Consider the SAT instance:
(x1 ∨ x3 ∨ ¬x4 ∨ x5) & (¬x1 ∨ x2 ∨ x3 ∨ x4 ∨ ¬x5) & (x1 ∨ x4)

1. Recast this as an instance of 3SAT.

ANS: (x1 ∨ x3 ∨ x6) & (¬x4 ∨ x5 ∨ ¬x6) & (¬x1 ∨ x2 ∨ x7) & (x3 ∨ ¬x7 ∨ x8) & (x4 ∨ ¬x5 ∨ ¬x8) & (x1 ∨ x4 ∨ x1)

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

ANS:
c1 = (x1 ∨ x3 ∨ x6)
c2 = (¬x4 ∨ x5 ∨ ¬x6)
c3 = (¬x1 ∨ x2 ∨ x7)
c4 = (x3 ∨ ¬x7 ∨ x8)
c5 = (x4 ∨ ¬x5 ∨ ¬x8)
c6 = (x1 ∨ x4 ∨ x1)

	x1	x2	x3	x4	x5	x6	x7	x8	C1	C2	C3	C4	C5	C6
x1	1	0	0	0	0	0	0	0	1	0	0	0	0	2
~x1	1	0	0	0	0	0	0	0	0	0	1	0	0	0
x2	0	1	0	0	0	0	0	0	0	0	1	0	0	0
~x2	0	1	0	0	0	0	0	0	0	0	0	0	0	0
x3	0	0	1	0	0	0	0	0	1	0	0	1	0	0
~x3	0	0	1	0	0	0	0	0	0	0	0	0	0	0
x4	0	0	0	1	0	0	0	0	0	0	0	0	1	1
~x4	0	0	0	1	0	0	0	0	0	1	0	0	0	0
x5	0	0	0	0	1	0	0	0	0	1	0	0	0	0
~x5	0	0	0	0	1	0	0	0	0	0	0	0	1	0
x6	0	0	0	0	0	1	0	0	1	0	0	0	0	0
~x6	0	0	0	0	0	1	0	0	0	1	0	0	0	0
x7	0	0	0	0	0	0	1	0	0	0	1	0	0	0
~x7	0	0	0	0	0	0	1	0	0	0	0	1	0	0
x8	0	0	0	0	0	0	0	1	0	0	0	1	0	0
~x8	0	0	0	0	0	0	0	1	0	0	0	0	1	0
C1	0	0	0	0	0	0	0	0	1	0	0	0	0	0
C1’	0	0	0	0	0	0	0	0	1	0	0	0	0	0
C2	0	0	0	0	0	0	0	0	0	1	0	0	0	0
C2’	0	0	0	0	0	0	0	0	0	1	0	0	0	0
C3	0	0	0	0	0	0	0	0	0	0	1	0	0	0
C3 ‘	0	0	0	0	0	0	0	0	0	0	1	0	0	0
C4	0	0	0	0	0	0	0	0	0	0	0	1	0	0
C4’	0	0	0	0	0	0	0	0	0	0	0	1	0	0
C5	0	0	0	0	0	0	0	0	0	0	0	0	1	0
C5’	0	0	0	0	0	0	0	0	0	0	0	0	1	0
C6	0	0	0	0	0	0	0	0	0	0	0	0	0	1
C6’	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	1	1	1	1	1	1	1	1	3	3	3	3	3	3

3. Recast the SubsetSum instance in Part 2 as a Partition instance (really easy). Show the Partitioning into equal subsets.

Ans:

G = 11111111333333

sum= 22222222555555

$2 * \text{sum} - G =$ 33333333777777

sum + G = 33333333888888

sum is the sum of all rows.

Note: If you use 1 in X1/C6 then

sum is 22222222555554 and so

$2 * \text{sum} - G =$ 33333333777775

sum + G = 33333333888887

The partitions for the case where we use 2 in x1/C6 are as follows:

Partition 1:

33333333	777777	2*sum -G
10000000	100002	x1
01000000	001000	x2
00100000	100100	x3
00010000	000011	x4
00001000	010000	x5
00000100	100000	x6
00000010	001000	x7
00000001	000100	x8
00000000	010000	C2
00000000	010000	C2’
00000000	001000	C3
00000000	000100	C4
00000000	000010	C5
00000000	000010	C5’

Partition 2:

33333333	888888	sum+G
10000000	001000	~x1
01000000	000000	~x2
00100000	010000	~x3
00010000	010000	~x4
00001000	000010	~x5
00000100	010000	~x6
00000010	000100	~x7
00000001	000010	~x8
00000000	100000	C1
00000000	100000	C1’
00000000	001000	C3’
00000000	000100	C4’
00000000	000001	C6
00000000	000001	C6’

4. For the 0-1 Integer Linear Programming instance:

$(x1 \vee x3 \vee \neg x4 \vee x5)\ \&\ (\neg x1 \vee x2 \vee x3 \vee x4 \vee \neg x5)\ \&\ (x1 \vee x4)$

ANS:

Assume $0 <= x1, x2, x3, x4, x5 <= 1$
$x1 + x3 + (1-x4) + x5 >= 1$
$(1-x1) + x2 + x3 + x4 + (1-x5) >= 1$
$x1 + (1-x4) >= 1$
We choose: $x1 = 1, x2 = 1, x3 = 1, x4 = 1, x5 = 1$