

# Failure-scenario Maker for Rule-Based Agent using Multi-agent Adversarial Reinforcement Learning and its Application to Autonomous Driving

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## Introduction

*How should we test an autonomous driving algorithm?*

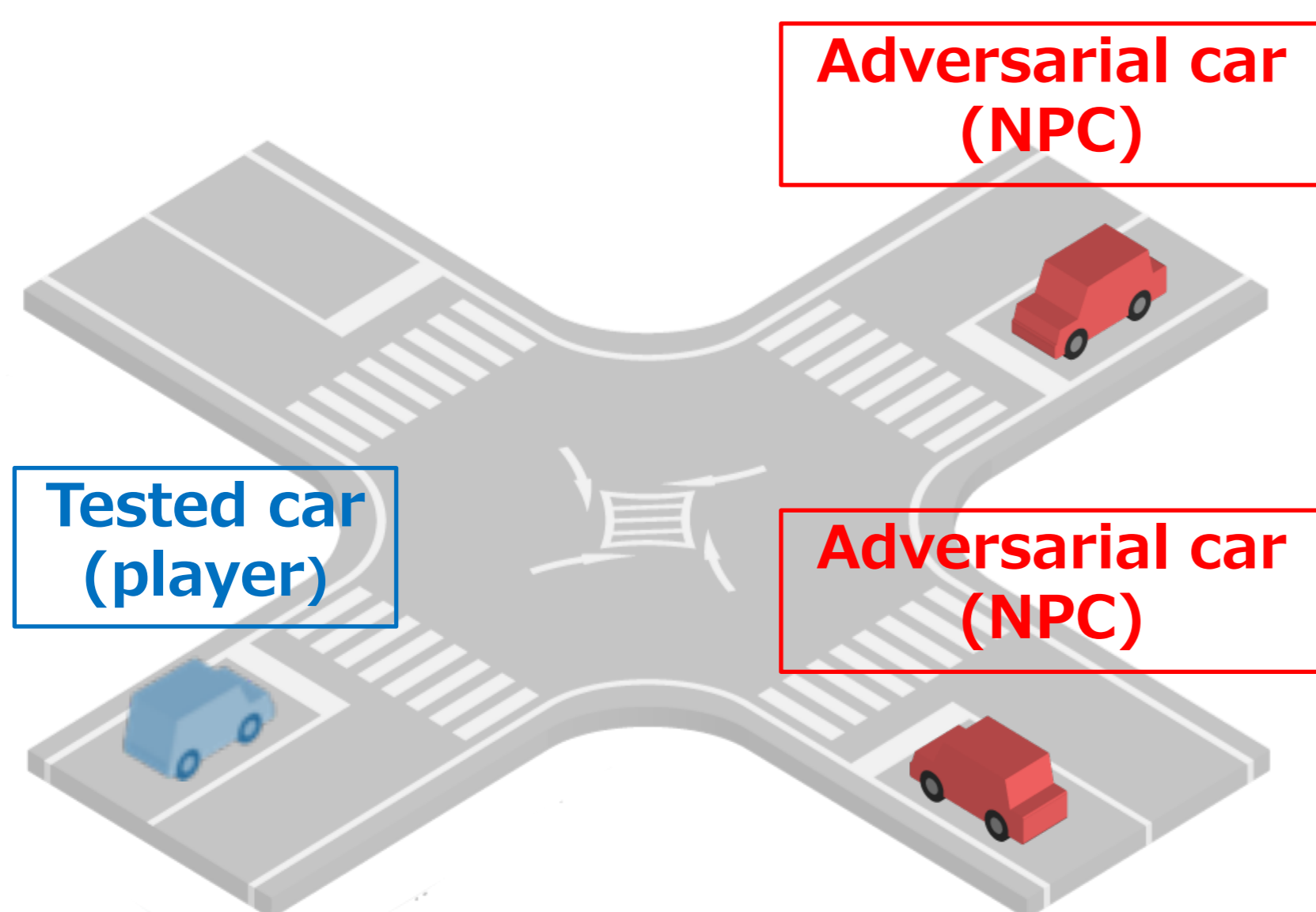


Photo-illustration: iStockphoto

**Simplest way is to test (almost) all the possible cases**, but such an approach is intractable due to the enormous number of test cases.

**Alternative way is to find the failure scenarios of the algorithm.**

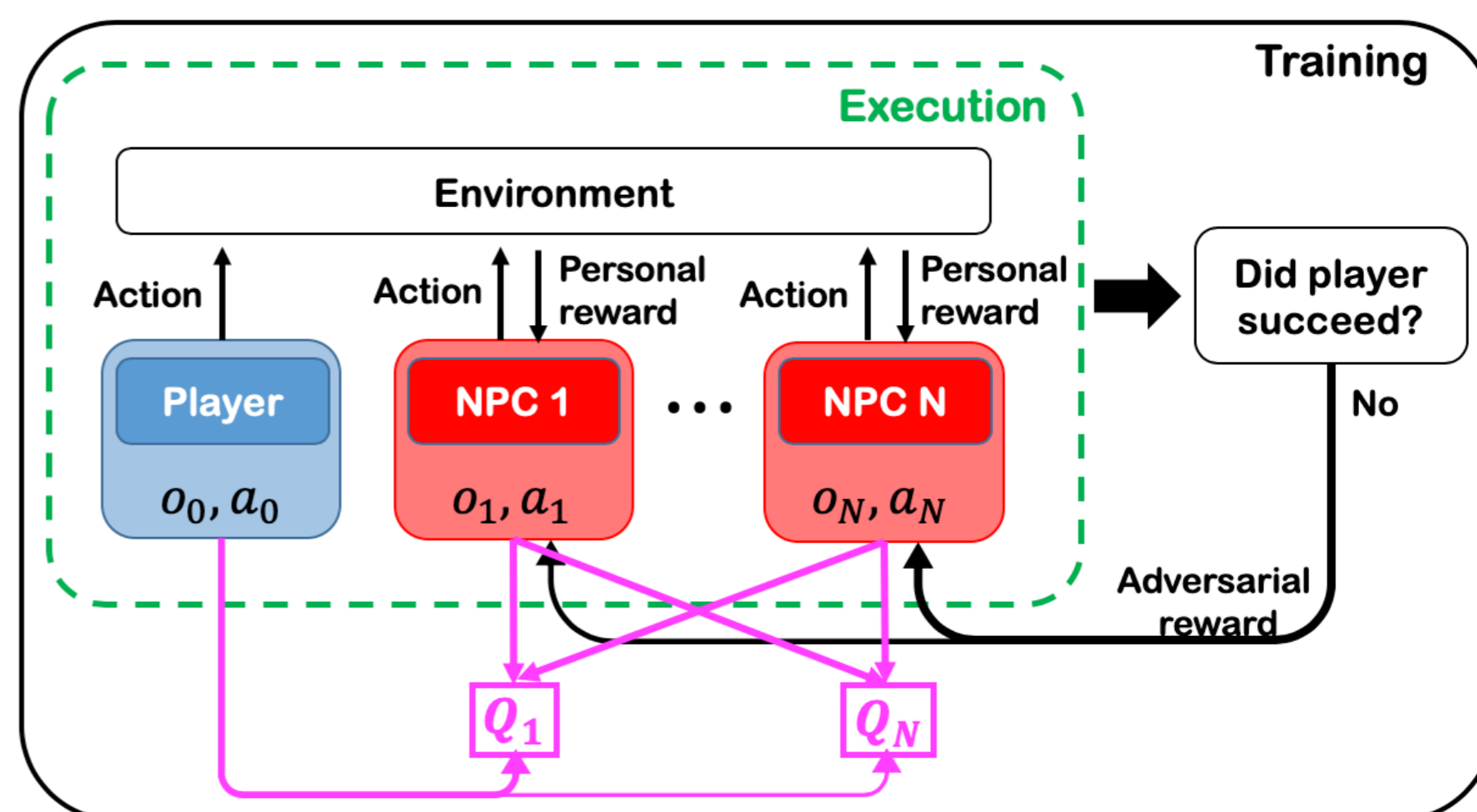
## Key Concept



We find the failure scenarios of a **tested car (player)** by training **adversarial cars (non-player characters, NPCs)** using multi-agent reinforcement learning (MARL).

## Proposed Method

We train adversarial NPCs as follows. The training structure is based on the MADDPG algorithm (Lowe et al., 2017).



Since pure adversarial RL crafts strange failure scenarios (e.g., NPCs intentionally collide with the player), we train the NPCs with two types of reward function.

**Personal reward:** incentivizes the NPCs to optimize their own goal.

**Adversarial reward:** encourages the NPCs to make the player fail.

## Experiments

We tested our proposed method using two types of environment.

1. Multi-agent particle environment (Mordatch and Abbeel, 2017)
2. Microsoft AirSim (Shah et al., 2017)



Example of failure of player (blue) induced by adversarial NPC (red).