

# Assignment 2

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## 1 Part 1

### 1.1

```
1 geng 4 -t -q | labelg -q > n4.g6
```

```
1 C?  
2 C@  
3 CB  
4 CF  
5 C'  
6 CR  
7 Cr
```

### 1.2

#### 1.2.1

```
1 for k in {4..13}; do python3 extend_graphs.py $k; done
```

n	# graphs
4	7
5	13
6	32
7	71
8	179
9	290
10	313
11	105
12	12
13	1
14	0

### 1.2.2

I used `addptg` to add a new vertex to each graph, then `pickg -k0:2` to remove any graph that has a triangle, `pickg -h0:4` to remove graphs with an independent set bigger than 4, and `uniqg` to get rid of duplicates. The pipe looks like this:

```
1 addptg -n1 -j0:k -l n{k}.g6 | pickg -h0:4 -k0:2 | uniqg > n{k}
  +1}.g6
```

### 1.2.3

n12.g6:

```
1 KQ '?pMCQ?bcU
2 K 'aAAGUEpRDo
3 KoCIHa0@XDHB
4 K ' '@0kcEICoL
5 Ks_HIGZKQSm_
6 K?CkQMp[cgL@
7 Ks_GagjLASko
8 K?GTa\cUDGrC
9 K@AAHWYoYwTO
10 K 'aAIOiDwsCh
11 K '?CGtDIkwL_
12 K?_YPMQoPokc
```

n13.g6:

```
1 Ls '?XGRQR@B 'Kc
```

n14.g6: (empty)

## 1.2.4

```
#!/usr/bin/env python3
import subprocess, sys

k = int(sys.argv[1])

cmd = (
    f"addptg -n1 -j0:{k} -l n{k}.g6"
    f" | pickg -h0:4 -k0:2"
    f" | uniqg"
    f" > n{k+1}.g6"
)

subprocess.run(cmd, shell=True)
print(f"n{k+1}.g6 created")
```

## 2 Part 2

To find the group of a graph, I first used `showg` to convert the graph6 string into an adjacency list, then I typed the edges into `dreadnaut` and ran `x` to get the generators. To find which `n12` graph is the most symmetric, I ran `countg --a n12.g6` which shows the group size of each graph.

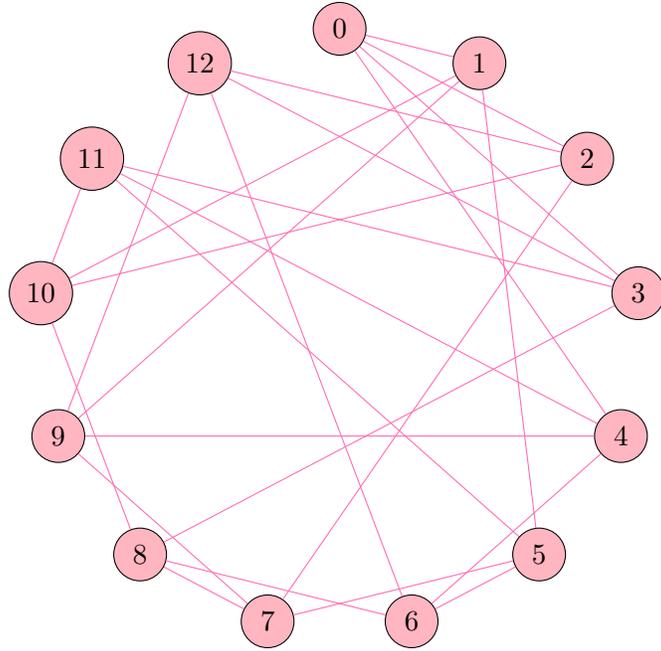
```
1 showg n13.g6
2 countg --a n12.g6
```

Then for each graph I opened `dreadnaut` and typed:

```
1 dreadnaut
2 n=13 g
3 0: 1 2 3 4;
4 1: 5 9 10;
5 ...
6 .
7 x
```

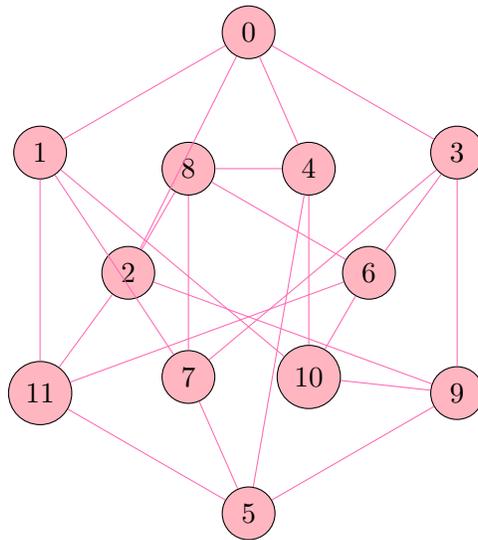
### 2.1

The only graph in `n13.g6` is `Ls'XGRQR0B'Kc` and it has a group size of 52. The generators are  $(1\ 2\ 3\ 4)(5\ 7\ 8\ 6)(9\ 10\ 12\ 11)$  and  $(0\ 1)(2\ 9)(3\ 5)(4\ 10)(6\ 8)(7\ 12)$ .



## 2.2

I ran `countg --a` on `n12.g6` to find the group sizes. The most symmetric graph is `Ks.GagjLASko` with group size 48. Its generators are  $(1\ 2)(3\ 4)(5\ 6)(7\ 8)(9\ 10)$ ,  $(1\ 2)(7\ 9)(8\ 10)$ ,  $(0\ 1)(2\ 11)(3\ 7)(4\ 10)(5\ 9)(6\ 8)$ , and  $(0\ 3)(1\ 7)(2\ 9)(4\ 6)(5\ 11)(8\ 10)$ .



The second most symmetric graph is `K'aAI0iDwsCh` with group size 16. Its generators are  $(2\ 3)(4\ 5)(6\ 7)(8\ 9)(10\ 11)$ ,  $(2\ 3)(8\ 10)(9\ 11)$ ,  $(0\ 1)(4\ 6)(5\ 7)$ , and  $(0\ 2)(1\ 3)(4\ 8)(5\ 11)(6\ 10)(7\ 9)$ .

