

# Discrete Mathematics D Term 2018

## Lectures 03 and 04

### Summary

We discussed other aspects the multiplicative principle.

- weak independence
- method with controlled over-counting (e.g. anagrams with repeated letters)
- method with controlled illegal elements (e.g. Empire State Building problem)

We also discussed the relationship between the magic trick and the binary numbers. In particular

- two methods of Base conversion
- arithmetic in other bases.

### Exercises on Lectures 01 and 02

#### Multiplicative Principle

1. How many seven digits numbers are there in which the same digit doesn't occur twice. (Assume there are no leading 0's, so 7 is not 007)
2. The Combinatarians have 666 letters in their alphabet. They love spelling. How many 66 letter words can they make? How many such words have no letter used twice.
3. How many rearrangements can be made from the letters in banana? (like NABANA)
4. "FORGET CHIPS" has the anagram "PEGRO FITSCH" in which the letters for "GO FISH" occur in the correct order. How many anagrams of "FORGET CHIPS" have this property.
5. How many anagrams for "CARUMBA" have the the letters  $A$ ,  $B$  and  $C$  occur in the correct order.

#### Number Bases

1. Add 101010101 to 11101110111 in binary.
2. Subtract 101010101 from 11101110111 in binary.
3. Multiply 1010111101 from 1011 in binary.

4. Convert 1215, 1492, 1688, and 1861 to binary.
5. Convert 1776 to bases 3, 8 and 16. For base 16 use for the “digits” 10, 11, 12, 13, 14 and 15 the symbols A, B, C, D, E and F.)
6. (Tricky?) Old Professor Fate is so indecisive, he cannot decide between 2 and 3 for a number base. So he ends up with a system in which he uses digits 0 and 1 in the even positions, but allows 0, 1 and 2 in odd positions.
  - (a) Count from 1 to 25 in the Professor Fate numbers.
  - (b) For the number 110011000 in Professor Fate’s system, what is the value associated with each of the 1’s.
  - (c) Convert 110011000 to decimal numbers.
  - (d) Convert 2018 to Professor Fate numbers. Try to adapt both methods we learned for base conversion to this system.
  - (e) What single base are the Professor Fate numbers most related to, and why?