Assign#5 Key

Spring 2023

Consider the SAT instance:

(x1 ∨ x3) & (¬x1 ∨ ¬x2 ∨ ¬x3 ∨ ¬x4 ∨ ¬x5) & (¬x1)

1. Recast this as an instance of 3SAT.

ANS:

(x1 ∨ x3 ∨ x3) & (¬x1 ∨ ¬x2 ∨ x6) & (¬x3 ∨ ¬x4 ∨ x7) & (¬x5 ∨ ¬x6 ∨ ¬ x7) & (¬x1 ∨ ¬x1 ∨ ¬x1)

ANS:

c1 = (x1 ∨ x3 ∨ x3)

c2 = (¬x1 ∨ ¬x2 ∨ x6)

c3 = (¬x3 ∨ ¬x4 ∨ x7)

c4 = (¬x5 ∨ ¬x6 ∨ ¬x7)

c5 = (¬x1 ∨ ¬x1 ∨ ¬x1)

One of many simple solutions is **¬x1, x2, x3, x4, ¬x5, x6, x7**

2. Construct the SubsetSum instance equivalent to this and state what rows must be chosen.

(x1 V x3 V x3) & (¬x1 V ¬x2 V x6) & (¬x3 V ¬x4 V x7) & (¬x5 V ¬x6 V ¬ x7) & (¬x1 V ¬x1 V ¬x1)

	x1	x2	x3	x4	x5	x6	x7	C1	C2	C3	C4	C5
x1	1	0	0	0	0	0	0	1	0	0	0	0
~x1	1	0	0	0	0	0	0	0	1	0	0	1
x2	0	1	0	0	0	0	0	0	0	0	0	0
~x2	0	1	0	0	0	0	0	0	1	0	0	0
x3	0	0	1	0	0	0	0	1	0	0	0	0
~x3	0	0	1	0	0	0	0	0	0	1	0	0
x4	0	0	0	1	0	0	0	0	0	0	0	0
~x4	0	0	0	1	0	0	0	0	0	1	0	0
x5	0	0	0	0	1	0	0	0	0	0	0	0
~x5	0	0	0	0	1	0	0	0	0	0	1	0
x6	0	0	0	0	0	1	0	0	1	0	0	0
~x6	0	0	0	0	0	1	0	0	0	0	1	0
x7	0	0	0	0	0	0	1	0	0	1	0	0
~x7	0	0	0	0	0	0	1	0	0	0	1	0
C1	0	0	0	0	0	0	0	1	0	0	0	0
C1’	0	0	0	0	0	0	0	1	0	0	0	0
C2	0	0	0	0	0	0	0	0	1	0	0	0
C2’	0	0	0	0	0	0	0	0	1	0	0	0
C3	0	0	0	0	0	0	0	0	0	1	0	0
C3 ‘	0	0	0	0	0	0	0	0	0	1	0	0
C4	0	0	0	0	0	0	0	0	0	0	1	0
C4’	0	0	0	0	0	0	0	0	0	0	1	0
C5	0	0	0	0	0	0	0	0	0	0	0	1
C5’	0	0	0	0	0	0	0	0	0	0	0	1
	1	1	1	1	1	1	1	3	3	3	3	3

3. Recast the SubsetSum instance in Part 2 as a Partition instance (really easy). You do not need to show the Partitioning into equal subsets but you should understand how it is done.

Ans:

G = 111111133333

sum= 222222245553

$2 * sum - G =$ 333333357773

sum + G = 333333378886

sum is the sum of all rows.

Note: If you use 2 in X3/C1 and a 3 in ¬X1/C5 then

sum is 222222255555 and so

$2 * sum - G =$ 333333377777

sum + G = 333333388888

4. Recast the original SAT as a 0-1 Integer Linear Programming instance:

(x1 ∨ x3) & (¬x1 ∨ ¬x2 ∨ ¬x3 ∨ ¬x4 ∨ ¬x5) & (¬x1)

ANS:

Assume 0 <= x1, x2, x3, x4, x5 <= 1

x1 + x3 >= 1

(1-x1) + (1-x2) + (1-x3) + (1-x4) + (1-x5) >= 1

(1-x1) >= 1 (or x1 = 0)

We can choose: **x1 = 0, x2 = 1, x3 = 1, x4 = 1, x5 = 1**

5. Consider the following set of independent tasks with associated task times:

(T1,4), (T2,2), (T3,8), (T4,4), (T5,2), (T6,6), (T7,1)

Fill in the schedules for these tasks under the associated strategies below.

Greedy using the list order above:

Greedy using a reordering of the list so that longest-running tasks appear earliest in the list:

Greedy then sorted high to low

T1	T1	T1	T1	T4	T4	T4	T4	T5	T5	T6	T6	T6	T6	T6	T6				
T2	T2	T3	T3	T3	T3	T3	T3	T3	T3	14									

(T1,4), (T2,2), (T3,8), (T4,4), (T5,2), (T6,6), (T7,1)

T3	T3	T3	T3	T3	T3	T3	T3	T4	T4	T4	T4	T5	T5						
T6	T6	T6	T6	T6	T6	T1	T1	T1	T1	T2	T2	T7							

(T3,8), (T6,6), (T1,4), (T4,4), (T2,2), (T5,2), (T7,1)