Intelligent Systems (AI-2)

Computer Science cpsc422, Lecture 1

Sept, 9, 2015
People

Instructor

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Natural Language Processing, Summarization, Preference Elicitation, Explanation, Adaptive Visualization, Intelligent Interfaces……
Office hour: my office, Mon 10-11

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Your UBC-AI Background

I took 322 Spring-15

A. yes  B. no

I took Machine Learning (340)

A. yes  B. no
Course Essentials(1)

• Course web-pages:


• This is where most information about the course will be posted, most handouts (e.g., slides) will be distributed, etc.

• CHECK IT OFTEN! (draft already available)

• Lectures:

• Cover basic notions and concepts known to be hard
• I will try to post the slides in advance (by 8:30).
• After class, I will post the same slides inked with the notes I have added in class.
• Each lecture will end with a set of learning goals:
  Student can….
Course Essentials(2)

Textbook: Selected Chapters from
- Artificial Intelligence, 2nd Edition, by Poole, Mackworth.  

Reference (if you want to buy a book in AI this is the one!)
  [book webpage on course webpage]

More readings on course webpage.....
Course Essentials(3)

Connect

• **Connect OR Piazza**: discussion board
  • Use the discussion board for questions about assignments, material covered in lecture, etc. That way others can learn from your questions and comments!
  • Use email for private questions (e.g., grade inquiries or health problems).

• **AISpace**: online tools for learning Artificial Intelligence [http://aispace.org/](http://aispace.org/)
  • Under development here at UBC!
Course Elements

- Practice Exercises: 0%
- Assignments: 15%
- Research Paper Questions & Summaries: 10%
- Midterm: 30%
- Final: 45%
- Clickers: 3% bonus (1% participation + 2% correct answers)

If your final grade is >= 20% higher than your midterm grade:
- Midterm: 15% ↓
- Final: 60% ↑
Assignments

• There will be **five** assignments in total
  • Counting “assignment zero”, which you’ll get today (as a Google Form)
  • They will not necessarily be weighted equally

• **Group work (same as 322)**
  • code questions:
    ✓ you can work with a partner
    ✓ always hand in **your own piece of code** (stating who your partner was)
  • written questions:
    ✓ you may **discuss** questions with other students
    ✓ you may **not look at or copy** each other's written work
    ✓ You may be asked to sign an **honour code** saying you've followed these rules
Assignments: Late Days (same as 322)

• Hand in by 9AM on due day (in class or on Connect)
• You get four late days 😊
  • to allow you the flexibility to manage unexpected issues
  • additional late days will not be granted except under truly exceptional circumstances
• A day is defined as: all or part of a 24-hour block of time beginning at 9 AM on the day an assignment is due
• Applicable to assignments 1-4 not applicable to assignment 0, midterm, final!
• if you've used up all your late days, you lose 20% per day
Missing Assignments / Midterm / Final

Hopefully late days will cover almost all the reasons you'll be late in submitting assignments.

• However, something more serious like an extended illness may occur 😞

• For all such cases: you'll need to provide a note from your doctor, psychiatrist, academic advisor, etc.

• If you miss:
  • an assignment, your score will be reweighted to exclude that assignment
  • the midterm, those grades will be shifted to the final.
  • the final, you'll have to write a make-up final as soon as possible.
How to Get Help?

• Use the course **discussion board** for questions on course material (so keep reading from it !)
• If you answer a challenging question you’ll get bonus points! 😊

• Go to **office hours** (newsgroup is NOT a good substitute for this) – times will be finalized next week
  • Giuseppe: Mon 10-11 (CICSR #105)
  • Ted: Wed 10-11 (X237)
  • Enamul: Fri 10-11 (X237)

Can schedule by appointment if you can document a conflict with the official office hours
Getting Help from Other Students? From the Web? (Plagiarism)

- It is **OK** to talk with your classmates about assignments; learning from each other is good.

- But you must:
  - **Not copy** from others (with or without the consent of the authors).
  - Write/present your work **completely on your own** (code questions exception).

- If you use external source (e.g., Web) in the assignments. Report this.

  e.g., “bla bla bla…..” [wikipedia]
Getting Help from Other Sources? (Plagiarism)

When you are in doubt whether the line is crossed:

- Talk to me or the TA’s
- See UBC official regulations on what constitutes plagiarism (pointer in course Web-page)
- Ignorance of the rules will not be a sufficient excuse for breaking them

Any unjustified cases will be severely dealt with by the Dean’s Office (that’s the official procedure)

- My advice: better to skip an assignment than to have “academic misconduct” recorded on your transcript and additional penalties as serious as expulsion from the university!
Clickers - Cheating

• Use of another person’s clicker
• Having someone use your clicker is considered cheating with the same policies applying as would be the case for turning in illicit written work.
To Summarize

• All the course logistics are described in the course Webpage

Or WebSearch: Giuseppe Carennini

(And summarized in these slides)

• Make sure you carefully read and understand them!
Agents acting in an environment

- Prior knowledge
- Past experiences
- Goals/values
- Observations

Agent

Representation & Reasoning

Actions

Solutions

Answers

Environment

Machine Learning 340

CPSC 422, Lecture 1
CPSC 322 Big Picture

Environment

- Deterministic
  - Arc Consistency
  - Search
  - Vars + Constraints

- Stochastic
  - Belief Nets
  - Var. Elimination
  - Markov Chains
  - HMM

Problem

- Static
  - Constraint Satisfaction
  - Query

- Sequential
  - Planning

Search

- Logics
  - STRIPS
  - CSP

Representation

Reasoning Technique

CPSC 322, Lecture 2
Applications of AI

- Deterministic
  - Logics
    - First Order Logics
    - Description Logics/Ontologies
    - Temporal rep.
  - Partial Order Planning
  - Full Resolution
  - SAT

- Stochastic
  - Belief Nets
    - More sophisticated reasoning
  - Markov Chains and HMMs
  - Undirected Graphical Models
    - Conditional Random Fields
  - Markov Decision Processes and Partially Observable MDP
    - Value Iteration
    - Approx. Inference
  - Reinforcement Learning

Where are the components of our representations coming from?
- The probabilities?
- The utilities?
- The logical formulas?

From people and from data!

322 big picture

Machine Learning
Knowledge Acquisition
Preference Elicitation

Reasoning Technique

Representation

Query

Planning
Datalog vs PDCL (better with colors)

First Order Logic

∀X∃Y p(X,Y) ↔ ¬q(Y)
  p(a₁,a₂)
  ¬q(a₃)

Propositional Logic

7(p ∨ q) → (r ∨ s ∨ t)
  p, r

Datalog

p(X) ← q(X) ∧ r(X,Y)
  r(X,Y) ← s(Y)
  s(a₁), q(a₂)

PDCL

p ← s ∨ t
  r ← s ∨ q ∨ p
  r
  p
Logics in AI: Similar slide to the one for planning

- Propositional Definite Clause Logics
- Semantics and Proof Theory
- Satisfiability Testing (SAT)
- Description Logics
- First-Order Logics
- Satisfiability Testing (SAT)
- Ontologies
- Production Systems
- Cognitive Architectures
- Semantic Web
- Video Games
- Summarization
- Tutoring Systems

Some Applications

- Hardware Verification
- Product Configuration

you will know a little

CPSC 322, Lecture 8
Answering Query under Uncertainty

- Probability Theory
- Static Belief Network & Variable Elimination
- Dynamic Bayesian Network
- Hidden Markov Models
- Natural Language Processing
- BioInformatics
- Student Tracing in tutoring Systems
- Monitoring (e.g., credit cards)
- Diagnostic Systems (e.g., medicine)
- Email spam filters

Some Applications:
- you will know
- you will know a little

CPSC 322, Lecture 18
Slide 22
Big Picture: Planning under Uncertainty

- Probability Theory
- Decision Theory
- One-Off Decisions/
  Sequential Decisions
- Markov Decision Processes (MDPs)
- Fully Observable
  MDPs
- Partially
  Observable MDPs (POMDPs)
- Decision Support Systems
  (medicine, business, …)
- Economics
- Control Systems
- Robotics

Some Applications

You know a little

[Handwritten notes: you know a little]
No 😞, but you (will) know the key ideas 😊!

- Ghallab, Nau, and Traverso
  Automated Planning: Theory and Practice
  Morgan Kaufmann, May 2004
  ISBN 1-55860-856-7
- Web site:
  ✓ http://www.laas.fr/planning

Applications

Slide 24
422 big picture

Hybrid: Det + Sto

Prob CFG
Prob Relational Models
Markov Logics

Deterministic

Logics
First Order Logics

Ontologies
Temporal rep.

• Full Resolution
• SAT

Stochastic

Belief Nets
Approx. : Gibbs

Markov Chains and HMMs
Forward, Viterbi…. Approx. : Particle Filtering

Undirected Graphical Models
Conditional Random Fields

Markov Decision Processes and Partially Observable MDP

• Value Iteration
• Approx. Inference

Reinforcement Learning

Applications of AI

CPSC 422, Lecture 34
Slide 25
Combining Symbolic and Probabilistic R&R systems

- (a) Probabilistic Relational models
  - Probs specified on relations

- (b) Markov Logics

\[ P(\text{world}) \propto \exp\left(\sum \text{weights of formulas it satisfies}\right) \]

- (c) Probabilistic Context-Free Grammars
  - NLP parsing
  - Hierarchical Planning
A customer C will / will not recommend a book B depending on the book quality, and the customer honesty and kindness.
(b) Markov Logics

Two constants: **Anna** (A) and **Bob** (B)

In general, they represent feature templates for Markov Networks
### Sample PCFG

<table>
<thead>
<tr>
<th>Rule</th>
<th>Probability</th>
</tr>
</thead>
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<td>$S \rightarrow NP \ VP$</td>
<td>.80</td>
</tr>
<tr>
<td>$S \rightarrow Aux \ NP \ VP$</td>
<td>.15</td>
</tr>
<tr>
<td>$S \rightarrow VP$</td>
<td>.05</td>
</tr>
<tr>
<td>$NP \rightarrow Det \ Nom$</td>
<td>.20</td>
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<tr>
<td>$NP \rightarrow Proper-Noun$</td>
<td>.35</td>
</tr>
<tr>
<td>$NP \rightarrow Nom$</td>
<td>.05</td>
</tr>
<tr>
<td>$NP \rightarrow Pronoun$</td>
<td>.40</td>
</tr>
<tr>
<td>$Nom \rightarrow Noun$</td>
<td>.75</td>
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<tr>
<td>$Nom \rightarrow Noun \ Nom$</td>
<td>.20</td>
</tr>
<tr>
<td>$Nom \rightarrow Proper-Noun \ Nom$</td>
<td>.05</td>
</tr>
<tr>
<td>$VP \rightarrow Verb$</td>
<td>.55</td>
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<tr>
<td>$VP \rightarrow Verb \ NP$</td>
<td>.40</td>
</tr>
<tr>
<td>$VP \rightarrow Verb \ NP \ NP$</td>
<td>.05</td>
</tr>
<tr>
<td>$Det \rightarrow that$</td>
<td>.05</td>
</tr>
<tr>
<td>$Det \rightarrow the$</td>
<td>.80</td>
</tr>
<tr>
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<td>.15</td>
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<td>.10</td>
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<td>$Noun \rightarrow meal$</td>
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<td>$Verb \rightarrow book$</td>
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<td>$Pronoun \rightarrow you$</td>
<td>.40</td>
</tr>
<tr>
<td>$Pronoun \rightarrow I$</td>
<td>.60</td>
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</tbody>
</table>
For Fri:
- Read textbook 9.4
- Read textbook 9.5
  - 9.5.1 Value of a Policy

For Mon:
- assignment0 – Google Form
- Read textbook
  - 9.5.2 Value of an Optimal Policy
  - 9.5.3 Value Iteration