Simultaneous equations can be solved at once using a matrix to represent those simultaneous equations, a solution, and the result of that solution — expressing those components in a singular expression and then manipulating that expression with the matrix inverse which in turn will produce an equation equating the numerical values of the solution.

$A^{-1}A = I$, where I is the identity matrix

Suppose A is an invertible matrix - then the numerical solution to A can be found,

$$Ax = y$$
$$A^{-1}Ax = A^{-1}y$$
$$Ix = A^{-1}y$$
$$x = A^{-1}y$$

This approach can be algebraically by changing the matrix into a reduced-row-echelon-form and using backpropogation to form a diagonal matrix.

<u>Matrix</u>

$$A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 2 & 4 \\ 1 & 1 & 2 \end{bmatrix}$$

<u>Reduced Row Echelon Form</u>

$A \Leftrightarrow \begin{bmatrix} 1 & 1 & 3 \\ 0 & 1 & 1 \\ 1 & 1 & 2 \end{bmatrix}$, subtract row#1 from row#2

$\Leftrightarrow \begin{bmatrix} 1 & 1 & 3 \\ 0 & 1 & 1 \\ 0 & 0 & -1 \end{bmatrix}$, subtract row#1 from row#3.

- Apply the same ops to y.

<u>Backpropogation.</u>

$$\begin{bmatrix} 1 & 1 & 3 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix}\begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} 15 \\ 6 \\ 2 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & 3 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}\begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} 15 \\ 4 \\ 2 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}\begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} 5 \\ 4 \\ 2 \end{bmatrix}.$$

□.