Supplementary Material

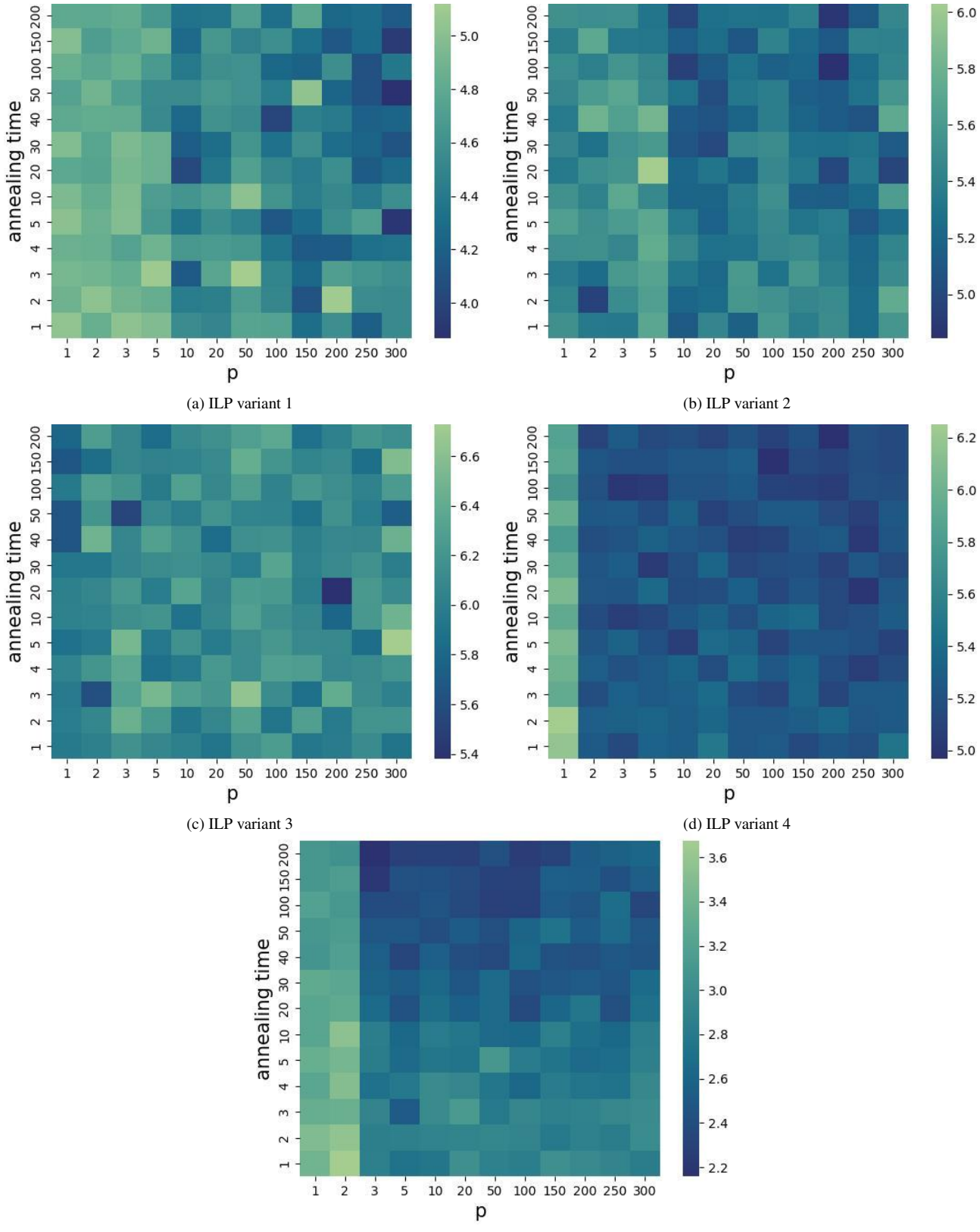
1 SUPPLEMENTARY TABLES AND FIGURES

1.1 Tables

Table S1. Definition of various trivial integer linear programs for benchmarking and solutions obtainable by classical solver.

ILP variant	$\mathbf{A}$	$\mathbf{b}$	$\mathbf{c}$	bits to represent values in $\mathbf{x}$	bits to represent values in $\mathbf{s}$	solution	cost value
1	$\begin{bmatrix} -1/3 & -1 \\ -3 & -1 \\ 0 & 1 \end{bmatrix}$	$\begin{bmatrix} -2 \\ -6 \\ 2 \end{bmatrix}$	$\begin{bmatrix} 1 \\ 3 \end{bmatrix}$	2	3	$\begin{bmatrix} 3 \\ 1 \end{bmatrix}$	6
2	$\begin{bmatrix} -2 & -2 \\ -1 & -4 \\ 1 & 0 \end{bmatrix}$	$\begin{bmatrix} -3 \\ -5 \\ 2 \end{bmatrix}$	$\begin{bmatrix} 2 \\ 1 \end{bmatrix}$	2	3	$\begin{bmatrix} 0 \\ 2 \end{bmatrix}$	2
3	$\begin{bmatrix} -2 & -2 \\ -3 & -4 \\ 1 & -1 \end{bmatrix}$	$\begin{bmatrix} -1 \\ -6 \\ 0 \end{bmatrix}$	$\begin{bmatrix} 1 \\ 2 \end{bmatrix}$	2	3	$\begin{bmatrix} 1 \\ 1 \end{bmatrix}$	3
4	$\begin{bmatrix} -1 & -2 & -3 \\ -3 & -4 & -1 \\ -1 & -1 & 0 \end{bmatrix}$	$\begin{bmatrix} -5 \\ -5 \\ -3 \end{bmatrix}$	$\begin{bmatrix} 1 \\ 2 \\ 1 \end{bmatrix}$	2	3	$\begin{bmatrix} 3 \\ 0 \\ 1 \end{bmatrix}$	4
5	$\begin{bmatrix} -1/3 & -1 \\ -3 & -1 \\ -1 & 1 \end{bmatrix}$	$\begin{bmatrix} 2 \\ 6 \\ 0 \end{bmatrix}$	$\begin{bmatrix} 3 \\ -3 \end{bmatrix}$	2	3	$\begin{bmatrix} 0 \\ 0 \end{bmatrix}$	0

1.2 Figures



(a) ILP variant 1

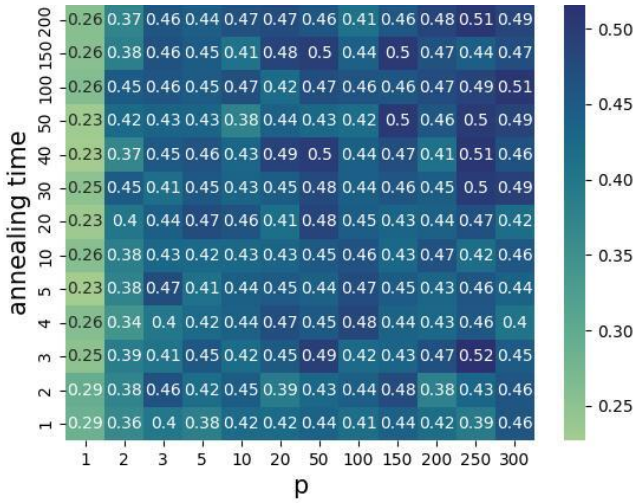
(b) ILP variant 2

(c) ILP variant 3

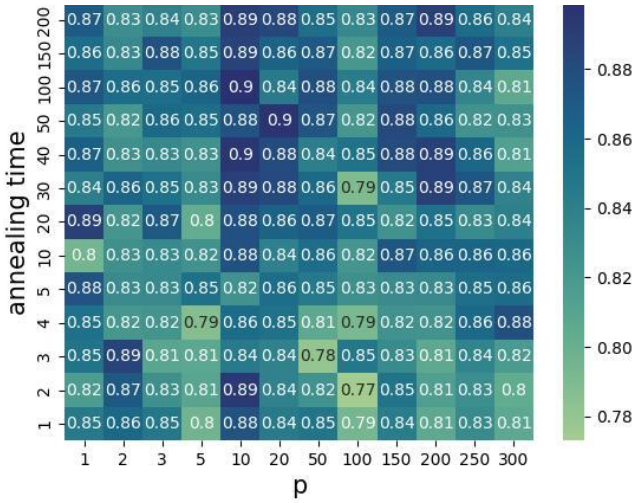
(d) ILP variant 4

(e) ILP variant 5

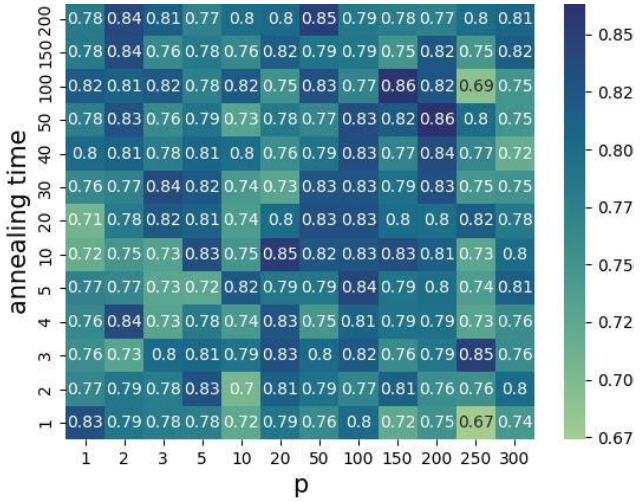
Figure S1: Average values of the Hamming distances between the best known solution and solutions obtained by the D-Wave Advantage™ quantum annealer for various trivial ILP problems that are defined according to Table S1. Varied parameters are the QUBO-specific penalty p and the annealing time.



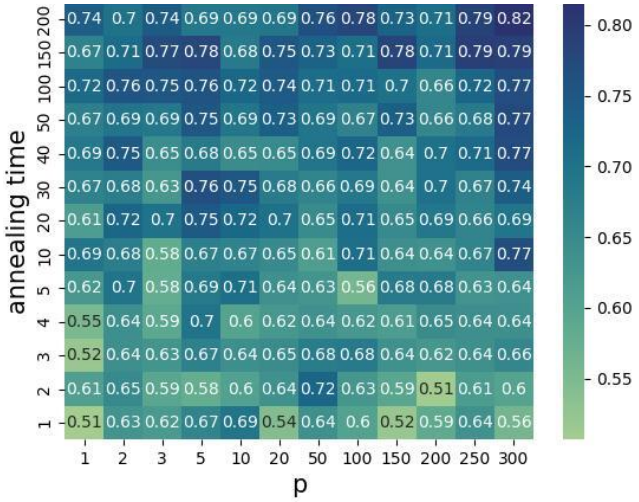
(a) ILP variant 1



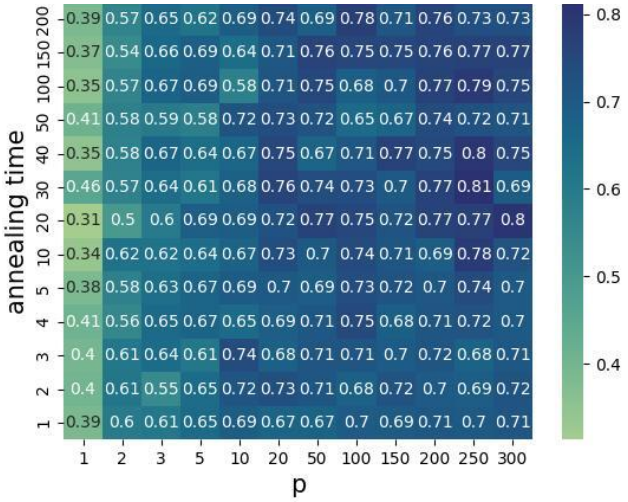
(b) ILP variant 2



(c) ILP variant 3

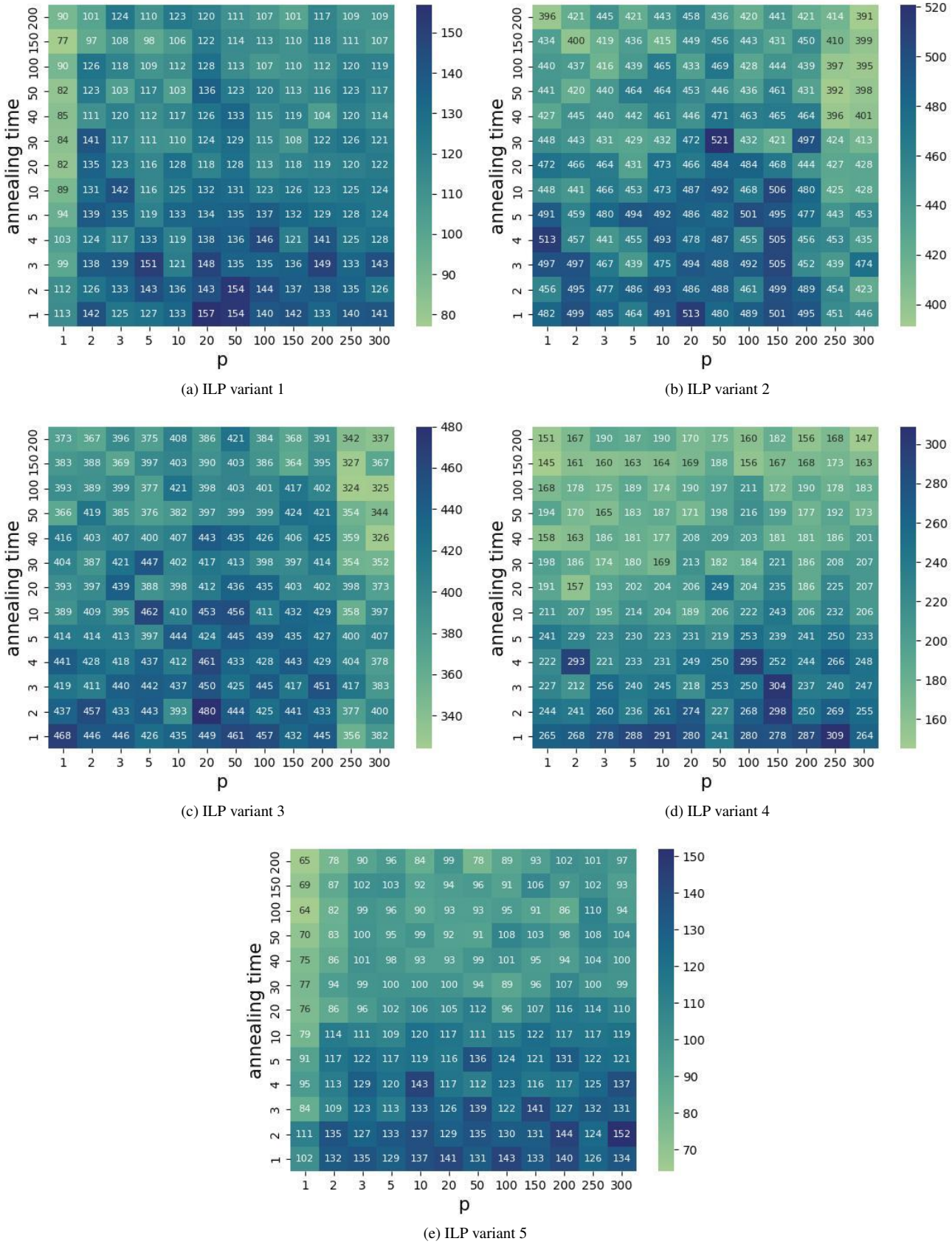


(d) ILP variant 4



(e) ILP variant 5

Figure S2: Rate of feasible solutions obtained by the D-Wave Advantage™ quantum annealer for various trivial ILP problems that are defined according to Table S1. Varied parameters are the QUBO-specific penalty p and the annealing time.



(a) ILP variant 1

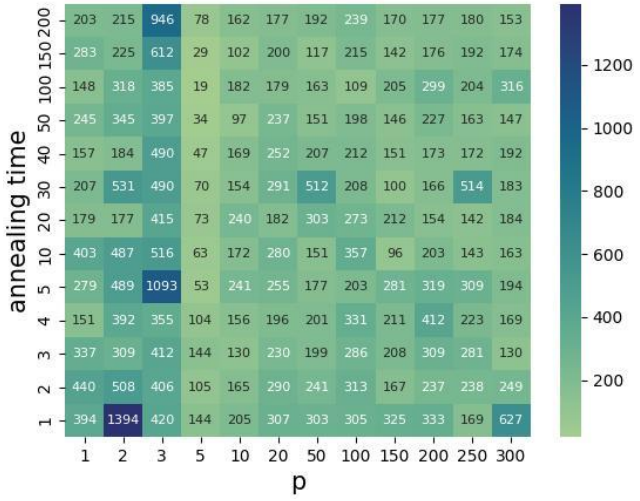
(b) ILP variant 2

(c) ILP variant 3

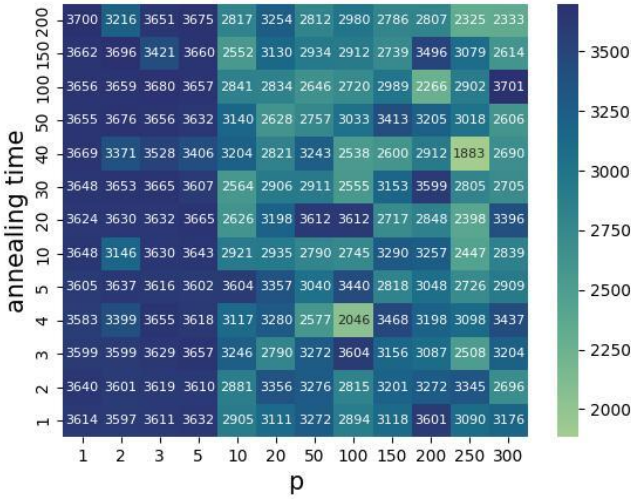
(d) ILP variant 4

(e) ILP variant 5

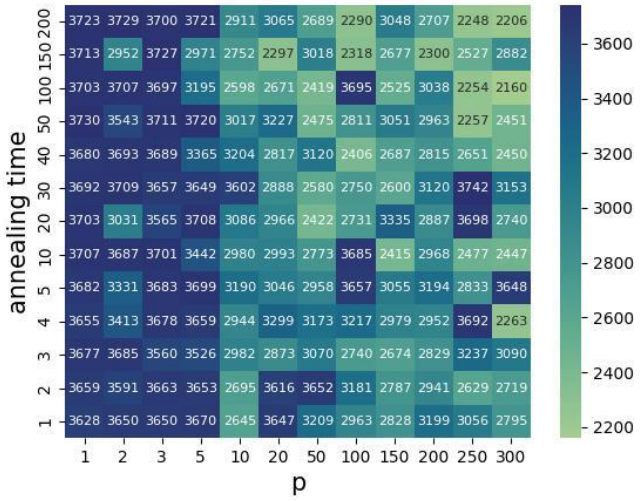
Figure S3: Amount of individual feasible solutions obtained by the D-Wave Advantage™ quantum annealer for various trivial ILP problems that are defined according to Table S1. Varied parameters are the QUBO-specific penalty p and the annealing time.



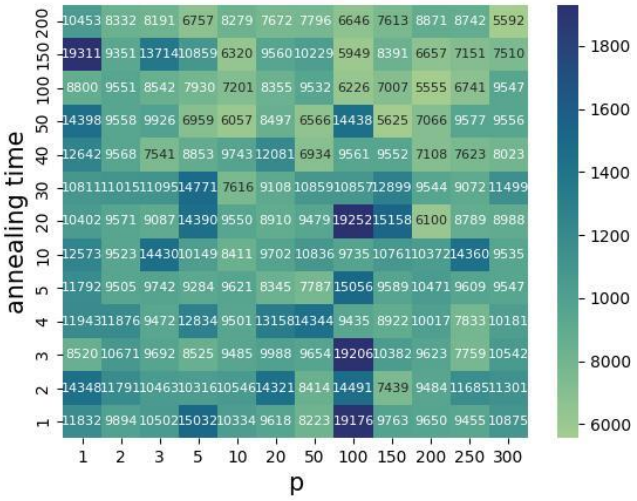
(a) ILP variant 1



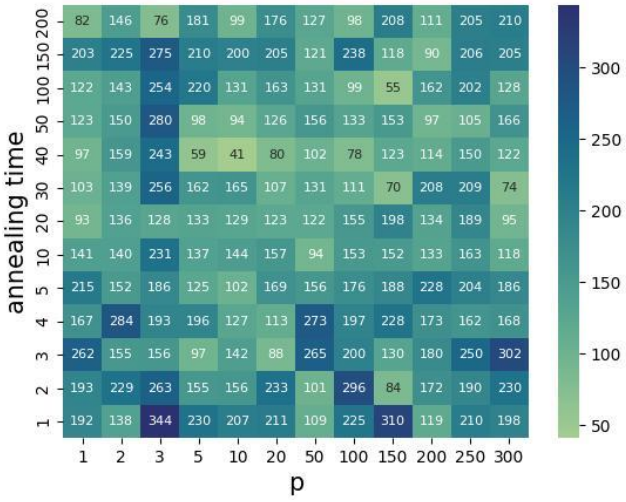
(b) ILP variant 2



(c) ILP variant 3

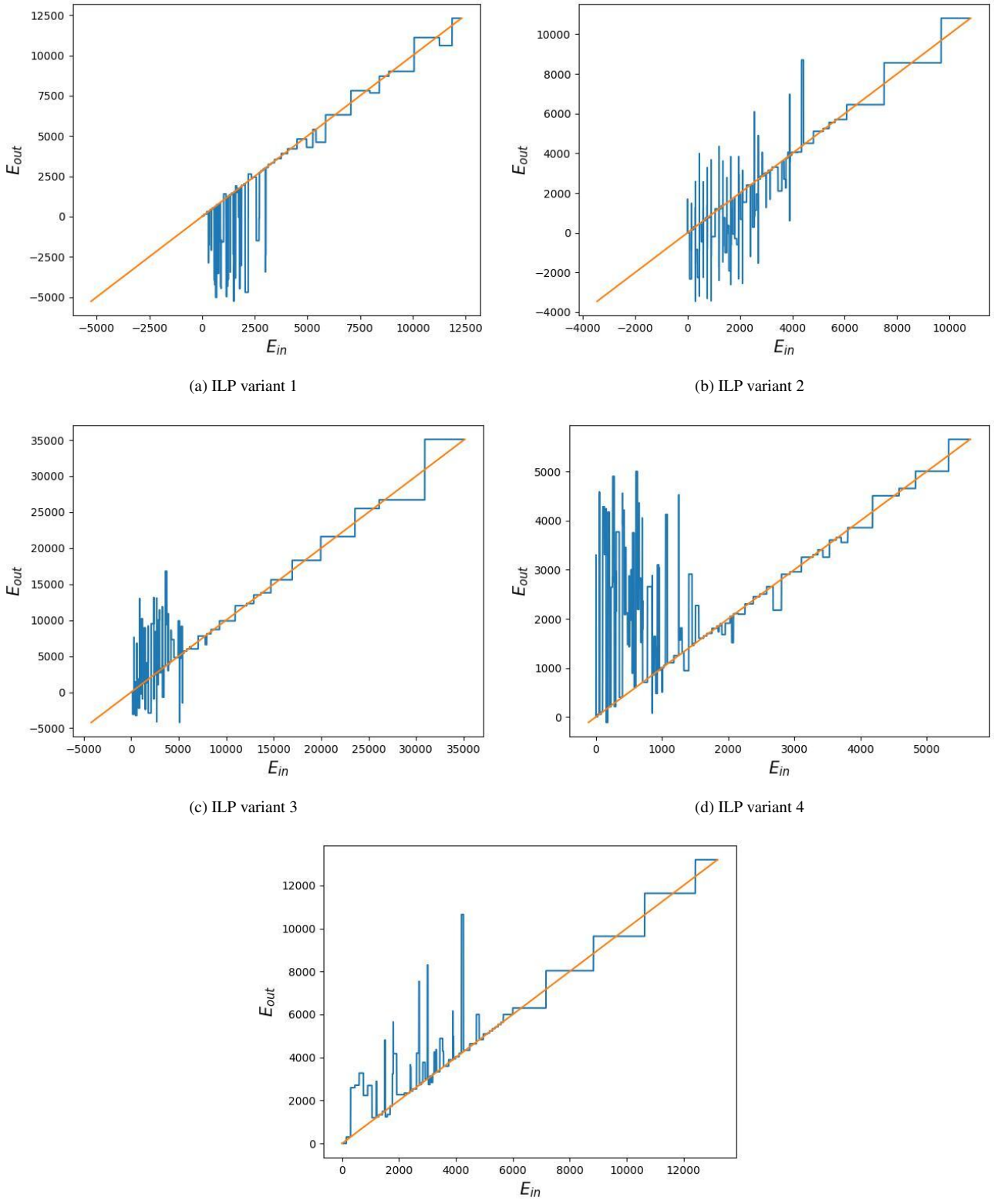


(d) ILP variant 4



(e) ILP variant 5

Figure S4: Amount of new feasible solutions obtained by a neural network based on the decision tree method. Results are shown for various trivial ILP problems that are defined according to Table S1. Varied parameters are the QUBO-specific penalty p and the annealing time.



(a) ILP variant 1

(b) ILP variant 2

(c) ILP variant 3

(d) ILP variant 4

(e) ILP variant 5

Figure S5: Coincidence of energy values for input and output samples obtained by the decision tree method. Results are shown for various trivial ILP problems that are defined according to Table S1.