

Given:

4 sensors (circles) and 4 targets (squares) that should be covered by sensors in the rectilinear (Manhattan) metric (the unit length of grid is 1), besides each sensor there is the initial number of batteries, the sensing radius is 5 (in rectilinear metric)

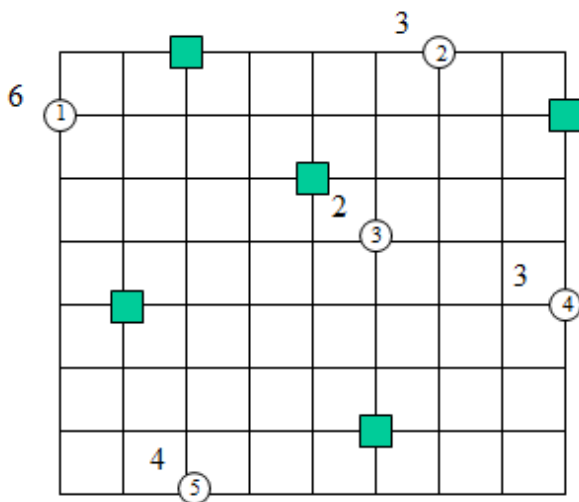
Write linear program formulation for sensor lifetime maximization problem

(a) List all sensor covers: $SC1 = \{ \quad \quad \quad \}$ $SC2 = \{ \quad \quad \quad \}$
 $\{ \quad \quad \quad \}$ $SC3 = \{ \quad \quad \quad \}$ $SC4 = \{ \quad \quad \quad \}$

(b) variables:

(c) objective:

(d) s.t.



For the linear program formulation for sensor lifetime maximization problem for the problem 1 (see previous slide)

Solution:

(a) List of sensor covers:

$$SC1=\{S1,S4\}$$

$$SC2=\{S1,S3\}$$

$$SC3=\{S2,S3\}$$

$$SC4=\{S2,S5\}$$

(b) variables:

Consider variables t_1, t_2, t_3, t_4 for sensor covers $SC1, SC2, SC3, SC4$ respectively.

Number of variables=4;

number of constraints=(5+4=9)

(c) Objective:

Maximize $t_1+t_2+t_3+t_4$

(d) Subject to: $t_1, t_2, t_3, t_4 \geq 0$

$$t_1+t_2 \leq 6$$

$$t_3+t_4 \leq 3$$

$$t_2+t_3 \leq 2$$

$$t_1 \leq 3$$

$$t_4 \leq 4$$

2. Give the optimal solution for the above linear program

$$t_1 = 3, t_2 = 2, t_3 = 0, t_4 = 3$$

Optimal solution=8

dual: 9

$$6y_1+3y_2+2y_3+3y_4+4y_5 \rightarrow \min$$

$$y_1+y_4 \geq 1$$

$$y_1+y_3 \geq 1$$

$$y_2 + y_3 \geq 1$$

$$y_2 + y_5 \geq 1$$

$$y_3, y_4, y_5 = 1; y_1, y_2 = 0$$

or

$$y_1 = y_2 = 1; y_3, y_4, y_5 = 0$$

3. For the linear program formulation for sensor lifetime maximization problem for the problem 1 (see previous slide) apply Garg-Konemann algorithm from the sensor paper with epsilon = 1. (Please disregard $D < 1$ in the paper and just make 3 iterations!)

Garg-Konemann:

Iteration3	Iteration2	Iteration1	Sensors	SC1	SC2	SC3	SC4	Battery
1/20	1/20	1/30	S1	1	1	0	0	6
2/15	1/15	1/15	S2	0	0	1	1*	3
1/10	1/10	1/10	S3	0	1*	1	0	2
2/15	2/15	1/15	S4	1*	0	0	0	3
7/80	1/20	1/20	S5	0	0	0	1	4
				1/10*	4/30	1/6	7/60	
				11/60	3/20	1/6	7/60*	
				11/60	3/20*	7/30	53/240	

Iteration1: SC1

Iteration2: SC4

Iteration3: SC2

4. Give all shifts of the Load Balancing Protocol for the instance above

Sensor	B	S1	B	S2	B	S3	B	S4	B	S5	B	S6	B	S7	B	S8	B
1	6	A	5	A	4	A	3	I	3	A	A	I	2	A	1	I	1
2	3	I	3	I	3	I	3	A	2	I	I	A	1	I	1	A	0
3	2	I	2	I	2	A	1	I	1	I	I	I	1	A	0	I	0
4	3	A	2	A	1	I	1	I	1	A	A	I	0	I	0	I	0
5	4	I	4	I	4	I	4	A	4	I	I	A	3	I	2	A	1

I = Idle, A = Active,

B = Battery left

S1,S2 . . . = Shifts

Shift 1 = 1,4

Shift 2 = 1,4

Shifts 3 1,3

Shifts 4 2,5

Shifts 5 1,4

Shift 6 2,5

Shift 7 1,3

Shift 8 2,3,5

Shift 9 = 2,3,4 are dead ; 1 & 5 cannot cover all the targets .

. Time = 8