An Introduction to Artificial Intelligence

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Star Wars™

If I had any
REAL brains
would I be doing this?

I hope that I don't
short out any
of his circuits.

What is Intelligence?

- Who knows what it is
- Ability to understand or reason (dictionary)
- Mental ability: learning, problem solving, abstract thinking, & reasoning (encyclopaedia)
- Herb Simon
  - Involves associations, pattern recognition, inference, experience, & intuition
- 1948 Conference

What does “Artificial” mean?

- Random House College Dictionary:
  - Produced by man
  - Made in imitation or as a substitute
  - Simulated
- Examples
  - Artificial Chocolate
    - May look and taste like chocolate, but it’s not
  - Hot dogs
    - Soy dogs look like hot dogs, kind of taste like them, are definitely healthier, but contain no meat.

Then what is Artificial Intelligence?

- Combining the terms
  - Simulated ability to understand, reason, and problem solve,
  - or at least appear to
- Ability of a computer to perform tasks (that human intelligence is capable of doing) such as reasoning and learning. (McGraw-Hill computer Handbook)

What are we Trying to Accomplish?

- Solve problems
- Improve performance
- Increase profits
- Forecasting
- Better decisions
  - DSS – Decision Support Systems
- Model biological to further understanding

Example applications

- Mycin
  - Expert system that helps doctors to diagnose infectious blood diseases
- Teresius
  - Expert system to help with investments
- Microsoft Office™
  - Uses AI to help correct mistakes
  - To do what it thinks is best
- My work in forecasting CD rates
  - Neural network time series forecasting

Current AI Methods

- Expert Systems
- Case Based Reasoning
- Neural Networks
- Genetic Algorithms
- Fuzzy logic
- Data Mining
- Hybrid
- Synthetic Immune Systems

Expert Systems

- Just like having a subject expert
- The same as a Decision Tree
- Stored in a set of “If.. then..” rules
- Consists of
  - Rule base
  - Inference engine/rule interpreter
- Get rules from Human Expert
- Knowledge engineer converts knowledge into rules
- Example
  - If this is a corner, then must go into second gear

Using an Expert System

- Steps
  - Hire an expert
  - Hire a knowledge engineer
  - Create rule set
  - Apply problem
- Limitations
  - Can only answer problems that it has already seen
  - Contains biases of expert
  - Where is the intelligence?

Case Based Reasoning

- Very similar to our legal system
- Store a large selection of cases
- Lookup engine
- Find case like problem at hand
- Example
  - The last time the car would not go it was a plugged fuel filter

Applying CBR

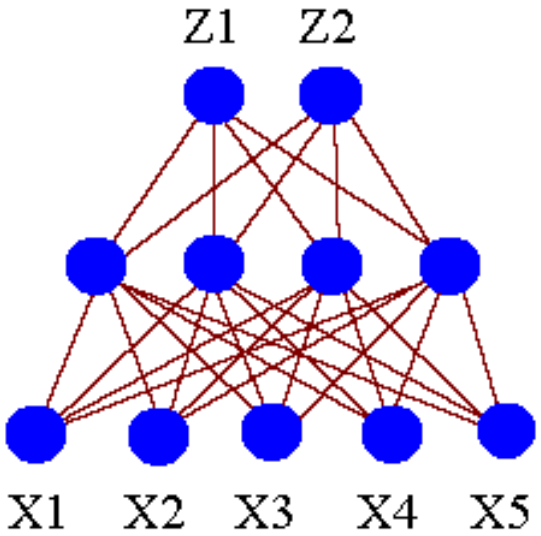
- Must have library of cases
- Inference engine is hard to create, looking for similarities between problem and database of cases
- Cannot solve anything that was not in the original database
- Where is the intelligence?

Neural Networks

- What is a neural network?
- Biological
- Computer emulation (ANN)
- Massively parallel system
- General data driven function approximator
- Functions performed
  - Pattern recognition
  - Classification
  - Forecasting/nonlinear regression
  - Brain emulation

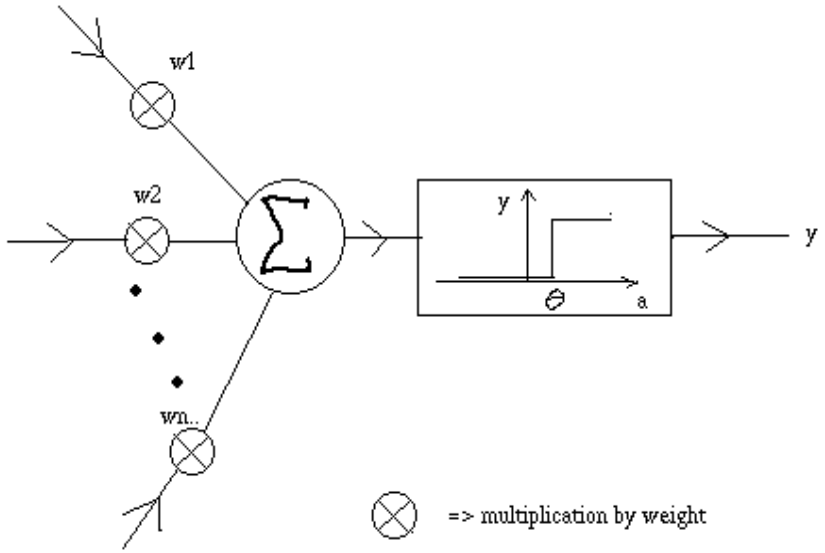
Feed Forward Neural Network

Output



input

Model of Individual Neuron



Input is a large number of weighted outputs from nerves or other neurons
It sums the weighted inputs
If the sum is greater than a threshold, then it fires

Using Neural Networks

- Steps
  - Get training data set
  - Optional clean the data
  - Set ANN architecture
  - Train the system
- Weaknesses
  - Operator designs architecture and sets training
  - Very operator dependent
- Where is the intelligence?

Genetic Algorithms (GA)

- John Holland and Schema Theorem, 1975
- Imitates natural evolution
  - Also called evolutionary computing
  - Modeled on natural selection
  - Survival of the fittest
- Exploited search in hyperspace (N space)
- Near optimal solution for complex problems

How GA's Work

- Start with initial population of chromosomes
  - Each one represents a possible solution
  - Chromosome is a string of binary values
- Mate with each other to produce new chromosomes, mutation included
- Test all chromosomes
- Rate them (figure of merit)
- Kill off worst solutions
- Mate again and start all over
- Stop by 3 criteria
  - No more improvement
  - Number of generations
  - Achieved desired level of performance

Using a Genetic Algorithm

- Must make fitness function
  - Dependent on criteria being searched
  - Rates fitness of each chromosome
- Give it initial population
- Watch out for local maxima/minima
- Can be used to find best or worst
  - Depends on fitness function
- Large overhead
- Where is the intelligence?

Fuzzy Logic

- Lotfi Zadeh, 1968
- Originally developed for “specificity” to help communicate
- To convert lingual variables into computer inputs
  - Hot, cold, high, medium, low, too much, etc
- Is there any intelligence here?
- Now Fuzzy Logic Type II Jerry Mendel
- Precisiated Natural Language

Data Mining

- Tons of data available today
- Look into the data
  - No preconceived ideas
  - Look and see what you find
  - Look for patterns
- Today, people search data for specific things
- Heavily operator dependent
- Try statistics first, then SVM or PSVM. Also cluster analysis, neural networks, other search methods
  - SVM is Support Vector Machine
  - PSVM is polynomial SVM
  - Methods to group observations upon dimensions
- Where is the intelligence?

Synthetic Immune Systems

- Mimics human autoimmune system
- Good for computer security
  - Detects intrusions
- Somewhat a reverse cluster analysis
  - Detects if not in acceptable cluster
- Uses statistics, clustering, pattern recognition, etc
- Where is the intelligence?

Hybrids

- Combinations of the methods
- My work
  - Neural network
  - Linked list database
  - Fuzzy logic on some inputs
  - Genetic algorithms to set architecture & weights
- Biological intelligence is truly a combination of methods

Future

- Systems that
  - set themselves up
  - learn from successes and mistakes
  - learn from the environment
  - Behave like biological intelligence
- Autonomous learning
- Driving factors:
  - Security
    - Anti terrorism
    - “Big Brother”
  - Business
    - Every facet including marketing

Some Applications

- Computer Security
  - Who to let in
  - Acceptable activity
  - Virus detection
- Detection
  - Sniper in tree
  - Submarine in under water
- Classification
  - Credit approval
  - Credit card transaction approval

More Applications

- Pattern recognition
  - Guidance system
  - Iris Scans
  - Retina scans
  - Finger prints
  - Criminal activity
  - Purchasing patterns
  - Voice recognition
  - Character recognition
- Forecasting
  - Stock prices or other financial data
  - Tracker for radar/sonar
  - Non-linear regression

Even More Applications

- Optimization
  - Traveling salesman problem
  - Complex scheduling problem
  - Setting weights and architecture of ANN
- Bio-medical
  - Seizure prediction
  - Model brain
  - Condition recognition
  - Diagnosis support

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