CS301 Assignment 5

Nofil Iqbal 28631

1. If there is a subset of projects within T that requires a total effort of c or less and yields a total profit of at least p, then the answer is YES. If these conditions are not met, the answer is NO.
2. To prove that the decision variable is in NP, we need to show that it can be solved in polynomial time by a non-deterministic Turing machine.

    2.1. Verifying inputs in polynomial time:
        2.1.1. Input consists of set of Projects T, and each project t in T has 2 positive integers: et and pt, for amount of effort and profit relating to the project respectively. Another positive integer c is also in the input, denoting the maximum amount of effort we can spend on these projects.
        2.1.2. For verification, we need to check that each project t in T is associated with et and pt, and also that c is a positive integer. We can do this in constant time, but since the size of the input is polynomial in size(no. of projects in T), this step will also be in polynomial time.
    2.2. Showing that a solution can be checked in polynomial time:
        2.2.1. The subset of projects T'(T complement) is a solution to this problem if it meets the following criterias:
            2.2.1.1. The total effort required to complete all the projects in T' is no more than c
            2.2.1.2. The total profit gained from completing the projects in T' is at least a specified positive integer p.
        2.2.2. To check the solution, we just have to calculate the total effort and the total profit in T', then check if total effort is <= c and the total profit is >= p. This can be done in polynomial time if we iterate over all the projects in T' and summing up all et and pt.

    By proving that the input can be verified in polynomial time and a solution can be checked in polynomial time, we have proved that the decision version is in NP