Rules for writing duals for a generic LP.

Primal Problem:

$$
\begin{array}{lll}
 & Min_{\ x} & d_1^\top x_1 + d_2^\top x_2 + d_3^\top x_3 \\
 & & \\
(P) & & \begin{array}{lcll}
A_1x_1 + A_2x_2 + A_3x_3 & \overset{(1)}{\geq} & a & \mid y_1 \\
B_1x_1 + B_2x_2 + B_3x_3 & = & b & \mid y_2 \\
C_1x_1 + C_2x_2 + C_3x_3 & \overset{(2)}{\leq} & c & \mid y_3 \\
x_1 \geq 0;\ x_2 \leq 0;\ x_3\ free & & &
\end{array}
\end{array}
$$

$$\Downarrow$$

$$
\begin{array}{lll}
 & Max_{\ y} & a^\top y_1 + b^\top y_2 + c^\top y_3 \\
 & & \\
(D) & & \begin{array}{lcll}
A_1^\top y_1 + B_1^\top y_2 + C_1^\top y_3 & \leq & d_1 & \leftarrow -x_1 (x_1 \geq 0) \\
A_2^\top y_1 + B_2^\top y_2 + C_2^\top y_3 & \geq & d_2 & \leftarrow -x_2 (x_2 \leq 0) \\
A_3^\top y_1 + B_3^\top y_2 + C_3^\top y_3 & = & d_3 & \leftarrow -x_3\ free \\
y_1 \overset{(1)}{\geq} 0;\ y_3 \overset{(2)}{\leq} 0;\ y_2\ free & & &
\end{array}
\end{array}
$$

Putting in Standard Form (P) and (D)

$$
\begin{pmatrix}
A_1 & -A_2 & A_3 & -A_3 & -I_a & 0 \\
B_1 & -B_2 & B_3 & -B_3 & 0 & 0 \\
C_1 & -C_2 & C_3 & -C_3 & 0 & I_c
\end{pmatrix}
\begin{pmatrix}
x_1 \\ x_2' \\ x_3^+ \\ x_3^- \\ \sigma_a \\ \sigma_c
\end{pmatrix}
=
\begin{pmatrix}
a \\ b \\ c
\end{pmatrix}
$$

$$x_1,\ x_2',\ x_3^+,\ x_3^-,\ \sigma_a,\ \sigma_c\ \geq 0; \quad (x_2' = -x_2)$$

$$\Downarrow$$

$$
\begin{pmatrix}
A_1^\top & B_1^\top & C_1^\top \\
-A_2^\top & -B_2 v & -C_2^\top \\
A_3^\top & B_3^\top & C_3^\top \\
-A_3^\top & -B_3^\top & C_3^\top \\
-I_a & 0 & 0 \\
0 & 0 & I_c
\end{pmatrix}
\begin{pmatrix}
y_1 \\ y_2 \\ y_3
\end{pmatrix}
\leq
\begin{pmatrix}
d_1 \\ -d_2 \\ d_3 \\ -d_3 \\ 0 \\ 0
\end{pmatrix}
$$