

# Chapter 34. Smart Tools

**The Quest for Artificial Intelligence, Nilsson, N. J., 2009.**

## Lecture Notes on Artificial Intelligence

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# Overview of Chapter 34

- Basic concept of smart tools
  - AI programs that are used by physicians, scientists, engineers, and business people to help them in their workaday tasks
- Smart tools in various applications
  - Medicine – Decision Support Systems
  - Scheduling – AURORA™, TEMPORIS™
  - Automated trading – Vhayu Velocity™, Streambase Systems
  - Business practices – Business Rule Management Systems
  - Translating languages – MASTOR, IraqComm, etc.
  - Automated invention – Genetic Programming
  - Recognizing faces – State-of-the-arts, algorithms, companies

# Smart Tools - Introduction

## ■ Basic concept of smart tools

- AI programs that are used by physicians, scientists, engineers, and business people to help them in their workaday tasks

## ■ Forms

- Stand-alone systems
- Integrated into a larger computational framework
- Integrated into hardware devices

## ■ Types



- Passive: work only when called upon to help to solve some particular problem. Ex) disease diagnosis
- Active: constantly on. ex) online stock-trading systems

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# 34.1 In Medicine



# Decision Support System (DSS)



- **Concept and history** 
  - Computer-based intelligent system that supports clinical/medical decisions
  - 1980s: Beginning of DSS → Around 2000: Emergence of DSS
- **Development of DSS** 
  - Ancestry systems: MYCIN, INTERNIST-1, PUFF
  - Current representatives: Athena DSS, Gideon, Iliad)



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## **34.2 For Scheduling**

# Intelligent Scheduling Software

- **AURORA™** 
  - Developer: Stottler Henke Associates
  - Customer example: Helping schedule and manage the building of the **Boeing Dreamliner™**
- **TEMPORIS™** 
  - Developer: United Space Alliance
  - Intelligent spaceflight mission management and planning tool for use by the crew on board future space missions
  - Stottler Henke's AURORA is an integral part of TEMPORIS



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## **34.3 For Automated Trading**

# Automated Trading



## ■ How

- AI data mining, text processing, decision methods
- Analysis of Real-time trading data and news feed
- Make automatic buy-and-sell decisions on stocks, commodities, and currencies

## ■ Up-to-the-minute news sources

- NewsScope Archive by the Reuters
- Elementized News Feed by the Dow Jones

## ■ Algorithmic trading services

- Vhayu Velocity™ by Vhayu Technologies Corporation
- Streambase Systems



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## **34.4 In Business Practices**

# Business Rule Management Systems

## ■ BRMSs

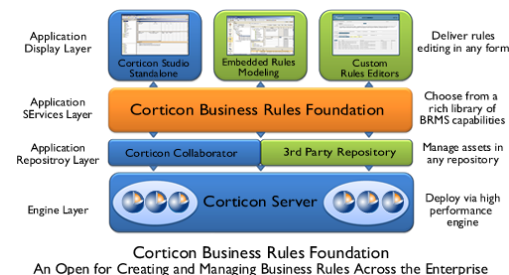
- Descendants of the rule-based expert systems of the 1980s
- Examples: BLAZE ADVISOR (Fair Issac), Jrules (ILOG), WebFOCUS (Information Builder)

- How BRMSs works



## ■ Business rules

- Information about how a business operates – its policies and constraints
- In BRMSs, these rules are encoded in English-like, computer-readable syntax
- They are not annotated with probabilities or certainty factors



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# 34.5 In Translating Languages

# Commercial Natural Language Translation Systems

- **MASTOR: IBM's speech-to-speech translator**
  - Translate free-form English speech into Mandarin speech (and vice versa)
- **Broadcast Monitoring System by BBN Technologies**
  - Creates a continuous searchable archive of international television broadcasts
  - Automatically transcribes the real-time audio stream and translates it into English
- **IraqComm by SRI International**
  - Transform spoken English into translated spoken colloquial Iraqi Arabic (and vice versa)

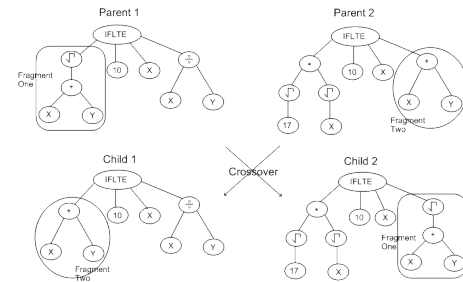
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## **34.6 For Automating Invention**

# Genetic Programming as Automated Inventor

## ■ Genetic Programming (GP)

- Invented by John Koza
- A search method based on simulating the processes of evolution

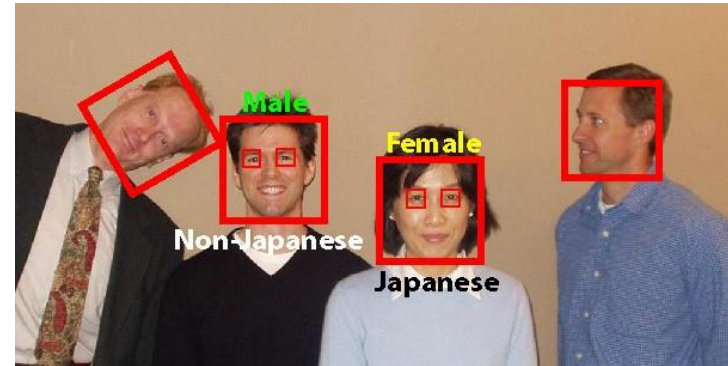


## ■ Applications of GP by Koza's group

- Optimal antenna system
  - Designs for optical lenses
  - Electrical circuits, controllers, mechanical systems, ...
- ## ■ The goal of the group is to produce what they call “human-competitive designs”






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# 34.7 For Recognizing Face

# Face Recognition

- **State-of-the-arts** 
  - Face-recognizing systems are becoming more common at airports, banks, and places where personal identity must be verified or established
  - 2007 NIST face-recognition tests
- **Algorithms** 
  - Pattern-recognition techniques
  - New approaches
- **Commercial companies** 
  - FaceVACS
  - FSE (Face Sensing Engine)

# Concluding Remark – Remaining Quests

## ■ Other areas for AI tools

- Aiding the processes of movie animation
- Computer program writing and debugging
- Industrial process control
- Enhancing and searching the semantic Web
- ...

## ■ Main goal of the quest still remains

- Endowing artifacts with full human capabilities for language, perception, reasoning, and learning

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# Appendix

# Decision Support System (DSS)



## ■ Concept of DSS

- computer-based intelligent system that supports clinical/medical decisions

## ■ 1980s – Beginning of DSS

- AI technology has been an important part of medical systems and devices

## ■ Around 2000 – Emergence of DSS

- Several AI-infused devices emerged in the medical device industry
- Ex) several intelligent electro-cardiogram (ECG) devices



# Development of DSS

## ■ Source of information



- OpenClinical: <http://www.openclinical.org/aisinpracticeDSS.html>
- Artificial Intelligence in Medicine (Elsevier journal)

## ■ Ancestry systems

- MYCIN, INTERNIST-1, PUFF, etc.

## ■ Current representatives

- Athena DSS – hypertension management
- Gideon – infectious diseases
- Iliad – internal medicine
- TherapyEdge HIV – HIV patient management



# Representative DSSs

## ■ ATHENA DSS

- Advice system to physicians about managing hypertension
- Function
  - Process a patient's clinical data against hypertension management knowledge in its knowledge base
  - Generate patient-specific recommendations for management during a clinical visit
- Related systems: MYCIN → ONCOCIN → EON task-specific architecture (rule-based systems)



# Representative DSSs

- **Gideon** (The Global Infectious Disease and Epidemiology Network)
  - Program to help physicians diagnose and treat country-specific diseases
  - Function
    - Diagnose based on a large DB of diseases (337 recognized), symptoms, signs and laboratory findings, and countries (224 included)
    - Four modules: Diagnosis, Epidemiology, Therapy and Microbiology
    - Bayesian analysis-based computation of the probability of a disease given data about a patient





# AURORA™

- Developed by Stottler Henke Associates, Inc.
- Boeing Company uses AURORA
  - Helping schedule and manage the building of the Boeing Dreamliner™
- Functions
  - Intelligent scheduling
  - Displaying scheduled activities in various graphical images
  - Displaying resource allocations and the temporal relationships among the activities



# TEMPORIS™



- Developed by United Space Alliance, LLC
- Functions
  - Intelligent spaceflight mission management and planning tool for use by the crew on board future space missions
  - Considers volumes of spaceflight constraints, flight rules, dependencies, sequences, medical guidelines and safety requirements
  - Help crews schedule all aspects of their in-flight lives
    - Daily activities, spacecraft housekeeping, and conducting on-board experiments
  - Reducing 2-week job of 50 planners to a few moments
  - Stottler Henke's AURORA is an integral part of TEMPORIS

# How BRMSs Work



## ■ Rule engines

- Perform both forward and backward inference over a network of rules
- Ex) Inference engine in BLAZE ADVISOR uses a descendant of the Rete algorithm (18.2.3 other expert systems)

## ■ Usage of conclusions

- Communicate policy, late-breaking business opportunities, and needs for action among staff and other parties
- Evoke automatic actions such as ordering, sending e-mails, and so on.

# State-of-the-Arts of Face Recognition

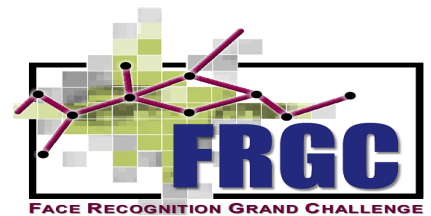


## ■ Human ability of recognizing face

- Can do it regardless of pose, scale, facial expression, or lighting conditions

## ■ Computers are getting better

- Ubiquitous Artificial Intelligence (Ch. 33)
- Face-recognizing systems are becoming more common at airports, banks, and places where personal identity must be verified or established
- 2007 NIST face-recognition tests
  - At low false alarm rates for humans, 7 algorithms were comparable to or better than humans
  - The best methods use machine learning algorithms working on very large data sets



# Algorithms for Face Recognition



- **Pattern-recognition techniques** (<http://www.face-rec.org>)
  - Sample features from a face image
  - Compare these features against those of a large library of identified faces to find the closest match
  - Some use Bayesian techniques and HMMs are
  - Many methods use projection technique from high to low dimension ex) eigenfaces
- **New approaches**
  - Image averaging
  - (Gardiner, 2009) reports a method which renders years of research in the field obsolete

# Commercial Companies



## ■ FaceVACS by Cognitec Systems GmbH

- Applications for security
- Applications for convenience and productivity



## ■ FSE (Face Sensing Engine) by Oki Electric Industry Co., Ltd.

- Controlling access to information in camera-equipped cell phones and other devices
- Sorting photographs based on recognizing faces
- Locating faces in a camera's field of views

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