

# 1 Lesson 13: More on matrices II

Adding rows and columns

To a matrix

$$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \\ \\ \\ \\ \\ \\ \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

or to a vector

**Exercise 1** Create the  $3 \times 3$  identity matrix (use the *Fill Matrix...Identity* command under the *Compute...Matrix* menu) and add a new row after the second. Your result should look like

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Also, copy and paste the above to a new display and add a new column after the first obtaining

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

## 1.1 Concatenation and stacking

**Example 2** *Concatenation*

$$\begin{bmatrix} -847 & -143 & 390 & 24 \\ -705 & -109 & -510 & -624 \\ -546 & -990 & -980 & 738 \end{bmatrix} \begin{bmatrix} 0 & 0 \\ 0 & 0 \\ 0 & 0 \end{bmatrix}$$

, concatenate: 
$$\begin{bmatrix} -847 & -143 & 390 & 24 & 0 & 0 \\ -705 & -109 & -510 & -624 & 0 & 0 \\ -546 & -990 & -980 & 738 & 0 & 0 \end{bmatrix}$$

**Example 3** *Stacking*

$$\begin{bmatrix} -847 & -143 & 390 & 24 \\ -705 & -109 & -510 & -624 \\ -546 & -990 & -980 & 738 \end{bmatrix} \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

$$, \text{ stack: } \begin{bmatrix} -847 & -143 & 390 & 24 \\ -705 & -109 & -510 & -624 \\ -546 & -990 & -980 & 738 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

## 1.2 Transposition

The transpose of an  $m \times n$  matrix  $(a_{i,j})$  is the  $n \times m$  matrix  $(a_{j,i})$ .

**Example 4** *The transpose of*

$$\begin{bmatrix} 610 & -355 \\ -837 & 316 \\ -869 & -733 \end{bmatrix}$$

*is the matrix*

$$\begin{bmatrix} 610 & -837 & -869 \\ -355 & 316 & -733 \end{bmatrix}$$

*Note that we could write*

$$\begin{bmatrix} 610 & -355 \\ -837 & 316 \\ -869 & -733 \end{bmatrix}^T = \begin{bmatrix} 610 & -837 & -869 \\ -355 & 316 & -733 \end{bmatrix}$$

*As the last example illustrates the transpose of a matrix  $A$  is denoted by  $A^T$ . Consequently, we could define*

$$A = \begin{bmatrix} 610 & -837 & -869 \\ -355 & 316 & -733 \end{bmatrix}$$

*so that  $A^T$*

**Exercise 5** *Compute the transpose of*

1. 
$$\begin{bmatrix} 74 & -246 & -669 & 549 \\ 808 & -297 & -514 & -555 \\ -688 & -433 & 874 & -877 \end{bmatrix}$$

2. 
$$\begin{bmatrix} 808 & -297 & -514 & -555 \end{bmatrix}$$

3. 
$$\begin{bmatrix} -669 \\ -514 \\ 874 \end{bmatrix}$$

### 1.3 Trace of a matrix

**Exercise 6** Read the information in the *SWP Help* file on the **trace** of a matrix, generate a random  $3 \times 3$  matrix, and compute its trace.

## 2 Project 13

Instructions: Create a file containing the answers to the exercises in this lesson. You do not need to include the definitions and examples. Submit a .tex version of your file to [teprice@uakron.edu](mailto:teprice@uakron.edu). The name of your files should be of the form **yourlastname12.tex**. All calculations should be done using the CAS in SWP.