Toolbox

1. *Given:* an unrestricted variable x
   Want: only non-negative variables
   Solution: replace x by $x^+ - x^-$ *s.t.* $x^+, x^- \geq 0$

2. *Given:* a constraint of type $|c^t x| \leq b$
   Want: get rid of the absolute value
   Solution: replace $|c^t x| \leq b$ by $c^t x \leq b$, $c^t x \geq -b$ or $c^t x \leq b$, $-c^t x \leq b$

   Note: If the starting constraint looks like $|c^t x| \geq b$, then this cannot be transformed into an LP-type problem. (Intuition for this: in a linear program the constraints are interpreted in an "and"-fashion, for $|c^t x| \geq b$ we would need an "or"-type of constraints.)

3. *Given:* a constraint of type $c^t x \leq b$
   Want: replace "$\leq$" by a "$=$"
   Solution: replace $c^t x \leq b$ by $c^t x + y = b$ *s.t.* $y \geq 0$

4. *Given:* a constraint of type $c^t x = b$
   Want: replace "$=$" by a "$\leq$"
   Solution: replace $c^t x = b$ by $c^t x \leq b$, $c^t x \geq b$ or $c^t x \leq b$, $-c^t x \leq -b$

5. *Given:* an objective of type min $c^t x$
   Want: "max" instead of "min"
   Solution: replace min $c^t x$ by max $-c^t x$

6. *Given:* an objective of type min $|c^t x|$
   Want: get rid of the absolute value
   Solution: replace min $|c^t x|$ by min y *s.t.* $y \geq c^t x$, $y \geq -c^t x$

   Note: For similar reasons as above, there is no way to transform max $|c^t x|$ into an LP-type problem.