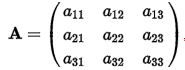
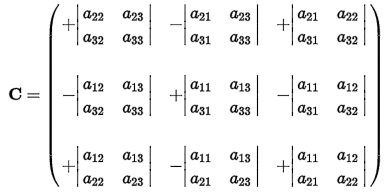
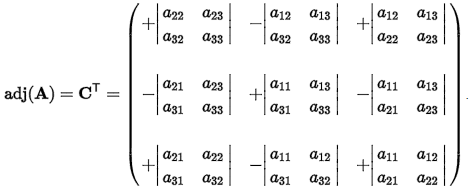
1. **Matrix Arithmetic**
   1. Adding (2 matrix must have same size)
   2. Multiplying
      1. By a scalar
      2. By a matrix (dot product of rows in left hand side matrix and the columns in right hand side matrix)
2. **Matrix Invertibility**
   1. If AB = I (the identity matrix), we say
      1. A is left inverse of B
      2. B is right inverse of A
   2. If AB = I and BA = I, we say A is invertible and write
   3. If A is invertible, it has a unique inverse
   4. If M & N are invertible matrices, then MN is also invertible. That means:
   5. Example:
3. **Matrix Elementary Row Operations:**
   1. Swapping 2 rows
   2. Add multiple of 1 row to another
   3. Multiplying one row with a scalar
4. **Elementary Matrix**
   1. An elementary matrix is obtained by performing a single elementary row operation to the identity matrix
   2. Every elementary matrix is invertible, and its inverse is an elementary matrix
   3. If E is an elementary matrix and EA is defined, then EA is the matrix defined by applying E’s operation to A.
   4. Example:
5. **LU Factorizations**
   1. When a square matrix A can be **brought to echelon form without any row interchanges**, then there are matrices L and U for which A=LU, L is a lower triangular square matrix with 1’s on the diagonal, U is an echelon matrix.
   2. Example:
6. **Matrix Determinants**
   1. Determinant of a matrix A (Using cofactor expansion across the first row) is defined as following:
   2. Example:
   3. Note:
      1. Row interchange: change the determinant sign
      2. Add multiple of one row to another: determinant is not changed
      3. Multiply row by a constant: multiply determinant by that constant
      4. Some properties:
      5. When a matrix be reduced to echelon form (not reduced echelon form), the determinant of that matrix is the product of the diagonal of the echelon matrix.
      6. The determinant of an upper or lower triangular matrix is the product of the diagonal of that matrix
      7. A matrix is invertible if and only if the determinant of that matrix
7. **Matrix Transposition**
   1. ;
   2. Some properties:
      1. is called adjugate (or adjoint, adjunct) matrix of A. It is the transpose of the cofactor matrix of A







1. **Eigenvalue & Eigen Vector**
   1. Given a matrix , an eigenvector for a matrix is a vector with property for some scalar for which for some
   2. That means, if:
   3. If is an eigenvalue of A, then all eigenvectors associated with are the vectors in null space of
   4. We define the characteristic polynomial as following:
      1. Eigenvalues:
      2. Algebraic multipliers:
      3. Geometric multipliers (Dimensions of eigenspaces):
      4. Note:
   5. We also have:
      1. Product of eigenvalues equals determinant of matrix
2. Sum of the eigenvalues = Trace of matrix
   1. Example:
3. Finally, we have:
4. **Similarity**
   1. Theorem: We say and are similar if there is an invertible matrix for which
   2. Theorem: If are similar, then and
5. **Diagonalizability**
6. We say is diagonalizable if is similar to a diagonal matrix
7. Theorem: is diagonalizable if and only if has a basis consisting of eigenvectors of. In fact, if are linear independent eigenvectors, then diagonalizes A.
8. Example: