CT - 04

① Write a short note on (a) Post Correspondence problem
(b) Classes of P and NP
(c) quantum computers with Example.

② Prove that every language that is accepted in multi-tape turing machine is also accepted by standard turing machine.

①(a) defn: The PCP can be stated as follows:
Given two sequence of n strings on some alphabet Σ says
$A = w_1, w_2 w_3 .. w_n$, and $B = v_1, v_2, v_3 ..... v_n$
we say that there exists a post correspondence solution for pair (A,B) if there is a non empty sequence of integer $i, j \ldots$ k such that

$w_i w_j \ldots w_k = v_i v_j \ldots v_k$.

The post correspondence problem is to device an algorithm, that will inform w_i for any (A,B) whether or not there exists a PC-Solution.

(b) classes of P and NP
def: A TM M is said to be of complexity T(n) if the following holds: Given an i/p w of length n, M halts after making at most T(n) moves.

def: A language L is in class P if there exists some polynomial T(M) such that L = T(M) for some deterministic TM M of time complexity T(n)
def: A language L is in class NP if there is a non deterministic TM M and a polynomial time complexity T(n) such that L = T(M) and M executes at most T(n) moves for every i/p w of length n.

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(C) def: A quantum computer ~~unit~~ is a System built from quantum computers circuits, containing wires and Elementary like quantum gates. to carry out manipulation of quantum information.

The digital Computers data is represented using binary States 0 & 1 where as the data in quantum Computers is represented mathematically as shown below:

$$|\psi\rangle = \alpha|0\rangle + \beta|1\rangle$$

Example: a two-qubit System has four computational basis state, $|00\rangle, |01\rangle, |10\rangle, |11\rangle$ & quantum States are represented as:

$$|\psi\rangle = \alpha_{00}|00\rangle + \alpha_{01}|01\rangle + \alpha_{10}|10\rangle + \alpha_{11}|11\rangle$$

where

$$|\alpha_{00}|^2 + |\alpha_{01}|^2 + |\alpha_{10}|^2 + |\alpha_{11}|^2 = 1$$

2) Proof: Every language L is accepted by a k-tape TM M, we Simulate M with a Single a Single tape TM with 2k tracks. The Second, fourth ... $(2k^{th})$ tracks hold the Contents of the k-tapes. The first, third ... $(2k-1)^{th}$ tracks hold a head marker to indicate the position of the respective tape head. In the figure below the Symbols A_2 and B_5 are the Current Symbols to be Scanned and So the head marker X is above the two Symbols

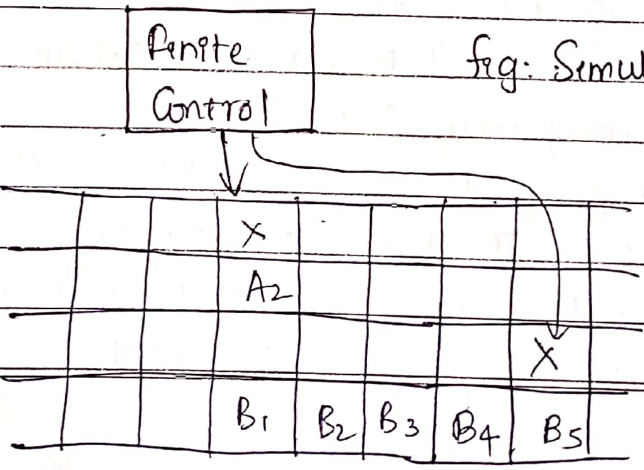

fig: Simulation of multi tape TM

Initially the Contents of tapes 1 and 2 of M are Stored in the Second and fourth tracks of M_1. The head markers of the first and third tracks are at the Cells Containing the first Symbol.

To Simulate a move of M_1 the 2k track TM M_1 has to visit the two headmarkers and Store the Scanned Symbols in its control - keeping Storing it in the finite Control of M_1. The finite Control of M_1 has also the information about the States of M and its moves. after visiting both head markers, M_1 knows the tape Symbols being Scanned by the two heads of M.

Now M_1 revisits each of the head markers.

(i) it changes its tape Symbol in the Corresponding track of M_1 based on the information regarding the move of M corresponding to the State (of M) and its tape Symbol in the Corresponding tape M.

(ii) it moves the head markers to the left or right.

(iii) M_1 changes the State of M in its Control. This is the Simulation of a Single move of m at the end of this M_1 is ready to implement its next move based on the revised position of its headmarkers and the changed State available in its Control.

Running time of M: the running time of M on input w, is the number of Steps and M takes before halting, if M does not halt on an input Strings w, then its running time of M on w is infinite.

Time complexity of M: Time complexity of M is the fnc T(n), n being the input Size, where T(n) is defined as the maximum of the running time of M over all inputs w of Size n.