# SFWRENG 2MP3 – Programming for Mechatronics Fall 2018

| Exercise 1 Solution | Submitted By: HARNEET SINGH, 400110275, SINGHH76@MCMASTER.CA |
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| **Question #** | **Answer** |
| **Entire Program** | |

```
#include <stdio.h>

void loadValues ();
void Subtract ();
void Print ();
void transpose ();
void rank ();

void main ()
{
	int m, n, input;
	int r, c;

	printf("\nThis program performs arithmetic operations on two matrices (A & B):\n");
	printf("Consider (m) to be number of rows and (n) to be number of columns,\n");
	printf("Please enter m-th dimension for the first matrix (A): ");
	scanf("%d", &m);
	printf("Please enter n-th dimension for the first matrix (A): ");
	scanf("%d", &n);

	printf("\nSimilarly, provide the m-th dimension of the second matrix (B): ");
	scanf("%d", &r);
	printf("Provide the n-th dimension of the second matrix (B): ");
	scanf("%d", &c);

	int mat_A[m][n]; int mat_B[r][c];

	do {

	input = -1;

	printf("\n\nPlease select one of the following to perform appropriate action:\n");
	printf("1 - Load Values in the Matrix (A or B)\n");
	printf("2 - Subtract matrices (A-B or B-A)\n");
	printf("3 - Print matrix (A or B)\n");
	printf("4 - Transpose matrix (A or B)\n");
	printf("5 - Rank of matrix (A or B)\n");
	printf("6 - Exit\n");
	printf("Please enter corresponding numerical value for the selected option: ");
	scanf("%d", &input);

	if (input == 1) {loadValues (m, n, r, c, mat_A, mat_B);}
	if (input == 2) {Subtract (m, n, r, c, mat_A, mat_B);}
	if (input == 3) {Print (m, n, r, c, mat_A, mat_B);}
	if (input == 4) {transpose (m, n, r, c, mat_A, mat_B);}
	if (input == 5) {rank(m, n, r, c, mat_A, mat_B);}
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```
        if (input == 6) {puts("\nPROGRAM EXITED NOW: Program termination value (of 6) is
entered"); break;}
        if (input == -1) {puts("Please enter a valid integer input");}
        } while (input >= 1 && input <= 6);
}


void loadValues (int m, int n, int r, int c, int mat_A[m][n], int mat_B[r][c]){
        char mat;
        puts ("This part of the program lets you populate a particular matrix");
        printf("Please specify which matrix needs to be loaded (A/a for A or B/b for B): ");
        scanf(" %c", &mat);                     //added an extra space before %c to remove any
leading space

        if (mat == 'A' || mat == 'a'){
                int x = -1;
                for (int i = 0; i < m; i++){
                        for (int j = 0; j < n; j++){
                                printf("Enter the value of A[%dx%d] element: ", (i+1), (j+1));
                                scanf("%d", &x);
                                mat_A[i][j] = x;
                        }
                }
        }
        else if (mat == 'B' || mat == 'b'){
                int x = -1;
                for (int i = 0; i < r; i++){
                        for (int j = 0; j < c; j++){
                                printf("Enter the value of B[%dx%d] element: ", (i+1), (j+1));
                                scanf("%d", &x);
                                mat_B[i][j] = x;
                        }
                }
        }
        else {puts("!!!Please enter a valid input");}
}


void Subtract (int m, int n, int r, int c, int mat_A[m][n], int mat_B[r][c]){
        int num;
        puts("This part of the program performs subtraction on equi-dimensional matrices:");
        printf("Please enter 1 for (A-B) operation\nOR enter 2 for (B-A) operation: ");
        scanf("%d", &num);

        if ((m == r) && (n == c)){
                if (num == 1) {
                        puts("Following is the result of the applied operation:");
                        for (int i = 0; i < m; i++) {
                                for (int j = 0; j < n; j++){
                                        printf("%6d", (mat_A[i][j] - mat_B[i][j]));
                                }
                        printf("\n");
```

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                }
        }

        else if (num == 2) {
                puts("Following is the result of the applied operation:");
                for (int i = 0; i < m; i++) {
                        for (int j = 0; j < n; j++){
                                printf("%6d", (mat_B[i][j] - mat_A[i][j]));
                        }
                printf("\n");
                }
        }

        else {puts("!!!Invalid input");}
    }

    else {puts("!!!Rows and Columns of the matrices must be equal");}
}


void Print (int m, int n, int r, int c, int mat_A[m][n], int mat_B[r][c]){
    puts ("\nThis part of the program prints a user-required matrix:");
    char num;

    printf("Please enter A/a to view matrix A\nOR enter B/b to view matrix B: ");
    scanf(" %c", &num);

    if (num == 'A' || num == 'a') {
        for (int i = 0; i < m; i++) {
                for (int j = 0; j < n; j++){
                        printf("%6d", mat_A[i][j]);
                }
        printf("\n");
        }
    }

    else if (num == 'B' || num == 'b') {
        for (int i = 0; i < r; i++) {
                for (int j = 0; j < c; j++){
                        printf("%6d", mat_B[i][j]);
                }
        printf("\n");
        }
    }

    else {puts("!!!Please enter a valid matrix");}
}


void transpose (int m, int n, int r, int c, int mat_A[m][n], int mat_B[r][c]) {
    puts ("\nThis part of the program computes transpose of a specified matrix:");
    char num;
```

```
	printf("Please enter A/a to transpose matrix A\nOR enter B/b to transpose matrix B: ");
	scanf(" %c", &num);

	if (num == 'A' || num == 'a') {
		for (int i = 0; i < n; i++) {
				for (int j = 0; j < m; j++){
					printf("%8d", mat_A[j][i]);
				}
		printf("\n");
		}
	}

	else if (num == 'B' || num == 'b') {
		for (int i = 0; i < c; i++) {
				for (int j = 0; j < r; j++){
					printf("%8d", mat_B[j][i]);
				}
		printf("\n");
		}
	}

	else {puts("!!!Please enter a valid character");}
}


void rank (int m, int n, int r, int c, int mat_A[m][n], int mat_B[r][c]) {
	puts ("\nThis part of the program determines the rank of a 2x2 matrix:");
	char num;

	printf("Please enter A/a to determine the rank of matrix A\nOR enter B/b for matrix B: ");
	scanf(" %c", &num);

	if (m == 2 && n == 2 && r == 2 && c == 2){
		if (num == 'A' || num == 'a'){
					int determinant = (((mat_A[0][0]) * (mat_A[1][1])) -
((mat_A[0][1]) * (mat_A[1][0])));

					if (determinant) { puts ("Rank of matrix A is 2");}

					else {puts ("Rank of matrix A is 1");}
				}

		else if (num == 'B' || num == 'b'){
			int determinant = (((mat_B[0][0]) * (mat_B[1][1])) - ((mat_B[0][1]) *
(mat_B[1][0])));

			if (determinant) { puts ("Rank of matrix B is 2");}

			else {puts ("Rank of matrix B is 1");}
		}
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| | else {puts("!!!Please enter a valid digit");}<br>}<br><br>else {puts("!!!This matrix is not 2x2");}<br>} |
| **Error Free Compilation** | [10/07/18]400110275@VM:~/.../Assignment#3$ gcc Q1.c<br>[10/07/18]400110275@VM:~/.../Assignment#3$ ./a.out<br><br>This program performs arithmetic operations on two matrices (A & B):<br>Consider (m) to be number of rows and (n) to be number of columns,<br>Please enter m-th dimension for the first matrix (A): 2<br>Please enter n-th dimension for the first matrix (A): 1<br><br>Similarly, provide the m-th dimension of the second matrix (B): 1<br>Provide the n-th dimension of the second matrix (B): 1<br><br><br>Please select one of the following to perform appropriate action:<br>1 - Load Values in the Matrix (A or B)<br>2 - Subtract matrices (A-B or B-A)<br>3 - Print matrix (A or B)<br>4 - Transpose matrix (A or B)<br>5 - Rank of matrix (A or B)<br>6 - Exit<br>Please enter corresponding numerical value for the selected option: |
| **Option 6, Successful Execution** | [10/07/18]400110275@VM:~/.../Assignment#3$ gcc Q1.c<br>[10/07/18]400110275@VM:~/.../Assignment#3$ ./a.out<br><br>This program performs arithmetic operations on two matrices (A & B):<br>Consider (m) to be number of rows and (n) to be number of columns,<br>Please enter m-th dimension for the first matrix (A): 2<br>Please enter n-th dimension for the first matrix (A): 1<br><br>Similarly, provide the m-th dimension of the second matrix (B): 1<br>Provide the n-th dimension of the second matrix (B): 1<br><br><br>Please select one of the following to perform appropriate action:<br>1 - Load Values in the Matrix (A or B)<br>2 - Subtract matrices (A-B or B-A)<br>3 - Print matrix (A or B)<br>4 - Transpose matrix (A or B)<br>5 - Rank of matrix (A or B)<br>6 - Exit<br>Please enter corresponding numerical value for the selected option: 6<br><br>PROGRAM EXITED NOW: Program termination value (of 6) is entered<br>[10/07/18]400110275@VM:~/.../Assignment#3$ |

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| **Option 1 – A** | [10/07/18]400110275@VM:~/.../Assignment#3$ ./a.out<br><br>This program performs arithmetic operations on two matrices (A & B):<br>Consider (m) to be number of rows and (n) to be number of columns,<br>Please enter m-th dimension for the first matrix (A): 2<br>Please enter n-th dimension for the first matrix (A): 2<br><br>Similarly, provide the m-th dimension of the second matrix (B): 1<br>Provide the n-th dimension of the second matrix (B): 1<br><br><br>Please select one of the following to perform appropriate action:<br>1 - Load Values in the Matrix (A or B)<br>2 - Subtract matrices (A-B or B-A)<br>3 - Print matrix (A or B)<br>4 - Transpose matrix (A or B)<br>5 - Rank of matrix (A or B)<br>6 - Exit<br>Please enter corresponding numerical value for the selected option: 1<br>This part of the program lets you populate a particular matrix<br>Please specify which matrix needs to be loaded (A/a for A or B/b for B): a<br>Enter the value of A[1x1] element: 4<br>Enter the value of A[1x2] element: 5<br>Enter the value of A[2x1] element: 1<br>Enter the value of A[2x2] element: 3 |
| **Option 1 - B** | This program performs arithmetic operations on two matrices (A & B):<br>Consider (m) to be number of rows and (n) to be number of columns,<br>Please enter m-th dimension for the first matrix (A): 1<br>Please enter n-th dimension for the first matrix (A): 1<br><br>Similarly, provide the m-th dimension of the second matrix (B): 3<br>Provide the n-th dimension of the second matrix (B): 2<br><br><br>Please select one of the following to perform appropriate action:<br>1 - Load Values in the Matrix (A or B)<br>2 - Subtract matrices (A-B or B-A)<br>3 - Print matrix (A or B)<br>4 - Transpose matrix (A or B)<br>5 - Rank of matrix (A or B)<br>6 - Exit<br>Please enter corresponding numerical value for the selected option: 1<br>This part of the program lets you populate a particular matrix<br>Please specify which matrix needs to be loaded (A/a for A or B/b for B): b<br>Enter the value of B[1x1] element: 2<br>Enter the value of B[1x2] element: 4<br>Enter the value of B[2x1] element: -1<br>Enter the value of B[2x2] element: 0<br>Enter the value of B[3x1] element: 3<br>Enter the value of B[3x2] element: 4 |

**Option 2 -A**

```
4 - Transpose matrix (A or B)
5 - Rank of matrix (A or B)
6 - Exit
Please enter corresponding numerical value for the selected option: 1
This part of the program lets you populate a particular matrix
Please specify which matrix needs to be loaded (A/a for A or B/b for B): a
Enter the value of A[1x1] element: 4
Enter the value of A[1x2] element: 5
Enter the value of A[2x1] element: 3
Enter the value of A[2x2] element: 4


Please select one of the following to perform appropriate action:
1 - Load Values in the Matrix (A or B)
2 - Subtract matrices (A-B or B-A)
3 - Print matrix (A or B)
4 - Transpose matrix (A or B)
5 - Rank of matrix (A or B)
6 - Exit
Please enter corresponding numerical value for the selected option: 1
This part of the program lets you populate a particular matrix
Please specify which matrix needs to be loaded (A/a for A or B/b for B): b
Enter the value of B[1x1] element: 5
Enter the value of B[1x2] element: 3
Enter the value of B[2x1] element: 2
Enter the value of B[2x2] element: 1


Please select one of the following to perform appropriate action:
1 - Load Values in the Matrix (A or B)
2 - Subtract matrices (A-B or B-A)
3 - Print matrix (A or B)
4 - Transpose matrix (A or B)
5 - Rank of matrix (A or B)
6 - Exit
Please enter corresponding numerical value for the selected option: 2
This part of the program performs subtraction on equi-dimensional matrices:
Please enter 1 for (A-B) operation
OR enter 2 for (B-A) operation: 1
Following is the result of the applied operation:
    -1     2
     1     3
```

**Option 2 – B**

```
Please select one of the following to perform appropriate action:
1 - Load Values in the Matrix (A or B)
2 - Subtract matrices (A-B or B-A)
3 - Print matrix (A or B)
4 - Transpose matrix (A or B)
5 - Rank of matrix (A or B)
6 - Exit
Please enter corresponding numerical value for the selected option: 2
This part of the program performs subtraction on equi-dimensional matrices:
Please enter 1 for (A-B) operation
OR enter 2 for (B-A) operation: 1
Following is the result of the applied operation:
    -1     2
     1     3


Please select one of the following to perform appropriate action:
1 - Load Values in the Matrix (A or B)
2 - Subtract matrices (A-B or B-A)
3 - Print matrix (A or B)
4 - Transpose matrix (A or B)
5 - Rank of matrix (A or B)
6 - Exit
Please enter corresponding numerical value for the selected option: 2
This part of the program performs subtraction on equi-dimensional matrices:
Please enter 1 for (A-B) operation
OR enter 2 for (B-A) operation: 2
Following is the result of the applied operation:
     1    -2
    -1    -3


Please select one of the following to perform appropriate action:
1 - Load Values in the Matrix (A or B)
2 - Subtract matrices (A-B or B-A)
3 - Print matrix (A or B)
4 - Transpose matrix (A or B)
5 - Rank of matrix (A or B)
6 - Exit
Please enter corresponding numerical value for the selected option:
```

**Option 3-A**

```
Please select one of the following to perform appropriate action:
1 - Load Values in the Matrix (A or B)
2 - Subtract matrices (A-B or B-A)
3 - Print matrix (A or B)
4 - Transpose matrix (A or B)
5 - Rank of matrix (A or B)
6 - Exit
Please enter corresponding numerical value for the selected option: 3

This part of the program prints a user-required matrix:
Please enter A/a to view matrix A
OR enter B/b to view matrix B: A
     4     5
     3     4
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| **Option 3-B** | Please select one of the following to perform appropriate action:<br>1 - Load Values in the Matrix (A or B)<br>2 - Subtract matrices (A-B or B-A)<br>3 - Print matrix (A or B)<br>4 - Transpose matrix (A or B)<br>5 - Rank of matrix (A or B)<br>6 - Exit<br>Please enter corresponding numerical value for the selected option: 3<br><br>This part of the program prints a user-required matrix:<br>Please enter A/a to view matrix A<br>OR enter B/b to view matrix B: B<br>5 3<br>2 1 |
| **Option 4-A** | Please select one of the following to perform appropriate action:<br>1 - Load Values in the Matrix (A or B)<br>2 - Subtract matrices (A-B or B-A)<br>3 - Print matrix (A or B)<br>4 - Transpose matrix (A or B)<br>5 - Rank of matrix (A or B)<br>6 - Exit<br>Please enter corresponding numerical value for the selected option: 1<br>This part of the program lets you populate a particular matrix<br>Please specify which matrix needs to be loaded (A/a for A or B/b for B): a<br>Enter the value of A[1x1] element: -1<br>Enter the value of A[1x2] element: 3<br>Enter the value of A[2x1] element: 4<br>Enter the value of A[2x2] element: 0<br><br>Please select one of the following to perform appropriate action:<br>1 - Load Values in the Matrix (A or B)<br>2 - Subtract matrices (A-B or B-A)<br>3 - Print matrix (A or B)<br>4 - Transpose matrix (A or B)<br>5 - Rank of matrix (A or B)<br>6 - Exit<br>Please enter corresponding numerical value for the selected option: 4<br><br>This part of the program computes transpose of a specified matrix:<br>Please enter A/a to transpose matrix A<br>OR enter B/b to transpose matrix B: a<br>-1 4<br>3 0 |

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| **Option 4-B** | This part of the program prints a user-required matrix:<br>Please enter A/a to view matrix A<br>OR enter B/b to view matrix B: B<br>5 3<br>2 1<br><br>Please select one of the following to perform appropriate action:<br>1 - Load Values in the Matrix (A or B)<br>2 - Subtract matrices (A-B or B-A)<br>3 - Print matrix (A or B)<br>4 - Transpose matrix (A or B)<br>5 - Rank of matrix (A or B)<br>6 - Exit<br>Please enter corresponding numerical value for the selected option: 4<br><br>This part of the program computes transpose of a specified matrix:<br>Please enter A/a to transpose matrix A<br>OR enter B/b to transpose matrix B: b<br>5 2<br>3 1 |
| **Option 5-A** | This part of the program computes transpose of a specified matrix:<br>Please enter A/a to transpose matrix A<br>OR enter B/b to transpose matrix B: a<br>-1 4<br>3 0<br><br>Please select one of the following to perform appropriate action:<br>1 - Load Values in the Matrix (A or B)<br>2 - Subtract matrices (A-B or B-A)<br>3 - Print matrix (A or B)<br>4 - Transpose matrix (A or B)<br>5 - Rank of matrix (A or B)<br>6 - Exit<br>Please enter corresponding numerical value for the selected option: 5<br><br>This part of the program determines the rank of a 2x2 matrix:<br>Please enter A/a to determine the rank of matrix A<br>OR enter B/b for matrix B: a<br>Rank of matrix A is 2 |

**Option 5-B**

```
Please select one of the following to perform appropriate action:
1 - Load Values in the Matrix (A or B)
2 - Subtract matrices (A-B or B-A)
3 - Print matrix (A or B)
4 - Transpose matrix (A or B)
5 - Rank of matrix (A or B)
6 - Exit
Please enter corresponding numerical value for the selected option: 3

This part of the program prints a user-required matrix:
Please enter A/a to view matrix A
OR enter B/b to view matrix B: B
     3     4
     6     8


Please select one of the following to perform appropriate action:
1 - Load Values in the Matrix (A or B)
2 - Subtract matrices (A-B or B-A)
3 - Print matrix (A or B)
4 - Transpose matrix (A or B)
5 - Rank of matrix (A or B)
6 - Exit
Please enter corresponding numerical value for the selected option: 5

This part of the program determines the rank of a 2x2 matrix:
Please enter A/a to determine the rank of matrix A
OR enter B/b for matrix B: B
Rank of matrix B is 1
```

**Prospective Error for Option 2 (Subtraction):**

In case, the user tries to subtract two matrices of different dimensions i.e. the two matrices must possess equal number of rows and columns

```
This program performs arithmetic operations on two matrices (A & B):
Consider (m) to be number of rows and (n) to be number of columns,
Please enter m-th dimension for the first matrix (A): 2
Please enter n-th dimension for the first matrix (A): 1

Similarly, provide the m-th dimension of the second matrix (B): 3
Provide the n-th dimension of the second matrix (B): 2


Please select one of the following to perform appropriate action:
1 - Load Values in the Matrix (A or B)
2 - Subtract matrices (A-B or B-A)
3 - Print matrix (A or B)
4 - Transpose matrix (A or B)
5 - Rank of matrix (A or B)
6 - Exit
Please enter corresponding numerical value for the selected option: 2
This part of the program performs subtraction on equi-dimensional matrices:
Please enter 1 for (A-B) operation
OR enter 2 for (B-A) operation: 1
!!!Rows and Columns of the matrices must be equal
```

**Prospective Error for Option 3 (Print):**

If the user forgets to initialize the elements of one/two matrices then, the matrix elements will, automatically, be assigned garbage values during compilation

```
[10/07/18]400110275@VM:~/.../Assignment#3$ ./a.out

This program performs arithmetic operations on two matrices (A & B):
Consider (m) to be number of rows and (n) to be number of columns,
Please enter m-th dimension for the first matrix (A): 2
Please enter n-th dimension for the first matrix (A): 2

Similarly, provide the m-th dimension of the second matrix (B): 2
Provide the n-th dimension of the second matrix (B): 2


Please select one of the following to perform appropriate action:
1 - Load Values in the Matrix (A or B)
2 - Subtract matrices (A-B or B-A)
3 - Print matrix (A or B)
4 - Transpose matrix (A or B)
5 - Rank of matrix (A or B)
6 - Exit
Please enter corresponding numerical value for the selected option: 3

This part of the program prints a user-required matrix:
Please enter A/a to view matrix A
OR enter B/b to view matrix B: a
-1217769472-1217769472
-1076576376134514156
```