

# Theorem 7

## Solving Problem LP

Construct a graph  $G$  such that

- For each inequality  $x_j - x_i \leq a_{ij}$  in  $S$ , there is an edge that goes from  $x_i$  to  $x_j$  in  $G$ , weighted with  $a_{ij}$ .
- Add an extra node  $x_s$  and connect it with all the other nodes, setting the weight on the newly-created edges to 0.

Run the Bellman-Ford algorithm on such graph with source  $x_s$ . If the algorithm terminates, the shortest-paths distances found are a possible solution of  $S$ . Otherwise, if it detects a negative cycle, the system is inconsistent.

# Algorithm OPT1

Given a synchronous circuit  $G$ , determine a retiming  $r$  such that  $\Phi(G_r)$  is as small as possible.

1. Compute  $W$  and  $D$  using Algorithm WD.
2. Sort the elements in the range of  $D$ .
3. Binary search among the elements  $D(u, v)$  for the minimum achievable clock period. To test whether each potential clock period is feasible, apply the Bellman-Ford algorithm to determine whether the conditions in Theorem 7 can be satisfied.
4. For the minimum achievable clock period, use the values for the  $r(v)$  found by the Bellman-Ford algorithm as the optimal retiming.