Review for the Final Exam

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5:12 PM    April 30, 2012
What We’ve Covered

- Chapter 1: Introduction
- Chapter 2: Representations for Classical Planning
- Chapter 3: Complexity of Classical Planning
- Chapter 4: State-Space Planning
- Chapter 5: Plan-Space Planning
- Chapter 6: Planning-Graph Techniques
- Chapter 7: Propositional Satisfiability Techniques
- Chapter 16: Planning based on MDPs
- Chapter 17: Planning based on Model Checking

- Chapter 9: Heuristics in Planning*
- Chapter 10: Control Rules in Planning*
- Chapter 11: Hierarchical Task Network Planning*
- Chapter 14: Temporal Planning*

* These weren’t on the midterm
Chapter 1: Introduction and Overview

● 1.1: First Intuitions on Planning
● 1.2: Forms of Planning
● 1.3: Domain-Independent Planning
● 1.4: Conceptual Model for Planning
● 1.5: Restricted Model
● 1.6: Extended Models
● 1.7: A Running Example: Dock-Worker Robots

No questions on Chapter 1
2: Representations for Classical Planning

- 2.1: Introduction
- 2.2: Set-Theoretic Representation
  - 2.2.1: Planning Domains, Problems, and Solutions
  - 2.2.2: State Reachability
  - 2.2.3: Stating a Planning Problem
  - 2.2.4: Properties of the Set-theoretic Representation
- 2.3: Classical Representation
  - 2.3.1: States
  - 2.3.2: Operators and Actions
  - 2.3.3: Plans, Problems, & Solutions
- 2.4: Extending the Classical Rep.
  - 2.4.1: Simple Syntactical Extensions
  - 2.4.2: Conditional Planning Operators
  - 2.4.3: Quantified Expressions
  - 2.4.4: Disjunctive Preconditions
  - 2.4.5: Axiomatic Inference
  - 2.4.6: Function Symbols
  - 2.4.7: Attached Procedures
  - 2.4.8: Extended Goals
- 2.5: State-Variable Representation
  - 2.5.1: State Variables
  - 2.5.2: Operators and Actions
  - 2.5.3: Domains and Problems
  - 2.5.4: Properties
- 2.6: Comparisons

No questions on these topics unless they were covered in other chapters:
- 2.3.4: Semantics of Classical Reps
- 2.4: Extending the Classical Rep.
Chapter 3: Complexity of Classical Planning

- 3.1: Introduction
- 3.2: Preliminaries
- 3.3: Decidability and Undecidability Results
- 3.4: Complexity Results
  - 3.4.1: Binary Counters
  - 3.4.2: Unrestricted Classical Planning
  - 3.4.3: Other results
- 3.5: Limitations

You don’t need to know the details of the complexity tables, but you should know the basic concepts, e.g.:
- What does it mean to allow or disallow function symbols, negative effects, etc.?
- What’s the difference between giving the operators in the input or in advance?
Chapter 4: State-Space Planning

4.1: Introduction

4.2: Forward Search
   - 4.2.1: Formal Properties
   - 4.2.2: Deterministic Implementations

4.3: Backward Search

4.4: The STRIPS Algorithm

4.5: Domain-Specific State-Space Planning
   - 4.5.1: The Container-Stacking Domain
   - 4.5.2: Planning Algorithm

No questions on this topic
Chapter 5: Plan-Space Planning

- 5.1: Introduction
- 5.2: The Search Space of Partial Plans
- 5.3: Solution Plans
- 5.4: Algorithms for Plan Space Planning
  - 5.4.1: The PSP Procedure
  - 5.4.2: The PoP Procedure
- 5.5: Extensions
- 5.6: Plan Space Versus State Space Planning
Chapter 6: Planning-Graph Techniques

- 6.1: Introduction
- 6.2: Planning Graphs
  - 6.2.1: Reachability Trees
  - 6.2.2: Reachability with Planning Graphs
  - 6.2.3: Independent Actions and Layered Plans
  - 6.2.4: Mutual Exclusion Relations
- 6.3: The Graphplan Planner
  - 6.3.1: Expanding the Planning Graph
  - 6.3.2: Searching the Planning Graph
  - 6.3.3: Analysis of Graphplan
- 6.4: Extensions and Improvements of Graphplan
  - 6.4.1: Extending the Language
  - 6.4.2: Improving the Planner
  - 6.4.3: Extending the Independence Relation

use my lecture notes rather than the book

No questions on these topics
7: Propositional Satisfiability Techniques

- 7.1: Introduction
- 7.2: Planning problems as Satisfiability problems
  - 7.2.1: States as propositional formulas
  - 7.2.2: State transitions as propositional formulas
  - 7.2.3: Planning problems as propositional formulas
- 7.3: Planning by Satisfiability
  - 7.3.1: Davis-Putnam
  - 7.3.2: Stochastic Procedures
- 7.4: Different Encodings
  - 7.4.1: Action Representation
  - 7.4.2: Frame axioms
Chapter 16: Planning Based on MDPs

- 16.1: Introduction
- 16.2: Planning in Fully Observable Domains
  - 16.2.1: Domains, Plans, and Planning Problems
  - 16.2.2: Planning Algorithms
- 16.3: Planning under Partial Observability
  - 16.3.1: Domains, Plans, and Planning Problems
  - 16.3.2: Planning Algorithms
- 16.4: Reachability and Extended Goals

No questions on these topics
17: Planning based on Model Checking

● 17.1: Introduction
● 17.2: Planning for Reachability Goals
  ◆ 17.2.1: Domains, Plans, and Planning Problems
  ◆ 17.2.2: Planning Algorithms

● 17.3: Planning for Extended Goals
  ◆ 17.3.1: Domains, Plans, and Planning Problems
  ◆ 17.3.2: Planning Algorithms
  ◆ 17.3.3: Beyond Temporal Logics
● 17.4: Planning under Partial Observability
  ◆ 17.4.1: Domains, Plans, and Planning Problems
  ◆ 17.4.2: Planning Algorithms
● 17.5: Planning as Model Checking vs. MDPs

No questions on these topics
Chapter 9: Heuristics in Planning

- 9.1: Introduction
- 9.2: Design Principle for Heuristics: Relaxation
- 9.3: Heuristics for State-Space Planning
  - 9.3.1: State Reachability Relaxation
  - 9.3.2: Heuristically Guided Backward Search
  - 9.3.3: Admissible State-Space Heuristics
  - 9.3.4: Graphplan as a Heuristic-Search Planner
- 9.4: Heuristics for Plan-Space Planning
  - 9.4.1: Flaw-Selection Heuristics
  - 9.4.2: Resolver-Selection Heuristics

Instead of this, I presented *FastForward*’s heuristic. Use my lecture notes instead of the text.

No questions on this topic
Chapter 10: Control Rules in Planning

- Intro to Part III: Heuristics and Control Strategies

- 10.1: Introduction
- 10.2: Simple Temporal Logic
- 10.3: Progression
- 10.4: Planning Procedure
- 10.5: Extensions
- 10.6: Extended Goals

Use the notation in my lecture notes rather than the book

No questions on this topic
Chapter 11: HTN Planning

- 11.1: Introduction
- 11.2: STN Planning
  - 11.2.1: Tasks and Methods
  - 11.2.2: Problems and Solutions
- 11.3: Total-Order STN Planning
- 11.4: Partial-Order STN Planning
- 11.5: HTN Planning
- 11.6: Comparisons
  - 11.6.1: HTN Planning Versus STN Planning
  - 11.6.2: HTN Methods Versus Control Rules
- 11.7: Extensions
  - 11.7.1: Extensions from Chapter 2
  - 11.7.2: Additional Extensions
- 11.8: Extended Goals

No questions on this topic

No questions on this topic

No questions on these topics
Chapter 14: Temporal Planning

- 14.1: Introduction
- 14.2: Planning with Temporal Operators
  - 14.2.1: Temporal Expressions and Temporal Databases
  - 14.2.2: Temporal Planning Operators
  - 14.2.3: Domain axioms
  - 14.2.4: Temporal Planning Domains, Problems and Plans
  - 14.2.5: Concurrent Actions with Interfering Effects
  - 14.2.6: A Temporal Planning Procedure
- 14.3: Planning with Chronicles
  - 14.3.1: State Variables, Timelines and Chronicles
  - 14.3.2: Chronicles as Planning Operators
  - 14.3.3: Chronicle Planning Procedures
  - 14.3.4: Constraint Management in CP
  - 14.3.5: Search Control in CP

No questions on these topics

Dana Nau: Lecture slides for Automated Planning
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The Exam

- Tuesday, May 15, 1:30–3:30 according to Testudo:
  - [http://www.testudo.umd.edu/soc/exam201201.html](http://www.testudo.umd.edu/soc/exam201201.html)

- Closed book, but you may bring two pages of notes
  - You can write on both sides

- No electronic devices
  - Numeric calculations will be simple enough that you won’t need a calculator
Studying for the Exam

- On the password-protected page, I’ve posted copies of old exams
  - both with and without answers
- Send me email if you’ve forgotten the name/password

- For each exam, look first at the version that has no answers, and try to write your own answers
  - Then look at the version that has answers, and compare those answers to yours
Miscellaneous

● If you have questions about what we’ve covered, please post them to Piazza rather than sending email
  ◆ You’ll get an answer faster
  ◆ Others might like to see the answers