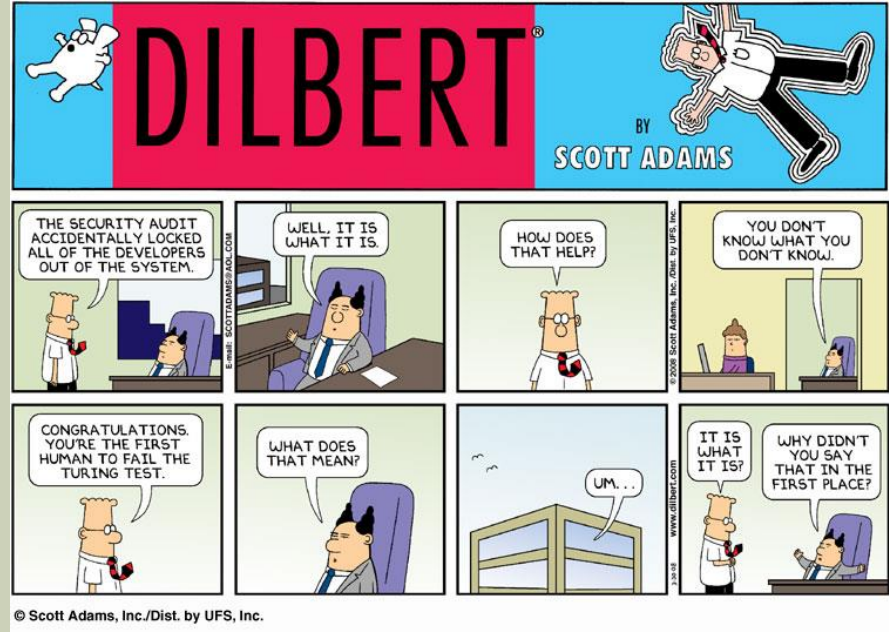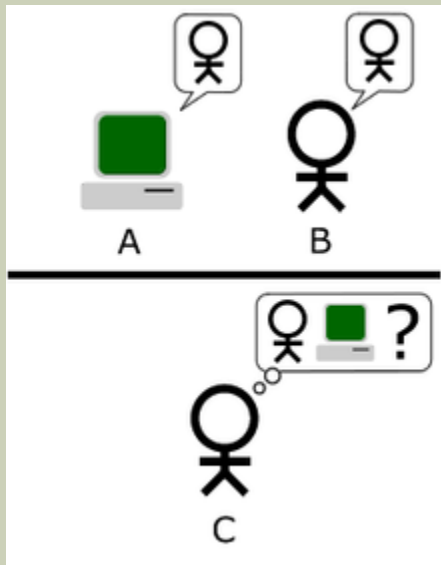# ARTIFICIAL INTELLIGENCE

SUCCEEDING IN COLLEGE: TAKING NOTES

- Not everything you need to know is on slides
  - Slides are meant to point out the main points, but often details are left off and the instructor talks about these details
  - Slides are not very good at documenting the process of doing something
- Taking notes on lectures allows you to capture the details (and remember them later, say for an exam?)
- Taking notes is also a way to keep you engaged in the topic being presented

- As I go through my presentation, take notes
  - Try to capture the important concepts
  - There will be a quiz at the end – and you can use your notes
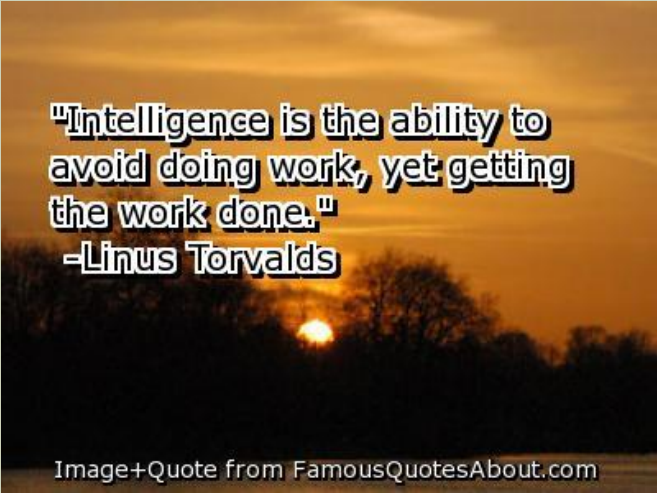
ARTIFICIAL INTELLIGENCE: DEFINITION

- Turing Test:
    - If a person typing input at one computer cannot tell whether the response s/he is getting is from another person or a computer, then the computer passes the Turing Test for "intelligence".
    - We haven't achieved this goal.
        - Well, not exactly...

ARTIFICIAL INTELLIGENCE: DEFINITION

- Intelligence:
  - The ability to understand and learn things
  - The ability to think and understand instead of doing things by instinct or automatically
- Artificial Intelligence:
  - The goal of artificial intelligence is to make machines do things that would require intelligence if done by humans

"Intelligence is the ability to avoid doing work, yet getting the work done."
-Linus Torvalds

Image+Quote from FamousQuotesAbout.com

ARTIFICIAL INTELLIGENCE: DEFINITION

- Intractability
  - A problem is called intractable if the time it takes to solve the problem is exponential to the number of "things" contained in the problem.
  - AI deals with searching for solutions to an intractable problem by using "heuristics", or rules of thumb.
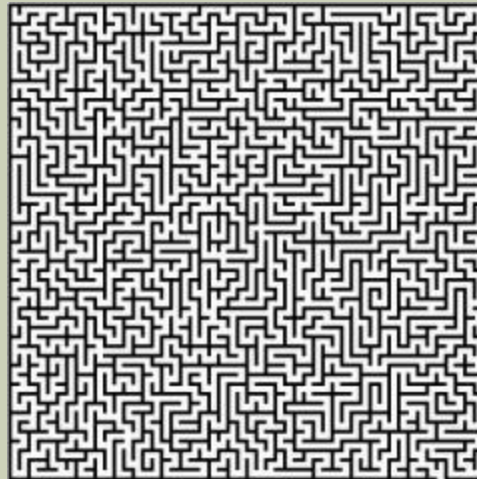
ARTIFICIAL INTELLIGENCE: TECHNOLOGIES

- **Knowledge Based Systems**
  - **Uncertainty Management**
  - **Fuzzy Logic**
- **Machine Learning**
  - **Statistical Methods**
  - **Inductive**
  - **Artificial Neural Networks**
  - **Genetic Algorithms**
- **Case Based Reasoning**
- **Others**
  - **Robotics**
  - **Natural Language**
  - **Computer Vision / Image Understanding**
 - **Intelligent Agents**

KNOWLEDGE BASED SYSTEMS

- **Rule Based Systems**
  - **Different from "if...then" constructs in programming**
    - **Non-deterministic**
  - **Attempt to capture human expertise**
- **Formal Logic**
- **Uncertainty Management**
- **Fuzzy Logic**
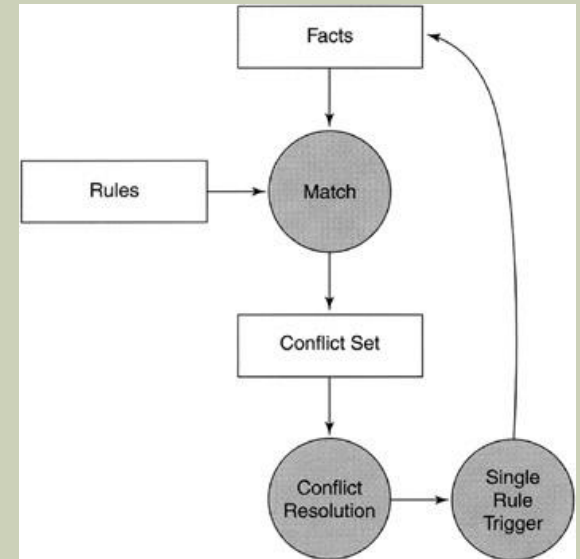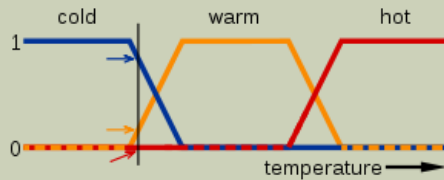
CASE BASED REASONING

- **Reasoning from examples rather than rules**
  - **Solution to problem is found based on the similarity of the current problem to one encountered in the past**
  - **Similar to the reasoning performed by doctors or lawyers**
 - **If new cases are retained, system continues to add to its knowledge, or learn**
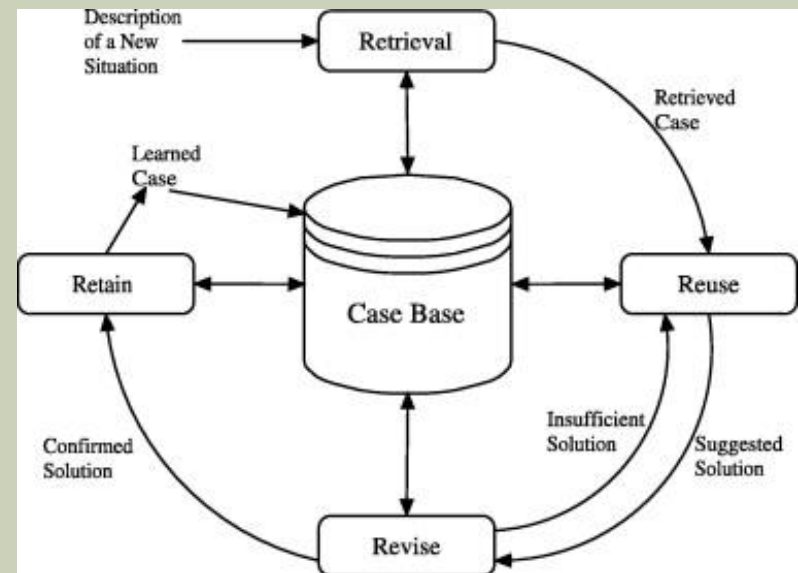
MACHINE LEARNING

- When the performance of a program improves over time, it is learning

- When a previously unknown solution is discovered by automated discovery of patterns in data, the solution has been learned
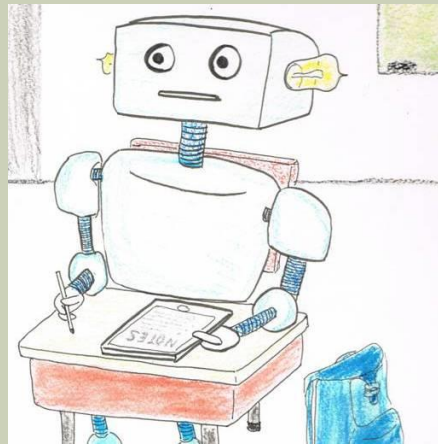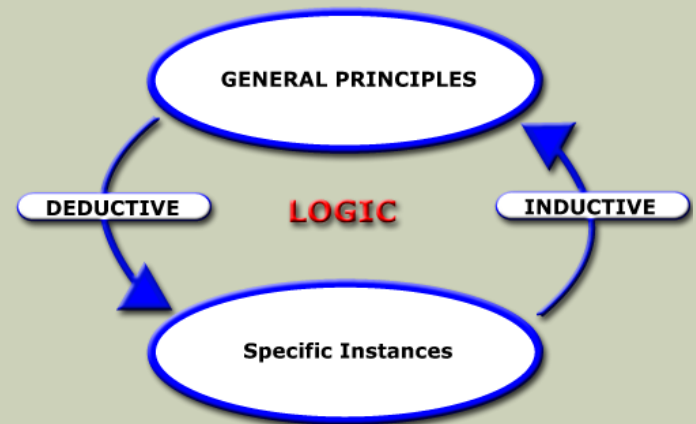
MACHINE LEARNING: DEDUCTION

- Using logic to derive new facts
- Guaranteed to be correct
  - Deduction
    - All birds fly
    - Tweety is a bird
    - Therefore Tweety flies
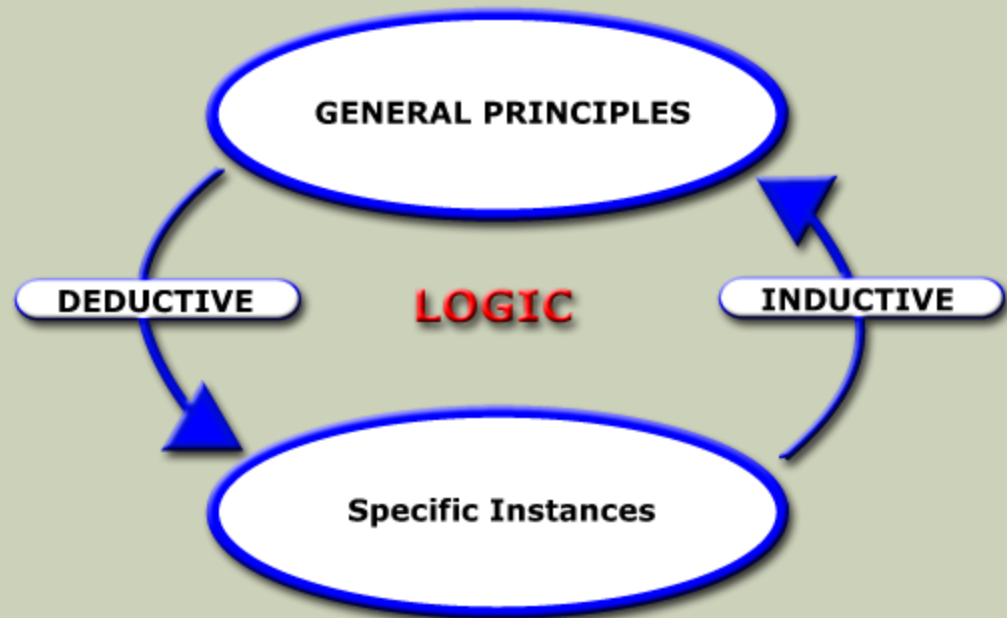
MACHINE LEARNING: INDUCTION

- Deduction
  - All birds fly
  - Tweety is a bird
  - Therefore Tweety flies
- Discovering rules from data
- Not guaranteed to be correct
  - Induction
    - All the birds I've seen in my yard fly
    - All the birds I've seen around town fly
    - Therefore all birds fly

MACHINE LEARNING: ABDUCTION

- Deduction
    - All birds fly
    - Tweety is a bird
    - Therefore Tweety flies
- Induction
    - All the birds I've seen in my yard fly
    - All the birds I've seen around town fly
    - Therefore all birds fly

- Using a conclusion to provide support for a precondition in a rule
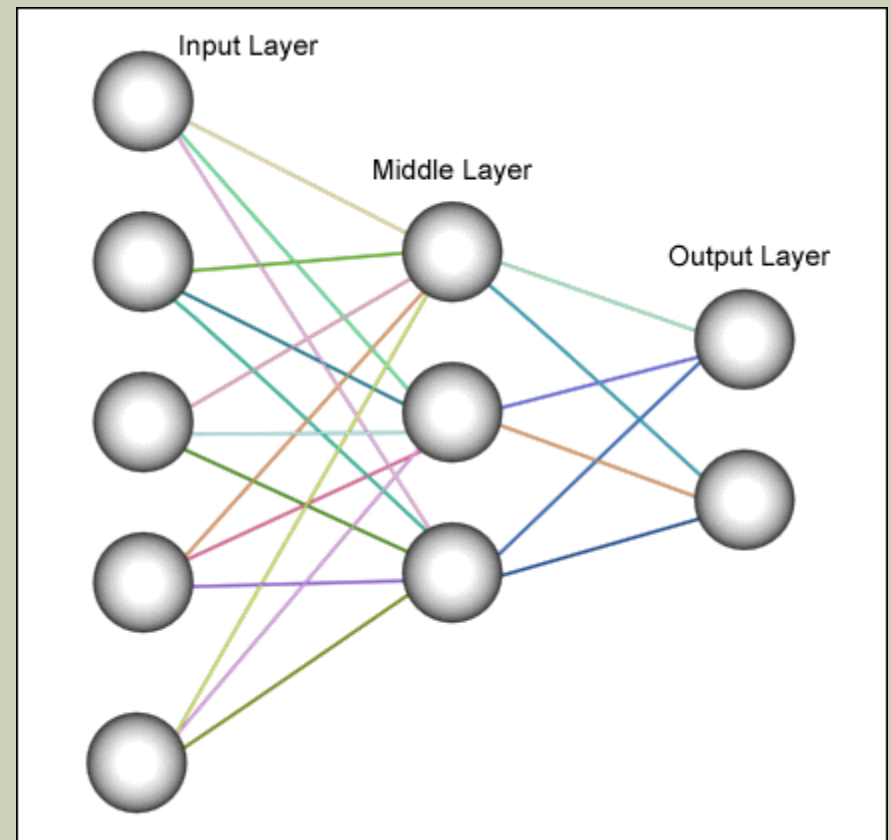- Not guaranteed to be correct
    - Abduction
        - Eating shrimp causes flamingoes to be pink
        - Tweety is a pink flamingo
   - Therefore Tweety eats shrimp

MACHINE LEARNING: NEURAL NETWORKS

- Patterned after brain biology
- Neurodes and connections between the neurodes
- Learns by adjusting the weights on the connections

MACHINE LEARNING: GENETIC ALGORITHMS

- Modeled after natural selection theory
- Solution is a string of genes
- Fitness function measures quality of solution
- "Good" solutions are
  allowed to remain in the gene pool
  - Reproduction
  - Crossover
  - Mutation
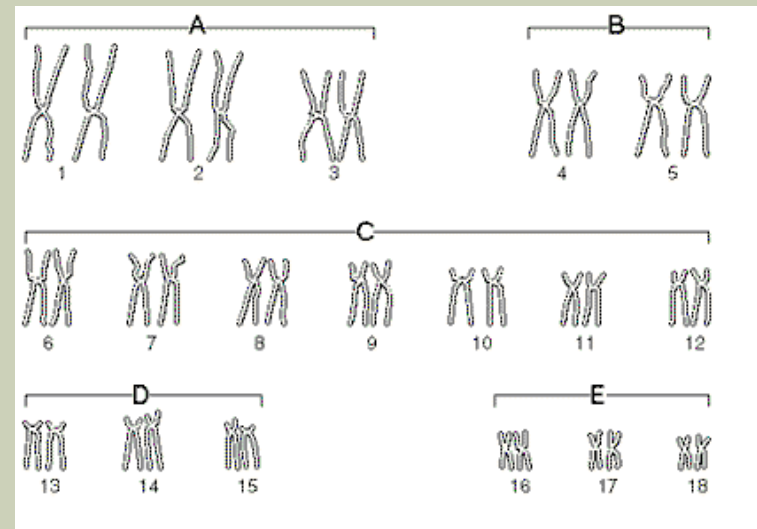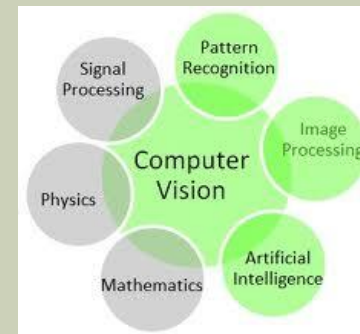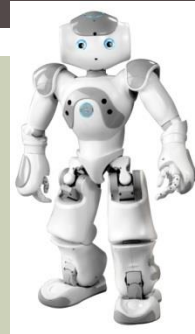
OTHER AI TECHNOLOGIES

- Robotics
  - Lego Mindstorms
  - NAO
- Natural Language
  - Speech Recognition
  - Language Translation
- Computer Vision / Image Understanding
- Intelligent Agents

PROJECTS

- Preterm Delivery Prediction
- Satellite Imagery of Sea Ice
- Identification of Larvae
- Hazardous Waste Incineration
- Space Shuttle: Orbital Redundancy Management
- Satellite Communications Scheduling
- Negotiated Collaboration between Intelligent Agents
- Civilian Aircraft Search and Rescue
- Nathan's Open Song Composer

IDENTIFICATION OF LARVAE

- Neural networks
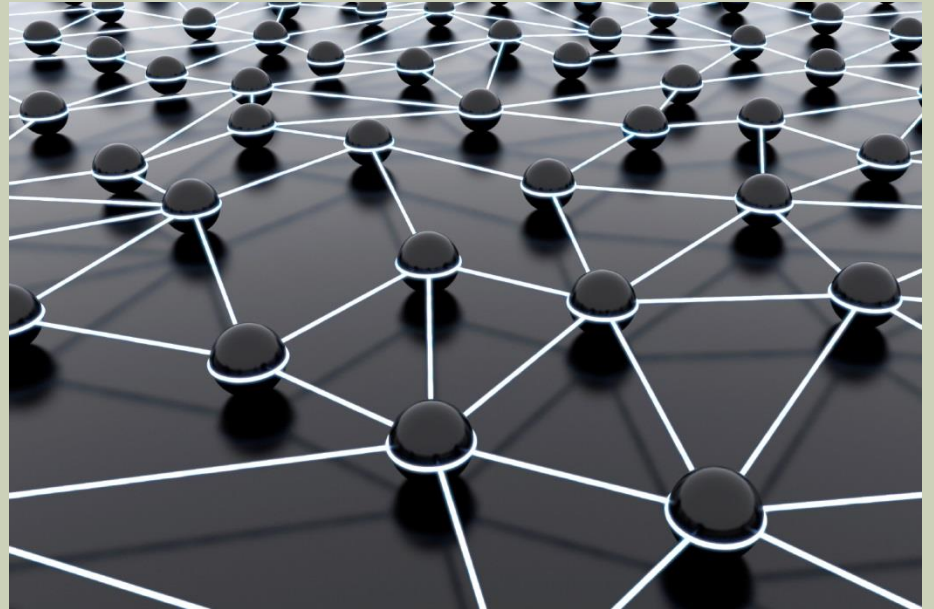- Robotics
- Image understanding

SPACE SHUTTLE: ORBITAL REDUNDANCY MANAGEMENT

- Rule based
- Case based
- Utility theory

NEGOTIATED COLLABORATION BETWEEN INTELLIGENT AGENTS

- Intelligent Agents
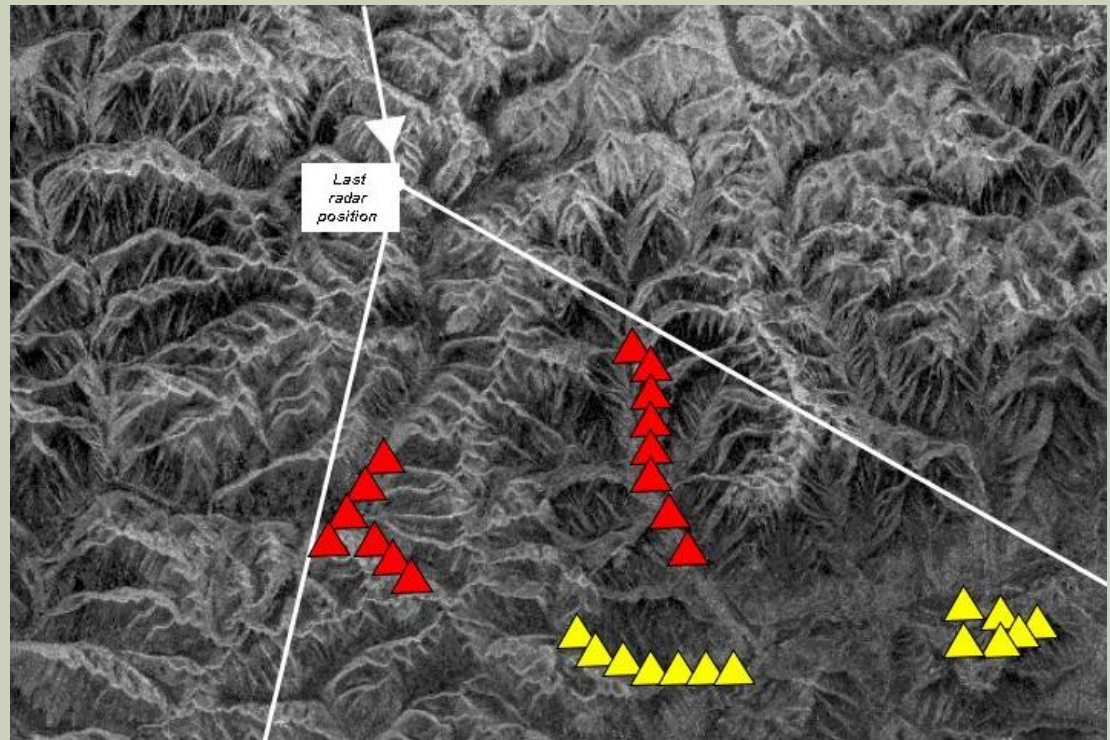- Negotiation
- Rule based
- Case based
- Inductive learning

Autonomous Negotiating Teams (ANT)

CIVILIAN AIRCRAFT SEARCH AND RESCUE

- Rule based
- Data fusion
- Uncertain reasoning

OPEN SONG COMPOSER

- Creates musical composition using a genetic algorithm and music theory
- Learns user preferences from original composition

QUESTIONS?