

# EECS 16A HW06

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## 1 Elementary Matrices

### 1.a

#### 1.a.i

$$\mathbf{E}_1 = \begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad (1)$$

#### 1.a.ii

$$\mathbf{E}_2 = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & -5 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad (2)$$

#### 1.a.iii

$$\mathbf{E}_3 = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 3 & 0 & 1 \end{bmatrix} \quad (3)$$

#### 1.a.iv

$$\mathbf{E}_4 = \begin{bmatrix} 1 & -1 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad (4)$$

The composite of the above matrix followed by the previous problem is

$$\mathbf{E}_3\mathbf{E}_4 = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 3 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & -1 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & -1 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 3 & 0 & 1 \end{bmatrix} \quad (5)$$

## 1.b

$\mathbf{E}_1$  makes sense as the negative of  $r_1$  is moved down to  $r_4$ .  $\mathbf{E}_2$  makes sense as  $r_2$  is multiplied by 2 and its negative is moved down to  $r_3$ .  $\mathbf{E}_3$  makes sense as  $r_3$  is moved up to  $r_4$  and all of  $r_3$  is multiplied by  $-1$ . Finally,  $\mathbf{E}_4$  makes sense as  $r_4$  is multiplied by 6 and its negative is moved up to  $r_3$ , then  $-5r_4$  is moved up to  $r_1$ , before  $r_4$  is multiplied by  $-1$ .

Verifying the matrix multiplication,

$$\mathbf{E}_4\mathbf{E}_3\mathbf{E}_2\mathbf{E}_1 = \left( \begin{bmatrix} 1 & 0 & 0 & -5 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & -6 \\ 0 & 0 & 0 & -1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 1 & 1 \end{bmatrix} \right) \left( \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & -2 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ -1 & 0 & 0 & 1 \end{bmatrix} \right) \quad (6)$$

$$= \begin{bmatrix} 1 & 0 & -5 & -5 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & -7 & -6 \\ 0 & 0 & -1 & -1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & -2 & 1 & 0 \\ -1 & 0 & 0 & 1 \end{bmatrix} \quad (7)$$

$$= \begin{bmatrix} 6 & 10 & -5 & -5 \\ 0 & 1 & 0 & 0 \\ 6 & 14 & -7 & -6 \\ 1 & 2 & -1 & -1 \end{bmatrix} \quad (8)$$

Multiplying  $\mathbf{EA}$ ,

$$\mathbf{EA} = \begin{bmatrix} 6 & 10 & -5 & -5 \\ 0 & 1 & 0 & 0 \\ 6 & 14 & -7 & -6 \\ 1 & 2 & -1 & -1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & -5 & | & 15 \\ 0 & 1 & 0 & 0 & | & -7 \\ 0 & 2 & -1 & 6 & | & 3 \\ 1 & 0 & 1 & -12 & | & -5 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & | & 30 \\ 0 & 1 & 0 & 0 & | & -7 \\ 0 & 0 & 1 & 0 & | & 1 \\ 0 & 0 & 0 & 1 & | & 3 \end{bmatrix} \quad (9)$$

## 2 Homework Process and Study Group

I did this homework by myself.