Robocademy.com

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

Robocademy.com

Module 1: ROS for Beginners

- ✓ **Simulating your robot using Gazebo** / Webots
  - 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 [Finish all needed Books]

- ✓ **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 , NVDIA TX1/TX2
    - ➢ 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

Sensors

- Velodyne
- ZED Camera
- TeraRanger
- Xsense MTi IMU
- Hokuyo Laser
- Intel RealSense

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