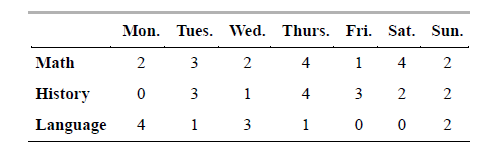
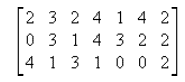
**1.4 Matrices and Matrix Operations**

Rectangular arrays of real numbers arise in contexts other than as augmented matrices for linear systems. In this section we will begin to study matrices as objects in their own right by defining operations of addition, subtraction, and multiplication on them (not on their rows).

The following rectangular array with three rows and seven columns might describe the number of hours that a student spent studying three subjects during a certain week:

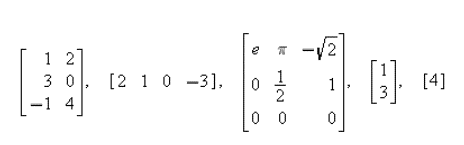


If we suppress the headings, then we are left with the following rectangular array of numbers with three rows and seven columns, called a “matrix”:

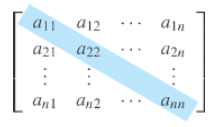


**Definition:** *A* ***matrix*** *is a rectangular array of numbers. The numbers in the array are called the* ***entries*** *in the matrix.*

Examples:



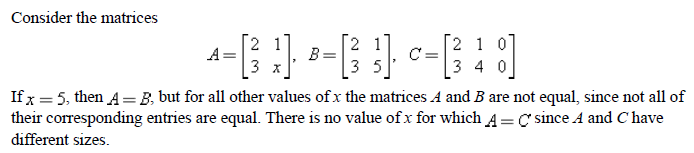
**Note:** *A matrix with only one column is called a* ***column vector*** *or a* ***column matrix****, and a matrix with only**one row is called a* ***row vector*** *or a* ***row matrix****.*



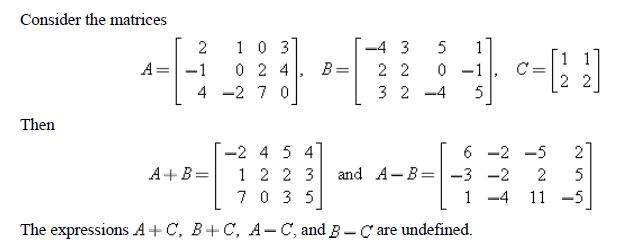
A matrix A with n rows and n columns is called a square matrix of order n, and the shaded entries are said to be on the main diagonal of A.

**Matrix Operations**

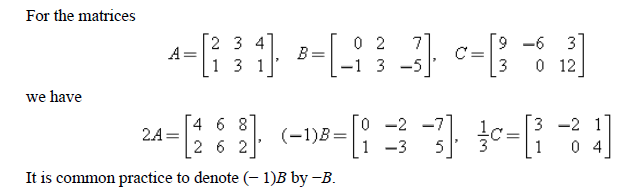
1. Two matrices are defined to be equal if they have the same size and their corresponding entries are equal.



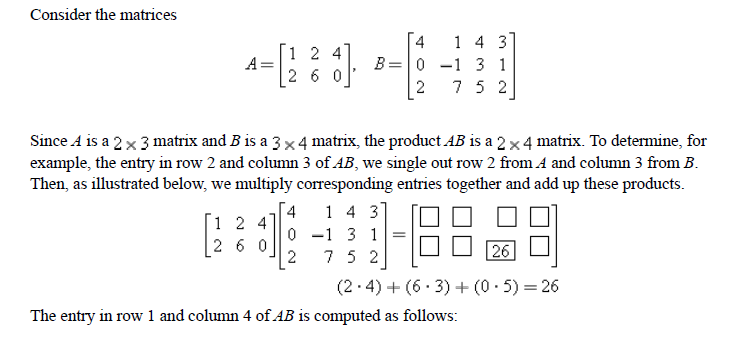
1. If A and B are matrices of the same size, then the sum A+B is the matrix obtained by adding the entries of B to the corresponding entries of A, and the difference A – B is the matrix obtained by subtracting the entries of B from the corresponding entries of A. Matrices of different sizes cannot be added or subtracted.

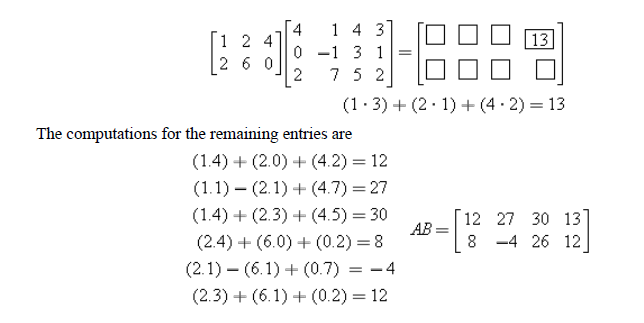


1. If A is any matrix and c is any scalar, then the product cA is the matrix obtained by multiplying each entry of the matrix A by c. The matrix cA is said to be a scalar multiple of A.

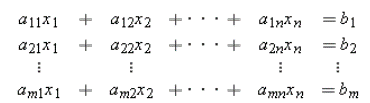


1. If A is an matrix and B is an matrix, then the product AB is the matrix whose entries are determined as follows: To find the entry in row i and column j of AB, single out row i from the matrix A and column j from the matrix B. Multiply the corresponding entries from the row and column together, and then add up the resulting products.

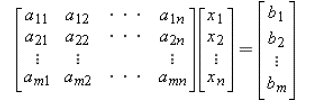


 And hence,

1. Matrix multiplication has an important application to systems of linear equations. Consider a system of m linear equations in n unknowns:

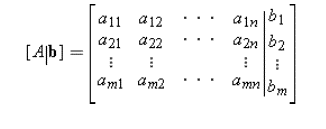


The matrix on the left side of this equation can be written as a product to give

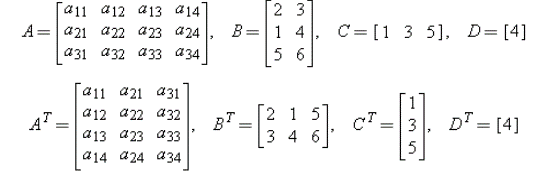


If we designate these matrices by A, **x**, and **b**, respectively, then we can replace the original system of m equations in n unknowns by the single matrix equation as

The matrix A in this equation is called the coefficient matrix of the system. The **augmented matrix** for the system is obtained by adjoining b to A as the last column; thus the augmented matrix is



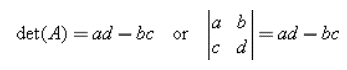
1. If *A* is any matrix, then the ***transpose of A***, denoted by , is defined to be the matrix that results by interchanging the rows and columns of *A*; that is, the first column of is the first row of *A*, the second column of is the second row of *A*, and so forth.



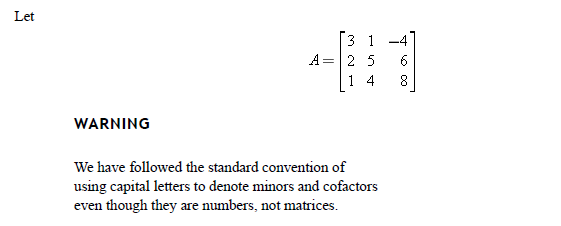
**Determinants**

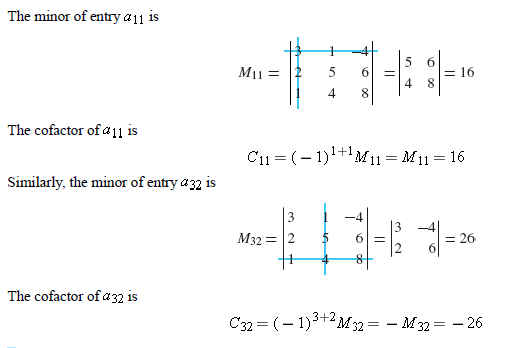
**WARNING:** It is important to keep in mind that is a number,whereas A is a matrix.

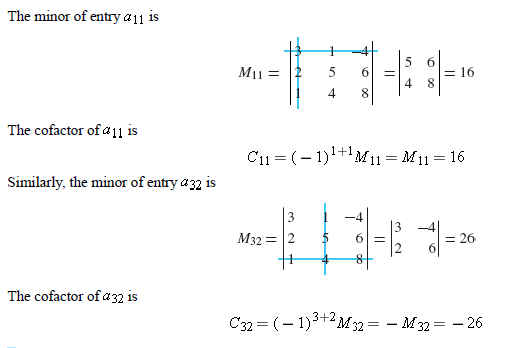
If , the expression is called the ***determinant*** of the matrix *A*. This determinant is denoted by writing



**Cofactors of a matrix**

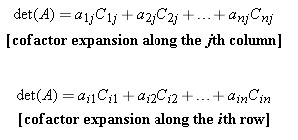




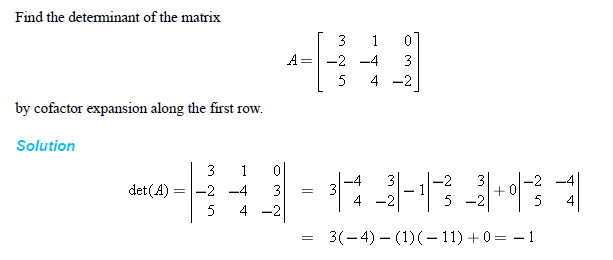


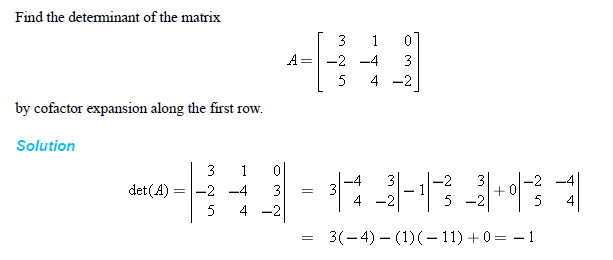
**Definition**

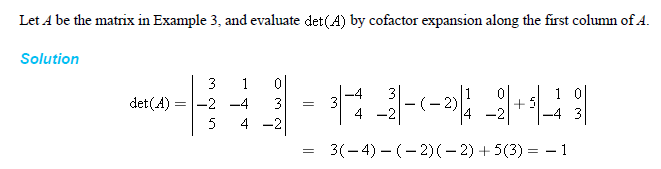
If *A* is an matrix, then the number obtained by multiplying the entries in any row or column of *A* by the corresponding cofactors and adding the resulting products is called the ***determinant of A***, and the sums themselves are called ***cofactor expansions of A***. That is:

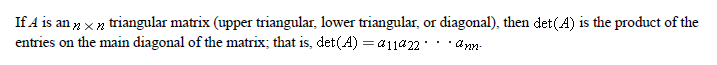


Example 3:





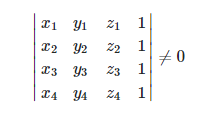


**Remark:**

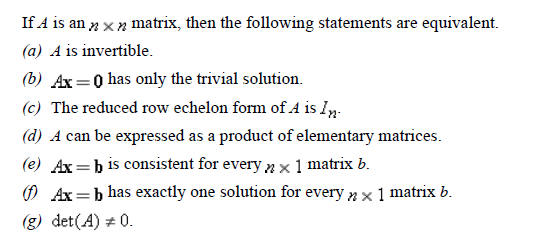
**Basic Properties of Determinants**

Suppose that *A* and *B* are matrices and *k* is any scalar. Then:

1. A square matrix *A* is invertible if and only if .
2. The points are not coplanar if and only if the determinant



**Remarks:**



**Work to do:**

Q1(a)



(b) Check whether the points and lie in the same plane or not.

Q2. For any square matrices A, B , P with P invertible, Complete the following

det = ……………… det(AB)=……………… det(PA………….

Q3. Let A and B be matrices with detA= 4 and det B = -3. Use properties of determinants to compute:

