

ROS Learning Path Modules

- ✓ **ROS for Beginners**
- ✓ **Mastering ROS**
- ✓ **ROS Advanced**
- ✓ **Becoming a ROS Developer**

Module 1: ROS for Beginners

✓ Introduction to Robotics and Robot Programming

- What is a Robot?
- Robotics in a nutshell
- Different types of robots
- Applications of robotics
- Selecting sensors, actuators and computing unit for your robot
- Building your own robot
- What is Robot Programming?
- How to program a robot?
- Software frameworks for programming robots

✓ Learning Prerequisites of Robot Operating System

- Learning Ubuntu Linux for ROS
- Learning C++ for ROS
- Learning Python for ROS

Module 1: ROS for Beginners

✓ Kickstarting Robot programming using ROS

- What is Robot Programming?
- Getting started with ROS
 - ROS Equation
 - Why use ROS?
 - Installing ROS
 - ROS Architecture and concepts
 - ROS Filesystem
 - ROS Coding styles, IDE
 - ROS Hello World
 - ROS TurtleSim

✓ Programming with ROS – Part 1

- ROS Workspace and package
- ROS Client libraries: roscpp & rospy
- Understanding roslaunch, rosbag, Rviz, rqt
- Implementing Topics, Service, Parameters
- Learning ROS programming using TurtleSim: roscpp and rospy
 - Understanding ROS concepts using TurtleSim
 - Moving TurtleSim using ROS programming

Module 1: ROS for Beginners

✓ Programming with ROS – TF Part 2

- What is ROS TF?
 - Understanding Transformation and frames
 - Working with TF broadcaster and listener
 - Creating TF for your robot
 - Working with ROS TF tools
 - TurtleSim projects
 - Draw your caricature using TurtleSim
 - Object tracking using TurtleSim

✓ Modeling a robot in ROS using URDF

- What is URDF & xacro?
 - Understanding URDF & xacro
 - Writing your own URDF and xacro
 - Visualizing your robot
 - Interacting with the robot model
 - Moving the robot model

Module 1: ROS for Beginners

- ✓ **Simulating your robot using Gazebo**
 - Introduction to Gazebo simulator
 - Getting started with Gazebo
 - Gazebo models and plugins
 - Spawning models into Gazebo
 - Interacting with a simulated robot
 - Working with Husky, Turtlebot3, and x-arm simulation
 - Visualizing robot sensor data in Rviz
 - Creating your own mobile robot and robot arm simulation
 - Visualizing robot in Rviz
 - Introduction to ROS controllers
 - Interacting with robot models
 - Moving robots using ROS programming

- ✓ **Building autonomous food delivery mobile robot using ROS**
 - What is an autonomous mobile robot?
 - Creating a robot model of a delivery robot
 - Understanding the basics of ROS navigation stack
 - Interfacing our mobile robot to ROS navigation stack
 - Implement Mapping and Localization using SLAM and AMCL
 - Commanding robot using GUI

Module 1: ROS for Beginners

- ✓ **Building Pick-Place application using Robotic arm**
 - Introduction to ROS MoveIt!
 - Interfacing Simulated robotic arm to MoveIt!
 - Path planning using MoveIt!
 - Grasping using MoveIt!
 - Implement pick-place using MoveIt! and Gazebo

- ✓ **Working with ROS perception**
 - What is robot perception?
 - Introduction to ROS perception stacks
 - Working with ROS OpenCV and Point Cloud
 - Robotic vision using OpenCV and ROS
 - Point cloud processing using PCL and ROS
 - Example projects using OpenCV and PCL

Module 1: ROS for Beginners

- ✓ **ROS and Embedded System programming**
 - Introduction to ROS serial
 - Working with ROS and Arduino
 - Working with ROS and Tiva C Launchpad
 - Working with ROS and Raspberry Pi
 - Interfacing RPI camera to ROS
 - Interfacing GPIO pins of RPI using ROS
 - Interfacing sensors to RPI and ROS
 - Controlling motors from RPI and ROS
 - Implementing a PID controller using RPI and ROS

Module 2: Mastering ROS

✓ Mastering URDF

- Deep dive into ROS URDF and xacro
- Discussing various tags in URDF
- Creating your own URDF/xacro for your robot
- Creating your URDF/xacro for a mobile robot
- Creating your URDF/xacro for a robotic arm
- Working with Joint state publisher and robot state publisher
- Working with Gazebo URDF tags and Spawning in Gazebo
- Writing launch file to simulation and visualization

✓ Mastering ROS Navigation stack

- Deep dive into ROS Navigation stack
- Configuring and fine-tuning navigation stack
- Using different path planners in Navigation stack
- Deep dive into ROS move_base node

Module 2: Mastering ROS

- ✓ **Mastering ROS MoveIt!**
 - Deep dive into ROS MoveIt!
 - Configuring and fine tuning MoveIt! for any robot
 - Using different planners in MoveIt!
 - Interfacing perception to MoveIt!
 - Complex motion planning and pick-place
 - Programming using MoveIt! APIs

- ✓ **Mastering ROS Perception**
 - Deep dive into ROS interface of OpenCV and PCL
 - Creating ROS nodelets for working with PCL
 - 2D & 3D Object detection using ROS
 - YOLO Object detection using ROS
 - ROS-Perception projects

Module 2: Mastering ROS

- ✓ **Docker for ROS App deployment**
 - Mastering Docker concepts and commands
 - Working with Docker-ROS container
 - Deploying your ROS app in docker
 - Working with NVIDIA Docker and ROS
 - Working with ROS Gazebo with Docker

- ✓ **Testing and Deployment of your Code**
 - Mastering GitHub and Travis CI for ROS project
 - Creating and pushing a ROS project in GitHub
 - Integrating Continuous Integration using Travis CI
 - Releasing your ROS package
 - Adding your own package in ROS distro

Module 3: ROS Advanced

✓ ROS-SLAM

- List of SLAM wrappers in ROS
- Gmapping, Cartographer
- Deep dive into Visual SLAM
- Configuring different SLAM package for your robot

✓ ROS-Controllers

- Deep dive into Controllers in ROS
- Configuring ROS controllers for your robot
- Writing ROS controllers for your robot
- Interfacing ROS controllers to actual actuator

Module 3: ROS Advanced

✓ ROS Nodelets

- Deep dive into ROS Nodelets
- Writing your first Nodelets
- Implementing vision algorithms using ROS nodelets

✓ ROS-Gazebo plugins

- Deep dive into ROS Gazebo plugin
- Writing your first Gazebo plugin
- Implementing a sensor in Gazebo using plugin

Module 3: ROS Advanced

✓ ROS Path planners

- Deep dive into ROS based path planners
- Working with existing planners in ROS
- Configuring a planner for your robot
- Writing your own planner for your robot

✓ Rviz and Rqt Plugins

- Deep dive into Rviz and Rqt plugins
- Working with existing Rviz and Rqt plugins
- Creating new Rviz plugin for visualization
- Creating new Rqt plugin

Module 3: ROS Advanced

- ✓ **ROS in Self-driving cars**
 - Deep dive into the self-driving car technology
 - Discussing hardware to built a self-driving car
 - Discussing the software architecture
 - ROS based software for self driving car
 - Working with Autoware project
 - Simulating and Visualizing a self-driving car
 - Visualization of Self-driving data in Webviz & XVIZ

- ✓ **ROS Deep learning**
 - Deep dive into Deep learning frameworks
 - Interfacing deep learning frameworks to ROS
 - Working with Object detection using ROS deep learning stacks

Module 3: ROS Advanced

✓ Migrating from ROS1 to ROS 2

- Understanding core concepts of ROS 2
- Migrating from ROS 1 to ROS 2
- ROS 2 concepts
- ROS 2 programming
- ROS 2 simulation in Gazebo
- Introduction to ROS Navigation 2 and MoveIt! 2
- Configuring simulated robot mobile robot with Navigation 2
- Configuring simulated robot arm with MoveIt! 2
- ROS 2 perception

Module 4: Becoming a ROS Developer

✓ Becoming a ROS Developer

- List of robotics companies working on ROS and Robotics
- Common interview questions for ROS developer
- Mock exams for ROS developer
- Mock interviews for a ROS developer
- More reference and materials