Programming Assignment - 4

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Excercise 1.1

- No. of IP prefixes that the internet have are = 525483 We can extract IP prefixes from RIB file from each and every entry and then we can count uniq no. of IP prefixes. bash command to do that is,

```
cut -d"|" -f 6 $RIB | sort | uniq | wc -l
```

- No.of unique AS are = 48119 We can extract all AS in each entry of as path field of RIB file. Then we can count no. of unique Ases.

```
while read p; do
        for i in $p; do
echo $i >> as.txt
done
done < aspaths.txt
sort -n as.txt | uniq | wc -l
```

Note:- Here, we are ignoring ... entries in as path field.

Excercise 1.2

- Fraction of prefixes in the RIB see announcements and withdrawals in the updates file = 17147/525483 =0.0326309319 = 3.26309319 percentage prefixes of RIB file.We can extract unique prefixes from update file,for which announcements or withdrawal has been done.Then, we can take its ratio with total prefixes.

- prefix that saw large no. of updates = 112.215.16.0/24 (1239 updates) This phenomenon is called "Route flapping". If a router is misconfigured or mismanaged then it may get into a rapid cycle between down and up states. This pattern of repeated re-announcements/withdrawals, can cause excessive activity in all the other routers that know about the link, as the same route is continuously injected/withdrawn in routing table. Here, we can see very less no. of withdrawals and more no. of announcements. So, this is not exactly route flapping, but it is some **"unexpected behaviour of router"**.

Excercise 1.3

- All the AS paths leads to prefix of IITB(AS132423 - IITB-in Powai)

```
103.21.127.0/24|8492 9002 6453 4755 132423
103.21.127.0/24|1239 6453 4755 132423
103.21.127.0/24|3561 6453 4755 132423
103.21.127.0/24|293 6453 4755 132423
103.21.127.0/24|701 6453 4755 132423
103.21.127.0/24|1668 6453 4755 132423
103.21.127.0/24|2914 6453 6453 4755 132423
103.21.127.0/24|37100 6453 4755 132423
103.21.127.0/24|2152 3356 6453 4755 132423
103.21.127.0/24|852 6453 4755 132423
103.21.127.0/24|3303 6453 4755 132423
103.21.127.0/24|22652 6453 4755 132423
103.21.127.0/24|6539 577 6453 4755 132423
103.21.127.0/24|5413 1299 6453 4755 132423
103.21.127.0/24|3741 3356 6453 4755 132423
103.21.127.0/24|1221 4637 6453 4755 132423
103.21.127.0/24|2497 6453 4755 132423
103.21.127.0/24|7660 4635 6453 4755 132423
103.21.127.0/24|6762 6453 4755 132423
103.21.127.0/24|11686 3356 6453 4755 132423
103.21.127.0/24|3549 6453 4755 132423
103.21.127.0/24|3130 1239 6453 4755 132423
103.21.127.0/24|3356 6453 4755 132423
103.21.127.0/24|3257 6453 4755 132423
103.21.127.0/24|13030 3549 6453 4755 132423
103.21.127.0/24|286 6453 4755 132423
103.21.127.0/24|7018 6453 4755 132423
103.21.127.0/24|1299 6453 4755 132423
103.21.127.0/24|6939 1299 6453 4755 132423
103.21.127.0/24|40191 3257 6453 4755 132423
```

- All the AS paths leads to prefix of MIT(AS3 - MIT)

```
18.0.0.0/8|8492 20485 3356 3
18.0.0.0/8|1239 174 3
18.0.0.0/8|3561 3356 3
18.0.0.0/8|293 3
18.0.0.0/8|1668 3356 3
18.0.0.0/8|701 3356 3
18.0.0.0/8|2914 3356 3
18.0.0.0/8|11537 10578 3 3 3
18.0.0.0/8|37100 3356 3
18.0.0.0/8|3257 3356 3
18.0.0.0/8|3130 1239 3356 3
18.0.0.0/8|40191 174 3
18.0.0.0/8|22388 11537 10578 3 3 3
```

```
18.0.0.0/8|1299 3356 3
18.0.0.0/8|3741 3356 3
18.0.0.0/8|6939 11164 10578 3
18.0.0.0/8|286 3356 3
18.0.0.0/8|3549 3356 3
18.0.0.0/8|13030 11164 10578 3
18.0.0.0/8|1221 4637 174 3
18.0.0.0/8|6539 577 174 3
18.0.0.0/8|2152 2153 11537 10578 3 3 3
18.0.0.0/8|3356 3
18.0.0.0/8|5413 3356 3
18.0.0.0/8|852 174 3
18.0.0.0/8|6762 3356 3
18.0.0.0/8|22652 3356 3
18.0.0.0/8|11686 19782 11537 10578 3 3 3
18.0.0.0/8|3549 3356 3
18.0.0.0/8|7018 174 3
18.0.0.0/8|2497 3356 3
18.0.0.0/8|3303 174 3
18.0.0.0/8|7660 22388 11537 10578 3 3 3
```

- A possible path of ASes traversed when we send an IP packet from **MIT to IITB = 3 3356 6453 4755 132423**
  AS3 is AS of MIT. When it sends packet destined to 103.21.127.0/24(IITB), it will be provided to one of the service provider(AS), as per our example to AS3356. Now, as we can see in IITB as paths when AS3356 receives packet with prefix of IITB it forwards it to 6453. And so on until packet reaches to IITB AS132423.

Excercise 2.1

- `A script pa4_part2_degree.sh has been submitted to get degree of each AS.`

  NOTE:- We are ignoring the entries with curly brackets in aspaths for AS degree calculation. So, in output all the entries like this will be displayed as a single AS with its degree, which we can ignore.(More specific 118 entries) Also while calculating degree for other AS, this type of entries are treated as single AS and if adjacent add 1 to the degree, which we can ignore/neglect.

Excercise 2.2

- A possible path of ASes traversed when we send an IP packet from MIT to IITB = 3 3356 6453 4755 132423.

ASN	ASNAME	DEGREE
3	MIT	9
3356	level 3 communications(America/Europe)	4040
6453	Tata communications(America) Inc.	617
4755	APNIC - TATA comm-AS	374
132423	IITB-in powai	3

Table 1: AS degrees

- Below are the inferred AS relationships based on described heuristics.

AS-AS	RELATIONSHIP
3 - 3356	customer - provider
3356 - 6453	provider - customer
6453 - 4755	provider - customer
4755 - 132423	provider - customer

Table 2: AS relationships

- By looking at whois database on internet, relation between these ASes can be confirmed. We can see peer-to-peer relationship between AS3356 and AS6453. Here, we are using limited form of heuristics which restrict us to infer only provider/customer relationship. If we use heuristics for peer-to-peer relationship then we would get this. So, the as relationships inferred are accurate according to described heuristics.

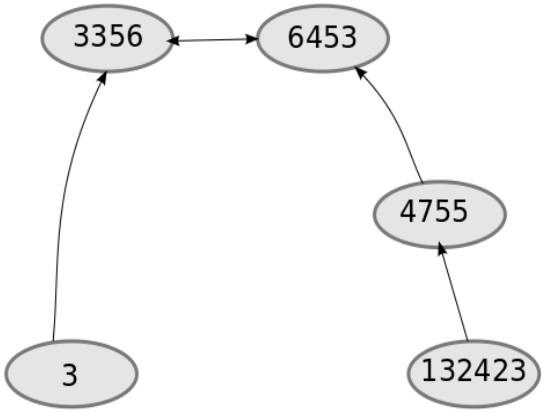

Figure 1: AS Relationships based on actual asgraphs provided on internet