VG101 LAB 3 - Cube

LAB3 is a simple introduction to computer graphics. In this lab, the input is a 3×3 matrix, named A, and your program should output corresponding picture in the command window. The input lays in a txt file named "input.txt".

There are some examples:

Input 1

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

Output 1

```
      +---------+
     /         /|
    /         / |
   +---------+  |
   |         |  +
   |         | /
   |         |/
   +---------+
```

Input 2

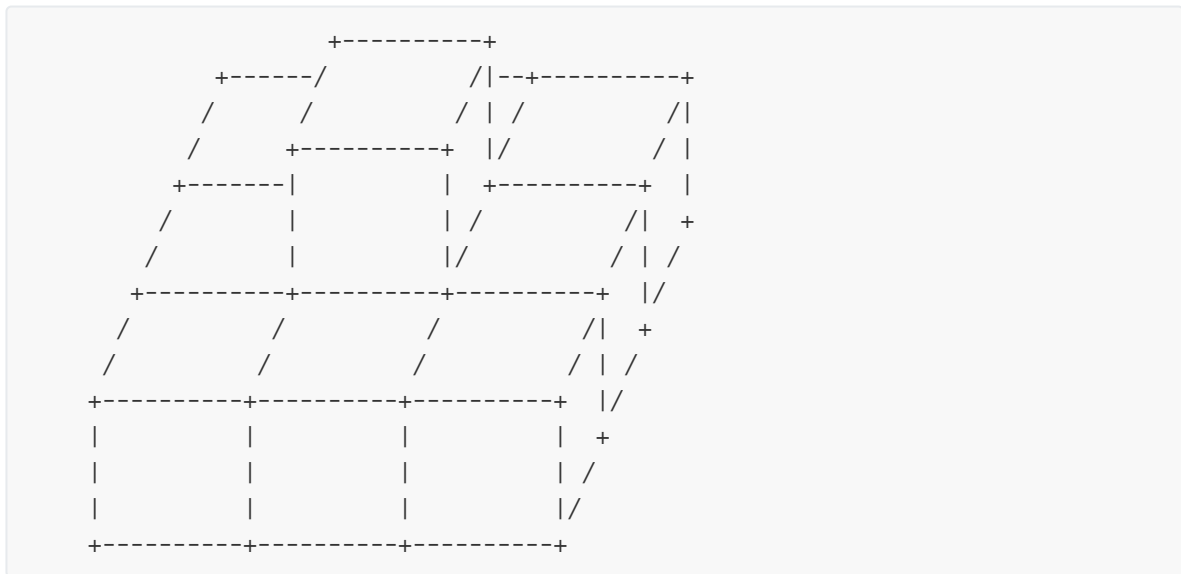$$A = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

Output 2

```
                    +---------+
                   /         /|
                  /         / |
                 +---------+  |
          +-------|         |  +
         /        |         | /|
        /         |         |/ |
       +---------+---------+  |
  +-------|         |         |  +
 /        |         |         | /|
/         |         |         |/ |
+---------+---------+---------+  |
|         |         |         |  +
|         |         |         | /
|         |         |         |/
+---------+---------+---------+
```

Input 3

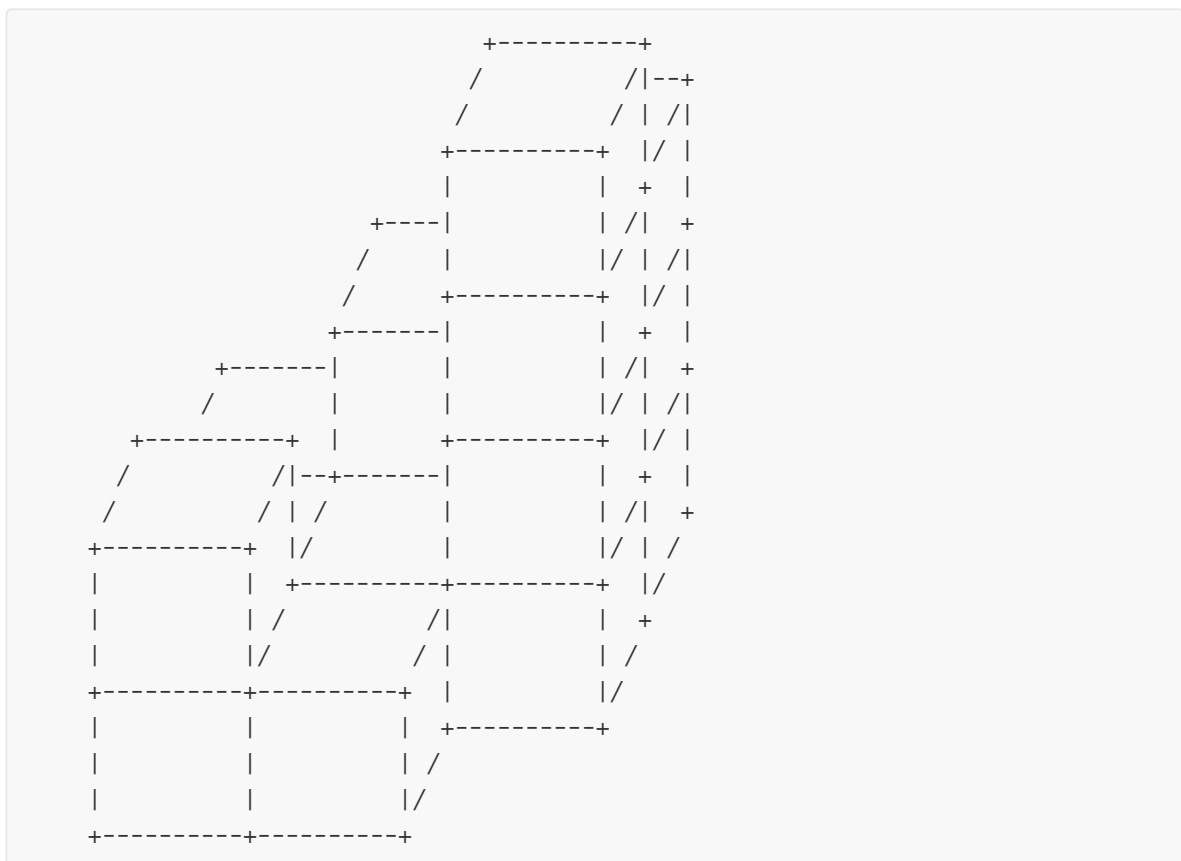$$A = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 2 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

Output 3

```
                    +---------+
            +------/          /|--+---------+
           /      /          / | /          /|
          /      +---------+ |/          / |
       +-------|          |  +---------+  |
      /        |          | /          /|  +
     /         |          |/          / | /
    +---------+---------+---------+  |/
   /         /         /          /|  +
  /         /         /          / | /
 +---------+---------+---------+  |/
 |         |         |          |  +
 |         |         |          | /
 |         |         |          |/
 +---------+---------+---------+
```

Input 4

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & 4 \\ 2 & 1 & 0 \end{bmatrix}$$

Output 4

```
                    +---------+
                   /          /|--+
                  /          / | /|
                 +---------+ |/ |
                 |          | + |
            +----|          | /|  +
           /     |          |/ | /|
          /      +---------+ |/ |
       +-------|          |  + |
      +-------|          |  /|  +
     /        |          |/ | /|
    +---------+ |        +---------+  |/ |
   /         /|--+-------|          |  + |
  /         / | /        |          | /|  +
 +---------+ |/          |          |/ | /
 |         |  +---------+---------+  |/
 |         | /          /|          |  +
 |         |/          / |          | /
 +---------+---------+  |          |/
 |         |          |  +---------+
 |         |          | /
 |         |          |/
 +---------+---------+
```
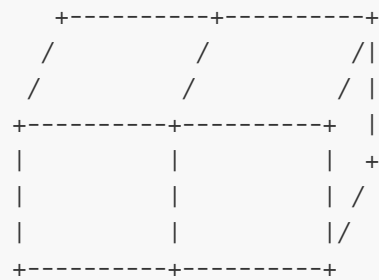
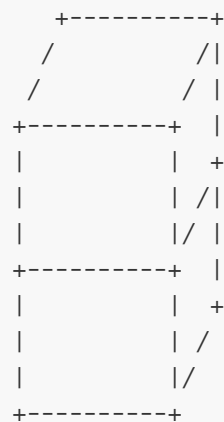It seems to be difficult to complete such a graph, but you may follow the following tasks:

Task 1 (5 pts)

Draw one cube on the screen, and then try to draw two cubes in parallel (calculate the top-left point of the second cube and concatenate it to the first cube). If you have finished this task, you will obtain a graph like this.
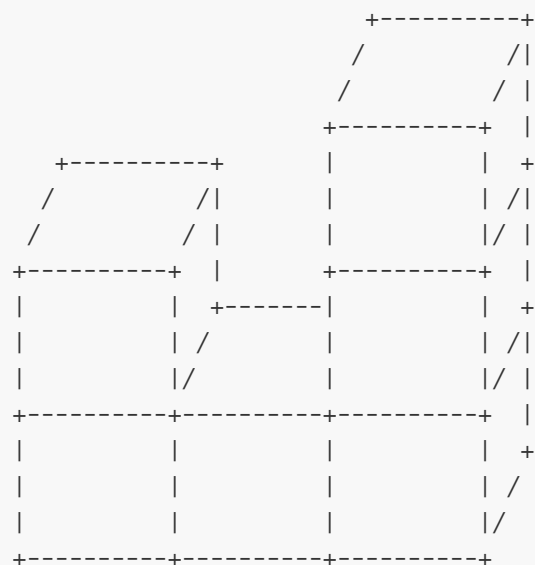
```
      +---------+---------+
     /         /         /|
    /         /         / |
   +---------+---------+  |
   |         |         |  +
   |         |         | /
   |         |         |/
   +---------+---------+
```

Task 2 (5 pts)

Draw two cubes in the first column. If you have finished this task, you will obtain a graph like this.

```
      +---------+
     /         /|
    /         / |
   +---------+  |
   |         |  +
   |         | /|
   |         |/ |
   +---------+  |
   |         |  +
   |         | /
   |         |/
   +---------+
```
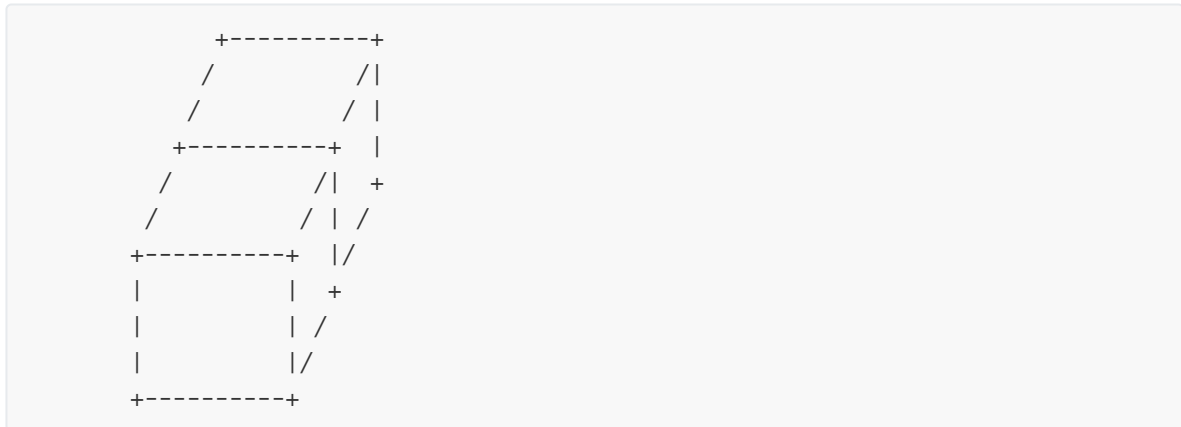
Task 3 (10 pts)

Calculate the position of cubes in row one of the matrix, and try to draw it on screen. After you have finished this task, you will be able to generate a graph like this.

```
                        +---------+
                       /         /|
                      /         / |
                     +---------+  |
      +---------+     |         |  +
     /         /|     |         | /|
    /         / |     |         |/ |
   +---------+  |     +---------+  |
   |         |  +-------|         |  +
   |         | /        |         | /|
   |         |/         |         |/ |
   +---------+---------+---------+  |
   |         |         |         |  +
   |         |         |         | /
   |         |         |         |/
   +---------+---------+---------+
```

Task 4 (5 pts)

Draw a cube in front of another cube (still, calculate the position of the top-left point, beware that you should transform a 3-D coordinate to 2-D). If you have finished this task, you will obtain a graph like this.
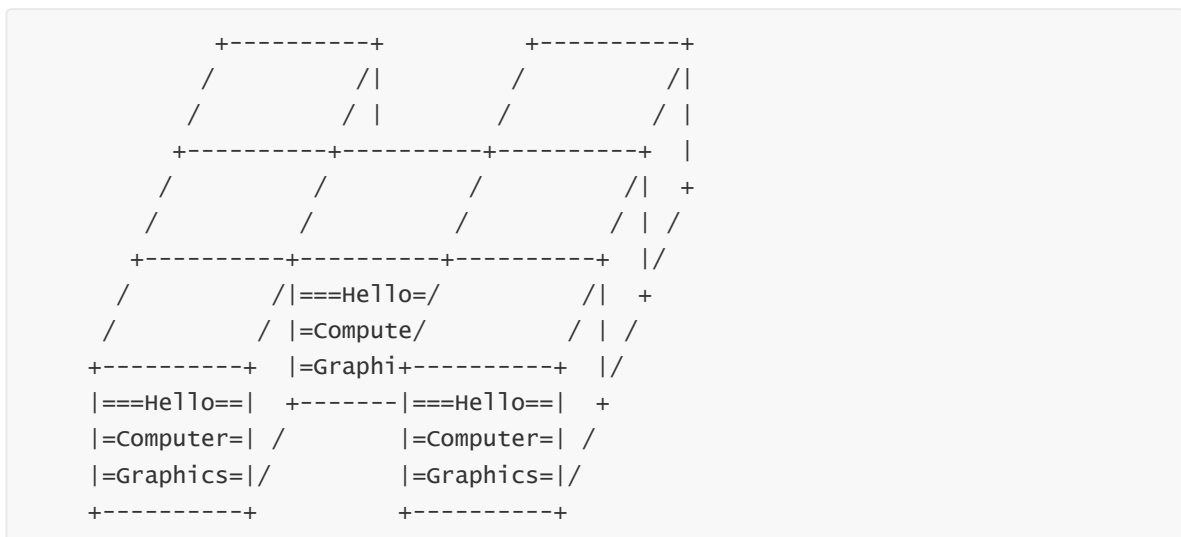
```
        +----------+
       /          /|
      /          / |
     +----------+  |
    /          /|  +
   /          / | /
  +----------+  |/
  |          |  +
  |          | /
  |          |/
  +----------+
```

Task 5 (20 pts)

Use the results above to generate the whole graph.

Task6 (5 pts)

Add some decorations to your cubes :) like this

```
        +----------+          +----------+
       /          /|         /          /|
      /          / |        /          / |
     +----------+---------+----------+  |
    /          /          /          /|  +
   /          /          /          / | /
  +----------+----------+----------+  |/
 /          /|===Hello=/          /|  +
/          / |=Compute/          / | /
+----------+  |=Graphi+----------+  |/
|===Hello==|  +-------|===Hello==|  +
|=Computer=| /        |=Computer=| /
|=Graphics=|/         |=Graphics=|/
+----------+          +----------+
```

Hints

1. Choose an easy-to-draw cube is very important. You can use the cube shown in this file, it's rather easy-to-draw.
2. A matrix is totally rectangular, but a cube is not exactly. Use 0 to fill the parts that should be transparent and use matrix manipulation to add it to a blank matrix.
3. Use series in mathematics to calculate position and you could get a equation [top, left] = [t(x, y), l(x, y)]. Remember what top and left means for a matrix (its actually not the "+" in the given cube)
4. Leave enough space for the matrix to grow to the left (use zeros function to generate a proper matrix in advance, it will make your life easier).