



CS 4104

APPLIED MACHINE LEARNING

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Course Details

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- Credit Hours: 3
- Focus on **general fundamental concepts, techniques and methods for Machine Learning** that have been employed in different types of applications.
- The **objective** is
 - ▣ To familiarize the participants with **machine learning algorithms**,
 - ▣ To familiarize with some of the most common questions regarding analysis of the available data.

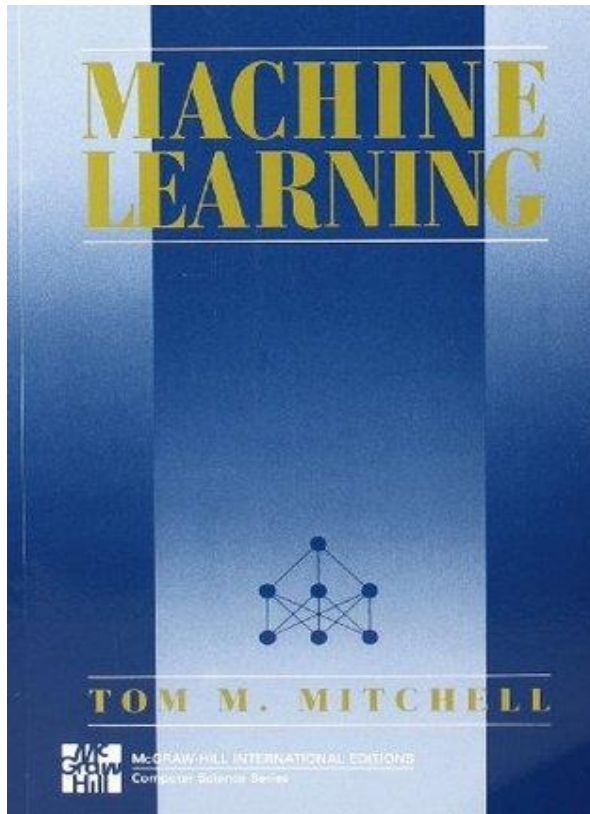
Tentative Marks Distribution

3

| Item Name | Marks (%) |
|--------------------------|-----------|
| Quizzes | 10-15 |
| Assignments / Project | 10-20 |
| Mid Exam1 | 15 |
| Mid Exam 2 | 15 |
| Final Exam | 40-55 |

Recommended Books

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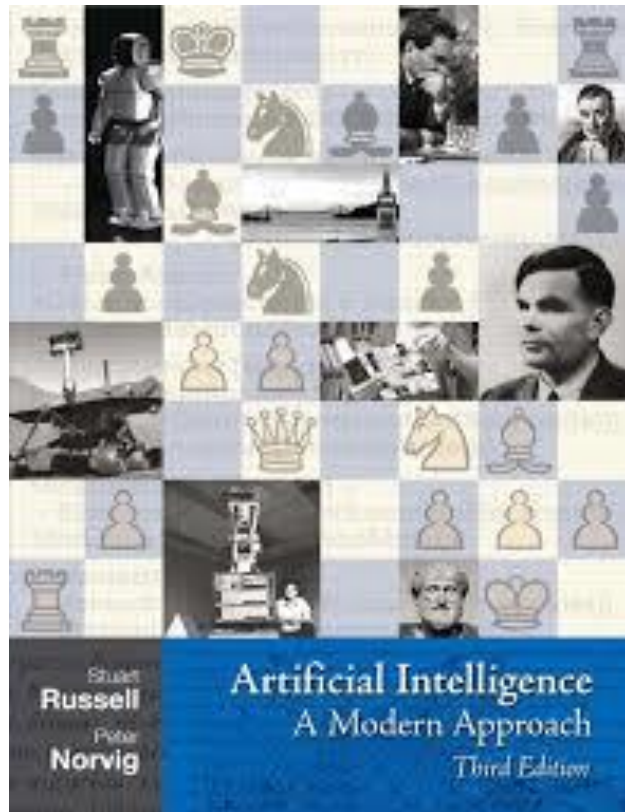


Machine Learning

Tom Mitchell

Recommended Books

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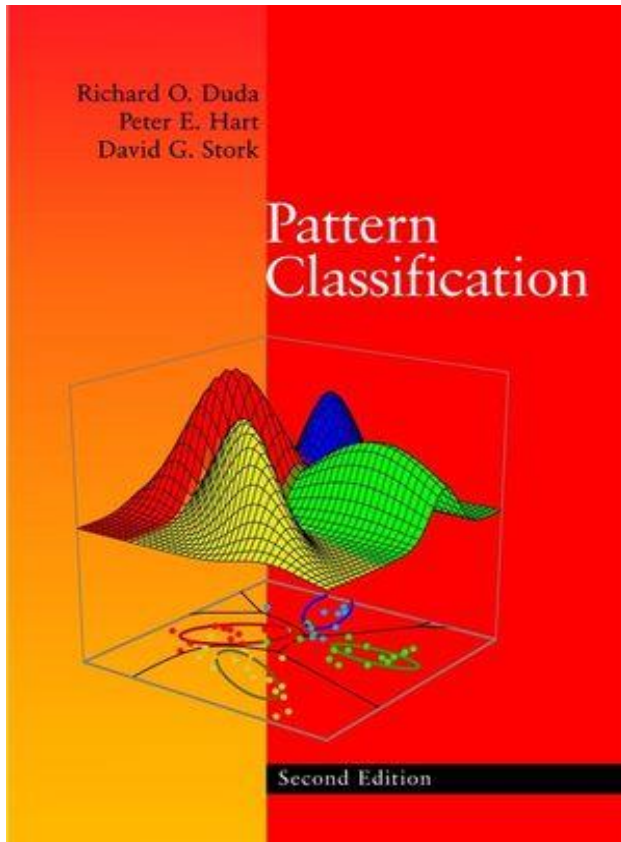
Artificial Intelligence

A Modern Approach

Stuart J. Russell and Peter Norvig

Recommended Books

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Pattern Classification
Richard O. Duda,
Peter E. Hart,
David G. Stork

Contents

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- ❑ Evaluating Hypothesis, Classification, Regression
- ❑ Linear Regression
- ❑ Logistic Regression
- ❑ Decision Trees and its variants
 - ▣ ID3, SLIQ
- ❑ Random Forest
- ❑ Instance-based Learning
 - ▣ K-nearest Neighbors

Contents

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- Bayesian Learning
 - ▣ Bayes theorem
 - ▣ Naïve Bayes Classifier
 - ▣ Bayesian Belief Network
- Support Vector Machine
- Artificial Neural Network
 - ▣ Perceptron
 - ▣ Multilayer networks
 - ▣ Backpropagation
 - ▣ Deep learning

Contents

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- Unsupervised Learning
 - ▣ Clustering
 - ▣ Types of clustering
- Deep Learning
 - ▣ architectures
- Reinforcement Learning
 - ▣ Q-Learning
- Density Estimation
- ...

WHAT IS MACHINE LEARNING



Machine Learning

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- Machine Learning is the study of algorithms that
 - improve their performance **P**
 - at some task **T**
 - with experience **E**
- well-defined learning task: $\langle \mathbf{P}, \mathbf{T}, \mathbf{E} \rangle$
- Optimize a **performance criterion** using example data or past experience

MACHINE LEARNING APPLICATIONS



Machine Learning Application

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□ Text Analysis and NLP

- A computer program automatically translates from **Arabic to English** and vice versa.
- A program analyses the text and execute the summary of the text.

Text analysis

Peter H. van Oppen, **Chairman of the Board & Chief Executive Officer**
Mr. van Oppen has served as **chairman of the board and chief executive officer of ADIC** since its acquisition by Interpoint in 1994 and a **director of ADIC** since 1986. Until its acquisition by Crane Co. in October 1998, **Mr. van Oppen** served as **chairman of the board of directors, president and chief executive officer of Interpoint**. Prior to 1985, **Mr. van Oppen** worked as a **consulting manager at Price Waterhouse LLP** and at Bain & Company in Boston and London. He has additional experience in medical electronics and venture capital. **Mr. van Oppen** also serves as a **director of Seattle FilmWorks Inc. and Spacekbs Medical, Inc.** He holds a B.A. from Whitman College and an M.B.A. from Harvard Business School, where he was a **Baker Scholar**.

Machine Learning Application

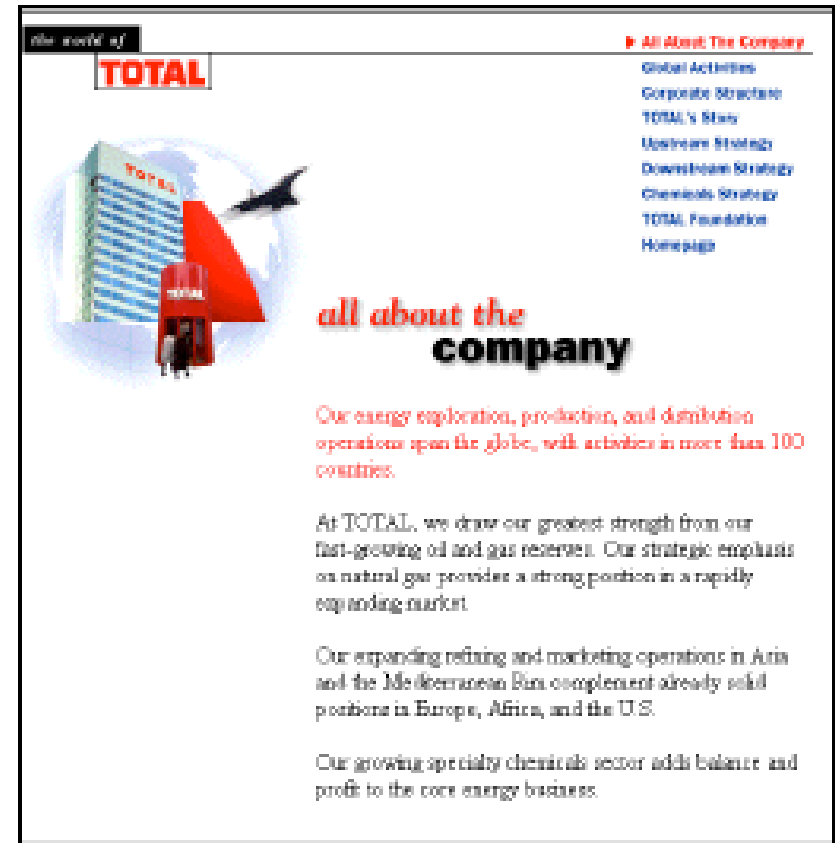
14

□ Document Classification

▣ Company home page

▣ Personal home page

▣ University home page



Machine Learning Application

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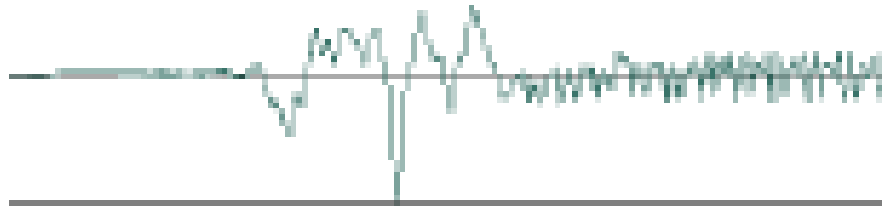
- ❑ Document Retrieval & Recognition
- ❑ Spam Detection



Machine Learning Application

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- **Signal Processing & Speech recognition:**
- **Speech classification**



Speech Recognition

Machine Learning Application

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□ Stock Market Prediction



□ Weather Prediction



Temperature
72° F

Predict the temperature at any given location

Machine Learning Application

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□ Face Recognition

Training examples of a person



Test images



Machine Learning Application

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□ Person Identification



Example training images
for each orientation



Machine Learning Application

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□ Action, Gesture or Activity Recognition



riding
sitting
horse
grass



riding
sitting
horse
grass



using
monitor
keyboard



using
monitor
keyboard
sitting



sitting
grass
riding
bike



bike
sitting
riding
skyscraper

Machine Learning Application

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- Machine learning is preferred approach to
 - ▣ Speech recognition
 - ▣ Natural language processing
 - ▣ Computer vision
 - ▣ Medical outcomes analysis
 - ▣ Robot control
 - ▣ Computational biology

Machine Learning Application

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- This trend is accelerating
 - ▣ New sensors / IO devices
 - ▣ Improved data capturing techniques, networking,
 - ▣ Faster computers with high processing speed
 - ▣ Software becomes too complex to write by hand
 - ▣ Improved machine learning algorithms
 - ▣ Demand for self-customization to user, environment

MACHINE LEARNING



Machine Learning

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Learning

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- An agent is **learning** if it **improves its performance** on future tasks after making observations about the world.
- **Learning** is the ability to improve its behavior based on experience.
- This could mean the following:
 - The **range of behaviors** is expanded;
 - the intelligent agent can do more.
 - The **accuracy level to perform tasks** is improved;
 - the intelligent agent can do things in a better way.
 - The efficiency in terms of **speed** is improved;
 - the intelligent agent can do things faster.

Learning

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- Any component of an agent can be improved by learning from data.
- The improvements may depend on four major factors:
 - Which **component** is to be improved.
 - What **prior knowledge** the agent already has.
 - What **representation** is used for the data and the component.
 - What **feedback** is available to learn from.

Acknowledgement

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Tom Mitchel, Russel & Norvig, Andrew Ng, Alpydin & Ch. Eick.