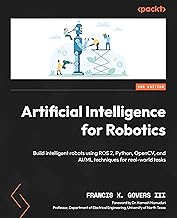
Artificial Intelligence for Robotics - 2024

*Pack Publishing*



# Part 1: Building Blocks for Robotics and Artificial Intelligence

# Chapter 1 - The Foundation of Robotics and Artificial Intelligence

## 1.1 Technical requirements

## 1.2 The basic principle of robotics and AI

## 1.3 What is AI and autonomy (and what is it not)?

## 1.4 Are recent developments in AI anything new?

## 1.5 What is a robot?

## 1.6 Our sample problem – clean up this room!

- The basics of robotics

- The techniques used in this book

## 1.7 When do you need AI for your robot?

## 1.8 Introducing the robot and our development environment

- Software components (ROS, Python, and Linux)

- Robot control systems and a decision-making framework

1.9 Summary

1.10 Questions

1.11 Further reading

# Chapter 2 - Setting Up Your Robot

## 2.1 Technical requirements

## 2.2 Understanding the anatomy of a robot

## 2.3 Introducing subsumption architecture

## 2.4 A brief introduction to ROS

## 2.5 Hardware and software setup

- Preparing the laptop

2.6 Summary

2.7 Questions

2.8 Further reading

# Chapter 3 - Conceptualizing the Practical Robot Design Process

## 3.1 A systems engineering-based approach to robotics

## 3.2 Understanding our task – cleaning up the playroom

## 3.3 Use cases

- Our robot’s task – part 1

- Our robot’s task – part 2

- What is our robot to do?

## 3.4 Using storyboards

- Storyboard – put away the toys

- Project goals

## 3.5 Understanding the scope of our use case

## 3.6 Identifying our hardware needs

## 3.7 Breaking down our software needs

## 3.8 Writing a specification

3.9 Summary

3.10 Questions

3.11 Further reading

# Part 2: Adding Perception, Learning, and Interaction to Robotics

# Chapter 4 - Recognizing Objects Using Neural Networks and Supervised Learning

## 4.1 Technical requirements

## 4.2 A brief overview of image processing

## 4.3 Understanding our object recognition task

## 4.4 Image manipulation

- Convolution

- Artificial neurons

- Training a CNN

## 4.5 Using YOLOv8 – an object recognition model

- Understanding how to train our toy detector

- Building the toy detector

## 4.6 Summary

4.7 Questions

4.8 Further reading

# Chapter 5 - Picking Up and Putting Away Toys using Reinforcement Learning and Genetic Algorithms

## 5.1 Technical requirements

## 5.2 Task analysis

## 5.3 Designing the software

## 5.4 Setting up the solution

- Machine learning for robot arms

- How do we pick actions?

## 5.5 Creating the interface to the arm

## 5.6 Introducing Q-learning for grasping objects

- Writing the code

## 5.7 Introducing GAs

- Understanding how the GA process works

- Building a GA process

## 5.8 Alternative robot arm ML approaches

- Google’s SAC-X

- Amazon Robotics Challenge

## 5.9 Summary

5.10 Questions

5.11 Further reading

# Chapter 6 - Teaching a Robot to Listen

## 6.1 Technical requirements

## 6.2 Exploring robot speech recognition with NLP

- Briefly introducing the NLP concept

- Setting our goals

- Understanding the STT process

- Clarifying the intent

## 6.3 Programming our robot

- Setting up the hardware

- Setting up the Mycroft software

- Adding skills

## 6.4 Summary

6.5 Questions

6.6 Further reading

# Part 3: Advanced Concepts – Navigation, Manipulation, Emotions, and More

# Chapter 7 - Teaching the Robot to Navigate and Avoid Stairs

## 7.1 Technical requirements

## 7.2 Task analysis

## 7.3 Understanding the SLAM methodology

## 7.4 Exploring alternative navigation techniques

## 7.5 Introducing the Floor Finder technique

## 7.6 Implementing neural networks

- Processing the image

- Training the neural network for navigation

- CNN robot control implementation

## 7.7 Summary

7.8 Questions

7.9 Further reading

# Chapter 8 - Putting Things Away

## 8.1 Technical requirements

## 8.2 Task analysis

## 8.3 Introducing decision trees

- What do we mean by pruning?

- Creating self-classifying decision trees

- Understanding entropy

- Implementing one-hot encoding

## 8.4 Random forests

## 8.5 Introducing robot path planning

- Understanding the coordinate system

- Developing a map based on our knowledge

- Introducing the A\* algorithm

- Introducing the D\* (D-star or dynamic A\*) algorithm

- GPS path finding

## 8.6 Summary

8.7 Questions

8.8 Further reading

# Chapter 9 - Giving the Robot an Artificial Personality

## 9.1 Technical requirements

## 9.2 What is an artificial personality?

## 9.3 A brief introduction to the (obsolete) Turing test, chatbots, and generative AI

## 9.4 The art and science of simulation

## 9.5 An emotion state machine

## 9.6 Playing the emotion game

## 9.7 Creating a model of human behavior

- Integrating an artificial personality into our robot

- Constructing a personality

- Adding context

- Under construction

## 9.8 Developing the robot emotion engine

- Creating a human emotion model

- Creating human information storage

- Context memory

## 9.9 Summary

9.10 Questions

9.11 Further reading

# Chapter 10 - Conclusions and Reflections

## 10.1 Learning when to stop

## 10.2 Careers in robotics

## 10.3 Exploring the current state of AI

- Looking ahead in AI and robotics

- Is AI phobia reasonable?

- Comparing the needs of humans and AI

## 10.4 Understanding risk in AI

## 10.5 Summary

10.6 Questions

10.7 Further reading

# Appendix

## A.1 Introducing MOSA

## A.2 A brief overview of ROS 2

- Understanding the basic concepts

- Comparing ROS 2 and ROS

## A.3 Software requirements for the robot

- Installing ROS 2

- Installing other packages

- Basic ROS 2 commands

## A.4 Introducing the hardware for the robot

- Effectors – base, motors, and wheels