International Baccalaureate

Computer Science Extended Essay

Title: **A Comparative Study of Deep Q-Network (DQN) and Asynchronous Advantage Actor-Critic (A3C) for Traffic Light Control: A Simulation-Based Approach**

Research Question:

How do Deep Q-Network (DQN) and Asynchronous Advantage Actor-Critic (A3C) compare in controlling traffic lights to reduce traffic congestion in a simulated environment based on my hometown?

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1. Introduction

Urban traffic congestion has always been a problem around the globe, which is even getting worse due to the increasing number of car owners. In Hong Kong, my home city, the number of total licensed vehicles has increased by about 24% over these ten years (Transport Department of Hong Kong, Monthly Traffic and Transport Digest, 2023). Consequently, traffic jams are growing more severe around my home city.

To tackle the problem, progress can be made by advancing the existing urban traffic sign control (TSC) systems (Zhao, Dai, & Zhang, 2012). Instead of obeying a pre-defined and timed-time program, dynamic control methods can be applied to TSC systems to match different traffic situations, to utilize the road efficiently and reduce the overall waiting time for each car.

Among all the intelligent algorithms, methods based on reinforcement learning are the most popular since it was first introduced in 1997 (Wu, Kong, Peng, & Fan, 2020). In this essay, the two most prominent reinforcement learning algorithms, Deep Q-Network (DQN) and Asynchronous Advantage Actor-Critic (A3C), will be compared in a simulated environment based on my hometown to find out which one will be better to implement in the TSC system at my hometown, which is the final answer to the research question: "**How do DQN and A3C compare in controlling traffic lights to reduce traffic congestion in a simulated environment based on my hometown?**".

It is believed that this essay could bring some insight for the Transport Department, which has commenced a pilot project of implementing real-time adaptive traffic signal systems at five selected junctions since June 2019 (Transport Department of Hong Kong, Pilot Real-time Adaptive Traffic Signal System, 2022).

2. Theoretical Background

2.1 Basics of Reinforcement Learning

2.1.1 Overview

Reinforcement learning is an approach to how a machine learns to do a task, essentially by the pre-defined reward that it will be given if certain sub-tasks are achieved. In most cases, the machine tries performing different actions in the beginning to learn their corresponding rewards, then the machine changes how it will behave in the future based on the rewards it gained, and eventually, the machine will do better and better in the task.

For instance, if a traffic light is implemented with a reinforcement learning algorithm, the traffic light will usually learn by the following steps:

1	While observing the surrounding traffic situation, the traffic light changes its phase signal to find out how it will gain rewards. For example, if the traffic light observes that it gained rewards after switching to the green phase signal when cars were queueing up, it finds out that the same action should be performed in the future whenever it faces similar traffic situations.
2	The traffic light changes its phase signal according to what it has learned, to maximize the rewards that it will gain. For example, while the cars are queueing up, many people passing the road; if the traffic light estimates that it will gain more rewards to keep the current phase signal based on what it has learned in the previous step, it will keep the current phase for some more time.

Based on different algorithms, there are several ways for the traffic light to learn. Nonetheless, all of them involve following a sequence of steps from step 1 to step 2.

2.1.2 Elements of Reinforcement Learning

In reinforcement learning, some elements need to be well-defined before delving into the field. Elements in the reinforcement learning of an intelligent traffic light will be used to illustrate the ideas.

Agent

An **agent** is a machine that learns and performs **action** a to interact with the environment. Define A as the random variable of a, so that A contains all possible actions performed by the agent at any given time based on its **policy**, which is a random event that determines which action the agent actually performs.

In the case of the intelligent traffic light, the traffic light is the agent that changes its phase signal as an action to interact with the environment. The traffic light can perform 3 actions in total: changes its phase signal to red, yellow, and green, thus it can be said that its action $A \in \{green, yellow, red\}$ and $a \in \{green, yellow, red\}$, where action a represents a specific action in A that is actually performed by the agent based on its policy.

Environment

The **environment** is the system that the **agent** interacts with to achieve certain goals, and the **state** s of it can be 'observed' by the agent. The transition of state (i.e., **state transition**) can be random due to the environment, even though the result of an action performed by the agent is deterministic. Therefore, mathematically, the state

transition function can be expressed as:

$$p(s'\mid s, a) = \mathrm{P}(S' = s' \mid S = s, A = a)$$

(Sutton & Barto, 2020), where s' is the next state of s; S and S' are the random variables of s and s' respectively.

In the case of the intelligent traffic light, the traffic environment is the environment that the agent interacts with. At any given moment, the traffic condition that can be 'observed' by the agent through cameras and sensors is the state of the environment. Since the incoming car of the environment has a certain extent of randomness, the state transition of the environment can be expressed as the equation above.

Policy

Policy π is defined as the agent's way of behaving in each state. It can be expressed mathematically as:

$$\pi\left(a\mid s\right) = \mathrm{P}(A = a \mid S = s)$$

(Sutton & Barto, 2020). The expression describes the probability of the **agent** performing **action** a given the **state** s.

In the case of the intelligent traffic light, the policy tells the agent what action to be performed in the given state. For example, in a state where there is a long queue of traffic, the probability of the agent taking different actions may be given by $\pi\left(green\mid s\right) = 0.7$, $\pi\left(yellow\mid s\right) = 0.2$, and $\pi\left(red\mid s\right) = 0.1$, where switching to the

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green phase has the highest probability so that the agent is more likely to perform that action.

Reward

The **reward** r is the signal that tells the **agent** how well it performs determined by:

$$R(r \mid s', s, a) = P(r \mid S' = s', S = s, A = a)$$

(Sutton & Barto, 2020), where r is the reward when the state is transitioned into s' after the agent performed action a in state s. At each timestep, the **environment** returns a number r which indicates the reward. Since ultimately, the agent adjusts its behavior to try to maximize the reward it gains, the rewards from the environment must be set carefully by the engineer.

It is also defined that R is the random variable of r, where the randomness of R comes from the randomness of the action A and the state S.

In the case of the intelligent traffic light, the reward may be set as the following:

EVENT	REWARD
One vehicle passed by:	$R = +5$
One person passed through the road:	$R = +10$
One vehicle is waiting:	$R = -0.5$
One person is waiting:	$R = -1$

At each timestep, multiple events listed above may happen. The environment therefore returns the sum of rewards.

Agent-Environment Interaction

Figure 1: Agent-Environment Interaction

The relationship between the agent and the environment can be illustrated in Figure 1. At time t, the agent performed action a_t in state s_t. As a result, the agent received rewards r_t from the environment, while the state of the environment transitioned into s_{t+1}.

Return

$$U_t = R_t + \gamma R_{t+1} + \gamma^2 R_{t+2} + \gamma^3 R_{t+3} + \ldots + \gamma^{n-1} R_{t+n-1} = \sum_{k=0}^{n-1} \gamma^k R_{t+k} = \sum_{k=0}^{n-1} \gamma^k R_{t+k} (r_{t+k} \mid s_{t+k+1}, s_{t+k}, a_{t+k})$$
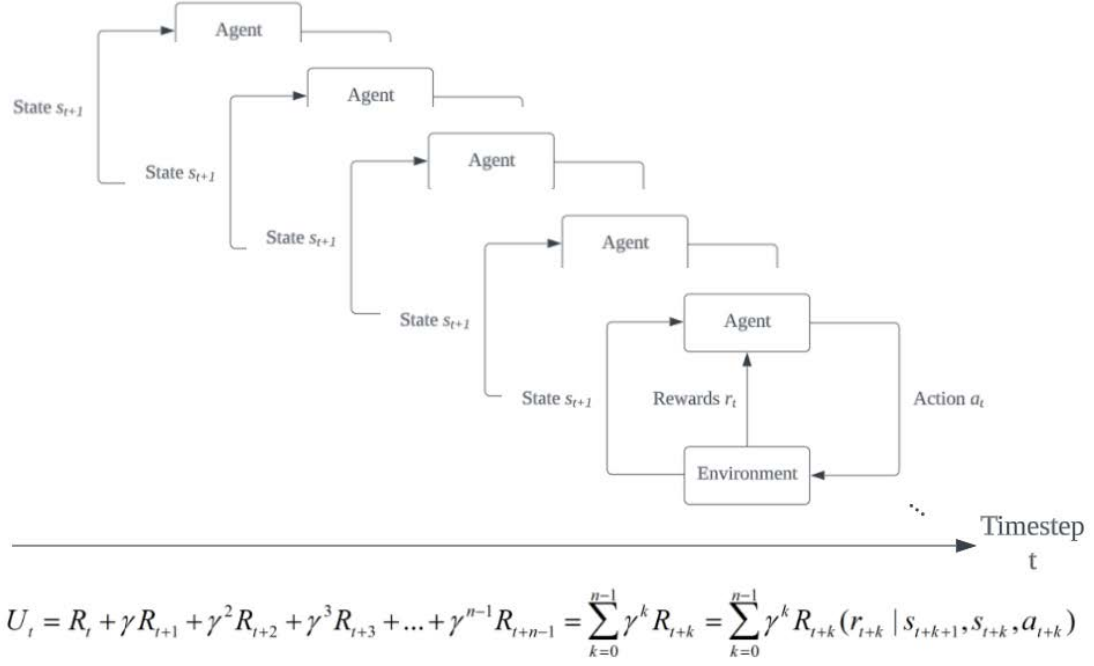
Figure 2: Iterations of Agent Environment Interaction

Return U is the cumulative future rewards, which is the sum of the current and future **rewards**. However, since future rewards are considered less valuable than immediate rewards, a discount rate γ is added to the mathematical expression of return at time t:

$$U_t = R_t + \gamma R_{t+1} + \gamma^2 R_{t+2} + \gamma^3 R_{t+3} + \ldots + \gamma^{n-1} R_{t+n-1} = \sum_{k=0}^{n-1} \gamma^k R_{t+k} = \sum_{k=0}^{n-1} \gamma^k R_{t+k} (r_{t+k} \mid s_{t+k+1}, s_{t+k}, a_{t+k})$$

(Sutton & Barto, 2020), where the nth term is the final term of reward obtained by the agent when the environment is transitioned into the **terminal state** (i.e., the last state of the environment).

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Since U is the discounted cumulative sum of R, and R is determined by the

environment that is affected by the two random variables A and S, it can be said that

U is also a random variable that is dependent on A and S. More accurately, given

state s_t, the return U_t depends on the random variables: $A_t, A_{t+1}, A_{t+2}, A_{t+3}, ..., A_{t+n-1}$ and

$S_{t+1}, S_{t+2}, S_{t+3}, ..., S_{t+n}$.

Value Functions

Value functions are essentially the functions that can be modeled by the agent

that estimate how good it is to perform the action a and/or to be in the state s. Hence,

there are two types of value function: Action-value function and State-value function.

The **action-value function** can be expressed as:

$$Q_\pi(s_t, a_t) = E_\pi\left[U_t \mid S_t = s_t, A_t = a_t\right] = E_\pi\left[\sum_{k=0}^{n-1} \gamma^k R_{t+k} \mid S_t = s_t, A_t = a_t\right]$$

(Sutton & Barto, 2020), which is essentially the expected value of U_t given π, s_t and

a_t. R_t can be obtained directly by a_t and s_t. Then, by calculating the expected value

of $A_{t+1}, A_{t+2}, A_{t+3}, ..., A_{t+n-1}$ and $S_{t+1}, S_{t+2}, S_{t+3}, ..., S_{t+n}$ recursively through the policy

function $\pi(a \mid s) = P(A = a \mid S = s)$ and the state transition function

$p(s' \mid s, a) = P(S' = s' \mid S = s, A = a)$, the expected value of $R_{t+1}, R_{t+2}, R_{t+3}, ..., R_{t+n-1}$ can

be obtained through $R(r \mid s', s, a) = P(r \mid S' = s', S = s, A = a)$, so as the expected value

of U_t through $U_t = \sum_{k=0}^{n-1} \gamma^k R_{t+k}$. Generally, the action-value function not only tells the

agent whether it is good to perform action a_t given the state s_t and the current policy

π, but also inherently assesses the current state s_t.

There is also another form of action-value function that gets rid of the current

policy π, which is the **optimal action-value function**:

$$Q^*(s_t, a_t) = \max_\pi Q_\pi(s_t, a_t)$$

(Sutton & Barto, 2020). Instead of calculating the expected value of

$A_t, A_{t+1}, A_{t+2}, ..., A_{t+n-1}$, the agent always chooses the action that will lead to the

maximum value of reward during the calculation. Thus, the optimal action-value

function tells the agent how well it is to perform action a_t given state s_t.

On the other hand, the **state-value function** tells the agent how well it is to be

in the current state. Mathematically, it can be expressed as:

$$V_\pi(s_t) = E_{A_t}\left[Q_\pi(s_t, A_t)\right] = \sum_{A_t} \pi\left(a \mid s_t\right) \cdot Q_\pi(s_t, a)$$

(Sutton & Barto, 2020). Comparing it to the action-value function, rather than providing

a_t in the equation, the expected value of A_t is calculated through the summation of all

potential actions a given the policy π.

2.1.3 Fundamentals of Reinforcement Learning
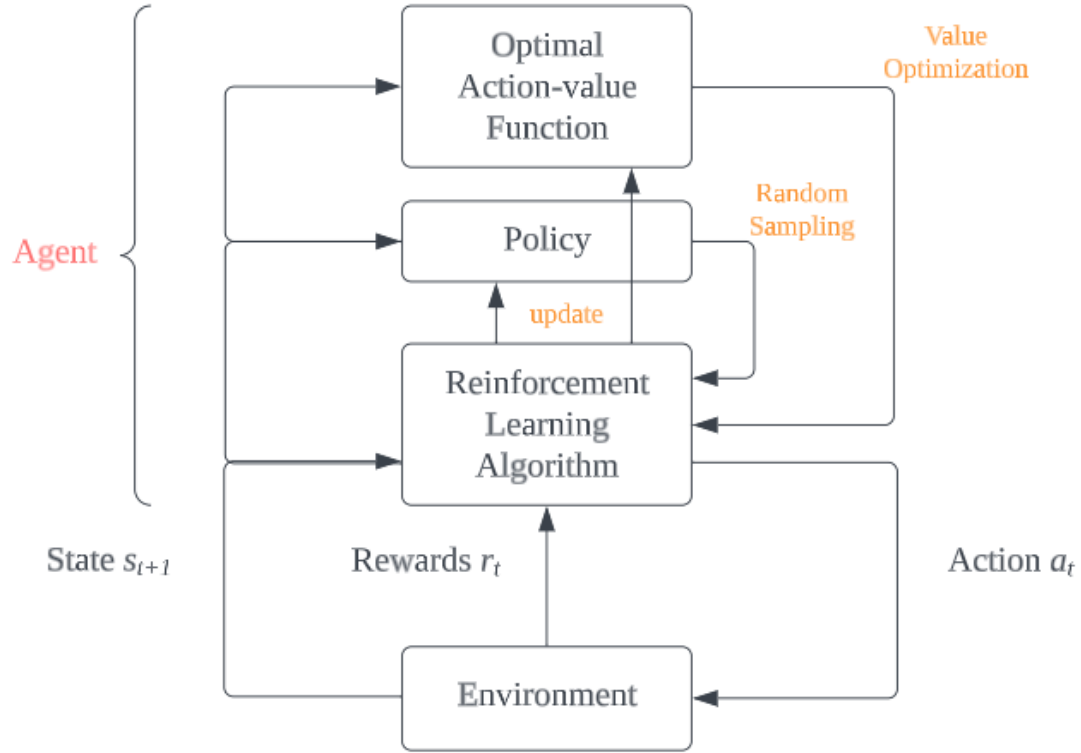
Figure 3: Detailed Agent-Environment Interaction

In general, to achieve the task with the maximum possible return, the agent either controls its action with an optimal policy π or an optimal action-value function $Q*(s,a)$. The former can be used to determine the best action a_t in the state s_t by random sampling: $a_t \sim \pi(a_t \mid s_t)$; the latter can also do that by selecting the action that maximizes the value of $Q*(s,a)$ by: $a_t = \arg\max_a Q*(s_t,a)$. Therefore, fundamentally,

the agent learns (updates) the optimal policy π (**policy-based learning**) and/or the value functions like $Q*(s,a)$ (**value-based learning**) throughout the process of reinforcement learning.

2.1.4 Bellman's Equation

To allow the agent to learn the optimal action-value function, it can be started from the other form of the state-value function:

$$V_\pi(s_t) = E_{A_t}\left[Q_\pi(s_t, A_t)\right]$$

$$V_\pi(s_t) = E_{A_t}\left[E_\pi\left[U_t \mid S_t = s_t, A_t = A_t\right]\right]$$

Since E_π contains E_{A_t} given that $A_t = A_t$, by removing the redundant expected value function:

$$V_\pi(s_t) = E_\pi\left[U_t \mid S_t = s_t, A_t = A_t\right]$$

$$V_\pi(s_t) = E_\pi\left[\sum_{k=0}^{n-1}\gamma^k R_{t+k} \mid S_t = s_t, A_t = A_t\right]$$

If it is assumed that the agent has the optimal policy and always chooses to perform the action with the highest reward, the value of the state s_t independent of the policy (i.e., **optimal state-value function**) can be given by:

$$V*(s_t) = \max_\pi E_\pi\left[\sum_{k=0}^{n-1}\gamma^k R_{t+k} \mid S_t = s_t\right]$$

By extracting the first term of the summation out:

$$V*(s_t) = \max_{\pi} \mathrm{E}_{\pi} \left[R_t + \sum_{k=1}^{n-1} \gamma^k R_{t+k} \mid S_{t+1} = s_{t+1} \right]$$

Since $\left(\sum_{k=1}^{n-1} \gamma^{k-1} R_{t+k} \mid S_{t+1} = s_{t+1} \right) = V*(s_{t+1})$, the expression becomes:

$$V*(s_t) = \max_{\pi} \mathrm{E}_{\pi} \left[R_t + \gamma V*(s_{t+1}) \right]$$

Once the state is transitioned from s_t into s_{t+1}, r_t can be observed by the agent, hence R_t can be replaced by r_t:

$$V*(s_t) = \max_{\pi} \mathrm{E}_{\pi} \left[r_t + \gamma V*(s_{t+1}) \right]$$

(Sutton & Barto, 2020). As a result, Bellman's equation, which enables the agent to break the optimization problem recursively into sub-problems, is obtained.

2.1.5 Temporal Difference (TD) Learning
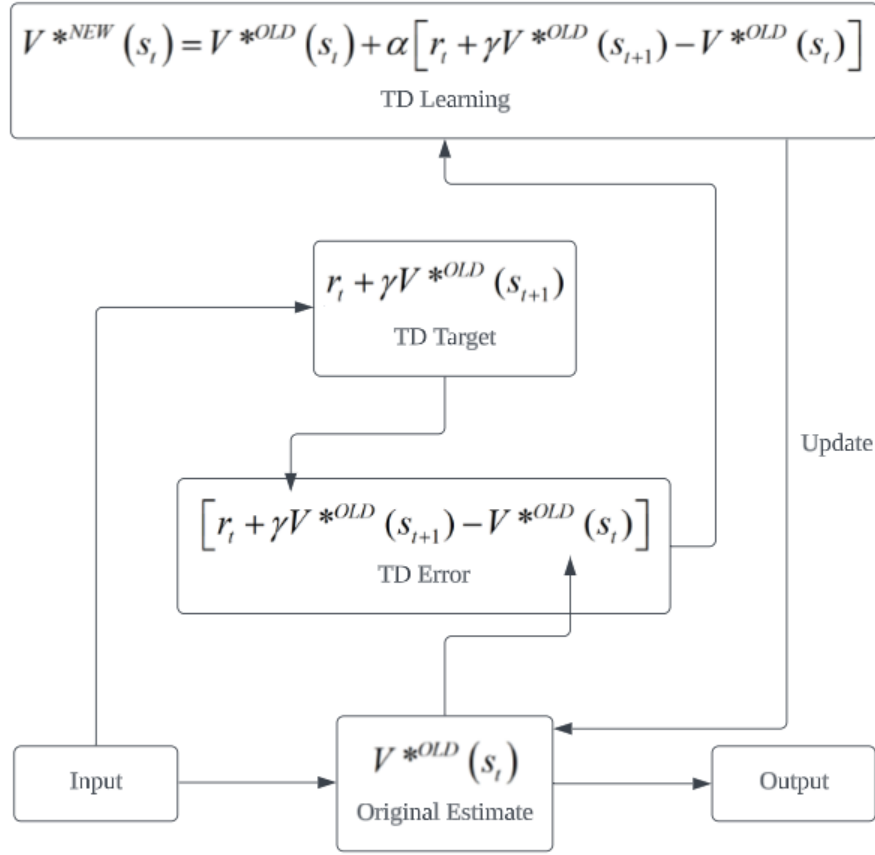
Figure 4: Procedure of TD Learning

TD learning is used for the agent to improve its estimation of the state-value function. Mathematically, it can be expressed as:

$$V*^{NEW}(s_t) = V*^{OLD}(s_t) + \alpha \left[r_t + \gamma V*^{OLD}(s_{t+1}) - V*^{OLD}(s_t) \right]$$

(Sutton & Barto, 2020). In the expression, $V*^{NEW}(s_t)$ is the improved estimation of $V*^{OLD}(s_t)$, and α is the predefined **learning rate** of the agent.

The expression uses the concept of Bellman's equation in the part

$r_t + \gamma V *^{OLD} (s_{t+1})$, which is also defined as the **TD target**. It is believed that the TD

target estimate is better than the estimation of $V *^{OLD} (s_t)$ since it contains the term r_t

which is returned by the environment after a state transition rather than a pure

estimation. The difference between them (i.e., $\left[r_t + \gamma V *^{OLD} (s_{t+1}) - V *^{OLD} (s_t) \right]$) is

defined as the **TD error**, which is multiplied by the learning rate α and is then

combined with the old estimation $V *^{OLD} (s_t)$ to form the new estimation $V *^{NEW} (s_t)$.

2.1.6 Q-Learning

$$Q*^{NEW}\left(s_t,a_t\right)=Q*^{OLD}\left(s_t,a_t\right)+\alpha\left[r_t+\gamma\max_a Q*^{OLD}\left(s_{t+1},a\right)-Q*^{OLD}\left(s_t,a_t\right)\right]$$

TD Learning

$$r_t+\gamma\max_a Q*^{OLD}\left(s_{t+1},a\right)$$

TD Target

$$\left[r_t+\gamma\max_a Q*^{OLD}\left(s_{t+1},a\right)-Q*^{OLD}\left(s_t,a_t\right)\right]$$

TD Error

Update

$$Q*^{OLD}\left(s_t,a_t\right)$$

Original Estimate

Input

Output
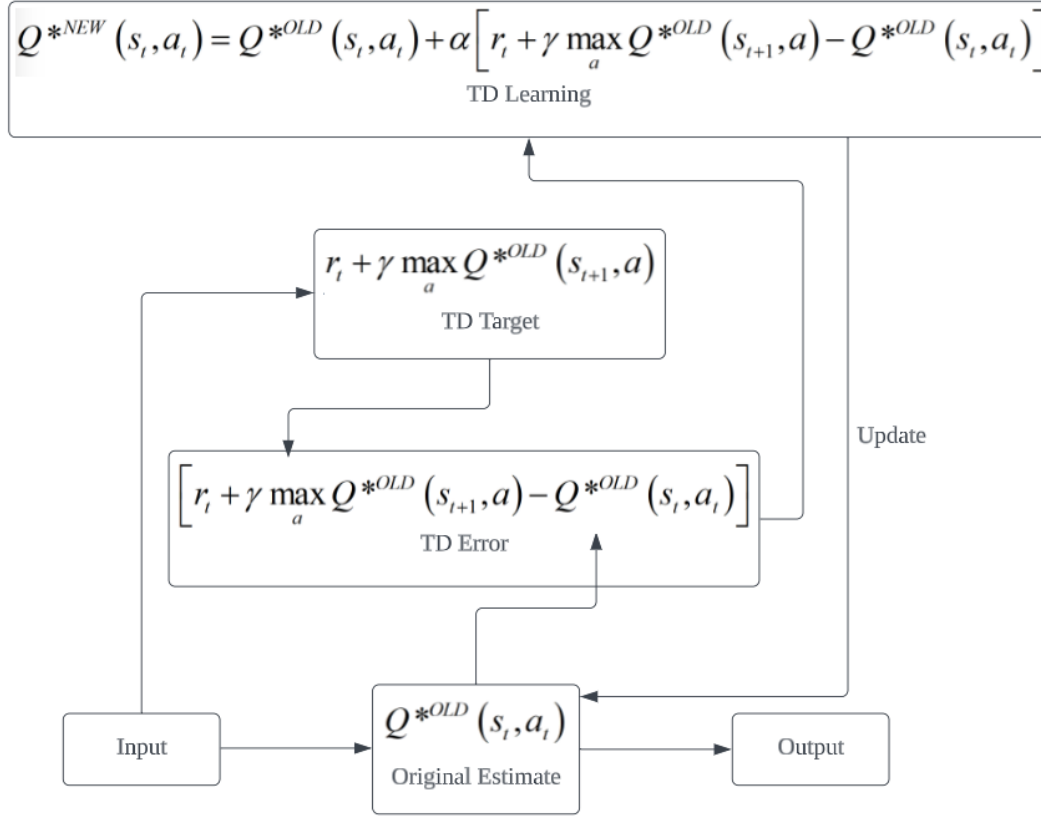
Figure 5: Procedure of Q-Learning

Using the concept of TD learning, the optimal action-value function can finally be learned by the following expression:

$$Q*^{NEW}\left(s_t,a_t\right)=Q*^{OLD}\left(s_t,a_t\right)+\alpha\left[r_t+\gamma\max_a Q*^{OLD}\left(s_{t+1},a\right)-Q*^{OLD}\left(s_t,a_t\right)\right]$$

(Sutton & Barto, 2020). Similar to TD learning, $Q*^{NEW}\left(s_t,a_t\right)$ is the improved estimation of $Q*^{OLD}\left(s_t,a_t\right)$, and α is the predefined learning rate of the agent.

However, the TD target is slightly different, which is

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$\left[r_t + \gamma \max\limits_{a} Q *^{OLD} \left(s_{t+1}, a \right) \right]$ instead of $\left[r_t + \gamma Q *^{OLD} \left(s_{t+1}, a_{t+1} \right) \right]$. This is due to the **off-policy** characteristic, for which the agent does not necessarily need to perform the action given by $a_t = \arg\max\limits_{a} Q *(s_t, a)$, hence providing the agent with the opportunity to explore alternative choices that may lead to more rewards by performing random action instead. Whenever an alternative is explored, the highest value of the action-value function in the next state is used to update the estimation of $Q *^{OLD} \left(s_t, a_t \right)$.

2.2 Deep Neural Network

Sometimes, the number of all possible states can be enormous, and the agent is impossible to learn the exact models of the policy or the value functions. Therefore, deep neural networks are used to approximate those high-dimensional functions.

Fundamentally, in the context of deep reinforcement learning, a neural network can be interpreted as a complex function that processes input and returns output, with multiple layers of nodes (neurons) and connection edges combined. Below is an example of a deep (i.e., multiple layers) neural network:

Input Layer $\in \mathbb{R}^2$ Hidden Layer $\in \mathbb{R}^6$ Hidden Layer $\in \mathbb{R}^8$ Hidden Layer $\in \mathbb{R}^5$ Output Layer $\in \mathbb{R}^1$
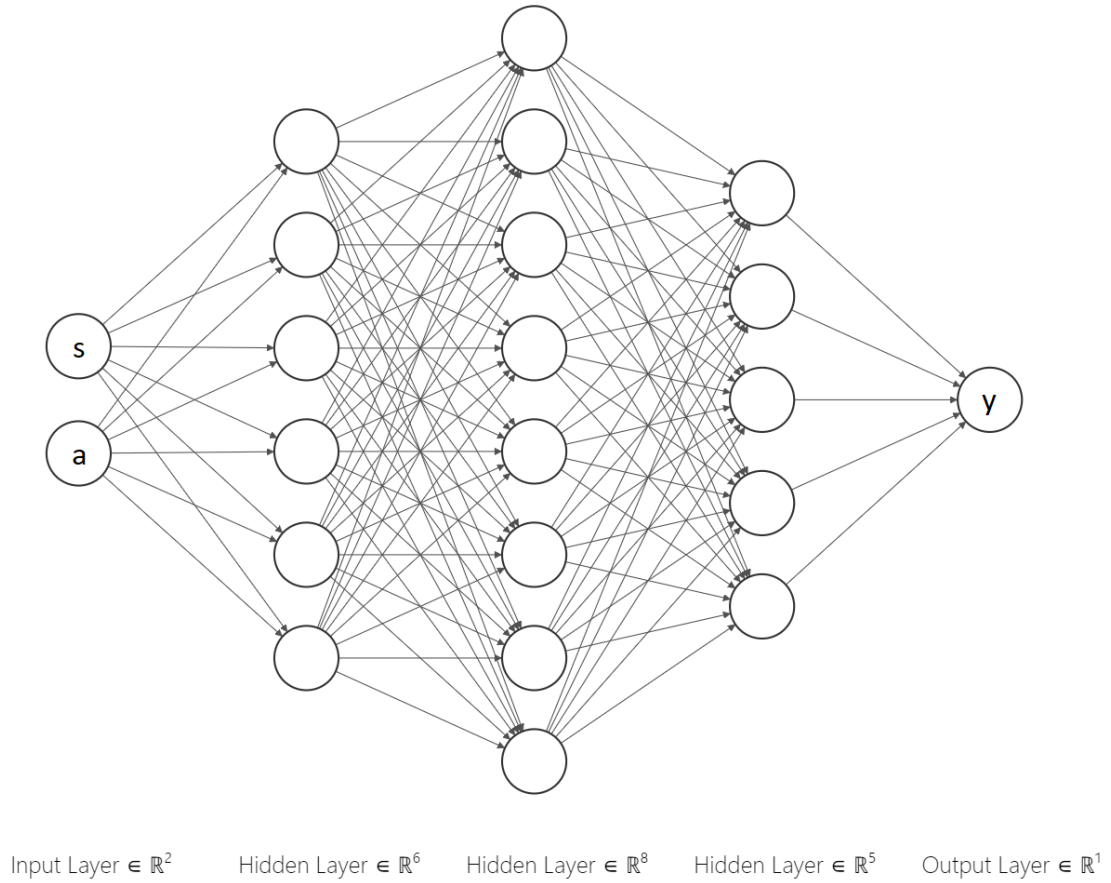
Figure 6: Deep Neural Network

In Figure 6, the deep neural network can be used to model the optimal action-value function as $q*(s,a;w)$. It takes 2 (multi-dimensional) inputs s, a and returns 1 (multi-dimensional) output y; w is the vector of all the connection weights of the network: neurons are densely connected with different connection weights, each of which is essentially a 'simple processing element' (Bishop & Mitchell, 1991) that processes an input and return an output.

2.3 Deep Reinforcement Learning

Using deep neural networks, reinforcement learning can be performed more effectively and efficiently by the ability to approximate complex functions. This type of reinforcement learning is called **deep reinforcement learning**, which consists of two popular approaches: DQN and A3C.

2.3.1 Deep Q-Network (DQN)

$$w_{t+1} = w_t - \alpha \cdot \frac{\partial L_t}{\partial w_t}$$

Gradient Descent

Update

$$\left[r_t + \gamma \max_a q*(s_{t+1}, a; w_t) \right]$$

TD Target

$$L_t = q*(s_t, a_t; w_t) - \left[r_t + \gamma \max_a q*(s_{t+1}, a; w_t) \right]$$

Loss (TD Error)

$$q*(s, a; w)$$

Estimation

Input

Output
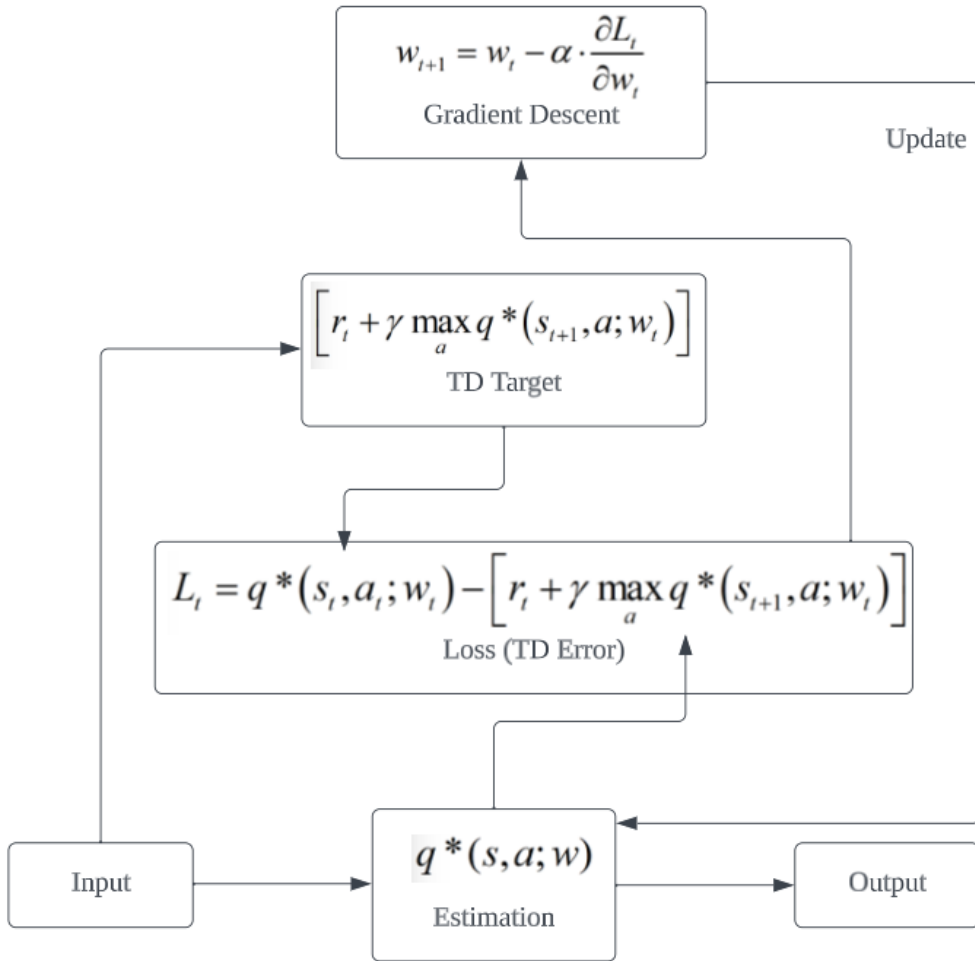
Figure 7: Procedure of DQN

DQN is an approach that directly learns the approximated optimal action-value function $q*(s, a; w)$ by the neural network, which is essentially Q-Learning with deep neural network. By applying the concept of Bellman's equation and TD learning, the

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TD target is $\left[r_t + \gamma \max_a q*\left(s_{t+1}, a; w_t\right) \right]$ and is believed to be better than the estimation

of $q*\left(s_t, a_t; w_t\right)$. To update the neural network, the loss L_t (i.e., TD error) is defined

to indicate the error of the approximation:

$$L_t = q*\left(s_t, a_t; w_t\right) - \left[r_t + \gamma \max_a q*\left(s_{t+1}, a; w_t\right) \right]$$

(Sutton & Barto, 2020). Finally, the model can be updated by **gradient descent** every

timestep, where w_t is subtract by the product of the learning rate α and the partial

derivative of L_t with respect to w_t:

$$w_{t+1} = w_t - \alpha \cdot \frac{\partial L_t}{\partial w_t}$$

As a result, the loss L_t will decrease over time hence maximizing the return U_t.

2.3.2 Asynchronous Advantage Actor-Critic (A3C)
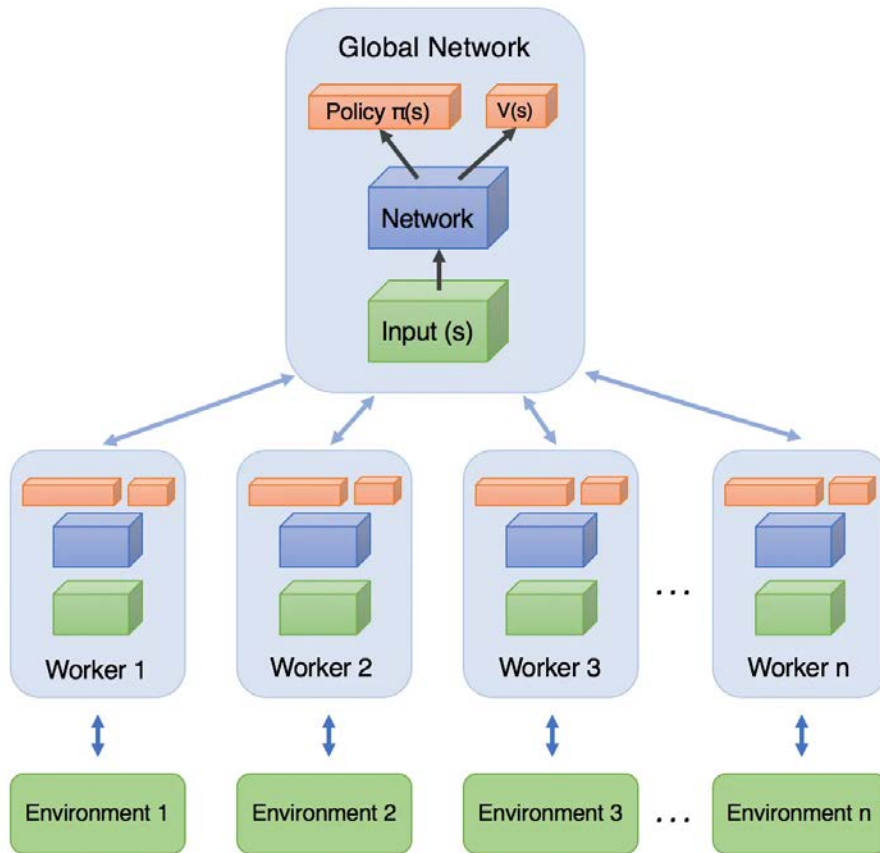
Figure 8: High-level architecture of A3C (Juliani, 2016)

On the other hand, A3C is an approach that trains multiple neural networks and interacts with multiple environments in parallel. Basically, for each worker who interacts with the environment, there are two components: the actor network and the critic network. The former is responsible for the choice of the agent's action, while the latter is responsible for evaluating the choice of action.
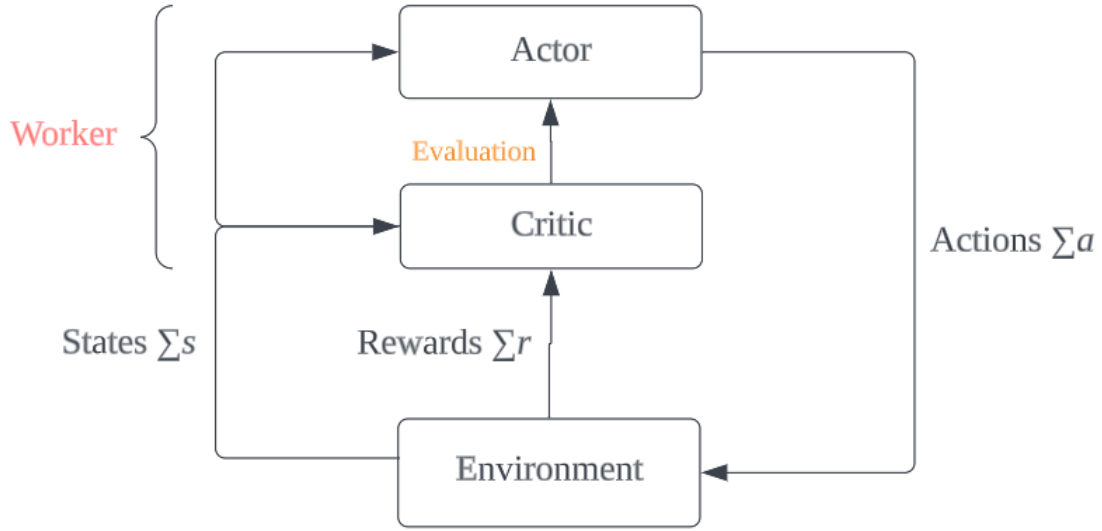
Figure 9: Actor-Critic Network

The action network is simply the policy of the agent modeled by the deep neural network: $\pi\left(a_t \mid s_t; \theta\right)$, where θ is the vector of all connection weights. The critic network approximates the **advantage function** $A_\pi\left(s_t, a_t\right) = Q_\pi\left(s_t, a_t\right) - V_\pi\left(s_t\right) = r_t + V_\pi\left(s_{t+1}\right) - V_\pi\left(s_t\right)$ (Paczolay & Harmati, 2020), which is defined as the additional rewards that it brings to perform a_t in s_t given policy π. Notice that the approximation of it is dependent on the policy $\pi\left(a_t \mid s_t; \theta\right)$, therefore, the approximation of $A_\pi\left(s_t, a_t\right)$ is: $a_\pi(s_t, a_t; \theta, \theta_v)$

Whenever the terminal state of an environment is reached (at $t = n$), the critic network can be updated by gradient descent where the loss (i.e, TD error squared) is:

$$L_t = \left\{\sum_{t=0}^{n-1} a_\pi(s_t, a_t; \theta, \theta_v) - \left[r_t + \gamma a_\pi(s_{t+1}, a_{t+1}; \theta, \theta_v)\right]\right\}^2$$

Notice that it is squared to prevent positive errors and negative errors canceling each other.

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Then, the critic network is used to update the actor network by gradient ascent, which maximizes the approximated value of $A_\pi\left(s_t, a_t\right)$ divided by the probability that a_t is performed:

$$\theta_{NEW} = \theta_{OLD} + \alpha \sum_{t=0}^{n-1} \frac{\partial \pi\left(a_t \mid s_t; \theta_{OLD}\right)}{\partial \theta_{OLD}} \frac{a_\pi(s_t, a_t; \theta_{OLD}, \theta_v)}{\pi\left(a_t \mid s_t; \theta_{OLD}\right)}$$

$$\theta_{NEW} = \theta_{OLD} + \alpha \sum_{t=0}^{n-1} \nabla_{\theta_{OLD}} \pi\left(a_t \mid s_t; \theta_{OLD}\right) \frac{a_\pi(s_t, a_t; \theta_{OLD}, \theta_v)}{\pi\left(a_t \mid s_t; \theta_{OLD}\right)}$$

$$\theta_{NEW} = \theta_{OLD} + \alpha \sum_{t=0}^{n-1} \pi\left(a_t \mid s_t; \theta_{OLD}\right) \nabla_{\theta_{OLD}} \log \pi\left(a_t \mid s_t; \theta_{OLD}\right) \frac{a_\pi(s_t, a_t; \theta_{OLD}, \theta_v)}{\pi\left(a_t \mid s_t; \theta_{OLD}\right)}$$

$$\theta_{NEW} = \theta_{OLD} + \alpha \sum_{t=0}^{n-1} \nabla_{\theta_{OLD}} \log \pi\left(a_t \mid s_t; \theta_{OLD}\right) \cdot a_\pi(s_t, a_t; \theta_{OLD}, \theta_v)$$

(Mnih, et al., 2016).

After a worker has reached the terminal state and updated its actor-critic network, it will update the global network and reset itself to the global network before beginning another iteration.

3. Methodology

3.1 Simulated Environment
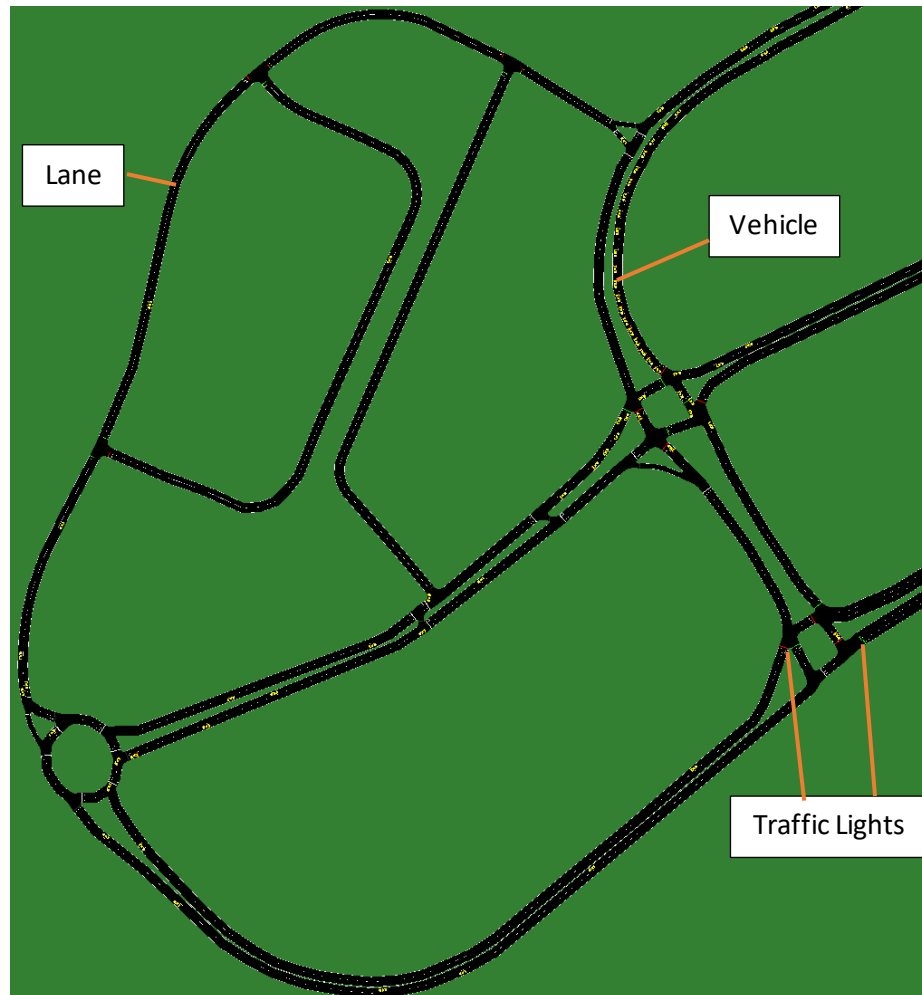
Figure 10: Simulated Environment

Simulation of Urban Mobility (SUMO) is a road traffic simulation software program used to model road networks and traffic flows (Lopez, et al., 2018), which is widely used and easy to implement. By importing the simplified road network near my hometown via OpenStreetMap (OSM), which is an open geographic database, a model of the road system can be configured and constructed.

To meet the reality, the traffic conditions were defined in `experiment.net.xml`

and `experiment.rou.xml`. The speed limit was defined as 50km/h (Transport Department of Hong Kong, ROADS WITH FASTER TRAFFIC, 2022), and the rush hour was set to be 7:30 a.m. to 9:30 a.m. and 5:30 p.m. to 7:30 p.m. (Hong Kong Tourism Board, 2020) according to government officials.

An on-site investigation was done to collect real-life data on the traffic flow. According to the data in `on-site_investigation.ods`, the inflow and outflow of the 3 main roads in the simulation were configured to the estimated values in real life. Additionally, it was ensured that vehicles were traveling evenly around the network, thus maintaining consistency with the observation.

3.2 Algorithms Implementation

For comparison, DQN and A3C were implemented in all traffic lights within the simulation through several libraries: SUMO-RL (Alegre, 2019), RAY (Philipp Moritz, et al., 2018) and SuperSuit (Terry, Black, & Hari, 2020). In `DQN.py` and `A3C.py`, DQN and A3C algorithms from Ray RLlib were imported to SUMO-RL, which is a reinforcement learning algorithms interface of SUMO. Then, to turn the simulated environment into a multi-agent environment, it was wrapped in `padding_wrappers` of SuperSuit.

The 3 essential elements of reinforcement learning algorithms were set as follows:

Element	Description
Environment	The environment was set to be the traffic network simulated by SUMO based on my hometown. The state transition of the network was provided by SUMO with some degree of randomness: time interval between each incoming car. Nonetheless, the expected inflow and outflow of traffic matched the result in `on-

	site_investigation.ods`. 1 day in the simulated network was defined as 80000 timesteps, which was also defined as 1 episode. After the algorithms had gone through 1 episode, another episode would be started, hence the last timestep in each episode was defined as the terminal state.
Agent	All the traffic lights on the network were set to be the agents. For each agent, it could perform action $a \in \{green, red\}$, each of which turns its phase signal into the corresponding color. Between the transition of phase signals, the 'yellow' phase would automatically be displayed for 2 timesteps. Additionally, to meet the reality, each 'green' phase should not be less than 5 timesteps or greater than 50 timesteps.
Reward	The reward function of each agent was defined as: $R(r_t) = D_t - D_{t+1}$, where D was the cumulative vehicle delay. Specifically, the reward function was how much the total delay (sum of the waiting times of all approaching vehicles) changed in relation to the previous timestep. (Alegre, 2019)

3.3 Variables

3.3.1 Independent Variable – Choice of Algorithm

The only changing factor of the experiment was the algorithm implemented in the simulated environment: DQN or A3C. The difference in choice was believed to bring different experimental results due to their fundamental principles.

3.3.2 Dependent Variables

Variable	Description
Total Waiting Time of Vehicles	It was defined as the accumulated waiting time of all vehicles on the network. It was directly related to the level of traffic congestion of the network at any given moment, hence was used to determine the performance of the two algorithms. It was also used in the reward function to train the agents.

Mean Waiting Time of Vehicles	It was defined as the total waiting time divided by the total number of vehicles on the network. In addition to the level of traffic congestion, the capacity of the network was also considered.
Mean Speed of Vehicles	It was defined as the average speed of all vehicles on the network. It was related to the congestion level, traffic flow and the overall travel time estimation of vehicles.
Convergence Speed of Algorithms	It was defined as the speed for each algorithm to reach the best performance that it can get. It was directly related to the time required to train the algorithms.

3.3.3 Controlled Variables

Variable	Description	Reasoning
Simulated Environment	All factors related to the environment were kept constant: traffic network, traffic density, traffic patterns, speed limit, etc.	To provide identical conditions for the two algorithms to train on.
Hardware and Operating System	The same computer was used throughout the experiment, which was running on Ubuntu 22.04.3 LTS.	To provide identical computational resources.
Hyperparameters of algorithms	Common hyperparameters were set to be the same values, e.g., learning rate $\alpha = 2 \times 10^{-5}$, discount factor $\gamma = 0.95$.	To provide identical training parameters.
Training Duration	The total number of timesteps was set to 2500000 in both algorithms.	To provide identical timesteps for training.
Versions of dependencies	All Python packages were kept in the same versions, as shown in the `dependencies.txt`.	To prevent changes in computational performance or overall efficiency caused by certain updates.

3.3.4 Procedure

STEPS	DESCRIPTION
1	Setup the experiment environment
2	Implement DQN into the simulated environment and begin the experiment
3	Wait until the end of the experiment and record the result of DQN
4	Repeat steps 3-4 for A3C
5	Process the data
6	Evaluate and compare the result

4. Hypothesis

In terms of Convergence Speed of Algorithms, it was expected that A3C would converge faster than DQN due to parallelization. In A3C, workers interact with the environment simultaneously, hence updating the global model independently and efficiently. Additionally, the advantage actor-critic architecture in A3C was also believed to increase the convergence speed. The advantage function used in A3C, which measures the additional rewards of taking certain actions over the state-value, should provide more informative and targeted updates.

In terms of the Total Waiting Time of Vehicles and Mean Waiting Time of Vehicles, it was expected that DQN would eventually converge to a better model than A3C could do, i.e., DQN could perform better than A3C when they were both trained for a very long time. It was believed to be due to the off-policy characteristic of DQN mentioned in Section 2.1.6, in contrast to the on-policy characteristic of A3C which would constantly perform actions according to the policy. Therefore, DQN could frequently explore different possibilities for the optimal model and could potentially escape local optima.

5. Data and Analysis

5.1 Data Collection

The raw data of each episode was returned by a spreadsheet, each of which has the following columns:

Timestep
Total Waiting Time of Vehicles
Mean Waiting Time of Vehicles
Mean Speed of Vehicles

To combine all the spreadsheets, a Python program `combine.py` was written as shown in the appendix. Then, charts could be drawn with Microsoft Excel.

Two scatter charts were drawn for each algorithm: one was for the Total Waiting Time of Vehicles and Mean Waiting Time of Vehicles, while the other was for the Mean Speed of Vehicles (upper bounds were set at 1000 timesteps and 13.89 m/s respectively to prevent extreme data or unreasonable data):

Figure 11: Waiting Time of Vehicles (DQN)
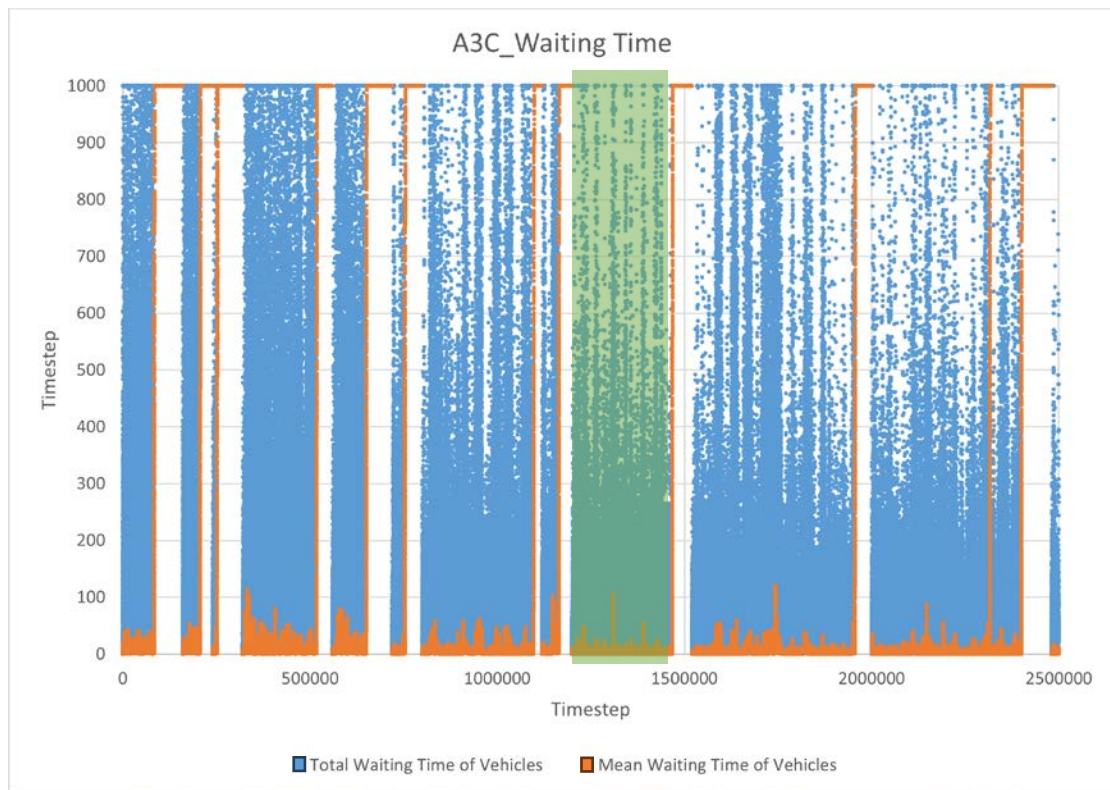
Figure 12: Waiting Time of Vehicles (A3C)
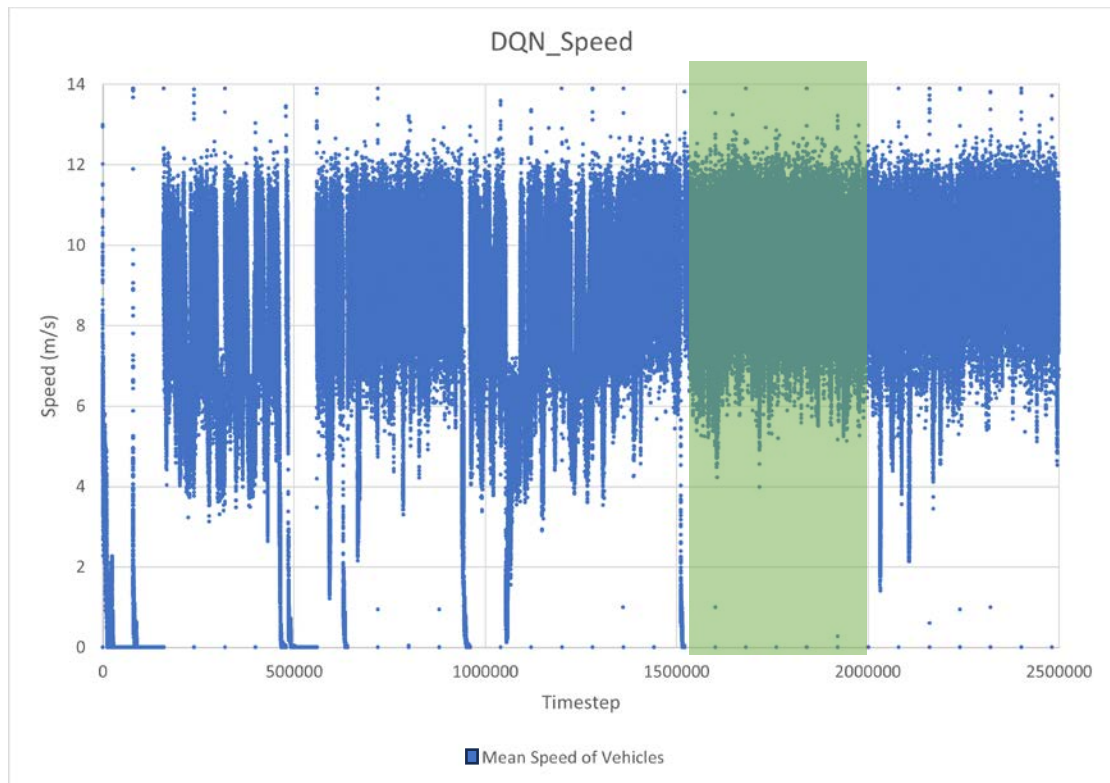
Figure 13: Mean Speed of Vehicles (DQN)
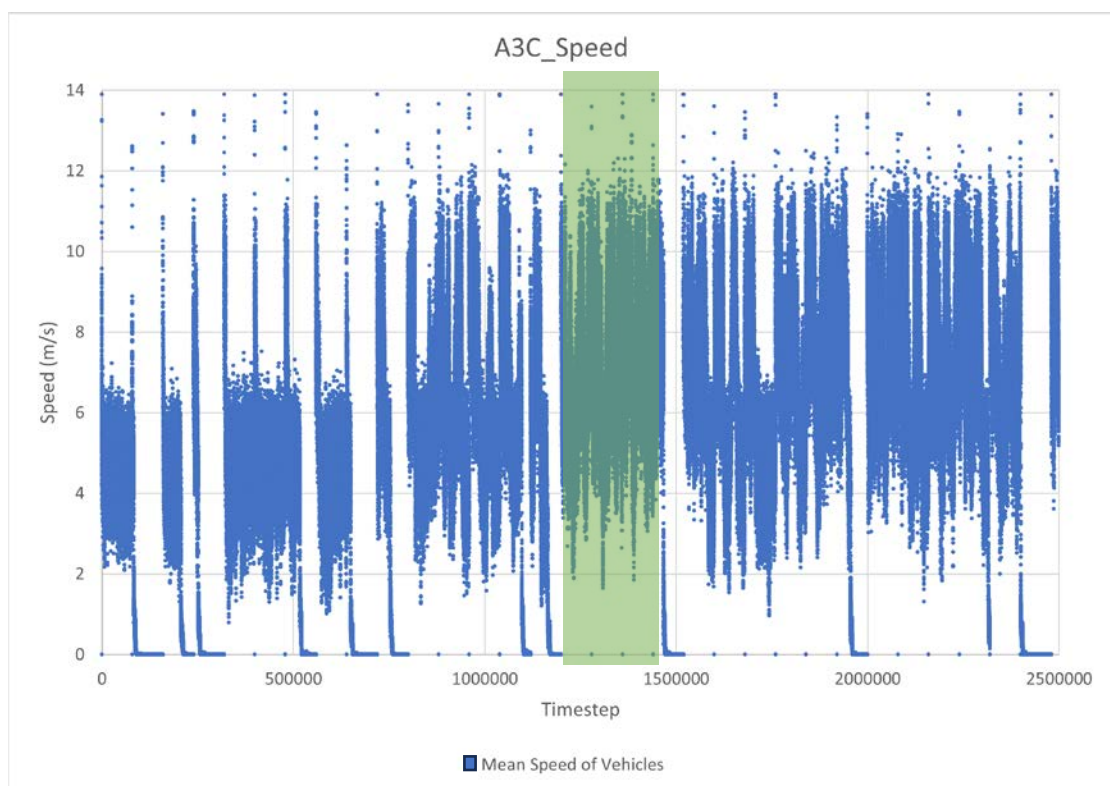
Figure 14: Mean Speed of Vehicles (A3C)

5.2 Data Analysis

In Figure 11, it can be shown that DQN had the best performance between 1500000 and 2000000 timesteps (green area) in reducing the Waiting Time of Vehicles. In Figure 13, it was also shown that DQN had reached the best performance between 1500000 and 2000000 (green area) timesteps in raising the Mean Speed of Vehicles.

In Figure 12, it was shown that A3C had reached the best performance between 1200000 and 1500000 (green area). In Figure 14, it was also suggested that A3C had reached the best performance between 1200000 and 1500000 (green area).

Therefore, it was shown that the Convergence Speed of A3C was faster than that of DQN.

On the other hand, by comparing the best performance of the two algorithms, it was shown that DQN generally performed better than A3C, despite taking more timesteps to reach its optimal performance. In the figures of the Waiting Time of Vehicles, the data points of DQN are generally lower than that of A3C within the green area. In the same way, in the figures of the Mean Speed of Vehicles, the data points of DQN are generally higher than that of A3C in the green area.

Moreover, the performance of DQN was shown to be more stable and consistent than the performance of A3C. By comparing Figure 11 and Figure 12, the number of times that DQN hit the upper boundary (1000 timesteps) is less than that of A3C. In addition, by comparing Figure 13 and Figure 14, data points of DQN generally have lower variance compared to that of A3C, especially in the latter half of the experiment.

6. Evaluation

6.1 Evaluation on Results

The results of the experiment partially support the initial hypothesis: A3C would converge faster than DQN, and DQN would eventually outperform A3C. For the former, the parallelism and the advantage actor-critic architecture of A3C enabled more efficient learning than DQN. For the latter, the off-policy characteristics of DQN helped its exploration of the global optimal.

However, both DQN and A3C did not fully converge at the end of the experiment, which may be due to various factors, including suboptimal hyperparameters, insufficient training time, or algorithmic implementation. One possible cause was believed to be overfitting. Overfitting occurs when models do not generalize well from observed data to unseen data (Xue Ying, 2019). In the experiment, the algorithms might have been adjusted specifically to its previous episodes, hence the randomness in the new episodes leads to worse performances.

In addition to what was mentioned in the hypothesis, the methods of how DQN and A3C choose the next action to be performed also contributed to the results. DQN would generally choose the next action with the highest estimated action-value, in contrast with A3C which would determine the next action by random sampling from the policy. Therefore, in tasks like controlling the signal of traffic lights that have discrete actions, DQN would perform better after partially converging.

Furthermore, the targeted network used in DQN was a delayed copy of the main network, compared to multiple separated actor-critic networks used in A3C. This may be one of the reasons why the performance of DQN appeared to be more stable than the performance of A3C.

6.2 Limitation of Investigation

Although valuable insights to the research question were obtained in Section 6.1, there were numerous limitations in the methodology used.

Simplified Traffic Network

The simulated traffic network was simplified so that the experiment could be conducted within a limited time. In the simulated environment based on my hometown, not only some minor roads were excluded, but also there were no pedestrians. Moreover, in the simulation, all the vehicles were private cars, and their behaviors were standardized. Therefore, the results in the simulated environment would not perfectly represent the consequences in reality.

Hyperparameter Selection

The selection of hyperparameters introduced or not introduced in previous sections could influence the performance and convergence properties of algorithms. The optimal selection of hyperparameters for one algorithm may not be suitable for the other algorithm, hence the minimum number of hyperparameters was set while others were kept default for fairness and simplicity.

Advanced Features of Algorithms

The field of reinforcement learning is huge, and there are numerous variants in algorithms like DQN, e.g., DDQN, Dueling DQN, Prioritized Experience Replay, etc. Therefore, the additional features that were added in those variants were not discussed in previous sections for simplicity.

Training Duration and Number of Experiments Conducted

The training duration and the number of experiments conducted were limited by the time constraint. Only a test trail was conducted before the experiment with a

total of 10000000 timesteps per algorithm. Although none of the algorithms converged in the test trial, there is still a possibility that the algorithms will converge if more trials are done.

7. Conclusion

From the results of the experiment, the research question ("**How do DQN and A3C compare in controlling traffic lights to reduce traffic congestion in a simulated environment based on my hometown?**") can be answered: it was shown that DQN performed better than A3C in terms of the Total Waiting Time of Vehicles, the Mean Waiting Time of Vehicles, the Mean Speed of Vehicles, and the stability of performance. Even though A3C outperformed DQN in terms of the Convergence Speed, it was believed that DQN generally performed better than A3C.

For future research, multiple intelligent traffic lights can indeed communicate with each other to further optimize the traffic flow. It is usually called Traffic Signal Coordination, one of the approaches using collaborative deep reinforcement learning, i.e., Multi-Agent Deep Reinforcement Learning (M. -D. Cano, 2016). DQN and Multi-Agent Actor-Critic are also two popular algorithms in this field, hence further investigations and comparisons can be made.

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df

Appendices

Appendix A – Experimental Setup

A1 - experiment.net.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>


<!-- generated on 2023-07-11 17:35:40 by Eclipse SUMO netedit Version 1.18.0

<configuration xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="http://sumo.dlr.de/xsd/neteditConfiguration.xsd">


    <input>
        <sumo-net-file
value="/home/sam/Documents/EE/Experiment/Map/TKL_2.0.net.xml"/>
    </input>


    <output>
        <output-file value="/home/sam/Documents/EE/Experiment/Map/TKL_2.0.net.xml"/>
    </output>


    <processing>
        <geometry.min-radius.fix.railways value="false"/>
        <geometry.max-grade.fix value="false"/>
        <offset.disable-normalization value="true"/>
        <lefthand value="true"/>
    </processing>


    <junctions>
        <junctions.left-before-right value="false"/>
        <no-turnarounds value="true"/>
        <junctions.corner-detail value="5"/>
        <junctions.limit-turn-speed value="5.50"/>
```

```
      <rectangular-lane-cut value="0"/>

   </junctions>


   <pedestrian>

      <walkingareas value="0"/>

   </pedestrian>


</configuration>

-->


<net version="1.16" junctionCornerDetail="5" lefthand="true" limitTurnSpeed="5.50"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="http://sumo.dlr.de/xsd/net_file.xsd">


   <location netOffset="-215117.34,-2468065.45"
convBoundary="1385.99,833.03,2086.54,1508.89"
origBoundary="114.234931,22.294905,114.262198,22.309664"  projParameter="+proj=utm
+zone=50 +ellps=WGS84 +datum=WGS84 +units=m +no_defs"/>


   <type id="highway.residential" priority="1" numLanes="1" speed="13.89" disallow="tram
rail_urban rail rail_electric rail_fast ship" oneway="0"/>

   <type id="highway.secondary" priority="1" numLanes="1" speed="13.89" disallow="tram
rail_urban rail rail_electric rail_fast ship" oneway="0"/>

   <type id="highway.service" priority="1" numLanes="1" speed="13.89" allow="pedestrian
delivery bicycle" oneway="0"/>

   <type id="highway.tertiary" priority="1" numLanes="1" speed="13.89" disallow="tram
rail_urban rail rail_electric rail_fast ship" oneway="0"/>

   <type id="highway.tertiary_link" priority="1" numLanes="1" speed="13.89"
disallow="tram rail_urban rail rail_electric rail_fast ship" oneway="0"/>

   <type id="highway.unclassified" priority="1" numLanes="1" speed="13.89"
disallow="tram rail_urban rail rail_electric rail_fast ship" oneway="0"/>


   <edge id=":10_0" function="internal">

      <lane id=":10_0_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="8.35" length="7.08" shape="1780.63,1388.48 1782.45,1388.43  1784.15,1388.75
1785.73,1389.44  1787.19,1390.50"/>

   </edge>
```

```xml
<edge id=":10_1" function="internal">

    <lane id=":10_1_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="7.16" shape="1782.76,1384.29 1783.83,1386.31  1784.60,1387.69
1785.56,1388.93  1787.19,1390.50"/>

    <lane id=":10_1_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="7.16" shape="1785.56,1382.74 1786.48,1384.49  1787.12,1385.69
1787.93,1386.76  1789.32,1388.12"/>

  </edge>

  <edge id=":11_0" function="internal">

    <lane id=":11_0_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="7.01" length="8.16" shape="1774.95,1370.51 1775.68,1372.29  1775.71,1374.12
1775.04,1376.02  1773.67,1377.98"/>

  </edge>

  <edge id=":11_1" function="internal">

    <lane id=":11_1_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="9.41" shape="1774.95,1370.51 1779.62,1378.59"/>

    <lane id=":11_1_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="9.41" shape="1777.67,1368.83 1782.42,1377.04"/>

  </edge>

  <edge id=":14_0" function="internal">

    <lane id=":14_0_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="13.61" shape="1780.92,1204.72 1778.95,1208.24  1777.69,1210.71
1776.70,1213.28  1775.56,1217.14"/>

    <lane id=":14_0_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="13.61" shape="1780.92,1204.72 1779.44,1208.37  1779.23,1211.14
1779.30,1214.02  1778.64,1218.01"/>

  </edge>

  <edge id=":14_2" function="internal">

    <lane id=":14_2_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="7.15" length="11.03" shape="1783.72,1206.28 1781.98,1209.92  1781.24,1212.81
1781.49,1214.94  1782.75,1216.33"/>

    <lane id=":14_2_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="6.26" length="8.21" shape="1783.72,1206.28 1782.66,1208.70  1782.41,1210.72
1782.97,1212.33  1784.34,1213.55"/>

  </edge>

  <edge id=":14_4" function="internal">

    <lane id=":14_4_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="11.74" length="11.66" shape="1773.78,1206.08 1775.34,1209.16  1776.19,1211.46
1776.27,1213.84  1775.56,1217.14"/>
```

```xml
    <lane id=":14_4_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="12.61" length="13.52" shape="1773.78,1206.08 1776.01,1209.50 1777.95,1211.87
1779.02,1214.34 1778.64,1218.01"/>

  </edge>

  <edge id=":14_6" function="internal">

    <lane id=":14_6_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="12.87" shape="1776.63,1204.64 1778.04,1208.48 1778.66,1211.46
1779.80,1213.94 1782.75,1216.33"/>

    <lane id=":14_6_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="12.87" shape="1776.63,1204.64 1778.24,1207.84 1779.57,1209.97
1781.35,1211.66 1784.34,1213.55"/>

  </edge>

  <edge id=":15_0" function="internal">

    <lane id=":15_0_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="11.66" length="11.53" shape="1799.39,1231.86 1802.28,1230.09 1804.50,1229.19
1806.87,1229.03 1810.21,1229.48"/>

    <lane id=":15_0_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="12.48" length="13.26" shape="1799.39,1231.86 1802.53,1229.40 1804.73,1227.40
1807.11,1226.25 1810.76,1226.33"/>

  </edge>

  <edge id=":15_2" function="internal">

    <lane id=":15_2_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="12.92" shape="1797.66,1229.16 1801.28,1227.38 1804.09,1226.50
1806.51,1225.25 1808.97,1222.32"/>

    <lane id=":15_2_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="12.92" shape="1797.66,1229.16 1800.70,1227.17 1802.67,1225.59
1804.28,1223.66 1806.26,1220.62"/>

  </edge>

  <edge id=":15_4" function="internal">

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speed="13.89" length="13.58" shape="1797.55,1224.81 1801.06,1226.79 1803.58,1227.97
1806.25,1228.73 1810.21,1229.48"/>

    <lane id=":15_4_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="13.58" shape="1797.55,1224.81 1801.13,1226.28 1803.86,1226.38
1806.75,1226.08 1810.76,1226.33"/>

  </edge>

  <edge id=":15_6" function="internal">

    <lane id=":15_6_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="7.18" length="10.88" shape="1799.14,1222.03 1802.52,1223.64 1805.28,1224.22
1807.43,1223.78 1808.97,1222.32"/>
```

```
    <lane id=":15_6_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
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1804.87,1222.23  1806.26,1220.62"/>

  </edge>

  <edge id=":16_0" function="internal">

    <lane id=":16_0_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="7.58" length="10.76" shape="1798.42,1180.98 1795.86,1182.57  1793.37,1183.15
1790.96,1182.73  1788.62,1181.30"/>

    <lane id=":16_0_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="8.65" length="14.26" shape="1798.42,1180.98 1794.71,1183.43  1791.32,1184.56
1788.24,1184.36  1785.48,1182.84"/>

  </edge>

  <edge id=":16_2" function="internal">

    <lane id=":16_2_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="16.23" shape="1800.42,1183.47 1796.22,1186.19  1792.93,1187.66
1790.09,1189.52  1787.24,1193.38"/>

    <lane id=":16_2_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="16.23" shape="1800.42,1183.47 1796.79,1186.36  1794.38,1188.49
1792.40,1190.98  1790.04,1194.94"/>

  </edge>

  <edge id=":16_4" function="internal">

    <lane id=":16_4_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="15.78" shape="1801.51,1190.11 1797.25,1188.30  1794.56,1186.57
1792.13,1184.41  1788.62,1181.30"/>

    <lane id=":16_4_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="17.79" shape="1801.51,1190.11 1796.47,1188.48  1792.93,1187.45
1789.67,1185.93  1785.48,1182.84"/>

  </edge>

  <edge id=":16_6" function="internal">

    <lane id=":16_6_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="8.46" length="14.11" shape="1800.40,1193.11 1795.53,1191.63  1791.72,1191.18
1788.95,1191.77  1787.24,1193.38"/>

    <lane id=":16_6_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="7.70" length="11.53" shape="1800.40,1193.11 1796.85,1192.15  1793.93,1192.14
1791.66,1193.06  1790.04,1194.94"/>

  </edge>

  <edge id=":17_0" function="internal">

    <lane id=":17_0_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="11.88" length="13.98" shape="1824.25,1210.12 1824.17,1208.45  1824.84,1205.70
1826.27,1201.86  1828.45,1196.95"/>
```

```xml
    <lane id=":17_0_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="12.29" length="15.00" shape="1824.25,1210.12 1823.37,1206.85  1823.30,1203.34
1824.03,1199.58  1825.56,1195.59"/>

  </edge>

  <edge id=":17_2" function="internal">

    <lane id=":17_2_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="12.84" length="16.60" shape="1821.29,1211.33 1818.52,1204.22  1816.83,1199.26
1816.25,1196.43  1816.75,1195.75"/>

    <lane id=":17_2_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="11.74" length="13.81" shape="1821.29,1211.33 1820.38,1209.02  1818.67,1204.82
1816.86,1200.73  1815.64,1198.75"/>

  </edge>

  <edge id=":17_4" function="internal">

    <lane id=":17_4_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="19.59" shape="1815.48,1211.91 1819.13,1207.29  1822.35,1204.64
1825.39,1201.89  1828.45,1196.95"/>

    <lane id=":17_4_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="19.59" shape="1815.48,1211.91 1818.62,1207.15  1820.89,1203.95
1822.98,1200.66  1825.56,1195.59"/>

  </edge>

  <edge id=":17_6" function="internal">

    <lane id=":17_6_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="7.95" length="6.79" shape="1812.76,1210.21 1816.05,1204.45  1816.11,1204.31"/>

    <lane id=":17_6_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="7.14" length="6.99" shape="1812.76,1210.21 1815.33,1205.68  1815.97,1204.02"/>

  </edge>

  <edge id=":17_8" function="internal">

    <lane id=":17_8_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="7.95" length="9.38" shape="1816.11,1204.31 1817.80,1200.13  1818.04,1197.22
1816.75,1195.75"/>

  </edge>

  <edge id=":17_9" function="internal">

    <lane id=":17_9_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="7.14" length="5.85" shape="1815.97,1204.02 1816.66,1202.26  1816.76,1199.95
1815.64,1198.75"/>

  </edge>

  <edge id=":18_0" function="internal">

    <lane id=":18_0_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="12.84" length="15.10" shape="1782.86,1169.65 1779.36,1169.70  1776.14,1169.17
```

1772.83,1167.68 1769.07,1164.85"/>

   </edge>

   <edge id=":18_1" function="internal">

      <lane id=":18_1_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="15.14" shape="1780.61,1174.58 1769.07,1164.85"/>

      <lane id=":18_1_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="15.14" shape="1778.55,1177.03 1766.95,1167.25"/>

   </edge>

   <edge id=":19_0" function="internal">

      <lane id=":19_0_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="18.84" shape="1824.92,1153.22 1820.81,1157.65 1816.79,1160.28 1812.97,1161.94 1809.46,1163.47"/>

   </edge>

   <edge id=":19_1" function="internal">

      <lane id=":19_1_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="19.01" shape="1824.92,1153.22 1821.48,1157.61 1818.87,1160.40 1816.10,1163.06 1812.19,1167.05"/>

      <lane id=":19_1_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="19.01" shape="1827.49,1155.12 1823.99,1159.60 1821.33,1162.44 1818.51,1165.16 1814.53,1169.24"/>

   </edge>

   <edge id=":20_0" function="internal">

      <lane id=":20_0_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="15.40" shape="1881.73,1052.90 1879.55,1056.95 1878.17,1059.80 1877.22,1062.80 1876.32,1067.29"/>

      <lane id=":20_0_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="15.40" shape="1881.73,1052.90 1880.06,1057.00 1879.76,1060.08 1879.88,1063.31 1879.48,1067.85"/>

   </edge>

   <edge id=":20_2" function="internal">

      <lane id=":20_2_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="7.73" length="12.68" shape="1884.56,1054.40 1882.62,1058.64 1881.79,1061.99 1882.05,1064.45 1883.42,1066.04"/>

      <lane id=":20_2_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="6.90" length="9.91" shape="1884.56,1054.40 1883.29,1057.40 1882.95,1059.88 1883.54,1061.85 1885.06,1063.29"/>

   </edge>

   <edge id=":20_4" function="internal">

```xml
    <lane id=":20_4_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="14.78" shape="1874.59,1053.59 1875.96,1057.54 1876.73,1060.34
1876.87,1063.20 1876.32,1067.29"/>

    <lane id=":20_4_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="14.78" shape="1874.59,1053.59 1876.55,1057.79 1878.42,1060.61
1879.60,1063.49 1879.48,1067.85"/>

  </edge>

  <edge id=":20_6" function="internal">

    <lane id=":20_6_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="15.34" shape="1877.62,1052.56 1878.63,1057.07 1879.04,1060.50
1880.18,1063.33 1883.42,1066.04"/>

    <lane id=":20_6_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.10" length="13.54" shape="1877.62,1052.56 1878.87,1056.38 1880.02,1058.99
1881.82,1061.07 1885.06,1063.29"/>

  </edge>

  <edge id=":21_0" function="internal">

    <lane id=":21_0_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="9.53" length="9.63" shape="1899.26,1080.50 1901.03,1078.88 1903.05,1077.74
1905.33,1077.09 1907.87,1076.92"/>

    <lane id=":21_0_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="10.25" length="11.22" shape="1899.26,1080.50 1902.07,1077.51 1904.45,1075.38
1906.41,1074.11 1907.95,1073.72"/>

    <lane id=":21_0_2" index="2" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="11.13" length="13.32" shape="1899.26,1080.50 1900.77,1078.62 1903.52,1075.22
1906.34,1071.96 1908.04,1070.52"/>

  </edge>

  <edge id=":21_3" function="internal">

    <lane id=":21_3_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="15.23" shape="1896.86,1078.38 1899.77,1075.00 1901.66,1072.59
1903.43,1070.09 1905.98,1066.42"/>

    <lane id=":21_3_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="15.23" shape="1896.86,1078.38 1899.39,1074.69 1900.36,1071.67
1901.20,1068.56 1903.36,1064.58"/>

  </edge>

  <edge id=":21_5" function="internal">

    <lane id=":21_5_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="14.80" shape="1894.08,1072.38 1897.84,1074.63 1900.59,1075.97
1903.53,1076.65 1907.87,1076.92"/>

  </edge>

  <edge id=":21_6" function="internal">
```

```xml
    <lane id=":21_6_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="8.35" length="14.66" shape="1894.08,1072.38 1896.86,1073.22  1899.77,1072.51
1902.81,1070.24  1905.98,1066.42"/>

  </edge>

  <edge id=":21_7" function="internal">

    <lane id=":21_7_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="12.92" shape="1895.71,1069.63 1899.06,1071.64  1901.49,1072.85
1904.10,1073.47  1907.95,1073.72"/>

    <lane id=":21_7_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="12.92" shape="1895.71,1069.63 1899.01,1071.08  1901.55,1071.20
1904.25,1070.75  1908.04,1070.52"/>

  </edge>

  <edge id=":22_0" function="internal">

    <lane id=":22_0_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="19.80" shape="1927.72,1055.89 1922.83,1052.51  1919.76,1049.82
1916.82,1046.96  1912.32,1043.07"/>

    <lane id=":22_0_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="19.80" shape="1925.24,1058.11 1920.50,1054.82  1917.54,1052.18
1914.70,1049.37  1910.32,1045.57"/>

  </edge>

  <edge id=":22_2" function="internal">

    <lane id=":22_2_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="8.61" length="15.81" shape="1912.47,1057.19 1914.83,1052.95  1915.58,1049.19
1914.75,1045.89  1912.32,1043.07"/>

    <lane id=":22_2_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="7.24" length="10.90" shape="1909.86,1055.35 1911.60,1052.30  1912.26,1049.66
1911.83,1047.41  1910.32,1045.57"/>

  </edge>

  <edge id=":23_0" function="internal">

    <lane id=":23_0_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="15.30" shape="1902.17,1034.94 1898.95,1031.73  1897.31,1028.99
1895.68,1026.22  1892.52,1022.94"/>

    <lane id=":23_0_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="15.30" shape="1902.17,1034.94 1890.47,1025.40"/>

  </edge>

  <edge id=":23_2" function="internal">

    <lane id=":23_2_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="6.99" length="12.09" shape="1900.17,1037.44 1896.84,1035.29  1894.02,1034.58
1891.72,1035.31  1889.93,1037.47"/>
```

```xml
    <lane id=":23_2_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="6.14" length="9.06" shape="1900.17,1037.44 1897.97,1036.15  1896.00,1035.97
1894.26,1036.91  1892.75,1038.97"/>

  </edge>

  <edge id=":26_0" function="internal">

    <lane id=":26_0_0" index="0" allow="pedestrian bus delivery bicycle" speed="5.53"
length="9.23" shape="1724.93,1135.71 1722.58,1136.63  1721.71,1138.00  1722.33,1139.85
1724.44,1142.16"/>

  </edge>

  <edge id=":26_1" function="internal">

    <lane id=":26_1_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="11.25" shape="1713.86,1137.18 1722.31,1144.54"/>

    <lane id=":26_1_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="11.25" shape="1715.93,1134.74 1724.44,1142.16"/>

  </edge>

  <edge id=":27_0" function="internal">

    <lane id=":27_0_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="8.67" shape="1734.52,1134.25 1727.71,1128.74"/>

    <lane id=":27_0_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="8.67" shape="1732.40,1136.65 1725.73,1131.25"/>

  </edge>

  <edge id=":27_2" function="internal">

    <lane id=":27_2_0" index="0" allow="pedestrian bus delivery bicycle" speed="8.12"
length="7.60" shape="1732.40,1136.65 1731.08,1135.81  1729.42,1135.37  1727.44,1135.32
1725.13,1135.67"/>

  </edge>

  <edge id=":28_0" function="internal">

    <lane id=":28_0_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="6.63" length="9.36" shape="1649.44,1090.92 1651.39,1089.13  1653.40,1088.35
1655.47,1088.60  1657.60,1089.86"/>

  </edge>

  <edge id=":28_1" function="internal">

    <lane id=":28_1_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="6.27" length="9.04" shape="1645.85,1081.25 1647.74,1082.91  1648.55,1084.74
1648.30,1086.73  1646.98,1088.88"/>

  </edge>

  <edge id=":28_2" function="internal">
```

```
<lane id=":28_2_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="14.76" shape="1645.85,1081.25 1649.46,1083.63 1651.90,1085.32
1654.25,1087.13  1657.60,1089.86"/>

    <lane id=":28_2_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="14.76" shape="1647.60,1078.57 1651.30,1081.01 1653.80,1082.74
1656.20,1084.59  1659.63,1087.39"/>

</edge>

<edge id=":29_0" function="internal">

    <lane id=":29_0_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="8.95" shape="1636.57,1074.11 1643.64,1079.80"/>

    <lane id=":29_0_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="8.95" shape="1638.54,1071.59 1645.40,1077.12"/>

</edge>

<edge id=":29_2" function="internal">

    <lane id=":29_2_0" index="0" allow="pedestrian delivery bicycle" speed="8.92"
length="8.33" shape="1642.13,1069.71 1642.59,1072.32 1643.29,1074.42  1644.23,1076.02
1645.40,1077.12"/>

</edge>

<edge id=":30_0" function="internal">

    <lane id=":30_0_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="7.12" shape="1648.06,1066.01 1646.38,1064.65  1645.24,1063.72
1644.05,1062.84  1642.26,1061.64"/>

    <lane id=":30_0_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="7.12" shape="1646.08,1068.52 1644.47,1067.22  1643.37,1066.32
1642.24,1065.48  1640.52,1064.32"/>

</edge>

<edge id=":30_2" function="internal">

    <lane id=":30_2_0" index="0" allow="pedestrian delivery bicycle" speed="4.61"
length="6.43" shape="1646.08,1068.52 1644.14,1067.25 1642.83,1066.99 1642.16,1067.74
1642.11,1069.51"/>

</edge>

<edge id=":33_0" function="internal">

    <lane id=":33_0_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="10.13" shape="1389.35,1009.91 1388.91,1012.85 1388.23,1014.81
1387.46,1016.76  1386.74,1019.66"/>

</edge>

<edge id=":33_1" function="internal">

    <lane id=":33_1_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="9.66" length="8.62" shape="1389.89,1020.21 1390.54,1018.05  1391.53,1016.81
```

1392.98,1015.83 1394.97,1014.51"/>

   </lane>

  </edge>

  <edge id=":34_0" function="internal">

    <lane id=":34_0_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="13.87" shape="1406.93,1009.37 1410.89,1008.28 1413.75,1008.24 1416.68,1008.47 1420.85,1008.20"/>

    <lane id=":34_0_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="13.87" shape="1406.87,1005.97 1410.71,1004.94 1413.48,1004.97 1416.33,1005.27 1420.37,1005.03"/>

  </edge>

  <edge id=":34_2" function="internal">

    <lane id=":34_2_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="10.74" length="13.42" shape="1408.34,1001.44 1411.67,1004.72 1414.87,1006.94 1417.93,1008.10 1420.85,1008.20"/>

    <lane id=":34_2_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="9.75" length="13.42" shape="1410.40,998.95 1413.27,1001.84 1415.88,1003.82 1418.25,1004.88 1420.37,1005.03"/>

  </edge>

  <edge id=":35_0" function="internal">

    <lane id=":35_0_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="10.79" length="8.23" shape="1438.59,1001.20 1440.66,1000.11 1442.29,999.90 1444.06,1000.16 1446.50,1000.47"/>

    <lane id=":35_0_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="11.48" length="9.36" shape="1438.59,1001.20 1440.80,999.47 1442.37,998.17 1444.08,997.40 1446.72,997.28"/>

  </edge>

  <edge id=":35_2" function="internal">

    <lane id=":35_2_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="9.16" shape="1436.79,998.55 1439.34,997.20 1441.31,996.52 1443.02,995.59 1444.75,993.47"/>

    <lane id=":35_2_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="9.16" shape="1436.79,998.55 1438.79,997.00 1439.90,995.64 1440.76,994.05 1442.02,991.80"/>

  </edge>

  <edge id=":37_0" function="internal">

    <lane id=":37_0_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"

speed="7.62" length="7.34" shape="1453.66,981.12 1451.65,980.12 1450.14,978.97 1449.13,977.66 1448.62,976.21"/>

      <lane id=":37_0_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="9.04" length="10.58" shape="1452.45,984.08 1449.70,982.68 1447.62,980.99 1446.21,979.01 1445.46,976.74"/>

  </edge>

  <edge id=":37_2" function="internal">

      <lane id=":37_2_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="9.68" shape="1447.62,986.41 1448.51,983.45 1448.98,981.36 1449.03,979.24 1448.62,976.21"/>

      <lane id=":37_2_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="9.68" shape="1444.55,985.51 1445.32,982.96 1445.75,981.17 1445.81,979.35 1445.46,976.74"/>

  </edge>

  <edge id=":38_0" function="internal">

      <lane id=":38_0_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="9.08" length="7.35" shape="1445.29,964.00 1444.56,962.05 1444.58,960.58 1445.09,959.06 1445.86,957.00"/>

      <lane id=":38_0_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="9.88" length="8.78" shape="1445.29,964.00 1443.93,961.73 1442.87,960.09 1442.40,958.41 1442.82,956.01"/>

  </edge>

  <edge id=":38_2" function="internal">

      <lane id=":38_2_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="8.49" shape="1442.43,965.43 1441.50,962.87 1441.12,960.90 1440.42,959.22 1438.54,957.51"/>

      <lane id=":38_2_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.11" length="8.49" shape="1442.43,965.43 1441.27,963.45 1440.16,962.31 1438.77,961.41 1436.77,960.17"/>

  </edge>

  <edge id=":40_0" function="internal">

      <lane id=":40_0_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="10.38" shape="1419.67,948.45 1417.95,950.88 1416.87,952.64 1415.64,954.25 1413.45,956.20"/>

      <lane id=":40_0_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="10.38" shape="1422.18,950.44 1420.31,953.04 1419.14,954.92 1417.79,956.63 1415.42,958.73"/>

  </edge>

  <edge id=":40_2" function="internal">

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<lane id=":40_2_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="12.71" length="10.09" shape="1424.02,954.20 1420.70,954.07 1418.31,953.98 1416.14,954.50 1413.45,956.20"/>

  <lane id=":40_2_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="11.50" length="10.09" shape="1424.05,957.40 1421.35,957.25 1419.39,957.07 1417.61,957.39 1415.42,958.73"/>

</edge>

<edge id=":41_0" function="internal">

  <lane id=":41_0_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="11.33" shape="1399.56,983.21 1399.16,986.58 1398.43,988.90 1397.27,990.97 1395.59,993.61"/>

</edge>

<edge id=":41_1" function="internal">

  <lane id=":41_1_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="10.55" shape="1402.76,983.41 1402.22,986.66 1401.51,988.93 1401.23,991.14 1401.98,994.19"/>

  <lane id=":41_1_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="10.44" length="10.55" shape="1402.76,983.41 1402.75,986.45 1403.13,989.06 1403.90,991.23 1405.07,992.97"/>

</edge>

<edge id=":42_0" function="internal">

  <lane id=":42_0_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="6.67" length="9.02" shape="1441.23,1176.73 1438.84,1177.40 1436.77,1177.19 1435.03,1176.11 1433.62,1174.16"/>

</edge>

<edge id=":42_1" function="internal">

  <lane id=":42_1_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="8.01" length="13.98" shape="1441.23,1176.73 1437.97,1178.73 1436.12,1181.30 1435.66,1184.44 1436.60,1188.14"/>

</edge>

<edge id=":42_2" function="internal">

  <lane id=":42_2_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="6.51" length="8.90" shape="1439.56,1186.92 1438.96,1184.57 1439.25,1182.57 1440.44,1180.94 1442.50,1179.66"/>

</edge>

<edge id=":42_3" function="internal">

  <lane id=":42_3_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="14.09" shape="1439.56,1186.92 1438.16,1183.60 1436.75,1180.47 1435.26,1177.37 1433.62,1174.16"/>
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```xml
    </edge>
    <edge id=":42_4" function="internal">
        <lane id=":42_4_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="13.79" shape="1430.78,1175.64 1432.40,1178.81 1433.85,1181.82 1435.22,1184.86 1436.60,1188.14"/>
    </edge>
    <edge id=":42_5" function="internal">
        <lane id=":42_5_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="8.14" length="3.89" shape="1430.78,1175.64 1432.97,1178.68 1433.10,1178.75"/>
    </edge>
    <edge id=":42_6" function="internal">
        <lane id=":42_6_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="8.14" length="10.03" shape="1433.10,1178.75 1435.66,1180.36 1438.84,1180.69 1442.50,1179.66"/>
    </edge>
    <edge id=":43_0" function="internal">
        <lane id=":43_0_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="6.44" length="8.87" shape="1541.14,1416.22 1539.26,1417.92 1537.34,1418.63 1535.40,1418.37 1533.43,1417.13"/>
    </edge>
    <edge id=":43_1" function="internal">
        <lane id=":43_1_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="8.03" length="14.68" shape="1541.14,1416.22 1539.02,1419.59 1538.55,1422.83 1539.73,1425.94 1542.55,1428.92"/>
    </edge>
    <edge id=":43_2" function="internal">
        <lane id=":43_2_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="6.62" length="9.63" shape="1544.55,1426.42 1542.73,1424.49 1542.00,1422.45 1542.34,1420.31 1543.77,1418.07"/>
    </edge>
    <edge id=":43_3" function="internal">
        <lane id=":43_3_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="14.49" shape="1544.55,1426.42 1533.43,1417.13"/>
    </edge>
    <edge id=":43_4" function="internal">
        <lane id=":43_4_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="14.62" shape="1531.33,1419.54 1542.55,1428.92"/>
```

```
    </edge>

    <edge id=":43_5" function="internal">

        <lane id=":43_5_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="8.01" length="3.99" shape="1531.33,1419.54 1534.51,1421.54 1534.74,1421.57"/>

    </edge>

    <edge id=":43_6" function="internal">

        <lane id=":43_6_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="8.01" length="10.31" shape="1534.74,1421.57 1537.64,1421.96 1540.73,1420.81
1543.77,1418.07"/>

    </edge>

    <edge id=":8_0" function="internal">

        <lane id=":8_0_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="6.20" length="9.05" shape="1706.65,1424.00 1704.33,1425.03 1702.34,1424.99
1700.68,1423.89 1699.35,1421.73"/>

    </edge>

    <edge id=":8_1" function="internal">

        <lane id=":8_1_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="14.62" shape="1706.65,1424.00 1703.50,1425.92 1700.36,1427.72
1697.16,1429.42 1693.85,1431.04"/>

    </edge>

    <edge id=":8_2" function="internal">

        <lane id=":8_2_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="15.00" shape="1695.22,1433.94 1698.58,1432.28 1701.89,1430.52
1705.14,1428.66 1708.35,1426.71"/>

    </edge>

    <edge id=":8_3" function="internal">

        <lane id=":8_3_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="8.20" length="4.07" shape="1695.22,1433.94 1698.41,1431.79 1698.53,1431.60"/>

    </edge>

    <edge id=":8_6" function="internal">

        <lane id=":8_6_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="8.20" length="10.51" shape="1698.53,1431.60 1700.16,1429.04 1700.47,1425.69
1699.35,1421.73"/>

    </edge>

    <edge id=":8_4" function="internal">

        <lane id=":8_4_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="6.75" length="9.55" shape="1696.41,1423.00 1697.17,1425.63 1697.00,1427.85
```

1695.89,1429.65   1693.85,1431.04"/>

　　</edge>

　　<edge id=":8_5" function="internal">

　　　　<lane id=":8_5_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="7.75" length="14.80" shape="1696.41,1423.00 1698.59,1426.53   1701.30,1428.33 1704.55,1428.39   1708.35,1426.71"/>

　　</edge>

　　<edge id=":9_0" function="internal">

　　　　<lane id=":9_0_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="5.30" shape="1767.31,1385.36 1766.25,1386.51   1765.42,1387.19 1764.50,1387.77   1763.15,1388.58"/>

　　</edge>

　　<edge id=":9_1" function="internal">

　　　　<lane id=":9_1_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="11.08" length="3.68" shape="1764.85,1391.29 1765.78,1390.72   1766.46,1390.40 1767.18,1390.22   1768.26,1390.07"/>

　　</edge>

　　<edge id="10-1" from="10" to="1" priority="1" type="highway.tertiary" spreadType="center" shape="1786.49,1387.73 1793.85,1394.32   1800.11,1399.94 1806.60,1404.95   1819.65,1415.01 1825.69,1419.65   1832.24,1424.07 1858.35,1441.68   1867.73,1448.01 1925.34,1478.60   1942.48,1487.69 1979.56,1508.89">

　　　　<lane id="10-1_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="226.27" acceleration="1" shape="1787.19,1390.50 1792.78,1395.51   1799.09,1401.17 1805.62,1406.22   1818.67,1416.28 1824.75,1420.95   1831.35,1425.40 1857.46,1443.01   1866.91,1449.38 1924.59,1480.01   1941.71,1489.09   1978.77,1510.28"/>

　　　　<lane id="10-1_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="226.27" shape="1789.32,1388.12 1794.92,1393.13   1801.13,1398.71 1807.58,1403.68   1820.63,1413.74 1826.63,1418.35   1833.13,1422.74 1859.24,1440.35   1868.55,1446.64 1926.09,1477.19   1943.25,1486.29 1980.35,1507.50"/>

　　</edge>

　　<edge id="11-10" from="11" to="10" priority="1" type="highway.tertiary" spreadType="center" shape="1778.20,1372.73 1780.54,1376.95 1786.49,1387.73">

　　　　<lane id="11-10_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="6.51" shape="1779.62,1378.59 1782.76,1384.29"/>

　　　　<lane id="11-10_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="6.51" shape="1782.42,1377.04 1785.56,1382.74"/>

　　</edge>

　　<edge id="11-9" from="11" to="9" priority="1" type="highway.unclassified"

spreadType="center">


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<lane id="11-9_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="9.75" shape="1773.67,1377.98 1767.31,1385.36"/>

  </edge>

  <edge id="14-11" from="14" to="11" priority="1" type="highway.tertiary" spreadType="center" shape="1778.63,1212.12 1776.37,1220.17 1769.91,1238.26 1762.38,1260.39  1757.35,1276.49  1756.60,1284.23  1756.89,1302.24  1758.31,1316.12 1761.19,1330.12  1765.43,1345.58  1771.21,1361.68  1775.89,1368.99  1778.20,1372.73">

    <lane id="14-11_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="158.80" shape="1775.56,1217.14 1774.84,1219.68  1768.40,1237.73 1760.86,1259.89  1755.77,1276.17  1755.00,1284.17  1755.29,1302.33  1756.73,1316.36 1759.63,1330.49  1763.90,1346.06  1769.77,1362.39  1774.54,1369.85  1774.95,1370.51"/>

    <lane id="14-11_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="158.80" shape="1778.64,1218.01 1777.90,1220.66  1771.42,1238.79 1763.90,1260.89  1758.93,1276.81  1758.20,1284.29  1758.49,1302.15  1759.89,1315.88 1762.75,1329.75  1766.96,1345.10  1772.65,1360.97  1777.24,1368.13  1777.67,1368.83"/>

  </edge>

  <edge id="14-15" from="14" to="15" priority="1" type="highway.unclassified" spreadType="center">

    <lane id="14-15_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="17.06" shape="1782.75,1216.33 1797.55,1224.81"/>

    <lane id="14-15_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="17.06" shape="1784.34,1213.55 1799.14,1222.03"/>

  </edge>

  <edge id="15-17" from="15" to="17" priority="1" type="highway.tertiary" spreadType="center" shape="1804.27,1226.82 1814.12,1211.06">

    <lane id="15-17_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="12.27" shape="1808.97,1222.32 1815.48,1211.91"/>

    <lane id="15-17_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="12.27" shape="1806.26,1220.62 1812.76,1210.21"/>

  </edge>

  <edge id="15-3" from="15" to="3" priority="1" type="highway.residential" spreadType="center" shape="1804.27,1226.82 1821.13,1229.77 2058.40,1344.03">

    <lane id="15-3_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="274.15" shape="1810.21,1229.48 1820.64,1231.31 2057.71,1345.47"/>

    <lane id="15-3_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="274.15" shape="1810.76,1226.33 1821.62,1228.23 2059.09,1342.59"/>

  </edge>
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<edge id="16-14" from="16" to="14" priority="1" type="highway.tertiary"
spreadType="center">

    <lane id="16-14_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="12.98" shape="1787.24,1193.38 1780.92,1204.72"/>

    <lane id="16-14_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="12.98" shape="1790.04,1194.94 1783.72,1206.28"/>

  </edge>

  <edge id="16-18" from="16" to="18" priority="1" type="highway.unclassified"
spreadType="center" shape="1791.92,1188.27 1790.28,1184.78 1769.16,1167.07">

    <lane id="16-18_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="9.75" shape="1788.62,1181.30 1780.61,1174.58"/>

    <lane id="16-18_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="9.75" shape="1785.48,1182.84 1778.55,1177.03"/>

  </edge>

  <edge id="17-16" from="17" to="16" priority="1" type="highway.unclassified"
spreadType="center">

    <lane id="17-16_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="16.25" shape="1816.75,1195.75 1801.51,1190.11"/>

    <lane id="17-16_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="16.25" shape="1815.64,1198.75 1800.40,1193.11"/>

  </edge>

  <edge id="17-21" from="17" to="21" priority="-1" shape="1822.00,1199.40
1828.88,1184.75  1833.77,1174.42  1836.27,1168.01  1841.07,1159.57  1848.63,1146.56
1854.13,1137.39  1861.76,1124.63  1873.85,1106.45  1880.50,1095.70  1885.42,1088.94
1899.05,1073.48">

    <lane id="17-21_0" index="0" speed="13.89" length="137.26" shape="1828.45,1196.95
1833.22,1186.80  1838.18,1176.32  1840.62,1170.08  1845.23,1161.96  1852.76,1149.00
1858.25,1139.86  1865.82,1127.19  1877.89,1109.04  1884.49,1098.38  1889.17,1091.95
1899.26,1080.50"/>

    <lane id="17-21_1" index="1" speed="13.89" length="137.26" shape="1825.56,1195.59
1830.33,1185.43  1835.24,1175.05  1837.72,1168.70  1842.46,1160.37  1850.01,1147.37
1855.50,1138.21  1863.11,1125.48  1875.20,1107.31  1881.83,1096.59  1886.67,1089.94
1896.86,1078.38"/>

  </edge>

  <edge id="18-27" from="18" to="27" priority="1" type="highway.unclassified"
spreadType="center">

    <lane id="18-27_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="46.15" shape="1769.07,1164.85 1734.52,1134.25"/>

    <lane id="18-27_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="46.15" shape="1766.95,1167.25 1732.40,1136.65"/>
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    </edge>

    <edge id="19-16" from="19" to="16" priority="1" type="highway.tertiary"
spreadType="center" shape="1825.55,1155.06 1802.71,1179.57 1791.92,1188.27">

        <lane id="19-16_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="19.84" shape="1812.19,1167.05 1801.62,1178.40
1798.42,1180.98"/>

        <lane id="19-16_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="19.84" shape="1814.53,1169.24 1803.80,1180.74
1800.42,1183.47"/>

    </edge>

    <edge id="19-18" from="19" to="18" priority="1" type="highway.tertiary_link"
spreadType="center" shape="1825.55,1155.06 1808.81,1163.81 1799.18,1167.74
1792.33,1169.14  1781.26,1169.74  1769.16,1167.07">

        <lane id="19-18_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="27.61" shape="1809.46,1163.47 1808.81,1163.81  1799.18,1167.74
1792.33,1169.14  1782.86,1169.65"/>

    </edge>

    <edge id="2-15" from="2" to="15" priority="1" type="highway.tertiary"
spreadType="center" shape="1979.39,1498.75 1898.44,1453.02 1871.16,1438.23
1865.12,1434.16  1837.98,1418.62  1823.27,1408.15  1813.24,1400.13  1806.62,1393.79
1799.68,1387.12  1795.35,1381.39  1789.01,1372.97  1786.97,1369.00  1784.86,1364.91
1778.38,1352.35  1774.72,1342.87  1771.01,1329.65  1769.85,1315.99  1768.91,1305.05
1768.91,1285.55  1770.41,1279.48  1773.43,1267.15  1785.29,1244.74  1794.44,1233.13
1804.27,1226.82">

        <lane id="2-15_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="385.19" shape="1980.18,1497.36 1899.21,1451.62  1871.99,1436.86
1865.97,1432.80  1838.84,1417.27  1824.23,1406.87  1814.30,1398.93  1807.73,1392.64
1800.88,1386.05  1796.63,1380.43  1790.37,1372.12  1788.39,1368.27  1786.28,1364.18
1779.84,1351.69  1776.24,1342.36  1772.59,1329.36  1771.44,1315.85  1770.51,1304.98
1770.51,1285.74  1771.96,1279.86  1774.94,1267.72  1786.64,1245.62  1795.53,1234.33
1799.39,1231.86"/>

        <lane id="2-15_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="385.19" shape="1978.60,1500.14 1897.67,1454.42  1870.33,1439.60
1864.27,1435.52  1837.12,1419.97  1822.31,1409.43  1812.18,1401.33  1805.51,1394.94
1798.48,1388.19  1794.07,1382.35  1787.65,1373.82  1785.55,1369.73  1783.44,1365.64
1776.92,1353.01  1773.20,1343.38  1769.43,1329.94  1768.26,1316.13  1767.31,1305.12
1767.31,1285.36  1768.86,1279.10  1771.92,1266.58  1783.94,1243.86  1793.35,1231.93
1797.66,1229.16"/>

    </edge>

    <edge id="20-19" from="20" to="19" priority="1" type="highway.tertiary"
spreadType="center" shape="1878.96,1061.52 1876.84,1073.63 1872.07,1084.85
1852.77,1117.84  1843.83,1130.17  1825.55,1155.06">

        <lane id="20-19_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
```

```xml
speed="13.89" length="101.57" shape="1876.32,1067.29 1875.30,1073.17  1870.64,1084.13
1851.43,1116.96  1842.54,1129.23  1824.92,1153.22"/>

    <lane id="20-19_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="101.57" shape="1879.48,1067.85 1878.38,1074.09  1873.50,1085.57
1854.11,1118.72  1845.12,1131.11  1827.49,1155.12"/>

  </edge>

  <edge id="20-21" from="20" to="21" priority="1" type="highway.secondary"
spreadType="center">

    <lane id="20-21_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="12.40" shape="1883.42,1066.04 1894.08,1072.38"/>

    <lane id="20-21_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="12.40" shape="1885.06,1063.29 1895.71,1069.63"/>

  </edge>

  <edge id="21-22" from="21" to="22" priority="1" type="highway.tertiary"
spreadType="center">

    <lane id="21-22_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="11.29" shape="1905.98,1066.42 1912.47,1057.19"/>

    <lane id="21-22_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="11.29" shape="1903.36,1064.58 1909.86,1055.35"/>

  </edge>

  <edge id="21-5" from="21" to="5" priority="1" type="highway.secondary"
spreadType="center" shape="1899.05,1073.48 1915.91,1073.93  1947.42,1087.71
1965.85,1098.95  1983.21,1109.04  2017.31,1125.29  2030.25,1130.90  2081.60,1146.39">

    <lane id="21-5_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="189.53" shape="1907.87,1076.92 1915.20,1077.11  1945.94,1090.55
1964.21,1101.70  1981.72,1111.87  2015.98,1128.20  2029.15,1133.91  2080.68,1149.45"/>

    <lane id="21-5_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="189.53" shape="1907.95,1073.72 1915.91,1073.93  1947.42,1087.71
1965.85,1098.95  1983.21,1109.04  2017.31,1125.29  2030.25,1130.90  2081.60,1146.39"/>

    <lane id="21-5_2" index="2" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="189.53" shape="1908.04,1070.52 1916.62,1070.75  1948.90,1084.87
1967.49,1096.20  1984.70,1106.21  2018.64,1122.38  2031.35,1127.89  2082.52,1143.33"/>

  </edge>

  <edge id="22-23" from="22" to="23" priority="1" type="highway.secondary"
spreadType="center">

    <lane id="22-23_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="13.00" shape="1912.32,1043.07 1902.17,1034.94"/>

    <lane id="22-23_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="13.00" shape="1910.32,1045.57 1900.17,1037.44"/>

  </edge>
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```xml
<edge id="23-20" from="23" to="20" priority="1" type="highway.tertiary"
spreadType="center">
    <lane id="23-20_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="17.47" shape="1889.93,1037.47 1881.73,1052.90"/>
    <lane id="23-20_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="17.47" shape="1892.75,1038.97 1884.56,1054.40"/>
</edge>

<edge id="23-40" from="23" to="40" priority="1" shape="1895.03,1031.28
1687.93,858.65 1672.25,849.67 1658.41,843.67 1644.49,838.12 1627.90,834.49
1612.15,833.03 1591.74,834.78 1567.76,839.10 1548.66,845.76 1533.20,853.72
1516.92,864.26 1489.39,890.41 1467.57,910.47 1435.06,936.78 1419.94,955.84">
    <lane id="23-40_0" index="0" speed="13.89" length="578.40" shape="1892.52,1022.94
1690.68,854.69 1674.40,845.37 1660.25,839.24 1645.90,833.52 1628.64,829.74
1612.17,828.21 1591.11,830.02 1566.54,834.44 1546.76,841.34 1530.79,849.56
1513.94,860.47 1486.11,886.90 1464.43,906.83 1431.63,933.38 1419.67,948.45"/>
    <lane id="23-40_1" index="1" speed="13.89" length="578.40" shape="1890.47,1025.40
1688.85,857.33 1672.97,848.24 1659.02,842.19 1644.96,836.59 1628.15,832.91
1612.16,831.42 1591.53,833.19 1567.35,837.55 1548.03,844.29 1532.40,852.33
1515.93,863.00 1488.30,889.24 1466.52,909.26 1433.92,935.65 1422.18,950.44"/>
</edge>

<edge id="26-14" from="26" to="14" priority="1" type="highway.unclassified"
spreadType="center" shape="1718.47,1138.98 1725.80,1145.51 1740.97,1159.02
1754.42,1171.73  1766.59,1188.35  1778.63,1212.12">
    <lane id="26-14_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="81.73" shape="1722.31,1144.54 1724.74,1146.70  1739.89,1160.20
1753.22,1172.79  1765.22,1189.19  1773.78,1206.08"/>
    <lane id="26-14_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="81.73" shape="1724.44,1142.16 1726.86,1144.32  1742.05,1157.84
1755.62,1170.67  1767.96,1187.51  1776.63,1204.64"/>
</edge>

<edge id="27-26" from="27" to="26" priority="1" type="highway.service"
spreadType="center" shape="1732.01,1134.16 1722.90,1136.16 1718.47,1138.98">
    <lane id="27-26_0" index="0" allow="pedestrian bus delivery bicycle" speed="13.89"
length="0.20" shape="1725.13,1135.67 1724.93,1135.71"/>
</edge>

<edge id="27-30" from="27" to="30" priority="1" type="highway.unclassified"
spreadType="center">
    <lane id="27-30_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="101.38" shape="1727.71,1128.74 1648.06,1066.01"/>
    <lane id="27-30_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="101.38" shape="1725.73,1131.25 1646.08,1068.52"/>
```

```xml
    </edge>
    <edge id="28-26" from="28" to="26" priority="1" type="highway.unclassified"
spreadType="center" shape="1653.07,1084.07 1670.06,1098.03 1718.47,1138.98">
        <lane id="28-26_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="73.54" shape="1657.60,1089.86 1669.04,1099.26
1713.86,1137.18"/>
        <lane id="28-26_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="73.54" shape="1659.63,1087.39 1671.08,1096.80
1715.93,1134.74"/>
    </edge>
    <edge id="28-8" from="28" to="8" priority="1" type="highway.unclassified"
shape="1653.07,1084.07 1629.56,1112.29 1616.24,1127.64 1594.47,1152.46
1591.37,1157.93 1589.88,1164.03 1590.10,1170.30 1592.01,1176.29 1676.19,1372.17
1683.84,1389.88 1700.95,1429.46">
        <lane id="28-8_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="377.27" shape="1646.98,1088.88 1628.34,1111.25 1615.03,1126.59
1593.16,1151.53 1589.87,1157.33 1588.27,1163.87 1588.51,1170.58 1590.51,1176.85
1674.72,1372.80 1682.37,1390.51 1696.41,1423.00"/>
    </edge>
    <edge id="29-28" from="29" to="28" priority="1" type="highway.unclassified"
spreadType="center">
        <lane id="29-28_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="2.64" shape="1643.64,1079.80 1645.85,1081.25"/>
        <lane id="29-28_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="2.64" shape="1645.40,1077.12 1647.60,1078.57"/>
    </edge>
    <edge id="30-29" from="30" to="29" priority="1" type="highway.service"
spreadType="center" shape="1642.75,1063.86 1642.19,1070.19 1642.66,1074.15
1645.77,1079.28">
        <lane id="30-29_0" index="0" allow="pedestrian delivery bicycle" speed="13.89"
length="0.20" shape="1642.11,1069.51 1642.13,1069.71"/>
    </edge>
    <edge id="30-37" from="30" to="37" priority="1" type="highway.unclassified"
spreadType="center" shape="1642.75,1063.86 1627.19,1053.78 1447.71,980.42">
        <lane id="30-37_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="205.05" shape="1642.26,1061.64 1627.93,1052.36
1453.66,981.12"/>
        <lane id="30-37_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="205.05" shape="1640.52,1064.32 1626.45,1055.20
1452.45,984.08"/>
```

</edge>

    <edge id="33-34" from="33" to="34" priority="1" type="highway.unclassified" spreadType="center" shape="1388.81,1017.12 1395.99,1011.75 1401.61,1009.70 1408.26,1007.15 1417.43,1007.10">

        <lane id="33-34_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="14.11" shape="1394.97,1014.51 1396.76,1013.17 1402.17,1011.20 1406.93,1009.37"/>

        <lane id="33-34_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="14.11" shape="1393.06,1011.94 1395.22,1010.33 1401.05,1008.20 1406.87,1005.97"/>

    </edge>

    <edge id="33-42" from="33" to="42" priority="1" type="highway.unclassified" shape="1388.81,1017.12 1386.87,1028.23 1385.99,1040.75 1386.74,1058.15 1388.84,1075.00 1392.62,1090.82 1399.41,1110.27 1413.19,1138.59 1435.40,1181.01">

        <lane id="33-42_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="165.76" shape="1386.74,1019.66 1385.28,1028.04 1384.39,1040.73 1385.14,1058.28 1387.26,1075.29 1391.08,1091.27 1397.93,1110.89 1411.76,1139.31 1430.78,1175.64"/>

    </edge>

    <edge id="34-35" from="34" to="35" priority="1" type="highway.unclassified" spreadType="center" shape="1417.43,1007.10 1429.87,1005.20 1439.85,998.41">

        <lane id="34-35_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="18.83" shape="1420.85,1008.20 1430.47,1006.73 1438.59,1001.20"/>

        <lane id="34-35_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="18.83" shape="1420.37,1005.03 1429.27,1003.67 1436.79,998.55"/>

    </edge>

    <edge id="35-29" from="35" to="29" priority="1" type="highway.unclassified" spreadType="center" shape="1439.85,998.41 1447.41,998.93 1459.96,998.91 1613.03,1056.21 1622.48,1061.06 1645.77,1079.28">

        <lane id="35-29_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="206.55" shape="1446.50,1000.47 1447.36,1000.53 1459.67,1000.51 1612.38,1057.68 1621.61,1062.41 1636.57,1074.11"/>

        <lane id="35-29_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="206.55" shape="1446.72,997.28 1447.46,997.33 1460.25,997.31 1613.68,1054.74 1623.35,1059.71 1638.54,1071.59"/>

    </edge>

    <edge id="35-37" from="35" to="37" priority="1" type="highway.unclassified" spreadType="center" shape="1439.85,998.41 1444.81,990.30 1447.71,980.42">

        <lane id="35-37_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="7.26" shape="1444.75,993.47 1446.29,990.95 1447.62,986.41"/>

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        <lane id="35-37_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="7.26" shape="1442.02,991.80 1443.33,989.65  1444.55,985.51"/>

    </edge>

    <edge id="37-38" from="37" to="38" priority="1" type="highway.tertiary" spreadType="center" shape="1447.71,980.42 1445.65,968.29 1442.53,962.07">

        <lane id="37-38_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="12.30" shape="1448.62,976.21 1447.19,967.79 1445.29,964.00"/>

        <lane id="37-38_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="12.30" shape="1445.46,976.74 1444.11,968.79 1442.43,965.43"/>

    </edge>

    <edge id="38-20" from="38" to="20" priority="1" type="highway.unclassified" spreadType="center" shape="1442.53,962.07 1446.47,949.98 1451.64,941.95 1458.56,931.94 1468.11,919.78 1476.84,910.48 1488.97,897.32 1500.15,885.45 1518.07,869.15 1535.37,857.30 1548.84,849.72 1561.70,845.34 1576.35,841.31 1593.26,838.77 1610.47,837.19 1627.68,838.41 1642.82,841.48 1657.33,847.53 1675.12,855.50 1690.61,865.71 1732.72,901.06 1781.04,940.80 1822.63,976.60 1856.03,1004.76 1862.66,1015.23 1866.86,1025.77  1870.75,1037.28  1878.96,1061.52">

        <lane id="38-20_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="569.96" shape="1445.86,957.00 1447.93,950.67  1452.97,942.84 1459.85,932.89 1469.32,920.82 1478.01,911.57 1490.14,898.41 1501.27,886.59 1519.07,870.41 1536.22,858.66 1549.50,851.19 1562.17,846.87 1576.68,842.88 1593.45,840.36 1610.49,838.80 1627.46,840.00 1642.35,843.02 1656.69,849.00 1674.35,856.91 1689.65,866.99 1731.70,902.29 1780.01,942.02 1821.59,977.82 1854.81,1005.82  1861.23,1015.96  1865.36,1026.32  1869.23,1037.79  1874.59,1053.59"/>

        <lane id="38-20_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="569.96" shape="1442.82,956.01 1445.01,949.29  1450.31,941.06 1457.27,930.99 1466.90,918.74 1475.67,909.39 1487.80,896.23 1499.03,884.31 1517.07,867.89 1534.52,855.94 1548.18,848.25  1561.23,843.81 1576.02,839.74 1593.07,837.18 1610.45,835.58 1627.90,836.82 1643.29,839.94 1657.97,846.06 1675.89,854.09 1691.57,864.43 1733.74,899.83 1782.07,939.58 1823.67,975.38 1857.25,1003.70  1864.09,1014.50  1868.36,1025.22  1872.27,1036.77  1877.62,1052.56"/>

    </edge>

    <edge id="38-40" from="38" to="40" priority="1" type="highway.unclassified" spreadType="center" shape="1442.53,962.07 1432.91,955.70 1419.94,955.84">

        <lane id="38-40_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="14.56" shape="1438.54,957.51 1433.38,954.09  1424.02,954.20"/>

        <lane id="38-40_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="14.56" shape="1436.77,960.17 1432.44,957.31  1424.05,957.40"/>

    </edge>

    <edge id="4-17" from="4" to="17" priority="1" type="highway.residential" spreadType="center" shape="2061.49,1337.85 2049.47,1332.33 2039.82,1327.44 2026.27,1320.79 2000.87,1308.35 1971.51,1294.38  1955.63,1286.37  1929.11,1273.52 1898.83,1259.09 1877.14,1248.85 1851.33,1236.92 1829.50,1222.56 1824.61,1215.26
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1822.65,1210.43">


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    <lane id="4-17_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="272.96" shape="2062.16,1336.40 2050.17,1330.89  2040.53,1326.01 2026.97,1319.35  2001.57,1306.91  1972.21,1292.94  1956.34,1284.94  1929.80,1272.08 1899.52,1257.64  1877.82,1247.40  1852.11,1235.52  1830.65,1221.40  1826.03,1214.51 1824.25,1210.12"/>

    <lane id="4-17_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="272.96" shape="2060.82,1339.30 2048.77,1333.77  2039.11,1328.87 2025.57,1322.23  2000.17,1309.79  1970.81,1295.82  1954.92,1287.80  1928.42,1274.96 1898.14,1260.54  1876.46,1250.30  1850.55,1238.32  1828.35,1223.72  1823.19,1216.01 1821.29,1211.33"/>

  </edge>
  <edge id="40-41" from="40" to="41" priority="1" type="highway.unclassified" spreadType="center" shape="1417.97,954.71 1410.04,960.89 1406.27,965.89 1401.78,973.52  1401.05,985.05">

    <lane id="40-41_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="30.50" shape="1413.45,956.20 1408.89,959.76  1404.94,965.00 1400.21,973.04  1399.56,983.21"/>

    <lane id="40-41_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="30.50" shape="1415.42,958.73 1411.19,962.02  1407.60,966.78 1403.35,974.00  1402.76,983.41"/>

  </edge>
  <edge id="41-33" from="41" to="33" priority="1" type="highway.unclassified" spreadType="center" shape="1400.91,984.96 1394.32,995.67 1390.99,1002.98 1389.47,1008.34  1388.81,1017.12">

    <lane id="41-33_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="17.60" shape="1395.59,993.61 1394.32,995.67  1390.99,1002.98 1389.47,1008.34  1389.35,1009.91"/>

  </edge>
  <edge id="41-34" from="41" to="34" priority="1" type="highway.unclassified" spreadType="center" shape="1400.10,984.88 1403.45,993.56 1410.25,1001.18 1417.43,1007.10">

    <lane id="41-34_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="8.84" shape="1401.98,994.19 1402.06,994.41  1408.34,1001.44"/>

    <lane id="41-34_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="8.84" shape="1405.07,992.97 1410.40,998.95"/>

  </edge>
  <edge id="42-33" from="42" to="33" priority="1" type="highway.unclassified" shape="1435.40,1181.01 1413.19,1138.59  1399.41,1110.27  1392.62,1090.82 1388.84,1075.00  1386.74,1058.15  1385.99,1040.75  1386.87,1028.23  1388.81,1017.12">

    <lane id="42-33_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship" speed="13.89" length="163.66" shape="1433.62,1174.16 1414.62,1137.87  1400.89,1109.65
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1394.16,1090.37 1390.42,1074.71 1388.34,1058.02 1387.59,1040.77 1388.46,1028.42
1389.89,1020.21"/>

   </edge>

   <edge id="42-43" from="42" to="43" priority="1" type="highway.unclassified"
shape="1435.40,1181.01 1477.40,1162.71 1483.60,1160.62 1492.62,1157.34
1509.47,1150.90 1527.91,1142.27 1539.35,1143.14 1548.69,1146.59 1556.33,1154.12
1563.45,1163.03 1579.03,1201.59 1582.83,1210.14 1599.77,1248.22 1636.39,1330.54
1638.97,1337.40 1639.87,1344.67 1639.02,1351.94 1636.48,1358.81 1632.39,1364.89
1626.97,1369.86 1620.54,1373.42 1601.79,1382.09 1576.29,1393.02 1566.41,1397.29
1563.67,1398.98 1560.38,1401.01 1557.25,1402.94 1551.75,1407.33 1546.68,1412.21
1542.11,1417.55 1538.07,1423.29">

     <lane id="42-43_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="457.22" shape="1442.50,1179.66 1477.98,1164.20 1484.13,1162.13
1493.18,1158.84 1510.10,1152.37 1528.21,1143.90 1539.01,1144.72 1547.81,1147.97
1555.14,1155.19 1562.05,1163.85 1577.56,1202.21 1581.37,1210.79 1598.31,1248.87
1634.91,1331.15 1637.41,1337.79 1638.26,1344.68 1637.45,1351.56 1635.05,1358.08
1631.17,1363.84 1626.03,1368.55 1619.82,1371.99 1601.14,1380.63 1575.66,1391.55
1565.67,1395.87 1562.83,1397.62 1559.54,1399.65 1556.33,1401.63 1550.69,1406.13
1545.51,1411.11 1541.14,1416.22"/>

   </edge>

   <edge id="42-43_1" from="42" to="43" priority="1" type="highway.unclassified"
shape="1435.40,1181.01 1456.65,1232.67 1462.83,1257.86 1479.19,1331.77
1484.59,1351.55 1489.50,1363.66 1495.46,1375.28 1502.43,1386.33 1510.36,1396.74
1519.18,1406.40 1528.83,1415.25 1538.07,1423.29">

     <lane id="42-43_1_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast
ship" speed="13.89" length="254.84" shape="1436.60,1188.14 1455.12,1233.17
1461.27,1258.22 1477.64,1332.15 1483.07,1352.06 1488.04,1364.33 1494.07,1376.07
1501.11,1387.24 1509.13,1397.77 1518.05,1407.53 1527.76,1416.44 1531.33,1419.54"/>

   </edge>

   <edge id="43-42" from="43" to="42" priority="1" type="highway.unclassified"
shape="1538.07,1423.29 1542.11,1417.55 1546.68,1412.21 1551.75,1407.33
1557.25,1402.94 1560.38,1401.01 1563.67,1398.98 1566.41,1397.29 1576.29,1393.02
1601.79,1382.09 1620.54,1373.42 1626.97,1369.86 1632.39,1364.89 1636.48,1358.81
1639.02,1351.94 1639.87,1344.67 1638.97,1337.40 1636.39,1330.54 1599.77,1248.22
1579.03,1201.59 1563.45,1163.03 1556.33,1154.12 1548.69,1146.59 1539.35,1143.14
1527.91,1142.27 1504.58,1152.79 1499.62,1154.76 1483.21,1160.44 1477.40,1162.71
1435.40,1181.01">

     <lane id="43-42_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="465.60" shape="1543.77,1418.07 1547.85,1413.31 1552.81,1408.53
1558.17,1404.25 1561.22,1402.37 1564.51,1400.34 1567.15,1398.71 1576.92,1394.49
1602.44,1383.55 1621.26,1374.85 1627.91,1371.17 1633.61,1365.94 1637.91,1359.54
1640.59,1352.32 1641.48,1344.66 1640.53,1337.01 1637.87,1329.93 1601.23,1247.57
1580.50,1200.97 1564.85,1162.21 1557.52,1153.05 1549.57,1145.21 1539.69,1141.56
1527.62,1140.64 1503.96,1151.32 1499.06,1153.26 1482.66,1158.94 1476.79,1161.23
1441.23,1176.73"/>

```
  </edge>

  <edge id="43-42_1" from="43" to="42" priority="1" type="highway.unclassified"
shape="1538.07,1423.29 1528.83,1415.25 1519.18,1406.40 1510.36,1396.74
1502.43,1386.33 1495.46,1375.28 1489.50,1363.66 1484.59,1351.55 1479.19,1331.77
1462.83,1257.86 1456.65,1232.67 1435.40,1181.01">

    <lane id="43-42_1_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast
ship" speed="13.89" length="253.36" shape="1533.43,1417.13 1529.90,1414.06
1520.31,1405.27 1511.59,1395.71 1503.75,1385.42 1496.85,1374.49 1490.96,1362.99
1486.11,1351.04 1480.74,1331.39 1464.39,1257.50 1458.18,1232.17 1439.56,1186.92"/>

  </edge>

  <edge id="43-8" from="43" to="8" priority="1" type="highway.unclassified"
shape="1538.07,1423.29 1547.46,1430.79 1566.48,1444.91 1576.43,1450.79
1587.06,1455.35 1598.19,1458.49 1609.64,1460.19 1621.21,1460.40 1632.71,1459.13
1643.95,1456.38 1700.95,1429.46">

    <lane id="43-8_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="167.40" shape="1542.55,1428.92 1546.48,1432.06 1565.59,1446.24
1575.70,1452.22 1586.53,1456.86 1597.85,1460.06 1609.51,1461.79 1621.28,1462.00
1632.99,1460.71 1644.49,1457.90 1695.22,1433.94"/>

  </edge>

  <edge id="6-22" from="6" to="22" priority="1" type="highway.secondary"
spreadType="center" shape="2086.54,1136.13 2049.22,1122.43 2019.10,1109.85
1972.61,1088.06 1929.86,1061.03 1926.10,1058.65 1924.94,1057.92 1916.60,1048.55">

    <lane id="6-22_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="179.78" shape="2087.64,1133.13 2050.39,1119.45 2020.40,1106.92
1974.15,1085.25 1931.57,1058.33 1927.81,1055.95 1927.72,1055.89"/>

    <lane id="6-22_1" index="1" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="179.78" shape="2086.54,1136.13 2049.22,1122.43 2019.10,1109.85
1972.61,1088.06 1929.86,1061.03 1926.10,1058.65 1925.24,1058.11"/>

    <lane id="6-22_2" index="2" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="179.78" shape="2085.44,1139.13 2048.05,1125.41 2017.80,1112.78
1971.07,1090.87 1928.15,1063.73 1924.39,1061.35 1922.85,1060.39 1922.78,1060.31"/>

  </edge>

  <edge id="8-28" from="8" to="28" priority="1" type="highway.unclassified"
shape="1700.95,1429.46 1676.19,1372.17 1592.01,1176.29 1590.10,1170.30
1589.88,1164.03 1591.37,1157.93 1594.47,1152.46 1616.24,1127.64 1629.56,1112.29
1653.07,1084.07">

    <lane id="8-28_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="373.72" shape="1699.35,1421.73 1677.66,1371.54 1593.51,1175.73
1591.69,1170.02 1591.49,1164.19 1592.87,1158.53 1595.78,1153.39 1617.45,1128.69
1630.78,1113.33 1649.44,1090.92"/>

  </edge>

  <edge id="8-43" from="8" to="43" priority="1" type="highway.unclassified"
```

```
shape="1700.95,1429.46 1643.95,1456.38  1632.71,1459.13  1621.21,1460.40
1609.64,1460.19  1598.19,1458.49  1587.06,1455.35  1576.43,1450.79  1566.48,1444.91
1547.46,1430.79  1538.07,1423.29">

    <lane id="8-43_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="163.83" shape="1693.85,1431.04 1643.41,1454.86  1632.43,1457.55
1621.14,1458.80  1609.77,1458.59  1598.53,1456.92  1587.59,1453.84  1577.16,1449.36
1567.37,1443.58  1548.44,1429.52  1544.55,1426.42"/>

  </edge>

  <edge id="8-9" from="8" to="9" priority="1" type="highway.unclassified">

    <lane id="8-9_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="66.69" shape="1708.35,1426.71 1764.85,1391.29"/>

  </edge>

  <edge id="9-10" from="9" to="10" priority="1" type="highway.unclassified"
spreadType="center">

    <lane id="9-10_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="12.48" shape="1768.26,1390.07 1780.63,1388.48"/>

  </edge>

  <edge id="9-8" from="9" to="8" priority="1" type="highway.unclassified">

    <lane id="9-8_0" index="0" disallow="tram rail_urban rail rail_electric rail_fast ship"
speed="13.89" length="66.69" shape="1763.15,1388.58 1706.65,1424.00"/>

  </edge>


  <tlLogic id="1273054236" type="static" programID="0" offset="0">

    <phase duration="42" state="rrGGGg"/>

    <phase duration="3"  state="rryyyy"/>

    <phase duration="42" state="GGGrrr"/>

    <phase duration="3"  state="yyyrrr"/>

  </tlLogic>

  <tlLogic id="1403795478" type="static" programID="0" offset="0">

    <phase duration="42" state="GGGGrrrr"/>

    <phase duration="3"  state="yyyyrrrr"/>

    <phase duration="42" state="rrrrGGGG"/>

    <phase duration="3"  state="rrrryyyy"/>

  </tlLogic>

  <tlLogic id="307392280" type="static" programID="0" offset="0">

    <phase duration="42" state="GGGGrrrr"/>
```

```
      <phase duration="3"  state="yyyyrrrr"/>

      <phase duration="42" state="rrrrGGGG"/>

      <phase duration="3"  state="rrrryyyy"/>

   </tlLogic>

   <tlLogic id="307392843"  type="static" programID="0" offset="0">

      <phase duration="42" state="rrGGGg"/>

      <phase duration="3"  state="rryyyy"/>

      <phase duration="42" state="GGGrrr"/>

      <phase duration="3"  state="yyyrrr"/>

   </tlLogic>

   <tlLogic id="307392857"  type="static" programID="0" offset="0">

      <phase duration="42" state="GGGgrr"/>

      <phase duration="3"  state="yyyyrr"/>

      <phase duration="42" state="GrrrGG"/>

      <phase duration="3"  state="yrrryy"/>

   </tlLogic>

   <tlLogic id="5099258524"  type="static" programID="0" offset="0">

      <phase duration="42" state="GGGGGrrrr"/>

      <phase duration="3"  state="yyyyyrrrr"/>

      <phase duration="42" state="rrrrrGgGG"/>

      <phase duration="3"  state="rrrrryyyy"/>

   </tlLogic>

   <tlLogic id="5099258525"  type="static" programID="0" offset="0">

      <phase duration="42" state="GGGGrrrr"/>

      <phase duration="3"  state="yyyyrrrr"/>

      <phase duration="42" state="rrrrGGGG"/>

      <phase duration="3"  state="rrrryyyy"/>

   </tlLogic>

   <tlLogic id="5099258526"  type="static" programID="0" offset="0">

      <phase duration="39" state="GGrr"/>

      <phase duration="6"  state="yyrr"/>

      <phase duration="39" state="rrGG"/>
```

```xml
      <phase duration="6"  state="rryy"/>

  </tlLogic>

  <tlLogic id="5099455589"  type="static"  programID="0"  offset="0">

    <phase duration="42" state="GGGGrrrr"/>

    <phase duration="3"  state="yyyyrrrr"/>

    <phase duration="42" state="rrrrGGGG"/>

    <phase duration="3"  state="rrrryyyy"/>

  </tlLogic>

  <tlLogic id="5099455590"  type="static"  programID="0"  offset="0">

    <phase duration="42" state="GGGGrrrr"/>

    <phase duration="3"  state="yyyyrrrr"/>

    <phase duration="42" state="rrrrGGGG"/>

    <phase duration="3"  state="rrrryyyy"/>

  </tlLogic>


  <junction id="1" type="dead_end" x="1979.56" y="1508.89" incLanes="10-1_0 10-1_1"
intLanes="" shape="1977.97,1511.67 1981.15,1506.11"/>

  <junction id="10" type="priority" x="1786.49" y="1387.73" incLanes="9-10_0 11-10_0 11-
10_1" intLanes=":10_0_0 :10_1_0 :10_1_1" shape="1790.39,1386.93 1786.12,1391.70
1784.53,1390.62  1783.67,1390.28  1782.77,1390.08  1781.83,1390.01  1780.84,1390.07
1780.43,1386.89  1781.34,1386.59  1781.57,1386.32  1781.65,1385.98  1781.58,1385.56
1781.36,1385.06  1786.96,1381.97  1788.00,1383.98  1788.38,1384.68  1788.83,1385.33
1789.46,1386.05">

    <request index="0" response="110" foes="110" cont="0"/>

    <request index="1" response="000" foes="001" cont="0"/>

    <request index="2" response="000" foes="001" cont="0"/>

  </junction>

  <junction id="11" type="priority" x="1778.20" y="1372.73" incLanes="14-11_0 14-11_1"
intLanes=":11_0_0 :11_1_0 :11_1_1" shape="1783.82,1376.26 1778.22,1379.37
1777.22,1378.19  1776.68,1378.00  1776.11,1378.07  1775.51,1378.42  1774.89,1379.02
1772.46,1376.93  1773.77,1374.94  1774.08,1373.99  1774.15,1373.08  1773.98,1372.20
1773.59,1371.35  1779.03,1367.99">

    <request index="0" response="000" foes="000" cont="0"/>

    <request index="1" response="000" foes="000" cont="0"/>

    <request index="2" response="000" foes="000" cont="0"/>

  </junction>
```

```
    <junction id="14" type="traffic_light" x="1778.63" y="1212.12" incLanes="16-14_0 16-
14_1 26-14_0 26-14_1"
intLanes=":14_0_0 :14_0_1 :14_2_0 :14_2_1 :14_4_0 :14_4_1 :14_6_0 :14_6_1"
shape="1779.52,1203.94 1785.11,1207.06 1784.16,1209.34 1784.04,1210.26
1784.17,1211.04 1784.53,1211.67 1785.14,1212.16 1781.95,1217.71 1781.15,1217.45
1780.83,1217.51 1780.56,1217.69 1780.35,1218.00 1780.18,1218.44 1774.02,1216.71
1774.52,1214.61 1774.69,1212.99 1774.54,1211.62 1774.09,1210.29 1773.36,1208.76
1772.35,1206.81 1778.06,1203.91 1778.54,1204.54 1778.78,1204.62 1779.02,1204.55
1779.27,1204.32">

        <request index="0" response="11110000" foes="11110000" cont="0"/>

        <request index="1" response="11110000" foes="11110000" cont="0"/>

        <request index="2" response="11000000" foes="11000000" cont="0"/>

        <request index="3" response="11000000" foes="11000000" cont="0"/>

        <request index="4" response="00000000" foes="00000011" cont="0"/>

        <request index="5" response="00000000" foes="00000011" cont="0"/>

        <request index="6" response="00000000" foes="00001111" cont="0"/>

        <request index="7" response="00000000" foes="00001111" cont="0"/>

    </junction>

    <junction id="15" type="traffic_light" x="1804.27" y="1226.82" incLanes="2-15_0 2-15_1
14-15_0 14-15_1"
intLanes=":15_0_0 :15_0_1 :15_2_0 :15_2_1 :15_4_0 :15_4_1 :15_6_0 :15_6_1"
shape="1804.90,1219.77 1810.33,1223.16 1810.04,1223.93 1810.09,1224.22
1810.28,1224.46 1810.59,1224.64 1811.04,1224.76 1809.94,1231.06 1807.81,1230.74
1806.18,1230.64 1804.83,1230.81 1803.53,1231.27 1802.08,1232.05 1800.25,1233.20
1796.79,1227.82 1797.37,1227.26 1797.44,1226.99 1797.36,1226.72 1797.13,1226.46
1796.75,1226.20 1799.94,1220.65 1801.93,1221.38 1802.80,1221.36 1803.59,1221.09
1804.29,1220.56">

        <request index="0" response="00000000" foes="00110000" cont="0"/>

        <request index="1" response="00000000" foes="00110000" cont="0"/>

        <request index="2" response="00000000" foes="11110000" cont="0"/>

        <request index="3" response="00000000" foes="11110000" cont="0"/>

        <request index="4" response="00001111" foes="00001111" cont="0"/>

        <request index="5" response="00001111" foes="00001111" cont="0"/>

        <request index="6" response="00001100" foes="00001100" cont="0"/>

        <request index="7" response="00001100" foes="00001100" cont="0"/>

    </junction>

    <junction id="16" type="traffic_light" x="1791.92" y="1188.27" incLanes="19-16_0 19-
16_1 17-16_0 17-16_1"
intLanes=":16_0_0 :16_0_1 :16_2_0 :16_2_1 :16_4_0 :16_4_1 :16_6_0 :16_6_1"
```

shape="1797.41,1179.73 1801.43,1184.71 1800.12,1186.26 1800.03,1186.94 1800.33,1187.56 1801.01,1188.12 1802.07,1188.61 1799.85,1194.61 1797.82,1193.98 1796.04,1193.67 1794.51,1193.69 1793.23,1194.04 1792.21,1194.72 1791.43,1195.72 1785.84,1192.60 1786.87,1189.37 1786.76,1187.84 1786.23,1186.38 1785.28,1184.97 1783.91,1183.62 1790.18,1180.52 1792.35,1181.58 1793.52,1181.61 1794.76,1181.31 1796.05,1180.69">

        <request index="0" response="00000000" foes="00110000" cont="0"/>

        <request index="1" response="00000000" foes="00110000" cont="0"/>

        <request index="2" response="00000000" foes="11110000" cont="0"/>

        <request index="3" response="00000000" foes="11110000" cont="0"/>

        <request index="4" response="00001111" foes="00001111" cont="0"/>

        <request index="5" response="00001111" foes="00001111" cont="0"/>

        <request index="6" response="00001100" foes="00001100" cont="0"/>

        <request index="7" response="00001100" foes="00001100" cont="0"/>

    </junction>

    <junction id="17" type="traffic_light" x="1822.00" y="1199.40" incLanes="4-17_0 4-17_1 15-17_0 15-17_1"
intLanes=":17_0_0 :17_0_1 :17_2_0 :17_2_1 :17_4_0 :17_4_1 :17_8_0 :17_9_0"
shape="1824.11,1194.91 1829.90,1197.63 1828.45,1200.81 1827.29,1203.52 1826.45,1205.74 1825.91,1207.48 1825.67,1208.74 1825.74,1209.52 1819.81,1211.93 1819.05,1210.96 1818.58,1210.95 1818.05,1211.24 1817.47,1211.84 1816.83,1212.76 1811.41,1209.36 1812.99,1206.75 1814.18,1204.57 1814.98,1202.83 1815.40,1201.53 1815.43,1200.67 1815.08,1200.25 1817.30,1194.25 1820.75,1195.32 1822.04,1195.54 1823.02,1195.54 1823.71,1195.33">

        <request index="0" response="00000000" foes="00110000" cont="0"/>

        <request index="1" response="00000000" foes="00110000" cont="0"/>

        <request index="2" response="00000000" foes="11110000" cont="0"/>

        <request index="3" response="00000000" foes="11110000" cont="0"/>

        <request index="4" response="00001111" foes="00001111" cont="0"/>

        <request index="5" response="00001111" foes="00001111" cont="0"/>

        <request index="6" response="00001100" foes="00001100" cont="1"/>

        <request index="7" response="00001100" foes="00001100" cont="1"/>

    </junction>

    <junction id="18" type="priority" x="1769.16" y="1167.07" incLanes="19-18_0 16-18_0 16-18_1" intLanes=":18_0_0 :18_1_0 :18_1_1" shape="1783.21,1168.03 1782.51,1171.27 1781.01,1171.58 1780.71,1171.88 1780.72,1172.28 1781.03,1172.77 1781.64,1173.36 1777.52,1178.26 1765.89,1168.44 1770.13,1163.65 1772.41,1165.59 1774.28,1166.90 1776.02,1167.70 1777.90,1168.08 1780.21,1168.15">

    <request index="0" response="110" foes="110" cont="0"/>

        <request index="1" response="000" foes="001" cont="0"/>

        <request index="2" response="000" foes="001" cont="0"/>

    </junction>

    <junction id="19" type="priority" x="1825.55" y="1155.06" incLanes="20-19_0 20-19_1" intLanes=":19_0_0 :19_1_0 :19_1_1" shape="1823.63,1152.27 1828.78,1156.06 1826.28,1159.34 1824.31,1161.65 1822.57,1163.46 1820.75,1165.22 1818.56,1167.35 1815.70,1170.33 1811.02,1165.96 1810.20,1164.89 1808.71,1162.05 1812.20,1160.39 1814.92,1159.28 1817.15,1158.31 1819.17,1157.09 1821.24,1155.21">

        <request index="0" response="000" foes="000" cont="0"/>

        <request index="1" response="000" foes="000" cont="0"/>

        <request index="2" response="000" foes="000" cont="0"/>

    </junction>

    <junction id="2" type="dead_end" x="1979.39" y="1498.75" incLanes="" intLanes="" shape="1977.82,1501.54 1980.96,1495.96"/>

    <junction id="20" type="traffic_light" x="1878.96" y="1061.52" incLanes="23-20_0 23-20_1 38-20_0 38-20_1" intLanes=":20_0_0 :20_0_1 :20_2_0 :20_2_1 :20_4_0 :20_4_1 :20_6_0 :20_6_1" shape="1880.32,1052.15 1885.97,1055.15 1884.73,1058.20 1884.57,1059.43 1884.70,1060.46 1885.14,1061.28 1885.87,1061.91 1882.60,1067.41 1881.86,1067.15 1881.57,1067.21 1881.34,1067.39 1881.17,1067.69 1881.05,1068.12 1874.75,1067.02 1875.16,1064.26 1875.28,1062.19 1875.11,1060.47 1874.68,1058.77 1874.00,1056.76 1873.07,1054.10 1879.13,1052.05 1879.48,1052.69 1879.67,1052.79 1879.87,1052.73 1880.09,1052.51">

        <request index="0" response="11110000" foes="11110000" cont="0"/>

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        <request index="4" response="00000000" foes="00000011" cont="0"/>

        <request index="5" response="00000000" foes="00000011" cont="0"/>

        <request index="6" response="00000000" foes="00001111" cont="0"/>

        <request index="7" response="00000000" foes="00001111" cont="0"/>

    </junction>

    <junction id="21" type="traffic_light" x="1899.05" y="1073.48" incLanes="17-21_0 17-21_1 20-21_0 20-21_1" intLanes=":21_0_0 :21_0_1 :21_0_2 :21_3_0 :21_3_1 :21_5_0 :21_6_0 :21_7_0 :21_7_1" shape="1902.05,1063.66 1907.29,1067.34 1906.90,1068.20 1906.95,1068.50 1907.16,1068.72 1907.54,1068.86 1908.08,1068.92 1907.82,1078.52 1904.97,1078.80 1903.70,1079.22 1902.52,1079.81 1901.44,1080.59 1900.46,1081.56 1895.66,1077.33 1895.94,1076.31 1895.68,1075.73 1895.14,1075.12 1894.34,1074.46 1893.26,1073.76 1896.53,1068.26 1897.86,1068.17 1898.72,1067.59 1899.70,1066.64 1900.81,1065.33">

<request index="0" response="110100000" foes="110100000" cont="0"/>

<request index="1" response="110100000" foes="110100000" cont="0"/>

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<request index="4" response="111100000" foes="111100000" cont="0"/>

<request index="5" response="000000000" foes="000011111" cont="0"/>

<request index="6" response="110000000" foes="110011000" cont="0"/>

<request index="7" response="000000000" foes="001011111" cont="0"/>

<request index="8" response="000000000" foes="001011111" cont="0"/>

</junction>

<junction id="22" type="traffic_light" x="1916.60" y="1048.55" incLanes="6-22_0 6-22_1 6-22_2 21-22_0 21-22_1" intLanes=":22_0_0 :22_0_1 :22_2_0 :22_2_1" shape="1928.95,1054.78 1921.59,1061.38 1919.81,1059.53 1918.22,1058.20 1916.82,1057.39 1915.61,1057.11 1914.60,1057.35 1913.78,1058.11 1908.55,1054.43 1910.28,1051.24 1910.59,1049.90 1910.54,1048.71 1910.11,1047.68 1909.32,1046.82 1913.32,1041.82 1916.63,1044.61 1918.99,1046.79 1920.89,1048.64 1922.85,1050.41 1925.37,1052.37">

<request index="0" response="0000" foes="1100" cont="0"/>

<request index="1" response="0000" foes="1100" cont="0"/>

<request index="2" response="0011" foes="0011" cont="0"/>

<request index="3" response="0011" foes="0011" cont="0"/>

</junction>

<junction id="23" type="priority" x="1895.03" y="1031.28" incLanes="22-23_0 22-23_1" intLanes=":23_0_0 :23_0_1 :23_2_0 :23_2_1" shape="1903.17,1033.70 1899.17,1038.69 1897.22,1037.69 1896.36,1037.70 1895.56,1038.04 1894.83,1038.71 1894.17,1039.72 1888.52,1036.72 1889.65,1034.35 1890.40,1032.25 1890.75,1030.43 1890.71,1028.89 1890.27,1027.62 1889.45,1026.63 1893.54,1021.71 1895.89,1023.97 1897.33,1025.94 1898.32,1027.75 1899.32,1029.55 1900.78,1031.48">

<request index="0" response="0000" foes="0000" cont="0"/>

<request index="1" response="0000" foes="0000" cont="0"/>

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<request index="3" response="0000" foes="0000" cont="0"/>

</junction>

<junction id="26" type="priority" x="1718.47" y="1138.98" incLanes="27-26_0 28-26_0 28-26_1" intLanes=":26_0_0 :26_1_0 :26_1_1" shape="1724.47,1134.18 1726.27,1137.06 1724.35,1137.90 1724.01,1138.49 1724.09,1139.20 1724.59,1140.02 1725.50,1140.96 1721.25,1145.74 1712.83,1138.40 1716.96,1133.51 1718.76,1134.40 1719.93,1134.60 1721.26,1134.62 1722.78,1134.48">

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        <request index="0" response="110" foes="110" cont="0"/>

        <request index="1" response="000" foes="001" cont="0"/>

        <request index="2" response="000" foes="001" cont="0"/>

    </junction>

    <junction id="27" type="priority" x="1732.01" y="1134.16" incLanes="18-27_0 18-27_1"
intLanes=":27_0_0 :27_0_1 :27_2_0" shape="1735.59,1133.05 1731.34,1137.84
1729.88,1137.11 1728.91,1136.95 1727.78,1136.94 1726.49,1137.06 1725.04,1137.33
1724.35,1134.20 1725.28,1133.82 1725.44,1133.56 1725.41,1133.26 1725.17,1132.90
1724.74,1132.51 1728.70,1127.48">

        <request index="0" response="000" foes="000" cont="0"/>

        <request index="1" response="000" foes="000" cont="0"/>

        <request index="2" response="000" foes="000" cont="0"/>

    </junction>

    <junction id="28" type="priority" x="1653.07" y="1084.07" incLanes="8-28_0 29-28_0 29-
28_1" intLanes=":28_0_0 :28_1_0 :28_2_0 :28_2_1" shape="1660.65,1086.15
1656.58,1091.10 1654.55,1090.07 1653.56,1090.04 1652.58,1090.35 1651.62,1090.98
1650.67,1091.95 1645.76,1087.85 1646.81,1085.90 1646.84,1085.00 1646.54,1084.14
1645.92,1083.34 1644.97,1082.58 1648.48,1077.23 1651.17,1079.00 1653.14,1080.32
1654.74,1081.45 1656.30,1082.63 1658.16,1084.12">

        <request index="0" response="1100" foes="1100" cont="0"/>

        <request index="1" response="0000" foes="0000" cont="0"/>

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        <request index="3" response="0000" foes="0001" cont="0"/>

    </junction>

    <junction id="29" type="priority" x="1645.77" y="1079.28" incLanes="35-29_0 35-29_1
30-29_0" intLanes=":29_0_0 :29_0_1 :29_2_0" shape="1646.28,1075.79 1642.77,1081.14
1640.00,1079.15 1639.09,1078.37 1638.20,1077.57 1637.11,1076.61 1635.58,1075.37
1639.52,1070.33 1640.08,1070.61 1640.29,1070.57 1640.45,1070.42 1640.56,1070.15
1640.62,1069.76 1643.99,1068.00 1644.01,1071.51 1644.30,1072.92 1644.77,1074.10
1645.43,1075.06">

        <request index="0" response="000" foes="100" cont="0"/>

        <request index="1" response="000" foes="100" cont="0"/>

        <request index="2" response="011" foes="011" cont="0"/>

    </junction>

    <junction id="3" type="dead_end" x="2058.40" y="1344.03" incLanes="15-3_0 15-3_1"
intLanes="" shape="2057.01,1346.91 2059.79,1341.15"/>

    <junction id="30" type="priority" x="1642.75" y="1063.86" incLanes="27-30_0 27-30_1"
intLanes=":30_0_0 :30_0_1 :30_2_0" shape="1649.05,1064.75 1645.09,1069.78
1644.29,1069.32 1644.04,1069.34 1643.87,1069.51 1643.80,1069.85 1643.82,1070.34
```

```
1640.60,1070.06  1640.63,1067.98  1640.52,1067.17  1640.32,1066.52  1640.03,1066.02
1639.65,1065.67  1643.13,1060.30  1645.40,1061.84  1646.17,1062.42  1646.92,1063.02
1647.82,1063.76">

    <request index="0" response="000" foes="000" cont="0"/>

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    <request index="2" response="000" foes="000" cont="0"/>

</junction>

<junction id="33" type="priority" x="1388.81" y="1017.12" incLanes="41-33_0 42-33_0"
intLanes=":33_0_0 :33_1_0 :33_1_1" shape="1387.76,1009.79 1390.95,1010.03
1391.02,1010.81  1391.18,1010.98  1391.41,1011.02  1391.71,1010.91  1392.10,1010.66
1395.93,1015.79  1392.94,1017.67  1392.30,1018.28  1391.81,1019.16  1391.47,1020.49
1385.17,1019.39  1385.63,1017.32  1386.13,1015.82  1386.64,1014.61  1387.11,1013.39
1387.49,1011.88">

    <request index="0" response="000" foes="000" cont="0"/>

    <request index="1" response="000" foes="000" cont="0"/>

    <request index="2" response="000" foes="000" cont="0"/>

</junction>

<junction id="34" type="priority" x="1417.43" y="1007.10" incLanes="33-34_0 33-34_1
41-34_0 41-34_1" intLanes=":34_0_0 :34_0_1 :34_2_0 :34_2_1" shape="1420.13,1003.45
1421.10,1009.78  1418.07,1010.07  1415.78,1010.03  1413.88,1009.88  1412.01,1009.85
1409.82,1010.17  1406.96,1011.08  1406.85,1004.26  1407.52,1003.85  1407.66,1003.60
1407.67,1003.33  1407.56,1003.02  1407.31,1002.69  1411.43,997.70  1413.22,999.59
1414.87,1001.11  1416.39,1002.25  1417.77,1003.02  1419.02,1003.42">

    <request index="0" response="0100" foes="0100" cont="0"/>

    <request index="1" response="1100" foes="1100" cont="0"/>

    <request index="2" response="0000" foes="0011" cont="0"/>

    <request index="3" response="0000" foes="0010" cont="0"/>

</junction>

<junction id="35" type="priority" x="1439.85" y="998.41" incLanes="34-35_0 34-35_1"
intLanes=":35_0_0 :35_0_1 :35_2_0 :35_2_1" shape="1440.65,990.96 1446.11,994.30
1445.85,995.02  1445.90,995.29  1446.08,995.48  1446.39,995.62  1446.83,995.68
1446.39,1002.07  1443.70,1001.65  1442.72,1001.48  1441.79,1001.49  1440.76,1001.80
1439.49,1002.52  1435.89,997.23  1438.12,995.37  1438.72,994.52  1439.23,993.59
1439.82,992.44">

    <request index="0" response="0000" foes="0000" cont="0"/>

    <request index="1" response="0000" foes="0000" cont="0"/>

    <request index="2" response="0000" foes="0000" cont="0"/>

    <request index="3" response="0000" foes="0000" cont="0"/>

</junction>
```

```xml
    <junction id="37" type="priority" x="1447.71" y="980.42" incLanes="30-37_0 30-37_1 35-
37_0 35-37_1" intLanes=":37_0_0 :37_0_1 :37_2_0 :37_2_1" shape="1454.26,979.64
1451.84,985.56 1450.63,985.33 1450.14,985.47 1449.73,985.77 1449.40,986.23
1449.16,986.86 1443.01,985.05 1443.90,982.13 1444.13,981.07 1444.21,980.01
1444.13,978.72 1443.89,977.01 1450.19,975.94 1450.81,977.32 1451.40,977.96
1452.17,978.56 1453.12,979.12">

        <request index="0" response="0100" foes="0100" cont="0"/>

        <request index="1" response="1100" foes="1100" cont="0"/>

        <request index="2" response="0000" foes="0011" cont="0"/>

        <request index="3" response="0000" foes="0010" cont="0"/>

    </junction>

    <junction id="38" type="priority" x="1442.53" y="962.07" incLanes="37-38_0 37-38_1"
intLanes=":38_0_0 :38_0_1 :38_2_0 :38_2_1" shape="1441.30,955.52 1447.38,957.50
1446.52,959.65 1446.22,960.45 1446.11,961.24 1446.25,962.14 1446.72,963.28
1441.00,966.15 1439.62,964.00 1438.94,963.39 1438.15,962.87 1437.16,962.30
1435.89,961.51 1439.42,956.17 1440.24,956.50 1440.58,956.46 1440.86,956.28
1441.11,955.97">

        <request index="0" response="0000" foes="0000" cont="0"/>

        <request index="1" response="0000" foes="0000" cont="0"/>

        <request index="2" response="0000" foes="0000" cont="0"/>

        <request index="3" response="0000" foes="0000" cont="0"/>

    </junction>

    <junction id="4" type="dead_end" x="2061.49" y="1337.85" incLanes="" intLanes=""
shape="2060.15,1340.76 2062.83,1334.94"/>

    <junction id="40" type="priority" x="1419.94" y="955.84" incLanes="23-40_0 23-40_1 38-
40_0 38-40_1" intLanes=":40_0_0 :40_0_1 :40_2_0 :40_2_1" shape="1418.42,947.46
1423.43,951.44 1423.08,952.09 1423.11,952.31 1423.27,952.47 1423.57,952.57
1424.00,952.60 1424.07,959.00 1421.04,958.74 1419.93,958.62 1418.89,958.68
1417.76,959.09 1416.40,959.99 1412.47,954.94 1414.01,953.63 1415.03,952.53
1415.74,951.50 1416.39,950.41 1417.21,949.11">

        <request index="0" response="0100" foes="0100" cont="0"/>

        <request index="1" response="1100" foes="1100" cont="0"/>

        <request index="2" response="0000" foes="0011" cont="0"/>

        <request index="3" response="0000" foes="0010" cont="0"/>

    </junction>

    <junction id="41" type="priority" x="1400.10" y="984.88" incLanes="40-41_0 40-41_1"
intLanes=":41_0_0 :41_1_0 :41_1_1" shape="1397.97,983.11 1404.35,983.51
1404.45,987.09 1404.74,988.64 1405.21,990.03 1405.85,991.27 1406.66,992.35
1400.49,994.77 1399.45,993.08 1398.88,992.82 1398.28,992.97 1397.63,993.51
1396.95,994.45 1394.23,992.77 1396.33,989.45 1396.99,988.22 1397.45,986.93
```

1397.76,985.31">


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    <request index="0" response="000" foes="000" cont="0"/>

    <request index="1" response="000" foes="000" cont="0"/>

    <request index="2" response="000" foes="000" cont="0"/>

  </junction>

  <junction id="42" type="traffic_light" x="1435.40" y="1181.01" incLanes="43-42_0 43-42_1_0 33-42_0" intLanes=":42_0_0 :42_1_0 :42_2_0 :42_3_0 :42_4_0 :42_6_0" shape="1440.59,1175.26 1443.14,1181.13 1441.31,1182.40 1440.82,1183.21 1440.61,1184.13 1440.69,1185.16 1441.04,1186.32 1435.12,1188.75 1434.02,1186.06 1433.18,1184.08 1432.46,1182.47 1431.69,1180.87 1430.71,1178.96 1429.37,1176.38 1435.04,1173.42 1436.46,1175.16 1437.33,1175.61 1438.31,1175.78 1439.40,1175.66">

    <request index="0" response="001000" foes="001000" cont="0"/>

    <request index="1" response="111000" foes="111000" cont="0"/>

    <request index="2" response="000000" foes="100000" cont="0"/>

    <request index="3" response="000000" foes="100011" cont="0"/>

    <request index="4" response="000000" foes="000010" cont="0"/>

    <request index="5" response="001100" foes="001110" cont="1"/>

  </junction>

  <junction id="43" type="traffic_light" x="1538.07" y="1423.29" incLanes="42-43_0 8-43_0 42-43_1_0" intLanes=":43_0_0 :43_1_0 :43_2_0 :43_3_0 :43_4_0 :43_6_0" shape="1539.83,1415.30 1545.08,1419.00 1543.82,1421.21 1543.72,1422.26 1543.98,1423.27 1544.59,1424.24 1545.55,1425.17 1541.55,1430.17 1530.28,1420.75 1534.48,1415.92 1536.30,1416.92 1537.19,1416.97 1538.08,1416.71 1538.96,1416.16">

    <request index="0" response="001000" foes="001000" cont="0"/>

    <request index="1" response="111000" foes="111000" cont="0"/>

    <request index="2" response="000000" foes="100000" cont="0"/>

    <request index="3" response="000000" foes="100011" cont="0"/>

    <request index="4" response="000000" foes="000010" cont="0"/>

    <request index="5" response="001100" foes="001110" cont="1"/>

  </junction>

  <junction id="5" type="dead_end" x="2081.60" y="1146.39" incLanes="21-5_0 21-5_1 21-5_2" intLanes="" shape="2080.21,1150.99 2082.99,1141.79"/>

  <junction id="6" type="dead_end" x="2086.54" y="1136.13" incLanes="" intLanes="" shape="2084.89,1140.64 2088.19,1131.62"/>

  <junction id="8" type="traffic_light" x="1700.95" y="1429.46" incLanes="9-8_0 43-8_0 28-8_0" intLanes=":8_0_0 :8_1_0 :8_2_0 :8_6_0 :8_4_0 :8_5_0" shape="1705.80,1422.64 1709.20,1428.07 1706.46,1429.78 1704.42,1431.03 1702.71,1432.02 1700.97,1432.94
```

1698.82,1434.00 1695.90,1435.38 1693.17,1429.60 1694.97,1428.18 1695.42,1427.25
1695.57,1426.19 1695.41,1424.98 1694.95,1423.64 1700.82,1421.10 1702.08,1422.90
1702.86,1423.32 1703.74,1423.42 1704.72,1423.19">

<request index="0" response="000000" foes="001000" cont="0"/>

<request index="1" response="000000" foes="111000" cont="0"/>

<request index="2" response="000000" foes="100000" cont="0"/>

<request index="3" response="000011" foes="100011" cont="1"/>

<request index="4" response="000010" foes="000010" cont="0"/>

<request index="5" response="001110" foes="001110" cont="0"/>

</junction>

<junction id="9" type="priority" x="1762.63" y="1390.79" incLanes="11-9_0 8-9_0" intLanes=":9_0_0 :9_1_0" shape="1766.10,1384.32 1768.52,1386.41 1767.60,1387.64 1767.43,1388.06 1767.45,1388.34 1767.66,1388.48 1768.06,1388.48 1768.46,1391.65 1767.38,1391.82 1767.00,1391.93 1766.64,1392.08 1766.23,1392.31 1765.70,1392.64 1762.30,1387.22 1763.84,1386.31 1764.37,1385.97 1764.87,1385.59 1765.42,1385.07">

<request index="0" response="00" foes="00" cont="0"/>

<request index="1" response="00" foes="00" cont="0"/>

</junction>

<junction id=":17_8_0" type="internal" x="1816.11" y="1204.31" incLanes=":17_6_0 4-17_1" intLanes=":17_2_0 :17_2_1"/>

<junction id=":17_9_0" type="internal" x="1815.97" y="1204.02" incLanes=":17_6_1 4-17_1" intLanes=":17_2_0 :17_2_1"/>

<junction id=":42_6_0" type="internal" x="1433.10" y="1178.75" incLanes=":42_5_0 43-42_1_0" intLanes=":42_1_0 :42_2_0 :42_3_0"/>

<junction id=":43_6_0" type="internal" x="1534.74" y="1421.57" incLanes=":43_5_0 8-43_0" intLanes=":43_1_0 :43_2_0 :43_3_0"/>

<junction id=":8_6_0" type="internal" x="1698.53" y="1431.60" incLanes=":8_3_0 9-8_0" intLanes=":8_0_0 :8_1_0 :8_5_0"/>

<connection from="11-10" to="10-1" fromLane="0" toLane="0" via=":10_1_0" dir="s" state="M"/>

<connection from="11-10" to="10-1" fromLane="1" toLane="1" via=":10_1_1" dir="s" state="M"/>

<connection from="11-9" to="9-8" fromLane="0" toLane="0" via=":9_0_0" dir="s" state="M"/>

<connection from="14-11" to="11-9" fromLane="0" toLane="0" via=":11_0_0" dir="l" state="M"/>

```xml
<connection from="14-11" to="11-10" fromLane="0" toLane="0" via=":11_1_0" dir="s" state="M"/>
<connection from="14-11" to="11-10" fromLane="1" toLane="1" via=":11_1_1" dir="s" state="M"/>
<connection from="14-15" to="15-3" fromLane="0" toLane="0" via=":15_4_0" tl="5099455590" linkIndex="4" dir="s" state="o"/>
<connection from="14-15" to="15-3" fromLane="0" toLane="1" via=":15_4_1" tl="5099455590" linkIndex="5" dir="s" state="o"/>
<connection from="14-15" to="15-17" fromLane="1" toLane="0" via=":15_6_0" tl="5099455590" linkIndex="6" dir="r" state="o"/>
<connection from="14-15" to="15-17" fromLane="1" toLane="1" via=":15_6_1" tl="5099455590" linkIndex="7" dir="r" state="o"/>
<connection from="15-17" to="17-21" fromLane="0" toLane="0" via=":17_4_0" tl="1403795478" linkIndex="4" dir="s" state="o"/>
<connection from="15-17" to="17-21" fromLane="0" toLane="1" via=":17_4_1" tl="1403795478" linkIndex="5" dir="s" state="o"/>
<connection from="15-17" to="17-16" fromLane="1" toLane="0" via=":17_6_0" tl="1403795478" linkIndex="6" dir="r" state="o"/>
<connection from="15-17" to="17-16" fromLane="1" toLane="1" via=":17_6_1" tl="1403795478" linkIndex="7" dir="r" state="o"/>
<connection from="16-14" to="14-11" fromLane="0" toLane="0" via=":14_0_0" tl="5099455589" linkIndex="0" dir="s" state="o"/>
<connection from="16-14" to="14-11" fromLane="0" toLane="1" via=":14_0_1" tl="5099455589" linkIndex="1" dir="s" state="o"/>
<connection from="16-14" to="14-15" fromLane="1" toLane="0" via=":14_2_0" tl="5099455589" linkIndex="2" dir="r" state="o"/>
<connection from="16-14" to="14-15" fromLane="1" toLane="1" via=":14_2_1" tl="5099455589" linkIndex="3" dir="r" state="o"/>
<connection from="16-18" to="18-27" fromLane="0" toLane="0" via=":18_1_0" dir="s" state="M"/>
<connection from="16-18" to="18-27" fromLane="1" toLane="1" via=":18_1_1" dir="s" state="M"/>
<connection from="17-16" to="16-18" fromLane="0" toLane="0" via=":16_4_0" tl="307392280" linkIndex="4" dir="l" state="o"/>
<connection from="17-16" to="16-18" fromLane="0" toLane="1" via=":16_4_1" tl="307392280" linkIndex="5" dir="l" state="o"/>
<connection from="17-16" to="16-14" fromLane="1" toLane="0" via=":16_6_0" tl="307392280" linkIndex="6" dir="r" state="o"/>
<connection from="17-16" to="16-14" fromLane="1" toLane="1" via=":16_6_1" tl="307392280" linkIndex="7" dir="r" state="o"/>
```

```
<connection from="17-21" to="21-5" fromLane="0" toLane="0" via=":21_0_0"
tl="5099258524" linkIndex="0" dir="l" state="o"/>

<connection from="17-21" to="21-5" fromLane="0" toLane="1" via=":21_0_1"
tl="5099258524" linkIndex="1" dir="l" state="o"/>

<connection from="17-21" to="21-5" fromLane="0" toLane="2" via=":21_0_2"
tl="5099258524" linkIndex="2" dir="l" state="o"/>

<connection from="17-21" to="21-22" fromLane="1" toLane="0" via=":21_3_0"
tl="5099258524" linkIndex="3" dir="s" state="o"/>

<connection from="17-21" to="21-22" fromLane="1" toLane="1" via=":21_3_1"
tl="5099258524" linkIndex="4" dir="s" state="o"/>

<connection from="18-27" to="27-30" fromLane="0" toLane="0" via=":27_0_0" dir="s"
state="M"/>

<connection from="18-27" to="27-30" fromLane="1" toLane="1" via=":27_0_1" dir="s"
state="M"/>

<connection from="18-27" to="27-26" fromLane="1" toLane="0" via=":27_2_0" dir="r"
state="M"/>

<connection from="19-16" to="16-18" fromLane="0" toLane="0" via=":16_0_0"
tl="307392280" linkIndex="0" dir="l" state="O"/>

<connection from="19-16" to="16-18" fromLane="0" toLane="1" via=":16_0_1"
tl="307392280" linkIndex="1" dir="l" state="O"/>

<connection from="19-16" to="16-14" fromLane="1" toLane="0" via=":16_2_0"
tl="307392280" linkIndex="2" dir="s" state="O"/>

<connection from="19-16" to="16-14" fromLane="1" toLane="1" via=":16_2_1"
tl="307392280" linkIndex="3" dir="s" state="O"/>

<connection from="19-18" to="18-27" fromLane="0" toLane="0" via=":18_0_0" dir="s"
state="m"/>

<connection from="2-15" to="15-3" fromLane="0" toLane="0" via=":15_0_0"
tl="5099455590" linkIndex="0" dir="L" state="O"/>

<connection from="2-15" to="15-3" fromLane="0" toLane="1" via=":15_0_1"
tl="5099455590" linkIndex="1" dir="L" state="O"/>

<connection from="2-15" to="15-17" fromLane="1" toLane="0" via=":15_2_0"
tl="5099455590" linkIndex="2" dir="s" state="O"/>

<connection from="2-15" to="15-17" fromLane="1" toLane="1" via=":15_2_1"
tl="5099455590" linkIndex="3" dir="s" state="O"/>

<connection from="20-19" to="19-18" fromLane="0" toLane="0" via=":19_0_0" dir="L"
state="M"/>

<connection from="20-19" to="19-16" fromLane="0" toLane="0" via=":19_1_0" dir="s"
state="M"/>

<connection from="20-19" to="19-16" fromLane="1" toLane="1" via=":19_1_1" dir="s"
state="M"/>
```

```xml
<connection from="20-21" to="21-5" fromLane="0" toLane="0" via=":21_5_0"
tl="5099258524"  linkIndex="5" dir="s" state="O"/>

<connection from="20-21" to="21-22" fromLane="0" toLane="0" via=":21_6_0"
tl="5099258524"  linkIndex="6" dir="r" state="O"/>

<connection from="20-21" to="21-5" fromLane="1" toLane="1" via=":21_7_0"
tl="5099258524"  linkIndex="7" dir="s" state="O"/>

<connection from="20-21" to="21-5" fromLane="1" toLane="2" via=":21_7_1"
tl="5099258524"  linkIndex="8" dir="s" state="O"/>

<connection from="21-22" to="22-23" fromLane="0" toLane="0" via=":22_2_0"
tl="5099258526"  linkIndex="2" dir="r" state="o"/>

<connection from="21-22" to="22-23" fromLane="1" toLane="1" via=":22_2_1"
tl="5099258526"  linkIndex="3" dir="r" state="o"/>

<connection from="22-23" to="23-40" fromLane="0" toLane="0" via=":23_0_0" dir="s"
state="M"/>

<connection from="22-23" to="23-40" fromLane="0" toLane="1" via=":23_0_1" dir="s"
state="M"/>

<connection from="22-23" to="23-20" fromLane="1" toLane="0" via=":23_2_0" dir="r"
state="M"/>

<connection from="22-23" to="23-20" fromLane="1" toLane="1" via=":23_2_1" dir="r"
state="M"/>

<connection from="23-20" to="20-19" fromLane="0" toLane="0" via=":20_0_0"
tl="5099258525"  linkIndex="0" dir="s" state="o"/>

<connection from="23-20" to="20-19" fromLane="0" toLane="1" via=":20_0_1"
tl="5099258525"  linkIndex="1" dir="s" state="o"/>

<connection from="23-20" to="20-21" fromLane="1" toLane="0" via=":20_2_0"
tl="5099258525"  linkIndex="2" dir="r" state="o"/>

<connection from="23-20" to="20-21" fromLane="1" toLane="1" via=":20_2_1"
tl="5099258525"  linkIndex="3" dir="r" state="o"/>

<connection from="23-40" to="40-41" fromLane="0" toLane="0" via=":40_0_0" dir="s"
state="m" visibility="9.00"/>

<connection from="23-40" to="40-41" fromLane="1" toLane="1" via=":40_0_1" dir="s"
state="m" visibility="9.00"/>

<connection from="26-14" to="14-11" fromLane="0" toLane="0" via=":14_4_0"
tl="5099455589"  linkIndex="4" dir="L" state="O"/>

<connection from="26-14" to="14-11" fromLane="0" toLane="1" via=":14_4_1"
tl="5099455589"  linkIndex="5" dir="L" state="O"/>

<connection from="26-14" to="14-15" fromLane="1" toLane="0" via=":14_6_0"
tl="5099455589"  linkIndex="6" dir="s" state="O"/>

<connection from="26-14" to="14-15" fromLane="1" toLane="1" via=":14_6_1"
tl="5099455589"  linkIndex="7" dir="s" state="O"/>
```

```xml
<connection from="27-26" to="26-14" fromLane="0" toLane="1" via=":26_0_0" dir="r" state="m"/>
<connection from="27-30" to="30-37" fromLane="0" toLane="0" via=":30_0_0" dir="s" state="M"/>
<connection from="27-30" to="30-37" fromLane="1" toLane="1" via=":30_0_1" dir="s" state="M"/>
<connection from="27-30" to="30-29" fromLane="1" toLane="0" via=":30_2_0" dir="r" state="M"/>
<connection from="28-26" to="26-14" fromLane="0" toLane="0" via=":26_1_0" dir="s" state="M"/>
<connection from="28-26" to="26-14" fromLane="1" toLane="1" via=":26_1_1" dir="s" state="M"/>
<connection from="28-8" to="8-43" fromLane="0" toLane="0" via=":8_4_0" tl="307392857" linkIndex="4" dir="l" state="o"/>
<connection from="28-8" to="8-9" fromLane="0" toLane="0" via=":8_5_0" tl="307392857" linkIndex="5" dir="r" state="o"/>
<connection from="29-28" to="28-8" fromLane="0" toLane="0" via=":28_1_0" dir="l" state="M"/>
<connection from="29-28" to="28-26" fromLane="0" toLane="0" via=":28_2_0" dir="s" state="M"/>
<connection from="29-28" to="28-26" fromLane="1" toLane="1" via=":28_2_1" dir="s" state="M"/>
<connection from="30-29" to="29-28" fromLane="0" toLane="1" via=":29_2_0" dir="s" state="m"/>
<connection from="30-37" to="37-38" fromLane="0" toLane="0" via=":37_0_0" dir="l" state="m" visibility="9.00"/>
<connection from="30-37" to="37-38" fromLane="1" toLane="1" via=":37_0_1" dir="l" state="m" visibility="9.00"/>
<connection from="33-34" to="34-35" fromLane="0" toLane="0" via=":34_0_0" dir="s" state="m" visibility="9.00"/>
<connection from="33-34" to="34-35" fromLane="1" toLane="1" via=":34_0_1" dir="s" state="m" visibility="9.00"/>
<connection from="33-42" to="42-43_1" fromLane="0" toLane="0" via=":42_4_0" tl="307392843" linkIndex="4" dir="s" state="O"/>
<connection from="33-42" to="42-43" fromLane="0" toLane="0" via=":42_5_0" tl="307392843" linkIndex="5" dir="r" state="o"/>
<connection from="34-35" to="35-29" fromLane="0" toLane="0" via=":35_0_0" dir="L" state="M"/>
<connection from="34-35" to="35-29" fromLane="0" toLane="1" via=":35_0_1" dir="L" state="M"/>
```

```
<connection from="34-35" to="35-37" fromLane="1" toLane="0" via=":35_2_0" dir="s"
state="M"/>

<connection from="34-35" to="35-37" fromLane="1" toLane="1" via=":35_2_1" dir="s"
state="M"/>

<connection from="35-29" to="29-28" fromLane="0" toLane="0" via=":29_0_0" dir="s"
state="M"/>

<connection from="35-29" to="29-28" fromLane="1" toLane="1" via=":29_0_1" dir="s"
state="M"/>

<connection from="35-37" to="37-38" fromLane="0" toLane="0" via=":37_2_0" dir="s"
state="M"/>

<connection from="35-37" to="37-38" fromLane="1" toLane="1" via=":37_2_1" dir="s"
state="M"/>

<connection from="37-38" to="38-20" fromLane="0" toLane="0" via=":38_0_0" dir="l"
state="M"/>

<connection from="37-38" to="38-20" fromLane="0" toLane="1" via=":38_0_1" dir="l"
state="M"/>

<connection from="37-38" to="38-40" fromLane="1" toLane="0" via=":38_2_0" dir="s"
state="M"/>

<connection from="37-38" to="38-40" fromLane="1" toLane="1" via=":38_2_1" dir="s"
state="M"/>

<connection from="38-20" to="20-19" fromLane="0" toLane="0" via=":20_4_0"
tl="5099258525" linkIndex="4" dir="s" state="O"/>

<connection from="38-20" to="20-19" fromLane="0" toLane="1" via=":20_4_1"
tl="5099258525" linkIndex="5" dir="s" state="O"/>

<connection from="38-20" to="20-21" fromLane="1" toLane="0" via=":20_6_0"
tl="5099258525" linkIndex="6" dir="R" state="O"/>

<connection from="38-20" to="20-21" fromLane="1" toLane="1" via=":20_6_1"
tl="5099258525" linkIndex="7" dir="R" state="O"/>

<connection from="38-40" to="40-41" fromLane="0" toLane="0" via=":40_2_0" dir="s"
state="M"/>

<connection from="38-40" to="40-41" fromLane="1" toLane="1" via=":40_2_1" dir="s"
state="M"/>

<connection from="4-17" to="17-21" fromLane="0" toLane="0" via=":17_0_0"
tl="1403795478" linkIndex="0" dir="l" state="O"/>

<connection from="4-17" to="17-21" fromLane="0" toLane="1" via=":17_0_1"
tl="1403795478" linkIndex="1" dir="l" state="O"/>

<connection from="4-17" to="17-16" fromLane="1" toLane="0" via=":17_2_0"
tl="1403795478" linkIndex="2" dir="r" state="O"/>

<connection from="4-17" to="17-16" fromLane="1" toLane="1" via=":17_2_1"
tl="1403795478" linkIndex="3" dir="r" state="O"/>
```

```
<connection from="40-41" to="41-33" fromLane="0" toLane="0" via=":41_0_0" dir="L"
state="M"/>

<connection from="40-41" to="41-34" fromLane="1" toLane="0" via=":41_1_0" dir="s"
state="M"/>

<connection from="40-41" to="41-34" fromLane="1" toLane="1" via=":41_1_1" dir="s"
state="M"/>

<connection from="41-33" to="33-42" fromLane="0" toLane="0" via=":33_0_0" dir="s"
state="M"/>

<connection from="41-34" to="34-35" fromLane="0" toLane="0" via=":34_2_0" dir="s"
state="M"/>

<connection from="41-34" to="34-35" fromLane="1" toLane="1" via=":34_2_1" dir="s"
state="M"/>

<connection from="42-33" to="33-34" fromLane="0" toLane="0" via=":33_1_0" dir="s"
state="M"/>

<connection from="42-33" to="33-34" fromLane="0" toLane="1" via=":33_1_1" dir="s"
state="M"/>

<connection from="42-43" to="43-42_1" fromLane="0" toLane="0" via=":43_0_0"
tl="1273054236" linkIndex="0" dir="l" state="o"/>

<connection from="42-43" to="43-8" fromLane="0" toLane="0" via=":43_1_0"
tl="1273054236" linkIndex="1" dir="r" state="o"/>

<connection from="42-43_1" to="43-8" fromLane="0" toLane="0" via=":43_4_0"
tl="1273054236" linkIndex="4" dir="s" state="O"/>

<connection from="42-43_1" to="43-42" fromLane="0" toLane="0" via=":43_5_0"
tl="1273054236" linkIndex="5" dir="r" state="o"/>

<connection from="43-42" to="42-33" fromLane="0" toLane="0" via=":42_0_0"
tl="307392843" linkIndex="0" dir="l" state="o"/>

<connection from="43-42" to="42-43_1" fromLane="0" toLane="0" via=":42_1_0"
tl="307392843" linkIndex="1" dir="r" state="o"/>

<connection from="43-42_1" to="42-43" fromLane="0" toLane="0" via=":42_2_0"
tl="307392843" linkIndex="2" dir="l" state="O"/>

<connection from="43-42_1" to="42-33" fromLane="0" toLane="0" via=":42_3_0"
tl="307392843" linkIndex="3" dir="s" state="O"/>

<connection from="43-8" to="8-9" fromLane="0" toLane="0" via=":8_2_0"
tl="307392857" linkIndex="2" dir="s" state="O"/>

<connection from="43-8" to="8-28" fromLane="0" toLane="0" via=":8_3_0"
tl="307392857" linkIndex="3" dir="r" state="o"/>

<connection from="6-22" to="22-23" fromLane="0" toLane="0" via=":22_0_0"
tl="5099258526" linkIndex="0" dir="s" state="O"/>

<connection from="6-22" to="22-23" fromLane="1" toLane="1" via=":22_0_1"
tl="5099258526" linkIndex="1" dir="s" state="O"/>
```

```
<connection from="8-28" to="28-26" fromLane="0" toLane="0" via=":28_0_0" dir="l" state="m"/>

<connection from="8-43" to="43-42" fromLane="0" toLane="0" via=":43_2_0" tl="1273054236" linkIndex="2" dir="l" state="O"/>

<connection from="8-43" to="43-42_1" fromLane="0" toLane="0" via=":43_3_0" tl="1273054236" linkIndex="3" dir="s" state="O"/>

<connection from="8-9" to="9-10" fromLane="0" toLane="0" via=":9_1_0" dir="s" state="M"/>

<connection from="9-10" to="10-1" fromLane="0" toLane="0" via=":10_0_0" dir="l" state="m"/>

<connection from="9-8" to="8-28" fromLane="0" toLane="0" via=":8_0_0" tl="307392857" linkIndex="0" dir="l" state="O"/>

<connection from="9-8" to="8-43" fromLane="0" toLane="0" via=":8_1_0" tl="307392857" linkIndex="1" dir="s" state="O"/>


<connection from=":10_0" to="10-1" fromLane="0" toLane="0" dir="l" state="M"/>
<connection from=":10_1" to="10-1" fromLane="0" toLane="0" dir="s" state="M"/>
<connection from=":10_1" to="10-1" fromLane="1" toLane="1" dir="s" state="M"/>
<connection from=":11_0" to="11-9" fromLane="0" toLane="0" dir="l" state="M"/>
<connection from=":11_1" to="11-10" fromLane="0" toLane="0" dir="s" state="M"/>
<connection from=":11_1" to="11-10" fromLane="1" toLane="1" dir="s" state="M"/>
<connection from=":14_0" to="14-11" fromLane="0" toLane="0" dir="s" state="M"/>
<connection from=":14_0" to="14-11" fromLane="1" toLane="1" dir="s" state="M"/>
<connection from=":14_2" to="14-15" fromLane="0" toLane="0" dir="r" state="M"/>
<connection from=":14_2" to="14-15" fromLane="1" toLane="1" dir="r" state="M"/>
<connection from=":14_4" to="14-11" fromLane="0" toLane="0" dir="L" state="M"/>
<connection from=":14_4" to="14-11" fromLane="1" toLane="1" dir="L" state="M"/>
<connection from=":14_6" to="14-15" fromLane="0" toLane="0" dir="s" state="M"/>
<connection from=":14_6" to="14-15" fromLane="1" toLane="1" dir="s" state="M"/>
<connection from=":15_0" to="15-3" fromLane="0" toLane="0" dir="L" state="M"/>
<connection from=":15_0" to="15-3" fromLane="1" toLane="1" dir="L" state="M"/>
<connection from=":15_2" to="15-17" fromLane="0" toLane="0" dir="s" state="M"/>
<connection from=":15_2" to="15-17" fromLane="1" toLane="1" dir="s" state="M"/>
<connection from=":15_4" to="15-3" fromLane="0" toLane="0" dir="s" state="M"/>
<connection from=":15_4" to="15-3" fromLane="1" toLane="1" dir="s" state="M"/>
```

```xml
<connection from=":15_6" to="15-17" fromLane="0" toLane="0" dir="r" state="M"/>
<connection from=":15_6" to="15-17" fromLane="1" toLane="1" dir="r" state="M"/>
<connection from=":16_0" to="16-18" fromLane="0" toLane="0" dir="l" state="M"/>
<connection from=":16_0" to="16-18" fromLane="1" toLane="1" dir="l" state="M"/>
<connection from=":16_2" to="16-14" fromLane="0" toLane="0" dir="s" state="M"/>
<connection from=":16_2" to="16-14" fromLane="1" toLane="1" dir="s" state="M"/>
<connection from=":16_4" to="16-18" fromLane="0" toLane="0" dir="l" state="M"/>
<connection from=":16_4" to="16-18" fromLane="1" toLane="1" dir="l" state="M"/>
<connection from=":16_6" to="16-14" fromLane="0" toLane="0" dir="r" state="M"/>
<connection from=":16_6" to="16-14" fromLane="1" toLane="1" dir="r" state="M"/>
<connection from=":17_0" to="17-21" fromLane="0" toLane="0" dir="l" state="M"/>
<connection from=":17_0" to="17-21" fromLane="1" toLane="1" dir="l" state="M"/>
<connection from=":17_2" to="17-16" fromLane="0" toLane="0" dir="r" state="M"/>
<connection from=":17_2" to="17-16" fromLane="1" toLane="1" dir="r" state="M"/>
<connection from=":17_4" to="17-21" fromLane="0" toLane="0" dir="s" state="M"/>
<connection from=":17_4" to="17-21" fromLane="1" toLane="1" dir="s" state="M"/>
<connection from=":17_6" to="17-16" fromLane="0" toLane="0" via=":17_8_0" dir="r" state="m"/>
<connection from=":17_8" to="17-16" fromLane="0" toLane="0" dir="r" state="M"/>
<connection from=":17_6" to="17-16" fromLane="1" toLane="1" via=":17_9_0" dir="r" state="m"/>
<connection from=":17_9" to="17-16" fromLane="0" toLane="1" dir="r" state="M"/>
<connection from=":18_0" to="18-27" fromLane="0" toLane="0" dir="s" state="M"/>
<connection from=":18_1" to="18-27" fromLane="0" toLane="0" dir="s" state="M"/>
<connection from=":18_1" to="18-27" fromLane="1" toLane="1" dir="s" state="M"/>
<connection from=":19_0" to="19-18" fromLane="0" toLane="0" dir="L" state="M"/>
<connection from=":19_1" to="19-16" fromLane="0" toLane="0" dir="s" state="M"/>
<connection from=":19_1" to="19-16" fromLane="1" toLane="1" dir="s" state="M"/>
<connection from=":20_0" to="20-19" fromLane="0" toLane="0" dir="s" state="M"/>
<connection from=":20_0" to="20-19" fromLane="1" toLane="1" dir="s" state="M"/>
<connection from=":20_2" to="20-21" fromLane="0" toLane="0" dir="r" state="M"/>
<connection from=":20_2" to="20-21" fromLane="1" toLane="1" dir="r" state="M"/>
<connection from=":20_4" to="20-19" fromLane="0" toLane="0" dir="s" state="M"/>
```

```xml
<connection from=":20_4" to="20-19" fromLane="1" toLane="1" dir="s" state="M"/>
<connection from=":20_6" to="20-21" fromLane="0" toLane="0" dir="R" state="M"/>
<connection from=":20_6" to="20-21" fromLane="1" toLane="1" dir="R" state="M"/>
<connection from=":21_0" to="21-5" fromLane="0" toLane="0" dir="l" state="M"/>
<connection from=":21_0" to="21-5" fromLane="1" toLane="1" dir="l" state="M"/>
<connection from=":21_0" to="21-5" fromLane="2" toLane="2" dir="l" state="M"/>
<connection from=":21_3" to="21-22" fromLane="0" toLane="0" dir="s" state="M"/>
<connection from=":21_3" to="21-22" fromLane="1" toLane="1" dir="s" state="M"/>
<connection from=":21_5" to="21-5" fromLane="0" toLane="0" dir="s" state="M"/>
<connection from=":21_6" to="21-22" fromLane="0" toLane="0" dir="r" state="M"/>
<connection from=":21_7" to="21-5" fromLane="0" toLane="1" dir="s" state="M"/>
<connection from=":21_7" to="21-5" fromLane="1" toLane="2" dir="s" state="M"/>
<connection from=":22_0" to="22-23" fromLane="0" toLane="0" dir="s" state="M"/>
<connection from=":22_0" to="22-23" fromLane="1" toLane="1" dir="s" state="M"/>
<connection from=":22_2" to="22-23" fromLane="0" toLane="0" dir="r" state="M"/>
<connection from=":22_2" to="22-23" fromLane="1" toLane="1" dir="r" state="M"/>
<connection from=":23_0" to="23-40" fromLane="0" toLane="0" dir="s" state="M"/>
<connection from=":23_0" to="23-40" fromLane="1" toLane="1" dir="s" state="M"/>
<connection from=":23_2" to="23-20" fromLane="0" toLane="0" dir="r" state="M"/>
<connection from=":23_2" to="23-20" fromLane="1" toLane="1" dir="r" state="M"/>
<connection from=":26_0" to="26-14" fromLane="0" toLane="1" dir="r" state="M"/>
<connection from=":26_1" to="26-14" fromLane="0" toLane="0" dir="s" state="M"/>
<connection from=":26_1" to="26-14" fromLane="1" toLane="1" dir="s" state="M"/>
<connection from=":27_0" to="27-30" fromLane="0" toLane="0" dir="s" state="M"/>
<connection from=":27_0" to="27-30" fromLane="1" toLane="1" dir="s" state="M"/>
<connection from=":27_2" to="27-26" fromLane="0" toLane="0" dir="r" state="M"/>
<connection from=":28_0" to="28-26" fromLane="0" toLane="0" dir="l" state="M"/>
<connection from=":28_1" to="28-8" fromLane="0" toLane="0" dir="l" state="M"/>
<connection from=":28_2" to="28-26" fromLane="0" toLane="0" dir="s" state="M"/>
<connection from=":28_2" to="28-26" fromLane="1" toLane="1" dir="s" state="M"/>
<connection from=":29_0" to="29-28" fromLane="0" toLane="0" dir="s" state="M"/>
<connection from=":29_0" to="29-28" fromLane="1" toLane="1" dir="s" state="M"/>
```

```xml
<connection from=":29_2" to="29-28" fromLane="0" toLane="1" dir="s" state="M"/>
<connection from=":30_0" to="30-37" fromLane="0" toLane="0" dir="s" state="M"/>
<connection from=":30_0" to="30-37" fromLane="1" toLane="1" dir="s" state="M"/>
<connection from=":30_2" to="30-29" fromLane="0" toLane="0" dir="r" state="M"/>
<connection from=":33_0" to="33-42" fromLane="0" toLane="0" dir="s" state="M"/>
<connection from=":33_1" to="33-34" fromLane="0" toLane="0" dir="s" state="M"/>
<connection from=":33_1" to="33-34" fromLane="1" toLane="1" dir="s" state="M"/>
<connection from=":34_0" to="34-35" fromLane="0" toLane="0" dir="s" state="M"/>
<connection from=":34_0" to="34-35" fromLane="1" toLane="1" dir="s" state="M"/>
<connection from=":34_2" to="34-35" fromLane="0" toLane="0" dir="s" state="M"/>
<connection from=":34_2" to="34-35" fromLane="1" toLane="1" dir="s" state="M"/>
<connection from=":35_0" to="35-29" fromLane="0" toLane="0" dir="L" state="M"/>
<connection from=":35_0" to="35-29" fromLane="1" toLane="1" dir="L" state="M"/>
<connection from=":35_2" to="35-37" fromLane="0" toLane="0" dir="s" state="M"/>
<connection from=":35_2" to="35-37" fromLane="1" toLane="1" dir="s" state="M"/>
<connection from=":37_0" to="37-38" fromLane="0" toLane="0" dir="l" state="M"/>
<connection from=":37_0" to="37-38" fromLane="1" toLane="1" dir="l" state="M"/>
<connection from=":37_2" to="37-38" fromLane="0" toLane="0" dir="s" state="M"/>
<connection from=":37_2" to="37-38" fromLane="1" toLane="1" dir="s" state="M"/>
<connection from=":38_0" to="38-20" fromLane="0" toLane="0" dir="l" state="M"/>
<connection from=":38_0" to="38-20" fromLane="1" toLane="1" dir="l" state="M"/>
<connection from=":38_2" to="38-40" fromLane="0" toLane="0" dir="s" state="M"/>
<connection from=":38_2" to="38-40" fromLane="1" toLane="1" dir="s" state="M"/>
<connection from=":40_0" to="40-41" fromLane="0" toLane="0" dir="s" state="M"/>
<connection from=":40_0" to="40-41" fromLane="1" toLane="1" dir="s" state="M"/>
<connection from=":40_2" to="40-41" fromLane="0" toLane="0" dir="s" state="M"/>
<connection from=":40_2" to="40-41" fromLane="1" toLane="1" dir="s" state="M"/>
<connection from=":41_0" to="41-33" fromLane="0" toLane="0" dir="L" state="M"/>
<connection from=":41_1" to="41-34" fromLane="0" toLane="0" dir="s" state="M"/>
<connection from=":41_1" to="41-34" fromLane="1" toLane="1" dir="s" state="M"/>
<connection from=":42_0" to="42-33" fromLane="0" toLane="0" dir="l" state="M"/>
<connection from=":42_1" to="42-43_1" fromLane="0" toLane="0" dir="r" state="M"/>
```

```
<connection from=":42_2" to="42-43" fromLane="0" toLane="0" dir="l" state="M"/>

<connection from=":42_3" to="42-33" fromLane="0" toLane="0" dir="s" state="M"/>

<connection from=":42_4" to="42-43_1" fromLane="0" toLane="0" dir="s" state="M"/>

<connection from=":42_5" to="42-43" fromLane="0" toLane="0" via=":42_6_0" dir="r"
state="m"/>

<connection from=":42_6" to="42-43" fromLane="0" toLane="0" dir="r" state="M"/>

<connection from=":43_0" to="43-42_1" fromLane="0" toLane="0" dir="l" state="M"/>

<connection from=":43_1" to="43-8" fromLane="0" toLane="0" dir="r" state="M"/>

<connection from=":43_2" to="43-42" fromLane="0" toLane="0" dir="l" state="M"/>

<connection from=":43_3" to="43-42_1" fromLane="0" toLane="0" dir="s" state="M"/>

<connection from=":43_4" to="43-8" fromLane="0" toLane="0" dir="s" state="M"/>

<connection from=":43_5" to="43-42" fromLane="0" toLane="0" via=":43_6_0" dir="r"
state="m"/>

<connection from=":43_6" to="43-42" fromLane="0" toLane="0" dir="r" state="M"/>

<connection from=":8_0" to="8-28" fromLane="0" toLane="0" dir="l" state="M"/>

<connection from=":8_1" to="8-43" fromLane="0" toLane="0" dir="s" state="M"/>

<connection from=":8_2" to="8-9" fromLane="0" toLane="0" dir="s" state="M"/>

<connection from=":8_3" to="8-28" fromLane="0" toLane="0" via=":8_6_0" dir="r"
state="m"/>

<connection from=":8_6" to="8-28" fromLane="0" toLane="0" dir="r" state="M"/>

<connection from=":8_4" to="8-43" fromLane="0" toLane="0" dir="l" state="M"/>

<connection from=":8_5" to="8-9" fromLane="0" toLane="0" dir="r" state="M"/>

<connection from=":9_0" to="9-8" fromLane="0" toLane="0" dir="s" state="M"/>

<connection from=":9_1" to="9-10" fromLane="0" toLane="0" dir="s" state="M"/>


<roundabout nodes="34 35 37 38 40 41" edges="34-35 35-37 37-38 38-40 40-41 41-34"/>


</net>
```

A2 - experiment.rou.xml

```
<!--

  In_Nodes: 2, 4, 6

  Out_Notes: 1, 3, 5


  id format: <period>-<In-Node>-<Out-Node>-<#>


  via edges: 42-43_1/43-42_1, 42-43/43-42, 28-8/8-28, 35-29/30-37, 38-20/23-40

-->


<routes>


  <!-- Non-rush hours: 00:00-7:30 = 0-25000 -->


    <!-- In-Node 2: Total probability = 0.107 -->


      <!-- Out-Node 1: (Reference) probability = 0.147/3 = 0.049 -->
      <flow id="1-2-1-1" from="2-15" to="10-1" via="42-43_1" begin="0" end="25000"
probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

      <flow id="1-2-1-2" from="2-15" to="10-1" via="42-43" begin="0" end="25000"
probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

      <flow id="1-2-1-3" from="2-15" to="10-1" via="28-8" begin="0" end="25000"
probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

      <flow id="1-2-1-4" from="2-15" to="10-1" via="30-37" begin="0" end="25000"
probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

      <flow id="1-2-1-5" from="2-15" to="10-1" via="23-40" begin="0" end="25000"
probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>
      <!-- Out-Node 3: (Reference) probability = 0.068/3 = 0.0227 -->

      <flow id="1-2-3-1" from="2-15" to="15-3" via="42-43_1" begin="0" end="25000"
probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

      <flow id="1-2-3-2" from="2-15" to="15-3" via="42-43" begin="0" end="25000"
probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

      <flow id="1-2-3-3" from="2-15" to="15-3" via="8-28" begin="0" end="25000"
probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>
```

```xml
<flow id="1-2-3-4" from="2-15" to="15-3" via="26-14" begin="0" end="25000" probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

<flow id="1-2-3-5" from="2-15" to="15-3" via="23-40" begin="0" end="25000" probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

<!-- Out-Node 5: (Reference) probability = 0.059/3 = 0.0197 -->

<flow id="1-2-5-1" from="2-15" to="21-5" via="42-43_1" begin="0" end="25000" probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

<flow id="1-2-5-2" from="2-15" to="21-5" via="42-43" begin="0" end="25000" probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

<flow id="1-2-5-3" from="2-15" to="21-5" via="28-8" begin="0" end="25000" probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

<flow id="1-2-5-4" from="2-15" to="21-5" via="30-37" begin="0" end="25000" probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

<flow id="1-2-5-5" from="2-15" to="21-5" via="38-20" begin="0" end="25000" probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>


<!-- In-Node 4: Total probability = 0.032 -->


<!-- Out-Node 1: (Reference) probability = 0.147/3 = 0.049 -->

<flow id="1-4-1-1" from="4-17" to="10-1" via="42-43_1" begin="0" end="25000" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<flow id="1-4-1-2" from="4-17" to="10-1" via="42-43" begin="0" end="25000" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<flow id="1-4-1-3" from="4-17" to="10-1" via="28-8" begin="0" end="25000" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<flow id="1-4-1-4" from="4-17" to="10-1" via="26-14" begin="0" end="25000" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<flow id="1-4-1-5" from="4-17" to="10-1" via="23-40" begin="0" end="25000" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<!-- Out-Node 3: (Reference) probability = 0.068/3 = 0.0227 -->

<flow id="1-4-3-1" from="4-17" to="15-3" via="42-43_1" begin="0" end="25000" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<flow id="1-4-3-2" from="4-17" to="15-3" via="42-43" begin="0" end="25000" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<flow id="1-4-3-3" from="4-17" to="15-3" via="28-8" begin="0" end="25000" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<flow id="1-4-3-4" from="4-17" to="15-3" via="29-28" begin="0" end="25000" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>
```

```xml
<flow id="1-4-3-5" from="4-17" to="15-3" via="23-40" begin="0" end="25000" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<!-- Out-Node 5: (Reference) probability = 0.059/3 = 0.0197 -->

<flow id="1-4-5-1" from="4-17" to="21-5" via="43-42_1" begin="0" end="25000" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<flow id="1-4-5-2" from="4-17" to="21-5" via="43-42" begin="0" end="25000" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<flow id="1-4-5-3" from="4-17" to="21-5" via="28-8" begin="0" end="25000" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<flow id="1-4-5-4" from="4-17" to="21-5" via="28-26" begin="0" end="25000" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<flow id="1-4-5-5" from="4-17" to="21-5" via="38-20" begin="0" end="25000" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>


<!-- In-Node 6: Total probability = 0.076 -->


<!-- Out-Node 1: (Reference) probability = 0.147/3 = 0.049 -->

<flow id="1-6-1-1" from="6-22" to="10-1" via="42-43_1" begin="0" end="25000" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

<flow id="1-6-1-2" from="6-22" to="10-1" via="42-43" begin="0" end="25000" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

<flow id="1-6-1-3" from="6-22" to="10-1" via="28-8" begin="0" end="25000" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

<flow id="1-6-1-4" from="6-22" to="10-1" via="28-26" begin="0" end="25000" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

<flow id="1-6-1-5" from="6-22" to="10-1" via="38-20" begin="0" end="25000" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

<!-- Out-Node 3: (Reference) probability = 0.068/3 = 0.0227 -->

<flow id="1-6-3-1" from="6-22" to="15-3" via="42-43_1" begin="0" end="25000" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

<flow id="1-6-3-2" from="6-22" to="15-3" via="42-43" begin="0" end="25000" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

<flow id="1-6-3-3" from="6-22" to="15-3" via="8-28" begin="0" end="25000" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

<flow id="1-6-3-4" from="6-22" to="15-3" via="18-27" begin="0" end="25000" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

<flow id="1-6-3-5" from="6-22" to="15-3" via="38-20" begin="0" end="25000" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>
```

<!-- Out-Node 5: (Reference) probability = 0.059/3 = 0.0197 -->

        <flow id="1-6-5-1" from="6-22" to="21-5" via="43-42_1" begin="0" end="25000" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="1-6-5-2" from="6-22" to="21-5" via="43-42" begin="0" end="25000" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="1-6-5-3" from="6-22" to="21-5" via="8-28" begin="0" end="25000" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="1-6-5-4" from="6-22" to="21-5" via="30-37" begin="0" end="25000" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="1-6-5-5" from="6-22" to="21-5" via="23-40" begin="0" end="25000" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

  <!-- Rush hours: 7:30-9:30 = 25001-31666 -->

    <!-- In-Node 2: Total probability = 0.117 -->

      <!-- Out-Node 1: (Reference) probability = 0.162/3 = 0.054 -->

        <flow id="2-2-1-1" from="2-15" to="10-1" via="42-43_1" begin="25001" end="31666" probability="0.0078" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="2-2-1-2" from="2-15" to="10-1" via="42-43" begin="25001" end="31666" probability="0.0078" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="2-2-1-3" from="2-15" to="10-1" via="28-8" begin="25001" end="31666" probability="0.0078" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="2-2-1-4" from="2-15" to="10-1" via="30-37" begin="25001" end="31666" probability="0.0078" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="2-2-1-5" from="2-15" to="10-1" via="23-40" begin="25001" end="31666" probability="0.0078" departSpeed="max" departPos="base" departLane="best"/>

      <!-- Out-Node 3: (Reference) probability = 0.073/3 = 0.0243 -->

        <flow id="2-2-3-1" from="2-15" to="15-3" via="42-43_1" begin="25001" end="31666" probability="0.0078" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="2-2-3-2" from="2-15" to="15-3" via="42-43" begin="25001" end="31666" probability="0.0078" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="2-2-3-3" from="2-15" to="15-3" via="8-28" begin="25001" end="31666" probability="0.0078" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="2-2-3-4" from="2-15" to="15-3" via="26-14" begin="25001" end="31666" probability="0.0078" departSpeed="max" departPos="base" departLane="best"/>

```xml
<flow id="2-2-3-5" from="2-15" to="15-3" via="23-40" begin="25001" end="31666" probability="0.0078" departSpeed="max" departPos="base" departLane="best"/>

<!-- Out-Node 5: (Reference) probability = 0.061/3 = 0.0203 -->

<flow id="2-2-5-1" from="2-15" to="21-5" via="42-43_1" begin="25001" end="31666" probability="0.0078" departSpeed="max" departPos="base" departLane="best"/>

<flow id="2-2-5-2" from="2-15" to="21-5" via="42-43" begin="25001" end="31666" probability="0.0078" departSpeed="max" departPos="base" departLane="best"/>

<flow id="2-2-5-3" from="2-15" to="21-5" via="28-8" begin="25001" end="31666" probability="0.0078" departSpeed="max" departPos="base" departLane="best"/>

<flow id="2-2-5-4" from="2-15" to="21-5" via="30-37" begin="25001" end="31666" probability="0.0078" departSpeed="max" departPos="base" departLane="best"/>

<flow id="2-2-5-5" from="2-15" to="21-5" via="38-20" begin="25001" end="31666" probability="0.0078" departSpeed="max" departPos="base" departLane="best"/>


<!-- In-Node 4: Total probability = 0.035 -->


<!-- Out-Node 1: (Reference) probability = 0.162/3 = 0.054 -->

<flow id="2-4-1-1" from="4-17" to="10-1" via="42-43_1" begin="25001" end="31666" probability="0.00233" departSpeed="max" departPos="base" departLane="best"/>

<flow id="2-4-1-2" from="4-17" to="10-1" via="42-43" begin="25001" end="31666" probability="0.00233" departSpeed="max" departPos="base" departLane="best"/>

<flow id="2-4-1-3" from="4-17" to="10-1" via="28-8" begin="25001" end="31666" probability="0.00233" departSpeed="max" departPos="base" departLane="best"/>

<flow id="2-4-1-4" from="4-17" to="10-1" via="26-14" begin="25001" end="31666" probability="0.00233" departSpeed="max" departPos="base" departLane="best"/>

<flow id="2-4-1-5" from="4-17" to="10-1" via="23-40" begin="25001" end="31666" probability="0.00233" departSpeed="max" departPos="base" departLane="best"/>

<!-- Out-Node 3: (Reference) probability = 0.073/3 = 0.0243 -->

<flow id="2-4-3-1" from="4-17" to="15-3" via="42-43_1" begin="25001" end="31666" probability="0.00233" departSpeed="max" departPos="base" departLane="best"/>

<flow id="2-4-3-2" from="4-17" to="15-3" via="42-43" begin="25001" end="31666" probability="0.00233" departSpeed="max" departPos="base" departLane="best"/>

<flow id="2-4-3-3" from="4-17" to="15-3" via="28-8" begin="25001" end="31666" probability="0.00233" departSpeed="max" departPos="base" departLane="best"/>

<flow id="2-4-3-4" from="4-17" to="15-3" via="29-28" begin="25001" end="31666" probability="0.00233" departSpeed="max" departPos="base" departLane="best"/>
```

```xml
<flow id="2-4-3-5" from="4-17" to="15-3" via="23-40" begin="25001" end="31666" probability="0.00233" departSpeed="max" departPos="base" departLane="best"/>

    <!-- Out-Node 5: (Reference) probability = 0.061/3 = 0.0203 -->

    <flow id="2-4-5-1" from="4-17" to="21-5" via="43-42_1" begin="25001" end="31666" probability="0.00233" departSpeed="max" departPos="base" departLane="best"/>

    <flow id="2-4-5-2" from="4-17" to="21-5" via="43-42" begin="25001" end="31666" probability="0.00233" departSpeed="max" departPos="base" departLane="best"/>

    <flow id="2-4-5-3" from="4-17" to="21-5" via="28-8" begin="25001" end="31666" probability="0.00233" departSpeed="max" departPos="base" departLane="best"/>

    <flow id="2-4-5-4" from="4-17" to="21-5" via="28-26" begin="25001" end="31666" probability="0.00233" departSpeed="max" departPos="base" departLane="best"/>

    <flow id="2-4-5-5" from="4-17" to="21-5" via="38-20" begin="25001" end="31666" probability="0.00233" departSpeed="max" departPos="base" departLane="best"/>


    <!-- In-Node 6: Total probability = 0.082 -->


    <!-- Out-Node 1: (Reference) probability = 0.162/3 = 0.054 -->

    <flow id="2-6-1-1" from="6-22" to="10-1" via="42-43_1" begin="25001" end="31666" probability="0.00547" departSpeed="max" departPos="base" departLane="best"/>

    <flow id="2-6-1-2" from="6-22" to="10-1" via="42-43" begin="25001" end="31666" probability="0.00547" departSpeed="max" departPos="base" departLane="best"/>

    <flow id="2-6-1-3" from="6-22" to="10-1" via="28-8" begin="25001" end="31666" probability="0.00547" departSpeed="max" departPos="base" departLane="best"/>

    <flow id="2-6-1-4" from="6-22" to="10-1" via="28-26" begin="25001" end="31666" probability="0.00547" departSpeed="max" departPos="base" departLane="best"/>

    <flow id="2-6-1-5" from="6-22" to="10-1" via="38-20" begin="25001" end="31666" probability="0.00547" departSpeed="max" departPos="base" departLane="best"/>

    <!-- Out-Node 3: (Reference) probability = 0.073/3 = 0.0243 -->

    <flow id="2-6-3-1" from="6-22" to="15-3" via="42-43_1" begin="25001" end="31666" probability="0.00547" departSpeed="max" departPos="base" departLane="best"/>

    <flow id="2-6-3-2" from="6-22" to="15-3" via="42-43" begin="25001" end="31666" probability="0.00547" departSpeed="max" departPos="base" departLane="best"/>

    <flow id="2-6-3-3" from="6-22" to="15-3" via="8-28" begin="25001" end="31666" probability="0.00547" departSpeed="max" departPos="base" departLane="best"/>

    <flow id="2-6-3-4" from="6-22" to="15-3" via="18-27" begin="25001" end="31666" probability="0.00547" departSpeed="max" departPos="base" departLane="best"/>
```

```xml
<flow id="2-6-3-5" from="6-22" to="15-3" via="38-20" begin="25001" end="31666" probability="0.00547" departSpeed="max" departPos="base" departLane="best"/>

    <!-- Out-Node 5: (Reference) probability = 0.061/3 = 0.0203 -->

    <flow id="2-6-5-1" from="6-22" to="21-5" via="43-42_1" begin="25001" end="31666" probability="0.00547" departSpeed="max" departPos="base" departLane="best"/>

    <flow id="2-6-5-2" from="6-22" to="21-5" via="43-42" begin="25001" end="31666" probability="0.00547" departSpeed="max" departPos="base" departLane="best"/>

    <flow id="2-6-5-3" from="6-22" to="21-5" via="8-28" begin="25001" end="31666" probability="0.00547" departSpeed="max" departPos="base" departLane="best"/>

    <flow id="2-6-5-4" from="6-22" to="21-5" via="30-37" begin="25001" end="31666" probability="0.00547" departSpeed="max" departPos="base" departLane="best"/>

    <flow id="2-6-5-5" from="6-22" to="21-5" via="23-40" begin="25001" end="31666" probability="0.00547" departSpeed="max" departPos="base" departLane="best"/>


  <!-- Non-rush hours: 9:30-17:30 = 31667-58333 -->


    <!-- In-Node 2: Total probability = 0.107 -->


    <!-- Out-Node 1: (Reference) probability = 0.147/3 = 0.049 -->

    <flow id="3-2-1-1" from="2-15" to="10-1" via="42-43_1" begin="31667" end="58333" probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

    <flow id="3-2-1-2" from="2-15" to="10-1" via="42-43" begin="31667" end="58333" probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

    <flow id="3-2-1-3" from="2-15" to="10-1" via="28-8" begin="31667" end="58333" probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

    <flow id="3-2-1-4" from="2-15" to="10-1" via="30-37" begin="31667" end="58333" probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

    <flow id="3-2-1-5" from="2-15" to="10-1" via="23-40" begin="31667" end="58333" probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

    <!-- Out-Node 3: (Reference) probability = 0.068/3 = 0.0227 -->

    <flow id="3-2-3-1" from="2-15" to="15-3" via="42-43_1" begin="31667" end="58333" probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

    <flow id="3-2-3-2" from="2-15" to="15-3" via="42-43" begin="31667" end="58333" probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

    <flow id="3-2-3-3" from="2-15" to="15-3" via="8-28" begin="31667" end="58333" probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>
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<flow id="3-2-3-4" from="2-15" to="15-3" via="26-14" begin="31667" end="58333" probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

<flow id="3-2-3-5" from="2-15" to="15-3" via="23-40" begin="31667" end="58333" probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

<!-- Out-Node 5: (Reference) probability = 0.059/3 = 0.0197 -->

<flow id="3-2-5-1" from="2-15" to="21-5" via="42-43_1" begin="31667" end="58333" probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

<flow id="3-2-5-2" from="2-15" to="21-5" via="42-43" begin="31667" end="58333" probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

<flow id="3-2-5-3" from="2-15" to="21-5" via="28-8" begin="31667" end="58333" probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

<flow id="3-2-5-4" from="2-15" to="21-5" via="30-37" begin="31667" end="58333" probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

<flow id="3-2-5-5" from="2-15" to="21-5" via="38-20" begin="31667" end="58333" probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

<!-- In-Node 4: Total probability = 0.032 -->

<!-- Out-Node 1: (Reference) probability = 0.147/3 = 0.049 -->

<flow id="3-4-1-1" from="4-17" to="10-1" via="42-43_1" begin="31667" end="58333" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<flow id="3-4-1-2" from="4-17" to="10-1" via="42-43" begin="31667" end="58333" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<flow id="3-4-1-3" from="4-17" to="10-1" via="28-8" begin="31667" end="58333" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<flow id="3-4-1-4" from="4-17" to="10-1" via="26-14" begin="31667" end="58333" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<flow id="3-4-1-5" from="4-17" to="10-1" via="23-40" begin="31667" end="58333" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<!-- Out-Node 3: (Reference) probability = 0.068/3 = 0.0227 -->

<flow id="3-4-3-1" from="4-17" to="15-3" via="42-43_1" begin="31667" end="58333" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<flow id="3-4-3-2" from="4-17" to="15-3" via="42-43" begin="31667" end="58333" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<flow id="3-4-3-3" from="4-17" to="15-3" via="28-8" begin="31667" end="58333" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

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<flow id="3-4-3-4" from="4-17" to="15-3" via="29-28" begin="31667" end="58333" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<flow id="3-4-3-5" from="4-17" to="15-3" via="23-40" begin="31667" end="58333" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<!-- Out-Node 5: (Reference) probability = 0.059/3 = 0.0197 -->

<flow id="3-4-5-1" from="4-17" to="21-5" via="43-42_1" begin="31667" end="58333" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<flow id="3-4-5-2" from="4-17" to="21-5" via="43-42" begin="31667" end="58333" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<flow id="3-4-5-3" from="4-17" to="21-5" via="28-8" begin="31667" end="58333" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<flow id="3-4-5-4" from="4-17" to="21-5" via="28-26" begin="31667" end="58333" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<flow id="3-4-5-5" from="4-17" to="21-5" via="38-20" begin="31667" end="58333" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>


<!-- In-Node 6: Total probability = 0.076 -->


<!-- Out-Node 1: (Reference) probability = 0.147/3 = 0.049 -->

<flow id="3-6-1-1" from="6-22" to="10-1" via="42-43_1" begin="31667" end="58333" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

<flow id="3-6-1-2" from="6-22" to="10-1" via="42-43" begin="31667" end="58333" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

<flow id="3-6-1-3" from="6-22" to="10-1" via="28-8" begin="31667" end="58333" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

<flow id="3-6-1-4" from="6-22" to="10-1" via="28-26" begin="31667" end="58333" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

<flow id="3-6-1-5" from="6-22" to="10-1" via="38-20" begin="31667" end="58333" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

<!-- Out-Node 3: (Reference) probability = 0.068/3 = 0.0227 -->

<flow id="3-6-3-1" from="6-22" to="15-3" via="42-43_1" begin="31667" end="58333" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

<flow id="3-6-3-2" from="6-22" to="15-3" via="42-43" begin="31667" end="58333" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

<flow id="3-6-3-3" from="6-22" to="15-3" via="8-28" begin="31667" end="58333" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>
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```
<flow id="3-6-3-4" from="6-22" to="15-3" via="18-27" begin="31667" end="58333" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

<flow id="3-6-3-5" from="6-22" to="15-3" via="38-20" begin="31667" end="58333" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

<!-- Out-Node 5: (Reference) probability = 0.059/3 = 0.0197 -->

<flow id="3-6-5-1" from="6-22" to="21-5" via="43-42_1" begin="31667" end="58333" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

<flow id="3-6-5-2" from="6-22" to="21-5" via="43-42" begin="31667" end="58333" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

<flow id="3-6-5-3" from="6-22" to="21-5" via="8-28" begin="31667" end="58333" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

<flow id="3-6-5-4" from="6-22" to="21-5" via="30-37" begin="31667" end="58333" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

<flow id="3-6-5-5" from="6-22" to="21-5" via="23-40" begin="31667" end="58333" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>


<!-- Rush hours: 17:30-19:30 = 58334-65000 -->


<!-- In-Node 2: Total probability = 0.117 -->


<!-- Out-Node 1: (Reference) probability = 0.162/3 = 0.054 -->

<flow id="4-2-1-1" from="2-15" to="10-1" via="42-43_1" begin="58334" end="65000" probability="0.0078" departSpeed="max" departPos="base" departLane="best"/>

<flow id="4-2-1-2" from="2-15" to="10-1" via="42-43" begin="58334" end="65000" probability="0.0078" departSpeed="max" departPos="base" departLane="best"/>

<flow id="4-2-1-3" from="2-15" to="10-1" via="28-8" begin="58334" end="65000" probability="0.0078" departSpeed="max" departPos="base" departLane="best"/>

<flow id="4-2-1-4" from="2-15" to="10-1" via="30-37" begin="58334" end="65000" probability="0.0078" departSpeed="max" departPos="base" departLane="best"/>

<flow id="4-2-1-5" from="2-15" to="10-1" via="23-40" begin="58334" end="65000" probability="0.0078" departSpeed="max" departPos="base" departLane="best"/>

<!-- Out-Node 3: (Reference) probability = 0.073/3 = 0.0243 -->

<flow id="4-2-3-1" from="2-15" to="15-3" via="42-43_1" begin="58334" end="65000" probability="0.0078" departSpeed="max" departPos="base" departLane="best"/>
```

```xml
        <flow id="4-2-3-2" from="2-15" to="15-3" via="42-43" begin="58334" end="65000"
probability="0.0078" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="4-2-3-3" from="2-15" to="15-3" via="8-28" begin="58334" end="65000"
probability="0.0078" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="4-2-3-4" from="2-15" to="15-3" via="26-14" begin="58334" end="65000"
probability="0.0078" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="4-2-3-5" from="2-15" to="15-3" via="23-40" begin="58334" end="65000"
probability="0.0078" departSpeed="max" departPos="base" departLane="best"/>

    <!-- Out-Node 5: (Reference) probability = 0.061/3 = 0.0203 -->

        <flow id="4-2-5-1" from="2-15" to="21-5" via="42-43_1" begin="58334"
end="65000" probability="0.0078" departSpeed="max" departPos="base"
departLane="best"/>

        <flow id="4-2-5-2" from="2-15" to="21-5" via="42-43" begin="58334" end="65000"
probability="0.0078" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="4-2-5-3" from="2-15" to="21-5" via="28-8" begin="58334" end="65000"
probability="0.0078" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="4-2-5-4" from="2-15" to="21-5" via="30-37" begin="58334" end="65000"
probability="0.0078" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="4-2-5-5" from="2-15" to="21-5" via="38-20" begin="58334" end="65000"
probability="0.0078" departSpeed="max" departPos="base" departLane="best"/>


    <!-- In-Node 4: Total probability = 0.035 -->


    <!-- Out-Node 1: (Reference) probability = 0.162/3 = 0.054 -->

        <flow id="4-4-1-1" from="4-17" to="10-1" via="42-43_1" begin="58334"
end="65000" probability="0.00233" departSpeed="max" departPos="base"
departLane="best"/>

        <flow id="4-4-1-2" from="4-17" to="10-1" via="42-43" begin="58334" end="65000"
probability="0.00233" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="4-4-1-3" from="4-17" to="10-1" via="28-8" begin="58334" end="65000"
probability="0.00233" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="4-4-1-4" from="4-17" to="10-1" via="26-14" begin="58334" end="65000"
probability="0.00233" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="4-4-1-5" from="4-17" to="10-1" via="23-40" begin="58334" end="65000"
probability="0.00233" departSpeed="max" departPos="base" departLane="best"/>

    <!-- Out-Node 3: (Reference) probability = 0.073/3 = 0.0243 -->

        <flow id="4-4-3-1" from="4-17" to="15-3" via="42-43_1" begin="58334"
end="65000" probability="0.00233" departSpeed="max" departPos="base"
departLane="best"/>
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```xml
        <flow id="4-4-3-2" from="4-17" to="15-3" via="42-43" begin="58334" end="65000" probability="0.00233" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="4-4-3-3" from="4-17" to="15-3" via="28-8" begin="58334" end="65000" probability="0.00233" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="4-4-3-4" from="4-17" to="15-3" via="29-28" begin="58334" end="65000" probability="0.00233" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="4-4-3-5" from="4-17" to="15-3" via="23-40" begin="58334" end="65000" probability="0.00233" departSpeed="max" departPos="base" departLane="best"/>

    <!-- Out-Node 5: (Reference) probability = 0.061/3 = 0.0203 -->

        <flow id="4-4-5-1" from="4-17" to="21-5" via="43-42_1" begin="58334" end="65000" probability="0.00233" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="4-4-5-2" from="4-17" to="21-5" via="43-42" begin="58334" end="65000" probability="0.00233" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="4-4-5-3" from="4-17" to="21-5" via="28-8" begin="58334" end="65000" probability="0.00233" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="4-4-5-4" from="4-17" to="21-5" via="28-26" begin="58334" end="65000" probability="0.00233" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="4-4-5-5" from="4-17" to="21-5" via="38-20" begin="58334" end="65000" probability="0.00233" departSpeed="max" departPos="base" departLane="best"/>


    <!-- In-Node 6: Total probability = 0.082 -->


    <!-- Out-Node 1: (Reference) probability = 0.162/3 = 0.054 -->

        <flow id="4-6-1-1" from="6-22" to="10-1" via="42-43_1" begin="58334" end="65000" probability="0.00547" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="4-6-1-2" from="6-22" to="10-1" via="42-43" begin="58334" end="65000" probability="0.00547" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="4-6-1-3" from="6-22" to="10-1" via="28-8" begin="58334" end="65000" probability="0.00547" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="4-6-1-4" from="6-22" to="10-1" via="28-26" begin="58334" end="65000" probability="0.00547" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="4-6-1-5" from="6-22" to="10-1" via="38-20" begin="58334" end="65000" probability="0.00547" departSpeed="max" departPos="base" departLane="best"/>

    <!-- Out-Node 3: (Reference) probability = 0.073/3 = 0.0243 -->

        <flow id="4-6-3-1" from="6-22" to="15-3" via="42-43_1" begin="58334" end="65000" probability="0.00547" departSpeed="max" departPos="base" departLane="best"/>
```

```xml
<flow id="4-6-3-2" from="6-22" to="15-3" via="42-43" begin="58334" end="65000" probability="0.00547" departSpeed="max" departPos="base" departLane="best"/>

<flow id="4-6-3-3" from="6-22" to="15-3" via="8-28" begin="58334" end="65000" probability="0.00547" departSpeed="max" departPos="base" departLane="best"/>

<flow id="4-6-3-4" from="6-22" to="15-3" via="18-27" begin="58334" end="65000" probability="0.00547" departSpeed="max" departPos="base" departLane="best"/>

<flow id="4-6-3-5" from="6-22" to="15-3" via="38-20" begin="58334" end="65000" probability="0.00547" departSpeed="max" departPos="base" departLane="best"/>

<!-- Out-Node 5: (Reference) probability = 0.061/3 = 0.0203 -->

<flow id="4-6-5-1" from="6-22" to="21-5" via="43-42_1" begin="58334" end="65000" probability="0.00547" departSpeed="max" departPos="base" departLane="best"/>

<flow id="4-6-5-2" from="6-22" to="21-5" via="43-42" begin="58334" end="65000" probability="0.00547" departSpeed="max" departPos="base" departLane="best"/>

<flow id="4-6-5-3" from="6-22" to="21-5" via="8-28" begin="58334" end="65000" probability="0.00547" departSpeed="max" departPos="base" departLane="best"/>

<flow id="4-6-5-4" from="6-22" to="21-5" via="30-37" begin="58334" end="65000" probability="0.00547" departSpeed="max" departPos="base" departLane="best"/>

<flow id="4-6-5-5" from="6-22" to="21-5" via="23-40" begin="58334" end="65000" probability="0.00547" departSpeed="max" departPos="base" departLane="best"/>


<!-- Non-rush hours: 19:30-24:00 = 65001-80000  -->


<!-- In-Node 2: Total probability = 0.107 -->


<!-- Out-Node 1: (Reference) probability = 0.147/3 = 0.049 -->

<flow id="5-2-1-1" from="2-15" to="10-1" via="42-43_1" begin="65001" end="80000" probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

<flow id="5-2-1-2" from="2-15" to="10-1" via="42-43" begin="65001" end="80000" probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

<flow id="5-2-1-3" from="2-15" to="10-1" via="28-8" begin="65001" end="80000" probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

<flow id="5-2-1-4" from="2-15" to="10-1" via="30-37" begin="65001" end="80000" probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

<flow id="5-2-1-5" from="2-15" to="10-1" via="23-40" begin="65001" end="80000" probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>
```

```xml
<!-- Out-Node 3: (Reference) probability = 0.068/3 = 0.0227 -->

<flow id="5-2-3-1" from="2-15" to="15-3" via="42-43_1" begin="65001"
end="80000" probability="0.00714" departSpeed="max" departPos="base"
departLane="best"/>

<flow id="5-2-3-2" from="2-15" to="15-3" via="42-43" begin="65001" end="80000"
probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

<flow id="5-2-3-3" from="2-15" to="15-3" via="8-28" begin="65001" end="80000"
probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

<flow id="5-2-3-4" from="2-15" to="15-3" via="26-14" begin="65001" end="80000"
probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

<flow id="5-2-3-5" from="2-15" to="15-3" via="23-40" begin="65001" end="80000"
probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

<!-- Out-Node 5: (Reference) probability = 0.059/3 = 0.0197 -->

<flow id="5-2-5-1" from="2-15" to="21-5" via="42-43_1" begin="65001"
end="80000" probability="0.00714" departSpeed="max" departPos="base"
departLane="best"/>

<flow id="5-2-5-2" from="2-15" to="21-5" via="42-43" begin="65001" end="80000"
probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

<flow id="5-2-5-3" from="2-15" to="21-5" via="28-8" begin="65001" end="80000"
probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

<flow id="5-2-5-4" from="2-15" to="21-5" via="30-37" begin="65001" end="80000"
probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>

<flow id="5-2-5-5" from="2-15" to="21-5" via="38-20" begin="65001" end="80000"
probability="0.00714" departSpeed="max" departPos="base" departLane="best"/>


<!-- In-Node 4: Total probability = 0.032 -->


<!-- Out-Node 1: (Reference) probability = 0.147/3 = 0.049 -->

<flow id="5-4-1-1" from="4-17" to="10-1" via="42-43_1" begin="65001"
end="80000" probability="0.00214" departSpeed="max" departPos="base"
departLane="best"/>

<flow id="5-4-1-2" from="4-17" to="10-1" via="42-43" begin="65001" end="80000"
probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<flow id="5-4-1-3" from="4-17" to="10-1" via="28-8" begin="65001" end="80000"
probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<flow id="5-4-1-4" from="4-17" to="10-1" via="26-14" begin="65001" end="80000"
probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<flow id="5-4-1-5" from="4-17" to="10-1" via="23-40" begin="65001" end="80000"
probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>
```

<!-- Out-Node 3: (Reference) probability = 0.068/3 = 0.0227 -->

<flow id="5-4-3-1" from="4-17" to="15-3" via="42-43_1" begin="65001" end="80000" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<flow id="5-4-3-2" from="4-17" to="15-3" via="42-43" begin="65001" end="80000" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<flow id="5-4-3-3" from="4-17" to="15-3" via="28-8" begin="65001" end="80000" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<flow id="5-4-3-4" from="4-17" to="15-3" via="29-28" begin="65001" end="80000" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<flow id="5-4-3-5" from="4-17" to="15-3" via="23-40" begin="65001" end="80000" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<!-- Out-Node 5: (Reference) probability = 0.059/3 = 0.0197 -->

<flow id="5-4-5-1" from="4-17" to="21-5" via="43-42_1" begin="65001" end="80000" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<flow id="5-4-5-2" from="4-17" to="21-5" via="43-42" begin="65001" end="80000" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<flow id="5-4-5-3" from="4-17" to="21-5" via="28-8" begin="65001" end="80000" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<flow id="5-4-5-4" from="4-17" to="21-5" via="28-26" begin="65001" end="80000" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<flow id="5-4-5-5" from="4-17" to="21-5" via="38-20" begin="65001" end="80000" probability="0.00214" departSpeed="max" departPos="base" departLane="best"/>

<!-- In-Node 6: Total probability = 0.076 -->

<!-- Out-Node 1: (Reference) probability = 0.147/3 = 0.049 -->

<flow id="5-6-1-1" from="6-22" to="10-1" via="42-43_1" begin="65001" end="80000" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

<flow id="5-6-1-2" from="6-22" to="10-1" via="42-43" begin="65001" end="80000" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

<flow id="5-6-1-3" from="6-22" to="10-1" via="28-8" begin="65001" end="80000" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

<flow id="5-6-1-4" from="6-22" to="10-1" via="28-26" begin="65001" end="80000" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

<flow id="5-6-1-5" from="6-22" to="10-1" via="38-20" begin="65001" end="80000" probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

```
<!-- Out-Node 3: (Reference) probability = 0.068/3 = 0.0227 -->

        <flow id="5-6-3-1" from="6-22" to="15-3" via="42-43_1" begin="65001"
end="80000" probability="0.00507"  departSpeed="max" departPos="base"
departLane="best"/>

        <flow id="5-6-3-2" from="6-22" to="15-3" via="42-43" begin="65001" end="80000"
probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="5-6-3-3" from="6-22" to="15-3" via="8-28" begin="65001" end="80000"
probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="5-6-3-4" from="6-22" to="15-3" via="18-27" begin="65001" end="80000"
probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="5-6-3-5" from="6-22" to="15-3" via="38-20" begin="65001" end="80000"
probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

    <!-- Out-Node 5: (Reference) probability = 0.059/3 = 0.0197 -->

        <flow id="5-6-5-1" from="6-22" to="21-5" via="43-42_1" begin="65001"
end="80000" probability="0.00507" departSpeed="max" departPos="base"
departLane="best"/>

        <flow id="5-6-5-2" from="6-22" to="21-5" via="43-42" begin="65001" end="80000"
probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="5-6-5-3" from="6-22" to="21-5" via="8-28" begin="65001" end="80000"
probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="5-6-5-4" from="6-22" to="21-5" via="30-37" begin="65001" end="80000"
probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>

        <flow id="5-6-5-5" from="6-22" to="21-5" via="23-40" begin="65001" end="80000"
probability="0.00507" departSpeed="max" departPos="base" departLane="best"/>


</routes>
```

A3 - on-site_investigation.ods

Traffic Light			
Green phase	15s		
Red phase	85s		
Rush hours			
weekdays	7:30-9:30, 17:30-19:30		
Traffic Inflow			
Raw Data			
		Non-rush hours (vehicles/10min)	Rush hours (vehicles/10min)
Top edge	1st attempt	64	68
	2nd attempt	67	71
	3rd attempt	62	71
Middle edge	1st attempt	19	21
	2nd attempt	20	22
	3rd attempt	18	20
Bottom edge	1st attempt	43	51
	2nd attempt	49	47
	3rd attempt	45	50
	Estimated value		
		Non-rush hours	Rush hours
	Top edge	64.3333333333333 vehicles/10min	70 vehicles/10min
		Probability for emitting a	Probability for emitting a

		vehicle each second = 0.107	vehicle each second = 0.117
	Middle edge	19 vehicles/10min	21 vehicles/10min
		Probability for emitting a vehicle each second = 0.032	Probability for emitting a vehicle each second = 0.035
	Bottom edge	45.6666666666667 vehicles/10min	49.3333333333333 vehicles/10min
		Probability for emitting a vehicle each second = 0.076	Probability for emitting a vehicle each second = 0.082
Traffic Outflow			
Raw Data			
		Non-rush hours (vehicles/10min)	Rush hours (vehicles/10min)
Top edge	1st attempt	84	98
	2nd attempt	96	93
	3rd attempt	84	100
Middle edge	1st attempt	39	44
	2nd attempt	43	42
	3rd attempt	41	46
Bottom edge	1st attempt	36	37
	2nd attempt	36	38
	3rd attempt	35	34
	Estimated value		
		Non-rush hours	Rush hours
	Top edge	88 vehicles/10min	97 vehicles/10min
		Probability for receiving a	Probability for receiving a

		vehicle each second = 0.147	vehicle each second = 0.162
	Middle edge	41 vehicles/10min	44 vehicles/10min
		Probability for receiving a vehicle each second = 0.068	Probability for receiving a vehicle each second = 0.073
	Bottom edge	35.6666666666667 vehicles/10min	36.3333333333333 vehicles/10min
		Probability for receiving a vehicle each second = 0.059	Probability for receiving a vehicle each second = 0.061

A4 – DQN.py

```python
import os
import sys

if "SUMO_HOME" in os.environ:
    tools = os.path.join(os.environ["SUMO_HOME"], "tools")
    sys.path.append(tools)
else:
    sys.exit("Please declare the environment variable 'SUMO_HOME'")
import numpy as np
import pandas as pd
import ray
import traci
from ray import tune
from ray.rllib.algorithms.dqn.dqn import DQNConfig
from ray.rllib.env.wrappers.pettingzoo_env import ParallelPettingZooEnv
from ray.tune.registry import register_env

from supersuit.multiagent_wrappers import padding_wrappers

import sumo_rl

if __name__ == "__main__":
    ray.init()

    env_name = "experiment "

    env = sumo_rl.parallel_env(
        net_file=".../experiment.net.xml",
        route_file=".../experiment.rou.xml",
        out_csv_name=".../DQN_result",
        use_gui=False,
```

```
        num_seconds=80000,
    )


    env = padding_wrappers.pad_observations_v0(env)

    env = padding_wrappers.pad_action_space_v0(env)

    env = ParallelPettingZooEnv(env)


    register_env(env_name, lambda _: env)


    config = (
        DQNConfig()
        .environment(env=env_name, disable_env_checking=True)
        .rollouts(num_rollout_workers=4, rollout_fragment_length=128)
        .training(
            train_batch_size=512,
            lr=2e-5,
            gamma=0.95,
            grad_clip=None,
        )
        .debugging(log_level="ERROR")
        .framework(framework="torch")
        .resources(num_gpus=int(os.environ.get("RLLIB_NUM_GPUS", "0")))
    )


    tune.run(
        "DQN",
        name="DQN",
        stop={"timesteps_total": 1500000},
        checkpoint_freq=10,
        local_dir="~/ray_results/" + env_name,
        config=config.to_dict(),
    )
```

A5 – A3C.py

```python
import os
import sys

if "SUMO_HOME" in os.environ:
    tools = os.path.join(os.environ["SUMO_HOME"], "tools")
    sys.path.append(tools)
else:
    sys.exit("Please declare the environment variable 'SUMO_HOME'")
import numpy as np
import pandas as pd
import ray
import traci
from ray import tune
from ray.rllib.algorithms.a3c.a3c import A3CConfig
from ray.rllib.env.wrappers.pettingzoo_env import ParallelPettingZooEnv
from ray.tune.registry import register_env

from supersuit.multiagent_wrappers import padding_wrappers

import sumo_rl

if __name__ == "__main__":
    ray.init()

    env_name = "experiment"

    env = sumo_rl.parallel_env(
        net_file=".../experiment.net.xml",
        route_file=".../experiment.rou.xml",
        out_csv_name=".../A3C_result",
        use_gui=False,
```

```python
        num_seconds=80000,
    )

    env = padding_wrappers.pad_observations_v0(env)
    env = padding_wrappers.pad_action_space_v0(env)
    env = ParallelPettingZooEnv(env)

    register_env(env_name, lambda _: env)

    config = (
        A3CConfig()
        .environment(env=env_name, disable_env_checking=True)
        .rollouts(num_rollout_workers=4, rollout_fragment_length=128)
        .training(
            train_batch_size=512,
            lr=2e-5,
            gamma=0.95,
            grad_clip=None,
        )
        .debugging(log_level="ERROR")
        .framework(framework="torch")
        .resources(num_gpus=int(os.environ.get("RLLIB_NUM_GPUS", "0")))
    )

    tune.run(
        "A3C",
        name="A3C",
        stop={"timesteps_total": 1500000},
        checkpoint_freq=10,
        local_dir="~/ray_results/" + env_name,
        config=config.to_dict(),
    )
```

A6 – dependencies.txt

Package	Version
absl-py	1.4.0
aiosignal	1.3.1
ale-py	0.8.1
apturl	0.5.2
astunparse	1.6.3
attrs	23.1.0
AutoROM	0.6.1
AutoROM.accept-rom-license	0.6.1
bcrypt	4.0.1
blinker	1.4
Brlapi	0.8.3
cachetools	5.3.1
certifi	2023.5.7
cffi	1.15.1
chardet	5.1.0
charset-normalizer	3.1.0
click	8.1.3
cloudpickle	2.2.1
cmake	3.26.4
colorama	0.4.6
command-not-found	0.3
contourpy	1.1.0
cryptography	41.0.1
cupshelpers	1.0
cycler	0.11.0
data	0.4
dbus-python	1.2.18
decorator	5.1.1
defer	1.0.6

distlib	0.3.6
distro	1.8.0
distro-info	1.0
dm-tree	0.1.8
duplicity	0.8.21
Farama-Notifications	0.0.4
fasteners	0.18
filelock	3.12.2
fire	0.5.0
flatbuffers	23.5.26
fonttools	4.40.0
frozenlist	1.3.3
fsspec	2023.6.0
funcsigs	1.0.2
future	0.18.3
gast	0.5.4
google-auth	2.21.0
google-auth-oauthlib	1.0.0
google-pasta	0.2.0
grpcio	1.51.3
gym	0.26.2
gym-notices	0.0.8
gymnasium	0.28.1
gymnasium-notices	0.0.1
h5py	3.9.0
httplib2	0.22.0
idna	3.4
imageio	2.31.1
importlib-metadata	6.7.0
importlib-resources	5.12.0
install	1.3.5
jaraco.classes	3.2.3

jax	0.4.13
jax-jumpy	1.0.0
jeepney	0.8.0
Jinja2	3.1.2
jsonschema	4.17.3
keras	2.13.1
keyring	24.2.0
kiwisolver	1.4.4
language-selector	0.1
latex	0.7.0
launchpadlib	1.11.0
lazr.restfulclient	0.14.5
lazr.uri	1.0.6
lazy_loader	0.3
libclang	16.0.0
linear-rl	0.1
lit	16.0.6
lockfile	0.12.2
louis	3.20.0
lz4	4.3.2
macaroonbakery	1.3.1
Mako	1.2.4
Markdown	3.4.3
markdown-it-py	3.0.0
MarkupSafe	2.1.3
matplotlib	3.7.1
mdurl	0.1.2
ml-dtypes	0.2.0
monotonic	1.6
more-itertools	9.1.0
mpmath	1.3.0
msgpack	1.0.5

netifaces	0.11.0
networkx	3.1
numpy	1.25.0
nvidia-cublas-cu11	11.10.3.66
nvidia-cuda-cupti-cu11	11.7.101
nvidia-cuda-nvrtc-cu11	11.7.99
nvidia-cuda-runtime-cu11	11.7.99
nvidia-cudnn-cu11	8.5.0.96
nvidia-cufft-cu11	10.9.0.58
nvidia-curand-cu11	10.2.10.91
nvidia-cusolver-cu11	11.4.0.1
nvidia-cusparse-cu11	11.7.4.91
nvidia-nccl-cu11	2.14.3
nvidia-nvtx-cu11	11.7.91
oauthlib	3.2.2
olefile	0.46
opencv-python	4.8.0.74
opt-einsum	3.3.0
packaging	23.1
pandas	2.0.3
paramiko	3.2.0
pettingzoo	1.23.1
pexpect	4.8.0
Pillow	10.0.0
pip	23.2.1
pip-review	1.3.0
platformdirs	3.8.0
protobuf	4.23.3
psutil	5.9.5
ptyprocess	0.7.0
pyarrow	12.0.1
pyasn1	0.5.0

pyasn1-modules	0.3.0
pycairo	1.20.1
pycparser	2.21
pycups	2.0.1
pygame	2.5.0
Pygments	2.15.1
PyGObject	3.42.1
PyJWT	2.7.0
pymacaroons	0.13.0
PyNaCl	1.5.0
pyparsing	3.1.0
pyproj	3.6.0
pyRFC3339	1.1
pyrsistent	0.19.3
python-apt	2.4.0+ubuntu2
python-dateutil	2.8.2
python-debian	0.1.49
pytz	2023.3
PyVirtualDisplay	3.0
PyWavelets	1.4.1
pyxdg	0.28
PyYAML	6.0
ray	2.5.1
reportlab	4.0.4
requests	2.31.0
requests-oauthlib	1.3.1
rich	13.4.2
rsa	4.9
Rtree	1.0.1
scikit-image	0.21.0
scipy	1.11.1
seaborn	0.12.2

SecretStorage	3.3.3
setuptools	68.0.0
Shimmy	1.1.0
shutilwhich	1.1.0
six	1.16.0
stable-baselines3	2.0.0
sumo-rl	1.4.3
sumolib	1.18.0
SuperSuit	3.8.0
svgwrite	1.4.3
sympy	1.12
systemd-python	234
tabulate	0.9.0
tempdir	0.7.1
tensorboard	2.13.0
tensorboard-data-server	0.7.1
tensorboardX	2.6.1
tensorflow	2.12.0
tensorflow-estimator	2.13.0
tensorflow-io-gcs-filesystem	0.32.0
tensorflow-probability	0.20.1
termcolor	2.3.0
tifffile	2023.4.12
tinyscaler	1.2.6
torch	2.0.1
tqdm	4.65.0
traci	1.18.0
triton	2.0.0
typer	0.9.0
typing_extensions	4.7.0
tzdata	2023.3
ubuntu-advantage-tools	8001

ubuntu-drivers-common	0.0.0
ufw	0.36.1
unattended-upgrades	0.1
urllib3	2.0.3
usb-creator	0.3.7
virtualenv	20.21.0
wadllib	1.3.6
Werkzeug	2.3.6
wheel	0.40.0
wrapt	1.15.0
xdg	5
xkit	0.0.0
zipp	3.15.0

Appendix B – Data and Analysis

B1 – combine.py

```python
# Import necessary packages
import pandas as pd
import os
import re


# Navigate to the folder where your CSV files are
os.chdir(r"<file_location>")


# Create an empty dataframe
df = pd.DataFrame([])


# Read all CSV files and append them to df
csv_files = []
for root, dirs, files in os.walk("."):
    for name in files:
        if name.endswith(".csv"):
            csv_files.append(name)


# Sort the CSV file names based on the "ep" number
csv_files.sort(key=lambda x: int(re.search(r'ep(\d+)', x).group(1)) if re.search(r'ep(\d+)', x) else 0)
print(csv_files)


for file_name in csv_files:
    file_path = os.path.join(root, file_name)
    df_temp = pd.read_csv(file_path, on_bad_lines='skip')
    df = pd.concat([df, df_temp])


# Save df to a CSV file
df.to_csv('Combined.csv')
```