# G51FAI
# Fundamentals of AI

Instructor: Siang Yew Chong

*Introduction*

# Introduction

- Module Goals
- Delivery and Assessment Methods
- Learning Resources
- Contents & Lecture Plan
- AI Terminologies
- Applications of AI

# Module Aims and Objectives

- Define what we mean by AI (or at least give us a working definition for this module)
- A brief overview of AI history, i.e. its key milestones and developments
- Provide an understanding of the basic theories of a range of AI techniques and applications

# Delivery & Assessments

- Lectures
  - Approx. 20 hours
  - supplemented by self readings
  - 2 hrs/week, Monday 2:00 – 4:00 pm
- Practicals
  - Approx. 4 weeks
- Assessments
  - 25% coursework
  - 75% examination (1.5 hours) – answer all questions

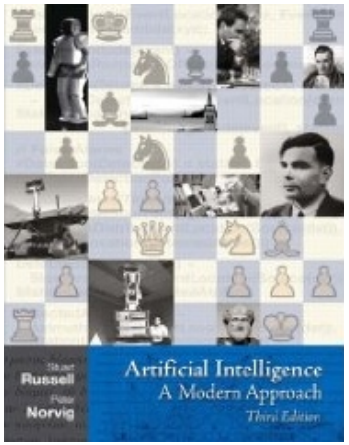
# Learning Support

- Module materials online and updated at
  - http://moodle.nottingham.ac.uk
    - presentations slides/notes
    - directed readings
    - tutorials
    - past examination papers
  - useful UK site - http://www.cs.nott.ac.uk/~gxk/courses/g5aiai/

  (readings from module's predecessor)

- Module convenor
  - Room: BB22 (BB40 Consultation Room)
  - E-mail: Siang-Yew.Chong@nottingham.edu.my

# Recommended Texts

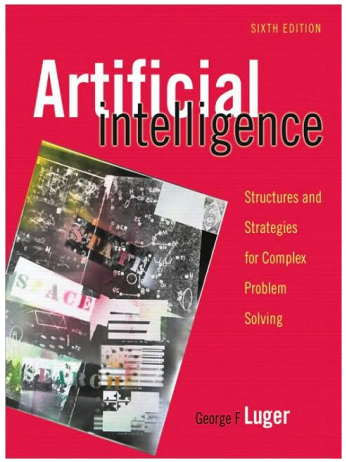



Artificial Intelligence : *A Modern Approach*

Third Edition by Stuart J. Russell & Peter Norvig

(2010, Prentice Hall, ISBN 0-13-207148-7)

( Main Course Text )




Artificial Intelligence : *Structures and Strategies for Complex Problem Solving*

Sixth Edition by George F. Luger

(2008, Addison Wesley, ISBN 0-321-54589-3)

*Note: previous edition can also be used*

# Useful Readings

- The Essence of Artificial Intelligence
  - by Alison Cawsey, Prentice Hall
- Artificial Intelligence: a Guide to Intelligent Systems
  - by Michael Negnevitsky, Addison Wesley
- Artificial Intelligence
  - by Elaine Rich & Kevin Knight, McGraw-Hill
- And other specific readings (research papers)

# Contents

- AI Definitions
- History and Philosophy
  - Stages of AI developments
  - Turing Test and Chinese Room
- Search Techniques
  - Problem Formulation
  - State Space Search
    - Tree Search: Depth-First and Breadth-First
    - Heuristic Search: A* Search

# Contents

- Game Playing
  - Iterative Algorithms
  - Performance Analysis
- Neural Networks
  - Perceptrons, Learning Algorithms
- Others
  - More Machine Learning topics
  - Probabilistic Reasoning

# Proposed Lecture Schedule

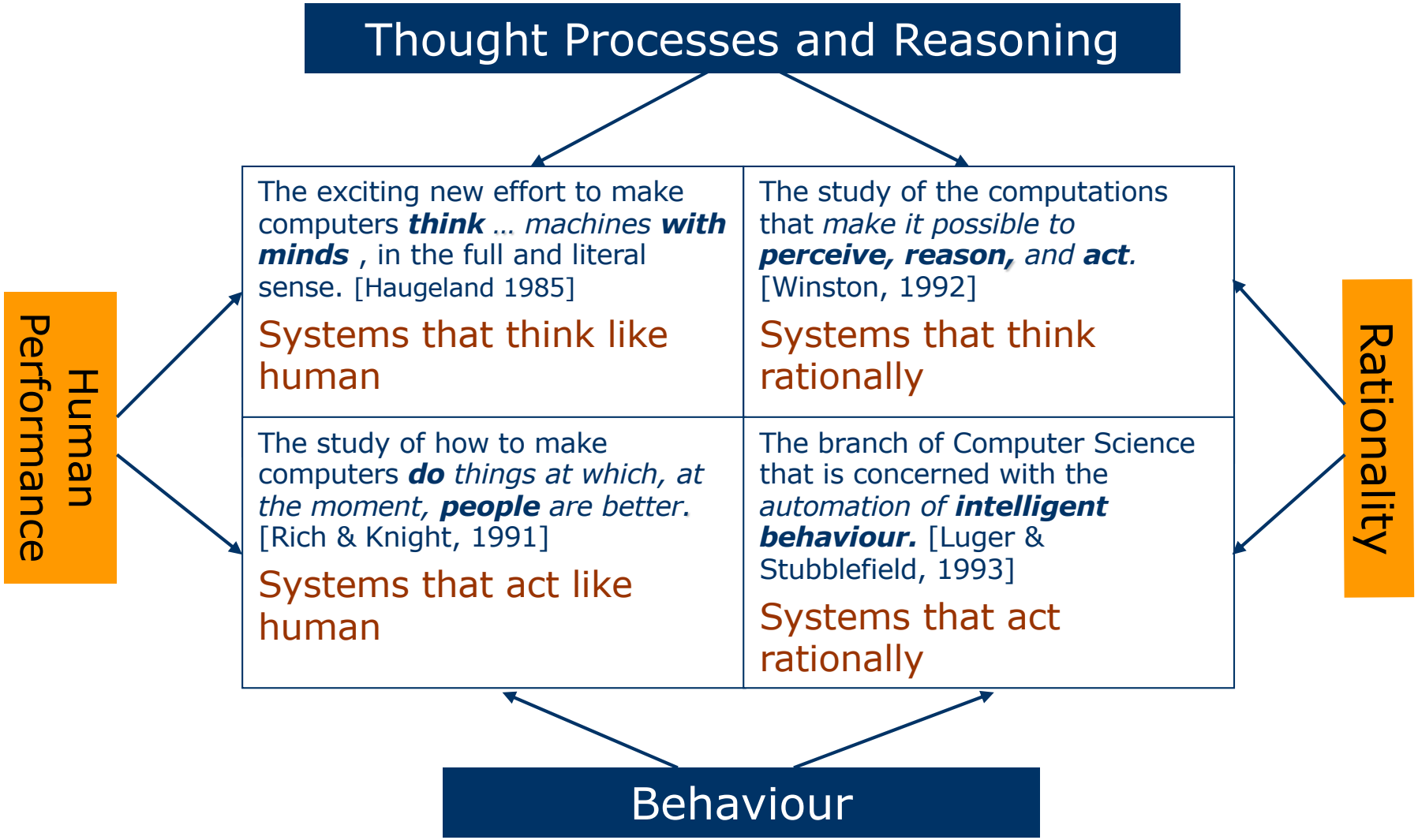
- **Lecture W1:** *Introduction, Overview*
- **Lecture W2:** *Problem Formulation*
- **Lecture W3:** *Blind Searches*
- **Lecture W4:** *Heuristic Searches*
- **Lecture W5:** *Game Playing I (Coursework)*
- **Lecture W6:** *Game Playing II*
- **Lecture W7:** *Neural Networks*
- **Lecture W8:** *Machine Learning*
- **Lecture W9:** *Discrete Probability, Bayesian*
- **Lecture W10:** *Guest Lecture*
- **Lecture W11:** *Revision*
- **Lecture W12:** *Study Week*

*NB. Schedule may be reviewed and adjusted if required*

# What is AI?

- A broad field that means different things to different people
- Defining "artificial" is easy, but no broad consensus in precise and concrete terms for "intelligence":
  - a single faculty or a collection of distinct and unrelated abilities?
  - a priori existence or learned?
  - exclusive province of human being?
  - natural phenomenon exhibited by living organisms?
  - creativity? intuition? perceptual abilities? self-awareness? other attributes?
  - other definitions?

# AI Definitions



# Think Like Human

- *The Cognitive Modeling Approach*
  - to develop a program that think like human, the way how human thinks should be known – using introspection, psychological experiments and brain imaging - then expressing the theory as a computer program
  - GPS (General Problem Solver) [by Newell & Simon, 1961] were concerned with comparing the trace of its reasoning steps to traces of human subjects solving the same problem rather than solving problems correctly

## *Cognitive Science*

*Computer models from AI + Experimental techniques from psychology*

→ *Constructing precise and testable theories of human mind*

# Act Like Human

- *The Turing Test Approach*
  - internal mechanisms of machine and human intelligence are too different and inspecting them may involve ethical considerations, so compare external manifestations of intelligence instead
  - Alan Turing [1950] designed a test for intelligent behaviour, i.e. ability to achieve human-level performance in all cognitive tasks and indistinguishable from human being, by an human interrogator
  - to pass the Turing Test, the computer would need:
    1. Natural Language Processing → communication
    2. Knowledge Representation → store information before and during interrogation
    3. Automated Reasoning → answer questions and draw new conclusions
    4. Machine Learning → adapt to new circumstances

# Think Rationally

- *The Law of Thought Approach*
  - Aristotle and his syllogism (right thinking): always give correct inference given correct premises
    - Socrates is a man. %fact
    - All men are mortal. %rule: if X is a man then X is mortal
    - Therefore Socrates is mortal. %inference
  - these laws of thoughts initiated the field of LOGIC
  - two main obstacles:
    1. not all things can be formally represented in logic notation, particularly if there is any uncertainty
    2. it is usually the case that even small scale problems can exhaust the computational power of any computer

# Act Rationally

- *The Rational Agent Approach*
  - an agent is an autonomous entity that perceives, adapts and acts to achieve the best outcome
  - making correct inferences is part but not all of being a rational agent; at times acting rationally may not involve inference, e.g. reflex actions
  - all skills needed for Turing Test also allow an agent to act rationally
  - two main advantages
    1. more general than "the laws of thought" (one of several mechanisms for achieving rationality)
    2. more amenable to scientific development than approaches based on human behaviour/thought

# AI Problems

- Formal tasks:
  - game playing
  - theorem proving
- Expert tasks (requires specialised skills and training) include the following:
  - medical diagnosis
  - equipment repair
  - computer configuration
  - financial planning

# AI Problems

- Mundane tasks correspond to the following problem areas:
  - Planning
    - the ability to decide on a good sequence of actions to achieve set goals
  - Vision
    - the ability to make sense of what are seen
  - Robotics
    - the ability to move and act in the world, possibly responding to new perceptions
  - Natural Language
    - the ability to communicate with others in any human language

# AI Problems

- AI is concerned with automating formal, expert and mundane tasks
- Much of the early works in the field of AI focused on formal and expert tasks
- Early assumptions were that mundane tasks could be easily programmed with little amount of knowledge about a particular problem domain
- Computer based intelligence must be specialised to very restricted domains to be at all comparable to human performance

# Human vs. Machine Intelligence

- The two hemispheres of the human brain deal with problems in two distinct paradigms:
  - sequential (or logical) approach that considers only a small portion of the available data at a time
  - parallel (or gestalt) processing looks at data on a global basis

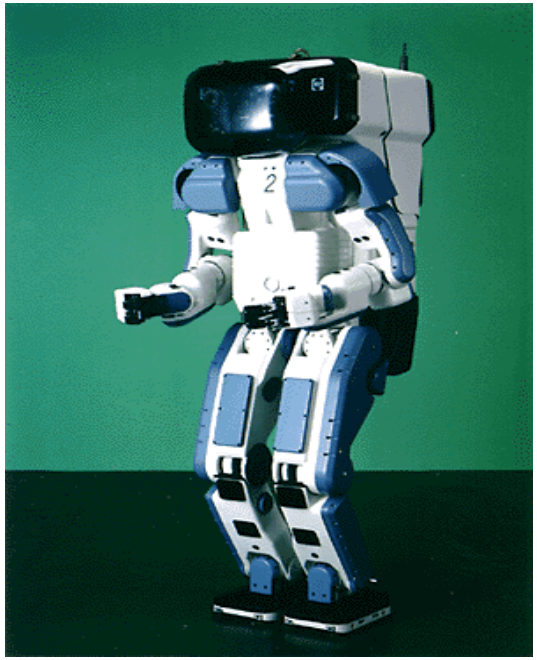
Many tasks which we might reasonably think require intelligence are performed by computers without even thinking → Complex arithmetic

Other tasks that people do without thinking are extremely difficult to automate → Recognizing faces

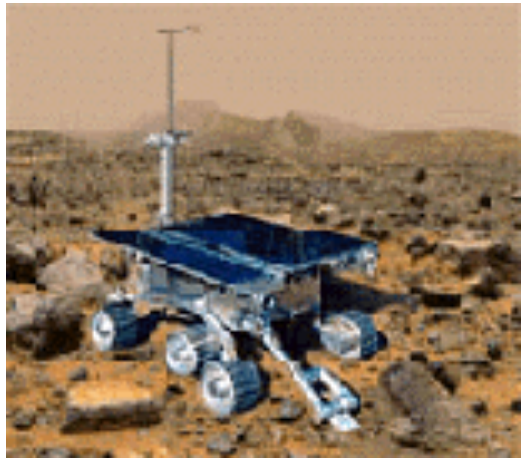
# AI Terminologies

- Strong AI
  - machines can actually think intelligently
- Weak AI
  - machine can possibly act intelligently
- AIMA: "Most AI researchers take the weak hypothesis for granted, and don't care about the strong AI hypothesis" (chap. 26. p. 1020, 3rd edition)
- Strong vs Weak AI Methods

# Applications of AI



Labour



Science

Google

YAHOO!

Search engines

Medicine/
Diagnosis


Appliances

*What else?*

# Summary

- Module goals, Structure and Contents
- Lecture Plan and Assessments
- Practical and Administrative Matters
- Review of Some Key Definitions
- Applications of AI

# Directed Readings

- Definitions of AI
- Differentiate between
  - ✓Strong and Weak AI
  - ✓Strong and Weak AI Methods

# Acknowledgements

Most of the lecture slides are adapted from the same module taught in Nottingham UK
by
Professor Graham Kendall,
Dr. Rong Qu
and
Dr. Andrew Parker