Module List for CS7638: Robotics: AI Techniques

Welcome to CS7638: Robotics: AI Techniques!

Getting Started

Problem Set 0

PS0 - Description

PS0 - Solutions

Localization Overview (Histogram Filters)

Localization Overview

1. Course Introduction

2. Nanodegree Program

3. Localization Overview

4. Total Probability

5. Uniform Probability Quiz

QUIZ: Localization Overview: Uniform Probability Quiz

5. Uniform Probability Quiz (Answer)

6. Uniform Distribution

6. Uniform Distribution (Answer)

7. Generalized Uniform Distribution

7. Generalized Uniform Distribution (Answer)

8. Probability After Sense

QUIZ: Localization Overview: Probability After Sense

8. Probability After Sense (Answer)

9. Compute Sum

QUIZ: Localization Overview: Compute Sum

9. Compute Sum (Answer)

10. Normalize Distribution

QUIZ: Localization Overview: Normalize Distribution

10. Normalize Distribution (Answer)

11. pHit and pMiss

11. pHit and pMiss (Answer)

12. Sum of Probabilities

12. Sum of Probabilities (Answer)

13. Sense Function

13. Sense Function (Answer)

14. Normalized Sense Function

14. Normalized Sense Function (Answer)
15. Test Sense Function
15. Test Sense Function (Answer)
16. Multiple Measurements
16. Multiple Measurements (Answer)
17. Lesson Breakpoint
18. Exact Motion
QUIZ: Localization Overview: Exact Motion
18. Exact Motion (Answer)
19. Move Function
19. Move Function (Answer)
20. Inexact Motion 1
QUIZ: Localization Overview: Inexact Motion 1
20. Inexact Motion 1 (Answer)
21. Inexact Motion 2
QUIZ: Localization Overview: Inexact Motion 2
21. Inexact Motion 2 (Answer)
22. Inexact Motion 3
QUIZ: Localization Overview: Inexact Motion 3
22. Inexact Motion 3 (Answer)
23. Inexact Move Function
23. Inexact Move Function (Answer)
24. Limit Distribution Quiz
QUIZ: Localization Overview: Limit Distribution Quiz
24. Limit Distribution Quiz (Answer)
25. Move Twice
25. Move Twice (Answer)
26. Move 1000
26. Move 1000 (Answer)
27. Sense and Move
27. Sense and Move (Answer)
28. Sense and Move 2
28. Sense and Move 2 (Answer)
29. Localization Summary
30. Formal Definition of Probability 1
QUIZ: Localization Overview: Formal Definition of Probability 1

30. Formal Definition of Probability 1 (Answer)
31. Formal Definition of Probability 2
QUIZ: Localization Overview: Formal Definition of Probability 2
31. Formal Definition of Probability 2 (Answer)
32. Formal Definition of Probability 3
QUIZ: Localization Overview: Formal Definition of Probability 3
32. Formal Definition of Probability 3 (Answer)
33. Bayes' Rule
34. Cancer Test
QUIZ: Localization Overview: Cancer Test
34. Cancer Test (Answer)
35. Theorem of Total Probability
36. Coin Flip Quiz
QUIZ: Localization Overview: Coin Flip Quiz
36. Coin Flip Quiz (Answer)
37. Two Coin Quiz
QUIZ: Localization Overview: Two Coin Quiz
37. Two Coin Quiz (Answer)

Problem Set 1

Problem Set 1
1. Probability
QUIZ: Problem Set 1: Probability
1. Probability (Answer)
2. Problem Set 1 Localization
QUIZ: Problem Set 1: Localization
2. Localization (Answer)
3. Bayes' Rule
QUIZ: Problem Set 1: Bayes' Rule
3. Bayes' Rule (Answer)
4. Localization Program
4. Localization Program (Answer)
5. Congratulations

Q&A 1

Q&A 1
1. Office Hours Week 1

Kalman Filters

Kalman Filters

1. Kalman Filters Introduction

2. Become a Professional

3. Tracking Intro

QUIZ: Kalman Filters: Tracking Intro

3. Tracking Intro (Answer)

4. Gaussian Intro

QUIZ: Kalman Filters: Gaussian Intro

4. Gaussian Intro (Answer)

5. Variance Comparison

QUIZ: Kalman Filters: Variance Comparison

5. Variance Comparison (Answer)

6. Preferred Gaussian

QUIZ: Kalman Filters: Preferred Gaussian

6. Preferred Gaussian (Answer)

7. Evaluate Gaussian

QUIZ: Kalman Filters: Evaluate Gaussian

7. Evaluate Gaussian (Answer)

8. Maximize Gaussian

8. Maximize Gaussian (Answer)

9. Measurement and Motion 1

QUIZ: Kalman Filters: Measurement and Motion 1

9. Measurement and Motion 1 (Answer)

10. Measurement and Motion 2

QUIZ: Kalman Filters: Measurement and Motion 2

10. Measurement and Motion 2 (Answer)

11. Shifting the Mean

QUIZ: Kalman Filters: Shifting the Mean

11. Shifting the Mean (Answer)

12. Predicting the Peak

QUIZ: Kalman Filters: Predicting the Peak

12. Predicting the Peak (Answer)

13. Parameter Update

QUIZ: Kalman Filters: Parameter Update

13. Parameter Update (Answer)

14. Parameter Update 2
QUIZ: Kalman Filters: Parameter Update 2
14. Parameter Update 2 (Answer)
15. Separated Gaussians
QUIZ: Kalman Filters: Separated Gaussians
15. Separated Gaussians (Answer)
16. Separated Gaussians 2
QUIZ: Kalman Filters: Separated Gaussians 2
16. Separated Gaussians 2 (Answer)
17. New Mean and Variance
17. New Mean and Variance (Answer)
18. Gaussian Motion
QUIZ: Kalman Filters: Gaussian Motion
18. Gaussian Motion (Answer)
19. Predict Function
19. Predict Function (Answer)
20. Kalman Filter Code
20. Kalman Filter Code (Answer)
21. Kalman Prediction
QUIZ: Kalman Filters: Kalman Prediction
21. Kalman Prediction (Answer)
22. Kalman Filter Land
23. Kalman Filter Prediciton
QUIZ: Kalman Filters: Kalman Filter Prediction
23. Kalman Filter Prediction (Answer)
24. Another Prediction
QUIZ: Kalman Filters: Another Prediction
24. Another Prediction (Answer)
25. More Kalman Filters
26. Kalman Filter Design
27. Kalman Matrices
27. Kalman Matrices (Answer)
28. Conclusion

Problem Set 2

Problem Set 2

1. Measurement Update

QUIZ: Problem Set 2: Measurement Update

1. Measurement Update (Answer)

2. New Variance

QUIZ: Problem Set 2: New Variance

2. New Variance (Answer)

3. Heavytail Gaussian

QUIZ: Problem Set 2: Heavytail Gaussian

3. Heavytail Gaussian (Answer)

4. How Many Dimensions

QUIZ: Problem Set 2: How Many Dimensions

4. How Many Dimensions (Answer)

5. State Transition Matrix

QUIZ: Problem Set 2: State Transition Matrix

5. State Transition Matrix (Answer)

6. Programming Exercise

6. Programming Exercise (Answer)

7. Congratulations

Problem Set 2 Help

Problem Set 2 Help

1. Question 5 Help

2. Question 6 Help

Q&A 2

Q&A 2

1. Office Hours Week 2

Particle Filters

Particle Filters

1. Field Trip

2. Program a Car Yourself

3. State Space

QUIZ: Particle Filters: State Space

3. State Space (Answer)

4. Belief Modality
QUIZ: Particle Filters: Belief Modality
4. Belief Modality (Answer)
5. Efficiency
QUIZ: Particle Filters: Efficiency
5. Efficiency (Answer)
6. Exact or Approximate
QUIZ: Particle Filters: Exact or Approximate
6. Exact or Approximate (Answer)
7. Particle Filters
8. Using Robot Class
9. Robot Class Details
10. Moving Robot
10. Moving Robot (Answer)
11. Add Noise
11. Add Noise (Answer)
12. Robot World
13. Creating Particles
13. Creating Particles (Answer)
14. Robot Particles
14. Robot Particles (Answer)
15. Importance Weight
15. Importance Weight (Answer)
16. Resampling
QUIZ: Particle Filters: Resampling
16. Resampling (Answer)
17. Never Sampled 1
QUIZ: Particle Filters: Never Sampled 1
17. Never Sampled 1 (Answer)
18. Never Sampled 2
QUIZ: Particle Filters: Never Sampled 2
18. Never Sampled 2 (Answer)
19. Never Sampled 3
QUIZ: Particle Filters: Never Sampled 3
19. Never Sampled 3 (Answer)
20. New Particle

20. New Particle (Answer)

21. Resampling Wheel

21. Resampling Wheel (Answer)

22. Orientation 1

QUIZ: Particle Filters: Orientation 1

22. Orientation 1 (Answer)

23. Orientation 2

23. Orientation 2 (Answer)

24. Error

24. Error (Answer)

25. You and Sebastian

26. Filters

QUIZ: Particle Filters: Filters

26. Filters (Answer)

27. 2012

28. Preview

Kinematic Bicycle Model: 101

Kinematic Bicycle Model - 01 - Topics

Kinematic Bicycle Model - 02 - Representation

Kinematic Bicycle Model - 03 - Controls

Kinematic Bicycle Model - 04 - Robot Pose

Kinematic Bicycle Model - 05 - Simple Movement - Horizontal

Kinematic Bicycle Model - 06 - Simple Movement - Vertical

Kinematic Bicycle Model - 07 - Simple Movement - Diagonal (Question)

QUIZ: Simple Bicycle Model - Simple Movement - Diagonal (Question)

Kinematic Bicycle Model - 08 - Simple Movement - Diagonal (Answer)

Kinematic Bicycle Model - 09 - Distinct Tracks A (Question)

QUIZ: Bicycle Model - Distinct Tracks A (Question)

Kinematic Bicycle Model - 10 - Distinct Tracks A (Answer)

Kinematic Bicycle Model - 11 - Track Shape (Question)

QUIZ: Bicycle Model - Track Shape (Question)

Kinematic Bicycle Model - 12 - Track Shape (Answer)

Kinematic Bicycle Model - 13 - Distinct Tracks B (Question)

QUIZ: Bicycle Model - Distinct Tracks B (Question)

Kinematic Bicycle Model - 14 - Distinct Tracks B (Answer)

Kinematic Bicycle Model - 15 - Problem to Solve

Kinematic Bicycle Model - 16 - Solution Steps

Kinematic Bicycle Model - 17 - Circle Center (Question)

QUIZ: Bicycle Model - Circle Center (Question)

Kinematic Bicycle Model - 18 - Circle Center (Answer)

Kinematic Bicycle Model - 19 - Circle Center Examples

Kinematic Bicycle Model - 20 - Step 1 - Radius

Kinematic Bicycle Model - 21 - Step 2 - Center Point Location

Kinematic Bicycle Model - 22 - Return to Same Point (Question)

QUIZ: Bicycle Model - Return to Same Point (Question)

Kinematic Bicycle Model - 23 - Return to Same Point (Answer)

Kinematic Bicycle Model - 24 - Step 3 - Arc Length

Kinematic Bicycle Model - 25 - Step 4 - Offset From Center

Kinematic Bicycle Model - 26 - New Orientation

Kinematic Bicycle Model - 27 - Formulas

Kinematic Bicycle Model - 28 - Example Problem (Question)

QUIZ: Bicycle Model - Example Problem (Question)

Kinematic Bicycle Model - 29 - Example Problem (Answer)

Problem Set 3

Problem Set 3

1. Empty Cell

QUIZ: Problem Set 3: Empty Cell

1. Empty Cell (Answer)

2. Motion Question

QUIZ: Problem Set 3: Motion Question

2. Motion Question (Answer)

3. Single Particle

QUIZ: Problem Set 3: Single Particle

3. Single Particle (Answer)

4. Circular Motion

4. Circular Motion (Answer)

5. Sensing

5. Sensing (Answer)

6. Final Quiz

6. Final Quiz (Answer)

Problem Set 3 Help

Problem Set 3 Help

1. Question 4 Radius

2. Question 4 Position

Q&A 3

Q&A 3

1. Office Hours Week 3

Search

Search

1. Motion Planning

2. Expert Motion Planning

3. Compute Cost

QUIZ: Search: Compute Cost

3. Compute Cost (Answer)

4. Compute Cost 2

QUIZ: Search: Compute Cost 2

4. Compute Cost 2 (Answer)

5. Optimal Path

QUIZ: Search: Optimal Path

5. Optimal Path (Answer)

6. Optimal Path 2

QUIZ: Search: Optimal Path 2

6. Optimal Path 2 (Answer)

7. Maze

QUIZ: Search: Maze

7. Maze (Answer)

8. Maze 2

QUIZ: Search: Maze 2

8. Maze 2 (Answer)

9. First Search Program

9. First Search Program (Answer)

10. Expansion Grid

10. Expansion Grid (Answer)

11. Print Path

11. Print Path (Answer)

12. A*

13. Implement A*

13. Implement A* (Answer)

14. A* in Action

15. Dynamic Programming

16. Computing Value

QUIZ: Search: Computing Value

16. Computing Value (Answer)

17. Computing Value 2

QUIZ: Search: Computing Value 2

17. Computing Value 2 (Answer)

18. Value Program

18. Value Program (Answer)

19. Optimum Policy

19. Optimum Policy (Answer)

20. Left Turn Policy

20. Left Turn Policy (Answer)

21. Planning Conclusion

Problem Set 4

Problem Set 4

1. Admissible Heuristic

QUIZ: Problem Set 4: Admissible Heuristic

1. Admissible Heuristic (Answer)

2. Admissible Heuristic 2

QUIZ: Problem Set 4: Admissible Heuristic 2

2. Admissible Heuristic 2 (Answer)

3. Bad Heuristic

QUIZ: Problem Set 4: Bad Heuristic

3. Bad Heuristic (Answer)

4. Diagonal Motion

QUIZ: Problem Set 4: Diagonal Motion

4. Diagonal Motion (Answer)

5. Stochastic Motion

5. Stochastic Motion (Answer)

Q&A 4

Q&A 4

1. Office Hours Week 4

PID Control

PID Control

1. Robot Motion

QUIZ: PID Control: Robot Motion

1. Robot Motion (Answer)

2. Control Simulator

3. Smoothing Algorithm

QUIZ: PID Control: Smoothing Algorithm

3. Smoothing Algorithm (Answer)

4. Smoothing Algorithm 2

QUIZ: PID Control: Smoothing Algorithm 2

4. Smoothing Algorithm 2 (Answer)

5. Smoothing Algorithm 3

QUIZ: PID Control: Smoothing Algorithm 3

5. Smoothing Algorithm 3 (Answer)

6. Path Smoothing

6. Path Smoothing (Answer)

7. Zero Data Weight

QUIZ: PID Control: Zero Data Weight

7. Zero Data Weight (Answer)

8. PID Control

QUIZ: PID Control: PID Control

8. PID Control (Answer)

9. Proportional Control

QUIZ: PID Control: Proportional Control

9. Proportional Control (Answer)

10. Implement P Controller

11. Implement P Controller (solution)

12. Oscillations

QUIZ: PID Control: Oscillations

12. Oscillations (Answer)

13. PD Controller

14. PD Controller (solution)

15. Systematic Bias

QUIZ: PID Control: Systematic Bias

15. Systematic Bias (Answer)

16. Is PD Enough

QUIZ: PID Control: Is PD Enough

16. Is PD Enough (Answer)

17. PID Implementation

18. PID Implementation (solution)

19. Twiddle

20. Parameter Optimization

21. Parameter Optimization (solution)

22. Summary

Problem Set 5

Problem Set 5

1. Missing Parameters

QUIZ: Problem Set 5: Missing Parameters

1. Missing Parameters (Answer)

2. Cyclic Smoothing

2. Cyclic Smoothing (Answer)

3. Constrained Smoothing

3. Constrained Smoothing (Answer)

4. Racetrack Control

4. Racetrack Control (Answer)

Problem Set 5 Help

Problem Set 5 Help

1. Gradient Descent

Q&A 5

Q&A 5

1. Office Hours Week 5

SLAM

SLAM

1. Putting It All Together

2. Keep Going!

3. SLAM Localization

QUIZ: SLAM: Localization

3. Localization (Answer)

4. Planning

QUIZ: SLAM: Planning

4. Planning (Answer)

5. PID

QUIZ: SLAM: PID

5. PID (Answer)

6. Your Robot Car

7. Segmented CTE

7. Segmented CTE (Answer)

8. Fun with Parameters

9. Wrap Up

10. SLAM

11. Is Localization Necessary

QUIZ: SLAM: Is Localization Necessary

11. Is Localization Necessary (Answer)

12. Graph SLAM

QUIZ: SLAM: Graph SLAM

12. Graph SLAM (Answer)

13. Implementing Constraints

QUIZ: SLAM: Implementing Constraints

13. Implementing Constraints (Answer)

14. Adding Landmarks

QUIZ: SLAM: Adding Landmarks

14. Adding Landmarks (Answer)

15. SLAM Quiz

QUIZ: SLAM: SLAM Quiz

15. SLAM Quiz (Answer)

16. Matrix Modification

QUIZ: SLAM: Matrix Modification

16. Matrix Modification (Answer)

17. Untouched Fields

QUIZ: SLAM: Untouched Fields

17. Untouched Fields (Answer)

18. Omega and Xi

18. Omega and Xi (Answer)

19. Landmark Position

QUIZ: SLAM: Landmark Position

19. Landmark Position (Answer)

20. Expand

20. Expand (Answer)

21. Introducing Noise

QUIZ: SLAM: Introducing Noise

21. Introducing Noise (Answer)

22. Confident Measurements

22. Confident Measurements (Answer)

23. Implementing SLAM

23. Implementing SLAM (Answer)

24. Congratulations

QUIZ: SLAM: Congratulations

Problem Set 6

Problem Set 6

1. Matrix Fill In

QUIZ: Problem Set 6: Matrix Fill In

1. Matrix Fill In (Answer)

2. Online SLAM

2. Online SLAM (Answer)

Q&A 6

Q&A 6

1. Office Hours Week 6

Project - Runaway Robot

Project - Runaway Robot

1. Welcome to Runaway Robot!

2. Part 1: Noiseless Prediction

3. Introduction to Adding Noise
4. Part 2: Adding Noise
5. Introduction to the Chase
6. Part 3: The Chase Begins
7. Introduction to Chasing with a Plan
8. Part 4: Chasing with a Plan
9. Introduction to the Final Hunt
10. Part 5: The Final Hunt (Bonus)
11. Closing Words