НАЦИОНАЛЬНЫЙ ИССЛЕДОВАТЕЛЬСКИЙ УНИВЕРСИТЕТ
«Московский энергетический институт»
Кафедра математического и компьютерного моделирования

«Технологии программирования»

Лабораторная работа
Вариант №16

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Группа: А-16-19

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Москва 2021г

Задание на лабораторную работу

Общее:

1) Составить на языке C++ описания классов для указанных объектов.
2) В среде Visual Studio разработать консольную программу, иллюстрирующую использование объектов заданных классов.
3) Программа должна иметь меню с пунктами для ввода исходных данных, вывода результатов, выполнения требуемых операций над объектами.
4) Отчёт по лабораторной работе должен содержать:

- Титульный лист
- Задание на работу (общее и индивидуальное)
- Описание работы программы
- Алгоритмы выполнения основных операций
- Тесты
- Распечатки экранов при работе программы
- Листинг программы

Индивидуальное:

Разработать матрицу и вектор на основе связанных списков (операции векторной и матричной алгебр).

Описание работы программы

1) Программа выдаёт приветствие и выбор последующего действия:
    a. Создать две матрицы
    b. Создать два вектора
    c. Завершить программу
2) В случае создания двух матриц программа предлагает дальнейшие действия: транспонирование первого, транспонирование второго, вывод первого, вывод второго, сложить матрицы, вычесть матрицы, перемножить матрицы, рестарт программы, завершение работы программы (реализованы операции матричной алгебры). Программа надёжна в плане ввода данных и операций, т.е. нельзя сложить матрицы разного размера и др.
3) В случае создания двух векторов программа предлагает дальнейшие действия: вывод первого, вывод второго, сложение, вычитание, умножение на константу первого, умножение на константу второго, рестарт программы, завершение работы программы (реализованы операции векторной алгебры). Программа надёжна в плане ввода исходных данных и операций.
4) В случае завершения программы исход очевиден.

Замечание 1:

Рестарт программы предполагает удаление уже имеющихся данных.

Замечание 2:

Были реализованы **основные** операции матричной и векторной алгебры. Для матриц – это сложение (вычитание), перемножение, транспонирование. Для векторов – это сумма векторов, умножение вектора на число.

Описание алгоритмов

1) Добавление «листа» списка

Создание новой структуры, представляющей лист => Запись данных в раздел «значение» => В указатель на следующий лист записывается 0 => Если список (строка для матрицы) пустой(ая), то автоматический первый и последний элемент представляется данным листом, иначе только последний элемент.

2) Добавление строки (для матрицы)

Создание новой структуры, представляющей строку матрицы => Как первый и последний элемент этой строки по умолчанию 0, аналогично указатель на следующую строку.

3) Заполнение строки по умолчанию (для матрицы)

Запускается цикл по кол-ву столбцов матрицы => В цикле принимается значение с клавиатуры => Создаётся лист с переданными данным => Переход на следующую итерацию.

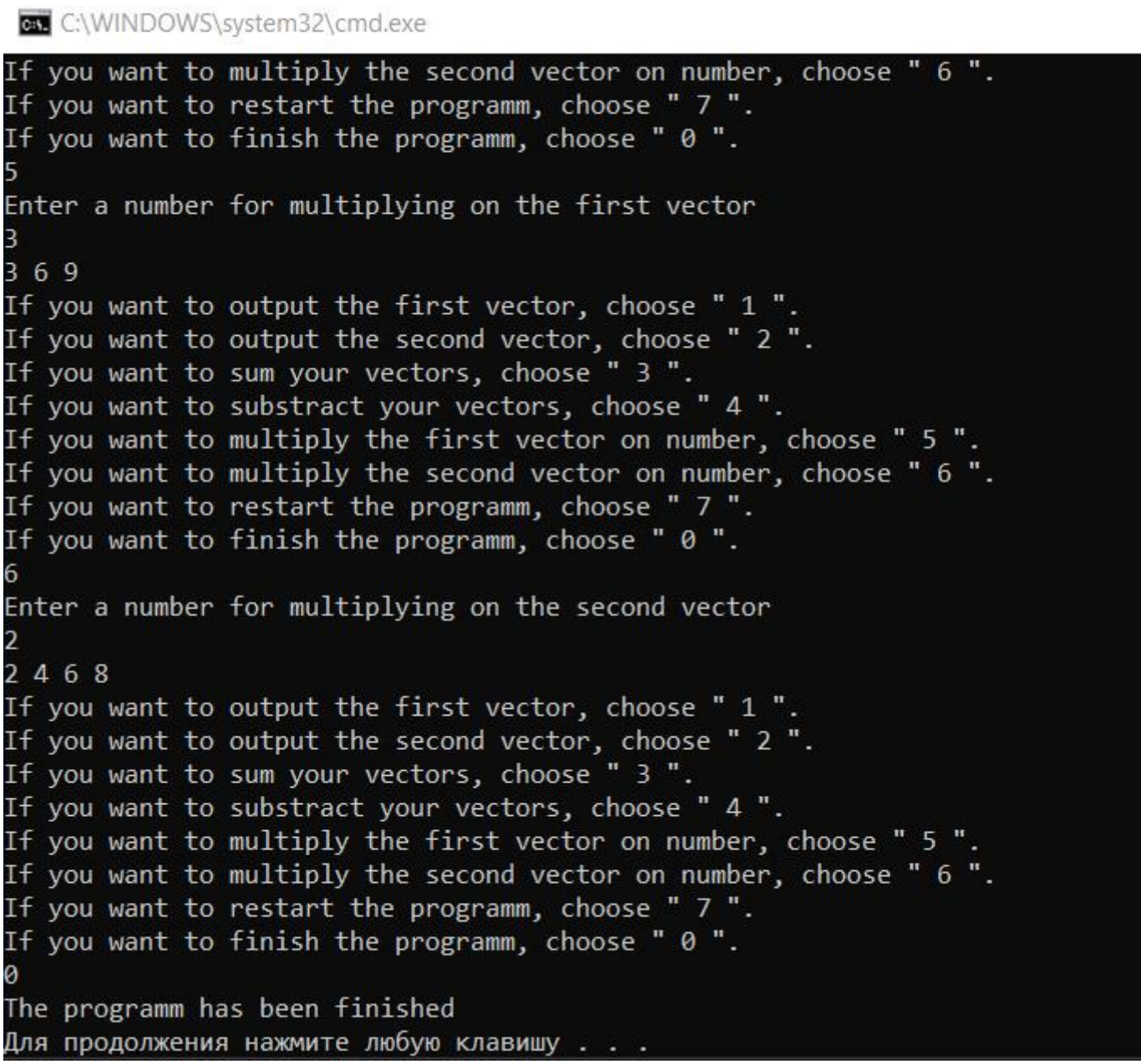
4) Основной конструктор: принимает кол-во строк и столбцов (либо размерность) => добавляет строку (или лист для вектора) => заполняет строку
5) Конструктор копирования: Принимает значения переданного элемента класса => Выполняет глубокое копирование динамической памяти
6) Деструктор: Проходит по объекту и удаляет листы => удаляет пустые строки (для матриц)
7) Вывод: Проходит по структуре и выводит значения
8) Оператор []: Для векторов: Возвращает значение, перебирая предыдущие листы. Для матриц: Перебирает строки, находя нужную => По нужной строке перебирает листы и возвращает нужное значение
9) Оператор транспонирования ! : Принимает матрицу => Создаёт новую матрицу, где кол-во столбцов равно кол-ву строку исходной, кол-во строк – кол-ву столбцов исходной => Перебирает элементы исходной матрицы и создаёт листы в новой с данными исходной матрицы.
10) Оператор + : Создаёт новую матрицу из элементов, являющихся суммой элементов переданных матриц. Для векторов – сумма соответствующих компонент. В случае разного размера исходных матриц выбрасывает исключение, аналогично для разных размерностей
11) Оператор - : аналогично п. 10, только разность
12) Оператор *: Создаёт новую матрицу из кол-ва строк первой и кол-ва столбцов второй, проверяет на равенство кол-во столбцов первой и кол-во строк второй, если не равно, то выбрасывает исключение. Далее посредством вложенных циклов перебираем элементы исходных, выполняем перемножение элементов по законам линейной алгебры и записываем результат в листы. Для векторов: принимает число с клавиатуры и умножает вектор на число (каждую компоненту вектора на число).

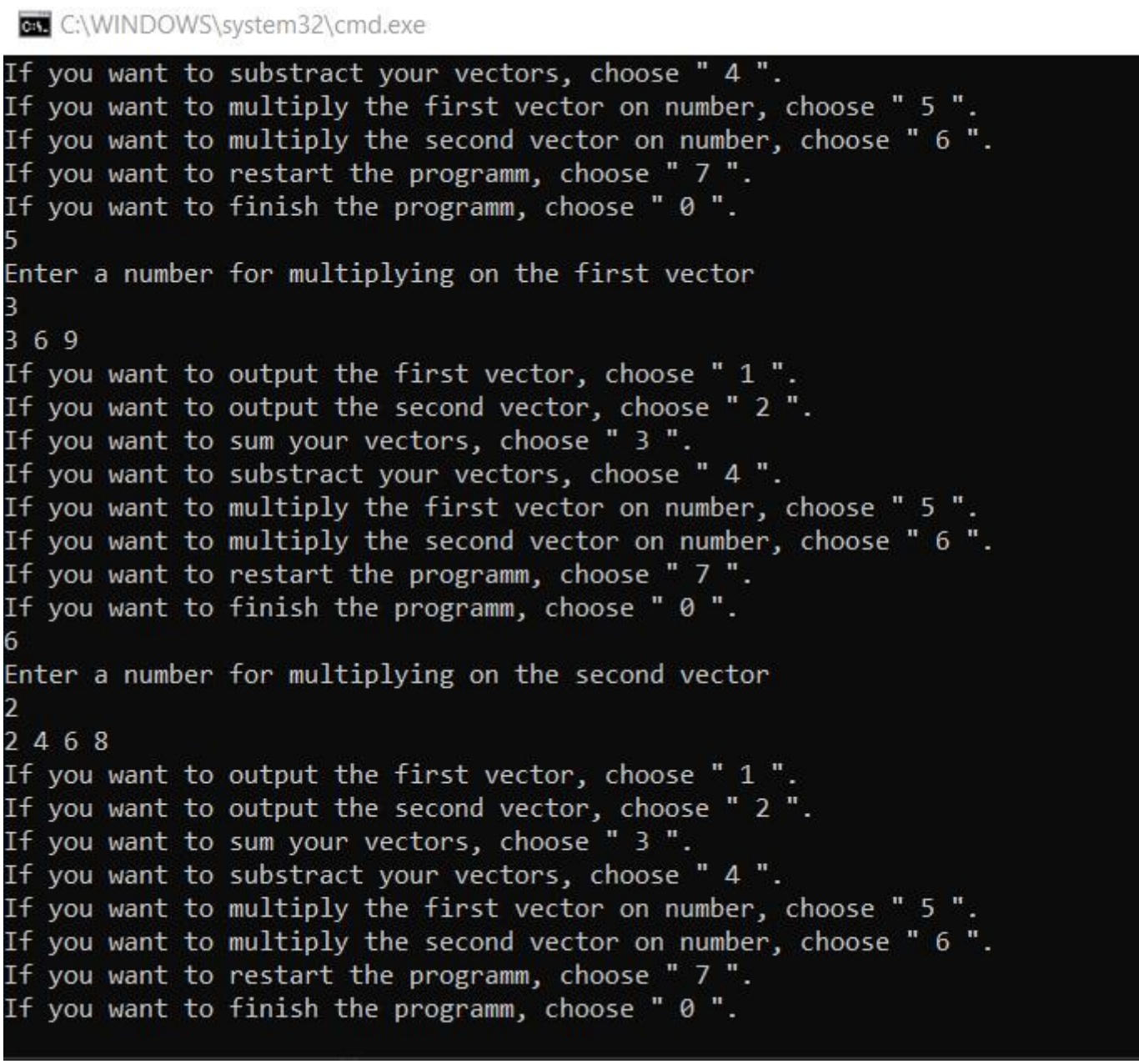
Тесты

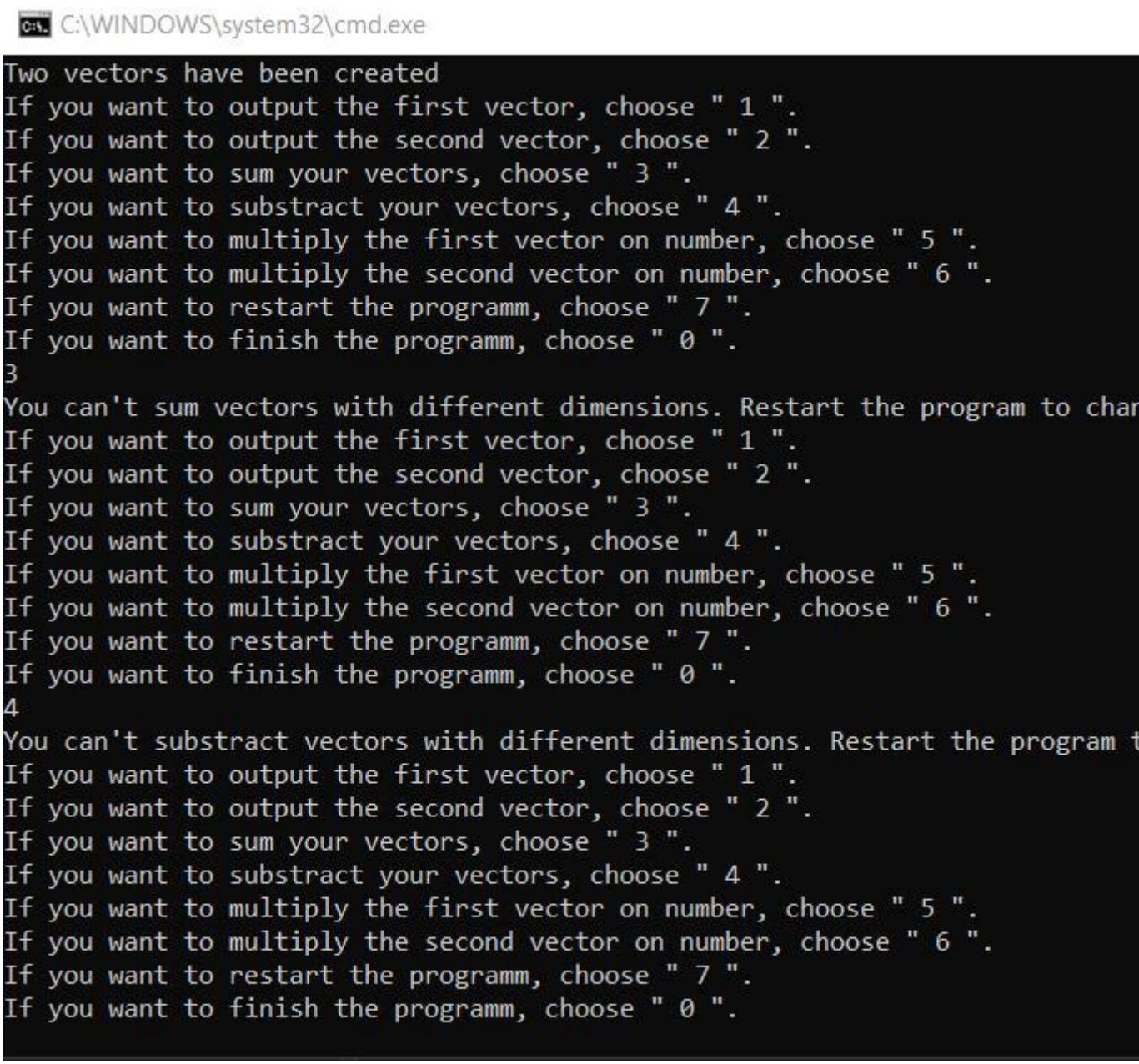
Создадим 2 матрицы: A (3x4) and B (3x4), обе вида:
1 2 3 4
5 6 7 8
9 10 11 12
Выведем A:
1 2 3 4
5 6 7 8
9 10 11 12
Выведем B:
1 2 3 4
5 6 7 8
9 10 11 12
Транспонируем A
1 5 9
2 6 10
3 7 11
4 8 12
Транспонируем B
1 5 9
2 6 10
3 7 11
4 8 12
Сложим
2 4 6 8
10 12 14 16
18 20 22 24
Вычтем
0 0 0 0
0 0 0 0
0 0 0 0
Перемножим
You can't multiply matrixes with different quantity of columns in first matrix and quantity of strings in second matrix. Restart the program to change your matrixes.
Рестарт программы и введём матрицы A (1 x 2), B (2 x 3)
1 2 1 2 3
И 4 5 6
Транспонируем
1
2
И
1 4
2 5
3 6

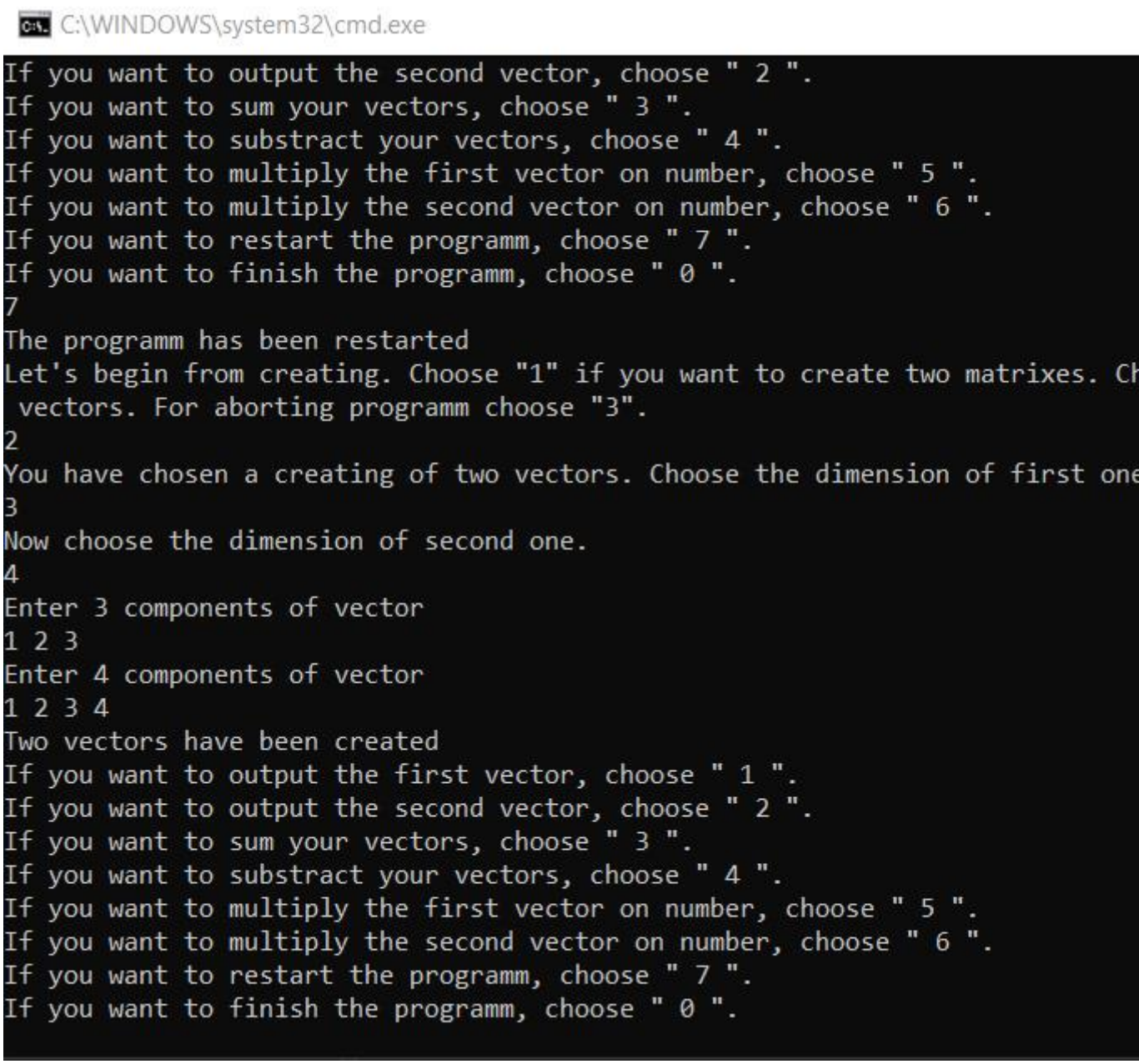
Сложим или вычтем
You can't sum matrixes with different sizes. Restart the program to change your matrixes.
Перемножим
9 12 15
Рестартнем программу и создадим 2 вектора: A и B размерностью 3 каждый
1 2 3
1 2 3
Выведем A
1 2 3
Выведем B
1 2 3
Сложим
2 4 6
Вычтем
0 0 0
Умножим A на 3
3 6 9
Умножим B на 5
5 10 15
Рестартнем программу и введём векторы A и B размерностью 3 и 5
1 2 3
1 2 3 4 5
Сложим или вычтем
You can't sum vectors with different dimensions. Restart the program to change your vectors.
You can't substract vectors with different dimensions. Restart the program to change your vectors.
Умножим A на 10
10 20 30
Умножим B на 3
3 6 9 12 15
Закончим программу

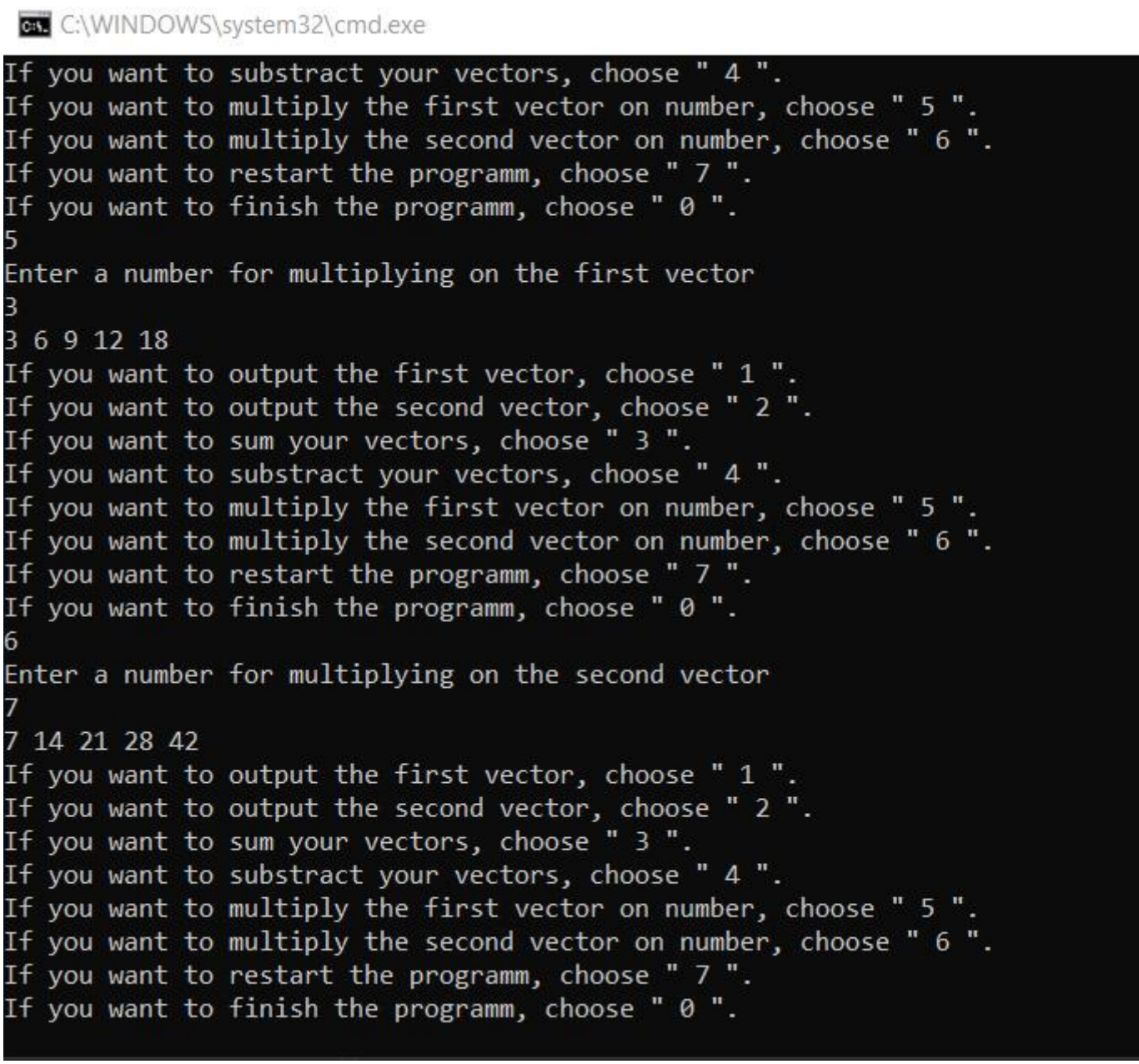
Распечатки экрана при работе программы

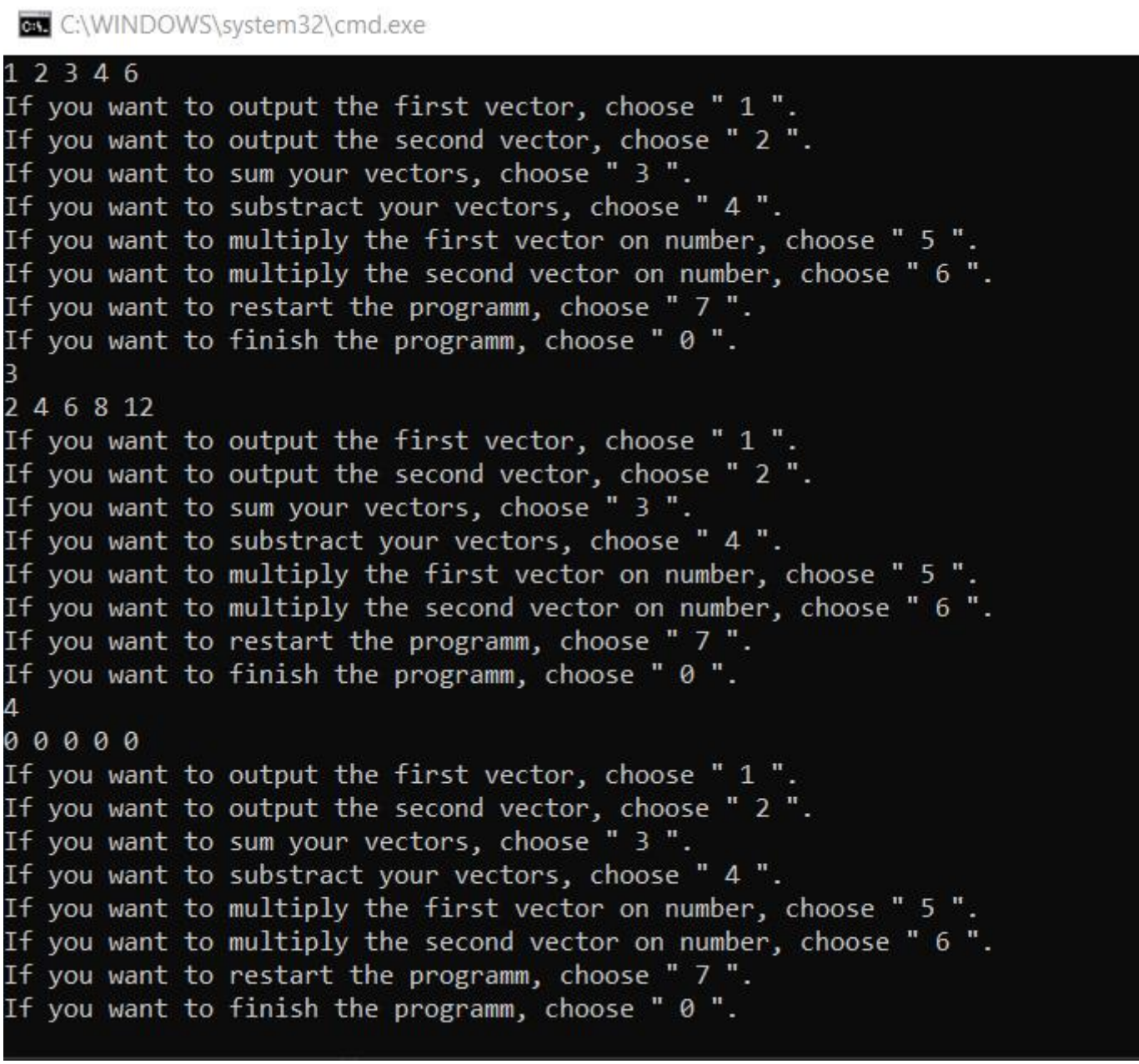


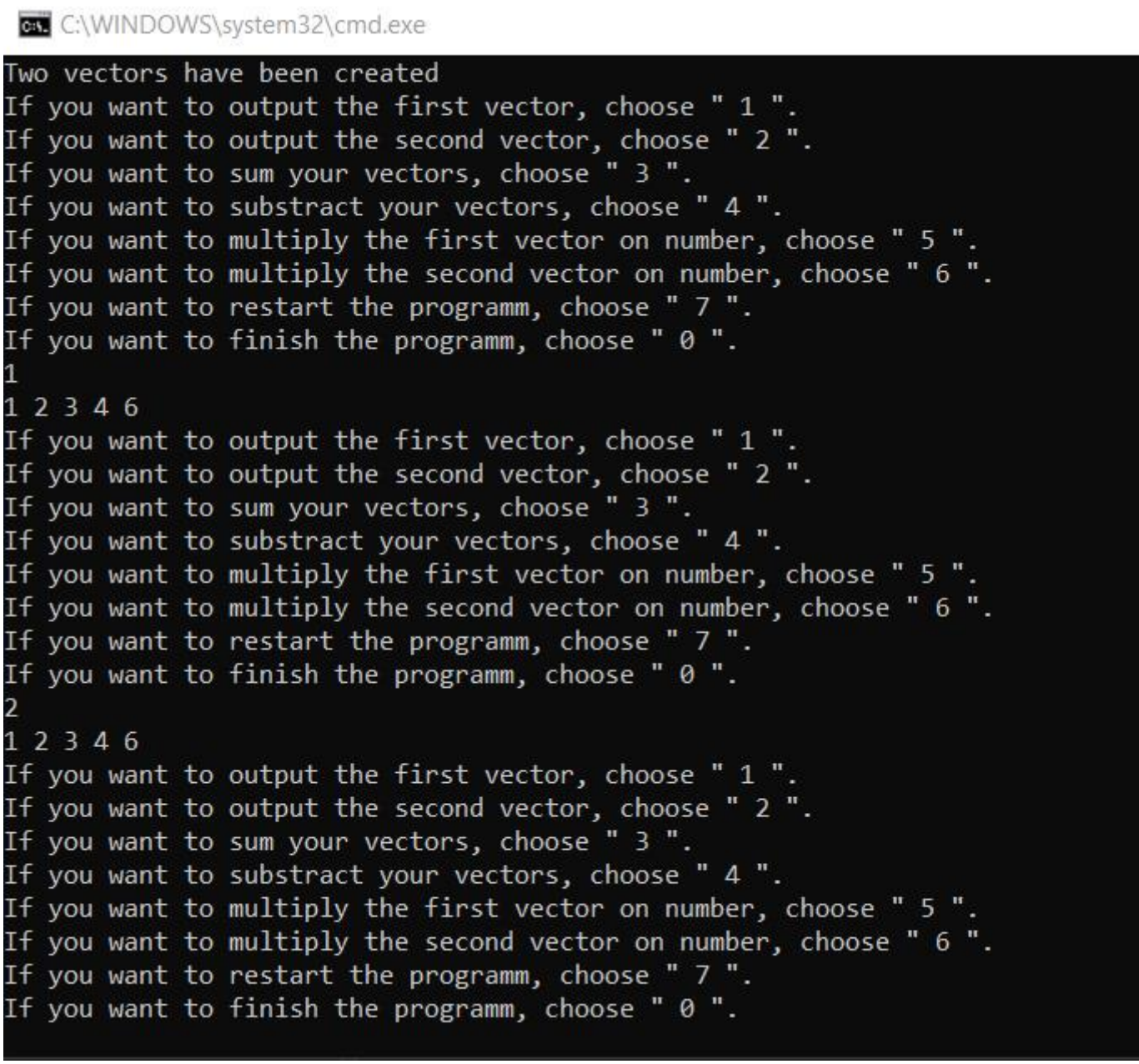

C:\WINDOWS\system32\cmd.exe
If you want to substract your vectors, choose " 4 ".
If you want to multiply the first vector on number, choose " 5 ".
If you want to multiply the second vector on number, choose " 6 ".
If you want to restart the programm, choose " 7 ".
If you want to finish the programm, choose " 0 ".
5
Enter a number for multiplying on the first vector
3
3 6 9
If you want to output the first vector, choose " 1 ".
If you want to output the second vector, choose " 2 ".
If you want to sum your vectors, choose " 3 ".
If you want to substract your vectors, choose " 4 ".
If you want to multiply the first vector on number, choose " 5 ".
If you want to multiply the second vector on number, choose " 6 ".
If you want to restart the programm, choose " 7 ".
If you want to finish the programm, choose " 0 ".
6
Enter a number for multiplying on the second vector
2
2 4 6 8
If you want to output the first vector, choose " 1 ".
If you want to output the second vector, choose " 2 ".
If you want to sum your vectors, choose " 3 ".
If you want to substract your vectors, choose " 4 ".
If you want to multiply the first vector on number, choose " 5 ".
If you want to multiply the second vector on number, choose " 6 ".
If you want to restart the programm, choose " 7 ".
If you want to finish the programm, choose " 0 ".

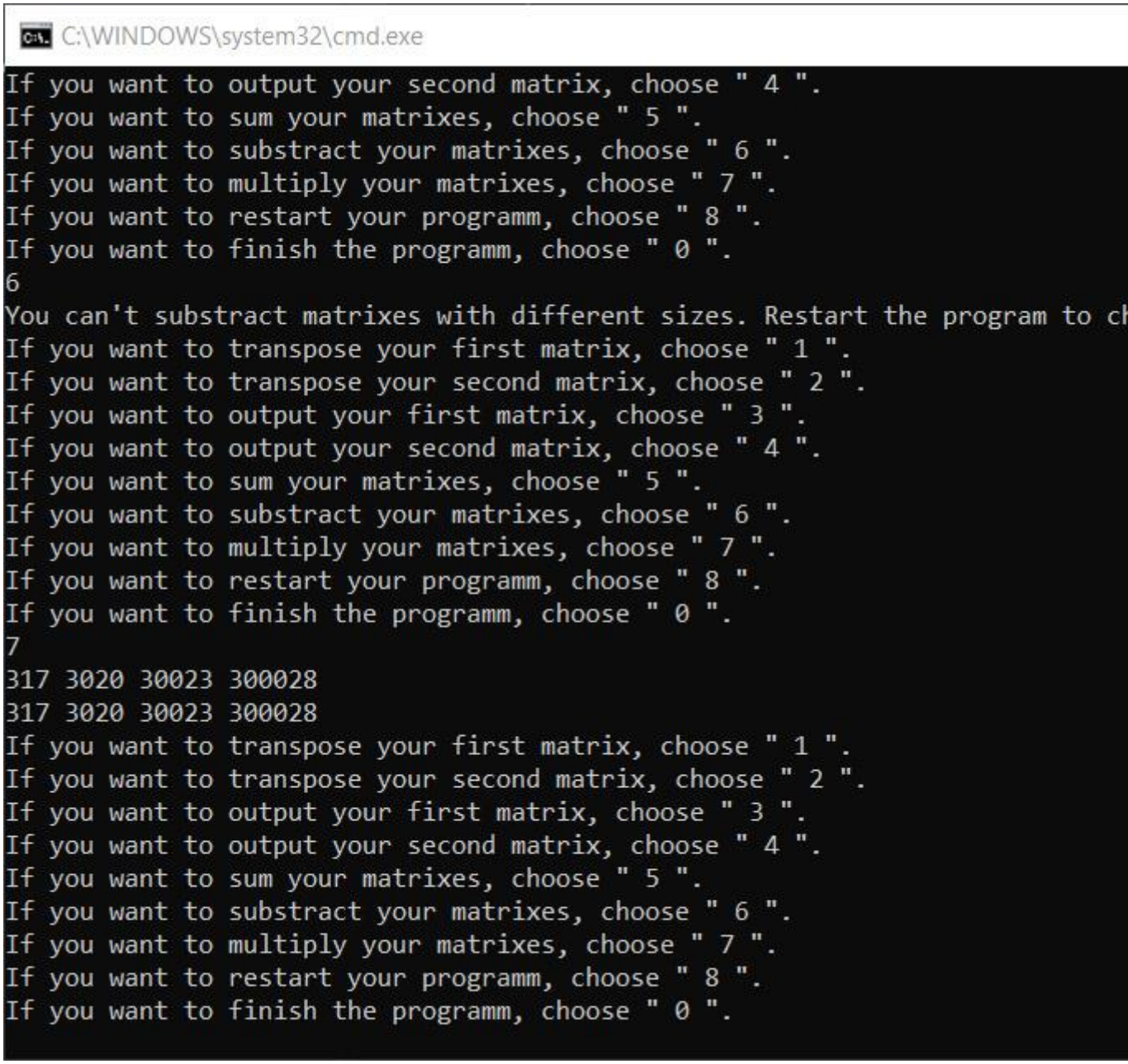

C:\WINDOWS\system32\cmd.exe
Two vectors have been created
If you want to output the first vector, choose " 1 ".
If you want to output the second vector, choose " 2 ".
If you want to sum your vectors, choose " 3 ".
If you want to substract your vectors, choose " 4 ".
If you want to multiply the first vector on number, choose " 5 ".
If you want to multiply the second vector on number, choose " 6 ".
If you want to restart the programm, choose " 7 ".
If you want to finish the programm, choose " 0 ".
3
You can't sum vectors with different dimensions. Restart the program to char
If you want to output the first vector, choose " 1 ".
If you want to output the second vector, choose " 2 ".
If you want to sum your vectors, choose " 3 ".
If you want to substract your vectors, choose " 4 ".
If you want to multiply the first vector on number, choose " 5 ".
If you want to multiply the second vector on number, choose " 6 ".
If you want to restart the programm, choose " 7 ".
If you want to finish the programm, choose " 0 ".
4
You can't substract vectors with different dimensions. Restart the program t
If you want to output the first vector, choose " 1 ".
If you want to output the second vector, choose " 2 ".
If you want to sum your vectors, choose " 3 ".
If you want to substract your vectors, choose " 4 ".
If you want to multiply the first vector on number, choose " 5 ".
If you want to multiply the second vector on number, choose " 6 ".
If you want to restart the programm, choose " 7 ".
If you want to finish the programm, choose " 0 ".

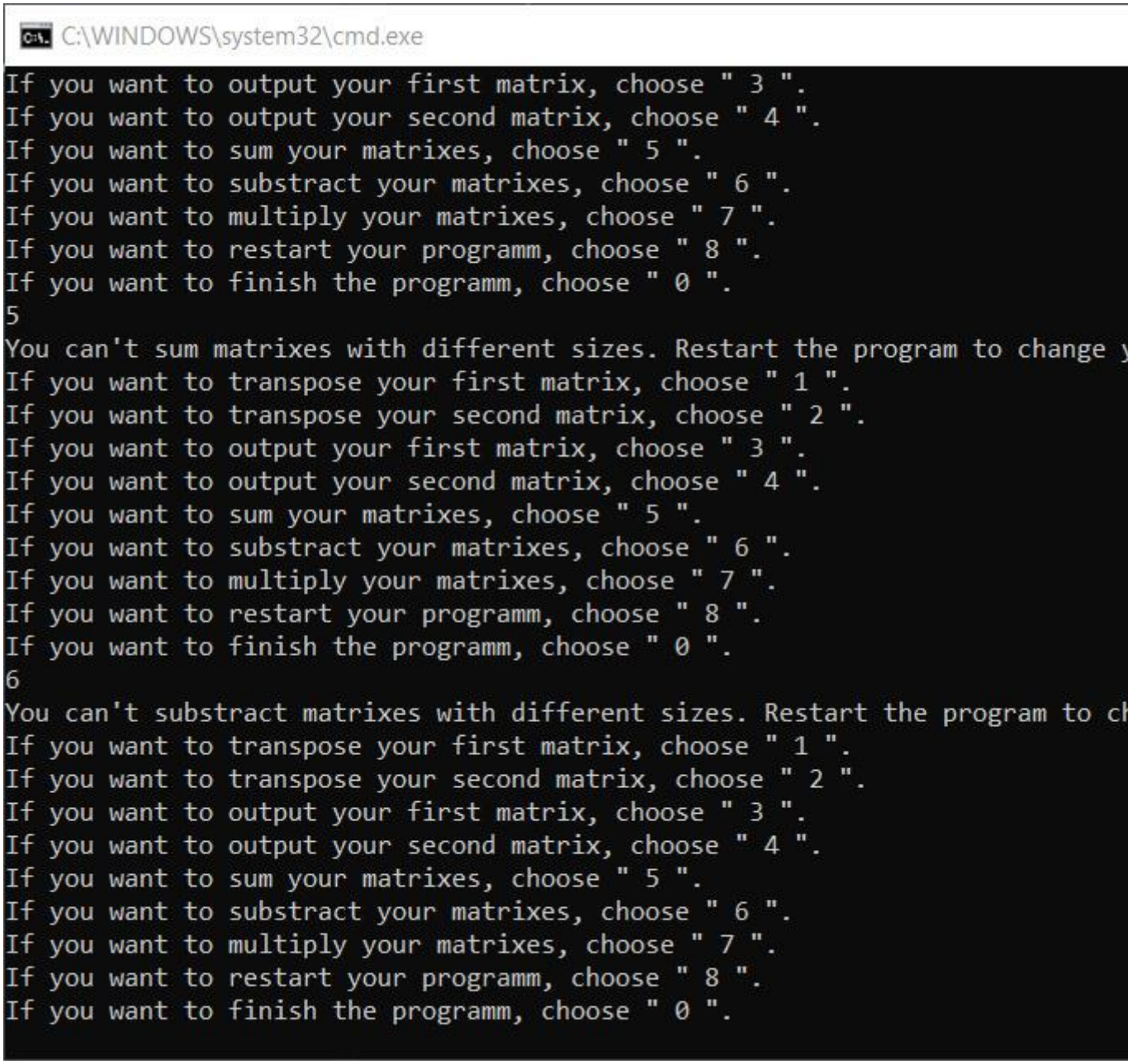

C:\WINDOWS\system32\cmd.exe
If you want to output the second vector, choose " 2 ".
If you want to sum your vectors, choose " 3 ".
If you want to substract your vectors, choose " 4 ".
If you want to multiply the first vector on number, choose " 5 ".
If you want to multiply the second vector on number, choose " 6 ".
If you want to restart the programm, choose " 7 ".
If you want to finish the programm, choose " 0 ".
7
The programm has been restarted
Let's begin from creating. Choose "1" if you want to create two matrixes. Ch
vectors. For aborting programm choose "3".
2
You have chosen a creating of two vectors. Choose the dimension of first one
3
Now choose the dimension of second one.
4
Enter 3 components of vector
1 2 3
Enter 4 components of vector
1 2 3 4
Two vectors have been created
If you want to output the first vector, choose " 1 ".
If you want to output the second vector, choose " 2 ".
If you want to sum your vectors, choose " 3 ".
If you want to substract your vectors, choose " 4 ".
If you want to multiply the first vector on number, choose " 5 ".
If you want to multiply the second vector on number, choose " 6 ".
If you want to restart the programm, choose " 7 ".
If you want to finish the programm, choose " 0 ".

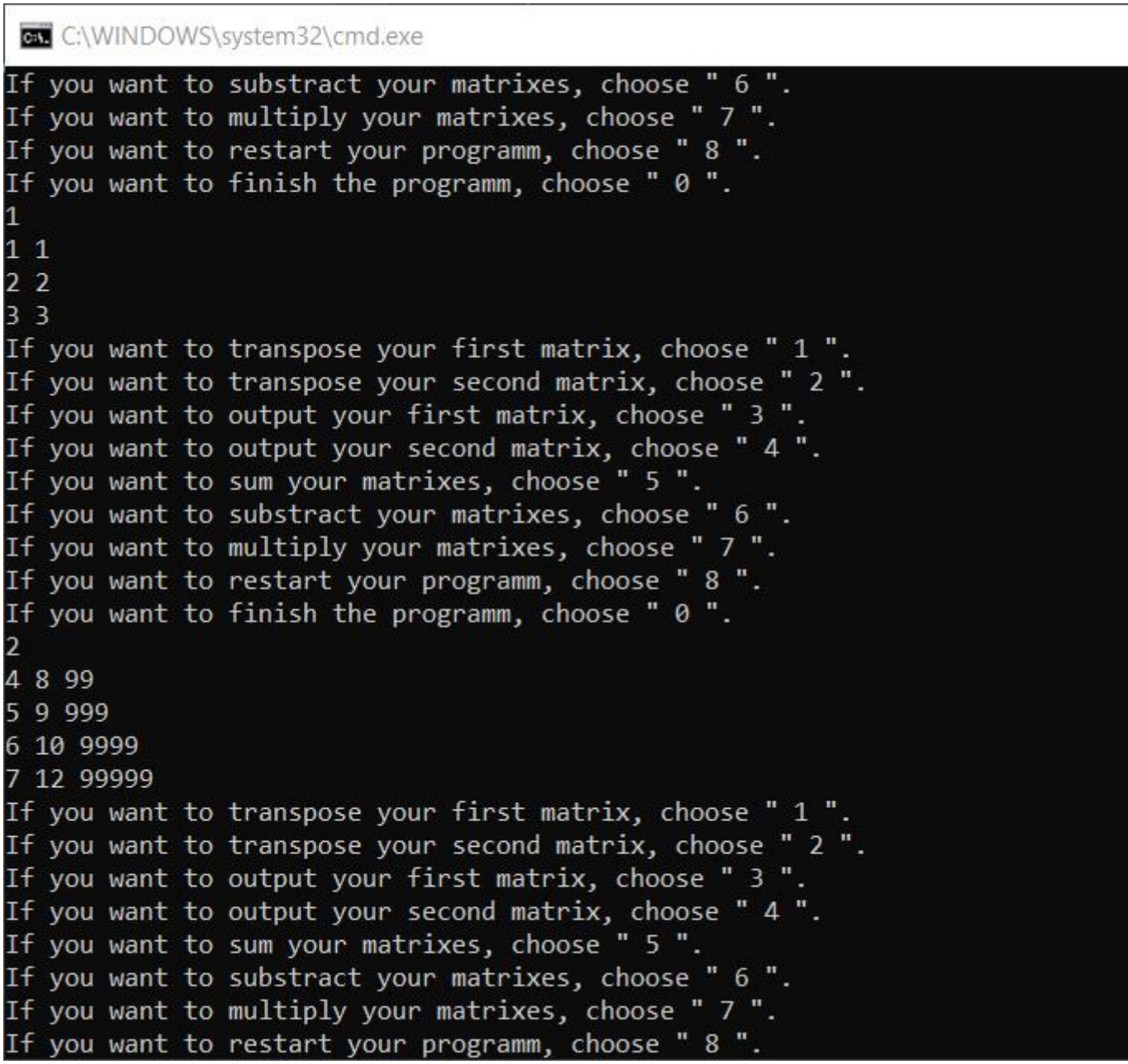

C:\WINDOWS\system32\cmd.exe
If you want to substract your vectors, choose " 4 ".
If you want to multiply the first vector on number, choose " 5 ".
If you want to multiply the second vector on number, choose " 6 ".
If you want to restart the programm, choose " 7 ".
If you want to finish the programm, choose " 0 ".
5
Enter a number for multiplying on the first vector
3
3 6 9 12 18
If you want to output the first vector, choose " 1 ".
If you want to output the second vector, choose " 2 ".
If you want to sum your vectors, choose " 3 ".
If you want to substract your vectors, choose " 4 ".
If you want to multiply the first vector on number, choose " 5 ".
If you want to multiply the second vector on number, choose " 6 ".
If you want to restart the programm, choose " 7 ".
If you want to finish the programm, choose " 0 ".
6
Enter a number for multiplying on the second vector
7
7 14 21 28 42
If you want to output the first vector, choose " 1 ".
If you want to output the second vector, choose " 2 ".
If you want to sum your vectors, choose " 3 ".
If you want to substract your vectors, choose " 4 ".
If you want to multiply the first vector on number, choose " 5 ".
If you want to multiply the second vector on number, choose " 6 ".
If you want to restart the programm, choose " 7 ".
If you want to finish the programm, choose " 0 ".

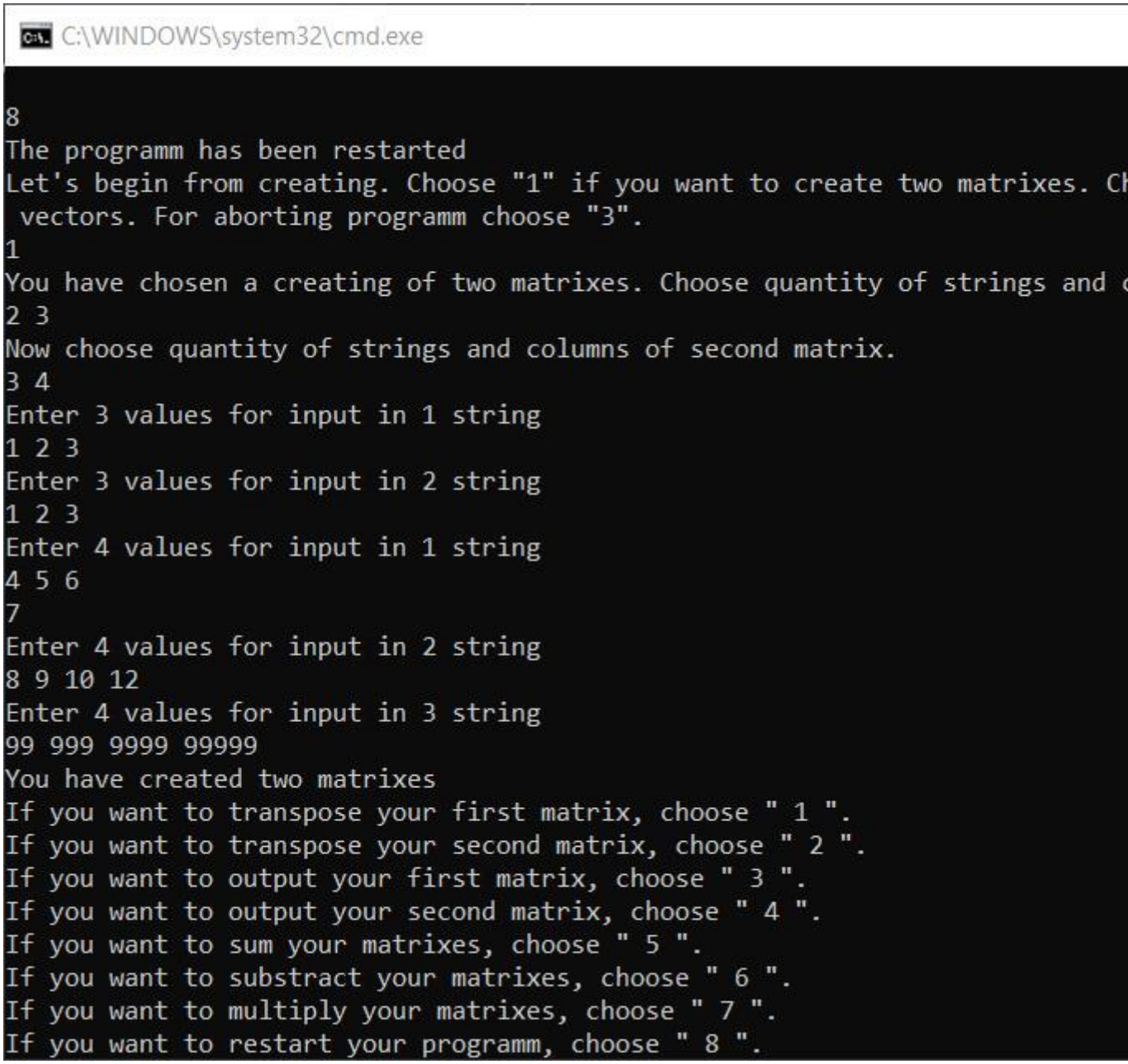

C:\WINDOWS\system32\cmd.exe
1 2 3 4 6
If you want to output the first vector, choose " 1 ".
If you want to output the second vector, choose " 2 ".
If you want to sum your vectors, choose " 3 ".
If you want to substract your vectors, choose " 4 ".
If you want to multiply the first vector on number, choose " 5 ".
If you want to multiply the second vector on number, choose " 6 ".
If you want to restart the programm, choose " 7 ".
If you want to finish the programm, choose " 0 ".
3
2 4 6 8 12
If you want to output the first vector, choose " 1 ".
If you want to output the second vector, choose " 2 ".
If you want to sum your vectors, choose " 3 ".
If you want to substract your vectors, choose " 4 ".
If you want to multiply the first vector on number, choose " 5 ".
If you want to multiply the second vector on number, choose " 6 ".
If you want to restart the programm, choose " 7 ".
If you want to finish the programm, choose " 0 ".
4
0 0 0 0 0
If you want to output the first vector, choose " 1 ".
If you want to output the second vector, choose " 2 ".
If you want to sum your vectors, choose " 3 ".
If you want to substract your vectors, choose " 4 ".
If you want to multiply the first vector on number, choose " 5 ".
If you want to multiply the second vector on number, choose " 6 ".
If you want to restart the programm, choose " 7 ".
If you want to finish the programm, choose " 0 ".

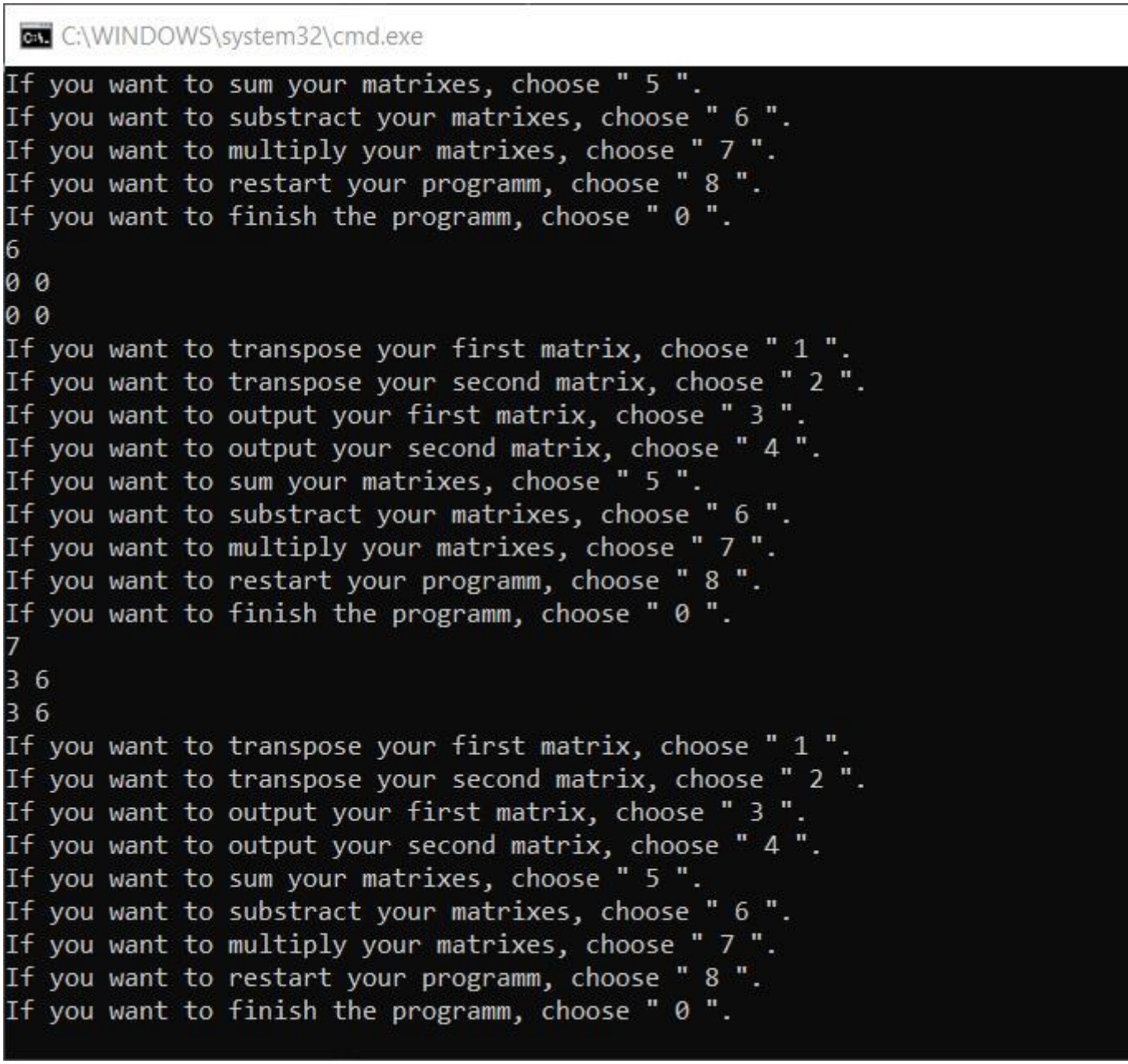

C:\WINDOWS\system32\cmd.exe
Two vectors have been created
If you want to output the first vector, choose " 1 ".
If you want to output the second vector, choose " 2 ".
If you want to sum your vectors, choose " 3 ".
If you want to substract your vectors, choose " 4 ".
If you want to multiply the first vector on number, choose " 5 ".
If you want to multiply the second vector on number, choose " 6 ".
If you want to restart the programm, choose " 7 ".
If you want to finish the programm, choose " 0 ".
1
1 2 3 4 6
If you want to output the first vector, choose " 1 ".
If you want to output the second vector, choose " 2 ".
If you want to sum your vectors, choose " 3 ".
If you want to substract your vectors, choose " 4 ".
If you want to multiply the first vector on number, choose " 5 ".
If you want to multiply the second vector on number, choose " 6 ".
If you want to restart the programm, choose " 7 ".
If you want to finish the programm, choose " 0 ".
2
1 2 3 4 6
If you want to output the first vector, choose " 1 ".
If you want to output the second vector, choose " 2 ".
If you want to sum your vectors, choose " 3 ".
If you want to substract your vectors, choose " 4 ".
If you want to multiply the first vector on number, choose " 5 ".
If you want to multiply the second vector on number, choose " 6 ".
If you want to restart the programm, choose " 7 ".
If you want to finish the programm, choose " 0 ".

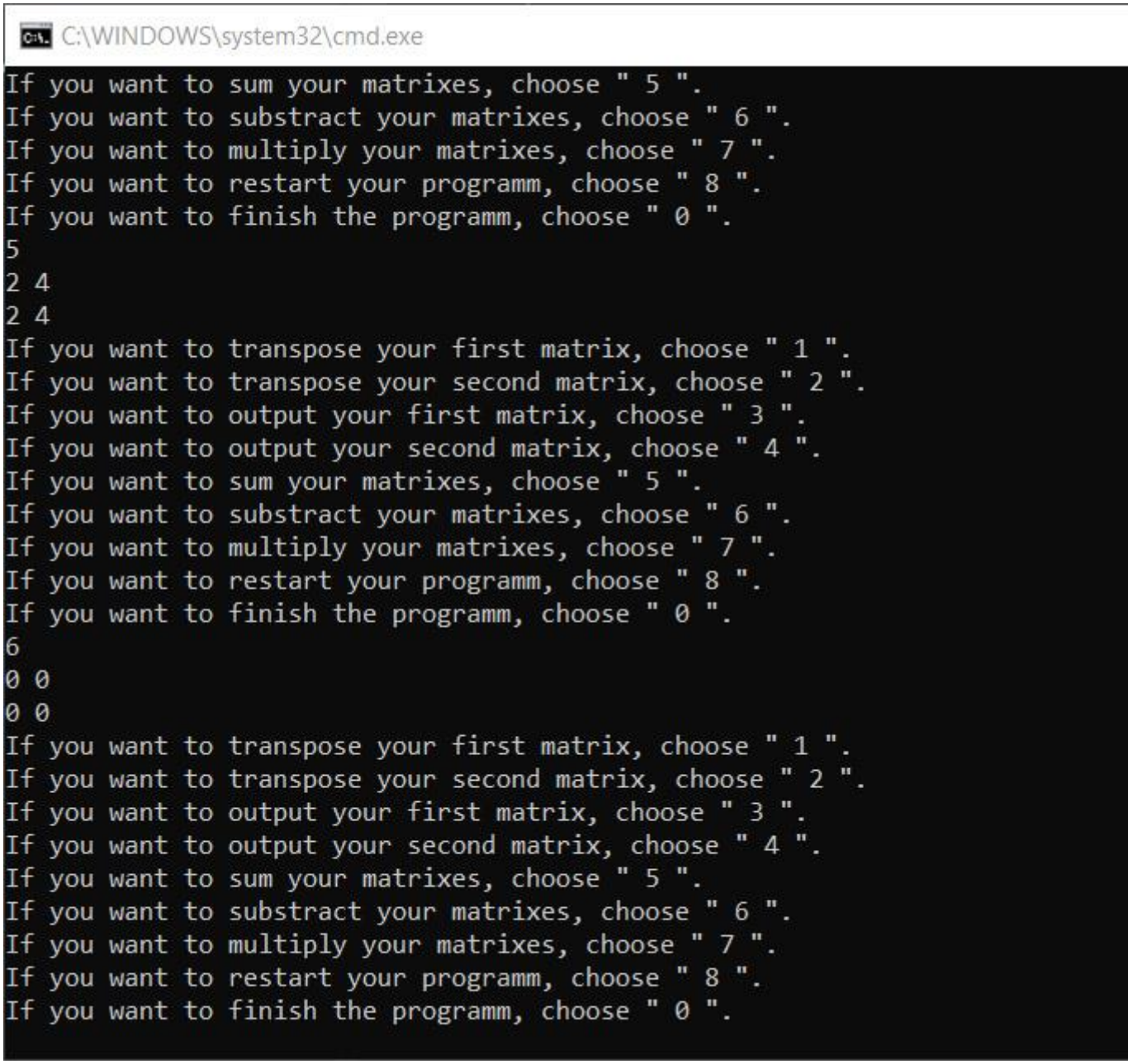

C:\WINDOWS\system32\cmd.exe
If you want to output your second matrix, choose " 4 ".
If you want to sum your matrixes, choose " 5 ".
If you want to substract your matrixes, choose " 6 ".
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".
6
You can't substract matrixes with different sizes. Restart the program to ch
If you want to transpose your first matrix, choose " 1 ".
If you want to transpose your second matrix, choose " 2 ".
If you want to output your first matrix, choose " 3 ".
If you want to output your second matrix, choose " 4 ".
If you want to sum your matrixes, choose " 5 ".
If you want to substract your matrixes, choose " 6 ".
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".
7
317 3020 30023 300028
317 3020 30023 300028
If you want to transpose your first matrix, choose " 1 ".
If you want to transpose your second matrix, choose " 2 ".
If you want to output your first matrix, choose " 3 ".
If you want to output your second matrix, choose " 4 ".
If you want to sum your matrixes, choose " 5 ".
If you want to substract your matrixes, choose " 6 ".
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".

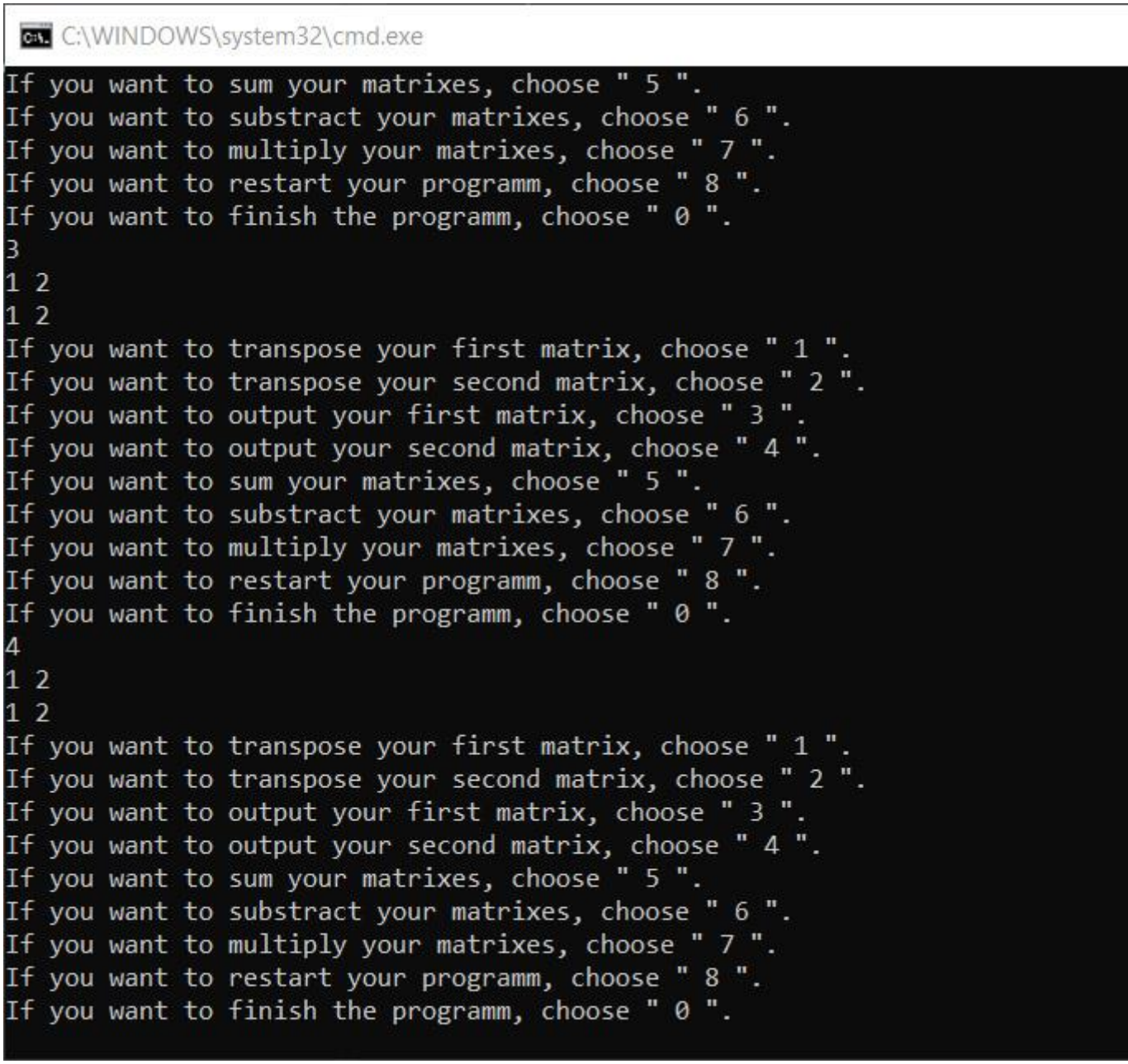

C:\WINDOWS\system32\cmd.exe
If you want to output your first matrix, choose " 3 ".
If you want to output your second matrix, choose " 4 ".
If you want to sum your matrixes, choose " 5 ".
If you want to substract your matrixes, choose " 6 ".
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".
5
You can't sum matrixes with different sizes. Restart the program to change
If you want to transpose your first matrix, choose " 1 ".
If you want to transpose your second matrix, choose " 2 ".
If you want to output your first matrix, choose " 3 ".
If you want to output your second matrix, choose " 4 ".
If you want to sum your matrixes, choose " 5 ".
If you want to substract your matrixes, choose " 6 ".
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".
6
You can't substract matrixes with different sizes. Restart the program to ch
If you want to transpose your first matrix, choose " 1 ".
If you want to transpose your second matrix, choose " 2 ".
If you want to output your first matrix, choose " 3 ".
If you want to output your second matrix, choose " 4 ".
If you want to sum your matrixes, choose " 5 ".
If you want to substract your matrixes, choose " 6 ".
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".

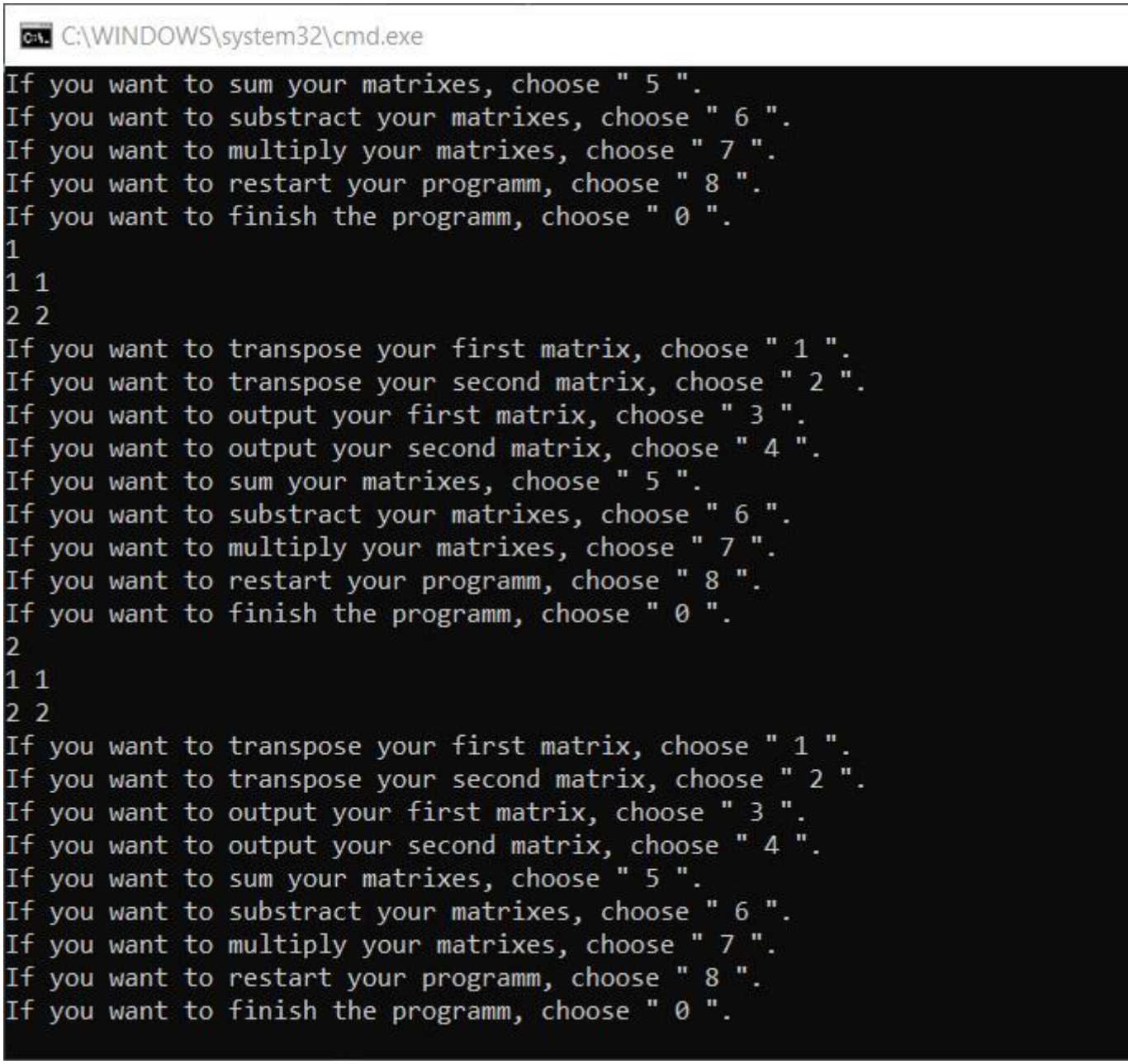

C:\WINDOWS\system32\cmd.exe
If you want to substract your matrixes, choose " 6 ".
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".
1
1 1
2 2
3 3
If you want to transpose your first matrix, choose " 1 ".
If you want to transpose your second matrix, choose " 2 ".
If you want to output your first matrix, choose " 3 ".
If you want to output your second matrix, choose " 4 ".
If you want to sum your matrixes, choose " 5 ".
If you want to substract your matrixes, choose " 6 ".
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".
2
4 8 99
5 9 999
6 10 9999
7 12 99999
If you want to transpose your first matrix, choose " 1 ".
If you want to transpose your second matrix, choose " 2 ".
If you want to output your first matrix, choose " 3 ".
If you want to output your second matrix, choose " 4 ".
If you want to sum your matrixes, choose " 5 ".
If you want to substract your matrixes, choose " 6 ".
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".

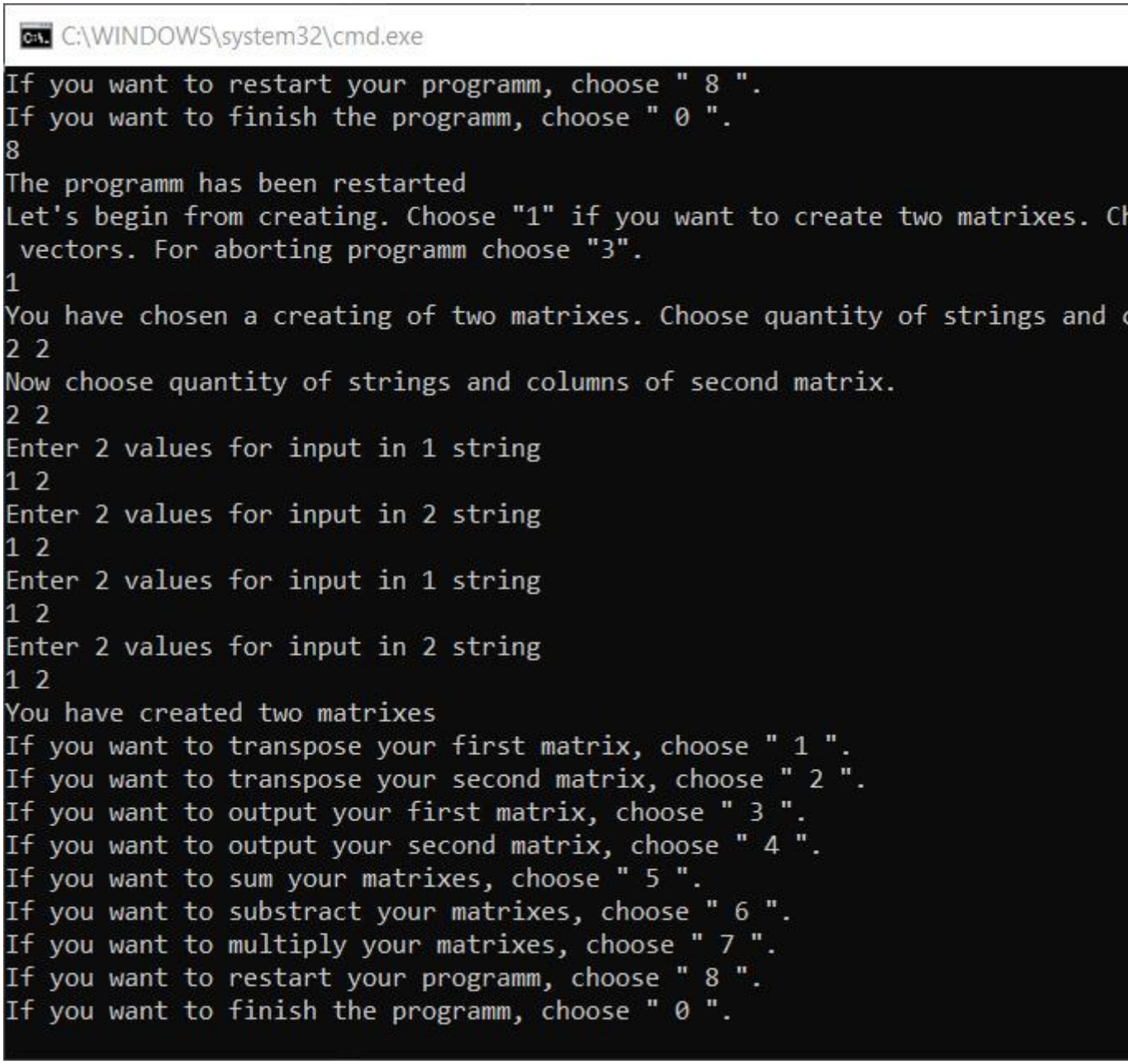

C:\WINDOWS\system32\cmd.exe
8
The programm has been restarted
Let's begin from creating. Choose "1" if you want to create two matrixes. Ch
vectors. For aborting programm choose "3".
1
You have chosen a creating of two matrixes. Choose quantity of strings and
2 3
Now choose quantity of strings and columns of second matrix.
3 4
Enter 3 values for input in 1 string
1 2 3
Enter 3 values for input in 2 string
1 2 3
Enter 4 values for input in 1 string
4 5 6
7
Enter 4 values for input in 2 string
8 9 10 12
Enter 4 values for input in 3 string
99 999 9999 99999
You have created two matrixes
If you want to transpose your first matrix, choose " 1 ".
If you want to transpose your second matrix, choose " 2 ".
If you want to output your first matrix, choose " 3 ".
If you want to output your second matrix, choose " 4 ".
If you want to sum your matrixes, choose " 5 ".
If you want to substract your matrixes, choose " 6 ".
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".

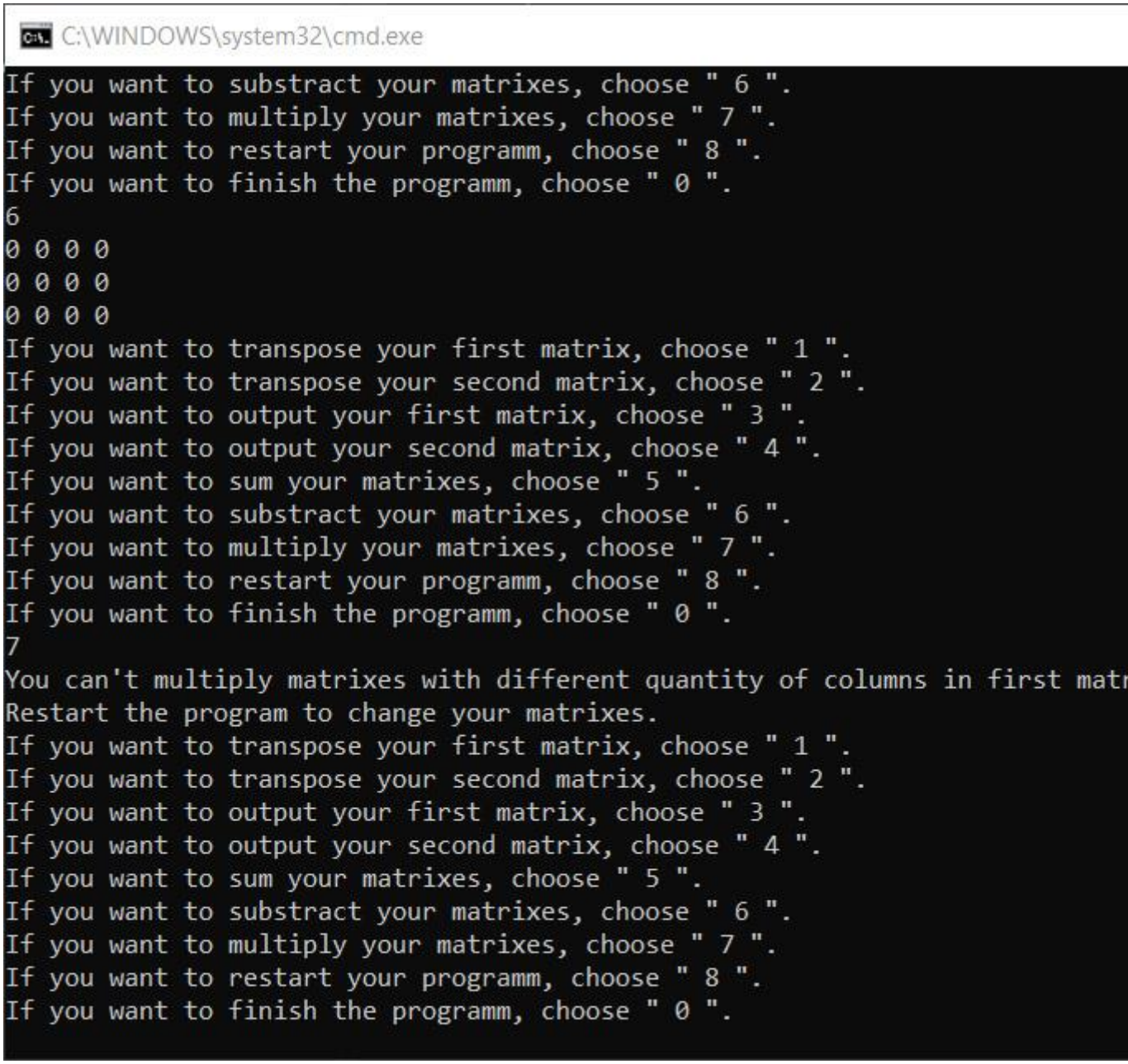

C:\WINDOWS\system32\cmd.exe
If you want to sum your matrixes, choose " 5 ".
If you want to substract your matrixes, choose " 6 ".
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".
6
0 0
0 0
If you want to transpose your first matrix, choose " 1 ".
If you want to transpose your second matrix, choose " 2 ".
If you want to output your first matrix, choose " 3 ".
If you want to output your second matrix, choose " 4 ".
If you want to sum your matrixes, choose " 5 ".
If you want to substract your matrixes, choose " 6 ".
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".
7
3 6
3 6
If you want to transpose your first matrix, choose " 1 ".
If you want to transpose your second matrix, choose " 2 ".
If you want to output your first matrix, choose " 3 ".
If you want to output your second matrix, choose " 4 ".
If you want to sum your matrixes, choose " 5 ".
If you want to substract your matrixes, choose " 6 ".
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".

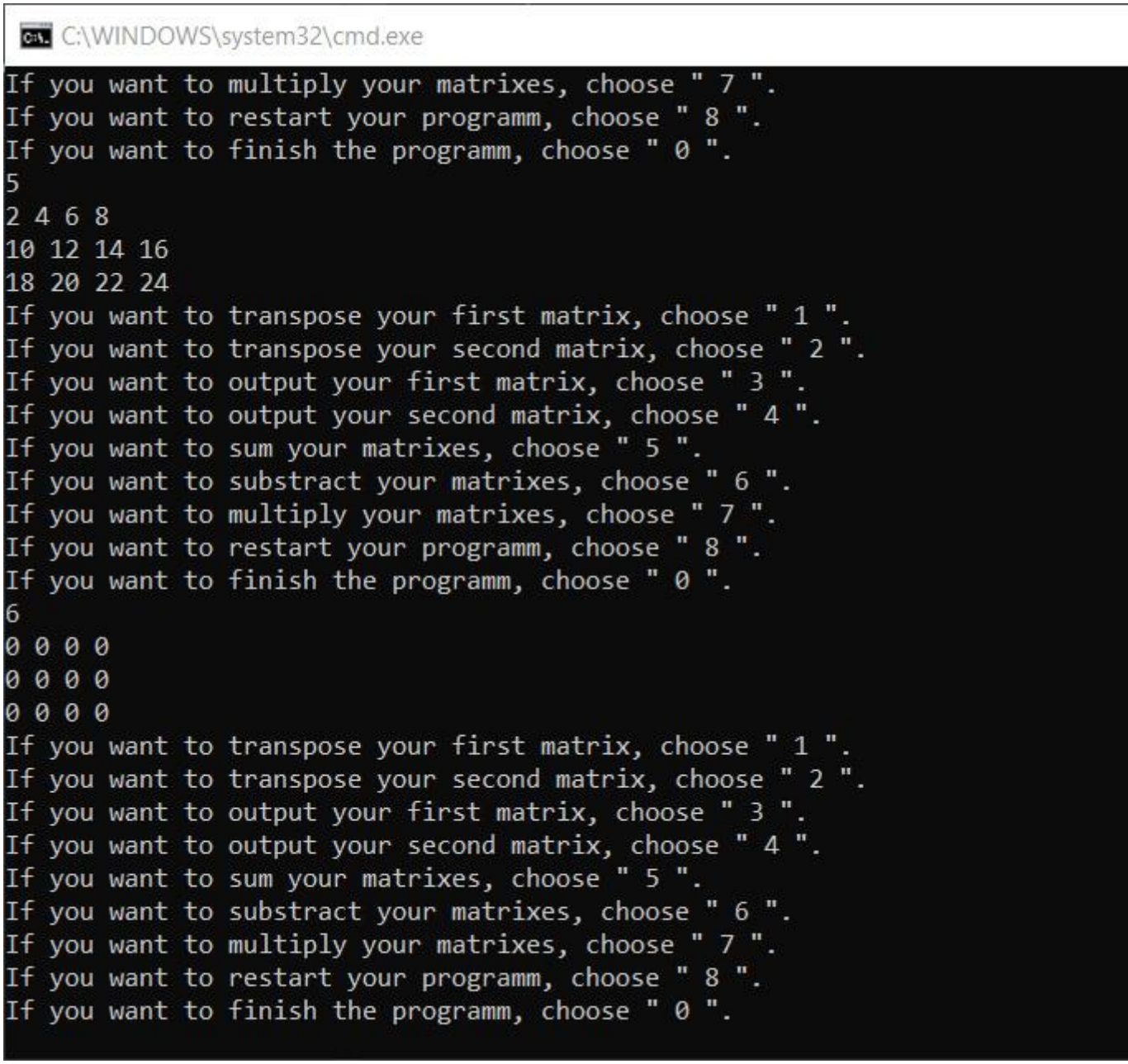

C:\WINDOWS\system32\cmd.exe
If you want to sum your matrixes, choose " 5 ".
If you want to substract your matrixes, choose " 6 ".
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".
5
2 4
2 4
If you want to transpose your first matrix, choose " 1 ".
If you want to transpose your second matrix, choose " 2 ".
If you want to output your first matrix, choose " 3 ".
If you want to output your second matrix, choose " 4 ".
If you want to sum your matrixes, choose " 5 ".
If you want to substract your matrixes, choose " 6 ".
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".
6
0 0
0 0
If you want to transpose your first matrix, choose " 1 ".
If you want to transpose your second matrix, choose " 2 ".
If you want to output your first matrix, choose " 3 ".
If you want to output your second matrix, choose " 4 ".
If you want to sum your matrixes, choose " 5 ".
If you want to substract your matrixes, choose " 6 ".
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".

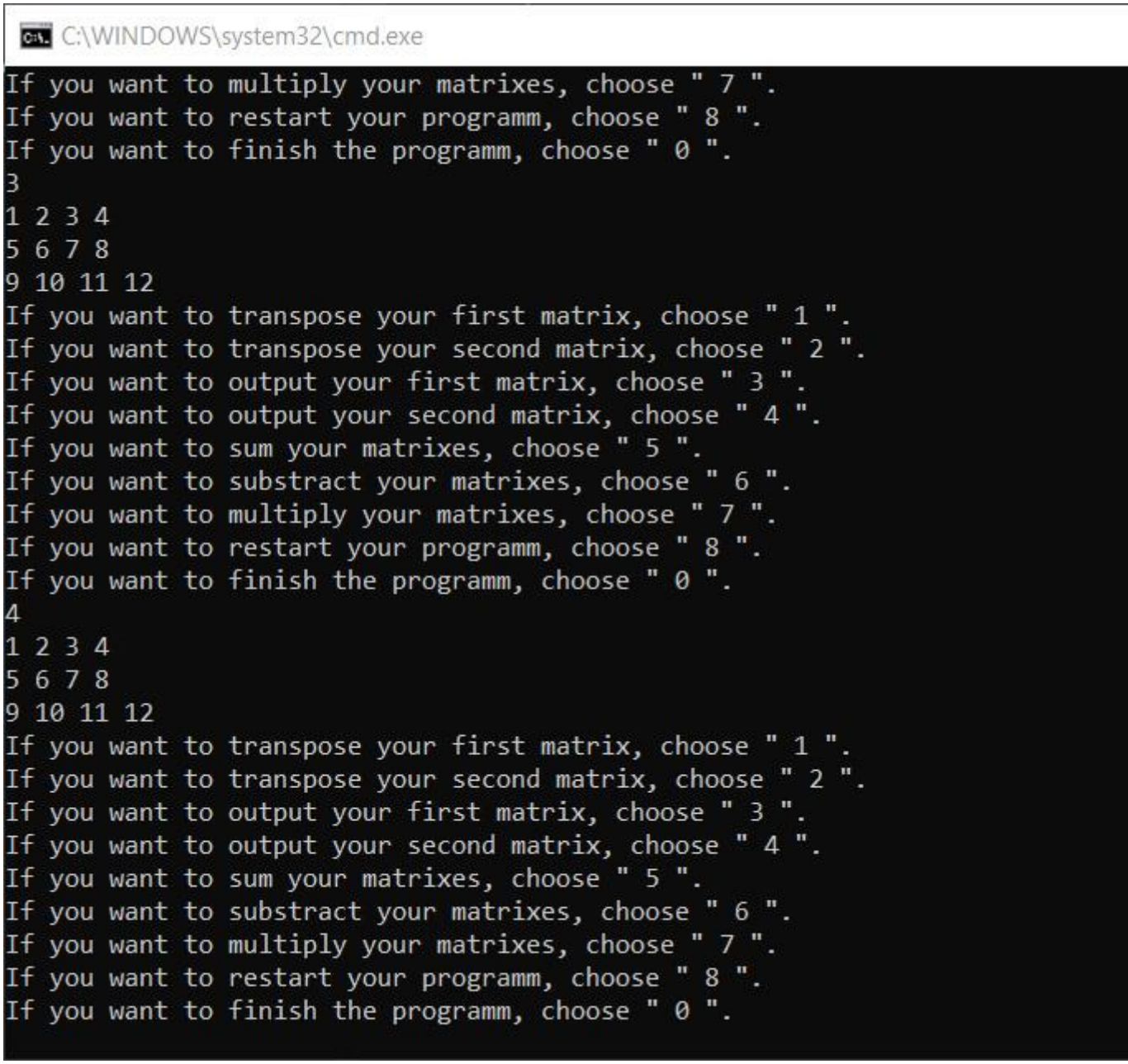

C:\WINDOWS\system32\cmd.exe
If you want to sum your matrixes, choose " 5 ".
If you want to substract your matrixes, choose " 6 ".
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".
3
1 2
1 2
If you want to transpose your first matrix, choose " 1 ".
If you want to transpose your second matrix, choose " 2 ".
If you want to output your first matrix, choose " 3 ".
If you want to output your second matrix, choose " 4 ".
If you want to sum your matrixes, choose " 5 ".
If you want to substract your matrixes, choose " 6 ".
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".
4
1 2
1 2
If you want to transpose your first matrix, choose " 1 ".
If you want to transpose your second matrix, choose " 2 ".
If you want to output your first matrix, choose " 3 ".
If you want to output your second matrix, choose " 4 ".
If you want to sum your matrixes, choose " 5 ".
If you want to substract your matrixes, choose " 6 ".
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".

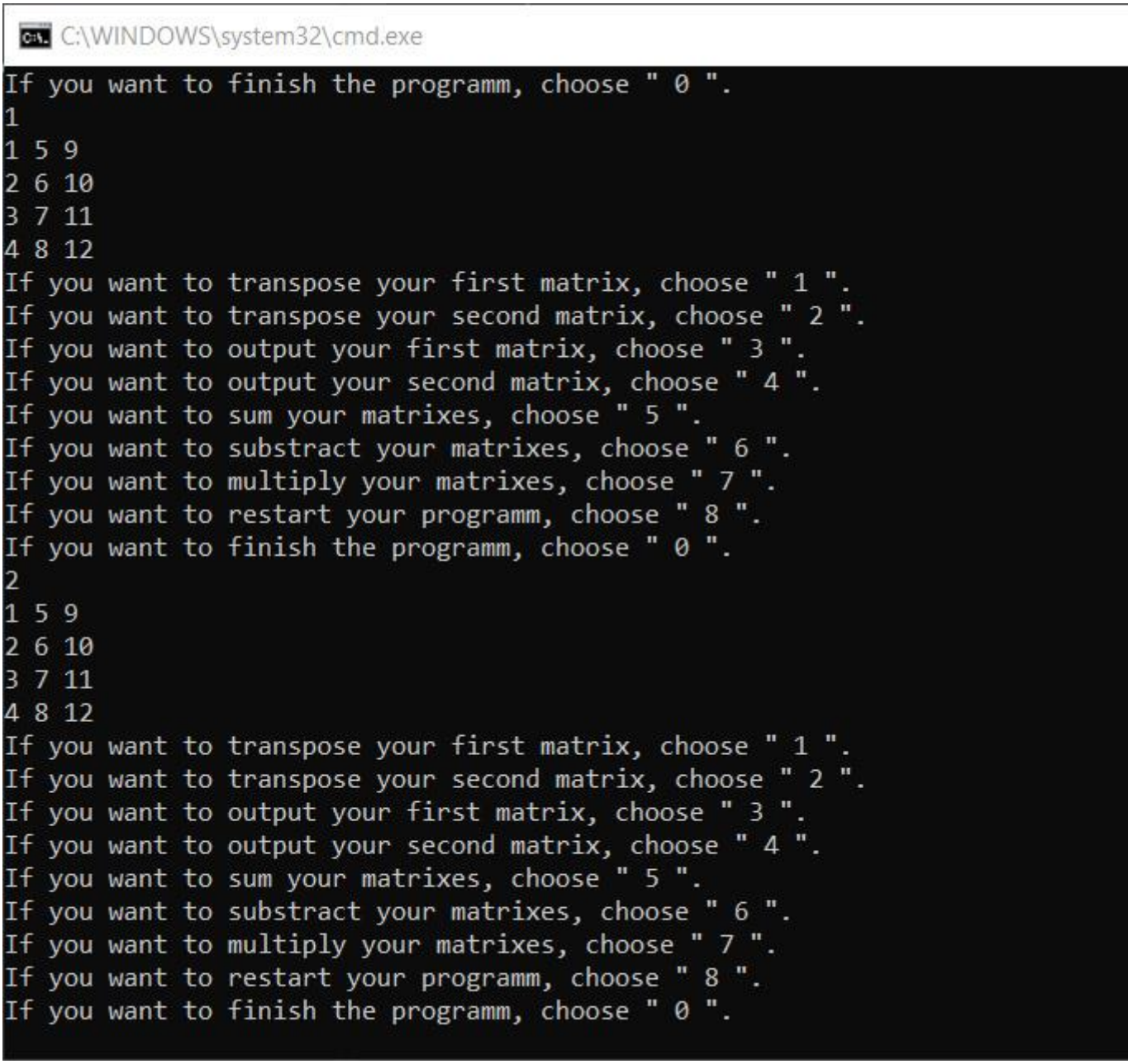

C:\WINDOWS\system32\cmd.exe
If you want to sum your matrixes, choose " 5 ".
If you want to substract your matrixes, choose " 6 ".
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".
1
1 1
2 2
If you want to transpose your first matrix, choose " 1 ".
If you want to transpose your second matrix, choose " 2 ".
If you want to output your first matrix, choose " 3 ".
If you want to output your second matrix, choose " 4 ".
If you want to sum your matrixes, choose " 5 ".
If you want to substract your matrixes, choose " 6 ".
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".
2
1 1
2 2
If you want to transpose your first matrix, choose " 1 ".
If you want to transpose your second matrix, choose " 2 ".
If you want to output your first matrix, choose " 3 ".
If you want to output your second matrix, choose " 4 ".
If you want to sum your matrixes, choose " 5 ".
If you want to substract your matrixes, choose " 6 ".
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".

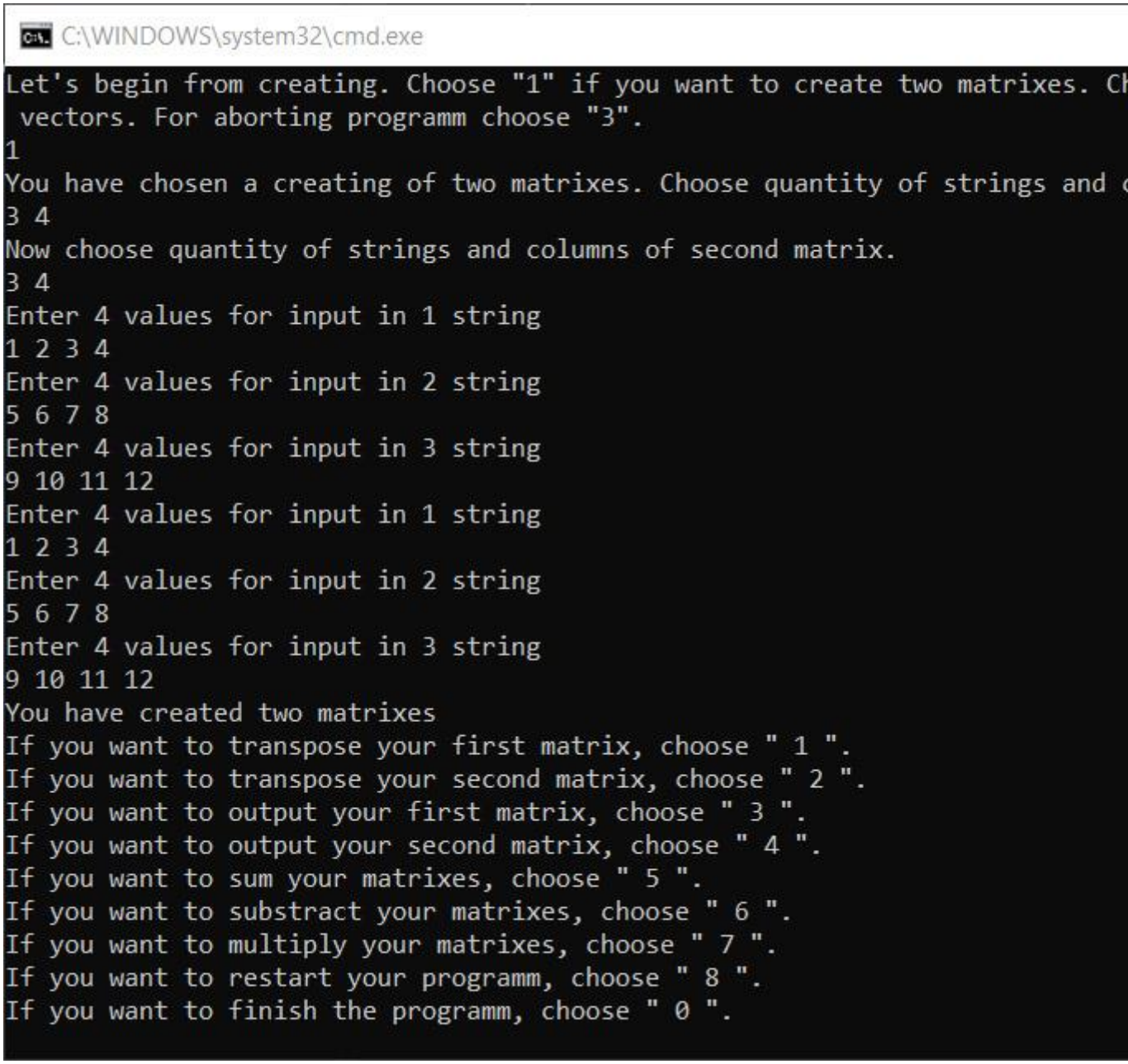

C:\WINDOWS\system32\cmd.exe
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".
8
The programm has been restarted
Let's begin from creating. Choose "1" if you want to create two matrixes. Ch
vectors. For aborting programm choose "3".
1
You have chosen a creating of two matrixes. Choose quantity of strings and
2 2
Now choose quantity of strings and columns of second matrix.
2 2
Enter 2 values for input in 1 string
1 2
Enter 2 values for input in 2 string
1 2
Enter 2 values for input in 1 string
1 2
Enter 2 values for input in 2 string
1 2
You have created two matrixes
If you want to transpose your first matrix, choose " 1 ".
If you want to transpose your second matrix, choose " 2 ".
If you want to output your first matrix, choose " 3 ".
If you want to output your second matrix, choose " 4 ".
If you want to sum your matrixes, choose " 5 ".
If you want to substract your matrixes, choose " 6 ".
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".


C:\WINDOWS\system32\cmd.exe
If you want to substract your matrixes, choose " 6 ".
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".
6
0 0 0 0
0 0 0 0
0 0 0 0
If you want to transpose your first matrix, choose " 1 ".
If you want to transpose your second matrix, choose " 2 ".
If you want to output your first matrix, choose " 3 ".
If you want to output your second matrix, choose " 4 ".
If you want to sum your matrixes, choose " 5 ".
If you want to substract your matrixes, choose " 6 ".
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".
7
You can't multiply matrixes with different quantity of columns in first matr
Restart the program to change your matrixes.
If you want to transpose your first matrix, choose " 1 ".
If you want to transpose your second matrix, choose " 2 ".
If you want to output your first matrix, choose " 3 ".
If you want to output your second matrix, choose " 4 ".
If you want to sum your matrixes, choose " 5 ".
If you want to substract your matrixes, choose " 6 ".
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".


C:\WINDOWS\system32\cmd.exe
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".
5
2 4 6 8
10 12 14 16
18 20 22 24
If you want to transpose your first matrix, choose " 1 ".
If you want to transpose your second matrix, choose " 2 ".
If you want to output your first matrix, choose " 3 ".
If you want to output your second matrix, choose " 4 ".
If you want to sum your matrixes, choose " 5 ".
If you want to substract your matrixes, choose " 6 ".
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".
6
0 0 0 0
0 0 0 0
0 0 0 0
If you want to transpose your first matrix, choose " 1 ".
If you want to transpose your second matrix, choose " 2 ".
If you want to output your first matrix, choose " 3 ".
If you want to output your second matrix, choose " 4 ".
If you want to sum your matrixes, choose " 5 ".
If you want to substract your matrixes, choose " 6 ".
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".


C:\WINDOWS\system32\cmd.exe
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".
3
1 2 3 4
5 6 7 8
9 10 11 12
If you want to transpose your first matrix, choose " 1 ".
If you want to transpose your second matrix, choose " 2 ".
If you want to output your first matrix, choose " 3 ".
If you want to output your second matrix, choose " 4 ".
If you want to sum your matrixes, choose " 5 ".
If you want to substract your matrixes, choose " 6 ".
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".
4
1 2 3 4
5 6 7 8
9 10 11 12
If you want to transpose your first matrix, choose " 1 ".
If you want to transpose your second matrix, choose " 2 ".
If you want to output your first matrix, choose " 3 ".
If you want to output your second matrix, choose " 4 ".
If you want to sum your matrixes, choose " 5 ".
If you want to substract your matrixes, choose " 6 ".
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".


C:\WINDOWS\system32\cmd.exe
If you want to finish the programm, choose " 0 ".
1
1 5 9
2 6 10
3 7 11
4 8 12
If you want to transpose your first matrix, choose " 1 ".
If you want to transpose your second matrix, choose " 2 ".
If you want to output your first matrix, choose " 3 ".
If you want to output your second matrix, choose " 4 ".
If you want to sum your matrixes, choose " 5 ".
If you want to substract your matrixes, choose " 6 ".
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".
2
1 5 9
2 6 10
3 7 11
4 8 12
If you want to transpose your first matrix, choose " 1 ".
If you want to transpose your second matrix, choose " 2 ".
If you want to output your first matrix, choose " 3 ".
If you want to output your second matrix, choose " 4 ".
If you want to sum your matrixes, choose " 5 ".
If you want to substract your matrixes, choose " 6 ".
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".


C:\WINDOWS\system32\cmd.exe
Let's begin from creating. Choose "1" if you want to create two matrixes. Ch
vectors. For aborting programm choose "3".
1
You have chosen a creating of two matrixes. Choose quantity of strings and
3 4
Now choose quantity of strings and columns of second matrix.
3 4
Enter 4 values for input in 1 string
1 2 3 4
Enter 4 values for input in 2 string
5 6 7 8
Enter 4 values for input in 3 string
9 10 11 12
Enter 4 values for input in 1 string
1 2 3 4
Enter 4 values for input in 2 string
5 6 7 8
Enter 4 values for input in 3 string
9 10 11 12
You have created two matrixes
If you want to transpose your first matrix, choose " 1 ".
If you want to transpose your second matrix, choose " 2 ".
If you want to output your first matrix, choose " 3 ".
If you want to output your second matrix, choose " 4 ".
If you want to sum your matrixes, choose " 5 ".
If you want to substract your matrixes, choose " 6 ".
If you want to multiply your matrixes, choose " 7 ".
If you want to restart your programm, choose " 8 ".
If you want to finish the programm, choose " 0 ".

Листинг программы

```
#include <iostream>

using namespace std;
class Matrix
{
	struct page
	{
		double info;
		page* next_in_str;
	};
	struct str
	{
		page* first_in_str = nullptr;
		page* last_in_str = nullptr;
		str* next_in_col;
		double& operator[](int j)			// Индексация для
вовзрата элемента
		{
			page* current = first_in_str;
			for (int k = 0; k < j; ++k)
				current = current->next_in_str;
			return current->info;
		}
	};
	int quan_of_col;
	int quan_of_str;
	str* first_in_col = nullptr;
	str* last_in_col = nullptr;
public:
	void add_page(str* st, double value)	// Добавление листа
	{
		page* newpage = new page;
		newpage->info = value;
		newpage->next_in_str = nullptr;
		if (st->first_in_str == nullptr)
			st->first_in_str = st->last_in_str = newpage;
		else
		{
			st->last_in_str->next_in_str = newpage;
			st->last_in_str = newpage;
		}
	}
	void add_str()		// Добавление строки
```

```
	{
		str* newstr = new str;
		newstr->next_in_col = nullptr;
		if (first_in_col == nullptr)
			first_in_col = last_in_col = newstr;
		else
		{
			last_in_col->next_in_col = newstr;
			last_in_col = newstr;
		}
	}
	void str_process(str* st, int iter = 1)		// Заполнение строки по умолчанию
	{
		cout << "Enter " << quan_of_col << " values for input in " << iter << " string" << endl;
		double value;
		for (int i = 0; i < quan_of_col; ++i)
		{
			str_process_again:
			cin >> value;
			if (cin.fail())
			{
				cin.clear();
				cin.ignore(32767, '\n');
				cout << "You have entered an incorrect value. Try it again" << endl;
				goto str_process_again;
			}
			else
				add_page(st, value);
		}
		cin.ignore(32767, '\n');
	}
	Matrix(int strin, int col) : quan_of_str(strin), quan_of_col(col)
	{
		if (strin <= 0 || col <= 0)
			cout << "You can create a matrix only with positive quantity of string and column" << endl;
		else
		{
			for (int i = 0; i < quan_of_str; ++i)
			{
				add_str();
				str_process(last_in_col, i + 1);
```

```
                }
            }
        }
        Matrix() {}             // Конструктор по умолчанию
        Matrix(const Matrix& x) : quan_of_col(x.quan_of_col),
quan_of_str(x.quan_of_str)
        {
            page* current_page;
            str* current_str = x.first_in_col;
            for (int i = 0; i < quan_of_str; ++i)
            {
                add_str();
                current_page = current_str->first_in_str;
                for (int j = 0; j < quan_of_col; ++j)
                {
                    add_page(last_in_col, current_page->info);
                    current_page = current_page->next_in_str;
                }
                current_str = current_str->next_in_col;
            }
        }
        ~Matrix()
        {
            page* current_page;
            str* current_str;
            for (int i = 0; i < quan_of_str; ++i)
            {
                current_str = first_in_col;
                for (int j = 0; j < quan_of_col; ++j)
                {
                    current_page = current_str->first_in_str;
                    current_str->first_in_str = current_str->first_in_str-
>next_in_str;
                    delete current_page;
                }
                current_str->last_in_str = nullptr;
                first_in_col = first_in_col->next_in_col;
                delete current_str;
            }
            last_in_col = nullptr;
        }
        void output_str(str* st)          //Вывод строки (для матрицы)
        {
            page* current = st->first_in_str;
            if (current != nullptr)
```

```
		{
			do
			{
				cout << current->info << " ";
				current = current->next_in_str;
			} while (current != nullptr);
			cout << endl;
		}
		else
			cout << "Error. You've tried to output an empty string" << endl;
	}
	void output_matrix()	// Вывод матрицы
	{
		str* current = first_in_col;
		do
		{
			output_str(current);
			current = current->next_in_col;
		} while (current != nullptr);
	}
	str operator[](int i)		//Индексация, возврат строки
	{
		str* current = first_in_col;
		for (int k = 0; k < i; ++k)
			current = current->next_in_col;
		return *current;
	}
	Matrix operator!()			// Транспонирование
	{
		Matrix result;
		result.quan_of_col = quan_of_str;
		result.quan_of_str = quan_of_col;
		for (int i = 0; i < quan_of_col; ++i)
		{
			result.add_str();
			for (int j = 0; j < quan_of_str; ++j)
				result.add_page(result.last_in_col, (*this)[j][i]);
		}
		return result;
	}
	friend Matrix operator+(Matrix& A, Matrix& B);
	friend Matrix operator-(Matrix& A, Matrix& B);
	friend Matrix operator*(Matrix& A, Matrix& B);
};
```

```
class Alg_vector
{
	int dimension;
	struct page
	{
		double info;
		page* next;
	};
	page* first = nullptr;
	page* last = nullptr;
public:
	void add_page(double value)		// Добавить лист
	{
		page* newcomp = new page;
		newcomp->next = nullptr;
		newcomp->info = value;
		if (first == nullptr)
			first = last = newcomp;
		else
		{
			last->next = newcomp;
			last = newcomp;
		}
	}
	Alg_vector(int dim) : dimension(dim)
	{
		if (dimension <= 0)
			cout << "You can't create zero-demensional vector. Set the right
demension" << endl;
		else
		{
			double value;
			cout << "Enter " << dimension << " components of vector" <<
endl;
			for (int i = 0; i < dimension; ++i)
			{
				vector_create:
				cin >> value;
				if (cin.fail())
				{
					cin.clear();
					cin.ignore(32767 , '\n');
					cout << "You have entered an incorrect value. Try
it again" << endl;
					goto vector_create;
```

```
                        }
                        else
                                add_page(value);
                }
                cin.ignore(32767, '\n');
        }
}
Alg_vector() {}                                 // Конструктор по умолчанию
Alg_vector(const Alg_vector& x) : dimension(x.dimension)
{
        page* current = x.first;
        for (int i = 0; i < dimension; ++i)
        {
                add_page(current->info);
                current = current->next;
        }
}
void output_vector()
{
        page* current = first;
        if (current == nullptr)
                cout << "You've tried to output a zero-demensional vector" <<
endl;
        else
        {
                do
                {
                        cout << current->info << " ";
                        current = current->next;
                } while (current != nullptr);
                cout << endl;
        }
}
double& operator[](int i)
{
        page* current = first;
        for (int k = 0; k < i; ++k)
                current = current->next;
        return current->info;
}
 ~Alg_vector()
{
        page* current;
        for (int i = 0; i < dimension; ++i)
        {
```

```
                current = first;
                first = first->next;
                delete current;
            }
            last = nullptr;
        }
        friend Alg_vector operator+(Alg_vector& A, Alg_vector& B);
        friend Alg_vector operator-(Alg_vector& A, Alg_vector& B);
        friend Alg_vector operator*(Alg_vector& A, double B);
        friend Alg_vector operator*(double A, Alg_vector& B);
};

Matrix operator+(Matrix& A, Matrix& B)
{
        if (A.quan_of_col != B.quan_of_col || A.quan_of_str != B.quan_of_str)
                throw 1;
        else
        {
                Matrix result;
                result.quan_of_col = A.quan_of_col;
                result.quan_of_str = A.quan_of_str;
                for (int i = 0; i < result.quan_of_str; ++i)
                {
                        result.add_str();
                        for (int j = 0; j < result.quan_of_col; ++j)
                                result.add_page(result.last_in_col, A[i][j] + B[i][j]);
                }
                return result;
        }
}

Matrix operator-(Matrix& A, Matrix& B)
{
        if (A.quan_of_col != B.quan_of_col || A.quan_of_str != B.quan_of_str)
                throw 1;
        else
        {
                Matrix result;
                result.quan_of_col = A.quan_of_col;
                result.quan_of_str = A.quan_of_str;
                for (int i = 0; i < result.quan_of_str; ++i)
                {
                        result.add_str();
                        for (int j = 0; j < result.quan_of_col; ++j)
                                result.add_page(result.last_in_col, A[i][j] - B[i][j]);
```

```
            }
            return result;
        }
}

Matrix operator*(Matrix& A, Matrix& B)
{
        if (A.quan_of_col != B.quan_of_str)
                throw 1;
        else
        {
                Matrix result;
                result.quan_of_col = B.quan_of_col;
                result.quan_of_str = A.quan_of_str;
                double expr;
                for (int i = 0; i < A.quan_of_str; ++i)
                {
                        result.add_str();
                        for (int j = 0; j < B.quan_of_col; ++j)
                        {
                                expr = 0;
                                for (int k = 0; k < A.quan_of_col; ++k)
                                        expr += A[i][k] * B[k][j];
                                result.add_page(result.last_in_col, expr);
                        }
                }
                return result;
        }
}

Alg_vector operator+(Alg_vector& A, Alg_vector& B)
{
        if (A.dimension != B.dimension)
                throw 1;
        else
        {
                Alg_vector result;
                result.dimension = A.dimension;
                for (int i = 0; i < result.dimension; ++i)
                {
                        result.add_page(A[i] + B[i]);
                }
                return result;
        }
}
```

```
Alg_vector operator-(Alg_vector& A, Alg_vector& B)
{
	if (A.dimension != B.dimension)
		throw 1;
	else
	{
		Alg_vector result;
		result.dimension = A.dimension;
		for (int i = 0; i < result.dimension; ++i)
			result.add_page(A[i] - B[i]);
		return result;
	}
}

Alg_vector operator*(Alg_vector& A, double B)
{
	Alg_vector result;
	result.dimension = A.dimension;
	for (int i = 0; i < result.dimension; ++i)
		result.add_page(A[i] * B);
	return result;
}

Alg_vector operator*(double A, Alg_vector& B)
{
	return B * A;
}

int main(int argc, char* argv[])
{
	cout << "Welcome to the lab1. The programm was made by Sergey Soshnikov. \nIt can create matrixes or algebraic vectors and compute them." << endl;
	int choice_1;
	while (true)
	{
		cout << "Let's begin from creating. Choose \"1\" if you want to create two matrixes. Choose \"2\" if you want to create two algebraic vectors. For aborting programm choose \"3\"." << endl;
		cin >> choice_1;
		if (cin.fail())
		{
			cin.clear();
			cin.ignore(32767, '\n');
```

```
                cout << "You have entered an incorrect value. Try it again" <<
endl;
        }
        else if (choice_1 == 1)
        {
                cin.ignore(32767, '\n');
                cout << "You have chosen a creating of two matrixes. Choose
quantity of strings and columns of first matrix." << endl;
                int quantity_of_string1, quantity_of_column1;
        making_matrix1:
                cin >> quantity_of_string1 >> quantity_of_column1;
                if (cin.fail())
                {
                        cin.clear();
                        cin.ignore(32767, '\n');
                        cout << "You have entered an incorrect value. Try it
again" << endl;
                        goto making_matrix1;
                }
                else
                        cin.ignore(32767, '\n');
                cout << "Now choose quantity of strings and columns of second
matrix." << endl;
                int quantity_of_string2, quantity_of_column2;
        making_matrix2:
                cin >> quantity_of_string2 >> quantity_of_column2;
                if (cin.fail())
                {
                        cin.clear();
                        cin.ignore(32767, '\n');
                        cout << "You have entered an incorrect value. Try it
again" << endl;
                        goto making_matrix2;
                }
                else
                        cin.ignore(32767, '\n');
                Matrix matrix1(quantity_of_string1, quantity_of_column1);
                Matrix matrix2(quantity_of_string2, quantity_of_column2);
                cout << "You have created two matrixes" << endl;
                int choice_2;
                while (true)
                {
                        cout << "If you want to transpose your first matrix,
choose \" 1 \".\nIf you want to transpose your second matrix, choose \" 2 \".\nIf you
want to output your first matrix, choose \" 3 \".\nIf you want to output your second
```

```
matrix, choose \" 4 \".\nIf you want to sum your matrixes, choose \" 5 \".\nIf you want to substract your matrixes, choose \" 6 \".\nIf you want to multiply your matrixes, choose \" 7 \".\nIf you want to restart your programm, choose \" 8 \".\nIf you want to finish the programm, choose \" 0 \"." << endl;
                                cin >> choice_2;
                                if (cin.fail())
                                {
                                        cin.clear();
                                        cin.ignore(32767, '\n');
                                        cout << "You have entered an incorrect value. Try it again" << endl;
                                }
                                else if (choice_2 == 1)
                                {
                                        cin.ignore(32767, '\n');
                                        (!matrix1).output_matrix();
                                }
                                else if (choice_2 == 2)
                                {
                                        cin.ignore(32767, '\n');
                                        (!matrix2).output_matrix();
                                }
                                else if (choice_2 == 3)
                                {
                                        cin.ignore(32767, '\n');
                                        matrix1.output_matrix();
                                }
                                else if (choice_2 == 4)
                                {
                                        cin.ignore(32767, '\n');
                                        matrix2.output_matrix();
                                }
                                else if (choice_2 == 5)
                                {
                                        cin.ignore(32767, '\n');
                                        try
                                        {
                                                (matrix1 + matrix2).output_matrix();
                                        }
                                        catch (int)
                                        {
                                                cout << "You can't sum matrixes with different sizes. Restart the program to change your matrixes." << endl;
                                        }
                                }
```

```
                else if (choice_2 == 6)
                {
                        cin.ignore(32767, '\n');
                        try
                        {
                                (matrix1 - matrix2).output_matrix();
                        }
                        catch (int)
                        {
                                cout << "You can't substract matrixes with
different sizes. Restart the program to change your matrixes." << endl;
                        }
                }
                else if (choice_2 == 7)
                {
                        cin.ignore(32767, '\n');
                        try
                        {
                                (matrix1 * matrix2).output_matrix();
                        }
                        catch (int)
                        {
                                cout << "You can't multiply matrixes with
different quantity of columns in first matrix and quantity of strings in second
matrix.Restart the program to change your matrixes." << endl;
                        }
                }
                else if (choice_2 == 8)
                {
                        cin.ignore(32767, '\n');
                        cout << "The programm has been restarted" <<
endl;
                        break;
                }
                else if (choice_2 == 0)
                {
                        cin.ignore(32767, '\n');
                        cout << "The programm has been finished" <<
endl;
                        return 0;
                }
                else
                {
                        cin.ignore(32767, '\n');
                        cout << "You have entered a wrong value. Try it
```

```
again" << endl;
                                }
                        }
                }
                else if (choice_1 == 2)
                {
                        cin.ignore(32767, '\n');
                        cout << "You have chosen a creating of two vectors. Choose the
dimension of first one." << endl;
                        int dimen1, dimen2;
                making_vector1:
                        cin >> dimen1;
                        if (cin.fail())
                        {
                                cin.clear();
                                cin.ignore(32767, '\n');
                                cout << "You have entered an incorrect value. Try it
again" << endl;
                                goto making_vector1;
                        }
                        else
                                cin.ignore(32767, '\n');
                        cout << "Now choose the dimension of second one." << endl;
                making_vector2:
                        cin >> dimen2;
                        if (cin.fail())
                        {
                                cin.clear();
                                cin.ignore(32767, '\n');
                                cout << "You have entered an incorrect value. Try it
again" << endl;
                                goto making_vector2;
                        }
                        else
                                cin.ignore(32767, '\n');
                        Alg_vector alg_vector1(dimen1);
                        Alg_vector alg_vector2(dimen2);
                        cout << "Two vectors have been created" << endl;
                        int choice_2;
                        while (true)
                        {
                                cout << "If you want to output the first vector, choose \" 1
\".\nIf you want to output the second vector, choose \" 2 \".\nIf you want to sum
your vectors, choose \" 3 \".\nIf you want to substract your vectors, choose \" 4
\".\nIf you want to multiply the first vector on number, choose \" 5 \".\nIf you want
```

```
to multiply the second vector on number, choose \" 6 \".\nIf you want to restart the programm, choose \" 7 \".\nIf you want to finish the programm, choose \" 0 \"." << endl;
                cin >> choice_2;
                if (cin.fail())
                {
                        cin.clear();
                        cin.ignore(32767, '\n');
                        cout << "You have entered an incorrect value. Try it again" << endl;
                }
                else if (choice_2 == 1)
                {
                        cin.ignore(32767, '\n');
                        alg_vector1.output_vector();
                }
                else if (choice_2 == 2)
                {
                        cin.ignore(32767, '\n');
                        alg_vector2.output_vector();
                }
                else if (choice_2 == 3)
                {
                        cin.ignore(32767, '\n');
                        try
                        {
                                (alg_vector1 + alg_vector2).output_vector();
                        }
                        catch (int)
                        {
                                cout << "You can't sum vectors with different dimensions. Restart the program to change your vectors." << endl;
                        }
                }
                else if (choice_2 == 4)
                {
                        cin.ignore(32767, '\n');
                        try
                        {
                                (alg_vector1 - alg_vector2).output_vector();
                        }
                        catch (int)
                        {
                                cout << "You can't substract vectors with different dimensions. Restart the program to change your vectors." << endl;
```

```
                }
            }
            else if (choice_2 == 5)
            {
                cin.ignore(32767, '\n');
                double num;
                cout << "Enter a number for multiplying on the
first vector" << endl;
            mult_vector1:
                cin >> num;
                if (cin.fail())
                {
                    cin.clear();
                    cin.ignore(32767, '\n');
                    cout << "You have entered an incorrect
value. Try it again" << endl;
                    goto mult_vector1;
                }
                else
                    cin.ignore(32767, '\n');
                (alg_vector1 * num).output_vector();
            }
            else if (choice_2 == 6)
            {
                cin.ignore(32767, '\n');
                double num;
                cout << "Enter a number for multiplying on the
second vector" << endl;
            mult_vector2:
                cin >> num;
                if (cin.fail())
                {
                    cin.clear();
                    cin.ignore(32767, '\n');
                    cout << "You have entered an incorrect
value. Try it again" << endl;
                    goto mult_vector2;
                }
                else
                    cin.ignore(32767, '\n');
                (alg_vector2 * num).output_vector();
            }
            else if (choice_2 == 7)
            {
                cin.ignore(32767, '\n');
```

```
                                        cout << "The programm has been restarted" <<
endl;
                                        break;
                                }
                                else if (choice_2 == 0)
                                {
                                        cin.ignore(32767, '\n');
                                        cout << "The programm has been finished" <<
endl;
                                        return 0;
                                }
                                else
                                {
                                        cin.ignore(32767, '\n');
                                        cout << "You have entered a wrong value. Try it
again" << endl;
                                }
                        }
                }
                else if (choice_1 == 3)
                {
                        cin.ignore(32767, '\n');
                        cout << "You have chosen an aborting of programm. Good
bye." << endl;
                        return 0;
                }
                else
                {
                        cin.ignore(32767, '\n');
                        cout << "You have tapped incorrect value. Try it again." <<
endl;
                }
        }
        return 0;
}
```