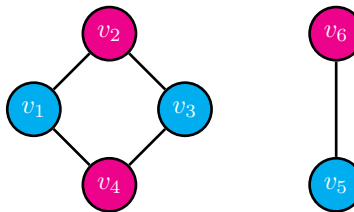


# Project 5

*Please read the entire document carefully!* I would suggest reading the entire document *before* writing any code.

## 1 Graph Colorings

A *vertex coloring* is an assignment of colors, one color to each vertex, such that no two adjacent vertices have the same color. If a graph can be colored using  $k$  colors, it is said to be  $k$ -colorable. For example:



The above graph can be colored using two colors, and it is said to be 2-colorable. This special case of determining if a graph is 2-colorable can be computed in linear\* time†.

You will implement an algorithm to determine whether or not a given graph is 2-colorable. To help you get started, note the following observations:

- In order to establish the 2-colorability of a graph, every vertex must be assigned exactly one color.
- This means that every vertex should be “explored” exactly once by the coloring algorithm.
- The colors assigned within one component will not affect the colors assigned within any other component. However, if any component is not 2-colorable, the entire graph is not 2-colorable.

Each input graph will be provided as an *edge list*. For example, the above graph could be represented as‡:

```
edges = [['v1', 'v2'], ['v2', 'v3'], ['v3', 'v4'], ['v4', 'v1'], ['v6', 'v5']]
```

Your function `is_two_colorable` will return `True` if the graph is 2-colorable, and `False` otherwise.

## 2 Testing

As mentioned in the syllabus, your code is periodically graded prior to the deadline and you will receive automated feedback based on the results of my tests. But, in order to receive any feedback, your tests must provide 100% test coverage of the code you are submitting. If you do not have 100% coverage, this is the only feedback you will receive.

100% test coverage means that every line of your code is run at some point in some test. Imagine if that weren't the case. That means that you have a line of code (or multiple lines of code) that could do anything, and you'd never know. You never tested them!

Your tests will go in a file named `two_colorable_tests.py`.

\*By linear, I mean  $O(|V| + |E|)$ .

†In general, determining if a graph is  $k$ -colorable (for  $k > 2$ ) is a very difficult problem. There isn't a known efficient way of doing it.

‡Note that the order of the edges is arbitrary. Similarly, which vertex is listed first is arbitrary.

### 3 GitHub Submission

Push your finished code back to GitHub. Refer to Lab 0, as needed, to remember how to push your local code.