- Addition
  - Two matrices *A* and *B* must have the same dimensions
  - Add the individual elements of the matrix
  - $A+B=\begin{pmatrix} a_{11}+b_{11} & a_{12}+b_{12} & \cdots & a_{1n}+b_{1n} \\ a_{21}+b_{21} & a_{22}+b_{22} & \cdots & a_{2n}+b_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1}+b_{m1} & a_{m2}+b_{m2} & \cdots & a_{mn}+b_{mn} \end{pmatrix}$
- Multiplication
  - Scalar: multiply each element of the matrix by the scalar quantity
    - $cA=\begin{pmatrix} ca_{11} & ca_{12} & \cdots & ca_{1n} \\ ca_{21} & ca_{22} & \cdots & ca_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ ca_{m1} & ca_{m2} & \cdots & ca_{mn} \end{pmatrix}$
  - Matrix or vector multiplication
    - In order for a matrix *A* and *B* to be multiplied, the number of columns of *A* must equal the numbers of rows of *B*.
    - Each entry of *AB* at position (i, j) is the dot product of the *i*th row vector of *A* and the *j*th column vector of *B*.
      - i.e. $AB_{ij}=\vec{a}_i\cdot\vec{b}_j$
      - *AB* will have the dimensions of the number of rows of *A* by the number of columns of *B*.
    - Example: Let $A=\begin{pmatrix} 2 & 5 \\ -1 & 3 \\ 4 & 2 \end{pmatrix}$ and $B=\begin{pmatrix} 3 \\ -2 \end{pmatrix}$. $AB=\begin{pmatrix} -4 \\ -9 \\ 8 \end{pmatrix}$
    - The best way to not screw up is to write your product matrix in the middle with *A* on the left and *B* on top.
    - $AB\neq BA$ (matrix multiplication is not commutative).
- **Inverse Matrix**
  - The inverse matrix A^{-1} is the matrix such that $AA^{-1}=A^{-1}A=I$.
- **Transposition**
  - The transposed matrix A^T is the matrix such that the matrix has been "reflected" across its diagonal.
  - If $A=\begin{pmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{pmatrix}$, then $A^T=\begin{pmatrix} a_{11} & a_{21} & \cdots & a_{m1} \\ a_{12} & a_{22} & \cdots & a_{m2} \\ \vdots & \vdots & \ddots & \vdots \\ a_{1n} & a_{2n} & \cdots & a_{mn} \end{pmatrix}$
  - If *A* is an $m\times n$ matrix, then A^T is an $n\times m$ matrix.