Linear Programming – A First Example

- One kg of **gadgets**
  - requires **1 hour** of work, **1 unit** of wood, and **2 units** of metal
  - yields a **net profit of $5**
- One kg of **gewgaws**
  - requires **2 hours** of work, **1 unit** of wood, and **1 unit** of metal
  - yields a **net profit of $4**
- The company has **120 hours** of work, **70 units** of wood, and **100 units** of metal available

x_1 := amount of gadgets

x_2 := amount of gewgaws

$$
\begin{aligned}
\max z &= 5x_1 + 4x_2 && \text{maximize profit} \\
\text{s.t. } x_1 + 2x_2 &\le 120 && \text{work hours constraint} \\
x_1 + x_2 &\le 70 && \text{wood constraint} \\
2x_1 + x_2 &\le 100 && \text{metal constraint} \\
x_1, x_2 &\ge 0
\end{aligned}
$$

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\text{s.t.}\ \ x_1 + 2x_2 &\le 120 \\
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2x_1 + x_2 &\le 100 \\
x_1, x_2 &\ge 0
\end{aligned}
$$

maximize profit

work hours constraint

wood constraint

metal constraint

c^T

x

A

b

$$
\begin{aligned}
\max & \begin{bmatrix} 5 & 4 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} \\
\text{s.t.} & \begin{bmatrix} 1 & 2 \\ 1 & 1 \\ 2 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} \le \begin{bmatrix} 120 \\ 70 \\ 100 \end{bmatrix} \\
& \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} \ge \begin{bmatrix} 0 \\ 0 \end{bmatrix}
\end{aligned}
$$

$$
\begin{aligned}
\max\ & c^T x \\
\text{s.t.}\ \ & Ax \le b \\
& x \ge O
\end{aligned}
$$