What sizes of matrix can you add? When can't you add matrices?

Matrices of the same dimensions (because we do it element wise). Maybe you can add a vector to a matrix if the number of rows is equal to the dimensionality of the vector.

What sizes of matrix can you multiply? When can't you multiply matrices?

Multiply: $N \times M$ * $M \times K$ => $N \times K$.

Multiply

$$\begin{bmatrix} 3 & 0 \\ 0 & 1 \end{bmatrix}, \begin{bmatrix} 1 & 0 \\ 0 & -2 \end{bmatrix}, \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}, \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$$

by vectors in $\mathbb{R}^2$ (for example, you could multiply by $\begin{bmatrix} 0 \\ 0 \end{bmatrix}$ or $\begin{bmatrix} 1 \\ -2 \end{bmatrix}$).

Can you characterize the transformations you get by multiplying (lots of vectors) by each of these matrices?

Action	Matrix
Identity	$\begin{bmatrix} 1 \\ 1 \end{bmatrix}$
Select left column	$\begin{bmatrix} 1 \\ 0 \end{bmatrix}$
Select right column	$\begin{bmatrix} 0 \\ 1 \end{bmatrix}$
Treat as expression (linear combination/transformation?)*	$\begin{bmatrix} a \\ b \end{bmatrix}$

*I'm not sure what linear combinations/transformations are, but I think this is somehow related? Anyways, it takes each row i and returns $\sigma A_{i,j} * B_j$

Which of the number systems we discussed today form a group under addition? Under multiplication?

Source: [[KBe]]-2020math520-flo-groups

Number System	Multiplication	Addition
Natural Numbers	No inverse	No identity
Whole Numbers	No inverse	No inverse
Integers	No inverse	Yes
Rationals	Yes	Yes
Reals	Yes	Yes
Complex Numbers	Yes	Yes