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* **[Question 1]**

We can use a reduction to 3-SAT (which is a well-known NP-Complete question) to prove that Integer Programming is NP-hard.

Let’s have integer variables:

And then we can convert any 3-SAT instances by doing the following:

* For each literal *i*, if negation then we have , otherwise we have solely .
* After having done that above, then for each clause (which should have 3 literals), we examinate is the sum of the clause greater than 0.

For example, this 3-SAT instance:

It would be converted to:

This way, we can convert all instances of 3-SAT to Integer Programming problems. Since 3-SAT is NP-Complete, that means all NP (includes 3-SAT itself) can be reduced to Integer Programming, which further proves that Integer Programming is NP-Hard.

* **[Question 2]**

We can use

* **[Question 3]**

We can use