

CMSC 452 PROJECT 2  
PROJECT IS MORALLY DUE April 24  
DEAD CAT POLICY April 26

## 1 Independent set

An independent set,  $S$ , is a set of vertices in a graph, no two of which are adjacent. That is to say, for every two vertices in  $S$ , there is no edge in the graph that connects the two.

A maximum independent set is an independent set of largest possible size, for a given graph  $G$ . In general, finding an maximum independent set is NP-hard.

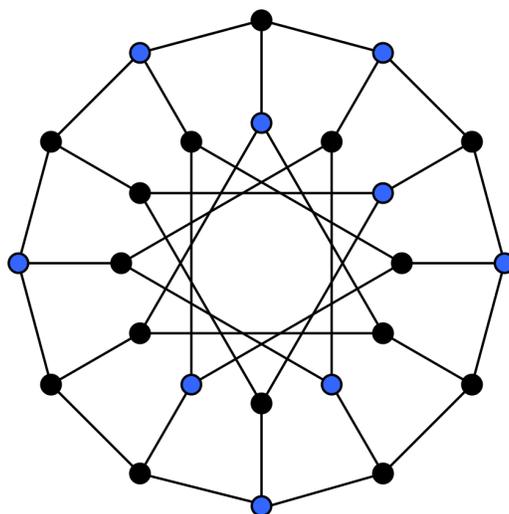


Figure 1: A maximum independent set

## 2 A greedy algorithm

Consider the following greedy algorithm:

```
Greedy(G):
  S <- {}
  While G is not empty:
    Let v be a node of minimum degree in G
    S <- S U {v}
    Remove v and its neighbors from G

  Return S
```

Where  $\{\}$  is the empty set and  $U$  is set union. This algorithm always returns an independent set for  $G$ , but may fail to find the *maximum* independent set.

## 3 Project requirements

Implement the greedy algorithm. The input will be a graph adjacency list, in the form of a JSON object. The output will be the independent set that the algorithm finds, in the form of a JSON list. Your program must **read from standard input** (until EOF), and **write to standard output**. In addition, the first line of your program must be a valid unix shebang (e.g. `#!/usr/bin/env python3`).

For example, if the file `example.json` contains:

```
{"x": ["y"],
 "y": ["x", "z"],
 "z": ["y"]}
```

Then running: `$ ./project.py < example.json` should output *either* `["x", "z"]` or `["z", "x"]`. (Sets are unordered, so any output order is acceptable.)

Since we'll be grading by script, it's vital that your program output a *valid* JSON list. This is most easily accomplished by using your language's built-in libraries for handling json.

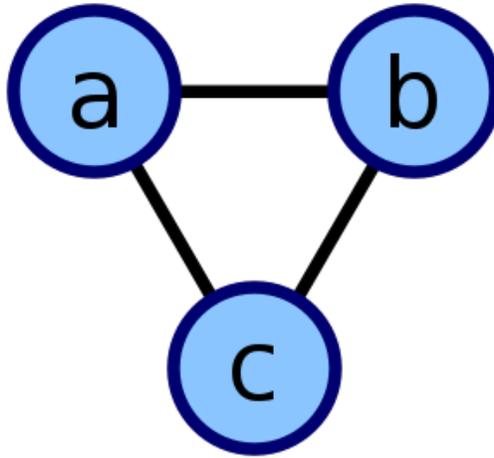


Figure 2: A simple graph

```
{"a": ["b", "c"],  
 "b": ["a", "c"],  
 "c": ["a", "b"]}
```

Figure 3: A simple graph as JSON

In particular, python has good json support. Reading from standard in and parsing the input can be done with:

```
#!/usr/bin/env python3  
  
import json  
import sys  
  
g = json.load(sys.stdin)
```

Converting a python list to a json list and printing that to standard out can be done with:

```
print(json.dumps(s))
```

The ‘officially sanctioned’ languages are python2, python3, perl, ruby. If you want to use a compiled language (Why do you want to use a compiled

language!?), or a different scripting language than listed, talk to Josh Brulé (the TA) first.

Regardless of the language you're writing in, put a comment near the top of your code (but *not* as the first line; **the first line should be the shebang**) that has your full name and UID.

When you're confident your program is correct (did you test your code?), submit your program to the submit server (<https://submit.cs.umd.edu/>)

## 4 Think About

Under what circumstances does the greedy algorithm give the true, maximum independent set? Under what circumstances does the greedy algorithm fail to give the true, maximum independent set?

For extra credit (goes towards a letter I might write for you, not towards the grade) think brilliant thoughts on this problem and tell me about them.