (2).

Similarly, run `TestCountInBase` with  $b = 3$  and  $n = 2$ . File `3_count_2.txt`, containing

```
00 01 02 10 11 12 20 21 22
```

(3)

will be created, which are the two-digit numbers counting from 0 to 22 in base 3. The 6 permutations of 3 things taken 2 at a time, *i.e.*,

```
01 02 10 12 20 21
```

are contained in list (3).

Finally, run `CountInBase` with  $b = 3$  and  $n = 1$  to create the file `3_count_1.txt` containing

```
0 1 2
```

(4)

which are the one-digit numbers counting from 0 to 2 in base 3. Note that list (4) also corresponds to the 3 permutations of 3 things taken 1 at a time.

The goal of this assignment is to write a class `Permutation` which constructs lists of permutations using the idea described above. Start with `PermutationStub.java` to make `Permutation.java`. Also, class `TestPermutation.java` will be used as-is.

In particular, finish class `Permutation` by:

- 1) Adding the required code to `public static int factorial ( int num )` to calculate  $num!$ .
- 2) Adding the required code to `public static int numPerms ( int bi, int ni )` to implement eqn. (1) above.
- 3) Adding the required code to `private void init ()` to calculate the permutations. The directions are in the comments of file `PermutationStub.java`.

## AP COMPUTER SCIENCE B – PERMUTATIONS

For example, when you run `TestPermutation` with the console looking like

```
b = ? 4  
n = ? 3
```

where the bold print is user input, the output file `4_P_3.txt` is created, which file contains

```
012  
013  
021  
023  
031  
032  
102  
103  
120  
123  
130  
132  
201  
203  
210  
213  
230  
231  
301  
302  
310  
312  
320  
321
```

*i.e.*, the  ${}_4P_3 = 24$  permutations.