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Homework 12

Q1 Here, we make an assumption that no clause can have a variable and its complement together.

We have the following 2-approximation algorithm:

Let I be an instance of MIN-2SAT consisting of clause set C_I and variable set S_I.
We construct an auxiliary graph $G_I(V_I, E_I)$ corresponding to I where the node set V_I corresponds with the clause set C_I. For any two nodes v_i and v_j, the edge (v_i, v_j) is in E_I iff the corresponding clauses are such that there is a variable s in S_I such that it appears as it is in c_i and in complemented form in c_j, or viceversa.

To construct a truth assignment, we construct an approximate vertex cover V' for G_I such that $|V'|$ is at most 2 times of a minimum vertex cover for G_I. Then, we can construct a truth assignment that causes all clauses in $V_I - V'$ to be false:

Q2 Here, our objective is:

$$\text{Minimize} \sum_{(u,v) \in E} c(u,v) \cdot x_{(u,v)}$$

Constraints:

$$x_v - x_u + x_{(u,v)} \geq 0 \quad \forall (u,v) \in E$$
$$x_u \in \{0,1\} \quad \forall\ u \in V$$
except $u=s$ and $u=t$
$$x_{(u,v)} \in \{0,1\} \quad \forall (u,v) \in E.$$
$$x_s = 1, \quad x_t = 0.$$

Here, we partition the vertices in the cuts. If $x_i = 0$, then i is on side s of cut. Also, we need to clearly set $x_s = 1$ and $x_t = 0$ for correct partitioning and s & t are seperated. With the first constraint, we ensure that edges travelling across the cut are included.

Q3 Objective Fn: Maximize $\sum_{i=1}^{16} H_i$

Constraints:

$$H_i = \alpha_i(D_i - S_i)$$
$$\sum_{i=1}^{16} S_i = 720$$
$$(D_i - S_i) \geq 0 \text{ for } 0 < i \leq 16$$
$$S_i \geq 0 \text{ for } 0 < i \leq 16$$

Our variable is S_i

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Q4 (a) r_i = Power of the r_i^{th} transmitter.
$i = 1 \cdots n$.

(b) Minimize $r_1 + r_2 + \cdots + r_n$

(c) $r_i + r_j \geq d_{i,j}$ where $d_{i,j}$ = distance of stations i and j.

We need $\sum_{i=1}^{n-1} (n^2 - n)/2$ constraints of inequality.