



## Introduction to the Course CSE 415 Introduction to Artificial Intelligence

University of Washington  
Spring, 2017

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## Introduction to Artificial Intelligence

- Knowledge representation techniques, including the use of ISA hierarchies, logic
- Python
- State-space search
- Problem formulation and solving
- Logical and probabilistic inference
- Machine learning
- Natural language understanding

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## What is Intelligence?

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## 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?

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## Examples of AI

- Game Playing
- Robot Control
- Machine vision in bank check processing
- Natural Language Translation
- Speech Recognition & Synthesis
- Intelligent Tutoring Systems
- Problem Solving and Design Agents

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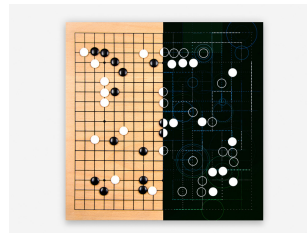
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## AlphaGo Masters Go

### 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/>

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**World Champion Checkers**

# Chinook

**World Man-Machine Checkers Champion**

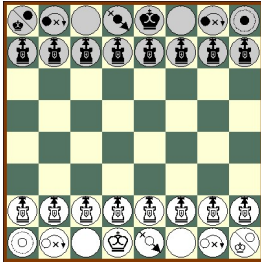


**April 29, 2007**  
Checkers is solved. From the starting position, black to play can only draw against a perfect opponent. This is the largest non-trivial game of skill to be solved -- it is more than one million times bigger than Connect Four and Awari (the previously biggest games that have been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

Perfect Play: Draw!

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**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>

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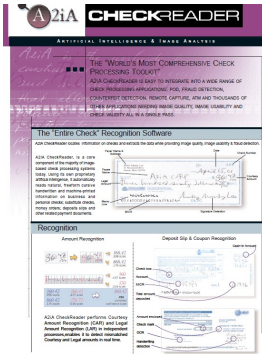
**Robot Team Competitions**

**Robocup 2006 Small Size League (Bot maintenance).**

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**Handwriting Recognition**



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

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**Machine Translation (e.g., in Google Wave)**

# (en) English The spirit is willing but the flesh is weak. The vodka is good but the meat is rotten.  
English spirit is willing but the flesh is weak. Vodka is good but the meat is rotten.

# (ru) Me and Multi Lingual Bot: This spirit is willing but the flesh is weak. 8:42 pm  
Это дух бодр, но плоть слаба.


# (en) This spirit is willing but the flesh is weak. This spirit is willing but the flesh is weak.

# (it) L'esprit est prompt mais la chair est faible.

# (en) The spirit is willing but the flesh is weak.

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

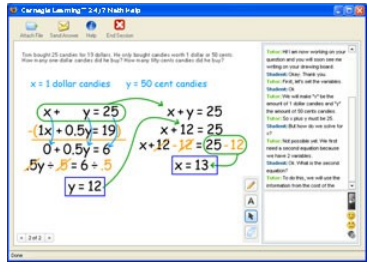


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**AI Artificial Intelligence**

## 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.

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**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.



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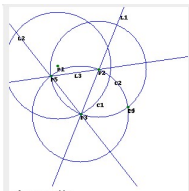
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## Collaborative Problem Solving Support

**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.



Choose an action  
 choice 0: make geometry  
 choice 1: remove geometry

(status)  
 Apply an operator | Add annotation

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## Where is AI Going?

Current hot topics:

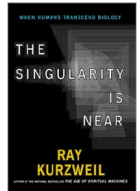
- machine learning
- Combining logical and probabilistic reasoning
- Intelligent web agents

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


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## “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.



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**AI Artificial Intelligence**

## 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.

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## Major Topics to be Covered

- **Python programming:** Symbolic Computation
- **Knowledge representation:** Relations, logic
- **Inference:** Logical, probabilistic
- **Communication:** Machine learning, understanding natural language.

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## Detailed Topics within Knowledge Representation

- Relationships among data, information, and knowledge
- ISA hierarchies
- Propositional logic and resolution
- Other inference methods

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## 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\* search
- Problem formulation
- Genetic search
- Minimax search for game playing programs
- Expectimax search

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## Other Topics

- Probabilistic reasoning
- Machine Learning: perceptrons, naïve Bayes classifiers, reinforcement learning, decision-tree induction
- Natural language understanding

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## Readings

- S. Tanimoto: *Python as a Second Language* 2012 --based on *Introduction to Python for Artificial Intelligence* (IEEE ReadyNotes series, 2006.)
- 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, 1995.
- Supplemental readings will be drawn from the Web and/or Russell and Norvig's *AI: A Modern Approach*.

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## Pedagogical Features

- Mix of theory and practice
- Python
- Game-playing competition
- In-class exercises & homework
- Projects

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## CSE 415 Teaching Team

Instructor:

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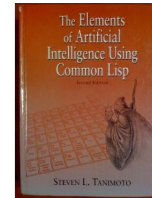
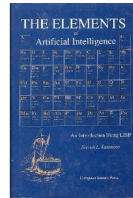


## About the Instructor

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: 40%
- Project: 20%
- Exams: 30%
- Class participation 10%

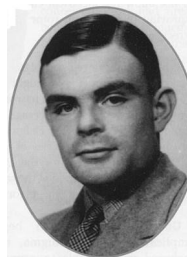


## How Can We Determine Whether A Computer is Intelligent?

- 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.