

## GEM 1501 Problem Solving With Computers

### Lecture 12:

## Algorithmic Intelligence

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### Algorithmics and Intelligence

- Algorithmic intelligence?
- Turing test
- Playing games
- Knowledge representation and expert systems
- Understanding natural language

### Summary of Previous Lecture

- Probabilistic Algorithms for
  - concurrency control
  - solving hard computational problems
  - generating large prime numbers
- Exploiting hardness of problems for cryptography
- Public-key cryptography allows safe end-to-end communication

### Algorithmic Intelligence?

- The Mechanical Chess Player <http://www.chesscentral.com/images1/capture-.jpg>
- Blocks world
- “Washing the dishes”
- Robotic exploration

## Social Game

- Human interrogator I
- Two rooms connected to I via terminal
- One room has a man, one room has a woman
- How does I find out which one is which?

## Turing Test

- Human interrogator I
- Two rooms connected to I via terminal
- One room has a human, one room has a computer
- How does I find out which one is which?

## Playing Games

- Many games have been “solved” with computers
- Example: Nine Men’s Morris
- In some games, computers beat the strongest players (Backgammon)
- In some games, medium-strength players beat strongest computer programs (Go)
- Special case: Chess

## Computers Playing Games

- Game trees
- Heuristic search
- Evaluating positions (minimax)
- Opening and endgame databases

## Knowledge Representation

- $2 \times 4 = 8$
- "Giraffes have long necks."
- "Alan Turing was brilliant."
- How to collect and store "knowledge?"

## Logic Programming

- Logic programming works in highly structured domains
- These domains are subject to "predicate logic"
- The truth of every statement can be rigorously judged

## Example

- "John is Mary's father."
- "A parent of any ancestor of a person is also an ancestor of the person."
- `father(john,mary).`  
`ancestor(X,Y) :- father(X,Y).`  
`ancestor(X,Y) :- father(X,Z), ancestor(Z,Y).`

## Expert Systems

- Some domains of knowledge require large amounts of data
- Data is sometimes highly structured
- Organic chemistry, genetics, microelectronics
- Expert systems formalize such knowledge and support the human decision maker
- Would you trust an expert system as your doctor in intensive care?

## Natural Language Processing

- Under investigation since early 1960s
- Good success in voice recognition
- Systems for language recognition currently being commercialized
- Language understanding in very limited domains possible
- General-purpose language understanding would require “true intelligence”