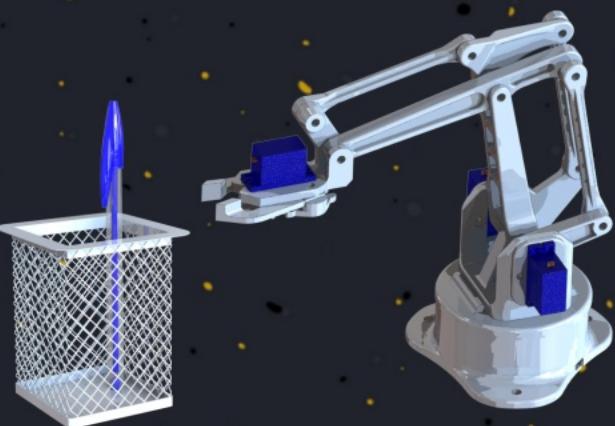
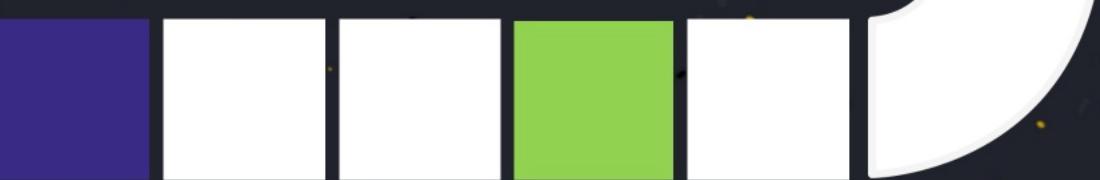
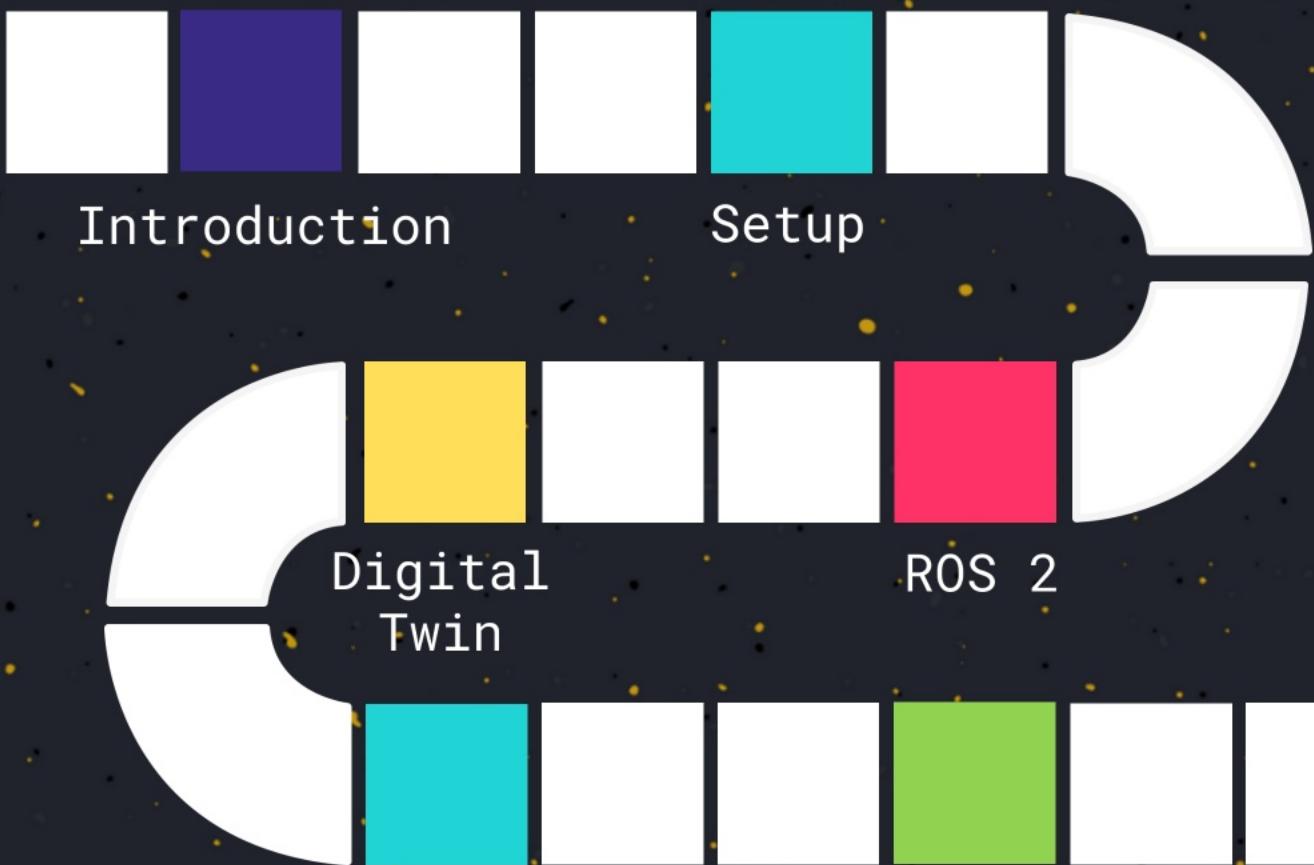
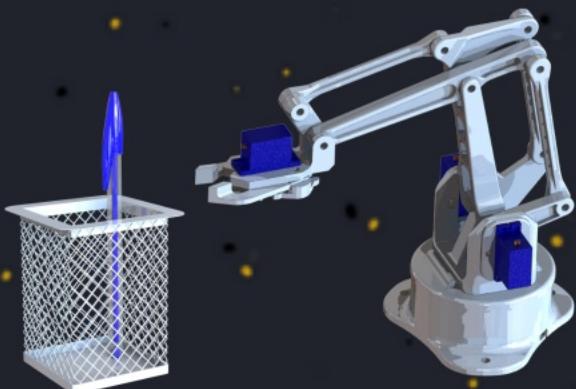


Arduinobot



“

“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

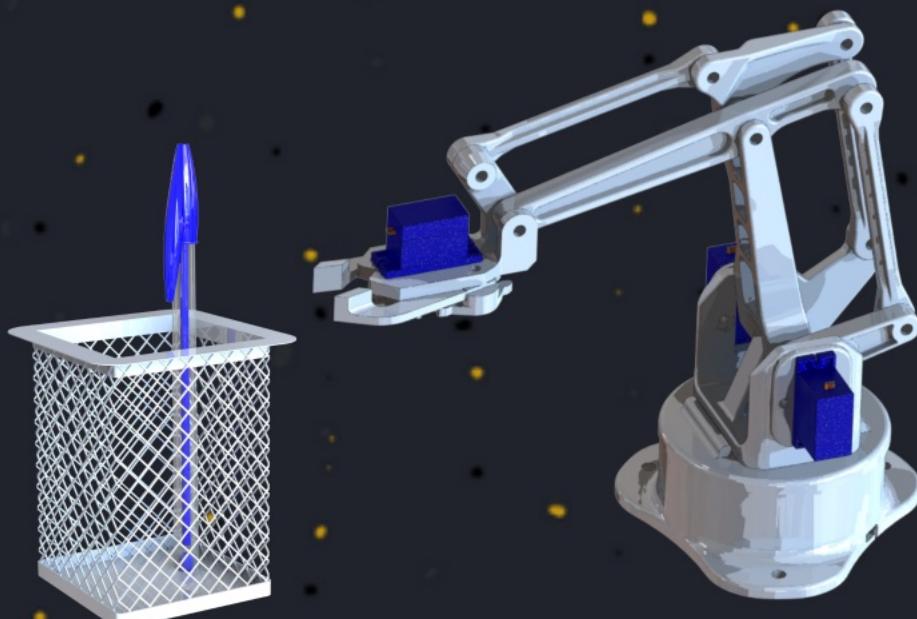
Network

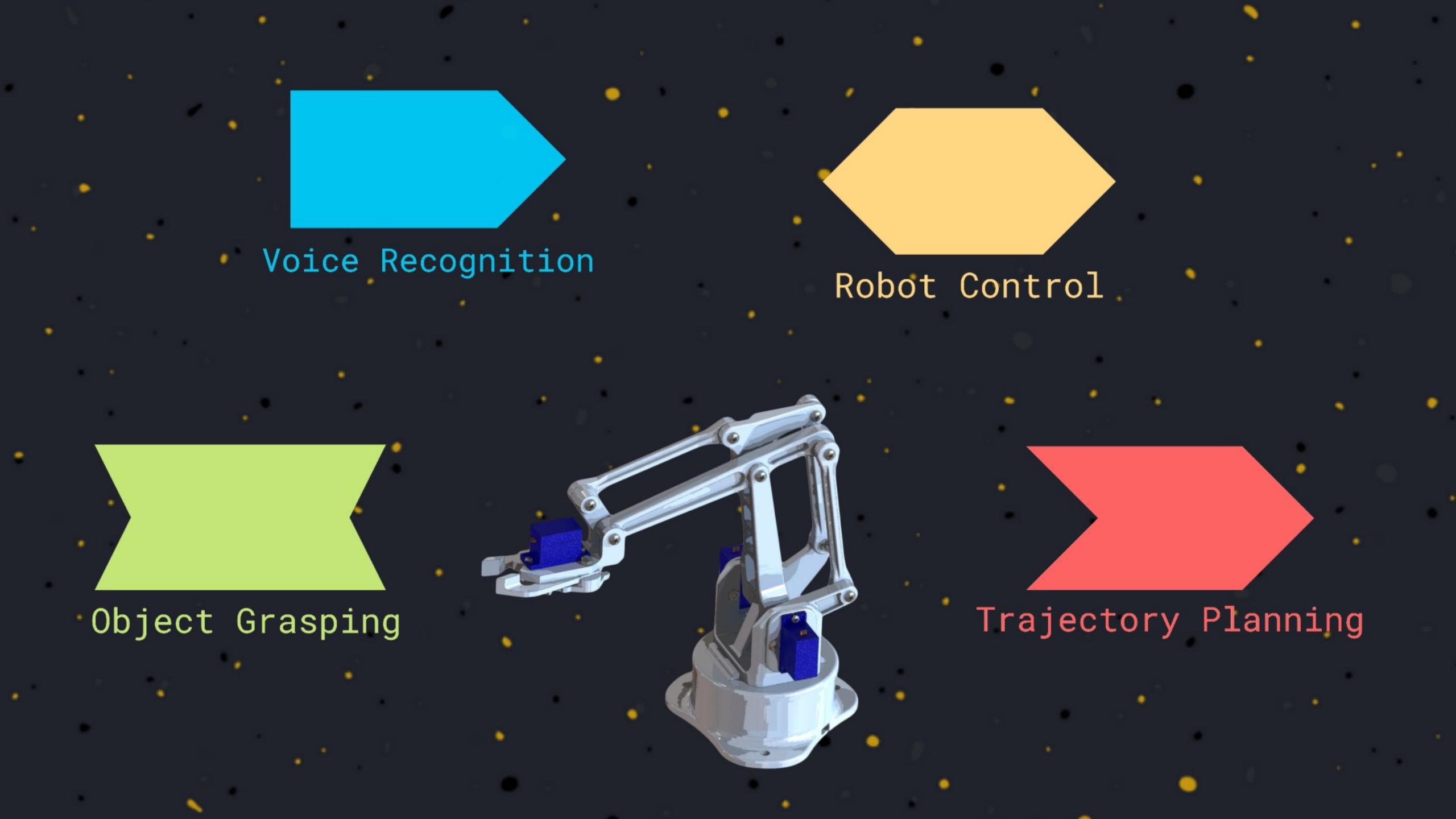
Artificial
Intelligence

Software

Control

Computer
Vision





Object Grasping

Voice Recognition

Robot Control

Trajectory Planning



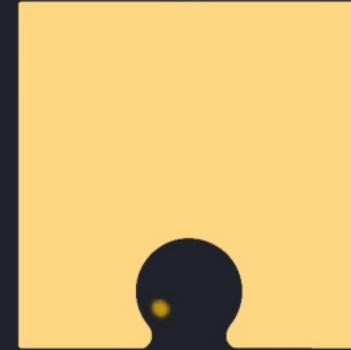


Voice Recognition



Object Grasping

ROS 2

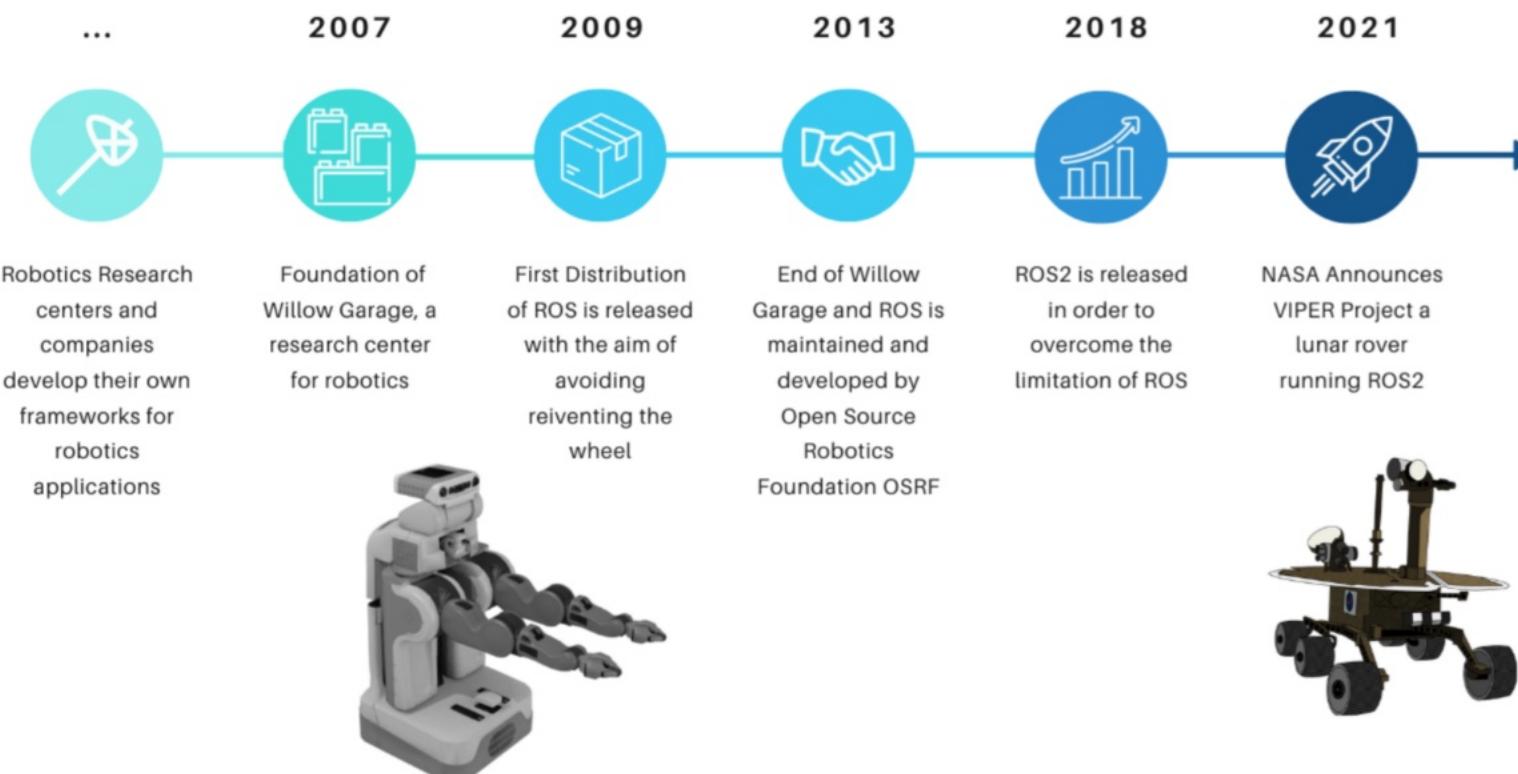


Robot Control



Trajectory Planning

ROS 2

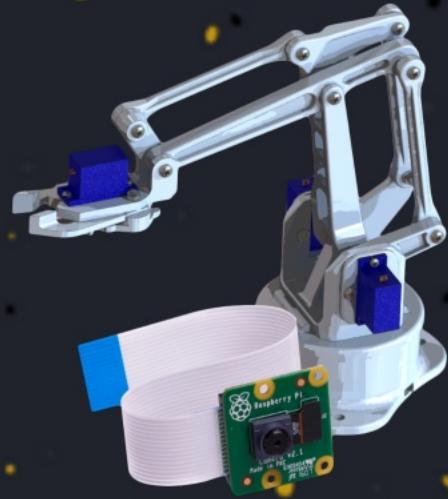


ROS 2



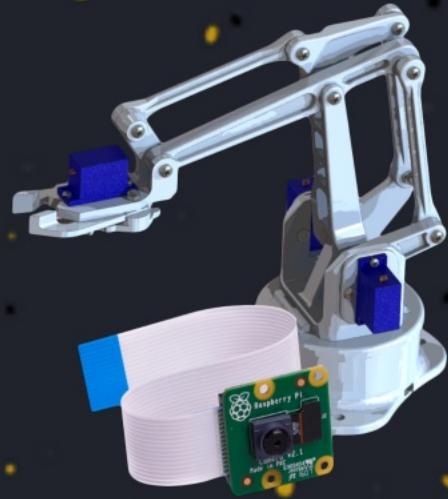
What is ROS 2?

What is ROS 2?



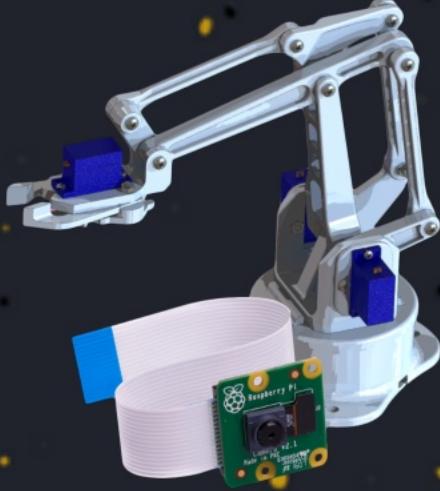
hand tracking
and following

What is ROS 2?



hand tracking
and following

What is ROS 2?

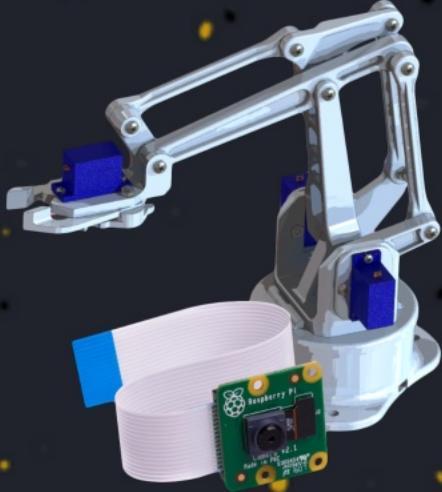


hand tracking
and following



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?



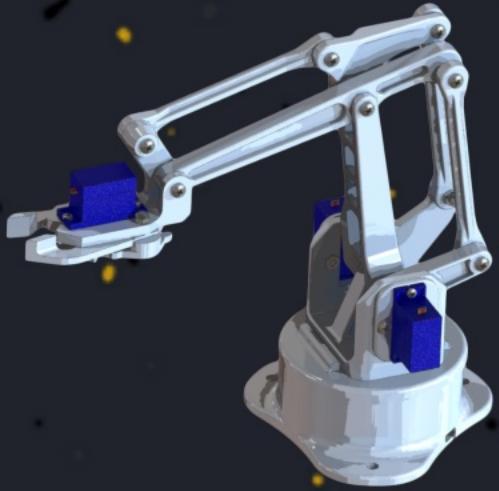
ROS 2



hand tracking
and following



What is ROS 2?



ROS 2



hand tracking
and following



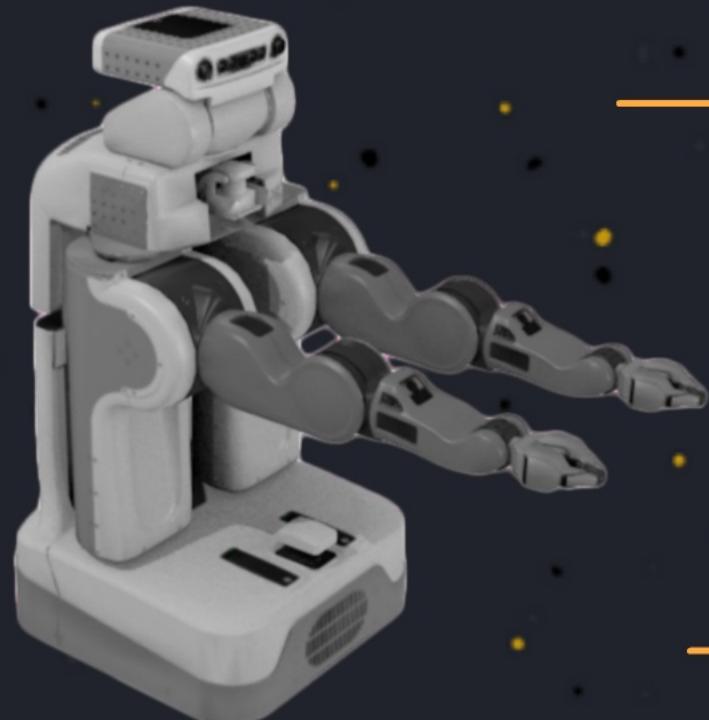
ROS 2



Why ROS 2?

Unreliable
Networks

Embedded
Platforms



Secure
Communication

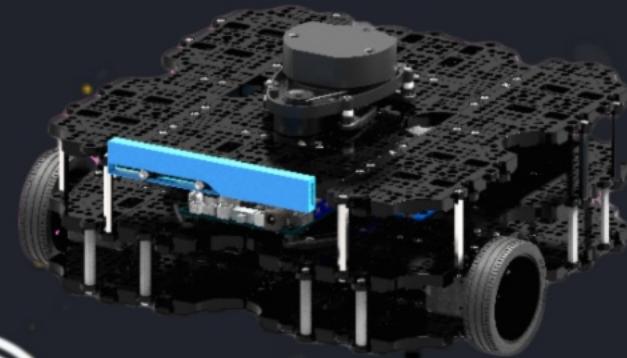
Fleet of
Robots

Realtime
Systems

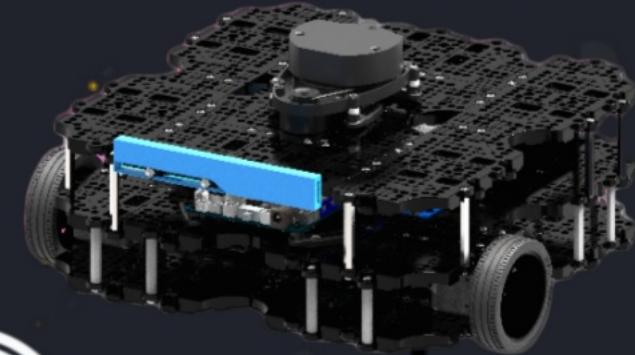
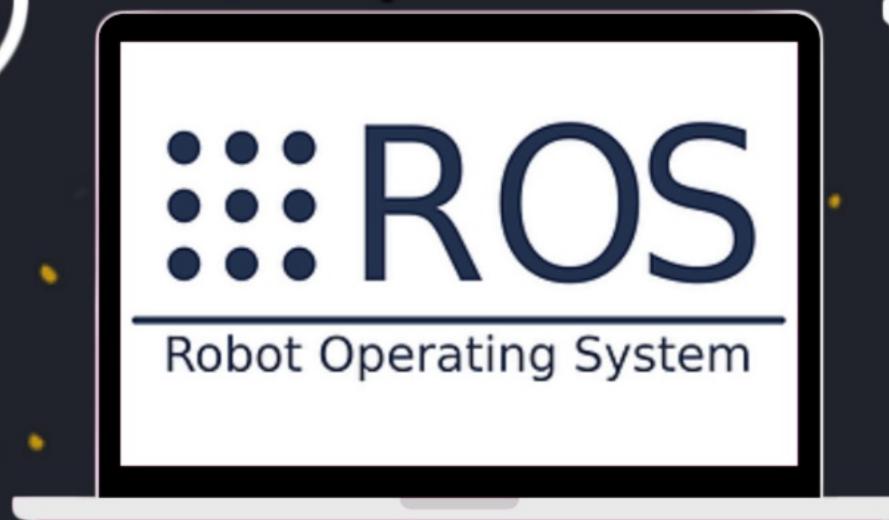
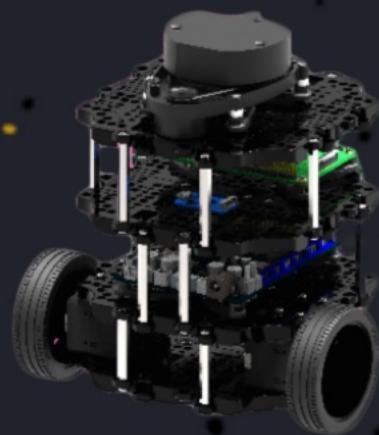
ROS



Unreliable Networks



Unreliable Networks



Why ROS 2?

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Networks

Embedded
Platforms



Secure
Communication

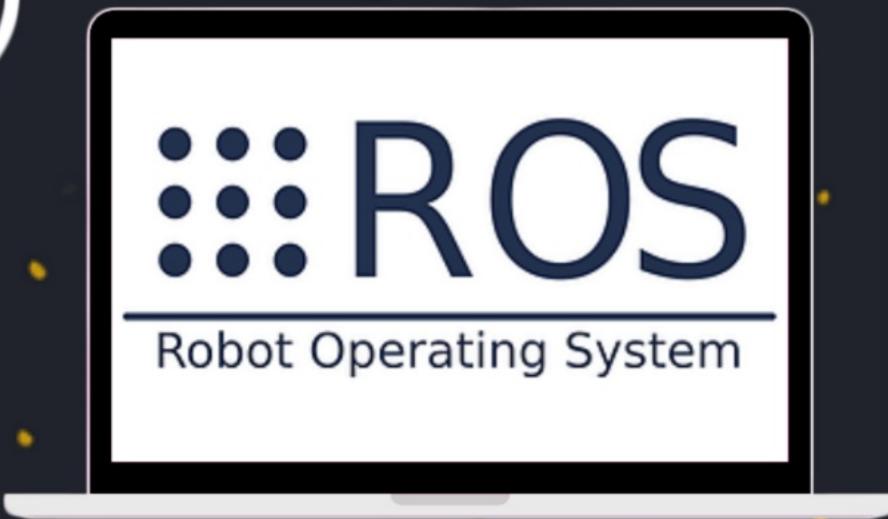
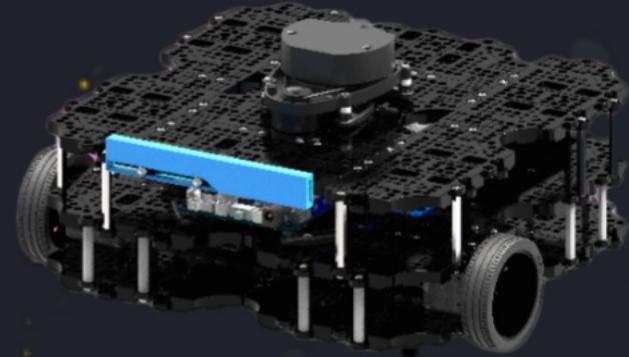
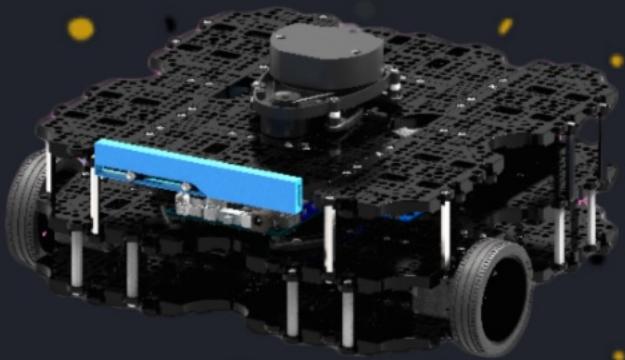
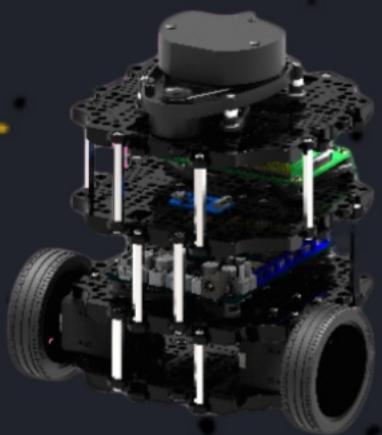
Fleet of
Robots

Realtime
Systems

ROS



Fleet of Robots



Why ROS 2?

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Secure
Communication

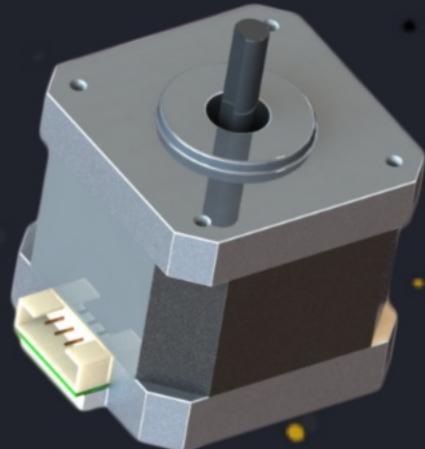
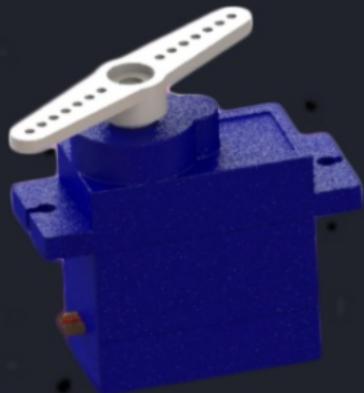
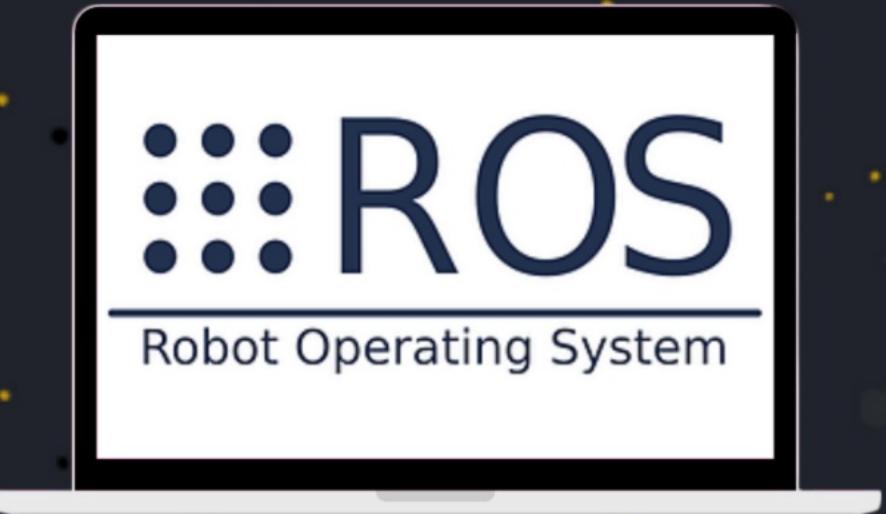
Fleet of
Robots

Realtime
Systems

ROS



Embedded Platforms



Why ROS 2?

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Networks

Embedded
Platforms



Secure
Communication

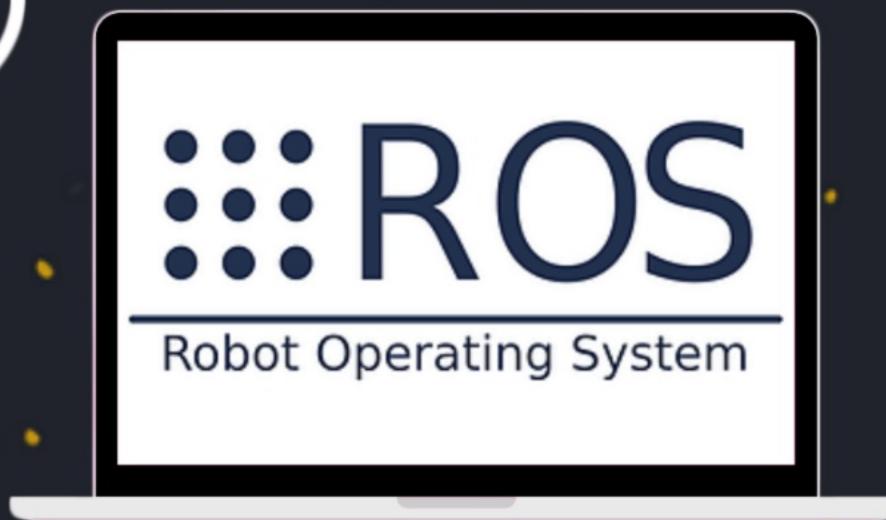
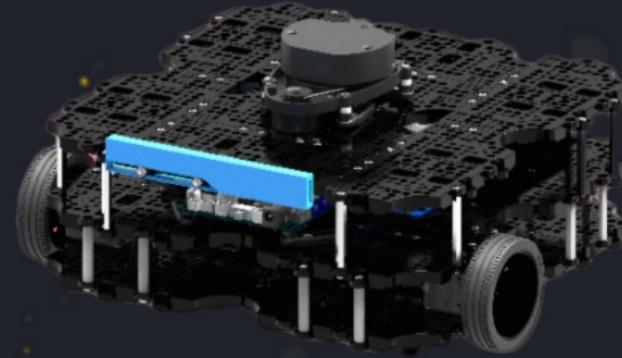
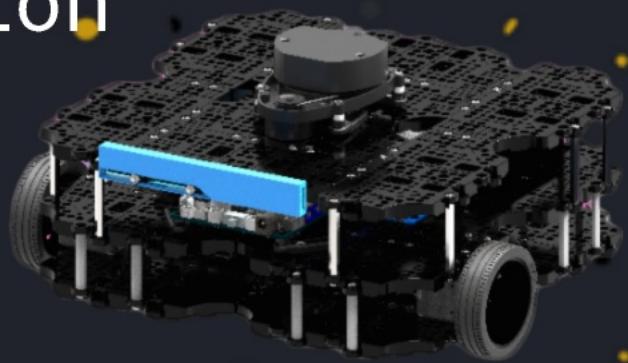
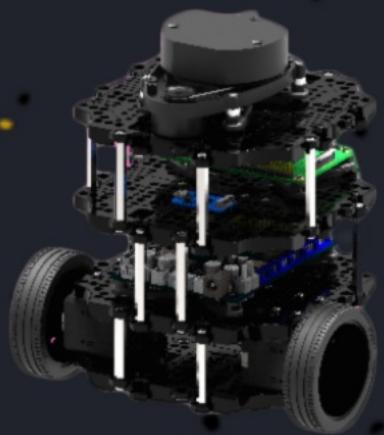
Fleet of
Robots

Realtime
Systems

ROS



Secure Communication



Why ROS 2?

Unreliable
Networks

Embedded
Platforms



Fleet of
Robots

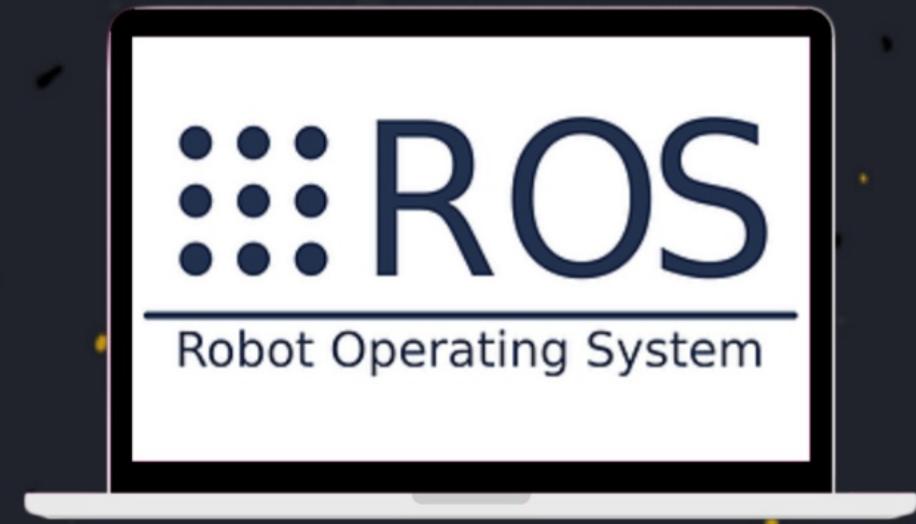
Secure
Communication

ROS



Realtime
Systems

Realtime Systems



Why ROS 2?

Unreliable
Networks

Embedded
Platforms



Fleet of
Robots

Secure
Communication

ROS



Realtime
Systems



DDS

Cyclone DDS

Fast DDS

Connexxt 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

Connexxt 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

Connexxt DDS

Why ROS 2?

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Secure
Communication

Fleet of
Robots

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ROS



ROS 2



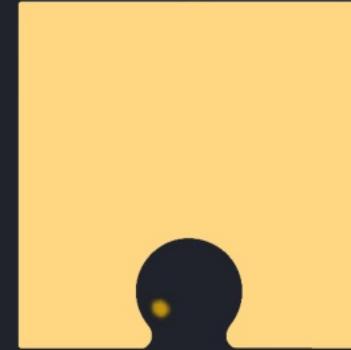


Voice Recognition



Object Grasping

ROS 2



Robot Control



Trajectory Planning

Electronics

Mechanics

Sensors

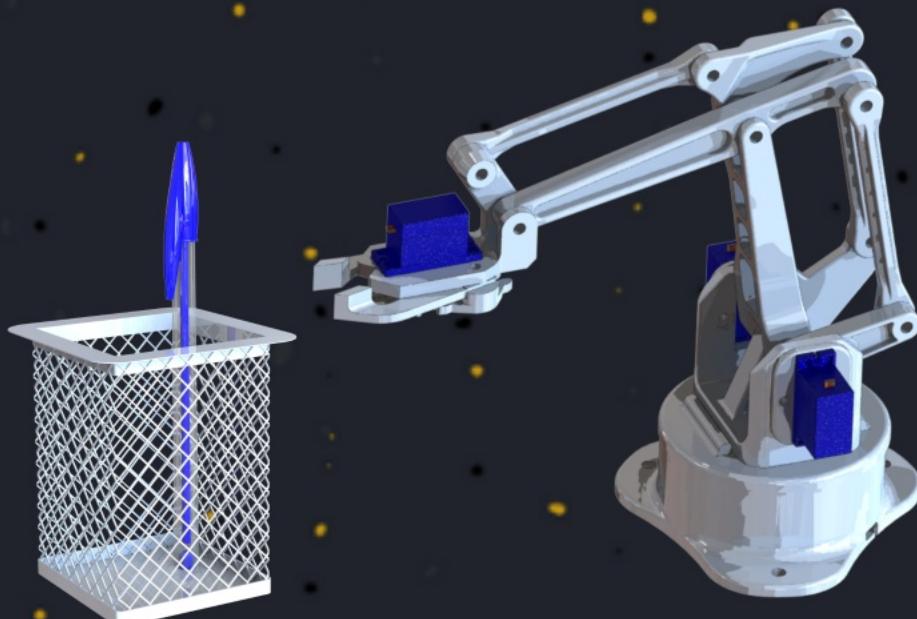
Network

Artificial
Intelligence

Software

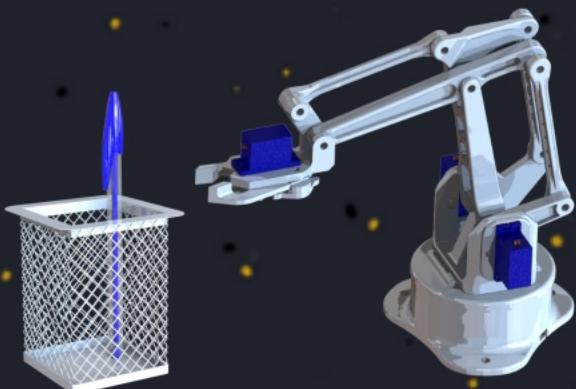
Control

Computer
Vision



“

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Robotics,
Sciavicco
Siciliano Villani



Hardware
Abstraction

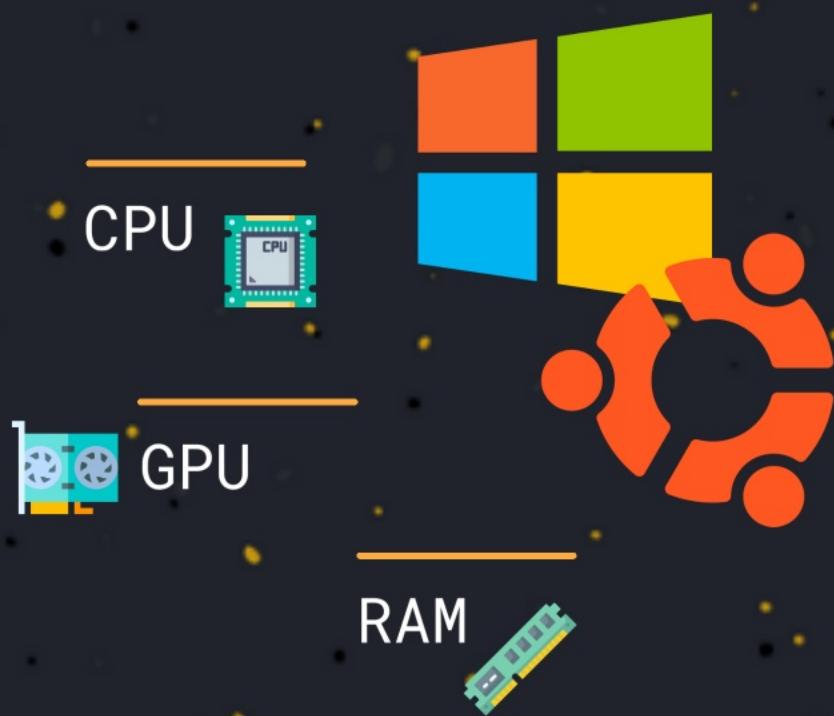


Low-Level
Device Control

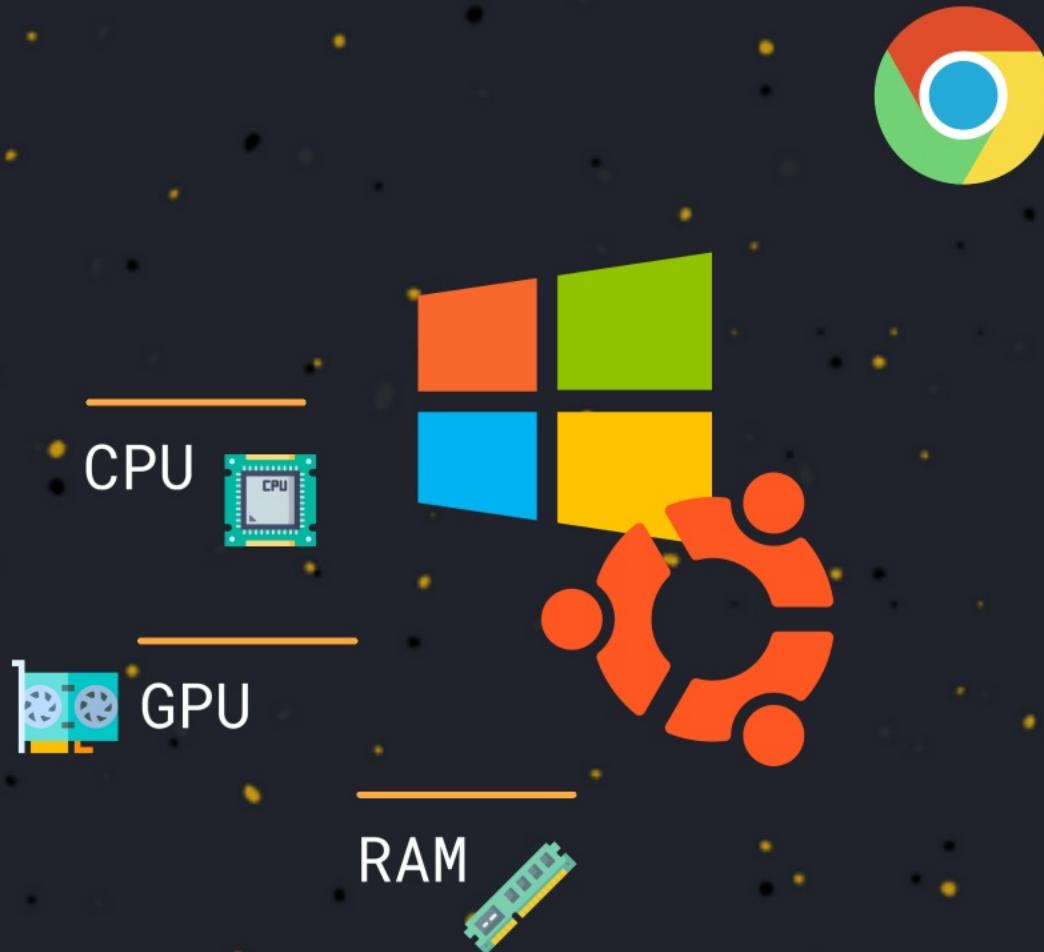
Communication
Between Process

Package
Management

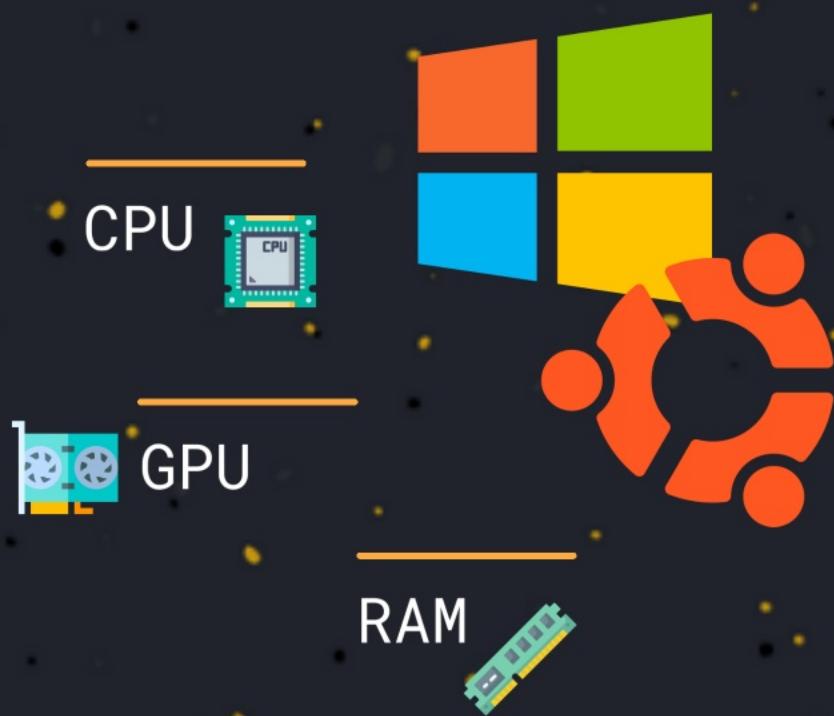
Hardware Abstraction



Hardware Abstraction

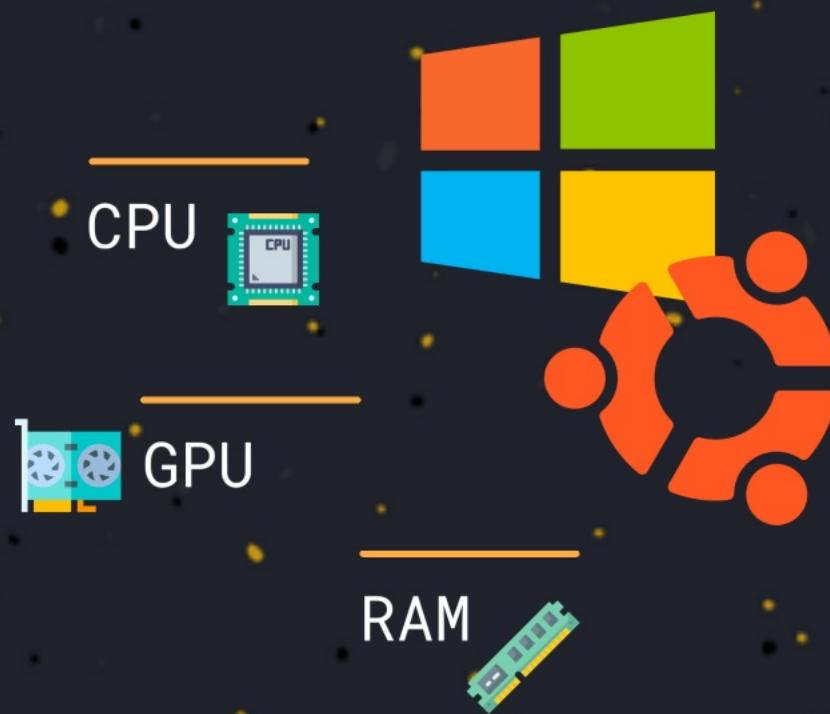


Hardware Abstraction

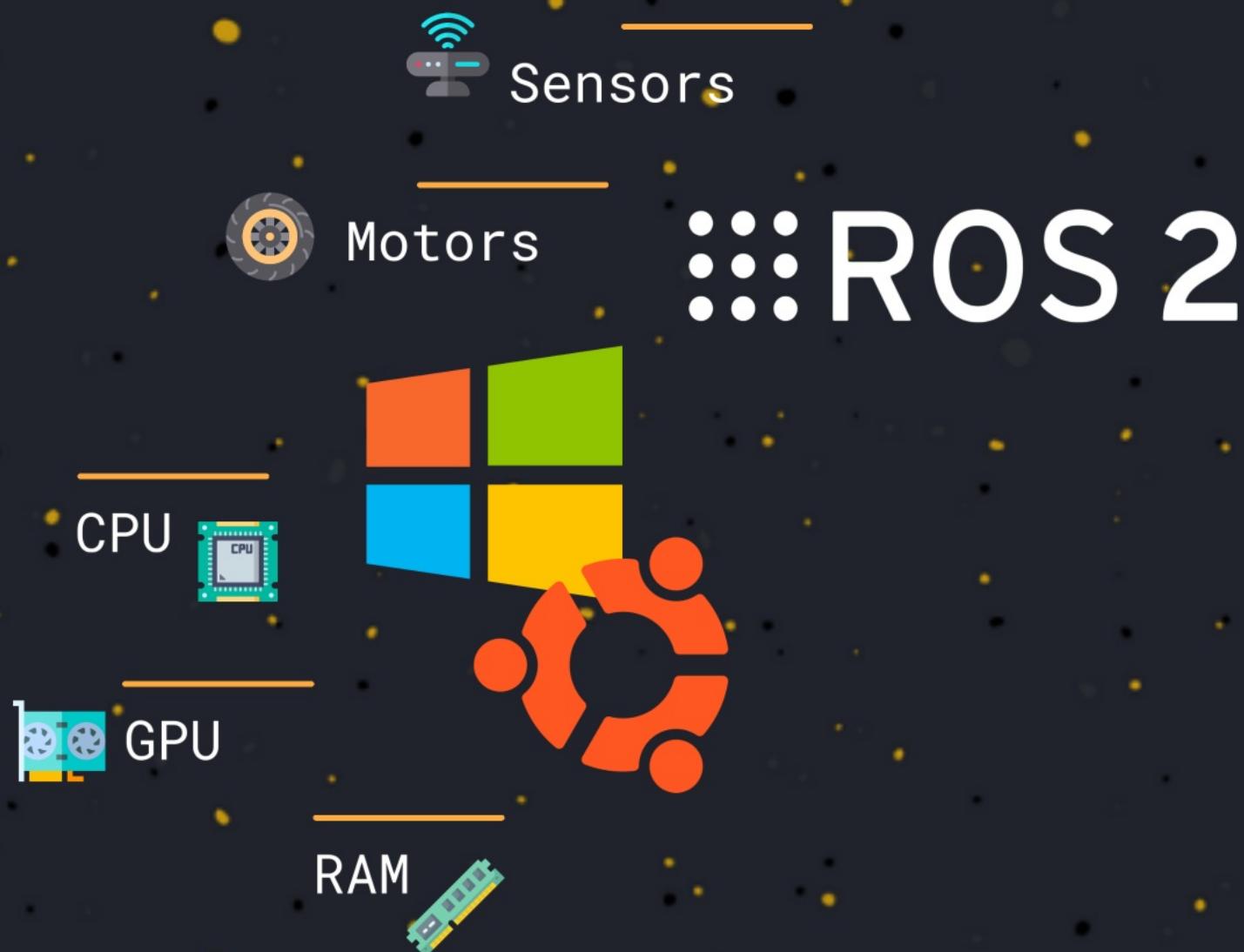


Hardware Abstraction

ROS 2

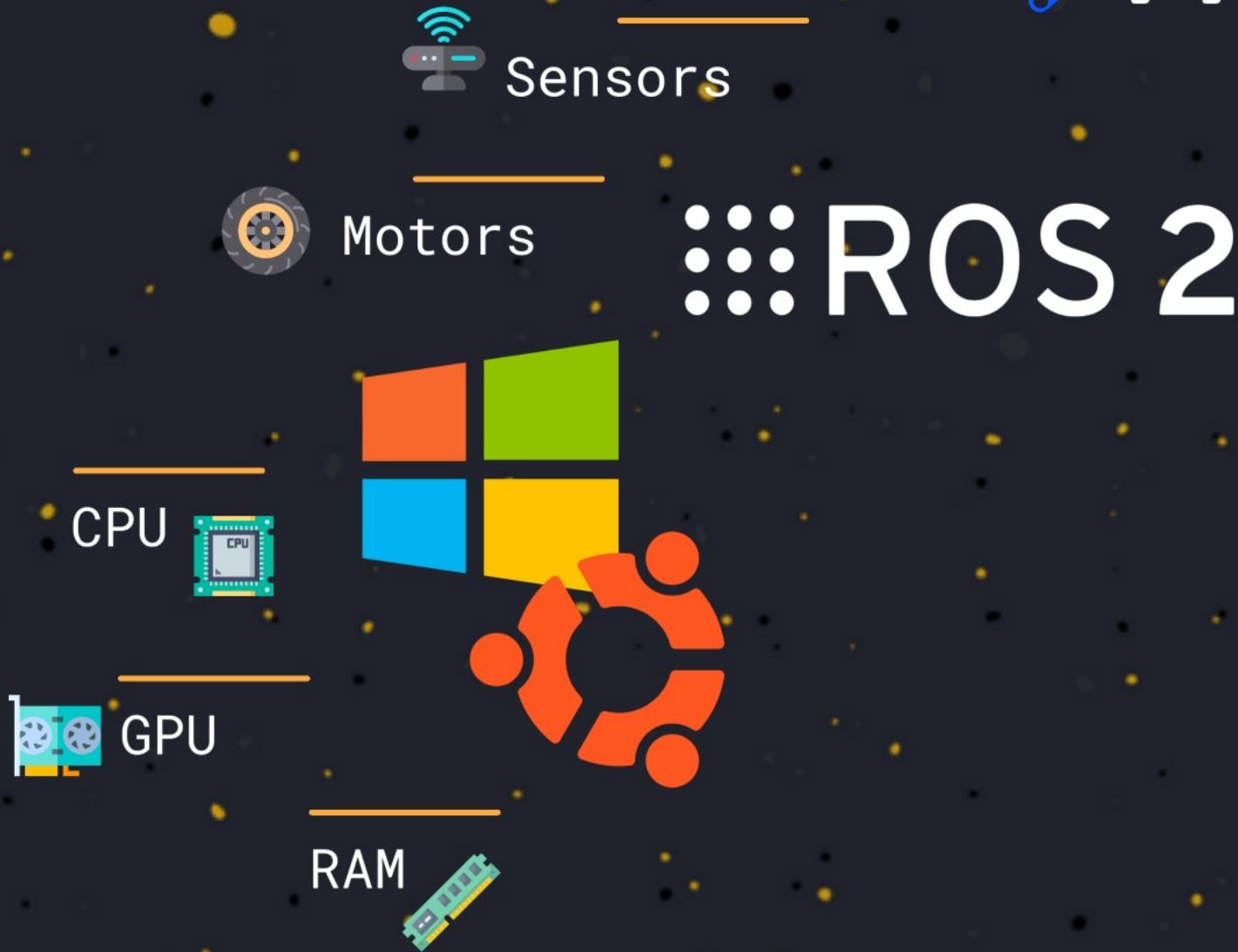


Hardware Abstraction



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

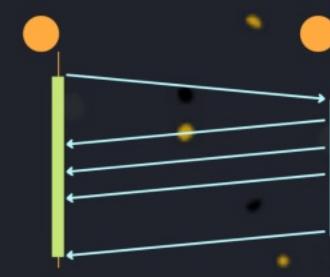
Topic



Service



Action



Topic



Topic



Topic



Topic

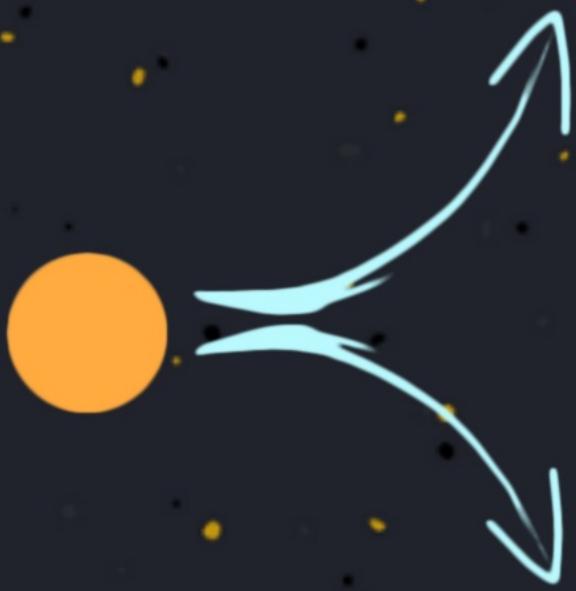
Topic



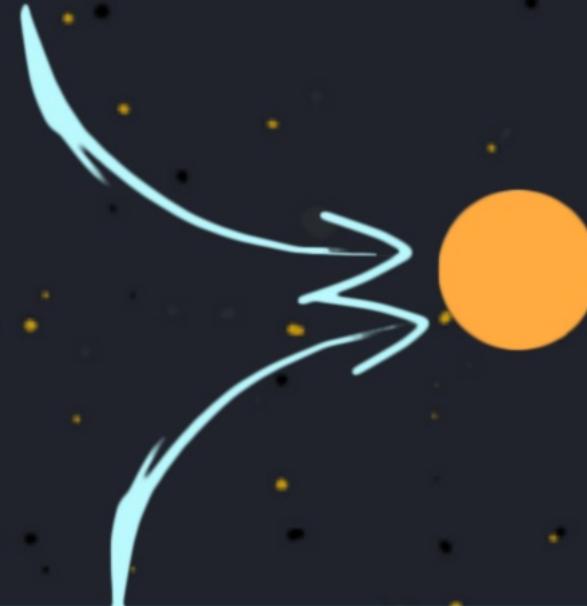
Topic

Topic

/topic_1



/topic_2



Topic

Topic

/topic_1



/topic_2



Communication Between Process

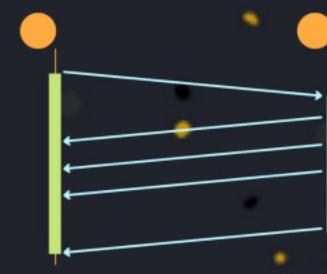
Topic



Service



Action



Service



Client



Server

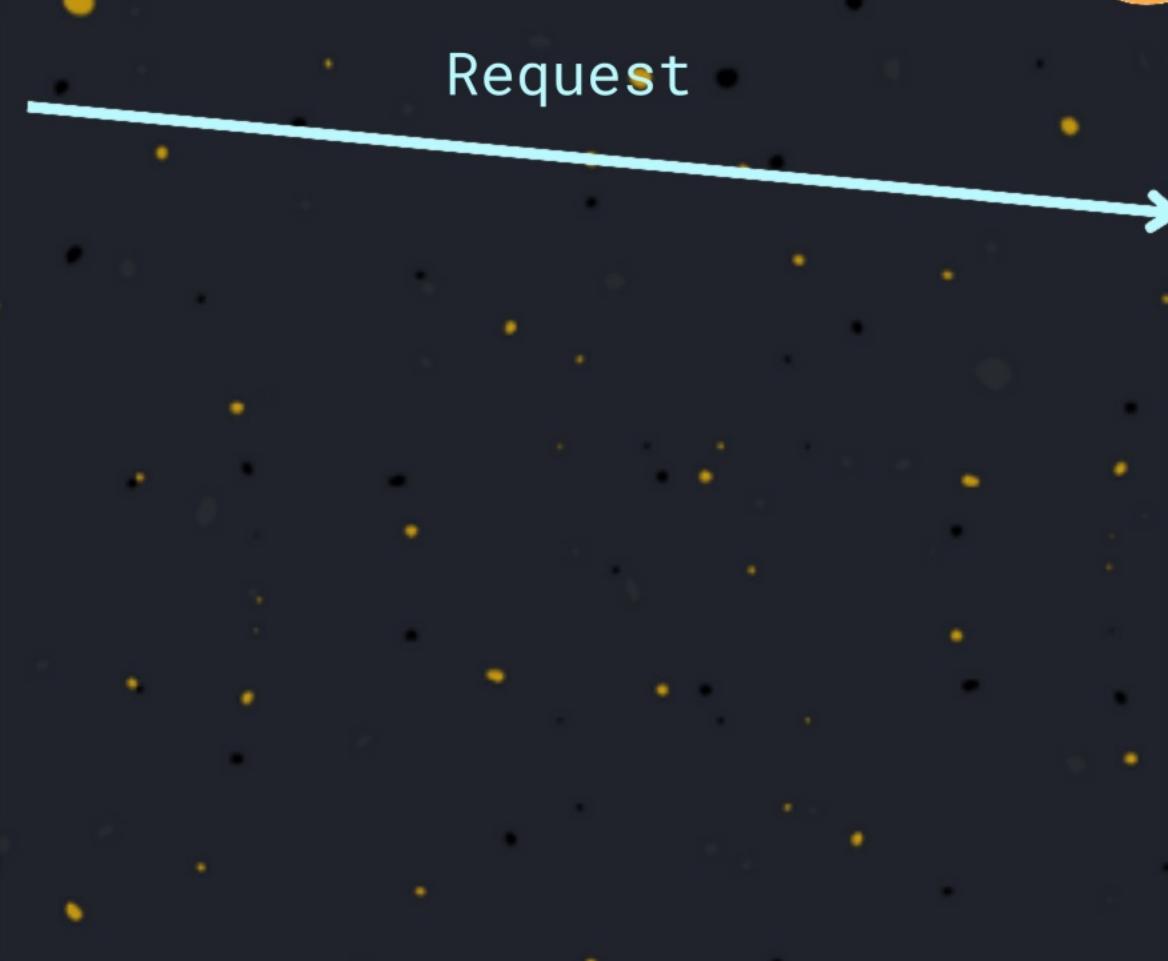
Service



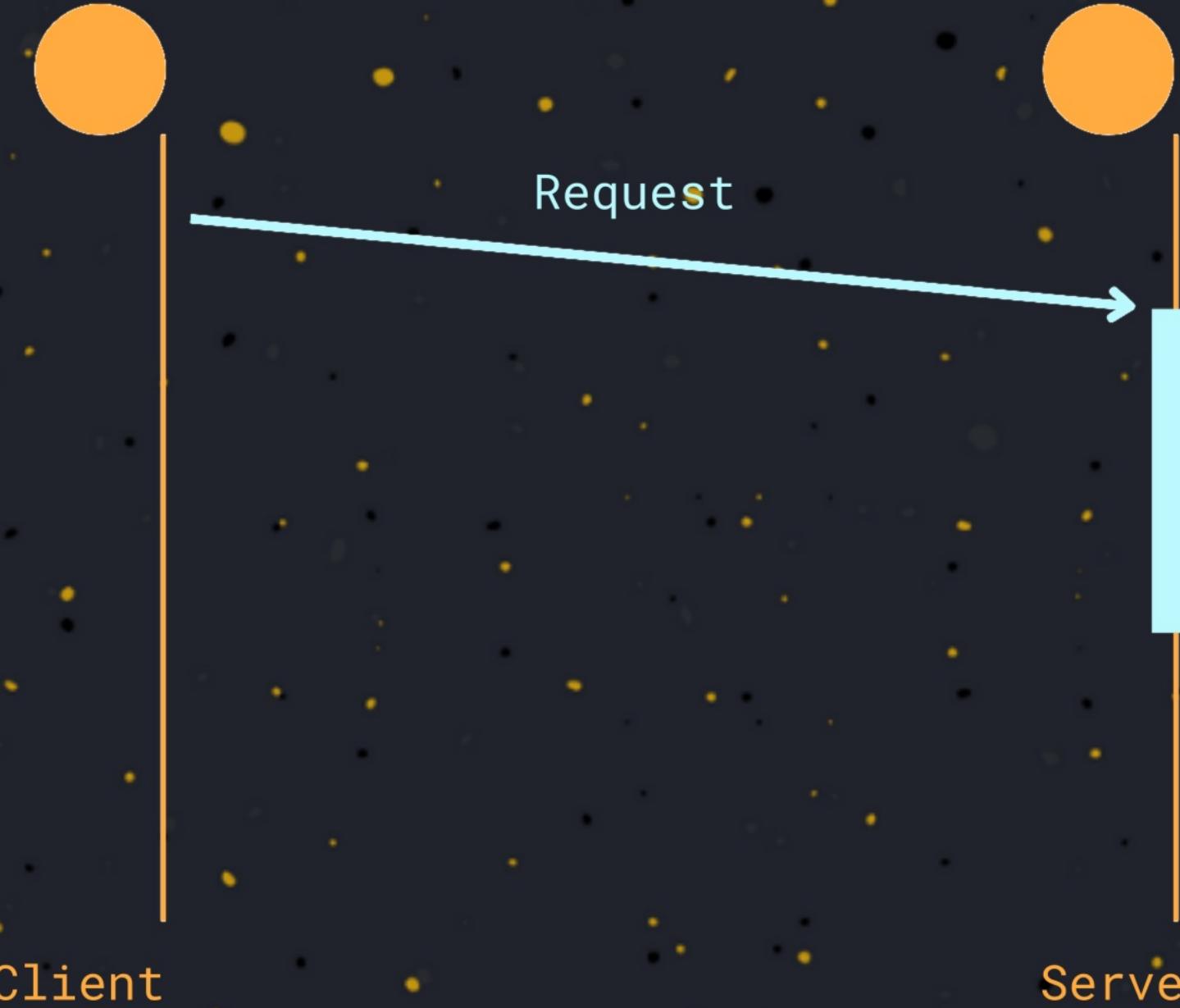
Request

Client

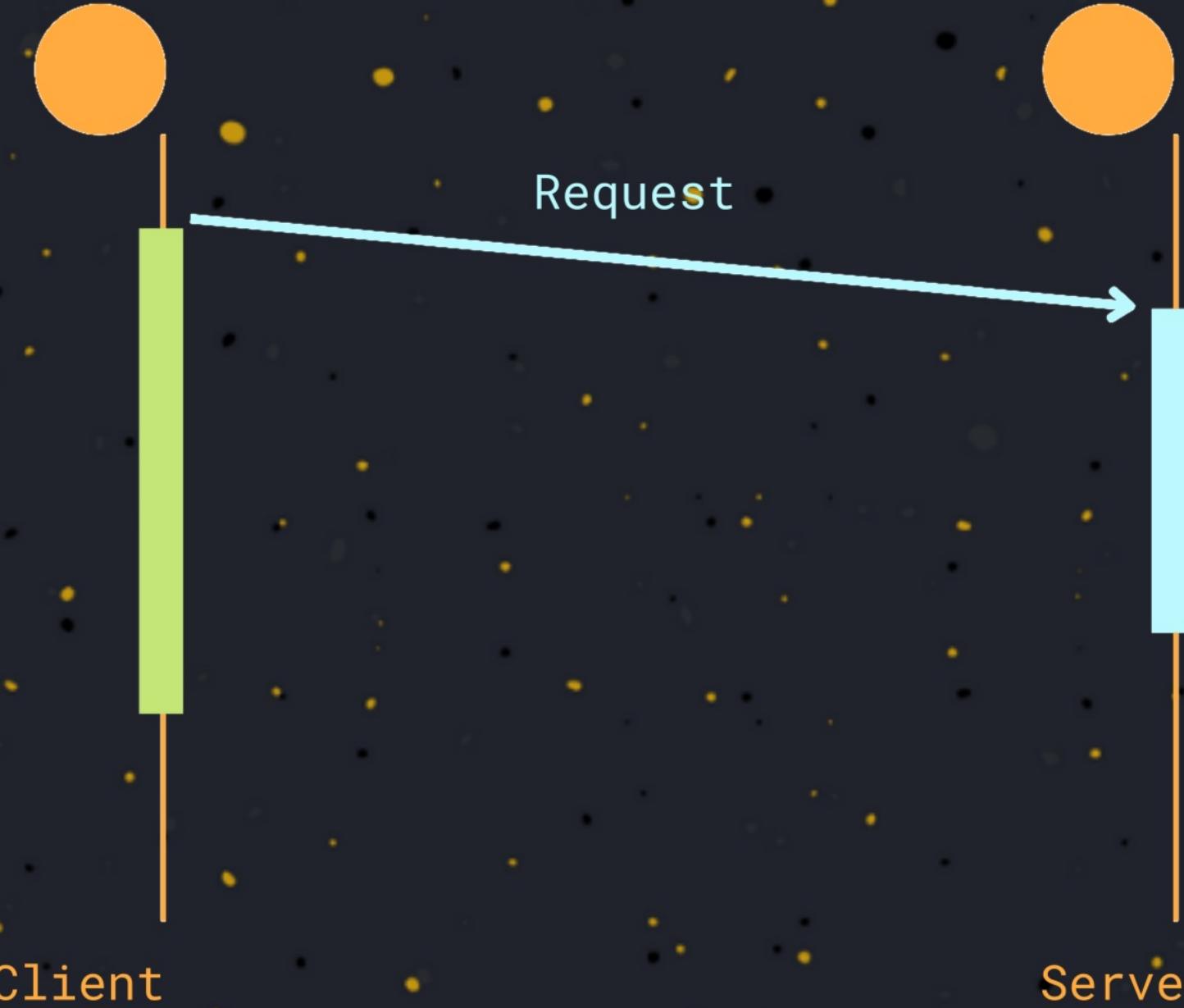
Server



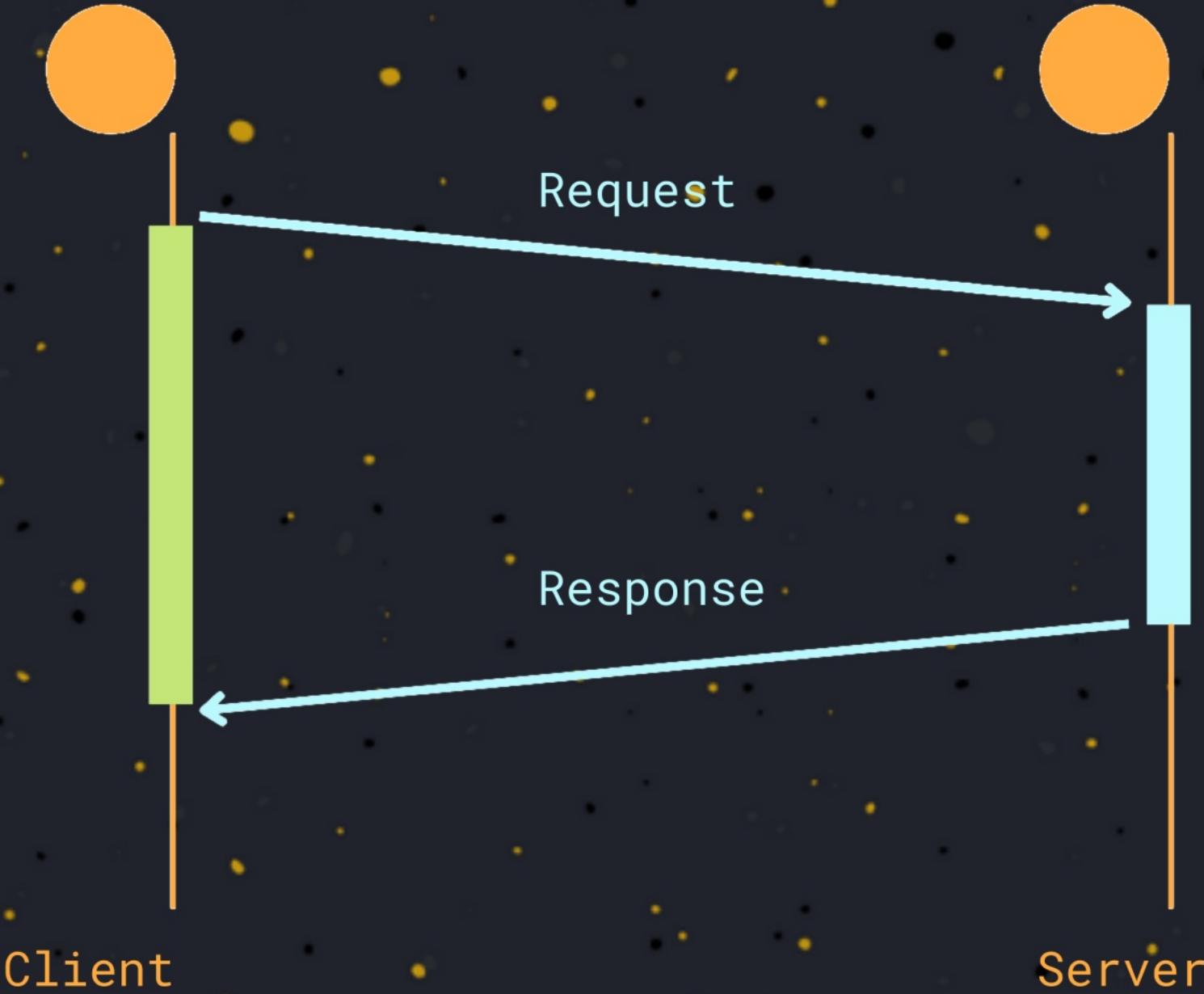
Service



Service



Service



Communication Between Process

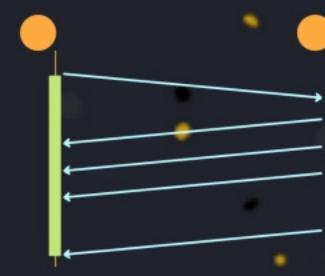
Topic



Service



Action



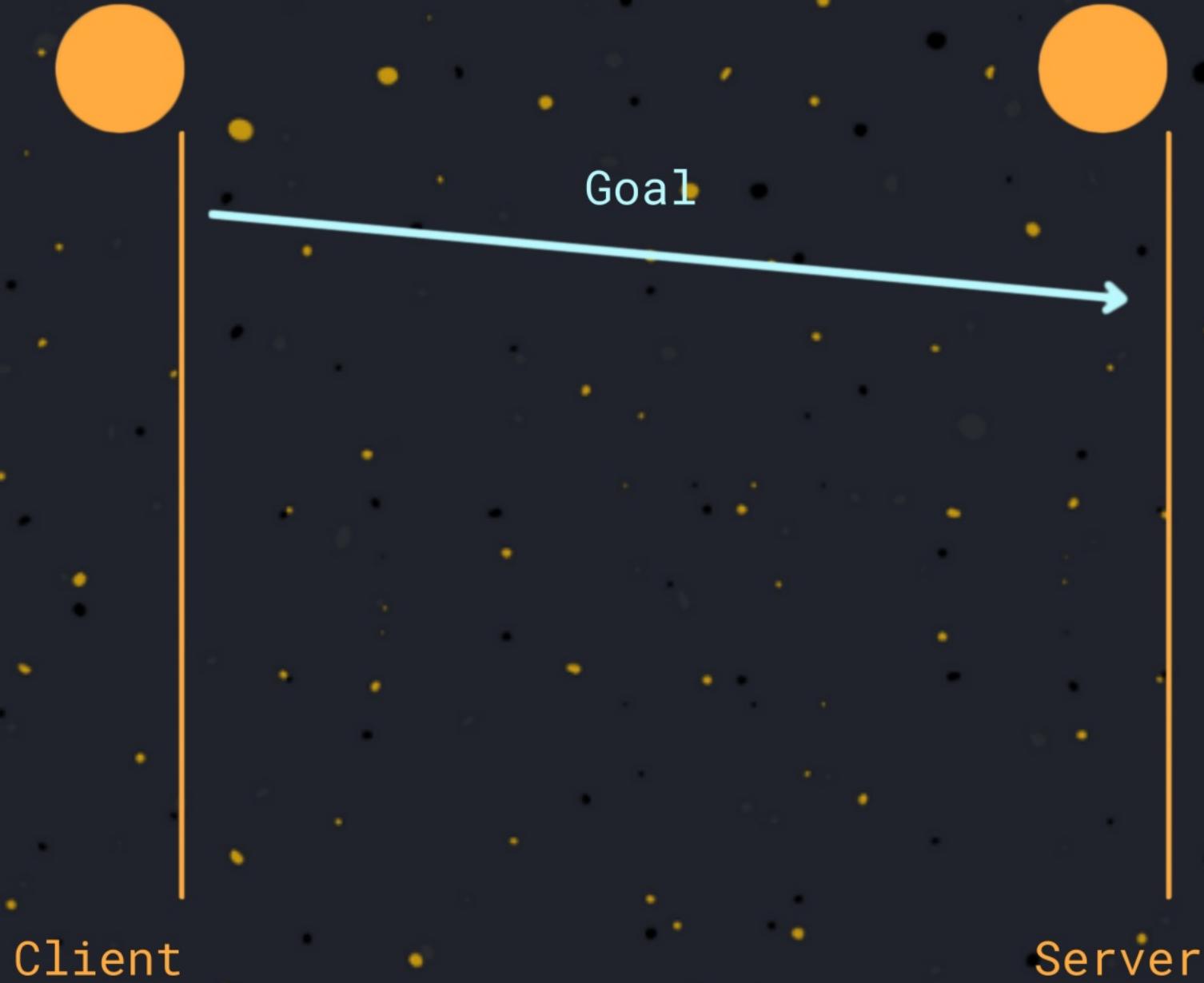
Action



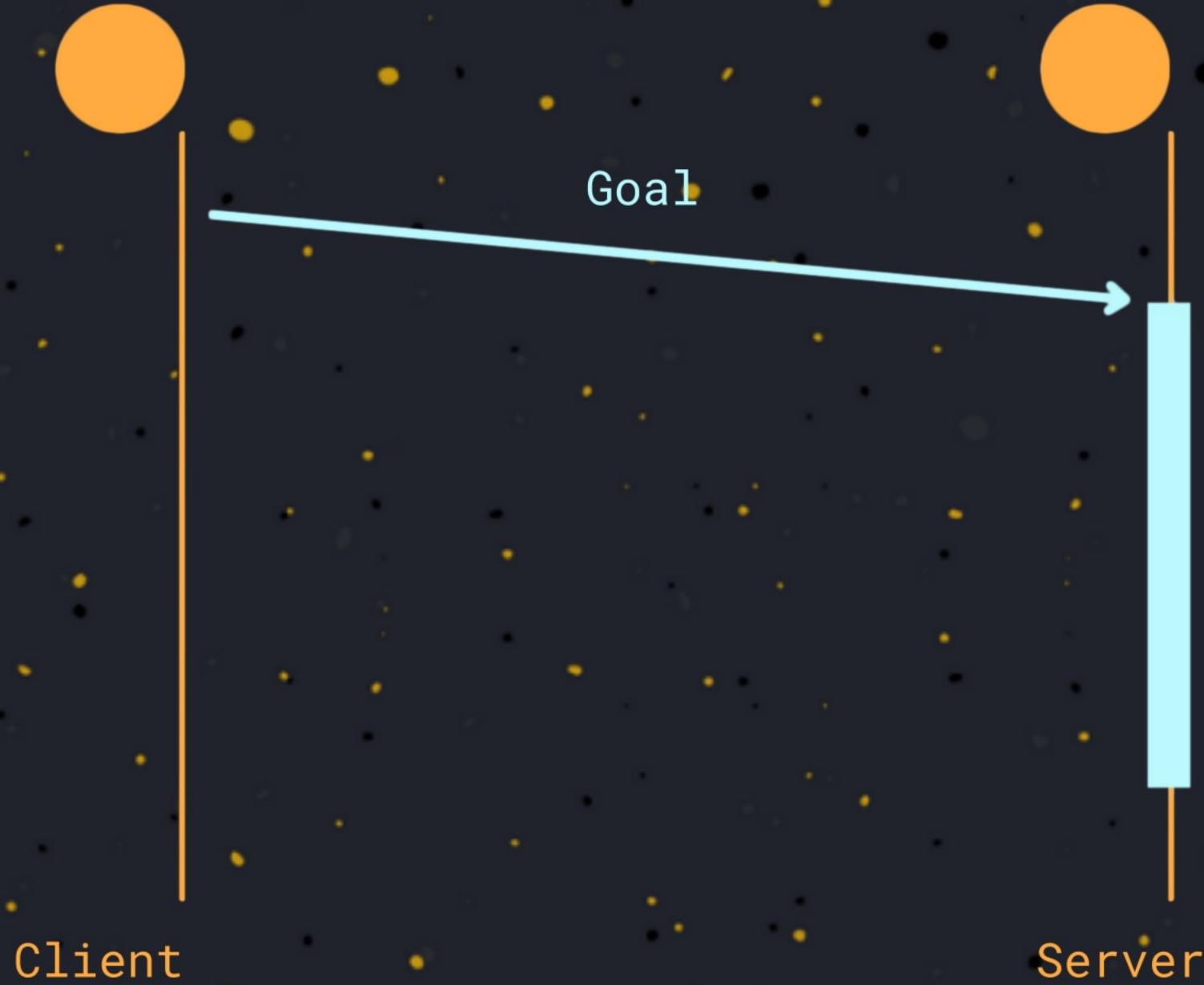
Client

Server

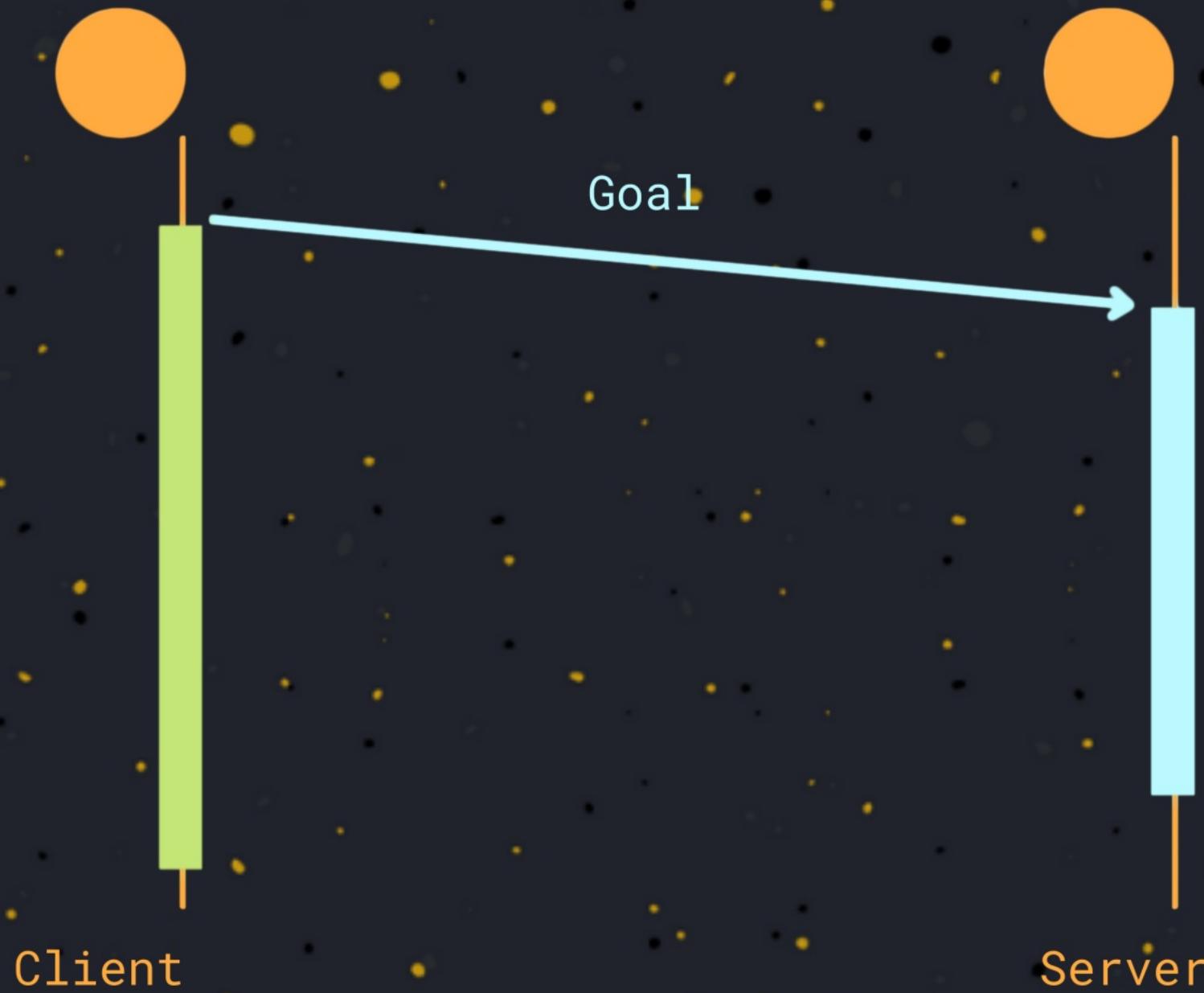
Action



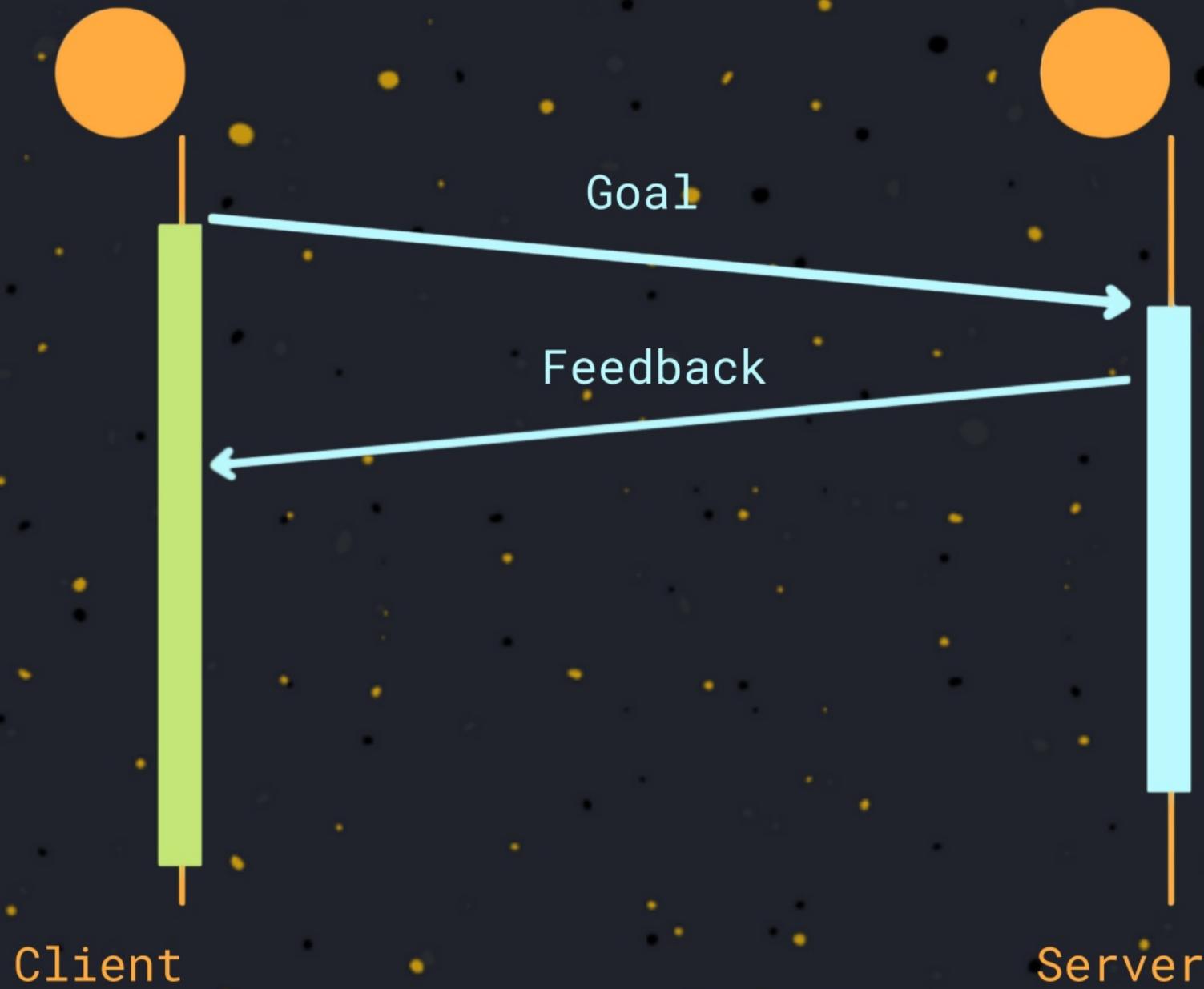
Action



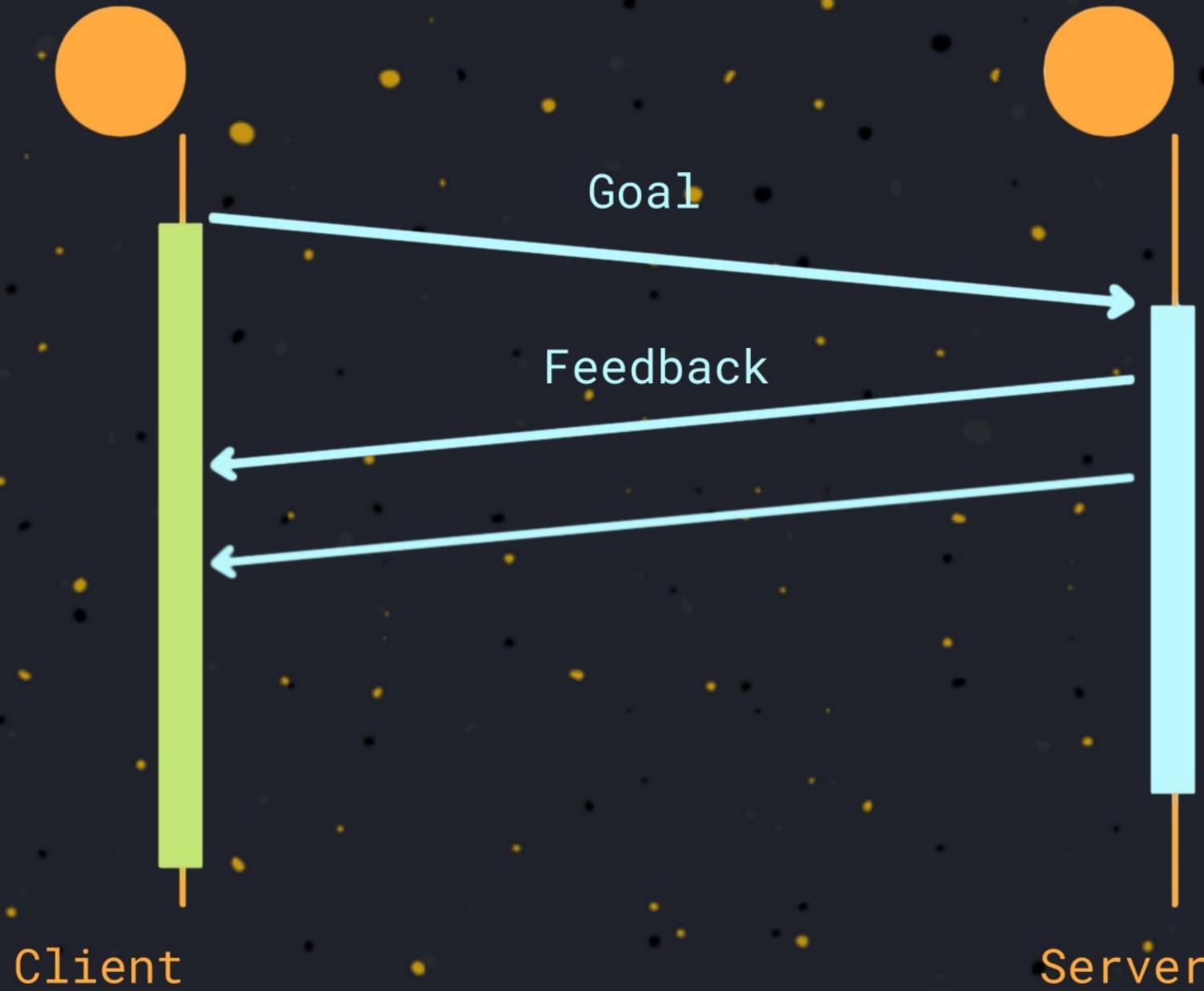
Action



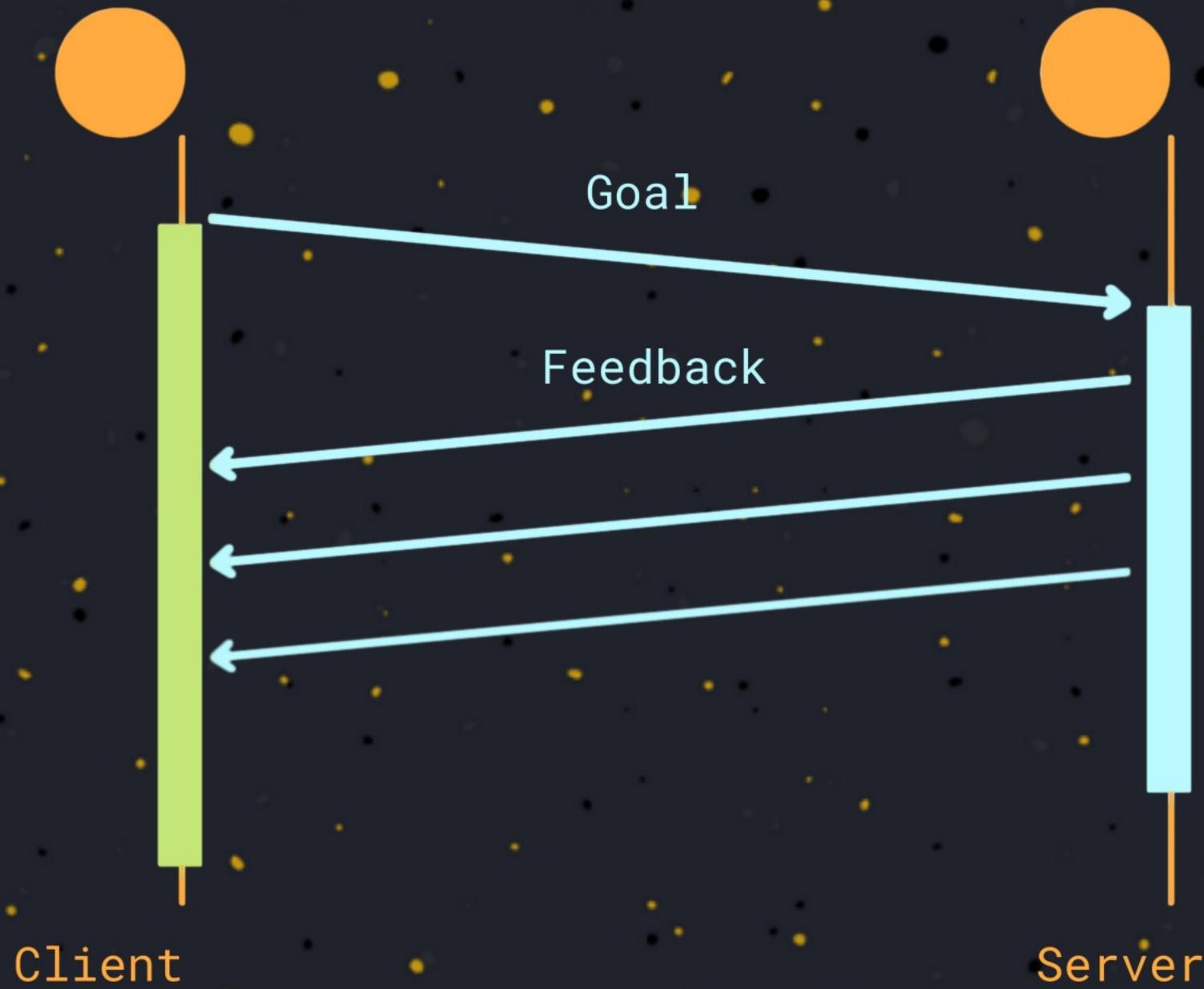
Action



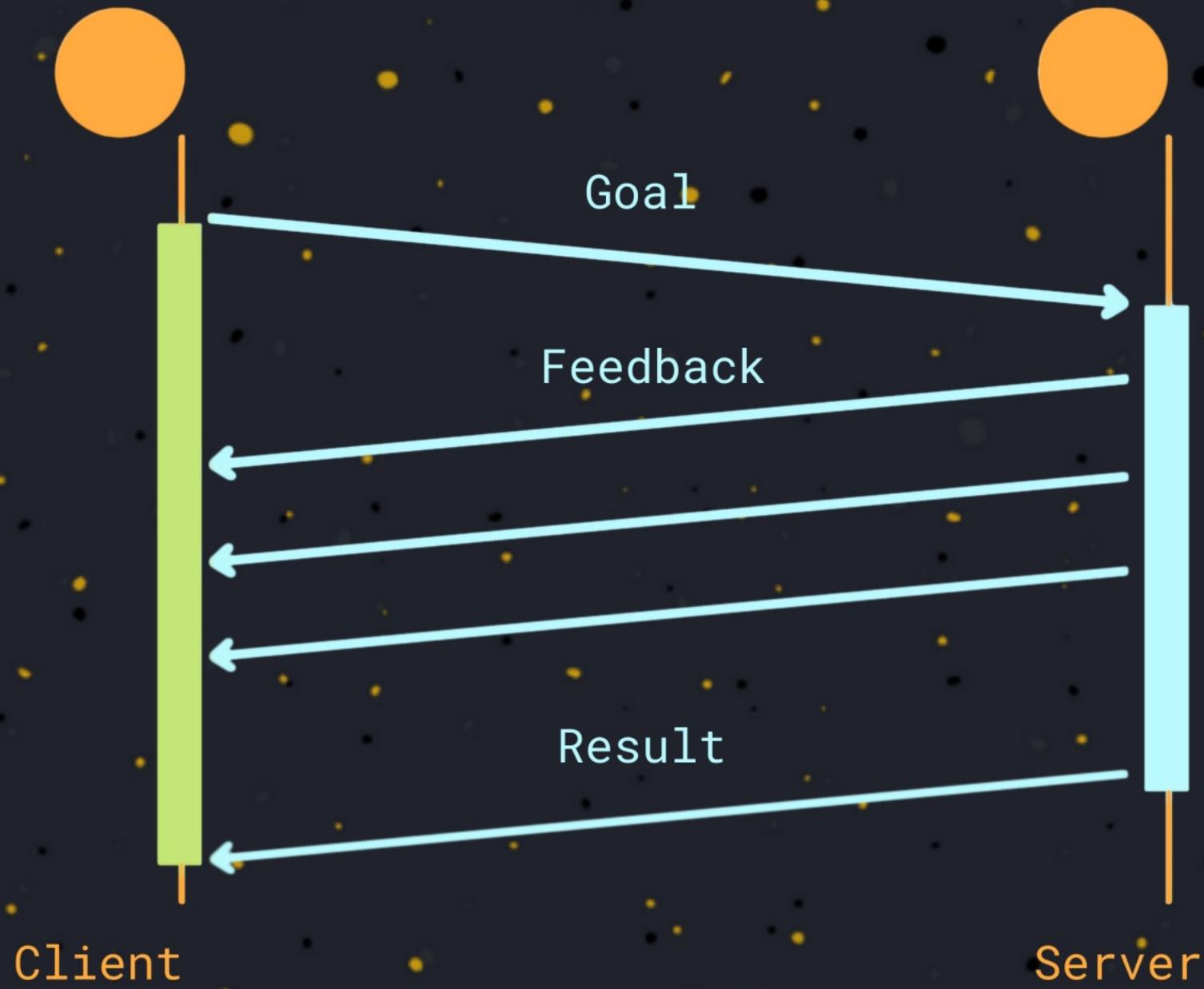
Action



Action



Action



Action

Client

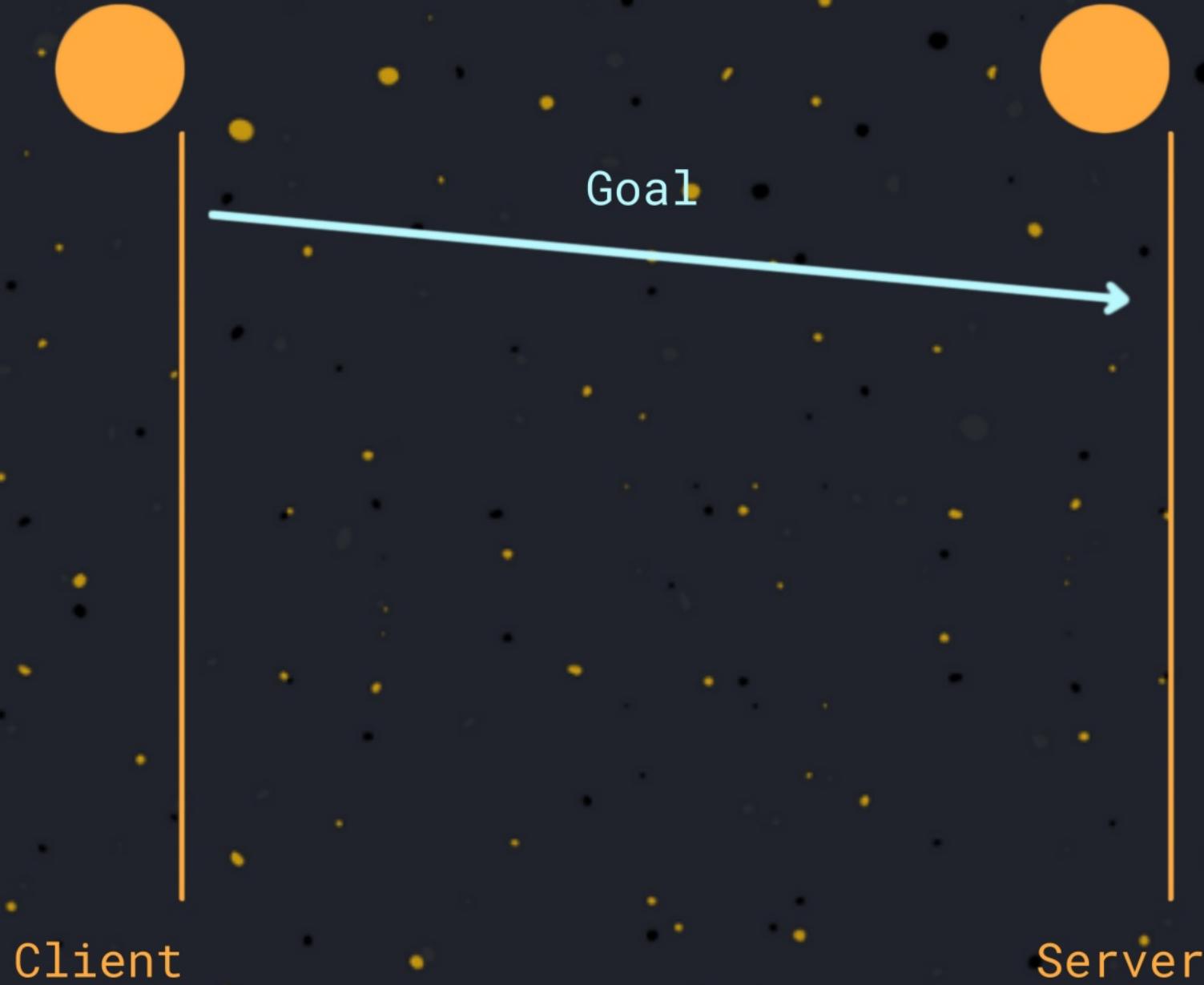
Server

Action

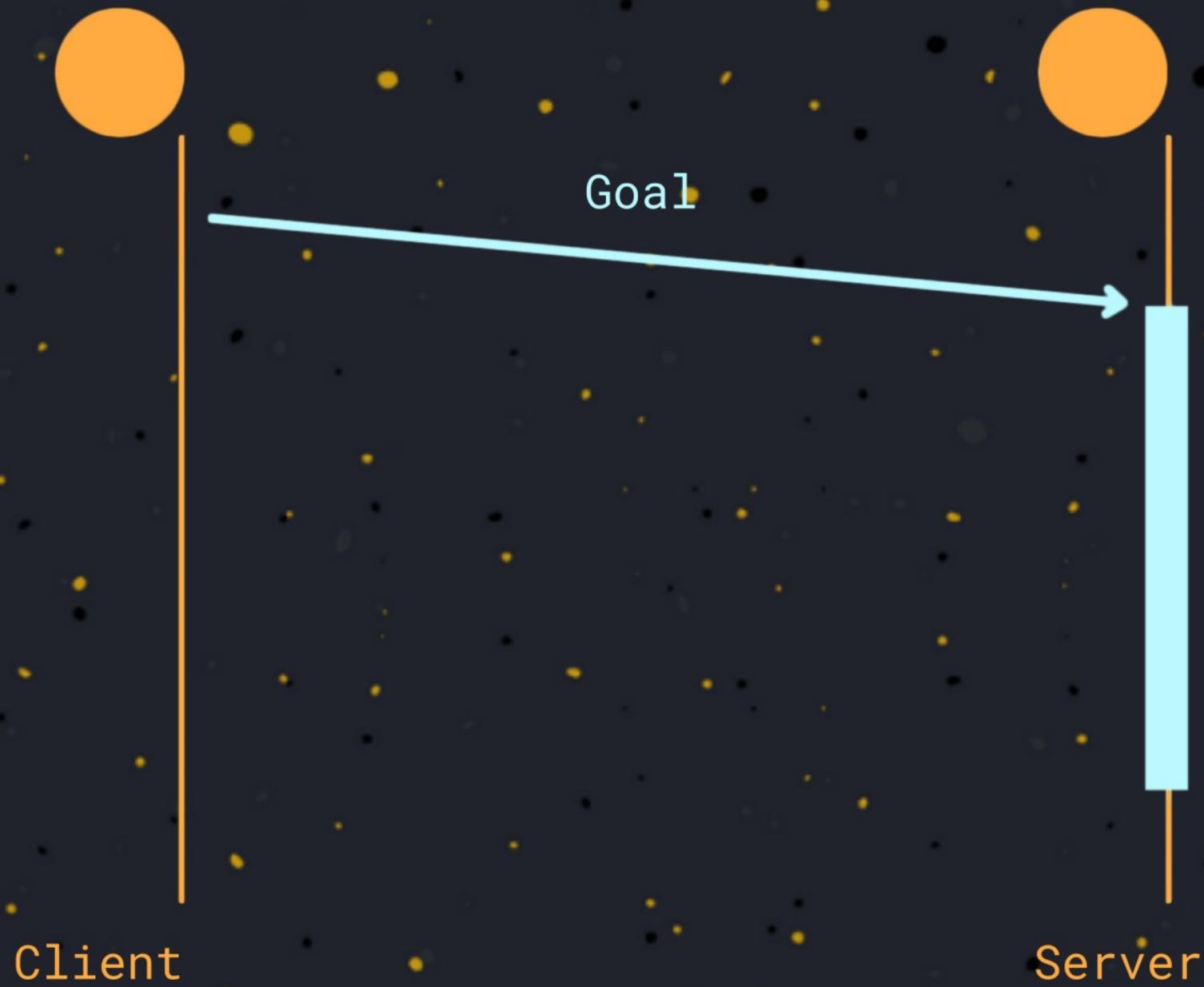
Client

Server

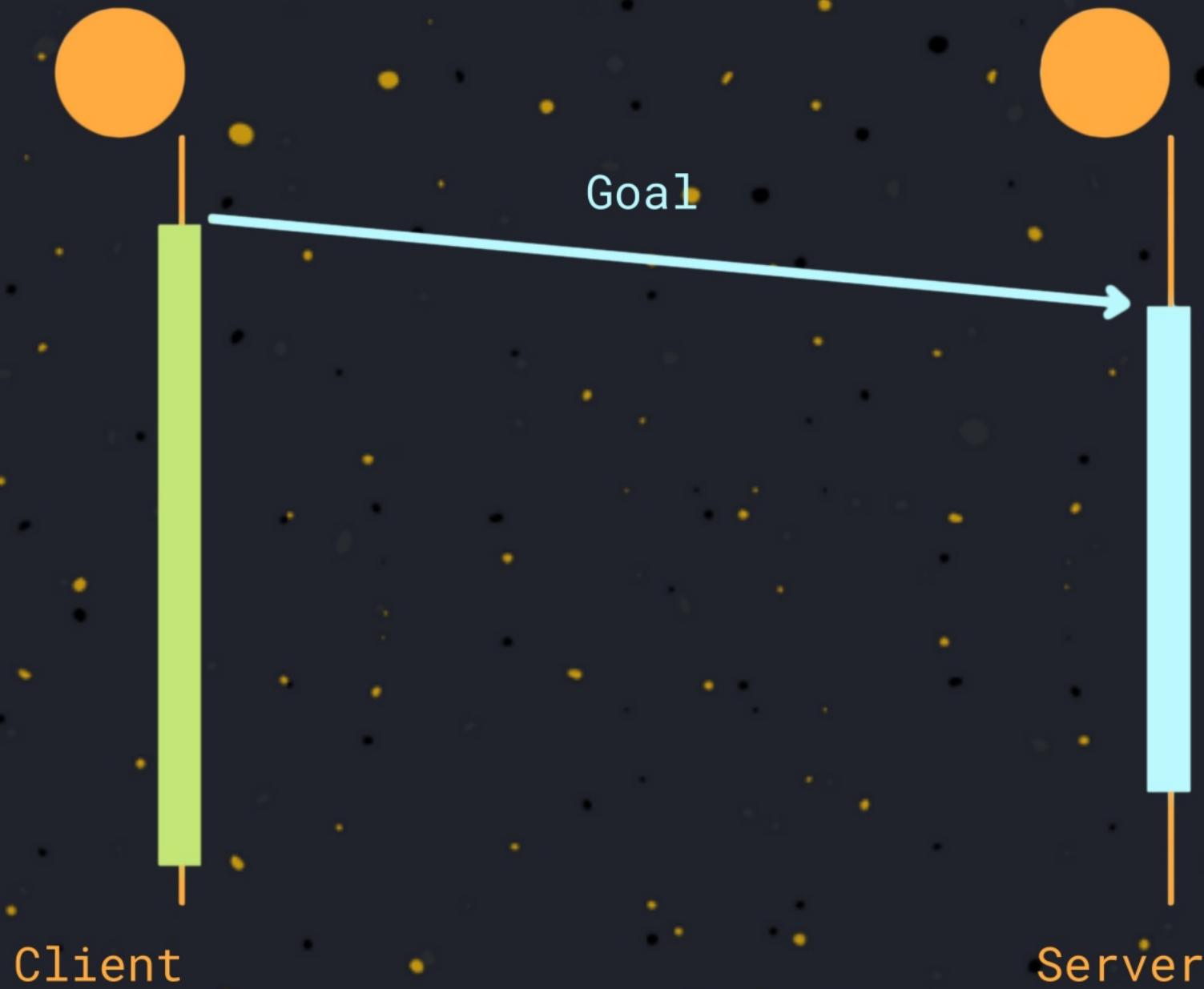
Action



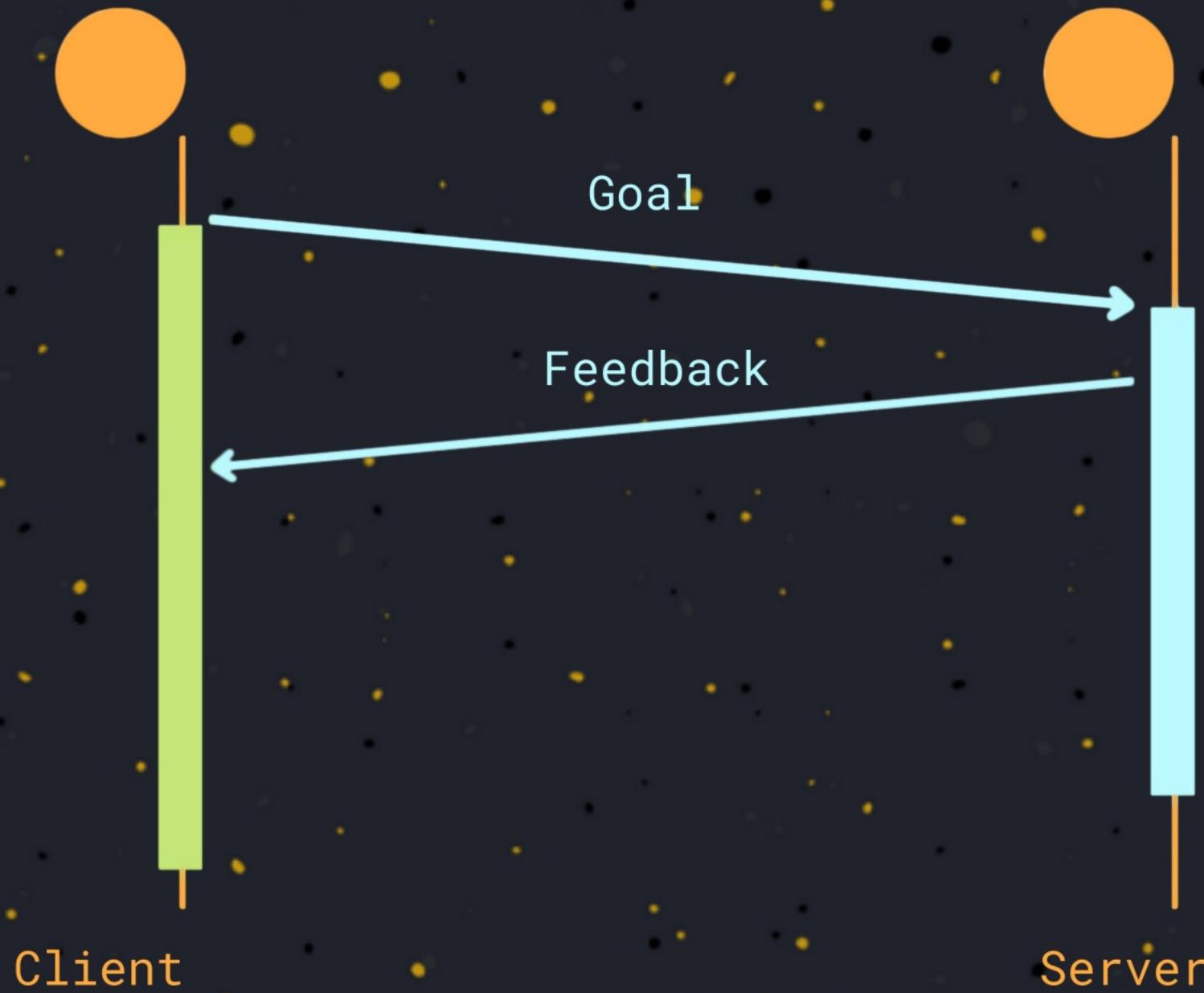
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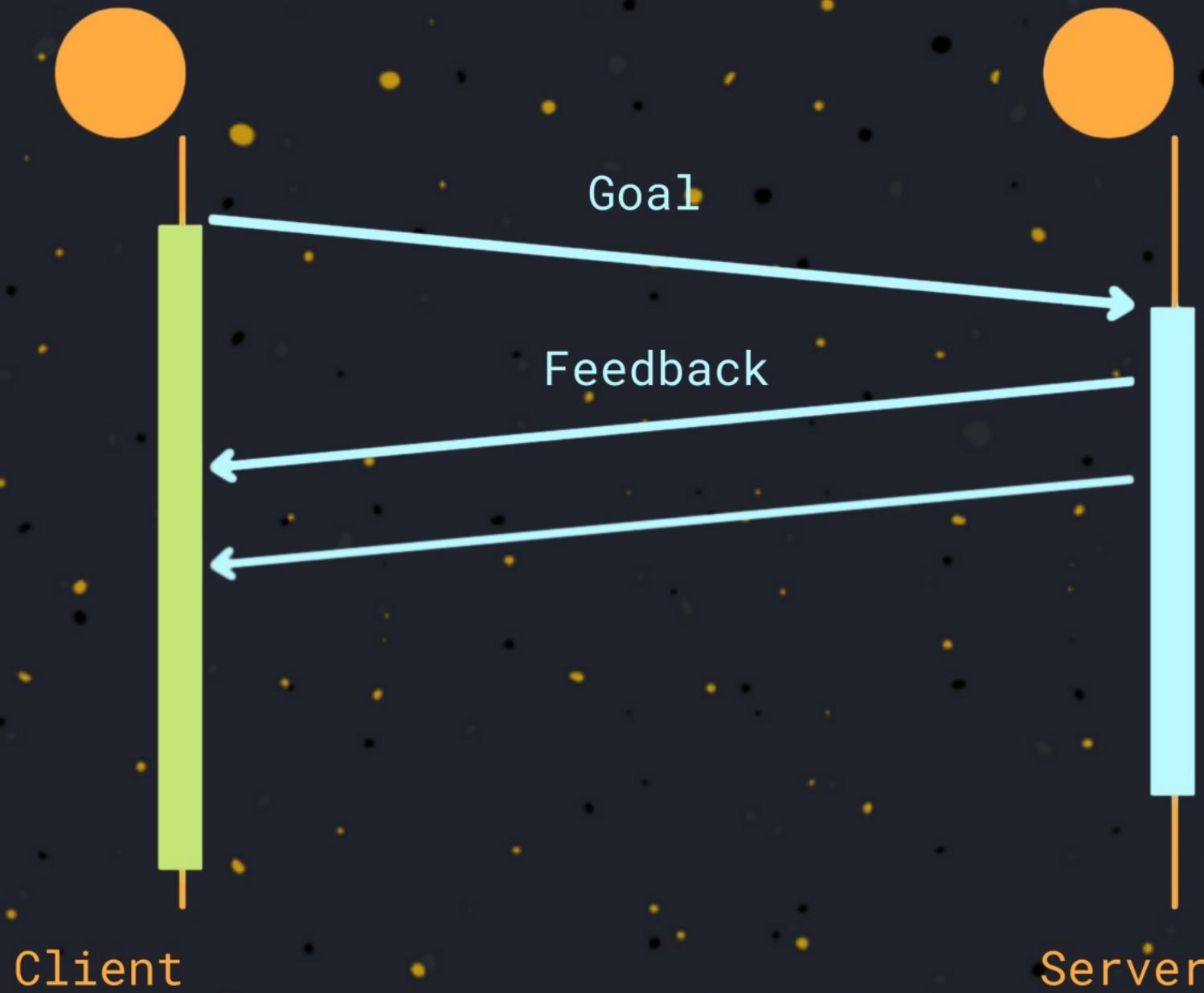
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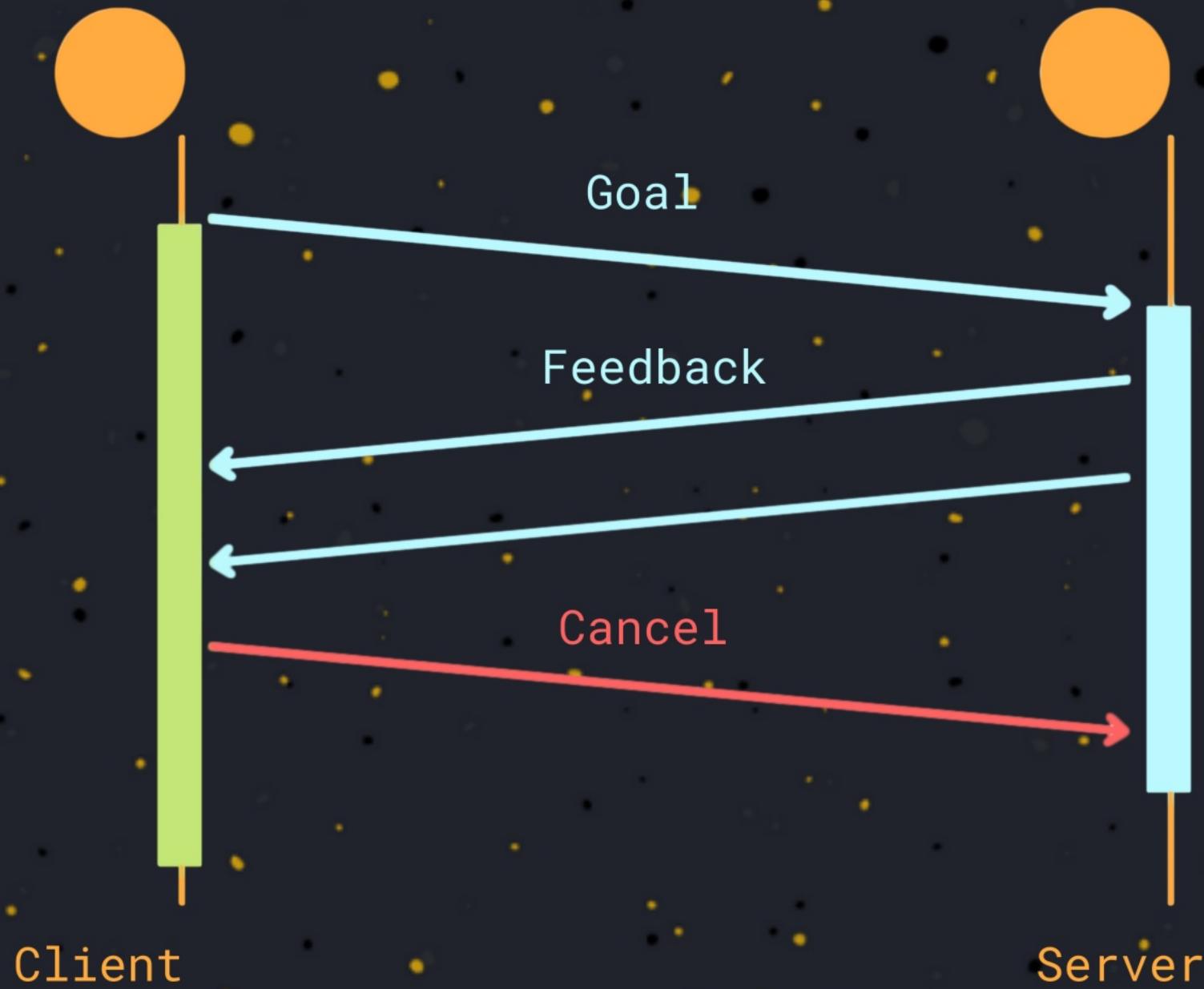
Action



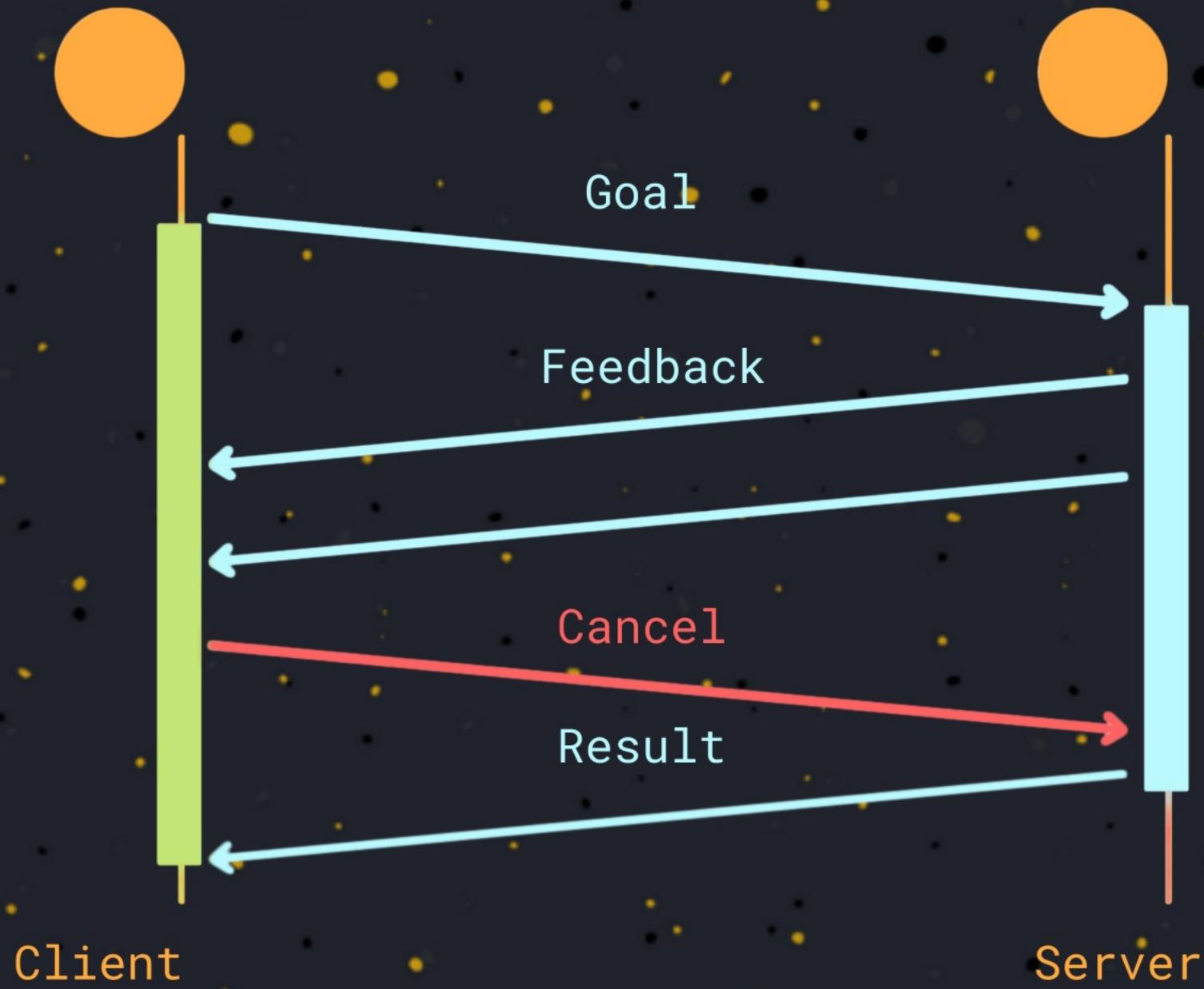
Action



Action



Action



Communication Between Process

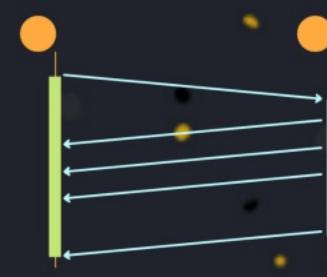
Topic



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



Underlay

rviz2

gazebo

Nav2

robot_vision

moveit

tf2

ros2_control

Workspace



robot_grasping

robot_vision

robot_simulation



Underlay

rviz2

gazebo

Nav2

robot_vision

moveit

tf2

ros2_control



Overlay

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Underlay

rviz2

gazebo

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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



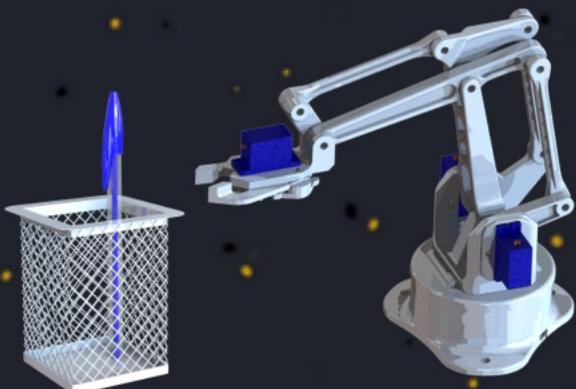
Low-Level
Device Control

Communication
Between Process

Package
Management

“

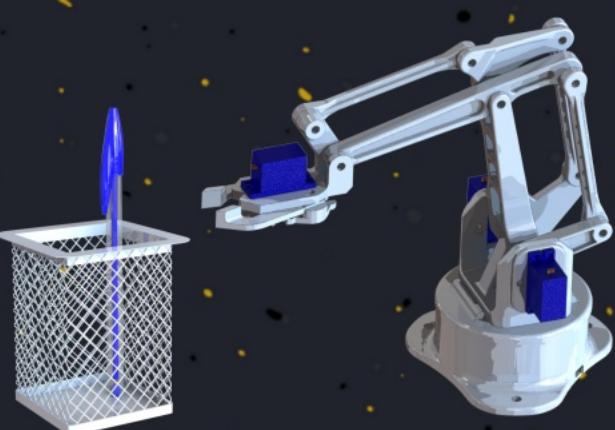
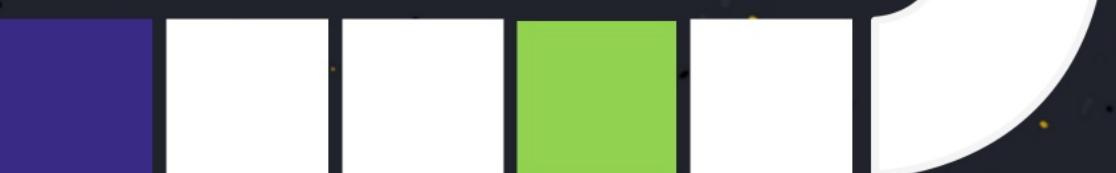
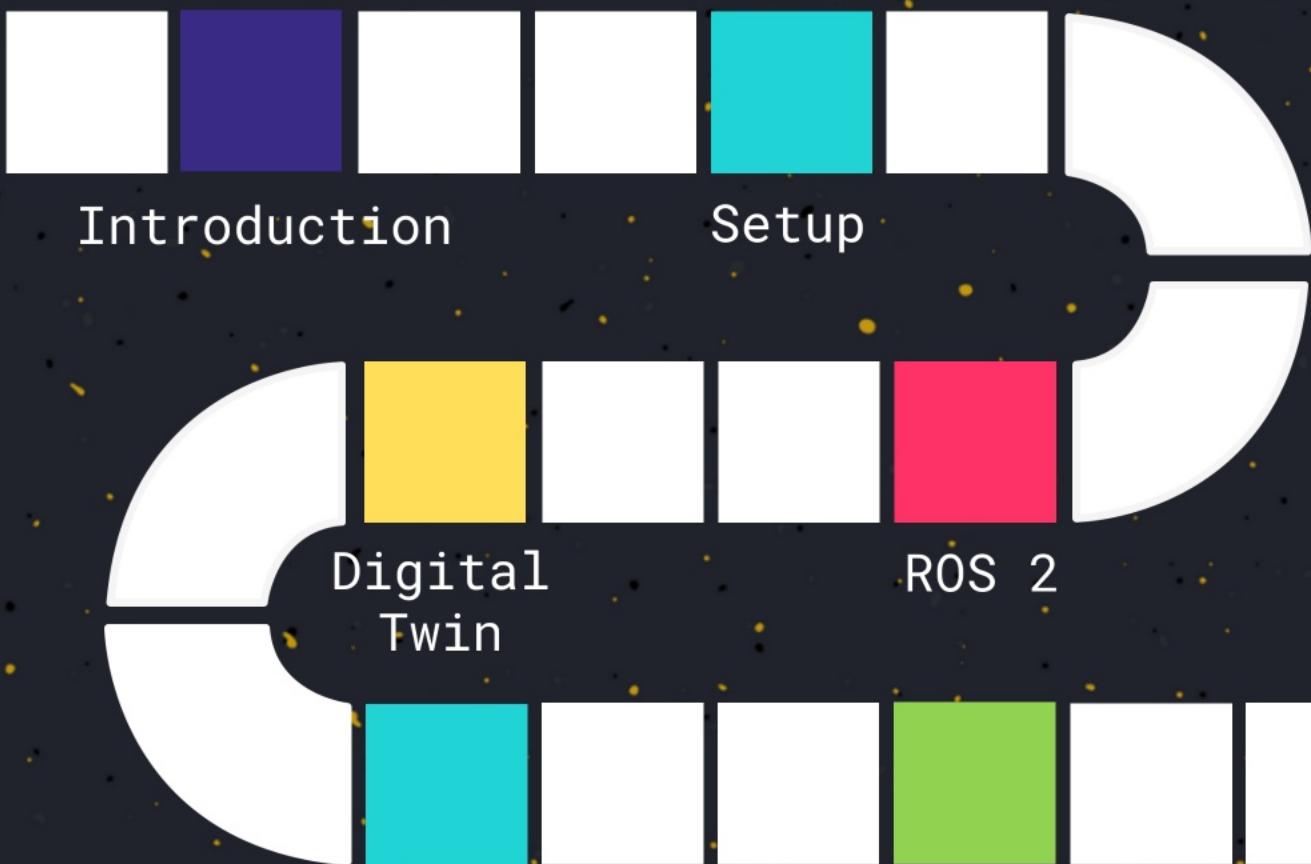
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Sciavicco
Siciliano Villani



Arduinobot



Conclusions

Build