

# Exercise 9:

## Foundations of Mathematical, WS24

Zichao Wei

This is **exercise** 9 for Foundations of Mathematical, WS24. Generated on 2024-11-11 with 10 problems per section.

2024-11-25

# 1. Introduction

! Practice makes perfect.

We need many exercises to master the skill of mathematical. However, it's not easy to find the exercise which just fit for you.

So, I create this repo to generate the exercise for you.

Just enjoy it!

The syntax of this document is Quarto syntax, which is a markdown-based language. It is designed to be human-readable and easy to write, while also being powerful enough to support complex document structures.

You can check the syllabus of this course in the following link: [Syllabus](#)<sup>o</sup>.

## 2. Exercise

### 2.1. Vector Arithmetic

#### 2.1.1. Addition

1. Let  $\mathbf{u} = \begin{bmatrix} 1 \\ -4 \\ -9 \end{bmatrix}$  and  $\mathbf{v} = \begin{bmatrix} 9 \\ 8 \\ 6 \end{bmatrix}$ . Compute  $\mathbf{u} + \mathbf{v}$ .
2. Let  $\mathbf{u} = \begin{bmatrix} 0 \\ 4 \\ 6 \end{bmatrix}$  and  $\mathbf{v} = \begin{bmatrix} 9 \\ 7 \\ 2 \end{bmatrix}$ . Compute  $\mathbf{u} + \mathbf{v}$ .
3. Let  $\mathbf{u} = \begin{bmatrix} 8 \\ 6 \\ 7 \end{bmatrix}$  and  $\mathbf{v} = \begin{bmatrix} 3 \\ 1 \\ 1 \end{bmatrix}$ . Compute  $\mathbf{u} + \mathbf{v}$ .
4. Let  $\mathbf{u} = \begin{bmatrix} -4 \\ -6 \\ 9 \end{bmatrix}$  and  $\mathbf{v} = \begin{bmatrix} -3 \\ 6 \\ 4 \end{bmatrix}$ . Compute  $\mathbf{u} + \mathbf{v}$ .
5. Let  $\mathbf{u} = \begin{bmatrix} 1 \\ -6 \\ -2 \end{bmatrix}$  and  $\mathbf{v} = \begin{bmatrix} -4 \\ 7 \\ -9 \end{bmatrix}$ . Compute  $\mathbf{u} + \mathbf{v}$ .
6. Let  $\mathbf{u} = \begin{bmatrix} 2 \\ -3 \\ 10 \end{bmatrix}$  and  $\mathbf{v} = \begin{bmatrix} -6 \\ 7 \\ 4 \end{bmatrix}$ . Compute  $\mathbf{u} + \mathbf{v}$ .
7. Let  $\mathbf{u} = \begin{bmatrix} 10 \\ 10 \\ -4 \end{bmatrix}$  and  $\mathbf{v} = \begin{bmatrix} -10 \\ 10 \\ 10 \end{bmatrix}$ . Compute  $\mathbf{u} + \mathbf{v}$ .
8. Let  $\mathbf{u} = \begin{bmatrix} -4 \\ 7 \\ 10 \end{bmatrix}$  and  $\mathbf{v} = \begin{bmatrix} 2 \\ 2 \\ 0 \end{bmatrix}$ . Compute  $\mathbf{u} + \mathbf{v}$ .
9. Let  $\mathbf{u} = \begin{bmatrix} 7 \\ 9 \\ 2 \end{bmatrix}$  and  $\mathbf{v} = \begin{bmatrix} -10 \\ 10 \\ 3 \end{bmatrix}$ . Compute  $\mathbf{u} + \mathbf{v}$ .
10. Let  $\mathbf{u} = \begin{bmatrix} -9 \\ -10 \\ -9 \end{bmatrix}$  and  $\mathbf{v} = \begin{bmatrix} -4 \\ -5 \\ 5 \end{bmatrix}$ . Compute  $\mathbf{u} + \mathbf{v}$ .

#### 2.1.2. Subtraction

1. Let  $\mathbf{u} = \begin{bmatrix} 10 \\ -5 \\ -1 \end{bmatrix}$  and  $\mathbf{v} = \begin{bmatrix} -4 \\ -3 \\ -10 \end{bmatrix}$ . Compute  $\mathbf{u} - \mathbf{v}$ .
2. Let  $\mathbf{u} = \begin{bmatrix} 5 \\ -3 \\ 4 \end{bmatrix}$  and  $\mathbf{v} = \begin{bmatrix} -1 \\ 8 \\ -3 \end{bmatrix}$ . Compute  $\mathbf{u} - \mathbf{v}$ .
3. Let  $\mathbf{u} = \begin{bmatrix} -1 \\ -2 \\ -10 \end{bmatrix}$  and  $\mathbf{v} = \begin{bmatrix} -7 \\ -6 \\ -4 \end{bmatrix}$ . Compute  $\mathbf{u} - \mathbf{v}$ .
4. Let  $\mathbf{u} = \begin{bmatrix} -2 \\ 1 \\ 9 \end{bmatrix}$  and  $\mathbf{v} = \begin{bmatrix} 4 \\ 2 \\ -6 \end{bmatrix}$ . Compute  $\mathbf{u} - \mathbf{v}$ .
5. Let  $\mathbf{u} = \begin{bmatrix} 10 \\ 0 \\ -9 \end{bmatrix}$  and  $\mathbf{v} = \begin{bmatrix} -9 \\ 10 \\ -8 \end{bmatrix}$ . Compute  $\mathbf{u} - \mathbf{v}$ .
6. Let  $\mathbf{u} = \begin{bmatrix} -2 \\ 8 \\ -9 \end{bmatrix}$  and  $\mathbf{v} = \begin{bmatrix} -4 \\ 3 \\ 8 \end{bmatrix}$ . Compute  $\mathbf{u} - \mathbf{v}$ .

7. Let  $\mathbf{u} = \begin{bmatrix} 5 \\ 5 \\ -2 \end{bmatrix}$  and  $\mathbf{v} = \begin{bmatrix} 4 \\ 4 \\ -10 \end{bmatrix}$ . Compute  $\mathbf{u} - \mathbf{v}$ .
8. Let  $\mathbf{u} = \begin{bmatrix} -5 \\ -4 \\ 5 \end{bmatrix}$  and  $\mathbf{v} = \begin{bmatrix} -7 \\ 10 \\ 2 \end{bmatrix}$ . Compute  $\mathbf{u} - \mathbf{v}$ .
9. Let  $\mathbf{u} = \begin{bmatrix} 5 \\ 2 \\ -5 \end{bmatrix}$  and  $\mathbf{v} = \begin{bmatrix} -5 \\ 4 \\ -6 \end{bmatrix}$ . Compute  $\mathbf{u} - \mathbf{v}$ .
10. Let  $\mathbf{u} = \begin{bmatrix} -3 \\ -1 \\ 7 \end{bmatrix}$  and  $\mathbf{v} = \begin{bmatrix} 9 \\ -2 \\ -8 \end{bmatrix}$ . Compute  $\mathbf{u} - \mathbf{v}$ .

### 2.1.3. Scalar Multiplication

1. Let  $\mathbf{u} = \begin{bmatrix} -8 \\ -7 \\ -5 \end{bmatrix}$ . Compute  $-8\mathbf{v}$ .
2. Let  $\mathbf{u} = \begin{bmatrix} 1 \\ -7 \\ -5 \end{bmatrix}$ . Compute  $6\mathbf{v}$ .
3. Let  $\mathbf{u} = \begin{bmatrix} -8 \\ 6 \\ -5 \end{bmatrix}$ . Compute  $-10\mathbf{v}$ .
4. Let  $\mathbf{u} = \begin{bmatrix} -6 \\ 6 \\ -4 \end{bmatrix}$ . Compute  $-4\mathbf{v}$ .
5. Let  $\mathbf{u} = \begin{bmatrix} 3 \\ 10 \\ 2 \end{bmatrix}$ . Compute  $-3\mathbf{v}$ .
6. Let  $\mathbf{u} = \begin{bmatrix} -9 \\ -10 \\ 6 \end{bmatrix}$ . Compute  $-2\mathbf{v}$ .
7. Let  $\mathbf{u} = \begin{bmatrix} 1 \\ -10 \\ 0 \end{bmatrix}$ . Compute  $0\mathbf{v}$ .
8. Let  $\mathbf{u} = \begin{bmatrix} -7 \\ 2 \\ 9 \end{bmatrix}$ . Compute  $8\mathbf{v}$ .
9. Let  $\mathbf{u} = \begin{bmatrix} -4 \\ -3 \\ -5 \end{bmatrix}$ . Compute  $6\mathbf{v}$ .
10. Let  $\mathbf{u} = \begin{bmatrix} 1 \\ 8 \\ 2 \end{bmatrix}$ . Compute  $6\mathbf{v}$ .

## 2.2. Matrix Arithmetic

### 2.2.1. Addition

1. Let  $A = \begin{bmatrix} -4 & 6 & -10 \\ -6 & -3 & 5 \\ -2 & -4 & 8 \end{bmatrix}$  and  $B = \begin{bmatrix} 5 & -8 & 7 \\ 2 & 5 & -9 \\ -7 & -9 & 0 \end{bmatrix}$ . Compute  $A + B$ .
2. Let  $A = \begin{bmatrix} -3 & -10 & -10 \\ 8 & -9 & 8 \\ 3 & 1 & 5 \end{bmatrix}$  and  $B = \begin{bmatrix} -10 & 6 & 5 \\ -3 & 5 & -7 \\ 2 & 0 & 1 \end{bmatrix}$ . Compute  $A + B$ .
3. Let  $A = \begin{bmatrix} -10 & -3 & 1 \\ 3 & -3 & 0 \\ -9 & 3 & -3 \end{bmatrix}$  and  $B = \begin{bmatrix} 8 & 8 & 9 \\ 6 & -3 & 9 \\ -5 & 7 & 6 \end{bmatrix}$ . Compute  $A + B$ .

4. Let  $A = \begin{bmatrix} -10 & -6 & 9 \\ -8 & 6 & -8 \\ 9 & 1 & -3 \end{bmatrix}$  and  $B = \begin{bmatrix} 7 & 2 & -2 \\ -4 & 4 & 5 \\ -1 & -10 & -2 \end{bmatrix}$ . Compute  $A + B$ .
5. Let  $A = \begin{bmatrix} -1 & -5 & -7 \\ 5 & -1 & -3 \\ -10 & -8 & -4 \end{bmatrix}$  and  $B = \begin{bmatrix} 7 & 5 & 3 \\ -6 & 3 & -7 \\ -10 & -2 & -4 \end{bmatrix}$ . Compute  $A + B$ .
6. Let  $A = \begin{bmatrix} -4 & 4 & 6 \\ -7 & -6 & 2 \\ 9 & 7 & 3 \end{bmatrix}$  and  $B = \begin{bmatrix} 7 & 2 & 5 \\ -7 & 6 & 7 \\ 4 & 4 & -1 \end{bmatrix}$ . Compute  $A + B$ .
7. Let  $A = \begin{bmatrix} 6 & -5 & -8 \\ -5 & -3 & -1 \\ 9 & -6 & -7 \end{bmatrix}$  and  $B = \begin{bmatrix} -8 & 1 & 1 \\ -2 & -1 & 8 \\ -10 & -6 & 5 \end{bmatrix}$ . Compute  $A + B$ .
8. Let  $A = \begin{bmatrix} -3 & 5 & -6 \\ -10 & 2 & -1 \\ -8 & -7 & 9 \end{bmatrix}$  and  $B = \begin{bmatrix} -4 & -7 & -9 \\ -3 & -5 & 9 \\ 3 & 8 & 7 \end{bmatrix}$ . Compute  $A + B$ .
9. Let  $A = \begin{bmatrix} 4 & -5 & -10 \\ 2 & 0 & 2 \\ -9 & 2 & 5 \end{bmatrix}$  and  $B = \begin{bmatrix} -10 & 5 & 2 \\ -8 & 1 & -6 \\ -10 & 5 & 0 \end{bmatrix}$ . Compute  $A + B$ .
10. Let  $A = \begin{bmatrix} -9 & -5 & 8 \\ 8 & 6 & -5 \\ -1 & 9 & -3 \end{bmatrix}$  and  $B = \begin{bmatrix} 4 & 6 & -5 \\ -4 & 3 & -2 \\ -9 & -6 & -1 \end{bmatrix}$ . Compute  $A + B$ .

### 2.2.2. Subtraction

1. Let  $A = \begin{bmatrix} -8 & 9 & 5 \\ -9 & 0 & 2 \\ 2 & 7 & 7 \end{bmatrix}$  and  $B = \begin{bmatrix} 8 & 8 & 7 \\ -6 & -5 & 4 \\ 9 & 2 & -4 \end{bmatrix}$ . Compute  $A - B$ .
2. Let  $A = \begin{bmatrix} 6 & 6 & -5 \\ -2 & 3 & -3 \\ 4 & 0 & -4 \end{bmatrix}$  and  $B = \begin{bmatrix} -4 & -7 & -1 \\ -5 & 9 & -9 \\ 1 & 7 & -2 \end{bmatrix}$ . Compute  $A - B$ .
3. Let  $A = \begin{bmatrix} -3 & -5 & 9 \\ 3 & -3 & 3 \\ 3 & -2 & -4 \end{bmatrix}$  and  $B = \begin{bmatrix} 3 & -1 & -7 \\ 5 & -7 & 3 \\ 8 & 8 & 6 \end{bmatrix}$ . Compute  $A - B$ .
4. Let  $A = \begin{bmatrix} 9 & -4 & 6 \\ 7 & -10 & 4 \\ 8 & -6 & -1 \end{bmatrix}$  and  $B = \begin{bmatrix} 5 & -6 & 1 \\ -3 & -5 & -7 \\ -5 & 5 & -7 \end{bmatrix}$ . Compute  $A - B$ .
5. Let  $A = \begin{bmatrix} 8 & 4 & 5 \\ 3 & 8 & 9 \\ -5 & -9 & 7 \end{bmatrix}$  and  $B = \begin{bmatrix} 1 & 5 & 1 \\ -1 & -2 & 5 \\ -9 & -6 & 6 \end{bmatrix}$ . Compute  $A - B$ .
6. Let  $A = \begin{bmatrix} -8 & -8 & 7 \\ 1 & -2 & -9 \\ 1 & -4 & 7 \end{bmatrix}$  and  $B = \begin{bmatrix} -9 & 5 & 9 \\ 2 & -4 & 2 \\ 1 & 6 & -9 \end{bmatrix}$ . Compute  $A - B$ .
7. Let  $A = \begin{bmatrix} -10 & 1 & 4 \\ -6 & 4 & -9 \\ -2 & 1 & -1 \end{bmatrix}$  and  $B = \begin{bmatrix} 7 & 2 & -1 \\ -5 & -8 & -1 \\ -3 & -9 & 0 \end{bmatrix}$ . Compute  $A - B$ .
8. Let  $A = \begin{bmatrix} 0 & -1 & 8 \\ 5 & -3 & -7 \\ 2 & -6 & -3 \end{bmatrix}$  and  $B = \begin{bmatrix} -3 & 5 & -1 \\ 3 & -6 & 6 \\ -6 & -3 & 8 \end{bmatrix}$ . Compute  $A - B$ .
9. Let  $A = \begin{bmatrix} -10 & -10 & -7 \\ 2 & 2 & -4 \\ 0 & -5 & 7 \end{bmatrix}$  and  $B = \begin{bmatrix} 0 & 2 & -1 \\ 4 & 1 & -10 \\ 9 & -9 & 1 \end{bmatrix}$ . Compute  $A - B$ .
10. Let  $A = \begin{bmatrix} 2 & -6 & -3 \\ 5 & -8 & 2 \\ -5 & -9 & 5 \end{bmatrix}$  and  $B = \begin{bmatrix} -6 & 4 & -3 \\ -7 & -7 & 0 \\ -10 & -5 & 7 \end{bmatrix}$ . Compute  $A - B$ .

### 2.2.3. Multiplication

1. Let  $A = \begin{bmatrix} 7 & -7 & -1 \\ 9 & -3 & 4 \\ 4 & -10 & -9 \end{bmatrix}$  and  $B = \begin{bmatrix} -1 & -1 & -4 \\ 3 & -1 & 2 \\ 1 & 1 & -3 \end{bmatrix}$ . Compute  $A \cdot B$ .
2. Let  $A = \begin{bmatrix} -9 & -5 & 3 \\ 1 & -3 & 8 \\ -1 & -2 & 8 \end{bmatrix}$  and  $B = \begin{bmatrix} 3 & -6 & -2 \\ 5 & -2 & 7 \\ 4 & 7 & -2 \end{bmatrix}$ . Compute  $A \cdot B$ .
3. Let  $A = \begin{bmatrix} 6 & 6 & 0 \\ 9 & 2 & -5 \\ -1 & 4 & 4 \end{bmatrix}$  and  $B = \begin{bmatrix} -6 & -8 & -10 \\ -9 & -8 & 0 \\ 6 & -4 & 8 \end{bmatrix}$ . Compute  $A \cdot B$ .
4. Let  $A = \begin{bmatrix} 2 & -2 & 8 \\ 8 & 9 & -9 \\ -6 & 2 & -8 \end{bmatrix}$  and  $B = \begin{bmatrix} 8 & 1 & -4 \\ 2 & -4 & -4 \\ -5 & 0 & -10 \end{bmatrix}$ . Compute  $A \cdot B$ .
5. Let  $A = \begin{bmatrix} -1 & -2 & -10 \\ 7 & 1 & 1 \\ 0 & 2 & -7 \end{bmatrix}$  and  $B = \begin{bmatrix} 9 & 9 & -4 \\ 7 & -4 & 6 \\ 3 & 7 & 8 \end{bmatrix}$ . Compute  $A \cdot B$ .
6. Let  $A = \begin{bmatrix} -7 & 1 & 9 \\ 7 & 8 & 3 \\ -8 & -2 & 9 \end{bmatrix}$  and  $B = \begin{bmatrix} 5 & 0 & 2 \\ -2 & 7 & 9 \\ -1 & -9 & -3 \end{bmatrix}$ . Compute  $A \cdot B$ .
7. Let  $A = \begin{bmatrix} -5 & -1 & -8 \\ -2 & 5 & 4 \\ 2 & 6 & -10 \end{bmatrix}$  and  $B = \begin{bmatrix} 2 & -1 & 7 \\ 4 & -3 & 0 \\ -6 & 8 & -10 \end{bmatrix}$ . Compute  $A \cdot B$ .
8. Let  $A = \begin{bmatrix} 4 & 2 & -1 \\ -1 & -9 & -8 \\ -5 & 4 & -4 \end{bmatrix}$  and  $B = \begin{bmatrix} 5 & -7 & -9 \\ -9 & 0 & 9 \\ -3 & -7 & -4 \end{bmatrix}$ . Compute  $A \cdot B$ .
9. Let  $A = \begin{bmatrix} -7 & -2 & 9 \\ -2 & 1 & -8 \\ -2 & -9 & 3 \end{bmatrix}$  and  $B = \begin{bmatrix} 2 & -5 & 0 \\ 1 & 3 & -6 \\ 2 & 6 & -4 \end{bmatrix}$ . Compute  $A \cdot B$ .
10. Let  $A = \begin{bmatrix} -2 & -1 & -6 \\ 2 & -3 & -10 \\ 7 & 5 & 1 \end{bmatrix}$  and  $B = \begin{bmatrix} 8 & -5 & -3 \\ 2 & -1 & 1 \\ -3 & -6 & 3 \end{bmatrix}$ . Compute  $A \cdot B$ .

## 3. Answer

### 3.1. Vector Arithmetic

#### 3.1.1. Addition

$$\begin{array}{lllll} 1: \begin{bmatrix} 10 \\ 4 \\ -3 \end{bmatrix} & 2: \begin{bmatrix} 9 \\ 11 \\ 8 \end{bmatrix} & 3: \begin{bmatrix} 11 \\ 7 \\ 8 \end{bmatrix} & 4: \begin{bmatrix} -7 \\ 0 \\ 13 \end{bmatrix} & 5: \begin{bmatrix} -3 \\ 1 \\ -11 \end{bmatrix} \\ 6: \begin{bmatrix} -4 \\ 4 \\ 14 \end{bmatrix} & 7: \begin{bmatrix} 0 \\ 20 \\ 6 \end{bmatrix} & 8: \begin{bmatrix} -2 \\ 9 \\ 10 \end{bmatrix} & 9: \begin{bmatrix} -3 \\ 19 \\ 5 \end{bmatrix} & 10: \begin{bmatrix} -13 \\ -15 \\ -4 \end{bmatrix} \end{array}$$

#### 3.1.2. Subtraction

$$\begin{array}{lllll} 1: \begin{bmatrix} 14 \\ -2 \\ 9 \end{bmatrix} & 2: \begin{bmatrix} 6 \\ -11 \\ 7 \end{bmatrix} & 3: \begin{bmatrix} 6 \\ 4 \\ -6 \end{bmatrix} & 4: \begin{bmatrix} -6 \\ -1 \\ 15 \end{bmatrix} & 5: \begin{bmatrix} 19 \\ -10 \\ -1 \end{bmatrix} \\ 6: \begin{bmatrix} 2 \\ 5 \\ -17 \end{bmatrix} & 7: \begin{bmatrix} 1 \\ 1 \\ 8 \end{bmatrix} & 8: \begin{bmatrix} 2 \\ -14 \\ 3 \end{bmatrix} & 9: \begin{bmatrix} 10 \\ -2 \\ 1 \end{bmatrix} & 10: \begin{bmatrix} -12 \\ 1 \\ 15 \end{bmatrix} \end{array}$$

#### 3.1.3. Scalar Multiplication

$$\begin{array}{lllll} 1: \begin{bmatrix} 64 \\ 56 \\ 40 \end{bmatrix} & 2: \begin{bmatrix} 6 \\ -42 \\ -30 \end{bmatrix} & 3: \begin{bmatrix} 80 \\ -60 \\ 50 \end{bmatrix} & 4: \begin{bmatrix} 24 \\ -24 \\ 16 \end{bmatrix} & 5: \begin{bmatrix} -9 \\ -30 \\ -6 \end{bmatrix} \\ 6: \begin{bmatrix} 18 \\ 20 \\ -12 \end{bmatrix} & 7: \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix} & 8: \begin{bmatrix} -56 \\ 16 \\ 72 \end{bmatrix} & 9: \begin{bmatrix} -24 \\ -18 \\ -30 \end{bmatrix} & 10: \begin{bmatrix} 6 \\ 48 \\ 12 \end{bmatrix} \end{array}$$

### 3.2. Matrix Arithmetic

#### 3.2.1. Addition

$$\begin{array}{lllll} 1: \begin{bmatrix} 1 & -2 & -3 \\ -4 & 2 & -4 \\ -9 & -13 & 8 \end{bmatrix} & 2: \begin{bmatrix} -13 & -4 & -5 \\ 5 & -4 & 1 \\ 5 & 1 & 6 \end{bmatrix} & 3: \begin{bmatrix} -2 & 5 & 10 \\ 9 & -6 & 9 \\ -14 & 10 & 3 \end{bmatrix} & 4: \begin{bmatrix} -3 & -4 & 7 \\ -12 & 10 & -3 \\ 8 & -9 & -5 \end{bmatrix} & 5: \begin{bmatrix} 6 & 0 & -4 \\ -1 & 2 & -10 \\ -20 & -10 & -8 \end{bmatrix} \\ 6: \begin{bmatrix} 3 & 6 & 11 \\ -14 & 0 & 9 \\ 13 & 11 & 2 \end{bmatrix} & 7: \begin{bmatrix} -2 & -4 & -7 \\ -7 & -4 & 7 \\ -1 & -12 & -2 \end{bmatrix} & 8: \begin{bmatrix} -7 & -2 & -15 \\ -13 & -3 & 8 \\ -5 & 1 & 16 \end{bmatrix} & 9: \begin{bmatrix} -6 & 0 & -8 \\ -6 & 1 & -4 \\ -19 & 7 & 5 \end{bmatrix} & 10: \begin{bmatrix} -5 & 1 & 3 \\ 4 & 9 & -7 \\ -10 & 3 & -4 \end{bmatrix} \end{array}$$

#### 3.2.2. Subtraction

$$\begin{array}{lllll} 1: \begin{bmatrix} -16 & 1 & -2 \\ -3 & 5 & -2 \\ -7 & 5 & 11 \end{bmatrix} & 2: \begin{bmatrix} 10 & 13 & -4 \\ 3 & -6 & 6 \\ 3 & -7 & -2 \end{bmatrix} & 3: \begin{bmatrix} -6 & -4 & 16 \\ -2 & 4 & 0 \\ -5 & -10 & -10 \end{bmatrix} & 4: \begin{bmatrix} 4 & 2 & 5 \\ 10 & -5 & 11 \\ 13 & -11 & 6 \end{bmatrix} & 5: \begin{bmatrix} 7 & -1 & 4 \\ 4 & 10 & 4 \\ 4 & -3 & 1 \end{bmatrix} \\ 6: \begin{bmatrix} 1 & -13 & -2 \\ -1 & 2 & -11 \\ 0 & -10 & 16 \end{bmatrix} & 7: \begin{bmatrix} -17 & -1 & 5 \\ -1 & 12 & -8 \\ 1 & 10 & -1 \end{bmatrix} & 8: \begin{bmatrix} 3 & -6 & 9 \\ 2 & 3 & -13 \\ 8 & -3 & -11 \end{bmatrix} & 9: \begin{bmatrix} -10 & -12 & -6 \\ -2 & 1 & 6 \\ -9 & 4 & 6 \end{bmatrix} & 10: \begin{bmatrix} 8 & -10 & 0 \\ 12 & -1 & 2 \\ 5 & -4 & -2 \end{bmatrix} \end{array}$$

#### 3.2.3. Multiplication

$$\begin{array}{lllll} 1: \begin{bmatrix} -29 & -1 & -39 \\ -14 & -2 & -54 \\ -43 & -3 & -9 \end{bmatrix} & 2: \begin{bmatrix} -40 & 85 & -23 \\ 20 & 56 & -39 \\ 19 & 66 & -28 \end{bmatrix} & 3: \begin{bmatrix} -90 & -96 & -60 \\ -102 & -68 & -130 \\ -6 & -40 & 42 \end{bmatrix} & 4: \begin{bmatrix} -28 & 10 & -80 \\ 127 & -28 & 22 \\ -4 & -14 & 96 \end{bmatrix} & 5: \begin{bmatrix} -53 & -71 & -88 \\ 73 & 66 & -14 \\ -7 & -57 & -44 \end{bmatrix} \\ 6: \begin{bmatrix} -46 & -74 & -32 \\ 16 & 29 & 77 \\ -45 & -95 & -61 \end{bmatrix} & 7: \begin{bmatrix} 34 & -56 & 45 \\ -8 & 19 & -54 \\ 88 & -100 & 114 \end{bmatrix} & 8: \begin{bmatrix} 5 & -21 & -14 \\ 100 & 63 & -40 \\ -49 & 63 & 97 \end{bmatrix} & 9: \begin{bmatrix} 2 & 83 & -24 \\ -19 & -35 & 26 \\ -7 & 1 & 42 \end{bmatrix} & 10: \begin{bmatrix} 0 & 47 & -13 \\ 40 & 53 & -39 \\ 63 & -46 & -13 \end{bmatrix} \end{array}$$