Bonus problem for Wednesday, 2/27. 5 bonus points on Test 2. To receive bonus credit you must HAND IN the problems written up by the beginning of class on Wednesday.

In class, we have been working with the following LP.

\[
\begin{align*}
\text{max} & \quad 10x_1 + 8x_2 + 4x_3 + x_4 & \quad \text{(value)} \\
\text{s.t.} & \quad 7x_1 + 5x_2 + 5x_3 + 2x_4 \leq 18 & \quad \text{(knapsack capacity)} \\
& \quad x_1, x_2, x_3, x_4 \geq 0
\end{align*}
\]

Recall that we have calculated

\[
x^{(3)} = \begin{pmatrix} 0 \\ 18/5 \\ 0 \\ 0 \end{pmatrix}
\]

and were considering the directions:

\[
\begin{align*}
\hat{d}^{(1)} & = \begin{pmatrix} 1 \\ \hat{d}_2^{(1)} \\ 0 \\ 0 \end{pmatrix} \\
\hat{d}^{(3)} & = \begin{pmatrix} 0 \\ \hat{d}_2^{(3)} \\ 1 \\ 0 \end{pmatrix} \\
\hat{d}^{(4)} & = \begin{pmatrix} 0 \\ \hat{d}_2^{(4)} \\ 0 \\ 1 \end{pmatrix}
\end{align*}
\]

We calculated in class that \(\hat{d}_2^{(1)} = -7/5\) so

\[
\hat{d}^{(1)} = \begin{pmatrix} 1 \\ -7/5 \\ 0 \\ 0 \end{pmatrix}
\]

and were use the directional derivative of the objective in this direction to determine that \(\hat{d}^{(1)}\) was not improving.

**To receive bonus credit:**

1. Calculate \(\hat{d}^{(3)}\) and \(\hat{d}^{(4)}\).
2. Determine whether \(\hat{d}^{(3)}\) and \(\hat{d}^{(4)}\) are improving or not.

You must show all your calculations.