ATSC

(Adaptive Traffic System Control)

BE Computers sem VII Project by

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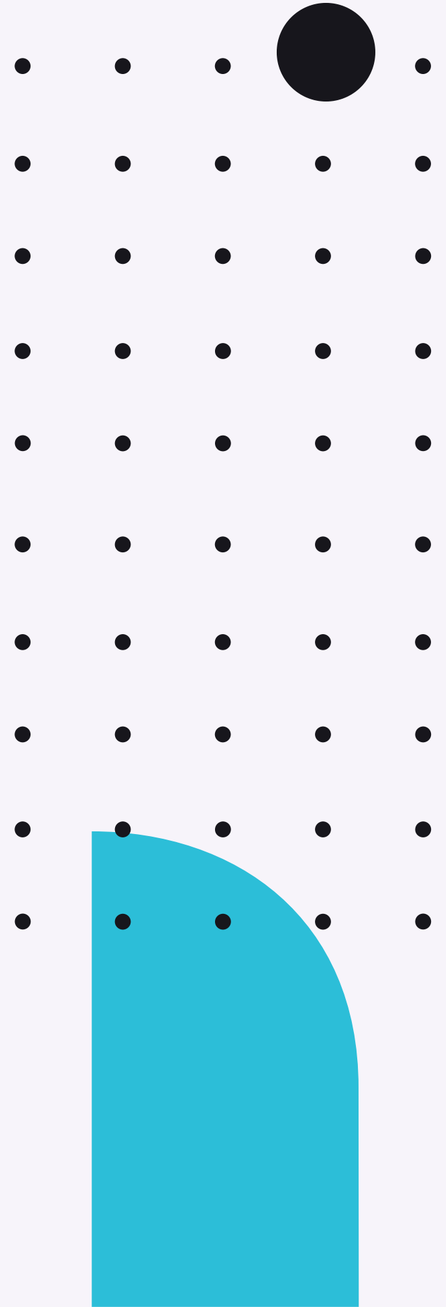
Traffic Signal Control

- Due to population growth and urbanization, the transportation demand is steadily rising in the metropolises worldwide.
- The increase in volume of traffic results in further strain on the urban infrastructure resulting in long traffic jams

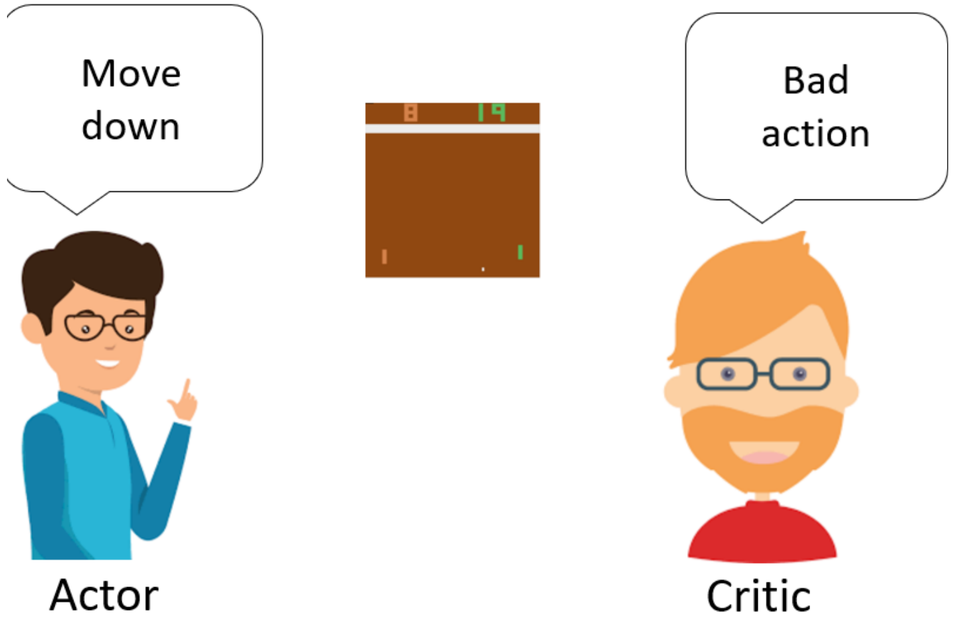
Challenges

- Dynamic nature of traffic volume in peak times make it difficult for traditional machine learning approaches to adapt to the system requirements
- Complex computational nature of a deep system reduces the latency of the system thus making it difficult to implement in real time
- Robustness throughout the system is inherently difficult to achieve due to bottleneck problems of the network

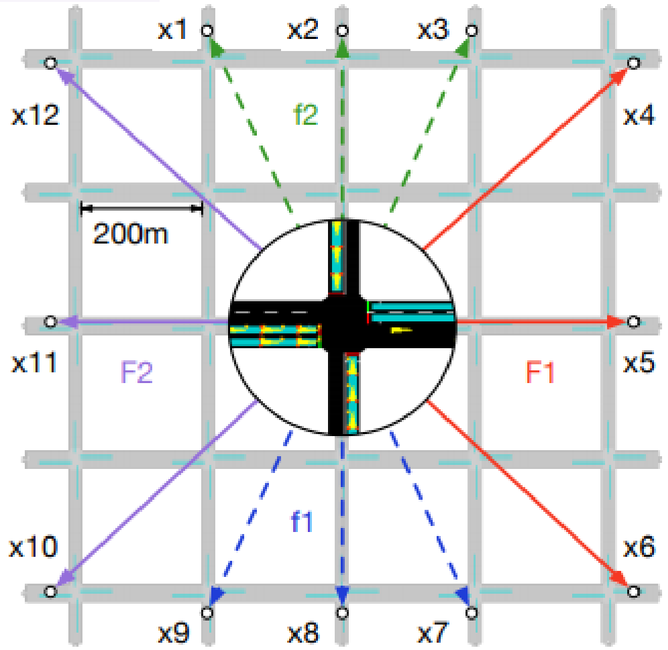


Solution with MARL

MARL - Multi Agent Reinforcement Learning
For this problem we use a specific type of MARL method called the advantage-actor critic method (A2C)



- Every intersection in the network has an independent A2C agent and traffic measurements at that node is provided to the network
- Also we provide observations and fingerprints of the neighboring nodes to the node
- A discount factor is set on observations and rewards of the neighboring nodes so that each node focuses on improving nearby traffic



Sample traffic grid

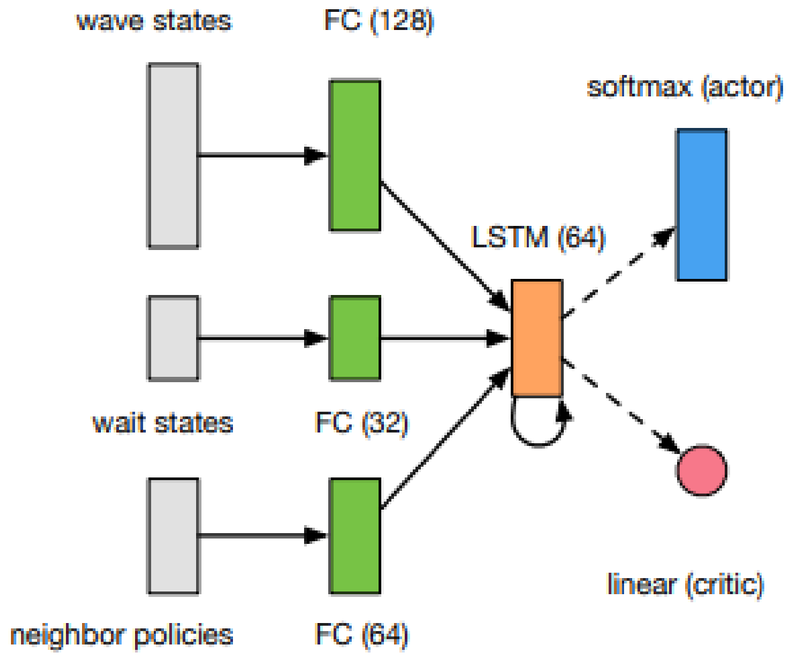
- Action - We define each local action as a possible phase i.e. the red-green combination of lights

- State - { wait[l],wave[l] }
  incoming lane of intersection
  wait - delay for first vehicle
  wave - number of vehicles on each lane

- Reward - reward is expressed as a combination of wait times and queue length of each incoming lane

Network Architecture

- wave,wait and neighor policies are handled by separate fully-connected layers
- Then all hidden units are combined to the LSTM layer
- The agent is trained separately for actor and critic agents by using a different ouput layer (softmax : actor , linear : critic)
- To avoid gradient explosion at each wave and wait states we apply normalization



Sample network architecture at a individual node

References

[1]. Multi-Agent Deep Reinforcement Learning for Large-scale Traffic Signal Control by Tianshu Chu, Jie Wang, Lara Codecà, and Zhaojian Li

[2]. Adaptive Traffic Signal Control : Exploring Reward Definition For Reinforcement Learning - Saad Touhbi, Mohamed Ait Babram, Tri Nguyen-Huu, Nicolas Marilleau, Moulay L. Hbid, Christophe Cambier, Serge Stinckwich