DISCRETE STRUCTURES (CS21001)

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QUESTION : 1

Show that there are at least six people in California (population: 36 million) with the same three initials who were born on the same day of the year (but not necessarily in the same year). Assume that everyone has three initials.

QUESTION : 2

In a room there are 11 people, none of whom are older than 60 (ages are given in whole numbers only) but each of whom is at least 1 year old. Prove that we can always find two groups of people (with no common person) the sum of whose ages is the same. Can 11 be replaced by a smaller number?

QUESTION : 3

a) Prove that of any five points chosen within an equilateral side of length 1, there are two whose distance is at most 1/2.

b) Prove that of any ten points chosen within an equilateral side of length 1, there are two whose distance is at most 1/3.

c) Determine an integer m_n, such that if m_n points are chosen within an equilateral triangle of side 1, there are two whose distance is at most 1/n.

QUESTION : 4

A 3X7 rectangle is divided into 21 squares each of which is coloured red or black. Prove that the board contains a non-trivial rectangle (not 1Xk or kX1), whose 4 corner squares are all black or all red.

QUESTION : 5

2kX2k grid is divided into $4k^2$ squares and 4 kXk sub grids. Show that it is impossible to mark k squares in the upper left kXk sub grids and k squares in lower right kXk sub grid such that no two marked squares are in the same row, column or diagonal of the 2kX2k grid.