Introduction to Artificial Intelligence

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Institute of Information Management, National Taipei University

https://web.ntpu.edu.tw/~myday

1111AI01
MBA, IM, NTPU (M6132) (Fall 2022)
Wed 2, 3, 4 (9:10-12:00) (B8F40)

https://meet.google.com/miy-fbif-max
Min-Yuh Day, Ph.D.

Associate Professor, Information Management, NTPU
Visiting Scholar, IIS, Academia Sinica
Ph.D., Information Management, NTU
Director, Intelligent Financial Innovation Technology, IFIT Lab, IM, NTPU

Artificial Intelligence, Financial Technology, Big Data Analytics,
Data Mining and Text Mining, Electronic Commerce
Course Syllabus
National Taipei University
Academic Year 111, 1st Semester (Fall 2022)

• Course Title: Artificial Intelligence
• Instructor: Min-Yuh Day
• Course Class: MBA, IM, NTPU (3 Credits, Elective)
• Details
  • In-Class and Distance Learning EMI Course
    (3 Credits, Elective, One Semester) (M6132)
• Time & Place: Wed, 2, 3, 4, (9:10-12:00) (B8F40)
• Google Meet: https://meet.google.com/miy-fbif-max
Course Objectives

1. Understand the **fundamental concepts and research issues of Artificial Intelligence**.
2. Equip with **Hands-on practices of Artificial Intelligence**.
3. Conduct **information systems research in the context of Artificial Intelligence**.
Course Outline

• This course introduces the **fundamental concepts, research issues, and hands-on practices of Artificial Intelligence**.

• Topics include:
  1. Introduction to Artificial Intelligence
  2. Artificial Intelligence and Intelligent Agents
  3. Problem Solving
  4. Knowledge, Reasoning and Knowledge Representation, Uncertain Knowledge and Reasoning
  5. Machine Learning: Supervised and Unsupervised Learning
  6. The Theory of Learning and Ensemble Learning
  7. Deep Learning, Reinforcement Learning
  8. Deep Learning for Natural Language Processing
  9. Computer Vision and Robotics
  10. Philosophy and Ethics of AI and the Future of AI
  11. Case Study on AI
Core Competence

• Exploring new knowledge in information technology, system development and application  80 %

• Internet marketing planning ability  10 %

• Thesis writing and independent research skills  10 %
Four Fundamental Qualities

• Professionalism
  • Creative thinking and Problem-solving 40 %
  • Comprehensive Integration 30 %

• Interpersonal Relationship
  • Communication and Coordination 5 %
  • Teamwork 5 %

• Ethics
  • Honesty and Integrity 5 %
  • Self-Esteem and Self-reflection 5 %

• International Vision
  • Caring for Diversity 5 %
  • Interdisciplinary Vision 5 %
College Learning Goals

• Ethics/Corporate Social Responsibility
• Global Knowledge/Awareness
• Communication
• Analytical and Critical Thinking
Department Learning Goals

• Information Technologies and System Development Capabilities
• Internet Marketing Management Capabilities
• Research capabilities
# Syllabus

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Subject/Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2022/09/14</td>
<td>Introduction to Artificial Intelligence</td>
</tr>
<tr>
<td>2</td>
<td>2022/09/21</td>
<td>Artificial Intelligence and Intelligent Agents</td>
</tr>
<tr>
<td>3</td>
<td>2022/09/28</td>
<td>Problem Solving</td>
</tr>
<tr>
<td>4</td>
<td>2022/10/05</td>
<td>Knowledge, Reasoning and Knowledge Representation; Uncertain Knowledge and Reasoning</td>
</tr>
<tr>
<td>5</td>
<td>2022/10/12</td>
<td>Case Study on Artificial Intelligence I</td>
</tr>
<tr>
<td>6</td>
<td>2022/10/19</td>
<td>Machine Learning: Supervised and Unsupervised Learning</td>
</tr>
<tr>
<td>Week</td>
<td>Date</td>
<td>Subject/Topics</td>
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<td>------</td>
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</tr>
<tr>
<td>7</td>
<td>2022/10/26</td>
<td>The Theory of Learning and Ensemble Learning</td>
</tr>
<tr>
<td>8</td>
<td>2022/11/02</td>
<td>Midterm Project Report</td>
</tr>
<tr>
<td>9</td>
<td>2022/11/09</td>
<td>Deep Learning and Reinforcement Learning</td>
</tr>
<tr>
<td>10</td>
<td>2022/11/16</td>
<td>Deep Learning for Natural Language Processing</td>
</tr>
<tr>
<td>11</td>
<td>2022/11/23</td>
<td>Invited Talk: AI for Information Retrieval</td>
</tr>
<tr>
<td>12</td>
<td>2022/11/30</td>
<td>Case Study on Artificial Intelligence II</td>
</tr>
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</table>
# Syllabus

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Subject/Topics</th>
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</thead>
<tbody>
<tr>
<td>13</td>
<td>2022/12/07</td>
<td>Computer Vision and Robotics</td>
</tr>
<tr>
<td>14</td>
<td>2022/12/14</td>
<td>Philosophy and Ethics of AI and the Future of AI</td>
</tr>
<tr>
<td>15</td>
<td>2022/12/21</td>
<td>Final Project Report I</td>
</tr>
<tr>
<td>16</td>
<td>2022/12/28</td>
<td>Final Project Report II</td>
</tr>
<tr>
<td>17</td>
<td>2023/01/04</td>
<td>Self-learning</td>
</tr>
<tr>
<td>18</td>
<td>2023/01/11</td>
<td>Self-learning</td>
</tr>
</tbody>
</table>
Teaching Methods and Activities

• Lecture
• Discussion
• Practicum
Evaluation Methods

• Individual Presentation 30 %
• Group Presentation 30 %
• Case Report 20 %
• Class Participation 10 %
• Assignment 10 %
Required Texts


Reference Books


• Steven D'Ascoli (2022), *Artificial Intelligence and Deep Learning with Python: Every Line of Code Explained For Readers New to AI and New to Python*, Independently published.

Aurélien Géron (2019),

https://github.com/ageron/handson-ml2

Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow

Notebooks
1. The Machine Learning landscape
2. End-to-end Machine Learning project
3. Classification
4. Training Models
5. Support Vector Machines
6. Decision Trees
7. Ensemble Learning and Random Forests
8. Dimensionality Reduction
9. Unsupervised Learning Techniques
10. Artificial Neural Nets with Keras
11. Training Deep Neural Networks
12. Custom Models and Training with TensorFlow
13. Loading and Preprocessing Data
14. Deep Computer Vision Using Convolutional Neural Networks
15. Processing Sequences Using RNNs and CNNs
16. Natural Language Processing with RNNs and Attention
17. Representation Learning Using Autoencoders
18. Reinforcement Learning
19. Training and Deploying TensorFlow Models at Scale

https://github.com/ageron/handson-ml2
Steven D'Ascoli (2022),

Artificial Intelligence and Deep Learning with Python:
Every Line of Code Explained For Readers New to AI and New to Python,
Independently published.

Source: https://www.amazon.com/Artificial-Intelligence-Deep-Learning-Python/dp/B09QNZBZMN/
Nithin Buduma, Nikhil Buduma, Joe Papa (2022),
Fundamentals of Deep Learning:
Designing Next-Generation Machine Intelligence Algorithms,

Artificial Intelligence (AI)
Evolution of Computerized Decision Support to Analytics/Data Science

The timeline in Figure 1.8 shows the terminology used to describe analytics since the 1970s. During the 1970s, the primary focus of information systems support for decision making focused on providing structured, periodic reports that a manager could use for decision making (or ignore them). Businesses began to create routine reports to inform decision makers (managers) about what had happened in the previous period (e.g., day, week, month, quarter). Although it was useful to know what had happened in the past, managers needed more than this: They needed a variety of reports at different levels of granularity to better understand and address changing needs and challenges of the business. These were usually called management information systems (MIS). In the early 1970s, Scott-Morton first articulated the major concepts of DSS. He defined DSSs as “interactive computer-based systems, which help decision makers utilize data and models to solve unstructured problems” (Gorry and Scott-Morton, 1971). The following is another classic DSS definition, provided by Keen and Scott-Morton (1978):

Decision support systems couple the intellectual resources of individuals with the capabilities of the computer to improve the quality of decisions. It is a computer-based support system for management decision makers who deal with semistructured problems.

Note that the term decision support system, like management information system and several other terms in the field of IT, is a content-free expression (i.e., it means different things to different people). Therefore, there is no universally accepted definition of DSS.

During the early days of analytics, data was often obtained from the domain experts using manual processes (i.e., interviews and surveys) to build mathematical or knowledge-based models to solve constrained optimization problems. The idea was to do the best with limited resources. Such decision support models were typically called operations research (OR). The problems that were too complex to solve optimally (using linear or nonlinear mathematical programming techniques) were tackled using heuristic methods such as simulation models. (We will introduce these as prescriptive analytics later in this chapter and in a bit more detail in Chapter 6.)

In the late 1970s and early 1980s, in addition to the mature OR models that were being used in many industries and government systems, a new and exciting line of models had emerged: rule-based expert systems. These systems promised to capture experts’ knowledge in a format that computers could process (via a collection of if–then–else rules or heuristics) so that these could be used for consultation much the same way that one...
Artificial Intelligence (A.I.) Timeline

1950
TURING TEST
Computer scientist Alan Turing proposes a test for machine intelligence, if a machine can trick humans into thinking it is human, then it has intelligence.

1955
A.I. BORN
Term artificial intelligence is coined by computer scientist John McCarthy to describe "the science and engineering of making intelligent machines."

1961
UNIMATE
First industrial robot, Unimate, goes to work at GM replacing humans on the assembly line.

1964
ELIZA
Pioneering chatbot developed by Joseph Weizenbaum at MIT holds conversations with humans.

1966
SHAKAY
The first electronic person from Stanford, Shakay is a general-purpose mobile robot that reasons about its own actions.

1977
A.I. WINTER
Many false starts and dead-ends leave A.I. out in the cold.

1997
DEEP BLUE
Drives computer from IBM defeats world chess champion Garry Kasparov.

1998
KISMET
Cyndia Bresacal at MIT introduces Kismet, an emotionally intelligent robot that detects and responds to people's feelings.

1999
AIBO
Sony launches first commercial robot pet dog, AIBO (E), with skills and personality that develop over time.

2002
ROOMBA
First mass-produced autonomous vacuum cleaner, iRobot learns to navigate and clean homes.

2011
SIRI
Apple integrates Siri, an intelligent virtual assistant with a voice interface, into the iPhone 4S.

2011
WATSON
IBM's question answering computer Watson wins first place on popular $1 million prize television quiz show "Jeopardy!"

2014
EUGENE
Eugene Goostman, a chatbot passes the Turing Test with a third of judges believing Eugene is human.

2014
ALEXA
Amazon launches Alexa, an intelligent virtual assistant with a voice interface that completes shopping tasks.

2016
TAY
Microsoft's chatbot Tay goes rogue on social media making inflammatory and offensive racist comments.

2017
ALPHAGO
Google's A.I. AlphaGo beats world champion Ke Jie in the complex board game of Go, notable for its vast number (10^{170}) of possible positions.

The Rise of AI

Artificial intelligence (AI) is not new. The term was coined in 1956 by John McCarthy, a Stanford computer science professor who organized an academic conference on the topic at Dartmouth College in the summer of that year. The field of AI has gone through a series of boom-bust cycles since then, characterized by technological breakthroughs that stirred activity and excitement about the topic, followed by subsequent periods of disillusionment and disinterest known as ‘AI Winters’ as technical limitations were discovered. As you can see in figure 1, today we are once again in an ‘AI Spring’.

Artificial intelligence can be defined as human intelligence exhibited by machines; systems that approximate, mimic, replicate, automate, and eventually improve on human thinking. Throughout the past half-century a few key components of AI were established as essential: the ability to perceive, understand, learn, problem solve, and reason. Countless working definitions of AI have been proposed over the years but the unifying thread in all of them is that computers with the right software can be used to solve the kind of problems that humans solve, interact with humans and the world as humans do, and create ideas like humans. In other words, while the mechanisms that give rise to AI are ‘artificial’, the intelligence to which AI is intended to approximate is indistinguishable from human intelligence. In the early days of the science, processing inputs from the outside world required extensive programming, which limited early AI systems to a very narrow set of inputs and conditions. However since then, computer science has worked to advance the capability of AI-enabled computing systems.

Board games have long been a proving ground for AI research, as they typically involve a finite number of players, rules, objectives, and possible moves. This essentially means that games – one by one, including checkers, backgammon, and even Jeopardy! to name a few – have been taken over by AI. Most famously, in 1997 IBM’s Deep Blue defeated Garry Kasparov, the then reigning world champion of chess. This trajectory persists with the ancient Chinese game of Go, and the defeat of reigning world champion Lee Sedol by DeepMind’s AlphaGo in March 2016.

Figure 1: An AI timeline; Source: Lavenda, D. / Marsden, P.

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>AI is born</td>
</tr>
<tr>
<td>1956</td>
<td>Dartmouth conference led by John McCarthy coins the term &quot;artificial intelligence&quot;</td>
</tr>
<tr>
<td>1964</td>
<td>Eliza, the first chatbot is developed by Joseph Weizenbaum at MIT</td>
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<tr>
<td>1975–1982</td>
<td>Edward Feigenbaum develops the first Expert System, giving rebirth to AI</td>
</tr>
<tr>
<td>1980</td>
<td>IBM’s Watson Q&amp;A machine wins Jeopardy!</td>
</tr>
<tr>
<td>1997</td>
<td>IBM’s Deep Blue defeats Garry Kasparov, the world’s reigning chess champion</td>
</tr>
<tr>
<td>2011</td>
<td>2016 AlphaGo defeats Lee Sedol</td>
</tr>
<tr>
<td>2014</td>
<td>YouTube recognizes cats from videos</td>
</tr>
<tr>
<td>2020</td>
<td></td>
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</tbody>
</table>
Definition of Artificial Intelligence (A.I.)
Artificial Intelligence

“... the science and engineering of making intelligent machines”

(John McCarthy, 1955)

Artificial Intelligence

“... technology that thinks and acts like humans”

Artificial Intelligence

“... intelligence exhibited by machines or software”
<table>
<thead>
<tr>
<th>Thinking Humanly</th>
<th>Thinking Rationally</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acting Humanly</td>
<td>Acting Rationally</td>
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</tbody>
</table>

# 4 Approaches of AI

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>3. Thinking Rationally: The “Laws of Thought” Approach</td>
<td></td>
</tr>
<tr>
<td>4. Acting Rationally: The Rational Agent Approach</td>
<td></td>
</tr>
</tbody>
</table>

AI Acting Humanly: The Turing Test Approach (Alan Turing, 1950)

- Knowledge Representation
- Automated Reasoning
- Machine Learning (ML)
  - Deep Learning (DL)
- Computer Vision (Image, Video)
- Natural Language Processing (NLP)
- Robotics

1. Artificial Intelligence
2. Problem Solving
3. Knowledge and Reasoning
4. Uncertain Knowledge and Reasoning
5. Machine Learning
6. Communicating, Perceiving, and Acting
7. Philosophy and Ethics of AI
Artificial Intelligence: Intelligent Agents
Artificial Intelligence: 2. Problem Solving

- Solving Problems by Searching
- Search in Complex Environments
- Adversarial Search and Games
- Constraint Satisfaction Problems

Artificial Intelligence: 3. Knowledge and Reasoning

- Logical Agents
- First-Order Logic
- Inference in First-Order Logic
- Knowledge Representation
- Automated Planning

Artificial Intelligence:

4. Uncertain Knowledge and Reasoning

• Quantifying Uncertainty
• Probabilistic Reasoning
• Probabilistic Reasoning over Time
• Probabilistic Programming
• Making Simple Decisions
• Making Complex Decisions
• Multiagent Decision Making

Artificial Intelligence: 5. Machine Learning

• Learning from Examples
• Learning Probabilistic Models
• Deep Learning
• Reinforcement Learning

Artificial Intelligence:
6. Communicating, Perceiving, and Acting

• Natural Language Processing
• Deep Learning for Natural Language Processing
• Computer Vision
• Robotics

Artificial Intelligence: Philosophy and Ethics of AI
The Future of AI
Since an early flush of optimism in the 1950s, smaller subsets of artificial intelligence – first machine learning, then deep learning, a subset of machine learning – have created ever larger disruptions.
Artificial Intelligence (AI)

Machine Learning (ML)
- Supervised Learning
- Unsupervised Learning
- Semi-supervised Learning
- Reinforcement Learning

Deep Learning (DL)
- CNN
- RNN LSTM GRU
- GAN

Source: https://leonardoaraujosantos.gitbooks.io/artificial-intelligence/content/deep_learning.html
3 Machine Learning Algorithms

Machine Learning (ML)

Source: https://www.mactores.com/services/aws-big-data-machine-learning-cognitive-services/
Machine Learning (ML) / Deep Learning (DL)

AI for Text Analytics

Source: Ramesh Sharda, Dursun Delen, and Efraim Turban (2017), Business Intelligence, Analytics, and Data Science: A Managerial Perspective, 4th Edition, Pearson
Hugging Face

The AI community building the future.

Build, train and deploy state of the art models powered by the reference open source in machine learning.

https://huggingface.co/
The Transformers Timeline

- Transformer
- ULMFit
- GPT
- BERT
- GPT-2
- RoBERTa
- DistilBERT
- XLM-R
- GPT-3
- DeBERTa
- T5
- GPT-Neo
- GPT-J

Source: Lewis Tunstall, Leandro von Werra, and Thomas Wolf (2022), Natural Language Processing with Transformers: Building Language Applications with Hugging Face, O'Reilly Media.
Transformer Models

Transformer

Encoder → Decoder

- DistilBERT
- BERT
- RoBERTa
- XLM-R
- XLM
- ALBERT
- ELECTRA
- DeBERTa
- T5
- BART
- M2M-100
- BigBird
- GPT
- GPT-2
- CTRL
- GPT-3
- GPT-Neo
- GPT-J

Source: Lewis Tunstall, Leandro von Werra, and Thomas Wolf (2022), Natural Language Processing with Transformers: Building Language Applications with Hugging Face, O'Reilly Media.
Transformer (Attention is All You Need) (Vaswani et al., 2017)

BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding

BERT (Bidirectional Encoder Representations from Transformers)

Overall pre-training and fine-tuning procedures for BERT

Fine-tuning BERT on Different Tasks

(a) Sentence Pair Classification Tasks: MNL1, QQP, OLU, STS-B, MRPC, RTE, SWAG

(b) Single Sentence Classification Tasks: SST-2, CoLA

(c) Question Answering Tasks: SQuAD v1.1

(d) Single Sentence Tagging Tasks: CoNLL-2003 NER

Sentiment Analysis: Single Sentence Classification

(b) Single Sentence Classification Tasks: SST-2, CoLA

Fine-tuning BERT on Question Answering (QA)

(c) Question Answering Tasks: SQuAD v1.1

Fine-tuning BERT on Dialogue

Intent Detection (ID; Classification)

Fine-tuning BERT on Dialogue Slot Filling (SF)

Task-Oriented Dialogue (ToD) System
Speech, Text, NLP

“Book me a cab to Russell Square“

“When do you want to leave?”

Source: Razumovskaia, Evgeniia, Goran Glavas, Olga Majewska, Edoardo M. Ponti, Anna Korhonen, and Ivan Vulic.
wav2vec 2.0: A framework for self-supervised learning of speech representations

Computer Vision: Image Classification, Object Detection, Object Instance Segmentation

Computer Vision: Object Detection

(a) Object Classification

(b) Generic Object Detection (Bounding Box)

(c) Semantic Segmentation

(d) Object Instance Segmentation

YOLOv7:
Trainable bag-of-freebies sets new state-of-the-art for real-time object detectors

Source: Wang, Chien-Yao, Alexey Bochkovskiy, and Hong-Yuan Mark Liao.
NLG from a Multilingual, Multimodal and Multi-task perspective

Multi³ (Natural Language) Generation

- Text
- Speech
- Vision

(M)Language
(natural languages and varieties)

(M)Modality

(M)Task

- Recognize and transcribe speech (ASR)
- Translate from one language to another (MT)
- Describe, ask or answer questions or converse about visual objects (Captioning, VQA, Visual Dialogue, ...)

Text-and-Video Dialog Generation Models with Hierarchical Attention

Multimodal Few-Shot Learning with Frozen Language Models

Curated samples with about five seeds required to get past well-known language model failure modes of either repeating text for the prompt or emitting text that does not pertain to the image. These samples demonstrate the ability to generate open-ended outputs that adapt to both images and text, and to make use of facts that it has learned during language-only pre-training.

Tom Lawry (2020),

AI in Health:
A Leader’s Guide to Winning in the New Age of Intelligent Health Systems,

HIMSS Publishing


AI in Healthcare

FinBrain: when Finance meets AI 2.0

(Zheng et al., 2019)

## Technology-driven Financial Industry Development

<table>
<thead>
<tr>
<th>Development stage</th>
<th>Driving technology</th>
<th>Main landscape</th>
<th>Inclusive finance</th>
<th>Relationship between technology and finance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fintech 1.0 (financial IT)</td>
<td>Computer</td>
<td>Credit card, ATM, and CRMS</td>
<td>Low</td>
<td>Technology as a tool</td>
</tr>
<tr>
<td>Fintech 2.0 (Internet finance)</td>
<td>Mobile Internet</td>
<td>Marketplace lending, third-party payment, crowdfunding, and Internet insurance</td>
<td>Medium</td>
<td>Technology-driven change</td>
</tr>
<tr>
<td>Fintech 3.0 (financial intelligence)</td>
<td>AI, Big Data, Cloud Computing, Blockchain</td>
<td>Intelligent finance</td>
<td>High</td>
<td>Deep fusion</td>
</tr>
</tbody>
</table>

DALL-E 2

AI system that can create realistic images and art from a description in natural language

TEXT DESCRIPTION

An astronaut
Teddy bears
A bowl of soup

riding a horse
lounging in a tropical resort in space
playing basketball with cats in space

in a photorealistic style
in the style of Andy Warhol as a pencil drawing

https://openai.com/dall-e-2/
Deep learning for financial applications: A survey

Applied Soft Computing (2020)

Source:
Financial
time series forecasting with
deep learning:
A systematic literature review:
2005–2019

Applied Soft Computing (2020)

Source:
Deep learning for financial applications: Topic-Model Heatmap

The histogram of publication count in model types.

Fig. 10. Topic-model heatmap.

The model-topic heatmap, in this case, we saw a distinction between the associations. Even though price data and technical indicators have been very popular for most of the research areas that are involved with time series forecasting, like algorithmic trading, portfolio management, financial sentiment analysis and financial text mining, the studies that had more significant spatial characteristics like risk assessment and fraud detection did not depend much on these temporal features. One other noteworthy difference came up with the adaptation of text related features. Highly text-based applications like financial sentiment analysis, financial text mining, risk assessment and fraud detection preferred to use features like text (extracted from tweets, news or financial data) and sentiments during their model development and implementation. However, the temporal characteristics of the financial time series data were also important for financial sentiment analysis and financial text mining, since a significant portion of these models were integrated into algorithmic trading systems.

Fig. 12 elaborates on the distribution of the dataset types for the research areas through a dataset-topic heatmap. If we analyze the heatmap, we see similarities with the feature-topic associations. However, this time, we had three main clusters of dataset types, the first one being the temporal datasets like Stock, Index, ETF, Cryptocurrency, Forex and Commodity price datasets, and the second one being the text-based datasets like News, Tweets, Microblogs and Financial Reports, and the last one being the datasets that had both numeric and textual components like Consumer Data, Credit Data and Financial Reports from companies or analysts. As far as the dataset vs. application area associations are concerned, these three main clusters were distributed as follows: Stock, Index, Cryptocurrency, ETF datasets were used almost in every application area except Risk Assessment and Fraud Detection which had less of temporal properties. Meanwhile, Credit Data, Financial Reports and Consumer Data were particularly used by these two application areas, namely Risk Assessment and Fraud Detection. Lastly, pure text based datasets like news, tweets, microblogs were preferred by Financial Sentiment Analysis and Financial Text Mining studies. However, as was the case in the feature-topic associations, temporal datasets like stock, ETF, Index price datasets were also used with these studies since some of them were tied with algorithmic trading models.

6. Discussion and open issues

After reviewing all the publications based on the selected criteria explained in the previous section, we wanted to provide our findings of the current state-of-the-art situation. Our discussions are categorized by the DL models and implementation topics.

6.1. Discussions on DL models

It is possible to claim that LSTM is the dominant DL model that is preferred by most researchers, due to its well-established structure for financial time series data forecasting. Most of the financial implementations have time-varying data representations requiring regression-type approaches which fits very well for LSTM and its derivatives due to their easy adaptations to the problems. As long as the temporal nature of the financial data remains, LSTM and its related family models will maintain their popularities.

Meanwhile, CNN based models started getting more traction among researchers in the last two years. Unlike LSTM, CNN works better for classification problems and is more suitable for either non-time varying or static data representations. However, since most financial data is time-varying, under normal circumstances,
Deep learning for financial applications:
Topic-Feature Heatmap

Deep learning for financial applications: Topic-Dataset Heatmap

Financial time series forecasting with deep learning: Topic-model heatmap

Papers with Code
State-of-the-Art (SOTA)

Browse State-of-the-Art

- 1,509 leaderboards • 1,327 tasks • 1,347 datasets • 17,810 papers with code

Follow on Twitter for updates

Computer Vision

- Semantic Segmentation: 33 leaderboards, 667 papers with code
- Image Classification: 62 leaderboards, 564 papers with code
- Object Detection: 54 leaderboards, 467 papers with code
- Image Generation: 51 leaderboards, 231 papers with code
- Pose Estimation: 40 leaderboards, 231 papers with code

See all 707 tasks

Natural Language Processing

- Machine Translation
- Language Modelling
- Question Answering
- Sentiment Analysis
- Text Generation

https://paperswithcode.com/sota
Python in Google Colab (Python101)

https://colab.research.google.com/drive/1FEG6DnGvwfUbeo4zJ1zTunjMqf2RkCrT

https://tinyurl.com/aintpupython101
Teaching

• Artificial Intelligence
  • Spring 2021, Fall 2022
• Artificial Intelligence in Finance and Quantitative
  • Fall 2021, Fall 2022
• Software Engineering
  • Fall 2020, Fall, 2021, Spring 2022, Spring 2023
• Artificial Intelligence for Text Analytics
  • Spring 2022
• Data Mining
  • Spring 2021
• Big Data Analytics
  • Fall 2020
• Foundation of Business Cloud Computing
  • Spring 2021, Spring 2022, Spring 2023

https://web.ntpu.edu.tw/~myday/teaching.htm
Research Project

• Applying AI technology to construct knowledge graphs of cryptocurrency anti-money laundering: a few-shot learning model
  • MOST, 110-2410-H-305-013-MY2, 2021/08/01~2023/07/31
• Deepen Corporate Sustainability: Enhance the Performance of Corporate Sustainability from AI, Financial, and Strategic Perspectives. AI for Corporate Sustainability Assessment and Cross Language Corporate Sustainability Reports Generative Mode
  • NTPU, 111-NTPU_ORDA-F-001, 2022/01/01~2022/12/31
• Artificial intelligence methods applied for analyzing the introduction of technological innovation: Patent text analysis and image analysis. Artificial Intelligence for FinTech Knowledge Graph from Patent Textual Analytics
  • NTPU, 111-NTPU_ORDA-F-003, 2022/01/01~2022/12/31
• Establishment and Implement of Smart Assistive Technology for Dementia Care and Its Socio-Economic Impacts. Intelligent, individualized and precise care with smart AT and system integration
  • MOST, 111-2627-M-038-001-, 2022/08/01~2023/07/31

https://web.ntpu.edu.tw/~myday/cindex.htm#projects
Summary

• This course introduces the **fundamental concepts, research issues, and hands-on practices of Artificial Intelligence**.

• Topics include:
  1. Introduction to Artificial Intelligence
  2. Artificial Intelligence and Intelligent Agents
  3. Problem Solving
  4. Knowledge, Reasoning and Knowledge Representation, Uncertain Knowledge and Reasoning
  5. Machine Learning: Supervised and Unsupervised Learning
  6. The Theory of Learning and Ensemble Learning
  7. Deep Learning, Reinforcement Learning
  8. Deep Learning for Natural Language Processing
  9. Computer Vision and Robotics
  10. Philosophy and Ethics of AI and the Future of AI
  11. Case Study on AI
Artificial Intelligence

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