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Number of Vertices	9	4	6	10	5
Number of Edges	8	4	9	11	7
Is bipartite	no	yes	yes	no	no
Disconnected subgraphs	no	no	no	yes	no
Gprolog(ms)	67377	9	6	162304	9
C++ (ms)	0	0	0	0	0

Explanation of solution.cpp

How to run

```
g++ solution.cpp -o solution
./solution matrix-10.txt
```

So, a bipartite graph is a graph in which the coloring is possible with only two colors. In this solution I assign a color to the source vertex, color all the vertex with blue and the first one red.

The convert function takes the matrix and figures out the adjacency list. The main function takes in the matrix input and parses via and identifies the adjacency list. Then the possible Bipartition function takes the adjacency list colors all the vertex in the list. Then it will make sure that no 2 edges have the same color and then pushes to the explore queue. It will return true if bipartite or false if not bipartite.

Explanation of converter.cpp

How to run

```
g++ converter.cpp -o converter
./converter matrix-10.txt
```

Then

```
gprolog
[bipartite10].
checkbipartite.
```

Explaining all predicates with map example [[1,2],[2,3],[3,1]]

find_color predicate:

Now we need to define the map using the list provided by map (), so with the adjacency list generated. So with the recursion statement, the find
neighbor will take the list ([1,2], [2,3],[3,1]) and return (3,1,2). The built-in member predicate will store the regions 3,2,1 as it goes via
the conditional statement and retrieves the region points.

Map predicate:

The map predicate will have the list of map in this format map ([[1,2],[2,3],[3,1]]). This section is to be changes by the TA to test multiple
cases.

Color Predicate:

The color predicate will have the list of colors. The minimum list of color is 2 because of the logic of the problem, no two adjacent should have
the same color.

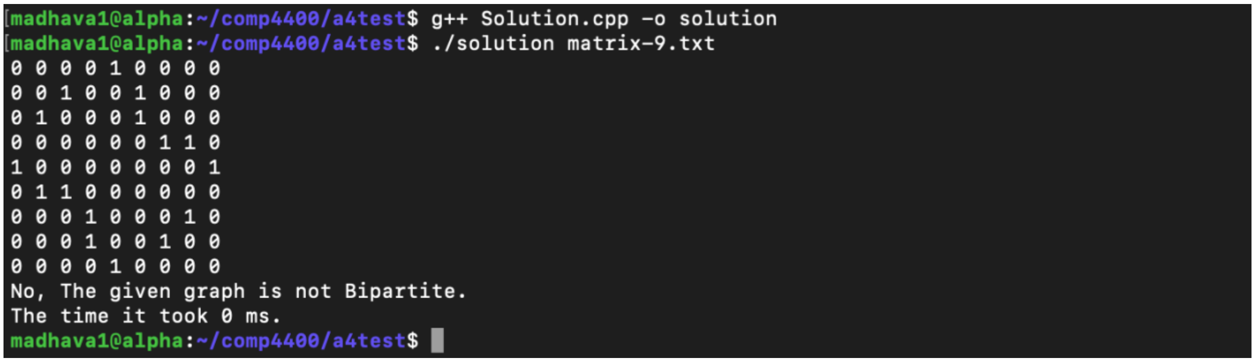
colors([red,,blue]).

Once the find colors predicate returns the Regions (3,1,2) for the examples I am using. The color predicate will take in a graph list, the Color Predicate list of colors and an empty list to store the region and color pair. Initially the first element in the list 3 will be mapped
to the first element in the color list red. Then from the second element in the region list, the valid predicate will be called to check if the
next color will be valid or not. In other terms the valid predicate will make sure the next adjacency region does not have the same color. The
color predicate will exhaust to the Regions lost and will return the following list [[3, red], [1, green], [2, blue]]. Once the color predicate is done, it will return the result to the user saying true because it is a bipartite graph. If not, it will return no since it is not a bipartite graph.

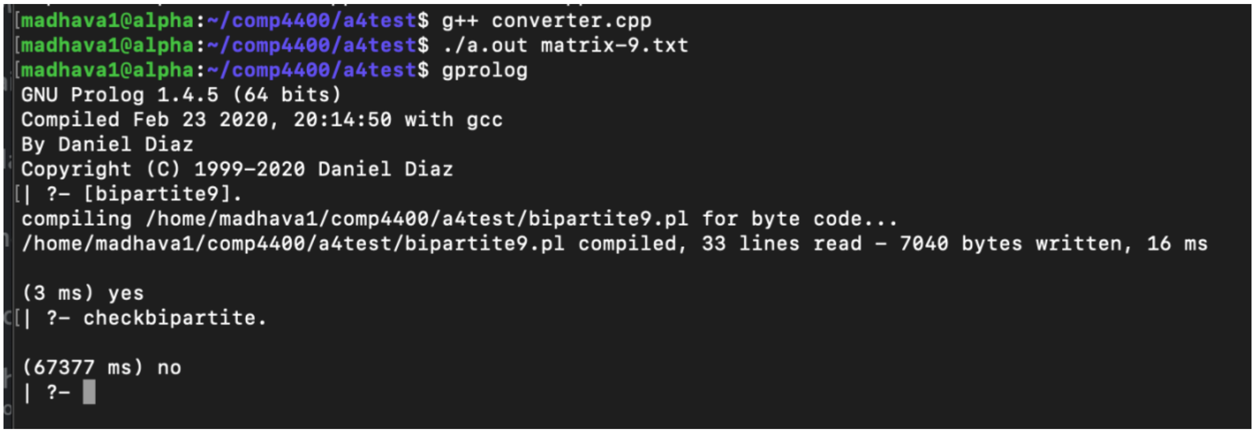
conflict predicate:

The adjacent predicate will take X, Y and compare if two regions are adjacent or not based on the members. The valid predicate will check if
there are any conflicts, like for worst case scenarios like a map starting with [1,1] or has edges like [2,2].

1. matrix-9.txt

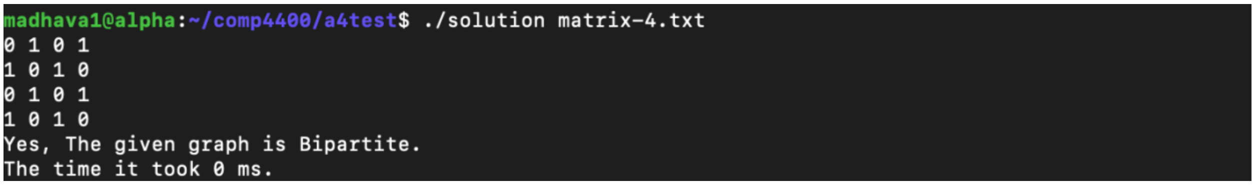


```
[madhava1@alpha:~/comp4400/a4test$ g++ Solution.cpp -o solution
[madhava1@alpha:~/comp4400/a4test$ ./solution matrix-9.txt
0 0 0 0 1 0 0 0 0
0 0 1 0 0 1 0 0 0
0 1 0 0 0 1 0 0 0
0 0 0 0 0 0 1 1 0
1 0 0 0 0 0 0 0 1
0 1 1 0 0 0 0 0 0
0 0 0 1 0 0 0 1 0
0 0 0 1 0 0 1 0 0
0 0 0 0 1 0 0 0 0
No, The given graph is not Bipartite.
The time it took 0 ms.
madhava1@alpha:~/comp4400/a4test$
```

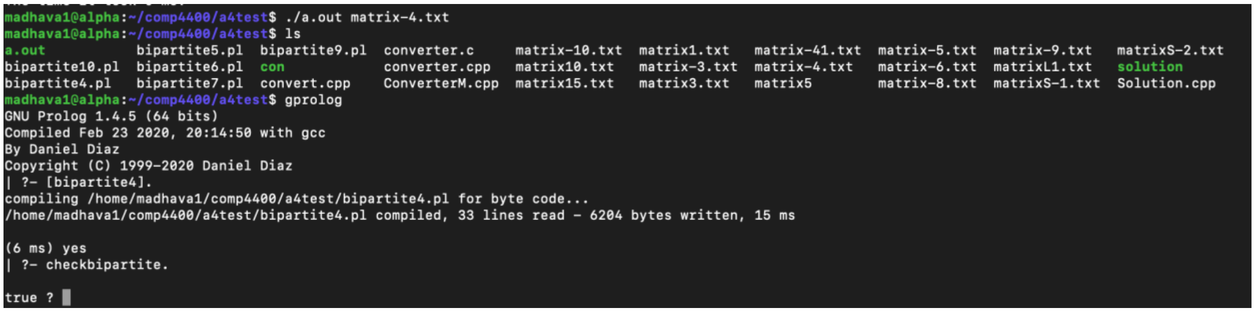


```
[madhava1@alpha:~/comp4400/a4test$ g++ converter.cpp
[madhava1@alpha:~/comp4400/a4test$ ./a.out matrix-9.txt
[madhava1@alpha:~/comp4400/a4test$ gprolog
GNU Prolog 1.4.5 (64 bits)
Compiled Feb 23 2020, 20:14:50 with gcc
By Daniel Diaz
Copyright (C) 1999-2020 Daniel Diaz
[| ?- [bipartite9].
compiling /home/madhava1/comp4400/a4test/bipartite9.pl for byte code...
/home/madhava1/comp4400/a4test/bipartite9.pl compiled, 33 lines read - 7040 bytes written, 16 ms

(3 ms) yes
[| ?- checkbipartite.

(67377 ms) no
| ?-
```

2. matrix4.txt

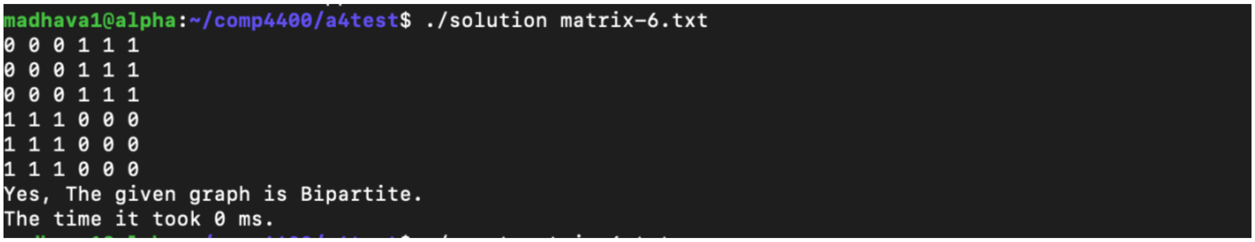


```
madhava1@alpha:~/comp4400/a4test$ ./solution matrix-4.txt
0 1 0 1
1 0 1 0
0 1 0 1
1 0 1 0
Yes, The given graph is Bipartite.
The time it took 0 ms.
```

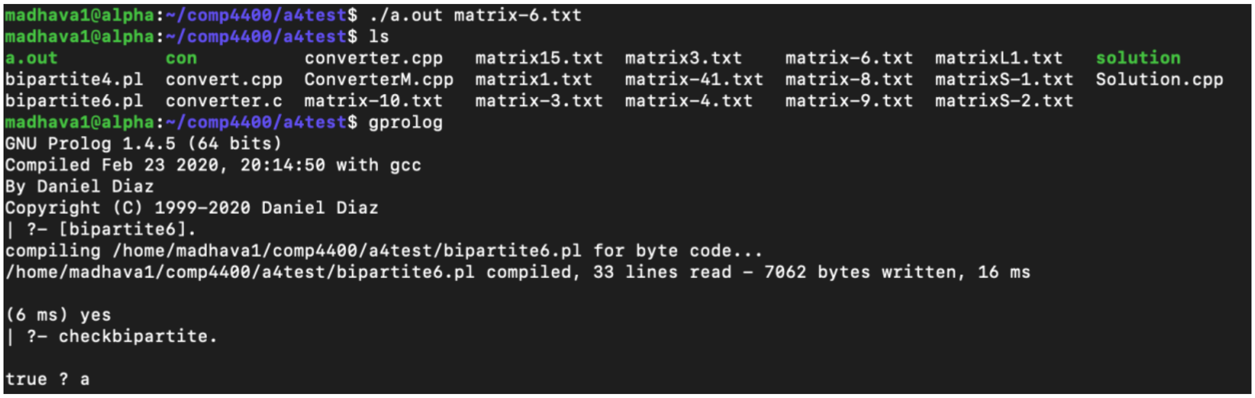


```
madhava1@alpha:~/comp4400/a4test$ ./a.out matrix-4.txt
madhava1@alpha:~/comp4400/a4test$ ls
a.out           bipartite5.pl  bipartite9.pl  converter.c     matrix-10.txt  matrix1.txt   matrix-41.txt  matrix-5.txt  matrix-9.txt   matrixS-2.txt
bipartite10.pl  bipartite6.pl  con            converter.cpp   matrix10.txt   matrix-3.txt  matrix-4.txt   matrix-6.txt  matrixL1.txt   solution
bipartite4.pl   bipartite7.pl  convert.cpp    ConverterM.cpp  matrix15.txt   matrix3.txt   matrix5        matrix-8.txt  matrixS-1.txt  Solution.cpp
madhava1@alpha:~/comp4400/a4test$ gprolog
GNU Prolog 1.4.5 (64 bits)
Compiled Feb 23 2020, 20:14:50 with gcc
By Daniel Diaz
Copyright (C) 1999-2020 Daniel Diaz
| ?- [bipartite4].
compiling /home/madhava1/comp4400/a4test/bipartite4.pl for byte code...
/home/madhava1/comp4400/a4test/bipartite4.pl compiled, 33 lines read - 6204 bytes written, 15 ms

(6 ms) yes
| ?- checkbipartite.

true ?
```

3. martrix6.txt

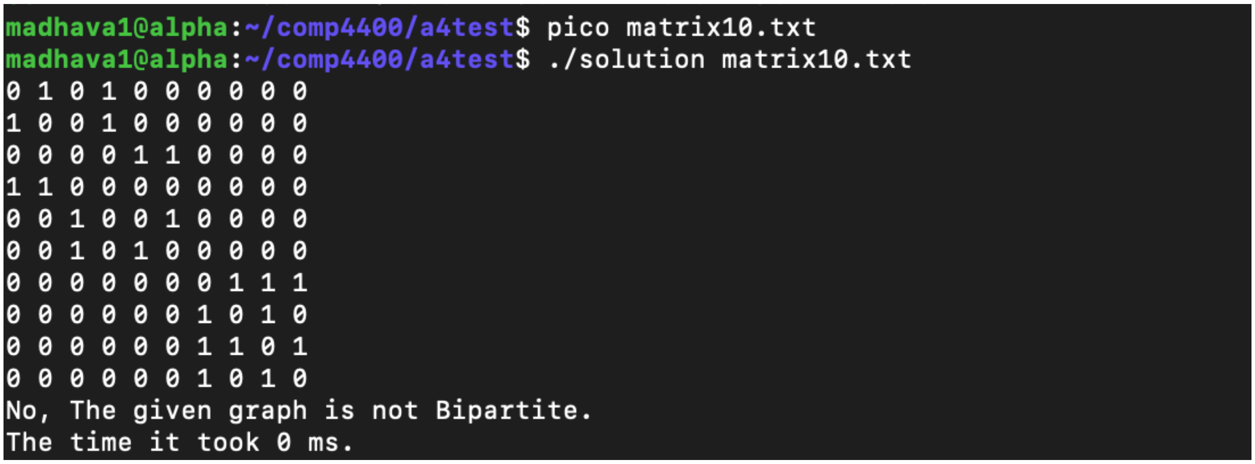


```
madhava1@alpha:~/comp4400/a4test$ ./solution matrix-6.txt
0 0 0 1 1 1
0 0 0 1 1 1
0 0 0 1 1 1
1 1 1 0 0 0
1 1 1 0 0 0
1 1 1 0 0 0
Yes, The given graph is Bipartite.
The time it took 0 ms.
```

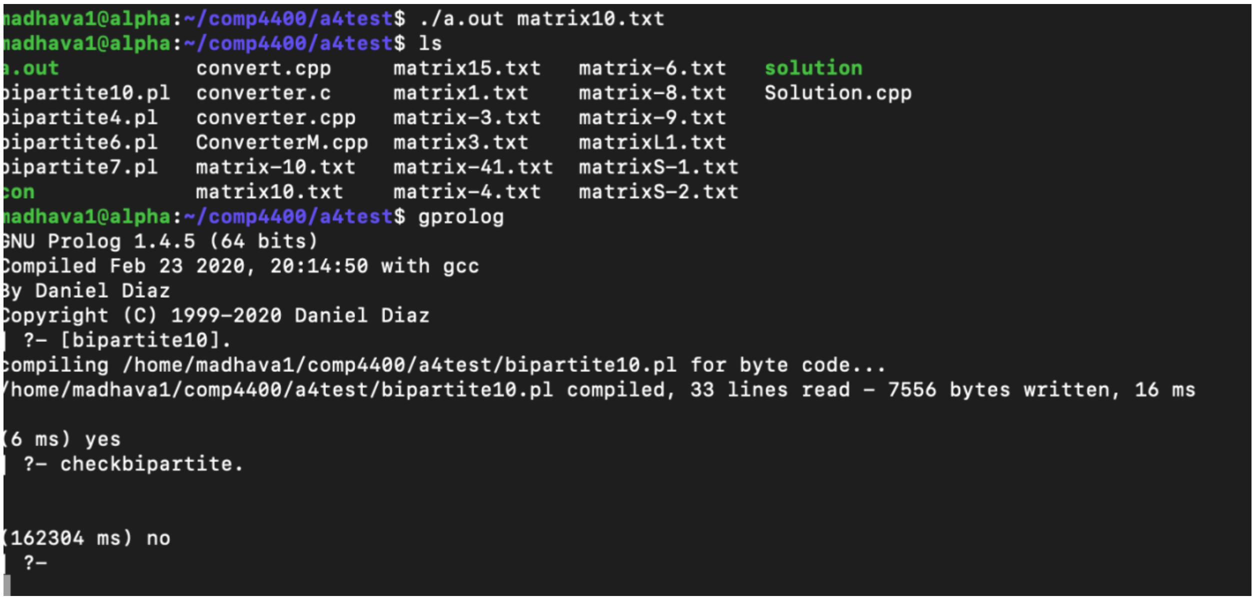


```
madhava1@alpha:~/comp4400/a4test$ ./a.out matrix-6.txt
madhava1@alpha:~/comp4400/a4test$ ls
a.out           con           converter.cpp   matrix15.txt  matrix3.txt    matrix-6.txt  matrixL1.txt   solution
bipartite4.pl   convert.cpp   ConverterM.cpp  matrix1.txt   matrix-41.txt  matrix-8.txt  matrixS-1.txt  Solution.cpp
bipartite6.pl   converter.c   matrix-10.txt   matrix-3.txt  matrix-4.txt   matrix-9.txt  matrixS-2.txt
madhava1@alpha:~/comp4400/a4test$ gprolog
GNU Prolog 1.4.5 (64 bits)
Compiled Feb 23 2020, 20:14:50 with gcc
By Daniel Diaz
Copyright (C) 1999-2020 Daniel Diaz
| ?- [bipartite6].
compiling /home/madhava1/comp4400/a4test/bipartite6.pl for byte code...
/home/madhava1/comp4400/a4test/bipartite6.pl compiled, 33 lines read - 7062 bytes written, 16 ms

(6 ms) yes
| ?- checkbipartite.

true ? a
```

4. Disconnected Subgraphs Matrix10.txt

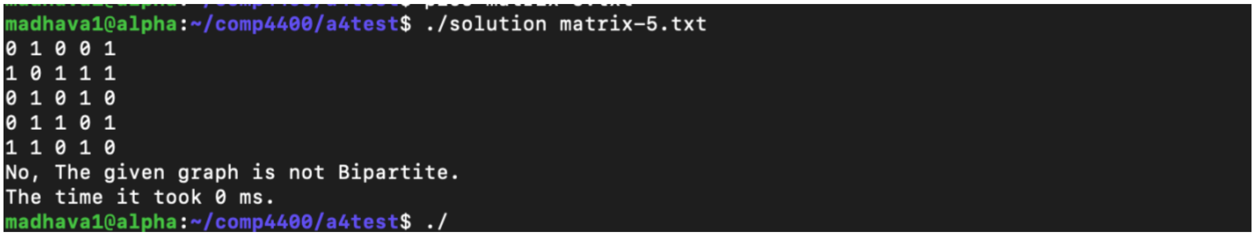


```
madhava1@alpha:~/comp4400/a4test$ pico matrix10.txt
madhava1@alpha:~/comp4400/a4test$ ./solution matrix10.txt
0 1 0 1 0 0 0 0 0 0
1 0 0 1 0 0 0 0 0 0
0 0 0 0 1 1 0 0 0 0
1 1 0 0 0 0 0 0 0 0
0 0 1 0 0 1 0 0 0 0
0 0 1 0 1 0 0 0 0 0
0 0 0 0 0 0 0 1 1 1
0 0 0 0 0 0 1 0 1 0
0 0 0 0 0 0 1 1 0 1
0 0 0 0 0 0 1 0 1 0
No, The given graph is not Bipartite.
The time it took 0 ms.
```

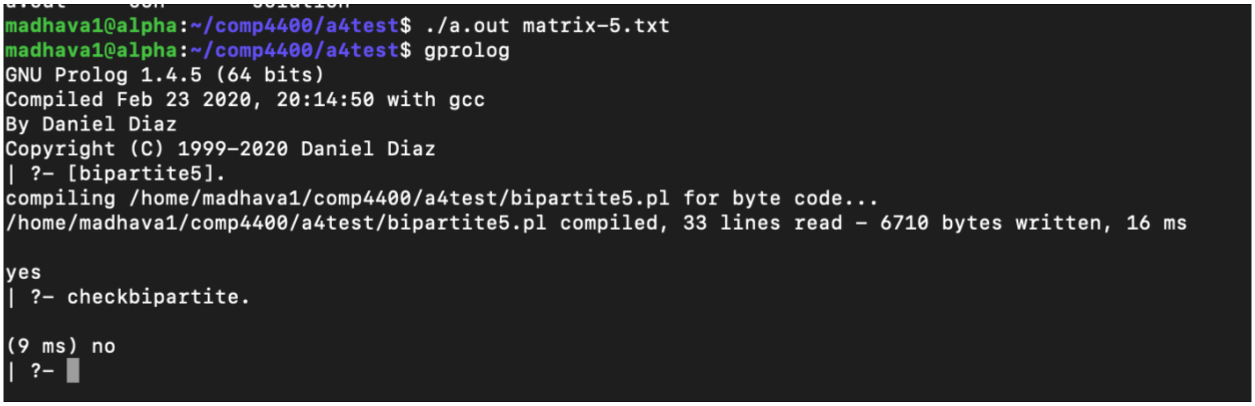


```
adhava1@alpha:~/comp4400/a4test$ ./a.out matrix10.txt
adhava1@alpha:~/comp4400/a4test$ ls
a.out           convert.cpp     matrix15.txt   matrix-6.txt   solution
bipartite10.pl  converter.c     matrix1.txt    matrix-8.txt   Solution.cpp
bipartite4.pl   converter.cpp   matrix-3.txt   matrix-9.txt
bipartite6.pl   ConverterM.cpp  matrix3.txt    matrixL1.txt
bipartite7.pl   matrix-10.txt   matrix-41.txt  matrixS-1.txt
con             matrix10.txt    matrix-4.txt   matrixS-2.txt
adhava1@alpha:~/comp4400/a4test$ gprolog
NU Prolog 1.4.5 (64 bits)
ompiled Feb 23 2020, 20:14:50 with gcc
y Daniel Diaz
opyright (C) 1999-2020 Daniel Diaz
| ?- [bipartite10].
ompiling /home/madhava1/comp4400/a4test/bipartite10.pl for byte code...
/home/madhava1/comp4400/a4test/bipartite10.pl compiled, 33 lines read - 7556 bytes written, 16 ms

(6 ms) yes
| ?- checkbipartite.


(162304 ms) no
| ?-
```

5. matrix5.txt



```
madhava1@alpha:~/comp4400/a4test$ ./solution matrix-5.txt
0 1 0 0 1
1 0 1 1 1
0 1 0 1 0
0 1 1 0 1
1 1 0 1 0
No, The given graph is not Bipartite.
The time it took 0 ms.
madhava1@alpha:~/comp4400/a4test$ ./
```



```
a.out     con       solution
madhava1@alpha:~/comp4400/a4test$ ./a.out matrix-5.txt
madhava1@alpha:~/comp4400/a4test$ gprolog
GNU Prolog 1.4.5 (64 bits)
Compiled Feb 23 2020, 20:14:50 with gcc
By Daniel Diaz
Copyright (C) 1999-2020 Daniel Diaz
| ?- [bipartite5].
compiling /home/madhava1/comp4400/a4test/bipartite5.pl for byte code...
/home/madhava1/comp4400/a4test/bipartite5.pl compiled, 33 lines read - 6710 bytes written, 16 ms

yes
| ?- checkbipartite.

(9 ms) no
| ?- 
```