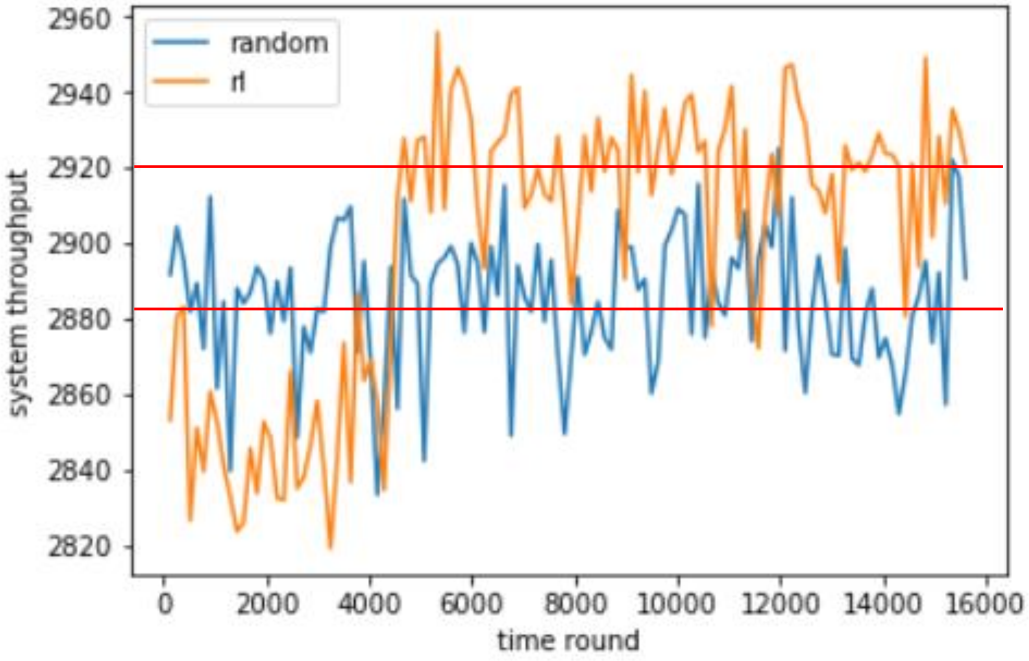
Experiment and Formulation

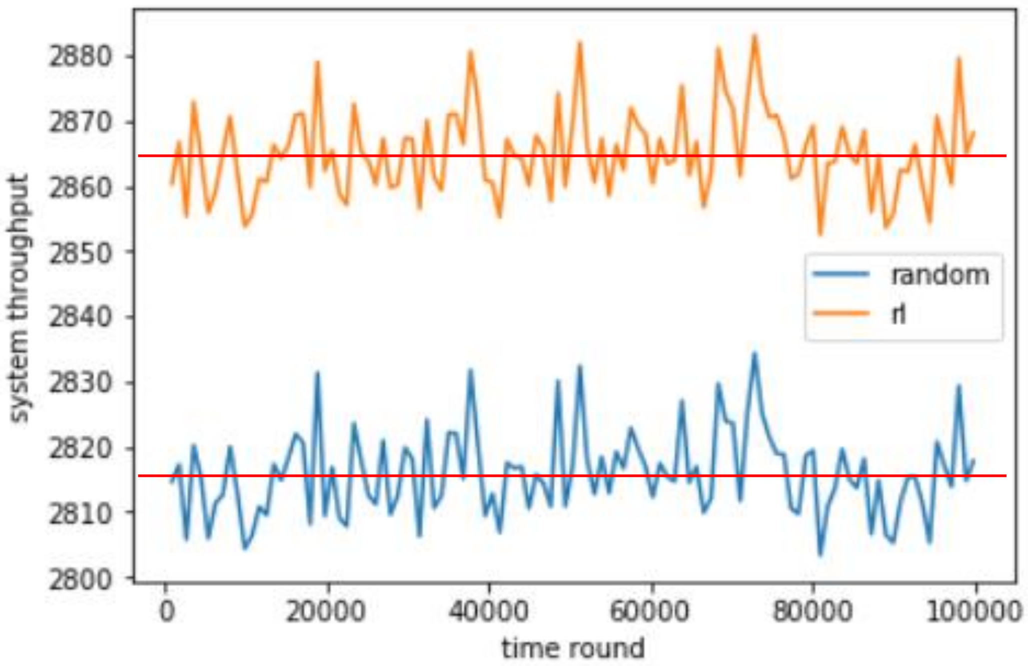
2018 12.19

Experiment Setting

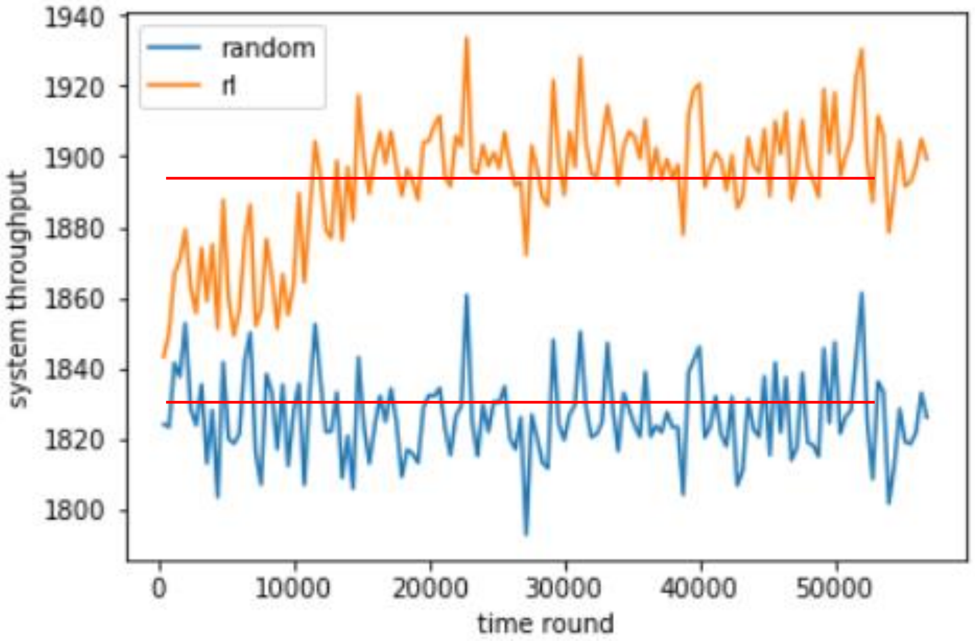
- Performance relates to Traffic Metrix:
  - How the traffic flows in the network
  - Sparsity of flows in topology

- When flows in topology are much dense:



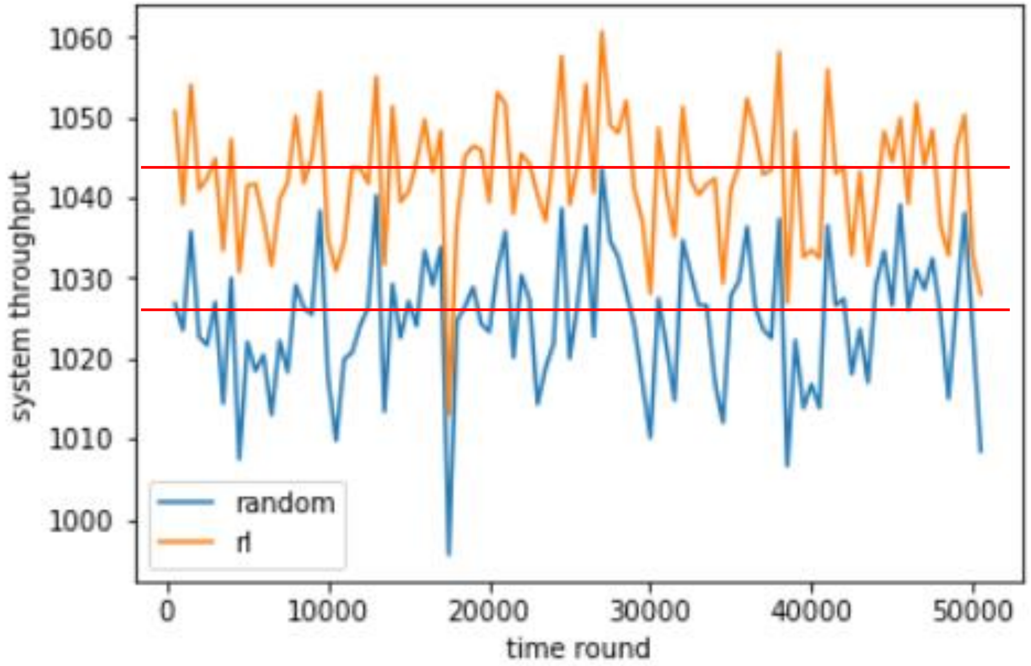


- When reduce sparsity appropriately:



Although not exceeding Random too much, it's better than a dense traffic and has an improvement for reinforcement learning process.

- When flows in topology are too much sparse:



Seems to get worse.

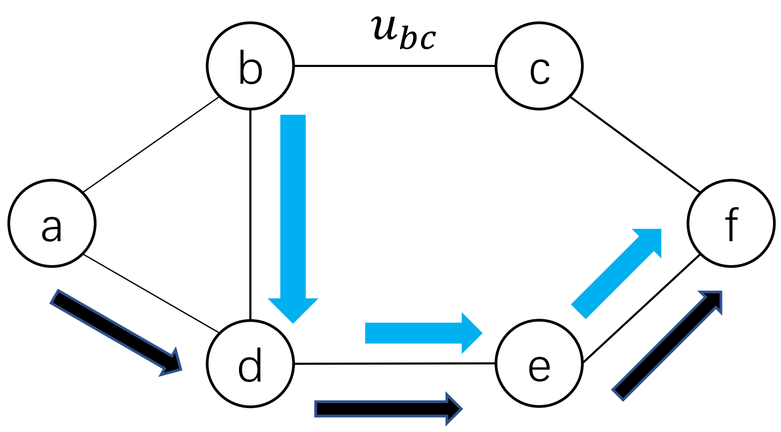
- Conclusion

- When flows in topology are dense, it's more easily to cause some "key links" crowded. For example, links between top nodes T to transfer flows, and links to bottom nodes C (C is the majority of the topology but has respectively less providers).

- For the point above, it is necessary to consider how "link capacity" should be set for each type of link according to required traffic metric. I'm still finding the right relationship between the two.

- When flows in topology are sparse, cause we define our action space using next-hop, size of action space can be millions. However, given sparse traffic demand, actual flows inside the network are much less. It's respectively difficult to get feedback using reinforcement learning.

Optimal Routing Formulation



- Network topology has flow $f \in F$, each with end-to-end rate v^f, source node s^f and destination node t^f.

  The goal is to maximize optimization variable

$$\max\left(\sum_{f \in F} v^f \right)$$

- With constrains:

$$\sum_{j:(i,j)\in E} x_{ij} - \sum_{i:(j,i)\in E} x_{ji} = \begin{cases} 0, & for\ all\ i \in V - \{s^f\}_{f\in F} - \{t^f\}_{f\in F} \\ \sum_{f:i=s^f} v^f - \sum_{f:i=t^f} v^f \end{cases}$$

$$x_{ij} = \sum_{f\in F} x_{ij}^f\ , \quad with\ x_{ij}^f = 0\ or\ v^f, \quad \forall (i,j) \in E$$

$$0 \le x_{ij} \le u_{ij}$$