

ASSIGNMENT WEEK 13

An automorphism of a graph $G = (V, E)$ is a permutation π of the vertex set V such that incidence is preserved, that is, if u, v are vertices in G then (u, v) is an edge if and only if $(\pi(u), \pi(v))$ is an edge. Constructing the automorphism group is at least as difficult as solving the graph isomorphism problem.

For this assignment, you will need to use Python since there are no good Java libraries for this problem.

```
if __name__ == '__main__':
    import igraph
    g = igraph.Graph()
    g.add_vertices(10)
    g.add_edges([(0,1), (1,2), (2,3), (3,4), (4,0), (0,5), (1,6), (2,7),
(3,8), (4,9), (5,7), (6,8), (7,9), (8,5), (9,6) ])
print(igraph.Graph.count_automorphisms_vf2(g))
print(igraph.Graph.get_automorphisms_vf2(g))
120
[[0, 1, 2, 3, 4, 5, 6, 7, 8, 9], [0, 1, 2, 7, 5, 4, 6, 3, 9, 8], ...]
```

You will use the **igraph** library to find the size of the automorphism group of a given graph. This graph is available as an adjacency matrix **A** in a Python script file.

0. You will need **igraph**. When using PyCharm, the line **import igraph** will automatically cause PyCharm to ask for installation. When you right-click **igraph** there will be options.
1. Read up on how to *execute* a Python script file from within another Python file. Then execute the provided file **adjacency.py**. This gives you access to a rather large adjacency matrix **A**. **Do not use `add_vertices` or `add_edges` from the above example.**
2. Read <https://igraph.org/python/doc/api/igraph.Graph.html> to determine which method to use to create a graph G from an adjacency matrix in Python (not from a file). Determine the size of the automorphism group using **`G.count_automorphisms_vf2()`**.

Each of the steps 1 – 2 will be graded according to the following rubric for a total of 8 points.

SCORE	4	3	2	1	0
SKILL LEVEL	Response gives evidence of a complete understanding of the problem; is fully developed; is clearly communicated.	Response gives the evidence of a clear understanding of the problem but contains minor errors or is not fully communicated.	Response gives evidence of a reasonable approach but indicates gaps in conceptual understanding. Explanations are incomplete, vague, or muddled.	Response gives some evidence of problem understanding but contains major math or reasoning errors.	No response or response is completely incorrect or irrelevant.