

Arduinobot

Introduction

Setup

Digital
Twin

ROS 2

Control

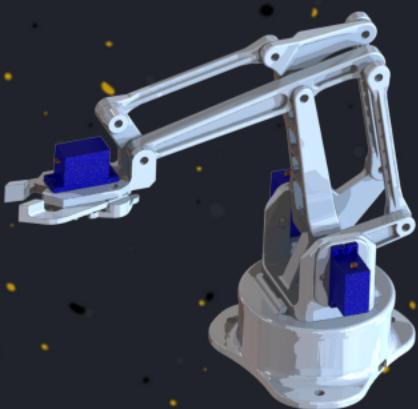
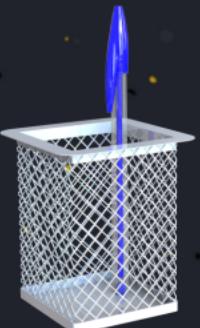
Kinematics

Application

Alexa

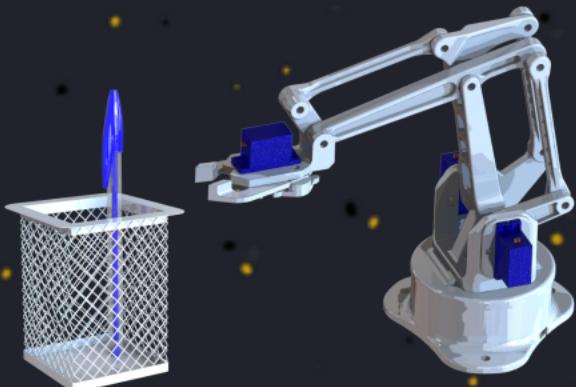
Conclusions

Build



“

“Robotics is concerned with the study of those machines that can replace human beings in the execution of a task, as regards both physical activity and decision making”



Robotics,
Sciavicco
Siciliano Villani



Electronics

Mechanics

Sensors

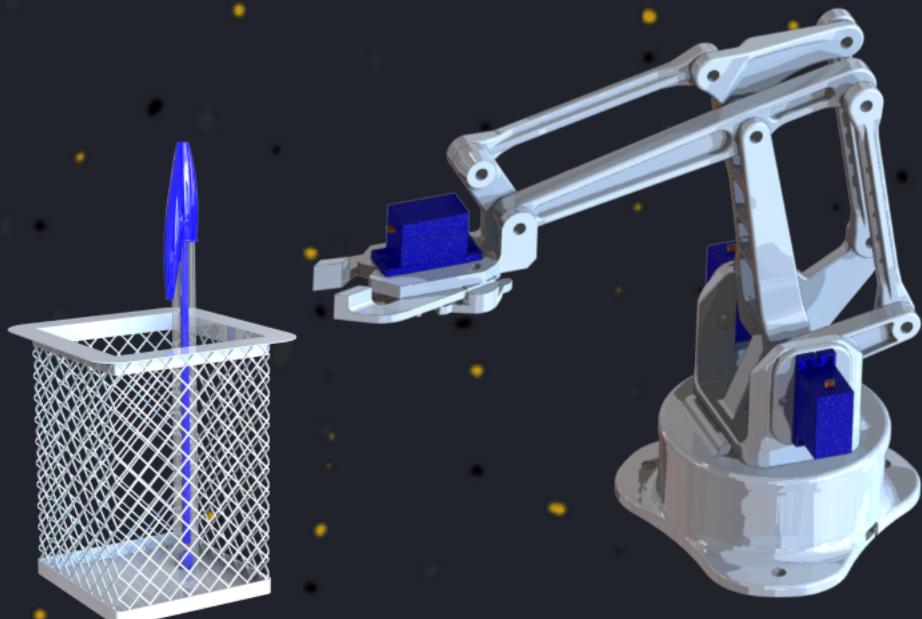
Network

Artificial
Intelligence

Software

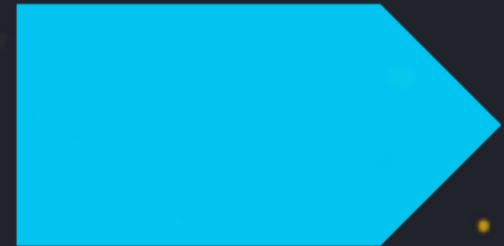
Control

Computer
Vision





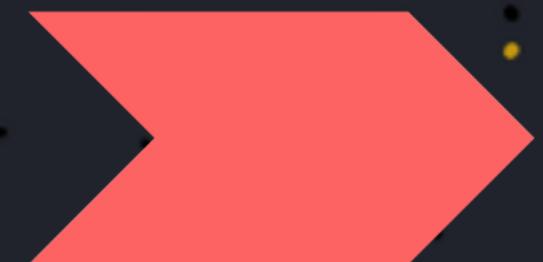
Object Grasping



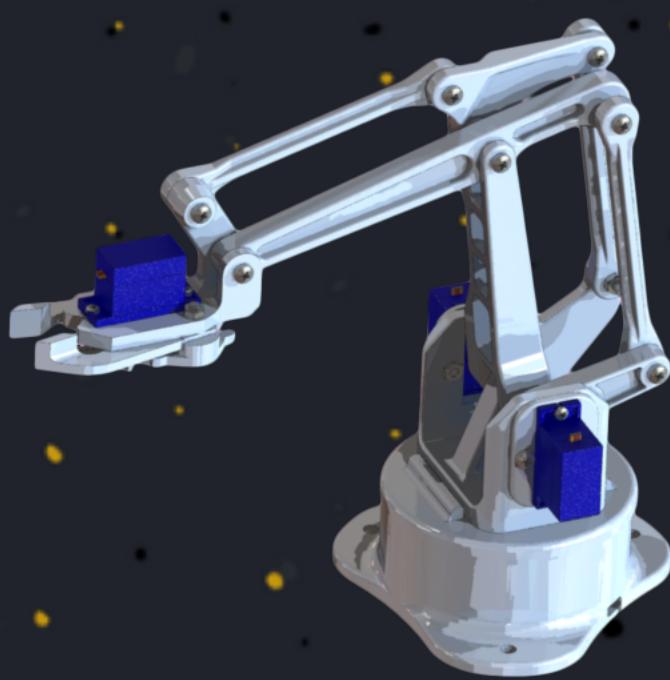
Voice Recognition

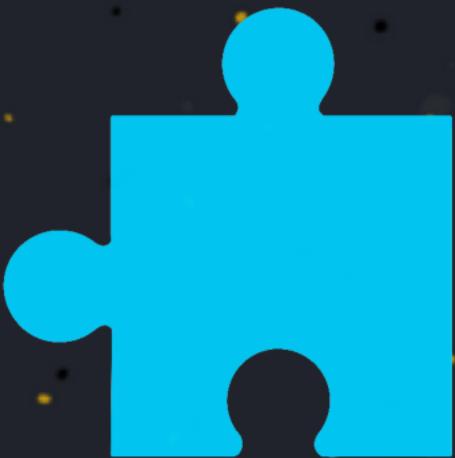


Robot Control



Trajectory Planning



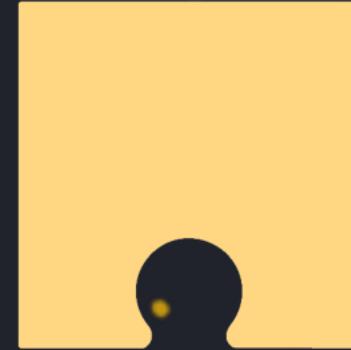


Voice Recognition



Object Grasping

ROS 2



Robot Control



Trajectory Planning

ROS 2



... 2007 2009 2013 2018 2021



Robotics Research centers and companies develop their own frameworks for robotics applications



Foundation of Willow Garage, a research center for robotics



First Distribution of ROS is released with the aim of avoiding reinventing the wheel



End of Willow Garage and ROS is maintained and developed by Open Source Robotics Foundation OSRF



ROS2 is released in order to overcome the limitation of ROS



NASA Announces VIPER Project a lunar rover running ROS2

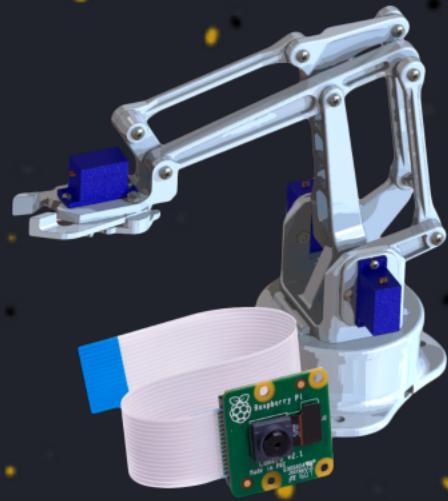


ROS 2



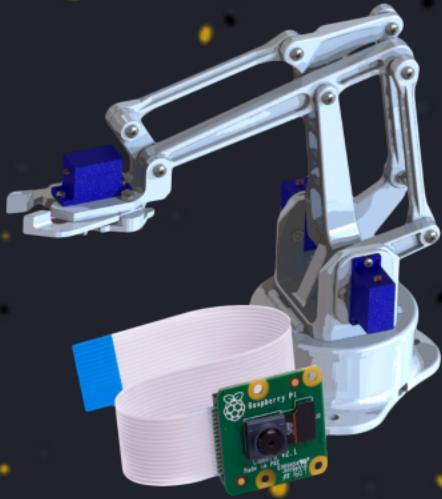
What is ROS 2?

What is ROS 2?



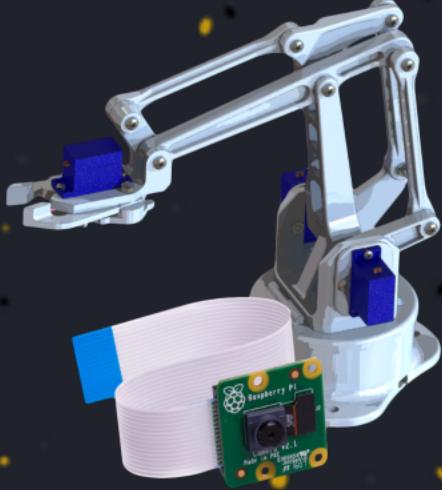
hand tracking
and following

What is ROS 2?



hand tracking
and following

What is ROS 2?

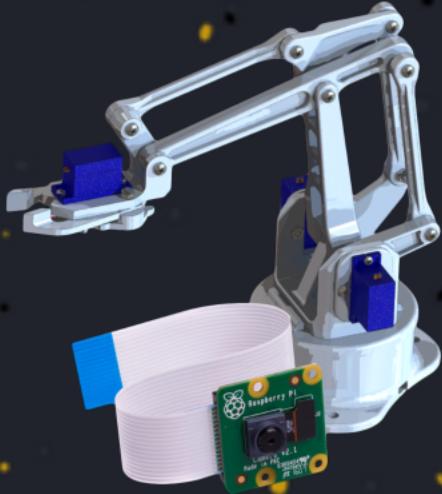


hand tracking
and following



hand tracking
and following
v2

What is ROS 2?



hand tracking
and following



hand tracking
and following
v2



hand tracking
and following
v2_final

What is ROS 2?

What is ROS 2?

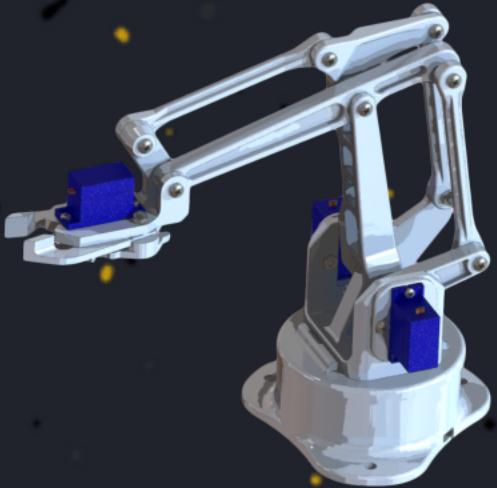


What is ROS 2?



hand tracking
and following

What is ROS 2?



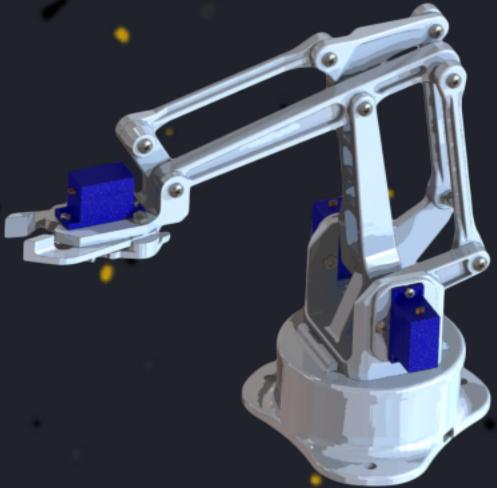
ROS 2



hand tracking
and following



What is ROS 2?



ROS 2



hand tracking
and following



What is ROS 2?



ROS 2



hand tracking
and following



ROS 2



Why ROS 2?

Unreliable
Networks

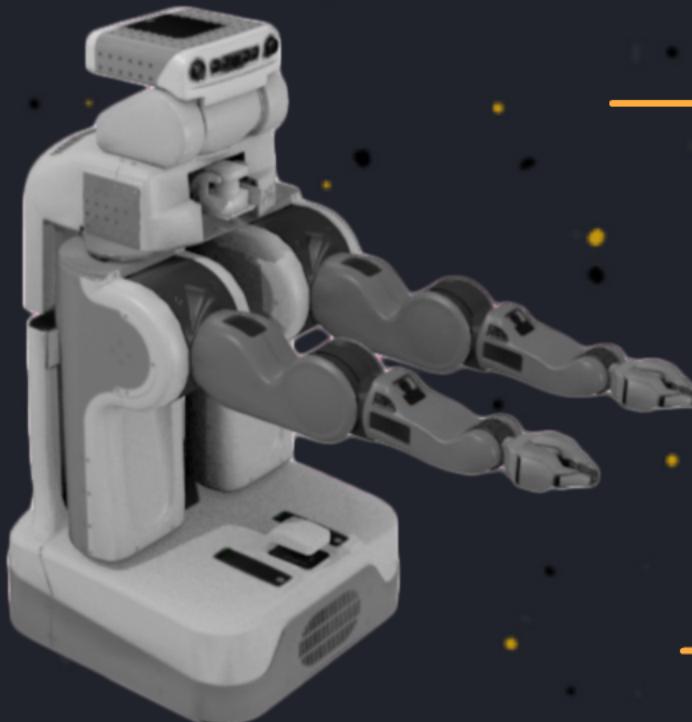
Fleet of
Robots

Embedded
Platforms

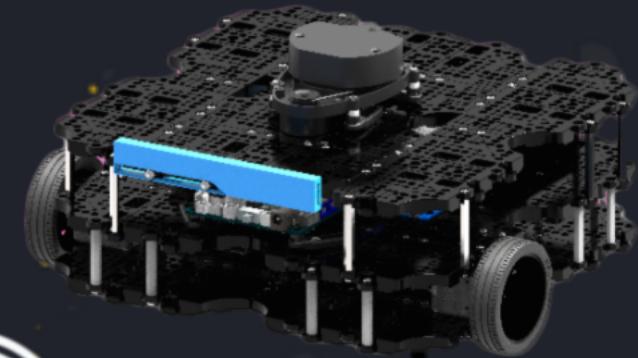
ROS

Secure
Communication

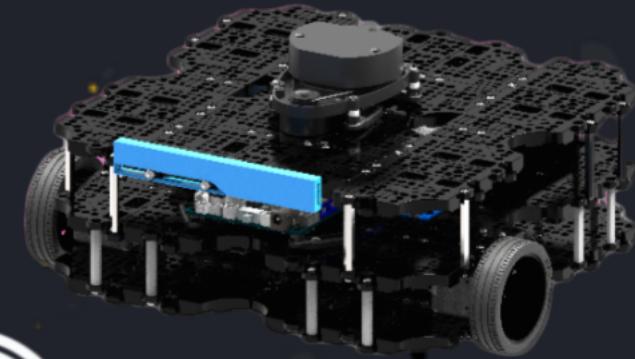
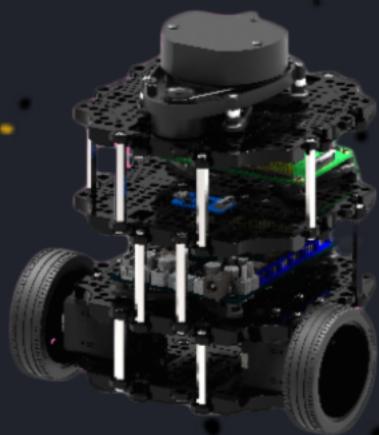
Realtime
Systems



Unreliable Networks



Unreliable Networks



Why ROS 2?

Unreliable
Networks

Fleet of
Robots

Embedded
Platforms

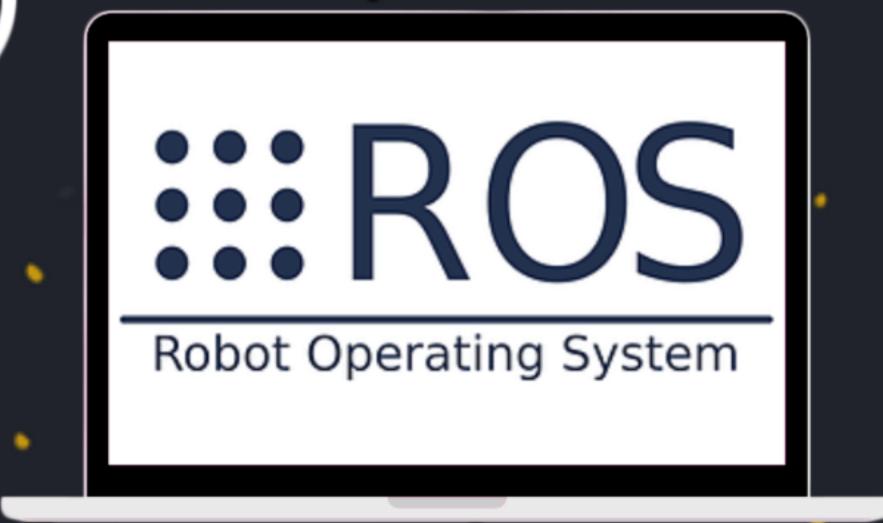
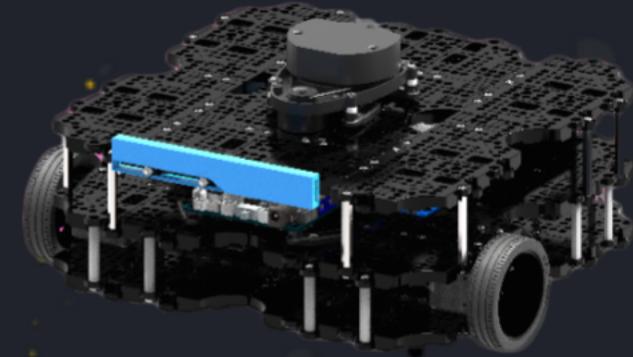
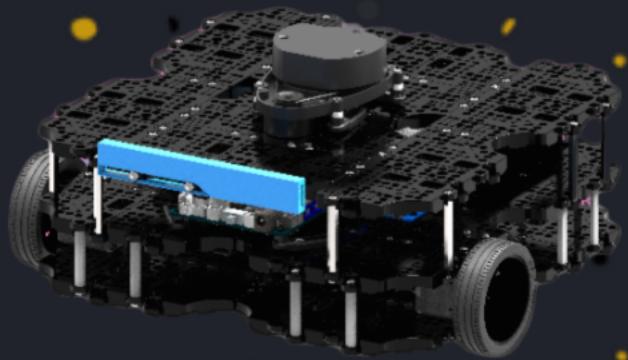
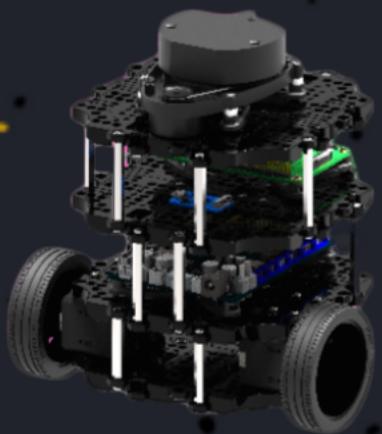
ROS

Secure
Communication

Realtime
Systems



Fleet of Robots



Why ROS 2?

Unreliable
Networks

Fleet of
Robots

Embedded
Platforms

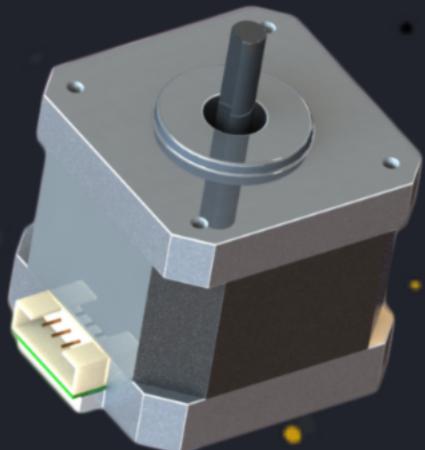
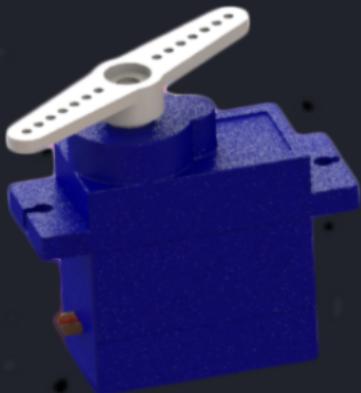
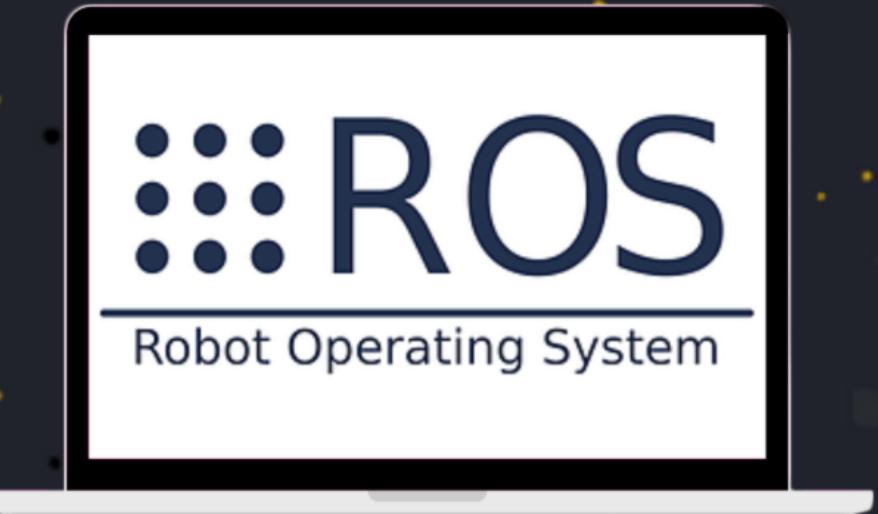
ROS

Secure
Communication

Realtime
Systems



Embedded Platforms



Why ROS 2?

Unreliable
Networks

Fleet of
Robots

Embedded
Platforms

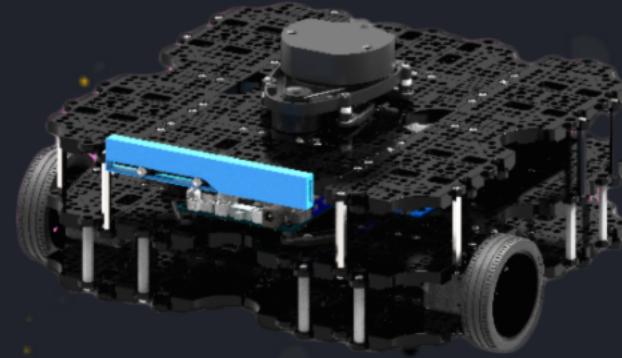
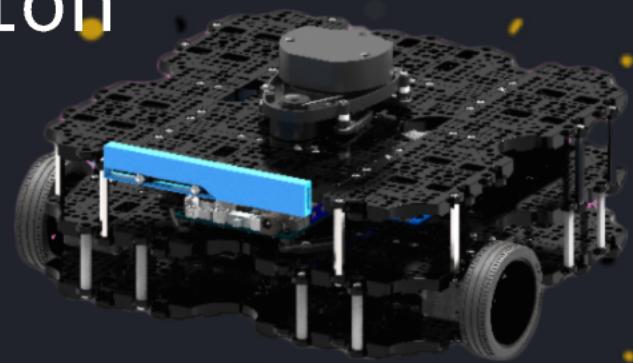
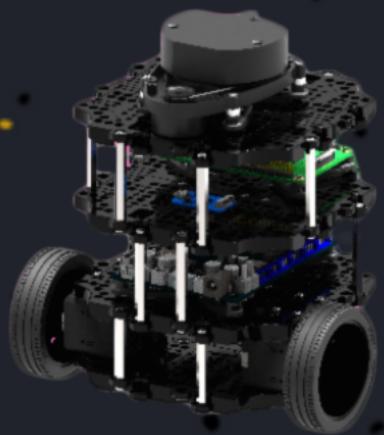
ROS

Secure
Communication

Realtime
Systems



Secure Communication



Why ROS 2?

Unreliable
Networks

Fleet of
Robots

Embedded
Platforms

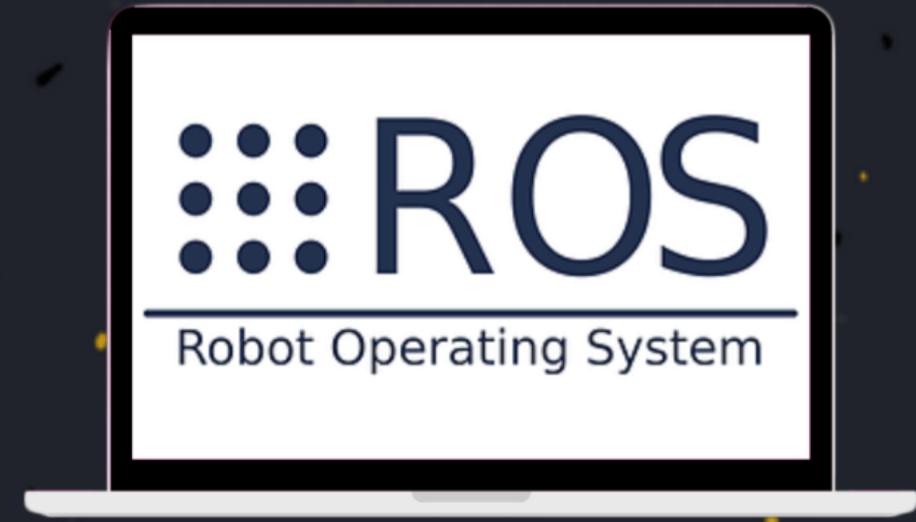
ROS

Secure
Communication

Realtime
Systems



Realtime Systems



Why ROS 2?

Unreliable
Networks

Fleet of
Robots

Embedded
Platforms

ROS

Secure
Communication





DDS

Cyclone DDS

Fast DDS

Connext DDS



ROS 2

ROS 2 Middleware (rmw)

DDS

Cyclone DDS

Fast DDS

Connexxt DDS



ROS 2

ROS 2 C++ Client
Library (rclcpp)

ROS 2 Python Client
Library (rclpy)

ROS 2 Java Client
Library (rcljava)

ROS 2 Client Library (rcl)

ROS 2 Middleware (rmw)

DDS

Cyclone DDS

Fast DDS

Connext DDS



User

Amazing ROS 2
User Application

ROS 2 C++ Client
Library (rclcpp)

ROS 2 Python Client
Library (rclpy)

ROS 2 Java Client
Library (rcljava)

ROS 2 Client Library (rcl)

ROS 2 Middleware (rmw)

DDS

Cyclone DDS

Fast DDS

Connext DDS

Why ROS 2?

Unreliable
Networks

Fleet of
Robots

Embedded
Platforms

ROS

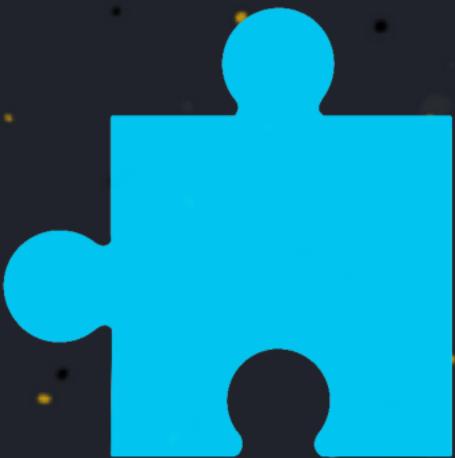
Secure
Communication

Realtime
Systems



ROS 2



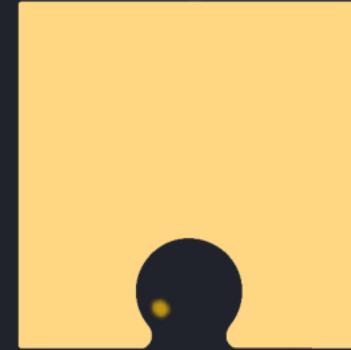


Voice Recognition



Object Grasping

ROS 2



Robot Control



Trajectory Planning

Electronics

Mechanics

Sensors

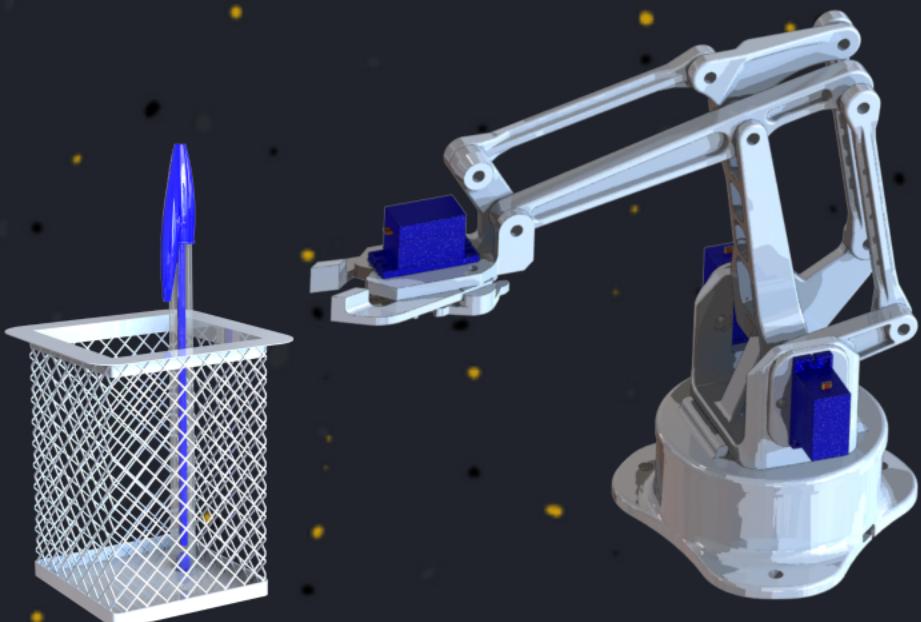
Network

Artificial
Intelligence

Software

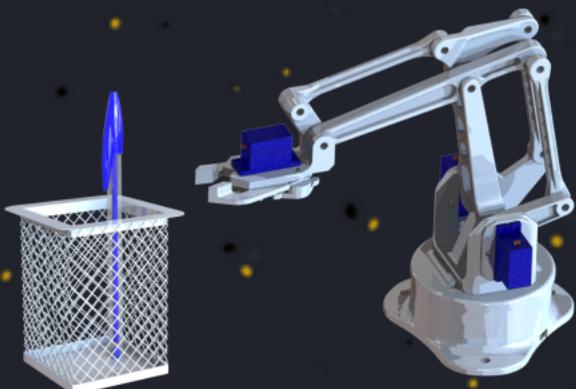
Control

Computer
Vision



“

“Robotics is concerned with the study of those machines that can replace human beings in the execution of a task, as regards both physical activity and decision making”



Robotics,
Sciavicco
Siciliano Villani



Hardware
Abstraction

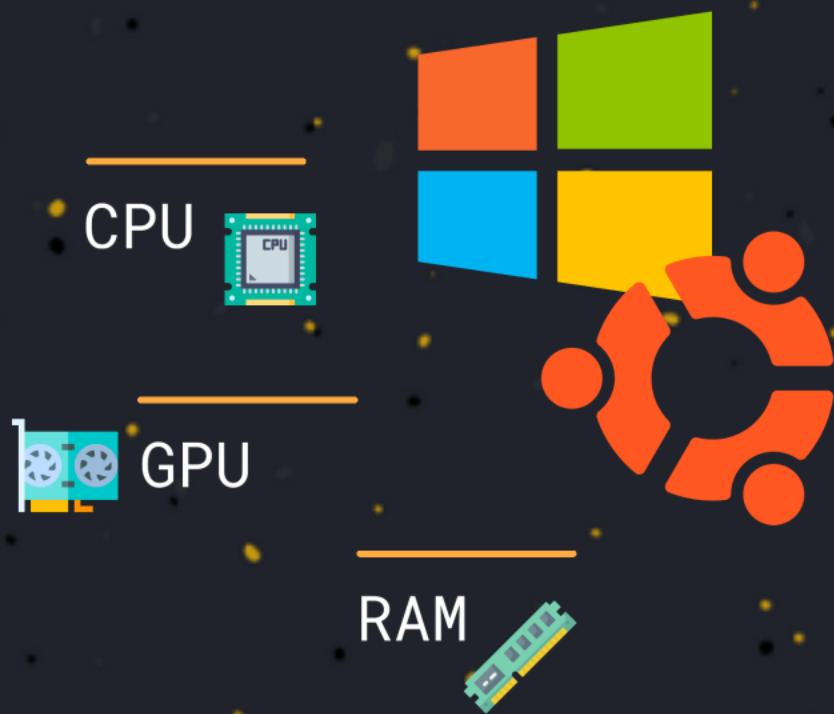
Low-Level
Device Control

Communication
Between Process

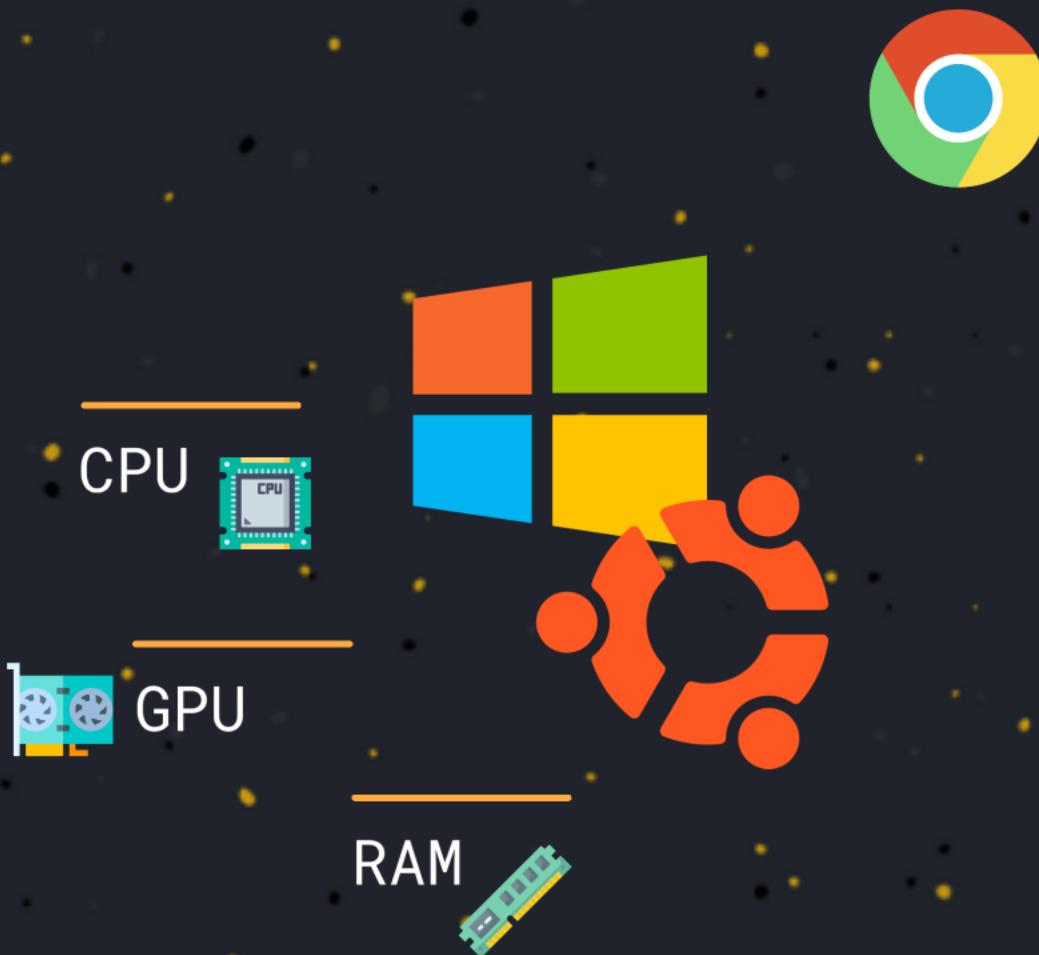


Package
Management

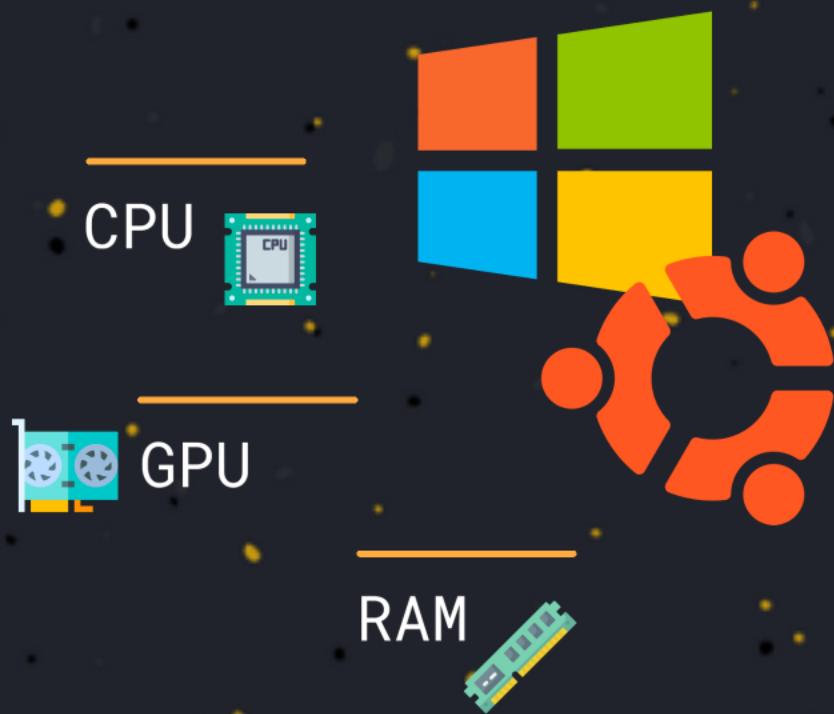
Hardware Abstraction



Hardware Abstraction

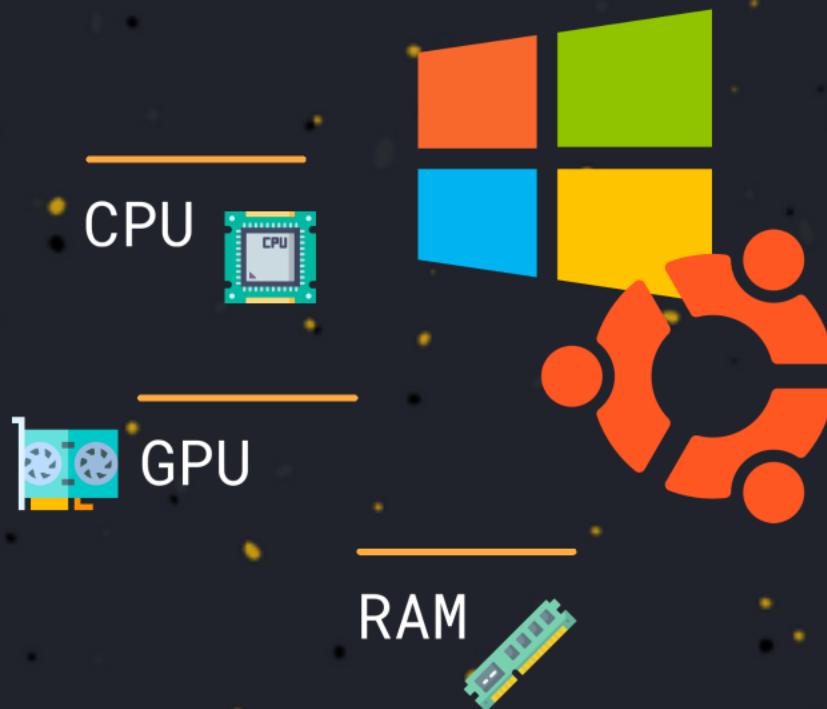


Hardware Abstraction

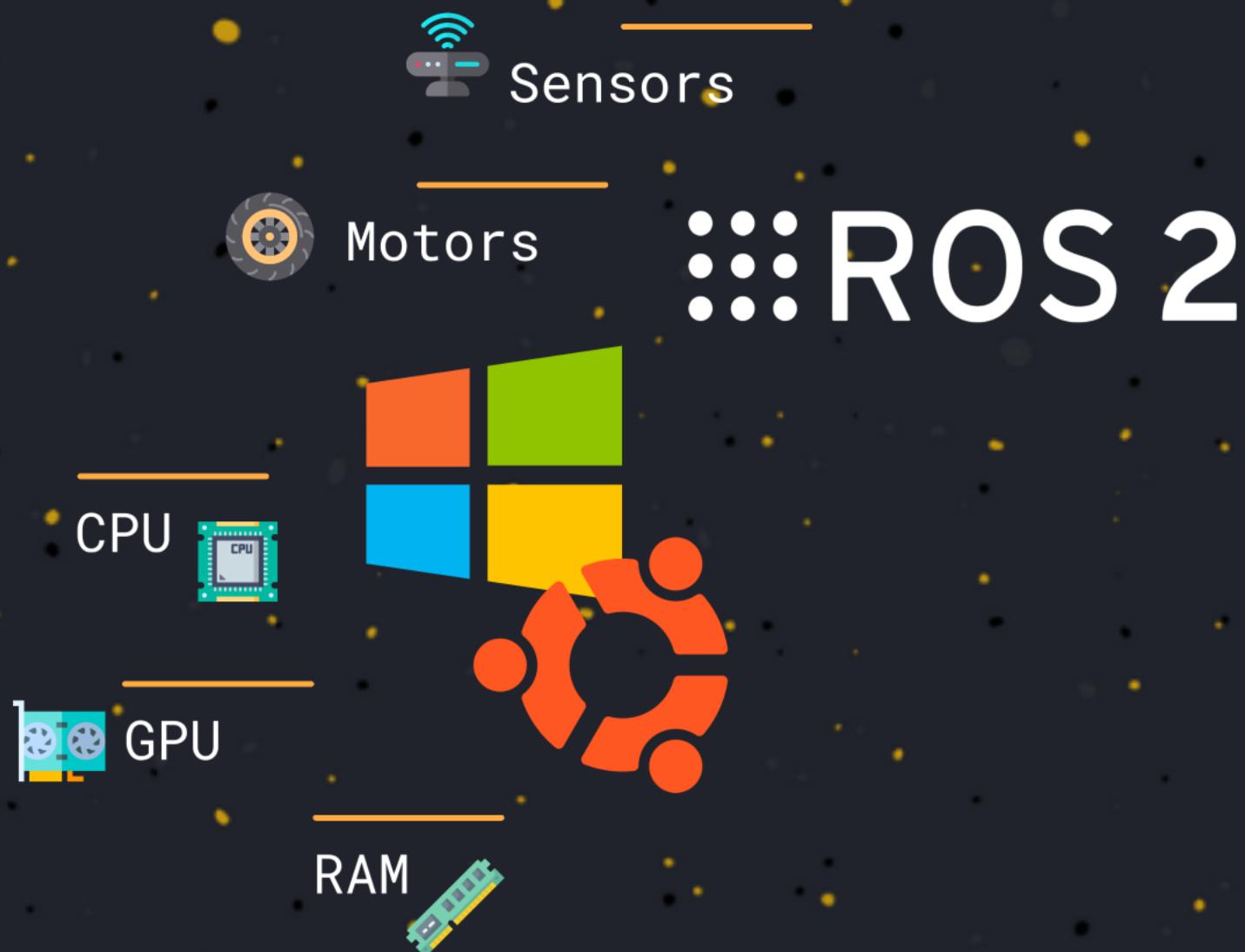


Hardware Abstraction

ROS 2

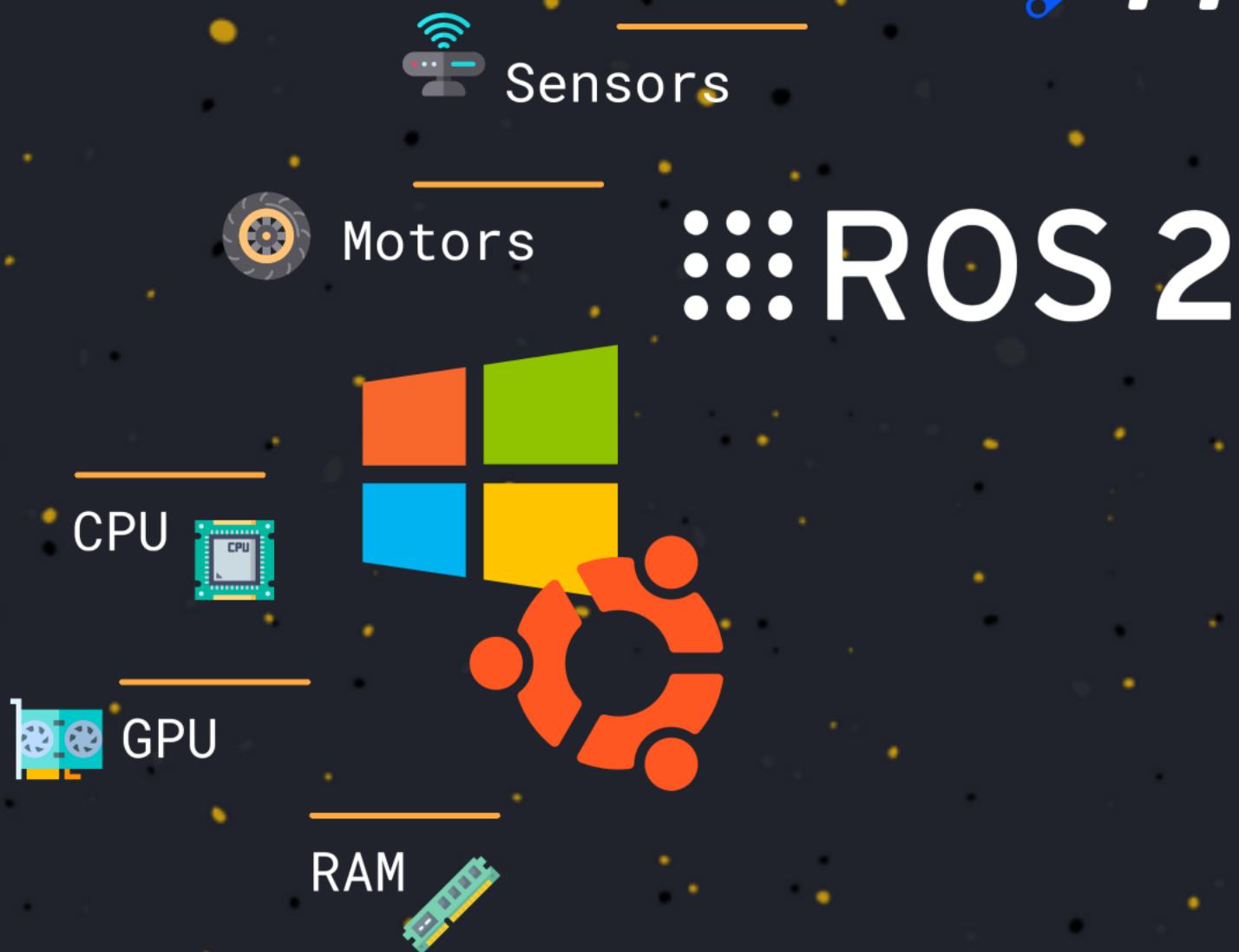


Hardware Abstraction



Hardware Abstraction

➤ **MoveIt2**



Hardware
Abstraction

Low-Level
Device Control

Communication
Between Process



Package
Management

Low-Level Device Control



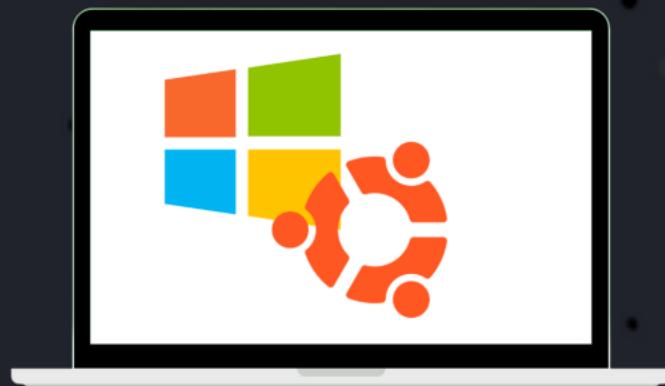
Low-Level Device Control



Low-Level Device Control



Low-Level Device Control



ROS 2

Low-Level Device Control



ROS 2



Hardware
Abstraction

Low-Level
Device Control

Communication
Between Process



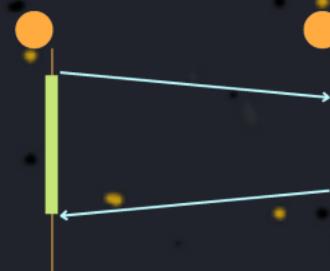
Package
Management

Communication Between Process

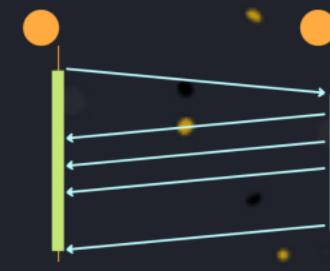
Topic



Service



Action



Topic



Topic



Topic



Topic

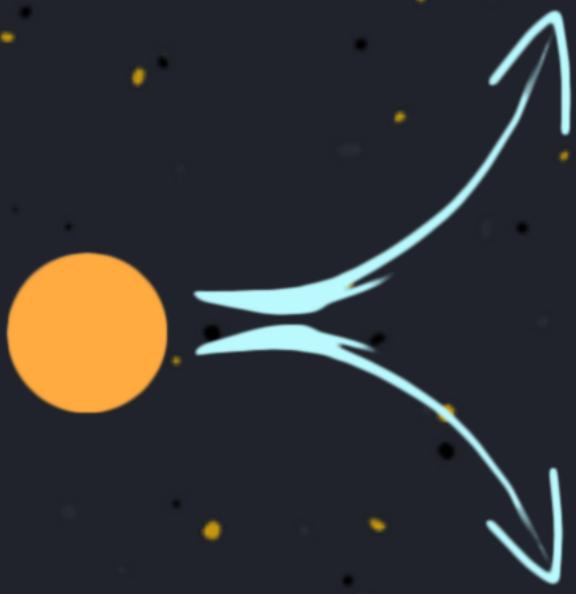
Topic



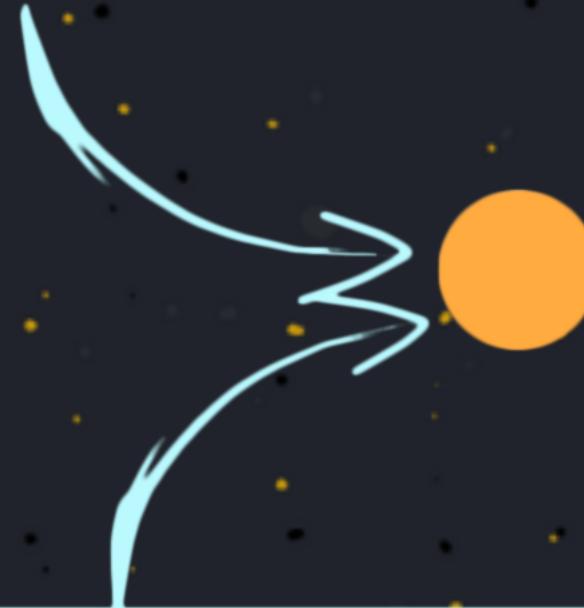
Topic

Topic

/topic_1



/topic_2



Topic

Topic

/topic_1



/topic_2

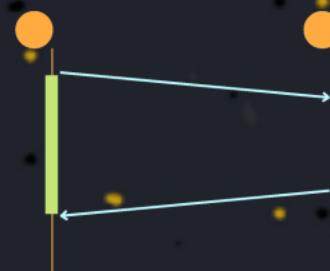


Communication Between Process

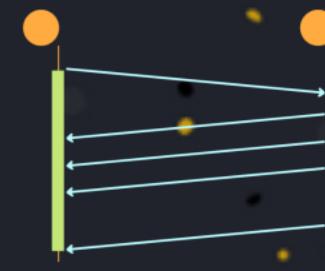
Topic



Service



Action



Service



Client



Server

Service

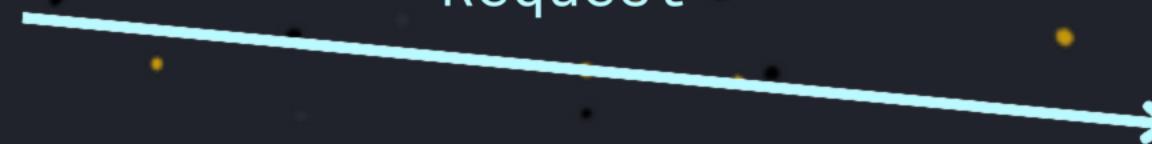


Client



Server

Request



Service



Request

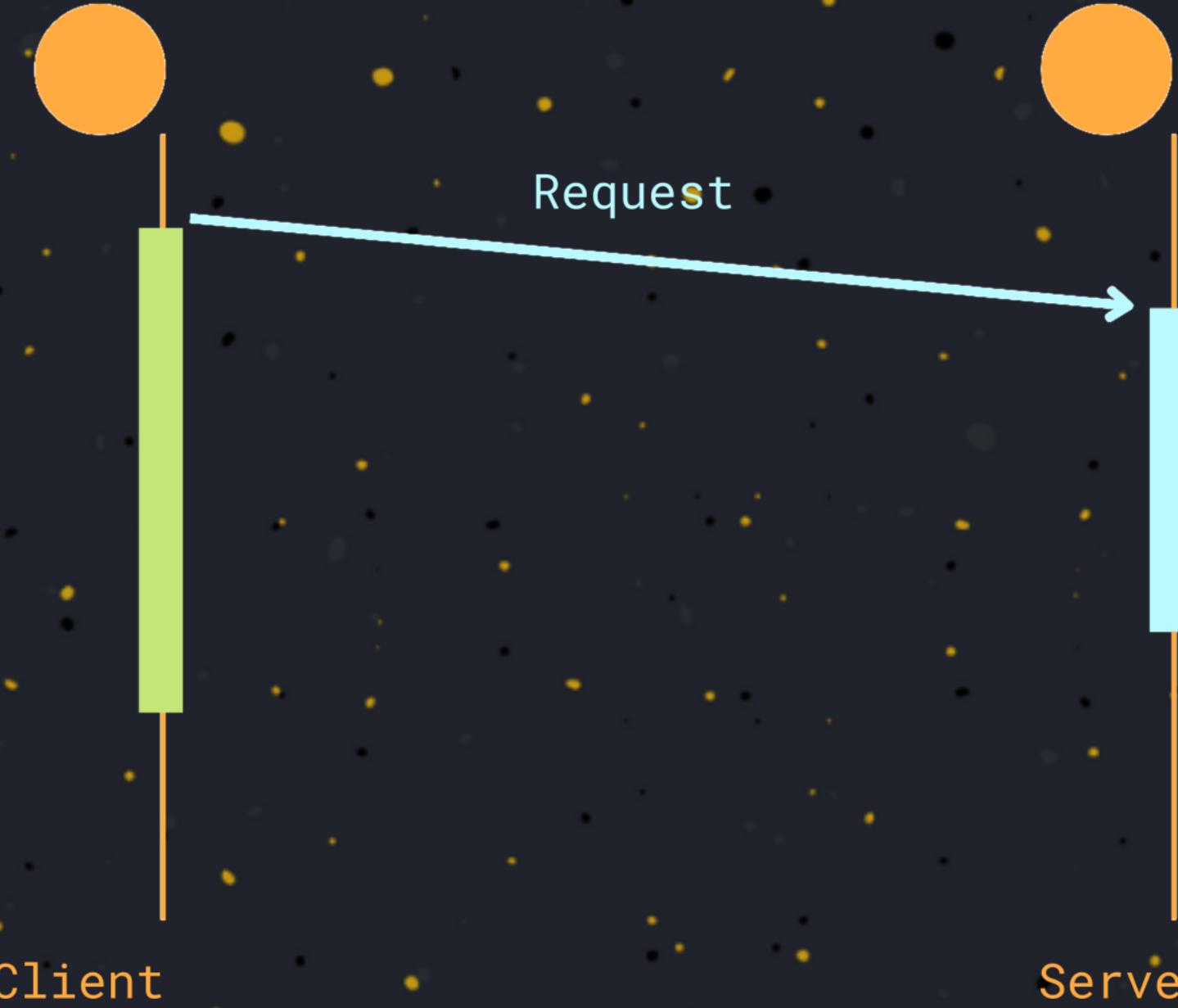


Client

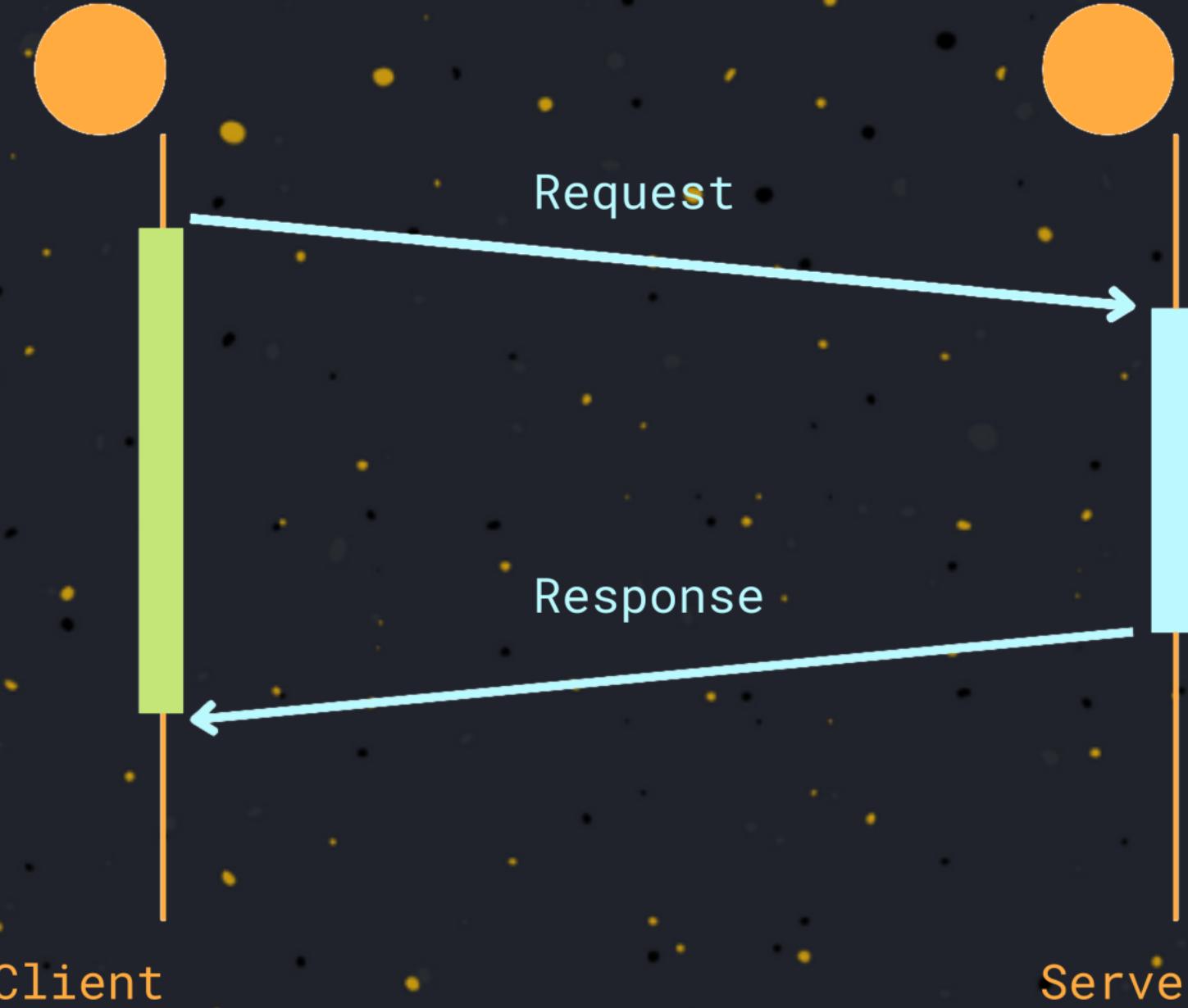
Server



Service



Service



Client

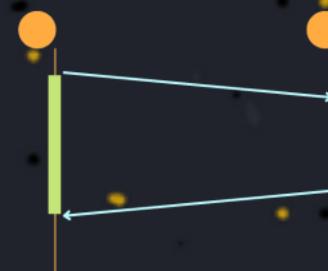
Server

Communication Between Process

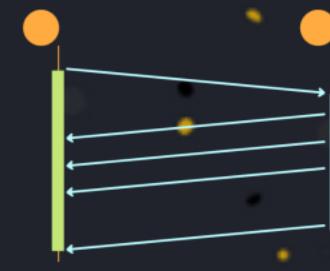
Topic



Service



Action

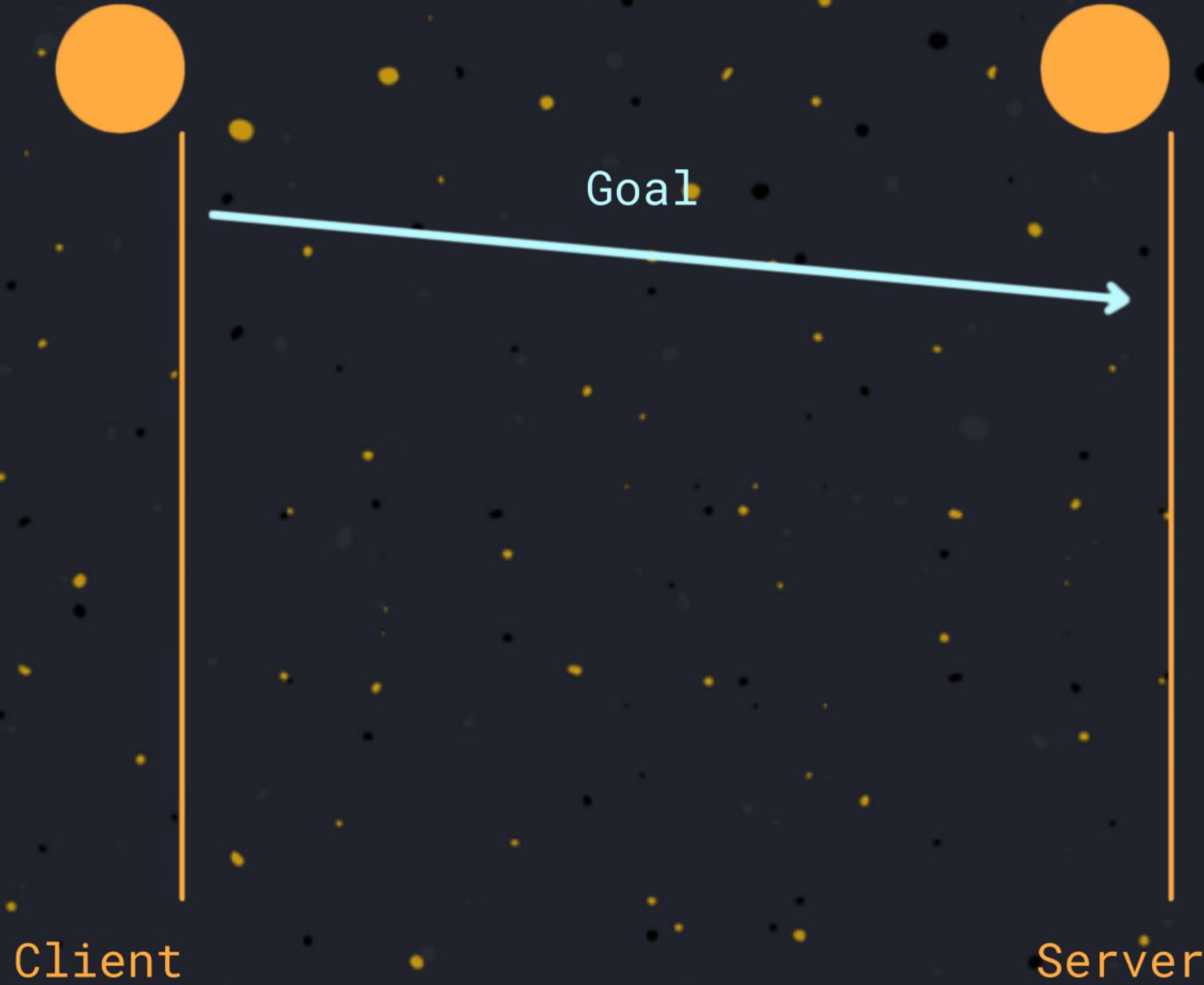


Action

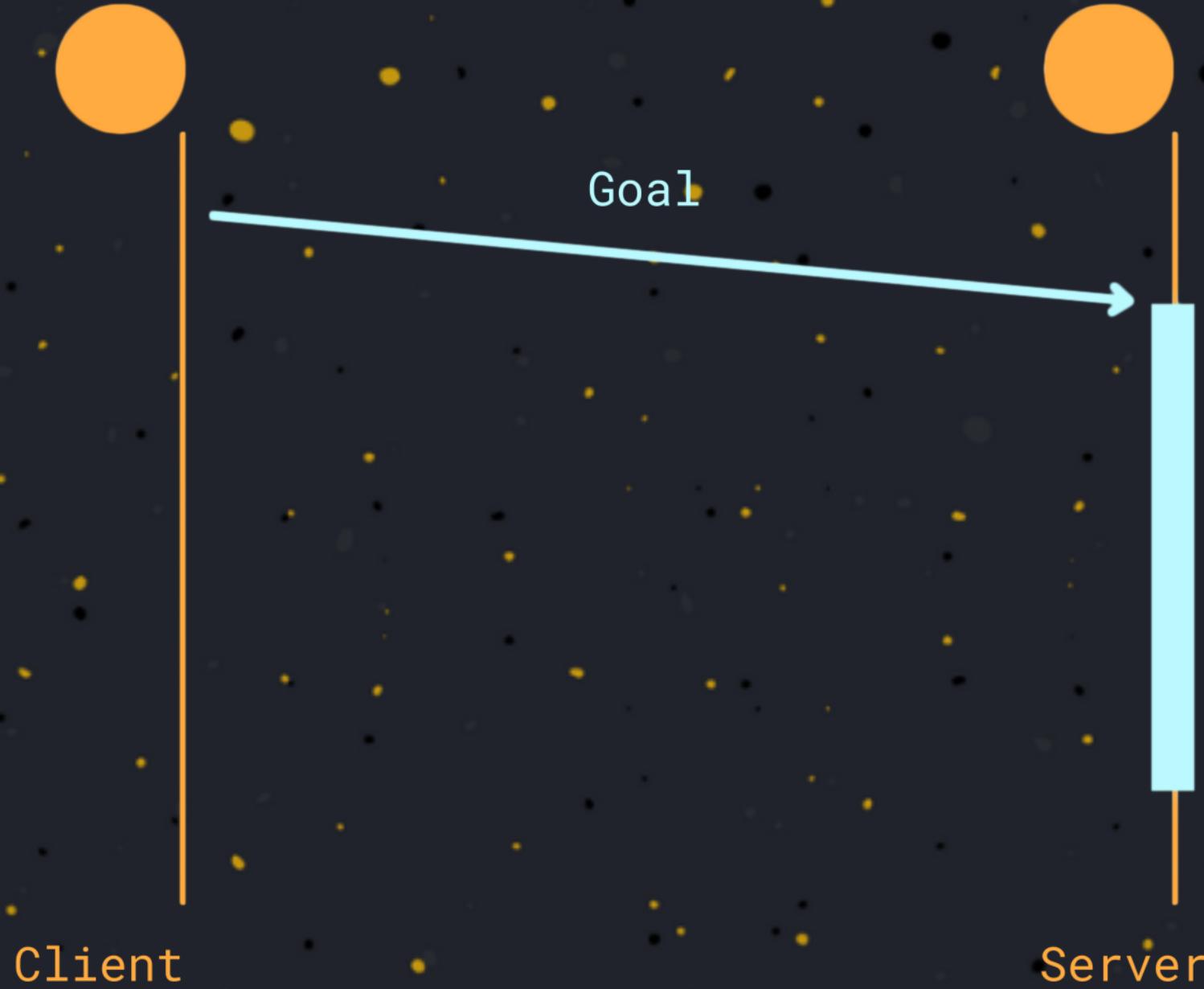
Client

Server

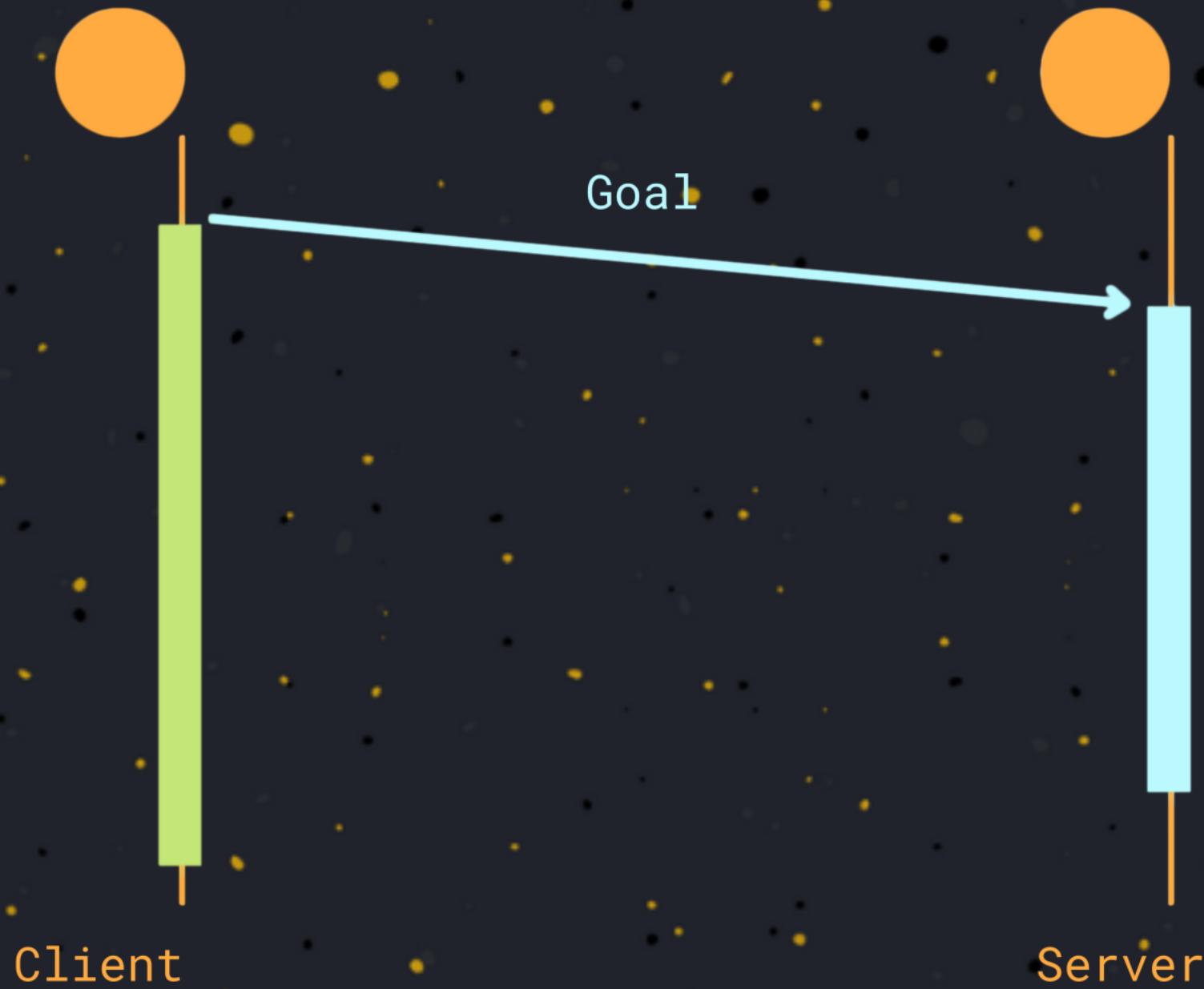
Action



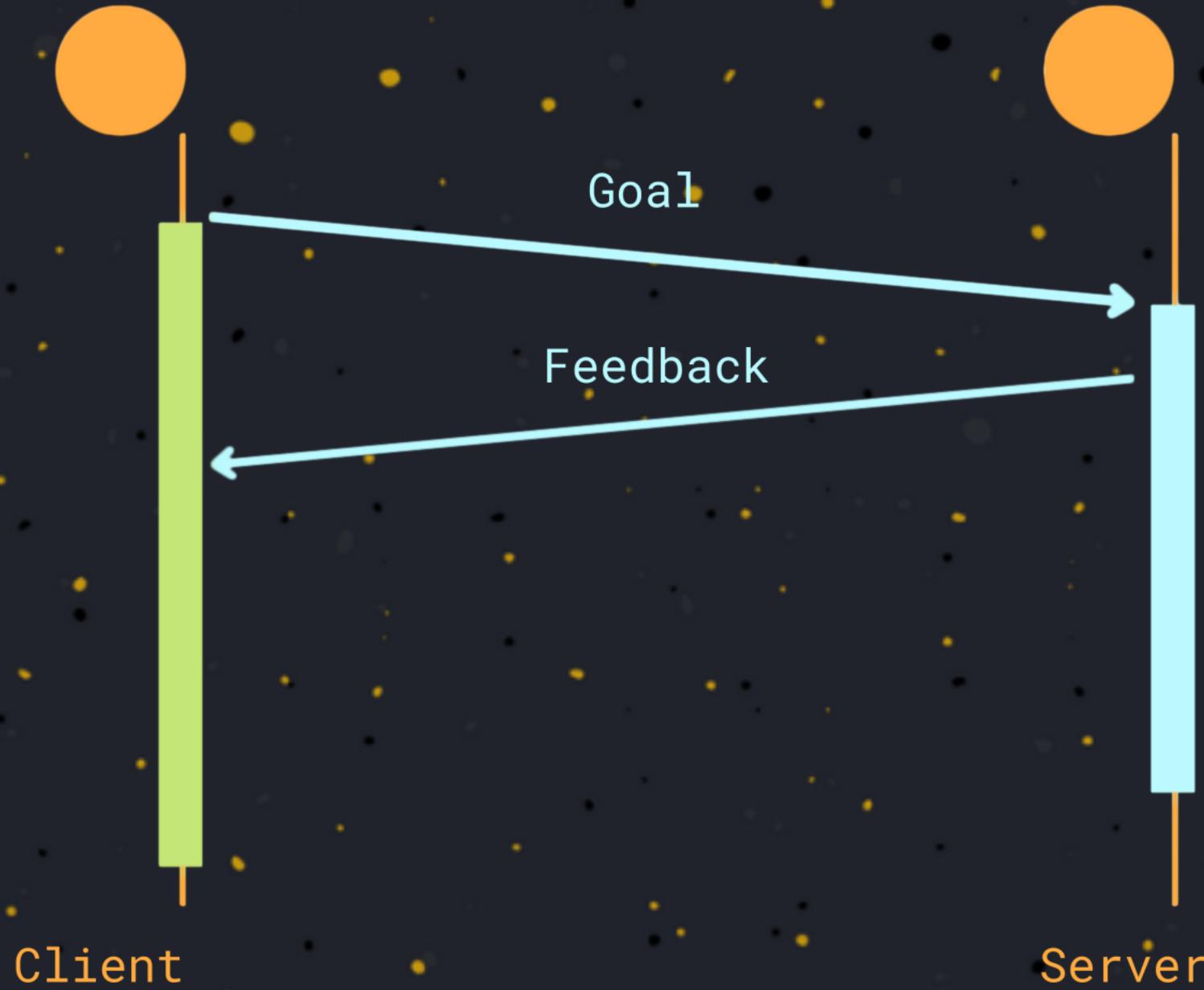
Action



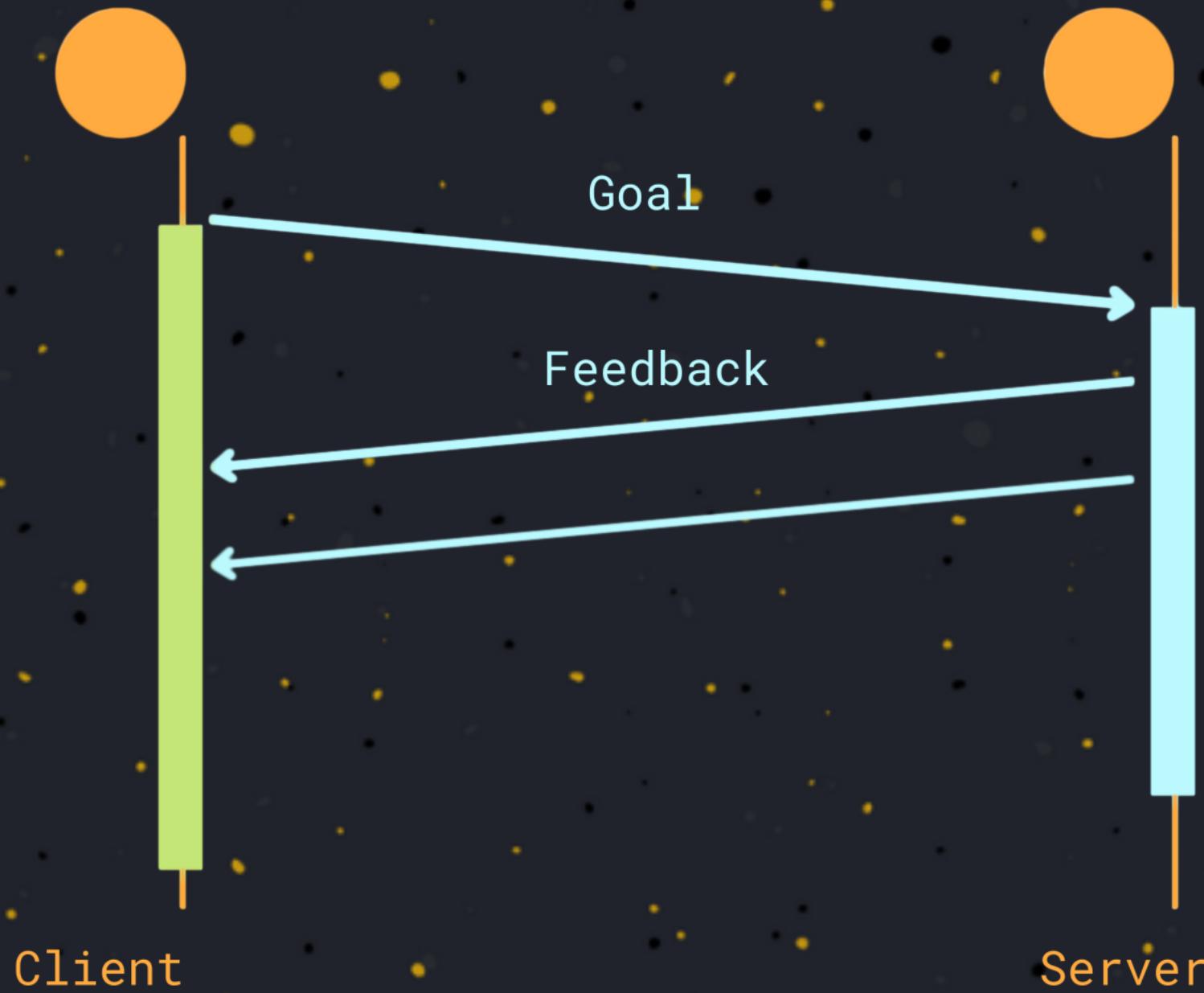
Action



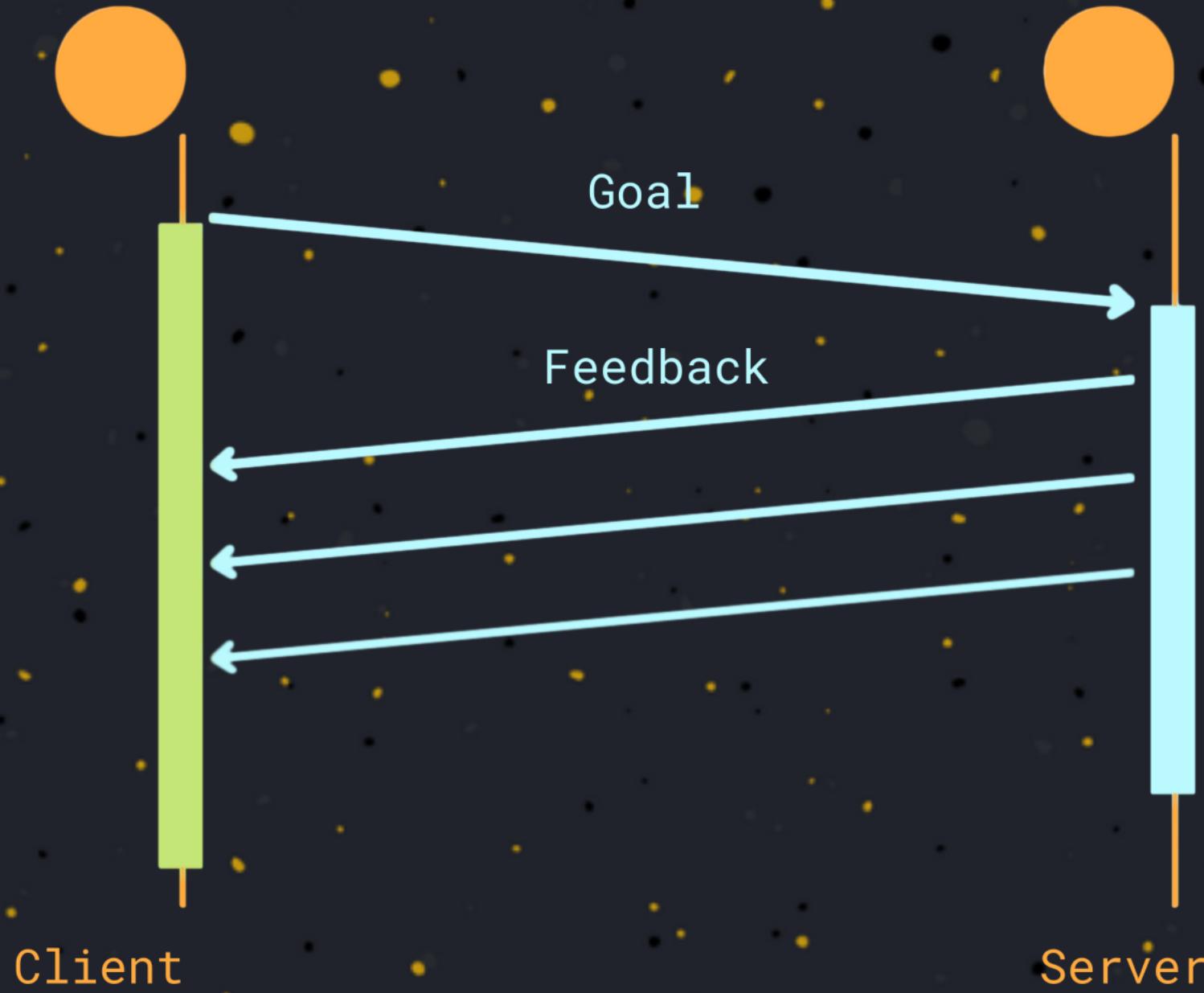
Action



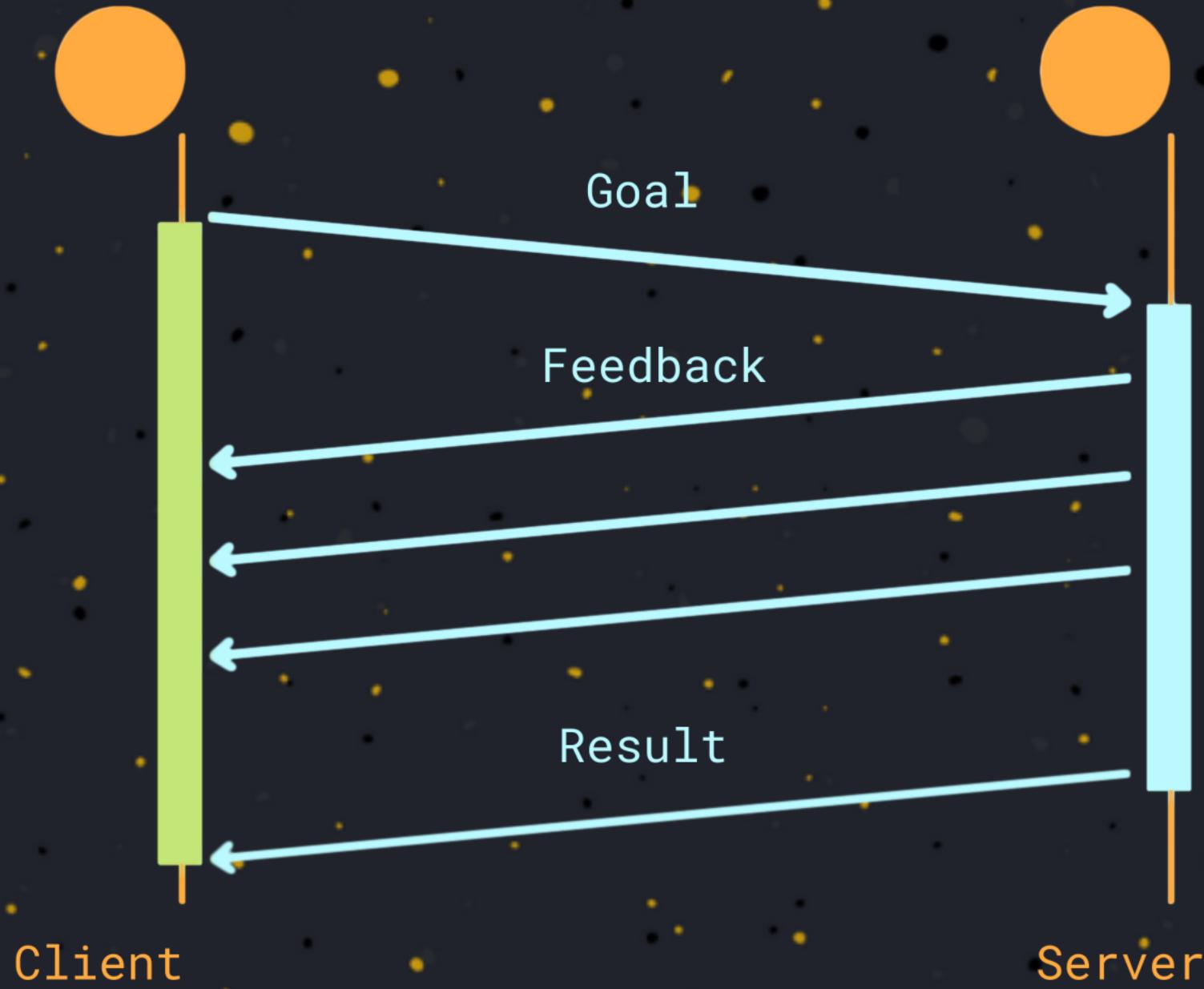
Action



Action



Action



Action

Client

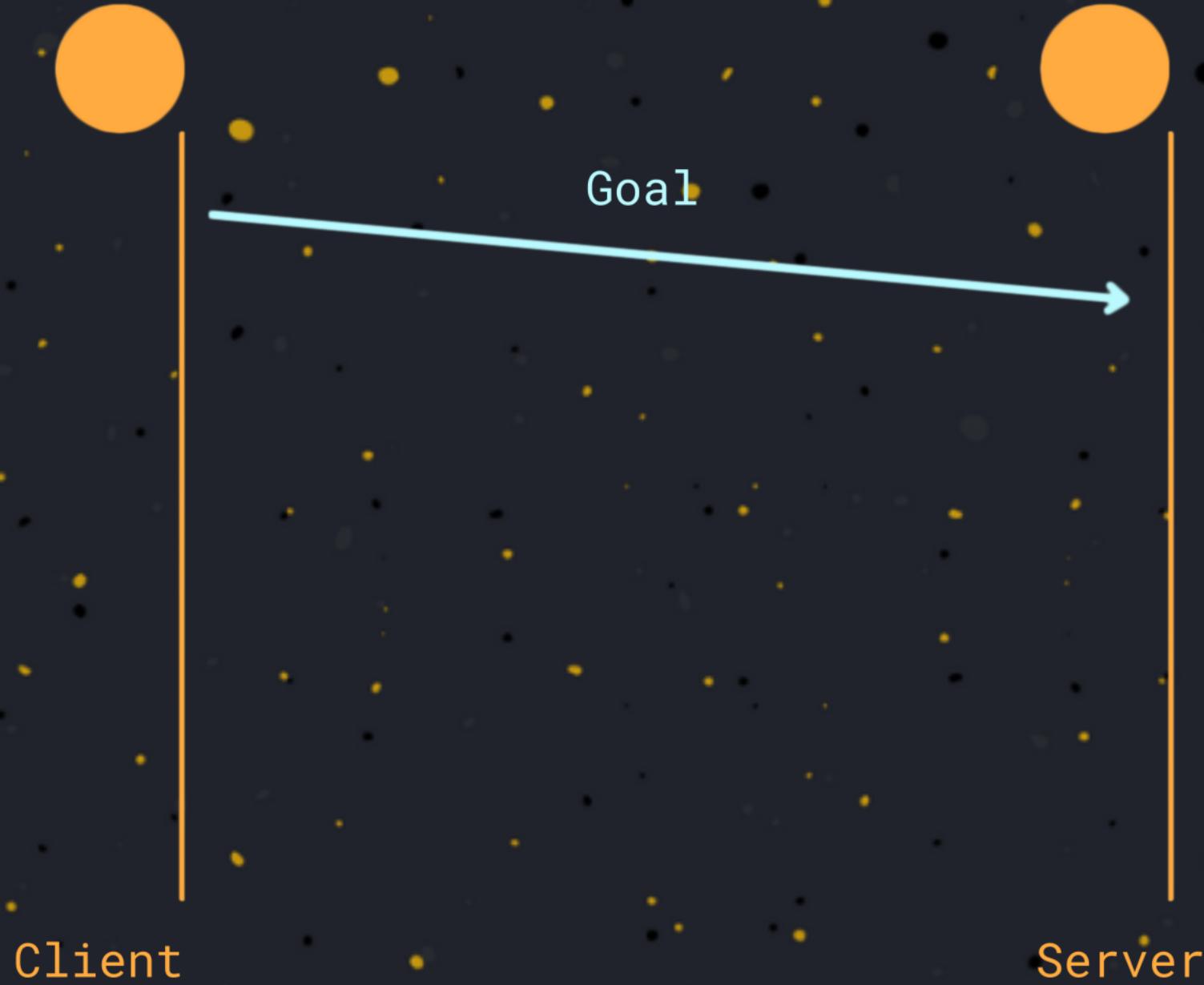
Server

Action

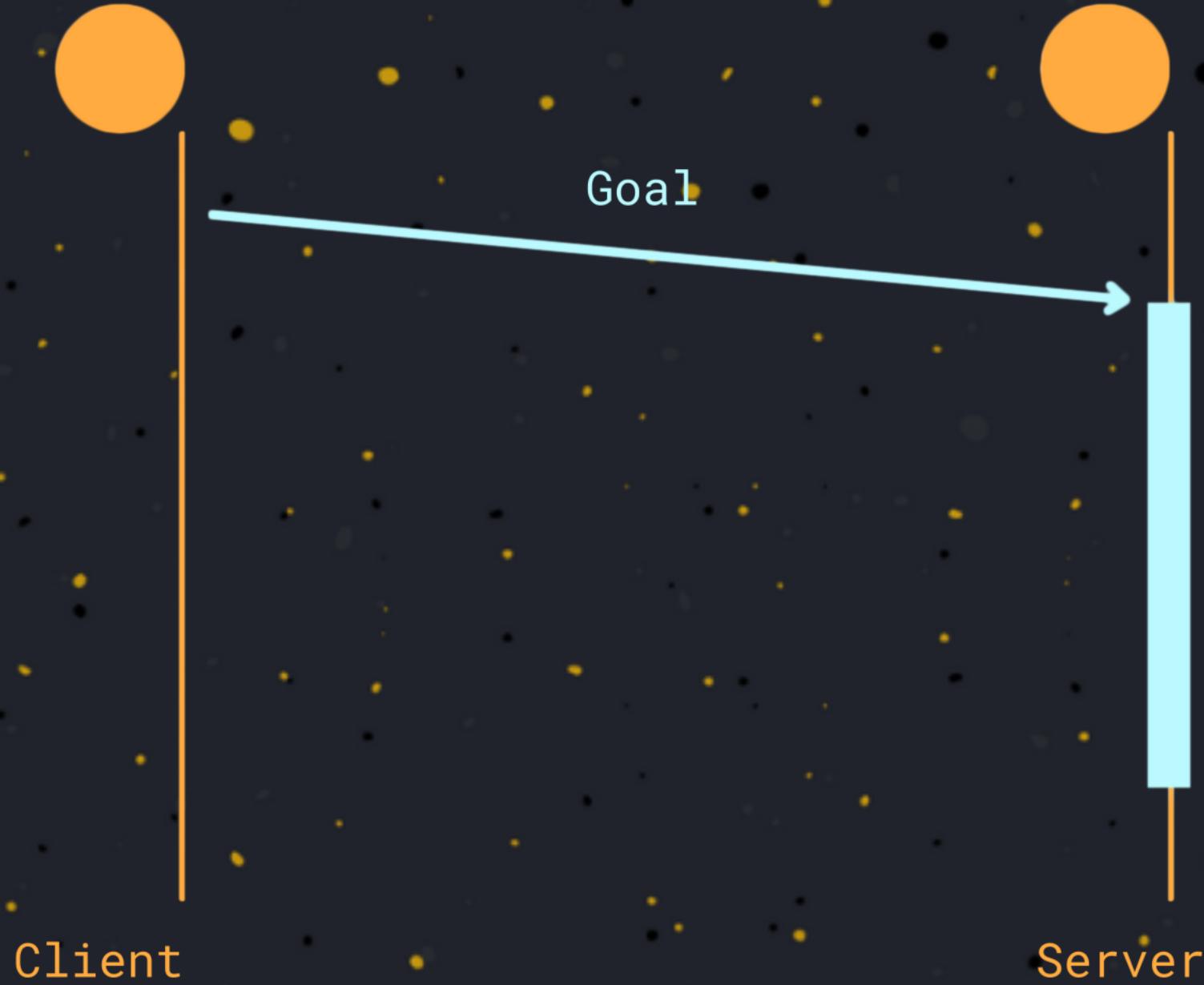
Client

Server

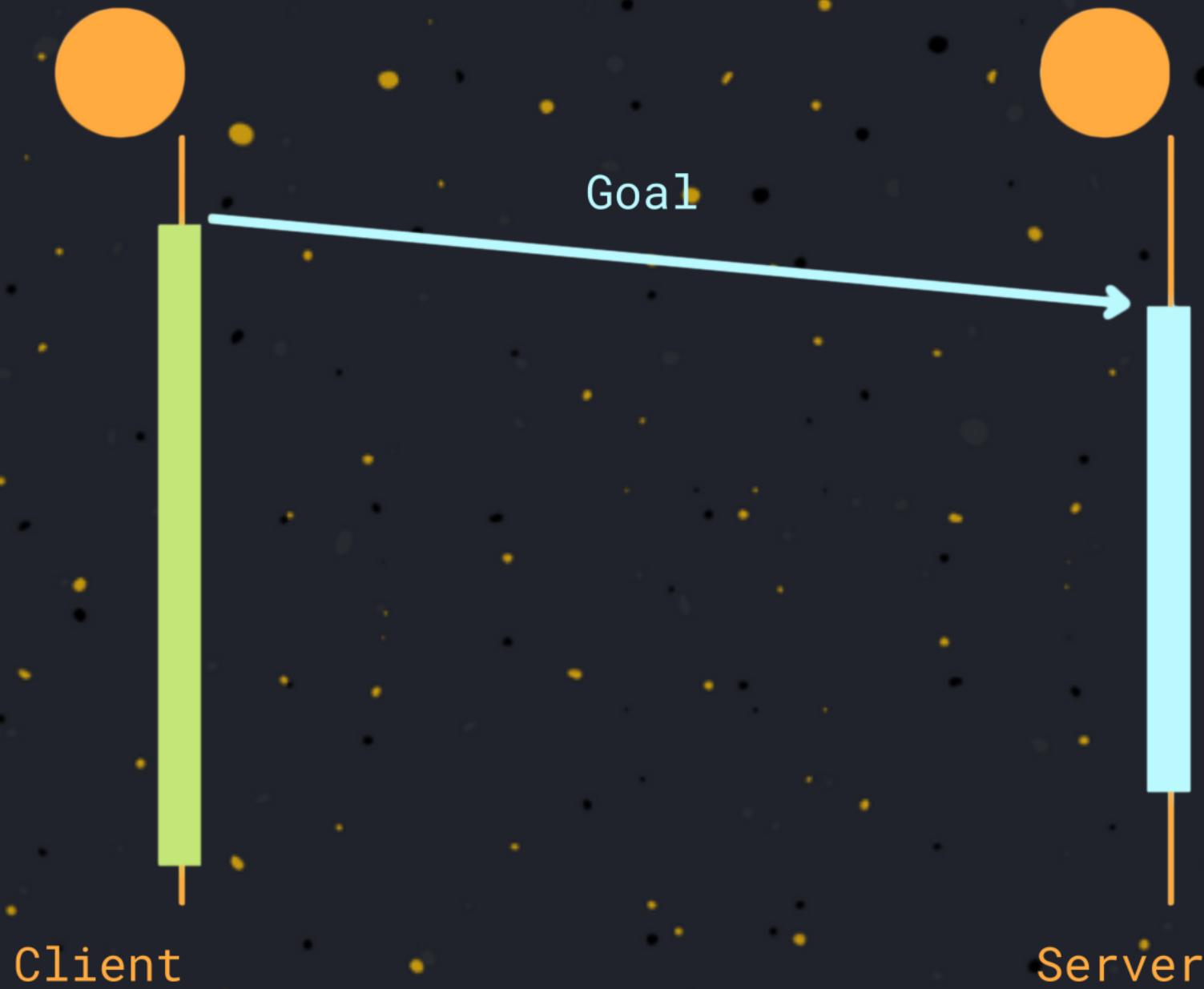
Action



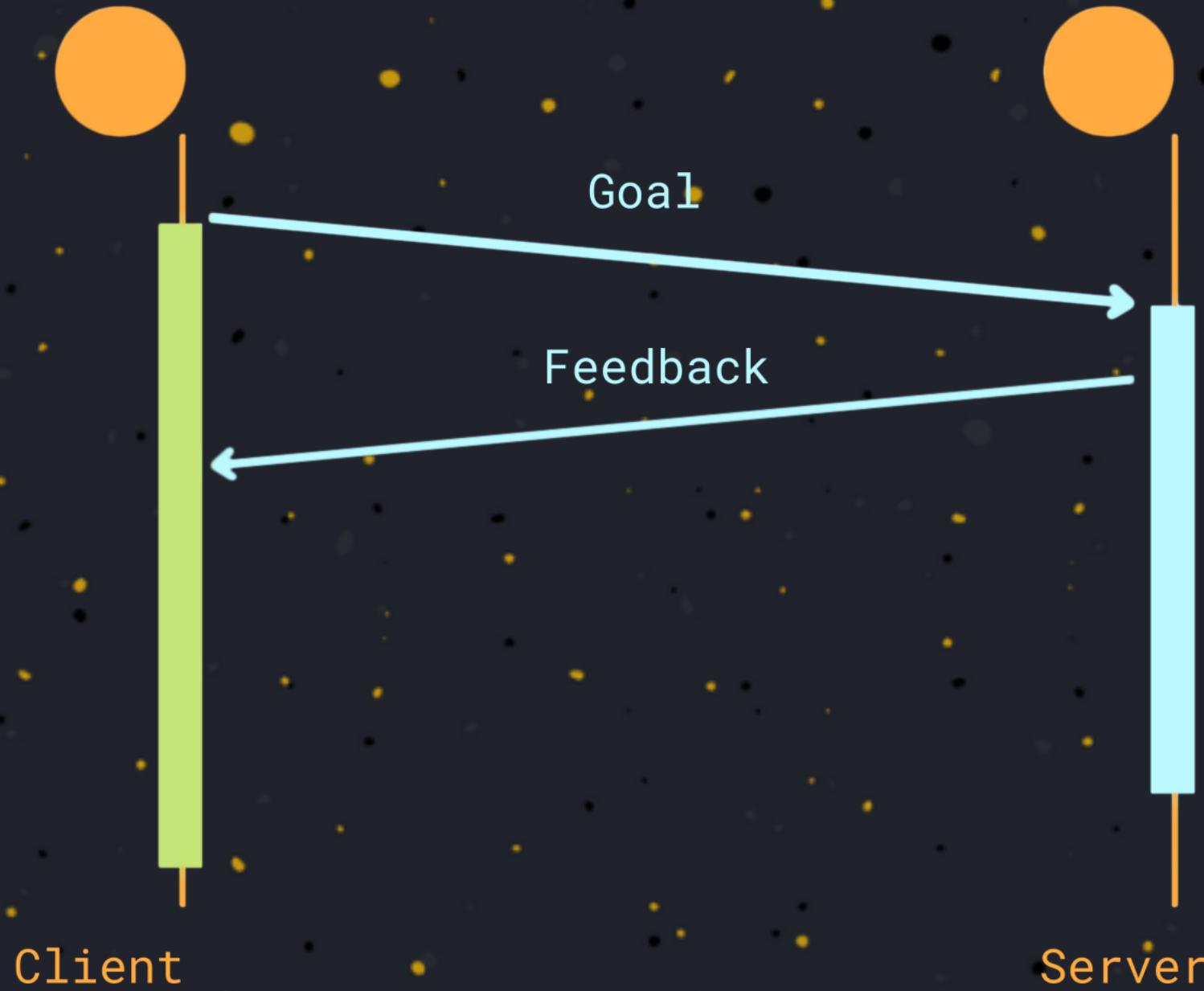
Action



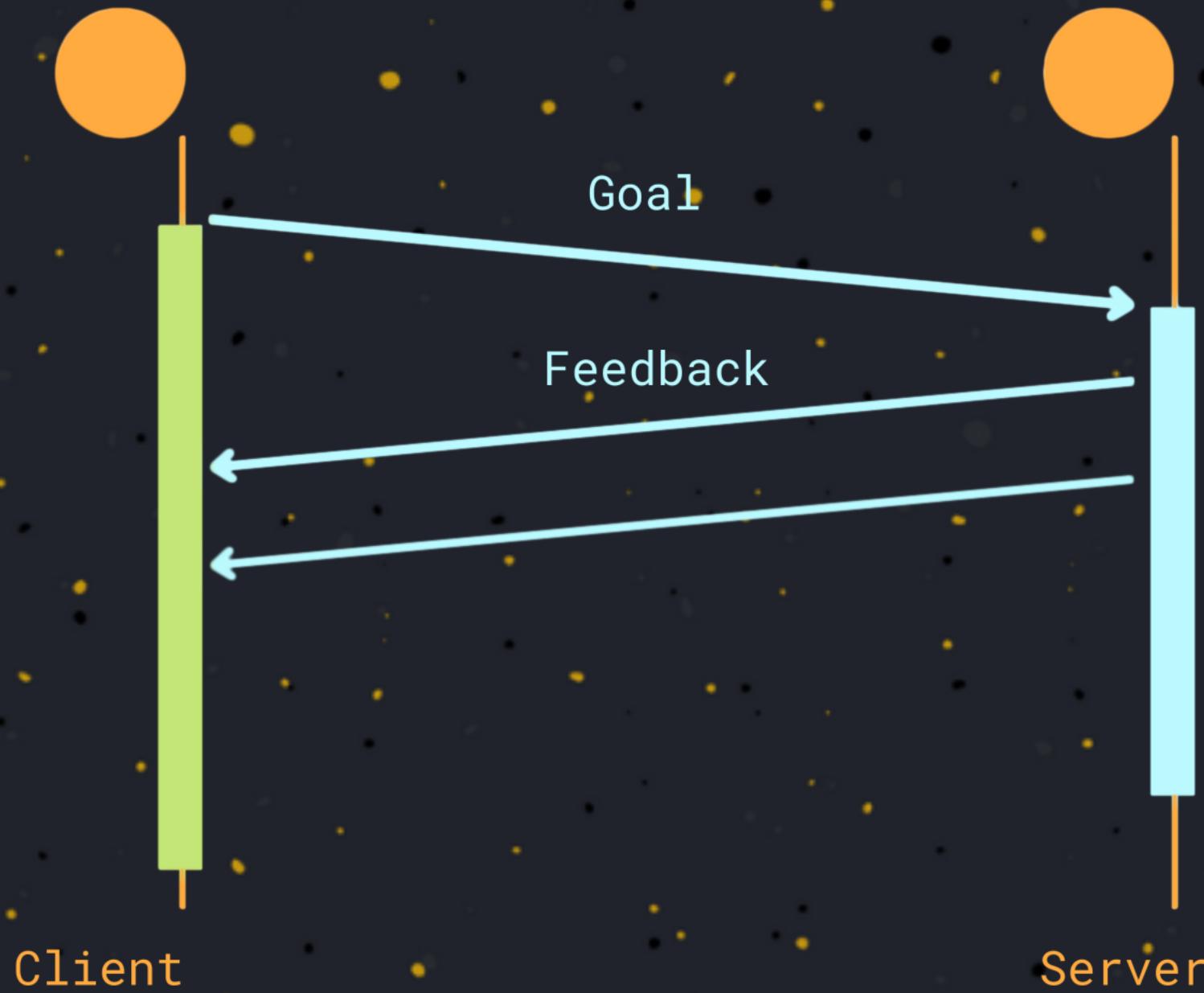
Action



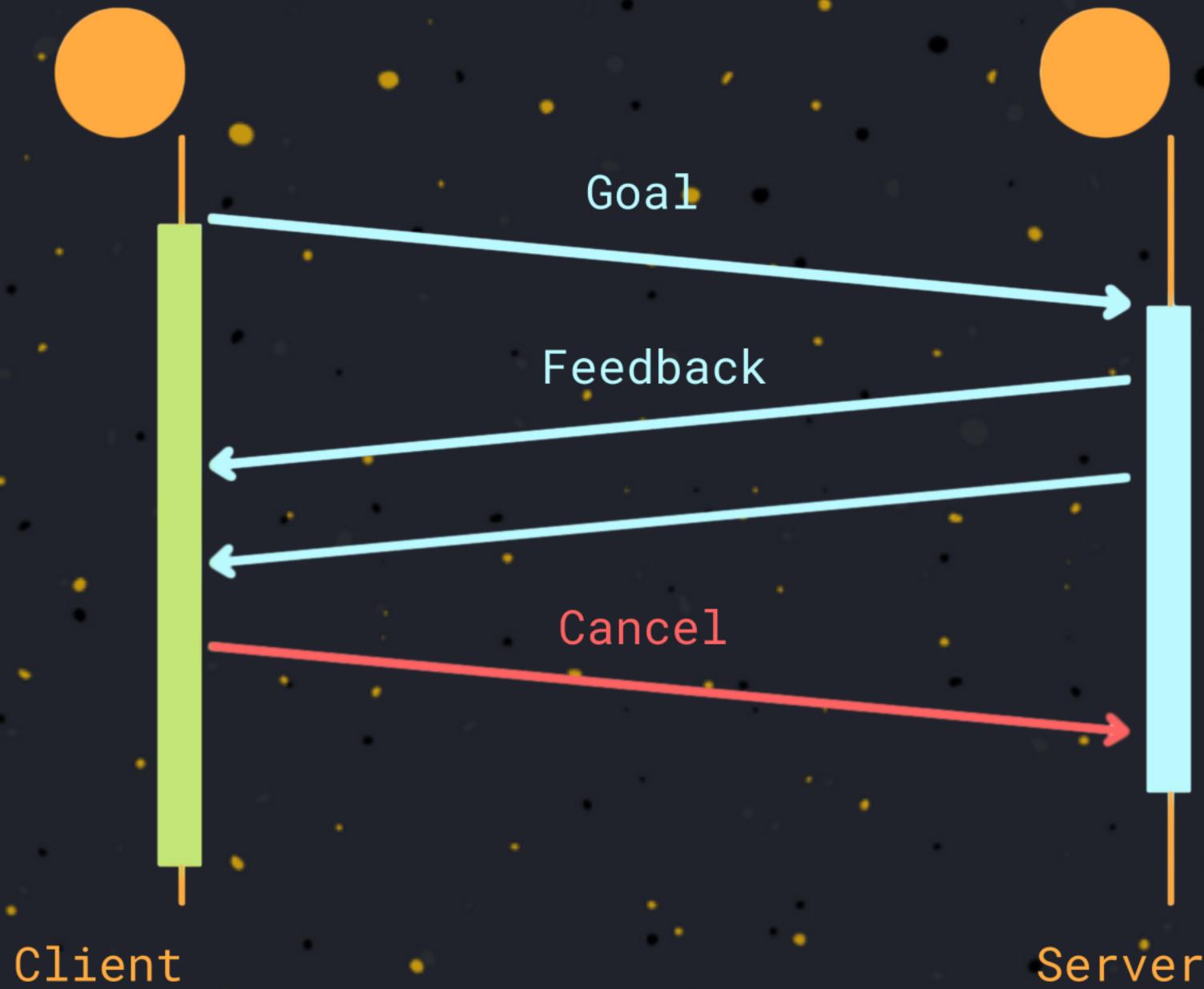
Action



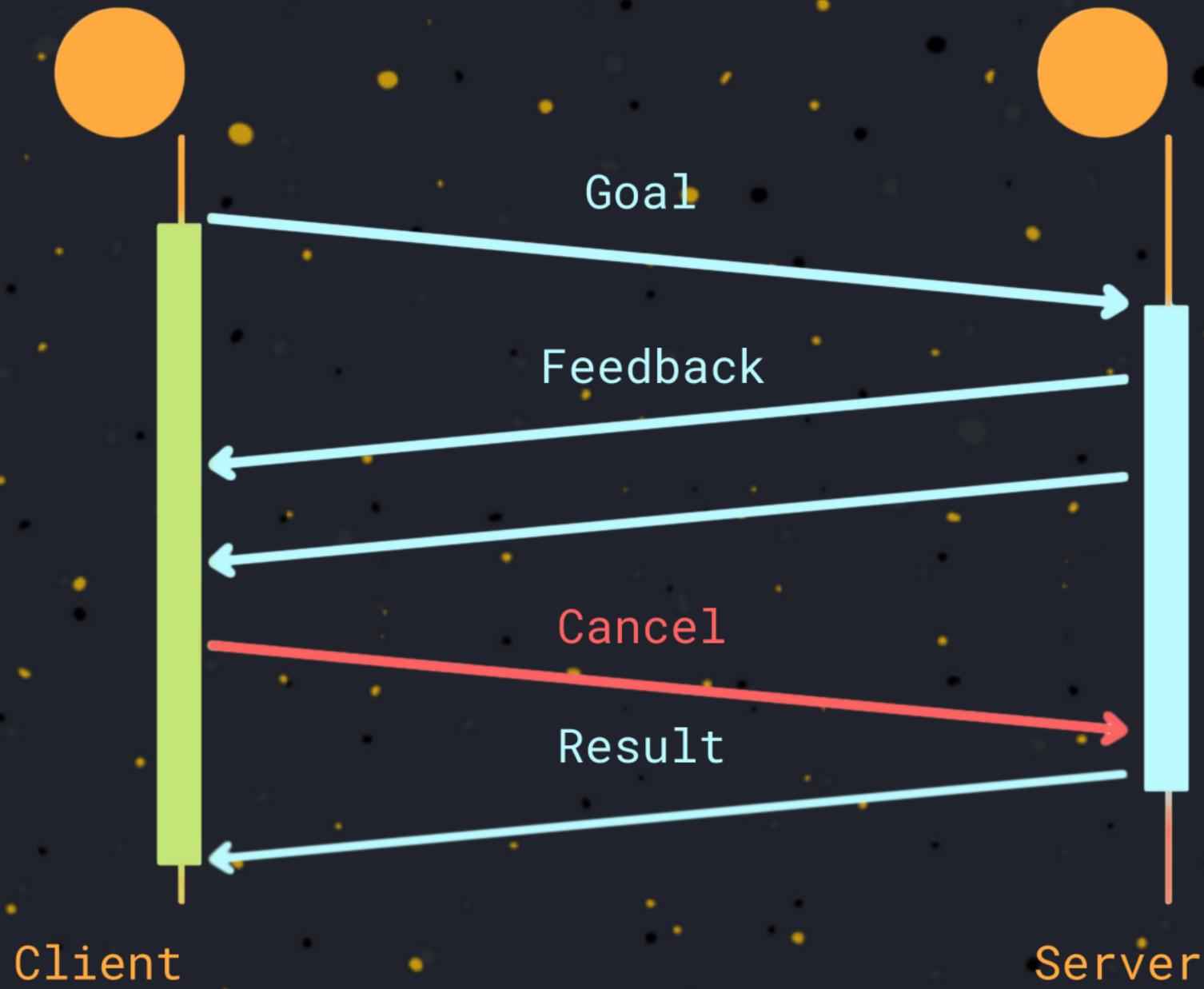
Action



Action



Action

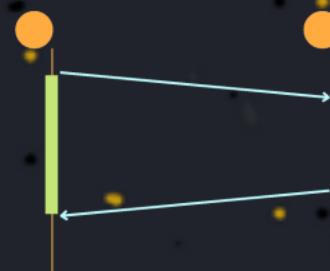


Communication Between Process

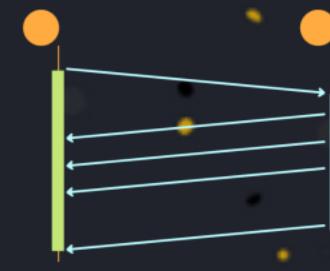
Topic



Service



Action



Hardware
Abstraction

Low-Level
Device Control

Communication
Between Process



Package
Management

Package Management

robot_description

robot_control

robot_simulation

robot_software

robot_vision

moveit

voice_recognition



Package Management

Package Management



description



simulation



control



vision



kinematic



voice
recognition

Hardware
Abstraction

Low-Level
Device Control

Communication
Between Process



Package
Management



rviz2

gazebo

Nav2

robot_vision

moveit

tf2

ros2_control



rviz2

gazebo

Nav2

robot_vision

moveit

tf2

ros2_control

Workspace



robot_grasping

robot_vision

robot_simulation



Workspace



Underlay

rviz2

gazebo

Nav2

robot_vision

moveit

tf2

ros2_control

robot_grasping

robot_vision

robot_simulation



Underlay

rviz2

gazebo

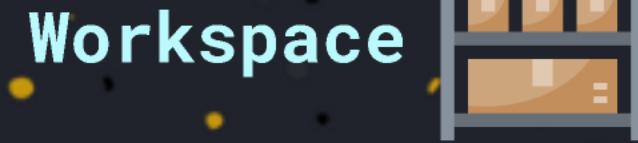
Nav2

robot_vision

moveit

tf2

ros2_control



Overlay

robot_grasping

robot_vision

robot_simulation



Underlay

rviz2

gazebo

Nav2

robot_vision

moveit

tf2

ros2_control

Workspace



Overlay

robot_grasping

robot_vision

robot_simulation

ROS 2



Underlay

rviz2

gazebo

Nav2

robot_vision

moveit

tf2

ros2_control

Workspace



Overlay

robot_grasping

robot_vision

robot_simulation

Package



C++ Node

Python Node

Launch File

Configuration
File

Hardware
Abstraction

Low-Level
Device Control

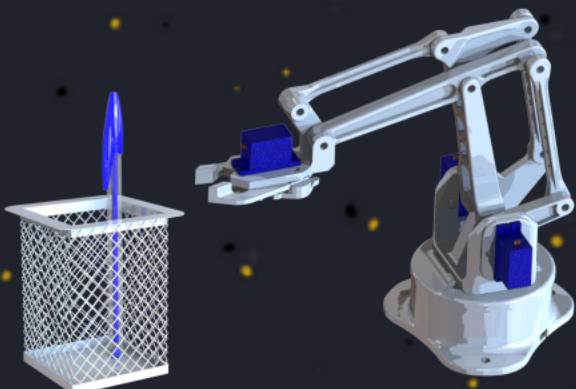
Communication
Between Process



Package
Management

“

“Robotics is concerned with the study of those machines that can replace human beings in the execution of a task, as regards both physical activity and decision making”



Robotics,
Sciavicco
Siciliano Villani



Arduinobot

Introduction

Setup

Digital
Twin

ROS 2

Control

Kinematics

Application

Alexa

Conclusions

Build

