```
● galogi@LAPTOP-HE5DUJQL:~/os_hw1/coverage_code$ make
g++ -std=c++17 -Wall -Wextra -pedantic -fprofile-arcs -ftest-coverage -g -c GraphApp.cpp -o GraphApp.o
g++ -std=c++17 -Wall -Wextra -pedantic -fprofile-arcs -ftest-coverage -g -c GraphBuilder.cpp -o GraphBuilder.o
g++ -std=c++17 -Wall -Wextra -pedantic -fprofile-arcs -ftest-coverage -g -c Dijkstra.cpp -o Dijkstra.o
g++ -std=c++17 -Wall -Wextra -pedantic -fprofile-arcs -ftest-coverage -g -o graph_app GraphApp.o GraphBuilder.o Dijkstra.o -fprofile-arcs -ftest-coverage
● galogi@LAPTOP-HE5DUJQL:~/os_hw1/coverage_code$ make run
./graph_app
Do you want to check a new graph? (y/n): 123
Invalid input. Please enter a single character: 'y' or 'n'.
Do you want to check a new graph? (y/n): 123
Invalid input. Please enter a single character: 'y' or 'n'.
Do you want to check a new graph? (y/n): 123
Invalid input. Please enter a single character: 'y' or 'n'.
You have entered invalid input 3 times. Exiting the program.
● galogi@LAPTOP-HE5DUJQL:~/os_hw1/coverage_code$ make run
./graph_app
Do you want to check a new graph? (y/n): 1
Invalid input. Please enter 'y' or 'n'.
Do you want to check a new graph? (y/n): 1
Invalid input. Please enter 'y' or 'n'.
Do you want to check a new graph? (y/n): 1
Invalid input. Please enter 'y' or 'n'.
You have entered invalid input 3 times. Exiting the program.
```

מקרה קצה:
הקלדת תו שגוי כאשר רוצים להכניס גרף חדש.
3 שגיאות יגרמו ליציאה מהתוכנית.

```
● galogi@LAPTOP-HE5DUJQL:~/os_hw1/coverage_code$ make run
./graph_app
Do you want to check a new graph? (y/n): n
Exiting program. Goodbye!
```

- לא רוצים עוד גרף

```
● galogi@LAPTOP-HE5DUJQL:~/os_hw1/coverage_code$ make run
./graph_app
Do you want to check a new graph? (y/n): y
Enter number of vertices (positive integer): -5
Invalid input. Please enter a single positive integer with no extra characters.
Enter number of vertices (positive integer): -5
Invalid input. Please enter a single positive integer with no extra characters.
Enter number of vertices (positive integer): -5
Invalid input. Please enter a single positive integer with no extra characters.
You have entered invalid input 3 times. Exiting the program.
```

מקרה קצה
הכנסת ערך שלילי למספר
הקודקודים שנרצה בגרף.

```
● galogi@LAPTOP-HE5DUJQL:~/os_hw1/coverage_code$ make
make: Nothing to be done for 'all'.
● galogi@LAPTOP-HE5DUJQL:~/os_hw1/coverage_code$ make run
./graph_app
Do you want to check a new graph? (y/n): y
Enter number of vertices (positive integer): 5
Enter an edge (format: u v weight) or -1 -1 -1 to stop: 123
Invalid input! Please enter exactly three integers separated by spaces.
Enter an edge (format: u v weight) or -1 -1 -1 to stop: 123
Invalid input! Please enter exactly three integers separated by spaces.
Enter an edge (format: u v weight) or -1 -1 -1 to stop: 123
Invalid input! Please enter exactly three integers separated by spaces.
Too many invalid attempts. Returning to main menu.
Do you want to check a new graph? (y/n): y
```

מקרה קצה
הכנסת צלע בפורמט לא נכון.
3 פעמים שגיאה ברצף מחזיר אחורה
לבניית גרף חדש.

```
Enter number of vertices (positive integer): 1 2 3 4
Invalid input. Please enter a single positive integer with no extra characters.
Enter number of vertices (positive integer): 1 2 3 4
Invalid input. Please enter a single positive integer with no extra characters.
Enter number of vertices (positive integer): 1 2 3 4
Invalid input. Please enter a single positive integer with no extra characters.
You have entered invalid input 3 times. Exiting the program.
```

מקרה קצה
הכנסת יותר מדי פרמטרים
לכמות הקודקודים.

```
galogi@LAPTOP-HE5DUJQL:~/os_hw1/coverage_code$ make run
./graph_app
Do you want to check a new graph? (y/n): y
Enter number of vertices (positive integer): 4
Enter an edge (format: u v weight) or -1 -1 -1 to stop: 0 1 2
Enter an edge (format: u v weight) or -1 -1 -1 to stop: 0 1 2
Edge between 0 and 1 already exists with weight 2.
Do you want to update it to weight 2? (y/n): y
Edge updated.
Enter an edge (format: u v weight) or -1 -1 -1 to stop: 0 1 2
Edge between 0 and 1 already exists with weight 2.
Do you want to update it to weight 2? (y/n): n
Edge not updated.
Enter an edge (format: u v weight) or -1 -1 -1 to stop: 0 0 1
Error: Self-loops are not allowed (u != v).
Enter an edge (format: u v weight) or -1 -1 -1 to stop: 1 2 -3
Error: Dijkstra does not support negative weights.
Enter an edge (format: u v weight) or -1 -1 -1 to stop: 7 8 9
Error: Vertex index out of range! Must be between 0 and 3.
Enter an edge (format: u v weight) or -1 -1 -1 to stop: -1 -1 -1
Enter source vertex (0 to 3): 8
Invalid input. Please enter a number between 0 and 3.
Enter source vertex (0 to 3): 0
Shortest distances from vertex 0:
To 0: 0
To 1: 2
To 2: INF
To 3: INF
Do you want to check a new graph? (y/n): y
Enter number of vertices (positive integer): 4
Enter an edge (format: u v weight) or -1 -1 -1 to stop: 0 1 2
Enter an edge (format: u v weight) or -1 -1 -1 to stop: 1 2 3
Enter an edge (format: u v weight) or -1 -1 -1 to stop: 2 3 4
Enter an edge (format: u v weight) or -1 -1 -1 to stop: -1 -1 -1
Enter source vertex (0 to 3): 0
Shortest distances from vertex 0:
To 0: 0
To 1: 2
To 2: 5
To 3: 9
Do you want to check a new graph? (y/n): n
Exiting program. Goodbye!
```

<u>מקרה קצה</u>
הכנסת אותה צלע
בין קודקודים.
מוודא האם לשנות את המשקל
של הצלע.
פעם אחת רוצים
פעם אחת לא רוצים

<u>מקרה קצה</u>
הוספת צלע מקודקוד לעצמו
לא מאפשר

<u>מקרה קצה</u>
משקל שלילי

<u>מקרה קצה</u>
קודקודים לא בטווח

<u>מקרה קצה</u>
סריקה לצאת מקודקוד
לא קיים.

```
galogi@LAPTOP-HE5DUJQL:~/os_hw1/coverage_code$ make coverage-summary
File 'GraphApp.cpp'
Lines executed:100.00% of 63

File 'GraphBuilder.cpp'
Lines executed:96.15% of 52

File 'Dijkstra.cpp'
Lines executed:100.00% of 16
```

בדיקת כיסוי קוד
מצאנו שבאחד הקבצים
כיסוי 96%

בדיקה בקובץ שמסר
כיסוי מלא.

GraphBuilder.cpp.gcov

```
galogi@LAPTOP-HE5DUJQL:~/os_hw1/coverage_code$ cat GraphBuilder.cpp.gcov
        -:    0:Source:GraphBuilder.cpp
        -:    1:#include "GraphBuilder.hpp"
        -:    2:#include <iostream>
        -:    3:#include <sstream>
        -:    4:
        -:    5:
        3:    6:vector<vector<vector<int>>> GraphBuilder::constructAdj(int V , int& x) {
        6:    7:    vector<vector<vector<int>>> adj(V);
        -:    8:
        -:    9:    while (true) {
       14:   10:        cout << "Enter an edge (format: u v weight) or -1 -1 -1 to stop: ";
       14:   11:        string line;
       14:   12:        getline(cin, line);
        -:   13:
       14:   14:        istringstream iss(line);
        -:   15:        int u, v, weight;
        -:   16:
       14:   17:        if (!(iss >> u >> v >> weight) || !iss.eof()) {
        -:   18:
        3:   19:            cerr << "Invalid input! Please enter exactly three integers separated by spaces." << endl;
        3:   20:                  x++;
        3:   21:            if (x == 3) {
        1:   22:                cerr << "Too many invalid attempts. Returning to main menu." << endl;
        1:   23:                break;
        -:   24:            }
        2:   25:            continue;
        -:   26:        }
        -:   27:
        -:   28:
        -:   29:
       11:   30:        if (u == -1 && v == -1 && weight == -1) {
        2:   31:            break;
        -:   32:        }
        -:   33:
        9:   34:        if (u < 0 || u >= V || v < 0 || v >= V) {
        -:   35:
        1:   36:            cerr << "Error: Vertex index out of range! Must be between 0 and " << V - 1 << "." << endl;
        1:   37:                  x++;
        1:   38:            if (x == 3) {
    #####:   39:                cerr << "Too many invalid attempts. Returning to main menu." << endl;
    #####:   40:                break;
        -:   41:            }
        1:   42:            continue;
        -:   43:        }
        -:   44:
        8:   45:        if (u == v) {
        -:   46:
        1:   47:            cerr << "Error: Self-loops are not allowed (u != v)." << endl;
        -:   48:
        1:   49:            continue;
        -:   50:        }
        -:   51:
        7:   52:        if (weight < 0) {
        -:   53:
        1:   54:            cerr << "Error: Dijkstra does not support negative weights." << endl;
        -:   55:
        1:   56:            continue;
        -:   57:        }
        -:   58:
        6:   59:        bool edgeExists = false;
        8:   60:        for (auto& neighbor : adj[u]) {
        4:   61:            if (neighbor[0] == v) {
        2:   62:                edgeExists = true;
        2:   63:                cout << "Edge between " << u << " and " << v << " already exists with weight " << neighbor[1] << "." << endl;
        2:   64:                cout << "Do you want to update it to weight " << weight << "? (y/n): ";
        -:   65:
        2:   66:                string response;
        2:   67:                getline(cin, response);
        -:   68:
        2:   69:                if (response == "y" || response == "Y") {
        1:   70:                    neighbor[1] = weight;
```

מציאה של השורה
לפי ###

```
        1:   70:                neighbor[1] = weight;
       1*:   71:                for (auto& reverseNeighbor : adj[v]) {
        1:   72:                    if (reverseNeighbor[0] == u) {
        1:   73:                        reverseNeighbor[1] = weight;
        1:   74:                        break;
        -:   75:                    }
        -:   76:                }
        1:   77:                cout << "Edge updated." << endl;
        -:   78:            } else {
        1:   79:                cout << "Edge not updated." << endl;
        -:   80:            }
        -:   81:
        2:   82:            break;
        2:   83:        }
        -:   84:    }
        -:   85:
        6:   86:    if (!edgeExists) {
        8:   87:        adj[u].push_back({v, weight});
        8:   88:        adj[v].push_back({u, weight});
        4:   89:                x=0;
        -:   90:    }
       33:   91: }
        -:   92:
        3:   93: return adj;}
● galogi@LAPTOP-HE5DUJQL:~/os_hw1/coverage_code$ make run
  ./graph_app
  Do you want to check a new graph? (y/n): y
  Enter number of vertices (positive integer): 4
  Enter an edge (format: u v weight) or -1 -1 -1 to stop: 7 8 9
  Error: Vertex index out of range! Must be between 0 and 3.
  Enter an edge (format: u v weight) or -1 -1 -1 to stop: 7 8 9
  Error: Vertex index out of range! Must be between 0 and 3.
  Enter an edge (format: u v weight) or -1 -1 -1 to stop: 7 8 9
  Error: Vertex index out of range! Must be between 0 and 3.
  Too many invalid attempts. Returning to main menu.
  Do you want to check a new graph? (y/n): n
  Exiting program. Goodbye!
```

השלמה

מקרה קצה הזין 3 פעמים קודקוד מחוץ לתחום.

```
● galogi@LAPTOP-HE5DUJQL:~/os_hw1/coverage_code$ make coverage-summary
  File 'GraphApp.cpp'
  Lines executed:100.00% of 63

  File 'GraphBuilder.cpp'
  Lines executed:100.00% of 52

  File 'Dijkstra.cpp'
  Lines executed:100.00% of 16
```

בדיקת כיסוי בשנית.
כל הקבצים 100%