Instance file format :

The software `SIQP (Solution of Integer Quadratic Programs` solve general instances of linearly constrained integer quadratic non convex programs that can be formalized as (QP) :

$$(QP)\begin{cases} Min & f(x) = x^T Q x + c^T x & \\ s.t & Ax = b & \text{m equalities} \\ & Dx \leq e & \text{p inequalities} \\ & 0 \leq x \leq u & \text{n variables} \\ & x \in \mathbb{N}^n & \end{cases}$$

Where $Q \in \mathbf{S}^n$, $c \in \mathbb{R}^n$, $A \in \mathbf{M}_{m\times n}$, $b \in \mathbb{R}^m$, $D \in \mathbf{M}_{p\times n}$, $e \in \mathbb{R}^p$, and $u \in \mathbb{N}^n$.

Any instance of (QP) can be solved by the methods `BBL`, `BBLr`, `BIL`, `BILr`, `CQCR` and `IQCR`.

For instances of binary quadratic programs (i.e. $u_i = 1\ \forall i$), the software `SIQP` provides two methods `QCR` and `IQCR`.

The software `SIQP` is also able to solve instances of linearly constrained Mixed Integer Quadratic Programs (MIQP) that can be formalized as (MQP) :

$$(MQP)\begin{cases} Min & f(x) = x^T Q x + c^T x & \\ s.t & Ax = b & \text{m equalities} \\ & Dx \leq e & \text{p inequalities} \\ & 0 \leq x \leq u & \\ & x_i \in \mathbb{N} & i \in 1 \ldots \text{nb\_int} \\ & x_i \in \mathbb{R} & i \in \text{nb\_int} + 1 \ldots n \end{cases}$$

Where $Q \in \mathbf{S}^n$, $c \in \mathbb{R}^n$, $A \in \mathbf{M}_{m\times n}$, $b \in \mathbb{R}^m$, $D \in \mathbf{M}_{p\times n}$, $e \in \mathbb{R}^p$, $u \in \mathbb{N}^n$, and $Q_R \succeq 0$, where Q_R is the sub-matrix of Q defined by $(q_{ij})_{(i,j)\in\{nb\_int\ldots n\}\times\{nb\_int\ldots n\}}$.

Only the method `IQCR` (for integer or binary programming) can solve that kind of instances.

The file format that for instances of (QP) and (MQP) is the following :

```
n nb_int m p
u
u_1 u_2 ... u_n
Q
Number of non zero elements of the Q matrix
i j Q_ij (elements of the Q matrix)
c
Number of non zero elements of the c vector
i c_i (elements of the c vector)
A
Number of non zero elements of the A matrix
r i A_ri (elements of the A matrix)
b
Number of non zero elements of the B vector
r b_r  (elements of the b vector)
D
Number of non zero elements of the D matrix
s i D_si (elements of the D matrix)
e
Number of non zero elements of the e vector
s e_s (elements of the e vector)
```

Remarks :

1. Each index start from 0.
2. Each non-zero term of the matrix Q has to be written in the file. If the matrix is not a symetric matrix, the software transform Q into a symetric matrix Q' such that $Q' = (Q + Q^T)/2$.
3. If the instance is an instance of binary quadratic programming, it is sufficient to put each u_i equals 1.
4. If there is no real variable, it is sufficient to put nb_int equals n.
5. If there is not equality or inequality constraints do not put the corresponding lines in the instance file.

Examples :

1. Example of an instance of (QP) :
   Let (QP_e) be an instance of (QP) with 4 integer variables, 1 equality constraint and 1 in-

equality constraint :

$$(QP_e)\begin{cases} Min & f(x) = x^T \begin{pmatrix} 5 & -7 & -6 & -1 \\ -7 & 3 & -8 & -18 \\ -6 & -8 & -17 & 10 \\ -1 & -18 & 10 & 3 \end{pmatrix} x + \begin{pmatrix} -5 \\ -11 \\ 4 \\ 1 \end{pmatrix} x \\ s.c. & 3x_1 + 19x_2 + 18x_3 + 11x_4 = 255 \\ & 11x_1 + 13x_2 + 8x_3 + x_4 \leq 165 \\ & 0 \leq x_i \leq 10 & i \in \{1, \ldots, 4\} \\ & x_i \in \mathbb{N} & i \in \{1, \ldots, 4\} \end{cases}$$

The file format is the following :

```
4 4 1 1
u
10 10 10 10
Q
16
0 0 5.000000
0 1 -7.000000
0 2 -6.000000
0 3 -1.000000
1 0 -7.000000
1 1 3.000000
1 2 -8.000000
1 3 -18.000000
2 0 -6.000000
2 1 -8.000000
2 2 -17.000000
2 3 10.000000
3 0 -1.000000
3 1 -18.000000
3 2 10.000000
3 3 3.000000
c
4
0 -5.000000
1 -11.000000
2 4.000000
3 1.000000
A
4
0 0 3.000000
0 1 19.000000
0 2 18.000000
0 3 11.000000
b
1
```

```
0 255.000000
D
4
0 0 11.000000
0 1 13.000000
0 2 8.000000
0 3 1.000000
e
1
0 165.000000
```

2. Example of an instance of (MQP) :
   Let (MQP_e) be an instance of (MQP) with 2 integer, 2 continuous variables, and 1 equality constraint :

$$(MQP_e)\begin{cases} Min & f(x) = x^T \left(\begin{array}{cc|cc} -7 & 3 & -15 & -4 \\ 3 & -14 & -7 & -13 \\ \hline -15 & -7 & 8 & 7 \\ -4 & -13 & 7 & 12 \end{array}\right) x + \begin{pmatrix} 15 \\ 10 \\ -7 \\ -4 \end{pmatrix} x \\ s.t & 5x_1 + x_2 + 8x_3 + 4x_4 = 95 \\ & 0 \leq x_i \leq 10 \qquad\qquad i \in \{1, \ldots, 4\} \\ & x_1, x_2 \in \mathbb{N} \\ & x_3, x_4 \in \mathbb{R} \end{cases}$$

   Observe that the sub-matrix $\begin{pmatrix} 8 & 7 \\ 7 & 12 \end{pmatrix}$ is positive semi-definite.
   The file format is the following :

```
4 2 1 0
u
10 10 10 10
Q
16
0 0 -7
0 1 3
0 2 -15
0 3-4
1 0 3
1 1 -14
1 2 -7
1 3 -13
2 0 -15
2 1 -7
2 2 8
2 3 7
3 0 -4
3 1 -13
3 2 7
```

```
3 3 12
c
4
0 15
1 10
2 -7
3 -4
A
4
0 0 5
0 1 1
0 2 8
0 3 4
b
1
0 95
```