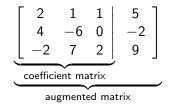## Linear Systems and Matrices

Our goal here is to solve linear systems (algebraic equations, differential equations, etc.)

Example:

$$
\begin{array}{rcr}
2u + v + w & = & 5 \\
4u - 6v + 0w & = & -2 \\
-2u + 7v + 2w & = & 9
\end{array}
$$

Equivalent matrix notation:

$$
\underbrace{\underbrace{\left[\begin{array}{rrr} 2 & 1 & 1 \\ 4 & -6 & 0 \\ -2 & 7 & 2 \end{array}\right.}_{\text{coefficient matrix}} \left|\begin{array}{r} 5 \\ -2 \\ 9 \end{array}\right]}_{\text{augmented matrix}}
$$

We solve this linear system by transforming it to a new, simpler, linear system **with the same solutions**.