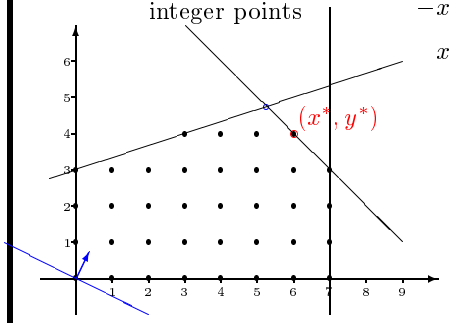
A linear integer model

$$
\begin{array}{lrcrcll}
\text{maximize} & x & + & 2y & & & \\
\text{subject to} & x & + & y & \leq & 10 & (1) \\
& -x & + & 3y & \leq & 9 & (2) \\
& x & & & \leq & 7 & (3) \\
& & & x, y & \geq & 0 & (4, 5) \\
& & & x, y & & \text{integer} &
\end{array}
$$

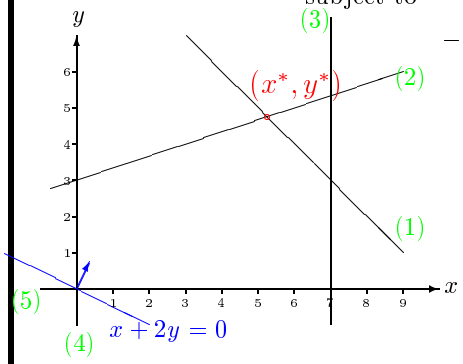
• = feasible integer points



$$(x^*, y^*) = \begin{pmatrix} 6 \\ 4 \end{pmatrix}$$

A linear continuous optimization model

$$
\begin{array}{lrcrcll}
\text{maximize} & x & + & 2y & & & \\
\text{subject to} & x & + & y & \leq & 10 & (1) \\
& -x & + & 3y & \leq & 9 & (2) \\
& x & & & \leq & 7 & (3) \\
& & & x, y & \geq & 0 & (4, 5)
\end{array}
$$



$$(x^*, y^*) = \begin{pmatrix} 5\frac{1}{4} \\ 4\frac{3}{4} \end{pmatrix}$$

In the worst case...

⇒ E.g. 50 integer variables: $x_0, \ldots, x_{49}$

⇒ $2^{50} \approx 10^{15}$ branches

- Solve one continuous problem in 10^{-6} seconds ⇒ 10^9seconds ≈ 30 years (10^{-9} seconds ⇒ ≈ 1.5 weeks)

Standard algorithm (in e.g. Cplex or Xpress-MP)

Relax integrality requirements ⇒
linear, continuous problem ⇒ $(x^*, y^*) = (5\frac{1}{4}, 4\frac{3}{4})$

Search tree: branch over fractional variable values