Introduction to the Course
CSE 415
Introduction to Artificial Intelligence

University of Washington
Spring, 2019

© S. Tanimoto and University of Washington, 2019

Teaching Team

- Steve Tanimoto, instructor
- Kimberly Bautista, TA
- Divye Jain, TA
- Rob Thompson, TA
- Bryan Van Draanen, TA

Steve Tanimoto   Kimberly Bautista   Divye Jain   Rob Thompson   Bryan Van Draanen

CSE 415, Univ. of Wash.

Introduction to Artificial Intelligence

- State-Space Search
- Problem Formulation and Solving
- Adversarial Search
- Probabilistic Inference
- Reinforcement Learning (ML)
- Perceptrons (ML)
- Applications such as NLP
- Social Issues (e.g., Asimov's Laws)

CSE 415, Univ. of Wash.   Introduction   3

A.I. in Our World

On the provided form, make a list of some present and possible future applications of A.I., and indicate which are of greatest interest to you.

CSE 415, Univ. of Wash.

What is Intelligence?

CSE 415, Univ. of Wash.   Introduction   5

What is Intelligence?

- Is it a quantity of information?
- Is it speed of processing?
- Are any computers intelligent?
- Are all people intelligent?
- Why is artificial intelligence covered in a separate course in the curriculum?

CSE 415, Univ. of Wash.   Introduction   6

One Answer

"A system is intelligent if it effectively maximizes its expected utility."

Utility: a function that maps sequences of states into a real value.

Expected utility: The statistical expectation of utility values over a random variable representing possible sequences of states.

CSE 415, Univ. of Wash.

Examples of AI

- Game Playing: Go, Tic-Tac-Toe, Toro-Tile Straight
- Robot Control
- Machine vision in bank check processing
- Natural Language Translation
- Speech Recognition & Synthesis
- Intelligent Tutoring Systems
- Problem Solving and Design Agents
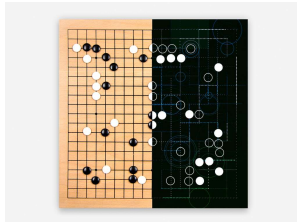
CSE 415, Univ. of Wash.　Introduction　8

AlphaGo Masters Go

Google's AI Wins Fifth And Final Game Against Go Genius Lee Sedol

March 15, 2016
SEOUL, SOUTH KOREA — In the final game of their historic match, Google's artificially intelligent Go-playing computer system has defeated Korean grandmaster Lee Sedol, finishing the best-of-five series with four wins and one loss.

http://www.wired.com/2016/03/googles-ai-wins-fifth-final-game-go-genius-lee-sedol/
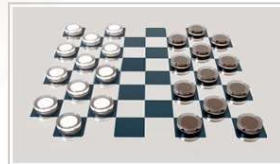
CSE 415, Univ. of Wash.　Introduction　9

World Champion Checkers

Chinook

World Man-Machine Checkers Champion

April 29, 2007
Checkers is solved. From the starting position, black to play can only draw against a perfect opponent. This is the largest non-trivial game of skill to be solved -- it is more than one million times bigger than Connect Four and Awari (the previously biggest games that have been solved).
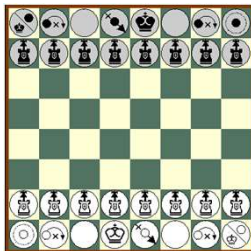
Perfect Play: Draw!

CSE 415, Univ. of Wash.　Introduction　10

Baroque Chess

Open Problem
Baroque Chess, also known as Ultima, is a game that uses the checkerboard and chess pieces, but with rather different rules. What is the optimal way to play this game? Is it possible to force a win or a draw from the starting position?

http://www.chessvariants.com/other.dir/ultima.html

CSE 415, Univ. of Wash.　Introduction　11

Robot Team Competitions

Robocup Small Size League (Bot maintenance).
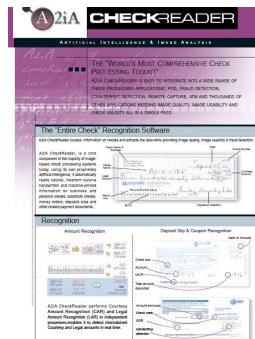
CSE 415, Univ. of Wash.　Introduction　12

2

Slide 13

Ai Artificial Intelligence

Handwriting Recognition

Using machine vision, the legal amounts and courtesy amounts on bank checks can be recognized and compared.

CSE 415, Univ. of Wash.   Introduction   13

Slide 14

Ai Artificial Intelligence

Speech Recognition & Synthesis In Automobile Accessories (e.g., GPS)
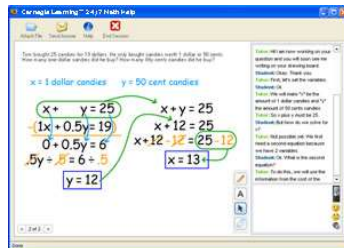

CSE 415, Univ. of Wash.   Introduction   14

Slide 15

Ai Artificial Intelligence

Intelligent Tutoring Systems

The Carnegie Learning Algebra Tutor

Using a "production system" to represent student knowledge, a tutor can predict and diagnose student errors and misconceptions.

CSE 415, Univ. of Wash.   Introduction   15

Slide 16

Ai Artificial Intelligence

Question-Answering Systems

IBM's Watson system is an expert at playing Jeopardy. It uses multiple AI techniques, including natural-language understanding and reasoning.

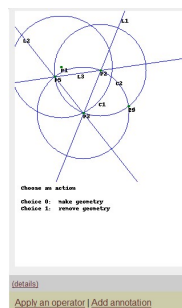CSE 415, Univ. of Wash.   Introduction   16

Slide 17

Ai Artificial Intelligence

Collaborative Problem Solving Support

⚙ **CoSolve**

"CoSolve" empowers human problem solvers to explore solution spaces for problems formulated in terms of state-space search.

CoSolve is a UW project directed by your instructor.

CSE 415, Univ. of Wash.   Introduction   17

Slide 18

Ai Artificial Intelligence

Where is AI Going?

Current hot topics:
– machine learning
– Combining logical and probabilistic reasoning
– Intelligent web agents

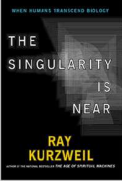One answer: to the "singularity" – exponential growth of technologies related to AI, plus convergence.

CSE 415, Univ. of Wash.   Introduction   18

"The Singularity Is Near"

The Singularity is a time at which our intelligence will become increasingly nonbiological and trillions of times more powerful than it is today—the dawning of a new civilization that will enable us to transcend our biological limitations and amplify our creativity.

Why Study Artificial Intelligence?

Gain insight into human intelligence by considering computational models of intelligence.

Gain the ability to create programs that perform functions normally thought to require intelligence.

Improve our own problem-solving skills by taking to heart lessons learned in AI.

Find solutions to specific modern problems such as dealing with information overload, providing online services in medicine, education, etc.

Work with neat technology.

Major Topics to be Covered

- *Python programming:* Symbolic Computation
- *Knowledge representation:* Problem formulations, Bayes Nets
- *Inference:* search, probabilistic reasoning
- *Communication:* Machine learning, understanding natural language.

Detailed Topics within Search

- Formal description of state-space search
- Recursive backtracking depth-first search
- Breadth-first, best-first, iterative-deepening, uniform-cost, and A* heuristic search
- Problem formulation
- Minimax search for game playing programs
- Expectimax search

Readings

- S. Tanimoto: *Python as a Second Language* 2012 --based on *Introduction to Python for Artificial Intelligence* (IEEE ReadyNotes series.)
- S. Tanimoto: *Elements of Artificial Intelligence with Python* (Draft Versions of Selected Chapters)
- Based on *The Elements of Artificial Intelligence: An Introduction using Common Lisp, 2d ed.* New York: W. H. Freeman.
- Supplemental readings will be drawn from the Web and/or:
  - Russell and Norvig's *AI: A Modern Approach.*
  - Sutton and Barto's *Reinforcement Learning: An Introduction*

Pedagogical Features

- Mix of theory and practice
- Python 3.x
- Game-playing competition
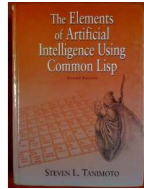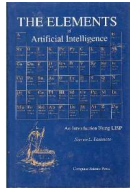- In-class exercises
- Programming assignments

About the Instructor

Steve Tanimoto:

Author: *The Elements of Artificial Intelligence: An Introduction Using Lisp; The Elements of Artificial Intelligence Using Common Lisp.*

Former editor-in-chief: *IEEE Transactions on Pattern Analysis and Machine Intelligence* .

Hobbies/personal

Evaluation (tentative weighting)

- Assignments (incl. project): 50%
- Exams: 40%
- Class participation 10%

How Can We Determine Whether A Computer is Intelligent?

- Measure its knowledge? Count bytes of knowledge? Count the number of its rules? Words in its vocabulary? Functions in its library?
- Measure processing speed? Logical inferences per second? Rule applications per second? Associations per second?
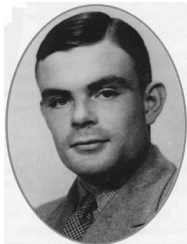- Compare it with a person in a blind test?

Turing's Test (The Imitation Game)

Alan Turing

- A computer (program) and a person compete by trying to answer questions intelligently. Randomly, one is assigned the name A and the other B.
- In another room, a human interrogator alternately poses questions to A and B.
- A messenger (an "intermediary") delivers questions and responses without revealing any other information about the identities of A and B.
- If the interrogator selects the computer as the more human or more intelligent respondent, then the computer passes that particular Turing Test.