Artificial Intelligence

Introduction to Artificial Intelligence

1131AI01
MBA, IM, NTPU (M5276) (Fall 2024)
Tue 2, 3, 4 (9:10-12:00) (B3F17)

https://meet.google.com/paj-zhhj-mya

Min-Yuh Day, Ph.D,
Professor

Institute of Information Management, National Taipei University

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

2024-09-10

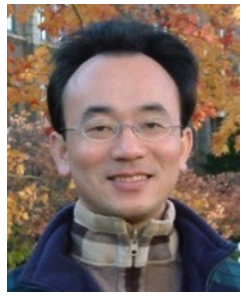
國立臺北大學
National Taipei University

aws educate | Cloud Ambassador
2020 Cohort

aws academy
Accredited Educator

aws certified
Solutions Architect
Associate

aws certified
Cloud Practitioner



Min-Yuh Day, Ph.D.

aws educate | Cloud Ambassador
2020 Cohort

Professor, Information Management, NTPU

Visiting Scholar, IIS, Academia Sinica

Ph.D., Information Management, NTU

Director, Intelligent Financial Innovation Technology, IFIT Lab, IM, NTPU

Director, Fintech and Green Finance Research Center, NTPU

Division Director, Sustainable Development, Sustainability Office, NTPU

Artificial Intelligence, Financial Technology, Big Data Analytics,
Data Mining and Text Mining, Electronic Commerce

國立臺北大學
National Taipei University

中央研究院 ACADEMIA SINICA 1928

Course Syllabus
National Taipei University
Academic Year 113, 1st Semester (Fall 2024)

- **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) (M5276)**
- **Time & Place: Tue, 2, 3, 4, (9:10-12:00) (B3F17)**
- **Google Meet:** https://meet.google.com/paj-zhhj-mya

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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
  5. Uncertain Knowledge and Reasoning
  6. Machine Learning: Supervised and Unsupervised Learning
  7. The Theory of Learning and Ensemble Learning
  8. Deep Learning and Reinforcement Learning
  9. Deep Learning for Natural Language Processing
  10. Computer Vision and Robotics
  11. Generative AI, Philosophy and Ethics of AI and the Future of AI
  12. 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 40 %
- Interpersonal Relationship
  - Communication and Coordination 10 %
  - Teamwork 5 %
- Ethics
  - Honesty and Integrity 0 %
  - Self-Esteem and Self-reflection 0 %
- International Vision
  - Caring for Diversity 0 %
  - 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

Week	Date	Subject/Topics
1	2024/09/10	Introduction to Artificial Intelligence
2	2024/09/17	Mid-Autumn Festival (Day off)
3	2024/09/24	Artificial Intelligence and Intelligent Agents; Problem Solving
4	2024/10/01	Knowledge, Reasoning and Knowledge Representation; Uncertain Knowledge and Reasoning
5	2024/10/08	Case Study on Artificial Intelligence I
6	2024/10/15	Machine Learning: Supervised and Unsupervised Learning

Syllabus

Week	Date	Subject/Topics
7	2024/10/22	The Theory of Learning and Ensemble Learning
8	2024/10/29	Midterm Project Report
9	2024/11/05	Self-Learning
10	2024/11/12	Deep Learning, Reinforcement Learning
11	2024/11/19	Case Study on Artificial Intelligence II
12	2024/11/26	Deep Learning for Natural Language Processing

Syllabus

Week	Date	Subject/Topics
13	2024/12/03	Computer Vision and Robotics
14	2024/12/10	Generative AI, Philosophy and Ethics of AI and the Future of AI
15	2024/12/17	Final Project Report I
16	2024/12/24	Final Project Report II

Teaching Methods and Activities

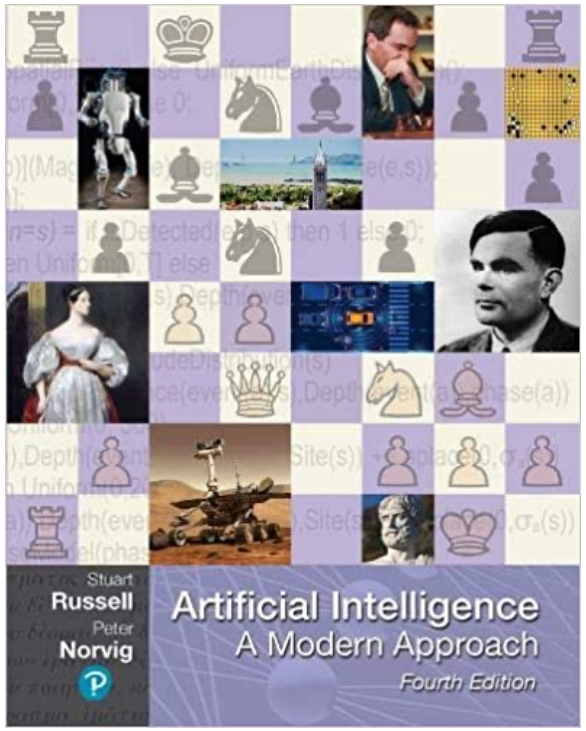
- Lecture
- Discussion
- Practicum

Evaluation Methods

- Individual Presentation 60 %
- Group Presentation 10 %
- Case Report 10 %
- Class Participation 10 %
- Assignment 10 %

Required Texts

Stuart Russell and Peter Norvig (2020),
Artificial Intelligence: A Modern Approach,
4th Edition, Pearson.



https://www.amazon.com/Artificial-Intelligence-A-Modern-Approach/dp/0134610997/

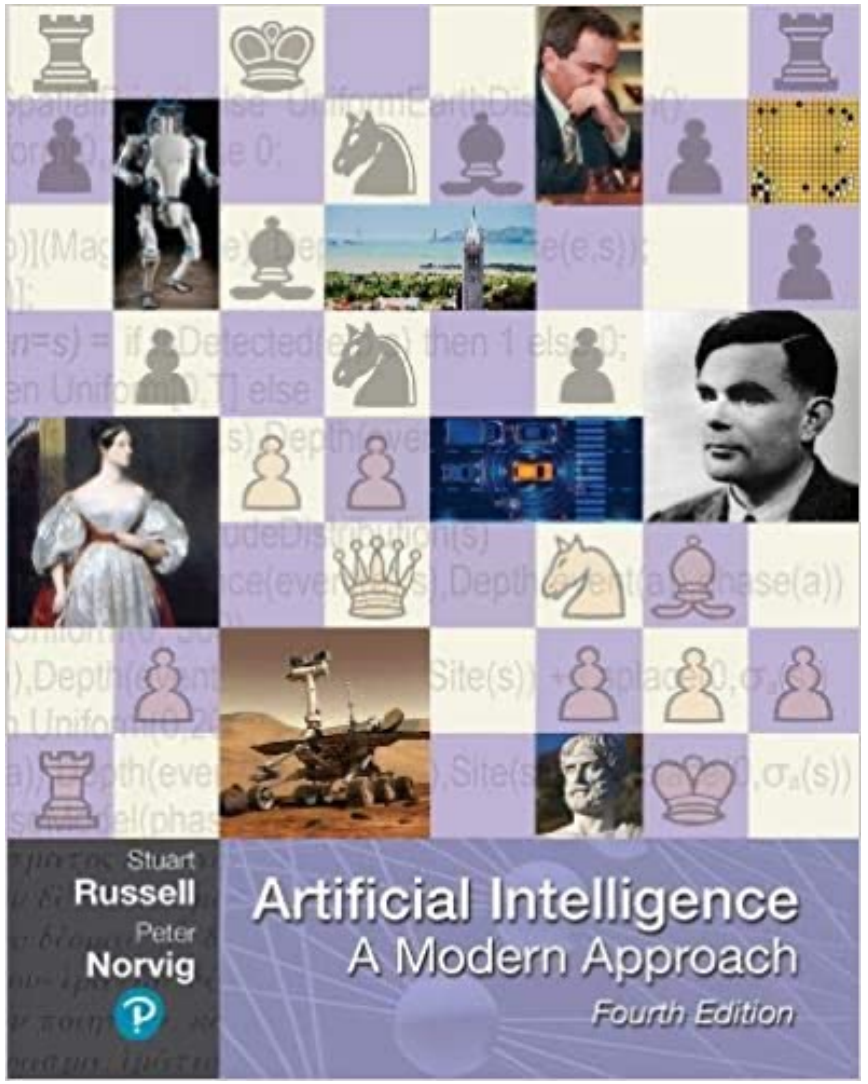
Reference Books

- Numa Dhamani and Maggie Engler (2024), Introduction to Generative AI, Manning
- Denis Rothman (2024), Transformers for Natural Language Processing and Computer Vision - Third Edition: Explore Generative AI and Large Language Models with Hugging Face, ChatGPT, GPT-4V, and DALL-E 3, 3rd ed. Edition, Packt Publishing
- Ben Auffarth (2023), Generative AI with LangChain: Build large language model (LLM) apps with Python, ChatGPT and other LLMs, Packt Publishing.
- Aurélien Géron (2022), Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, 3rd Edition, O'Reilly Media.
- 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.
- Nithin Buduma, Nikhil Buduma, Joe Papa (2022), Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms, 2nd Edition, O'Reilly Media.

Stuart Russell and Peter Norvig (2020),

Artificial Intelligence: A Modern Approach,

4th Edition, Pearson



Source: Stuart Russell and Peter Norvig (2020), Artificial Intelligence: A Modern Approach, 4th Edition, Pearson

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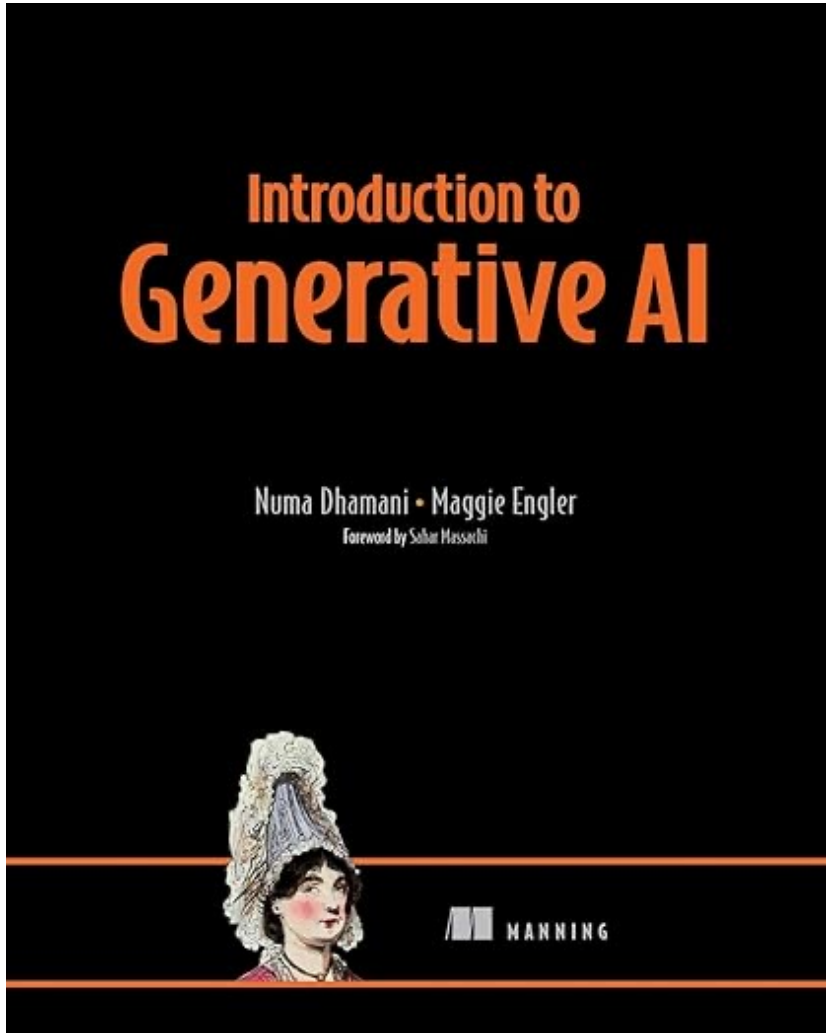
Numa Dhamani and Maggie Engler (2024),

Introduction to Generative AI,

Manning

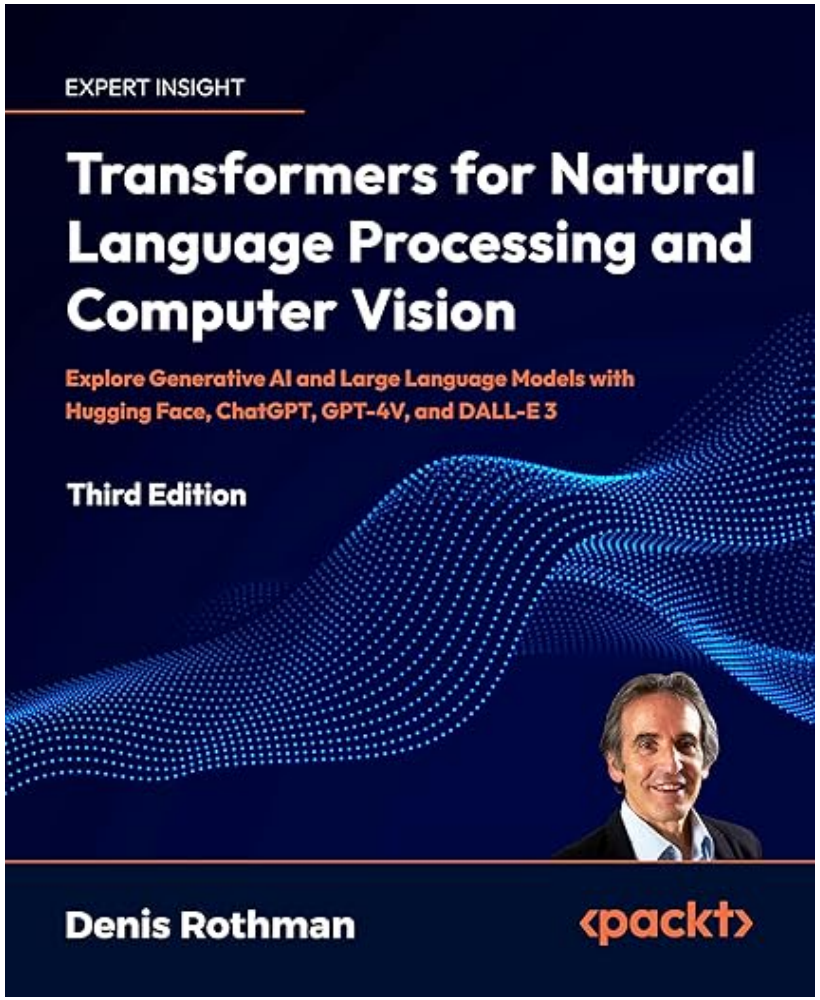


Source: Numa Dhamani and Maggie Engler (2024), Introduction to Generative AI, Manning
https://www.amazon.com/Introduction-Generative-AI-Numa-Dhamani/dp/1633437191/

Denis Rothman (2024),

Transformers for Natural Language Processing and Computer Vision:

Explore Generative AI and Large Language Models with Hugging Face, ChatGPT, GPT-4V, and DALL-E 3, 3rd Edition, Packt Publishing



Source: https://www.amazon.com/Transformers-Natural-Language-Processing-Computer/dp/1805128728

Ben Auffarth (2023),

Generative AI with LangChain:

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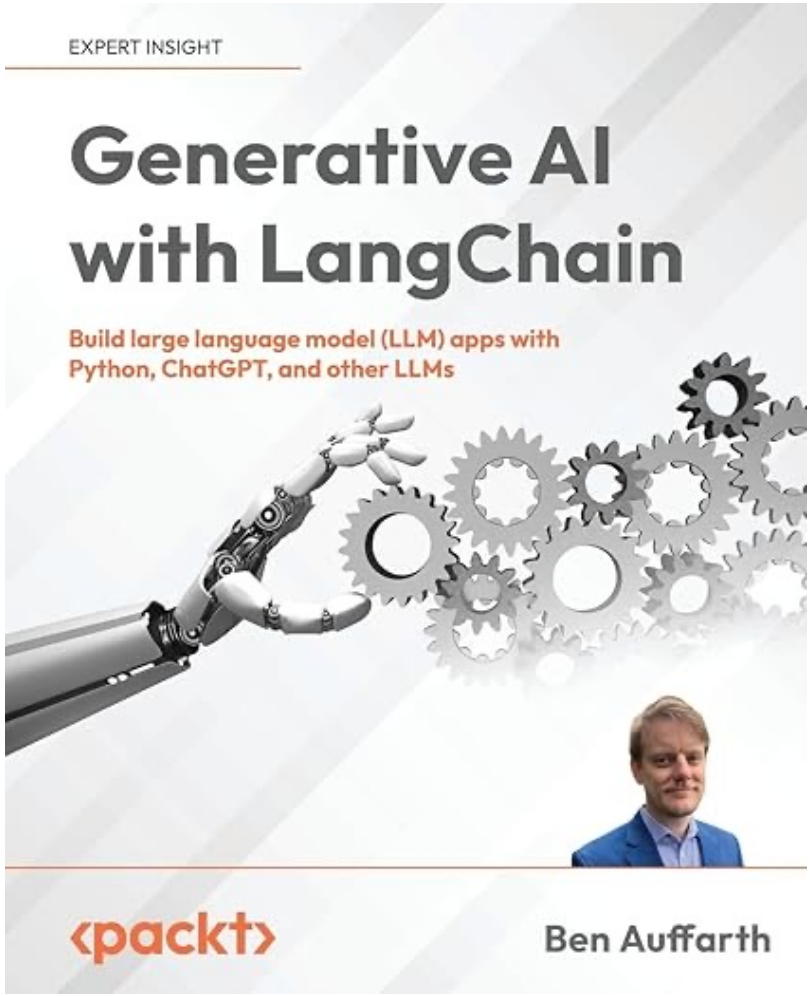


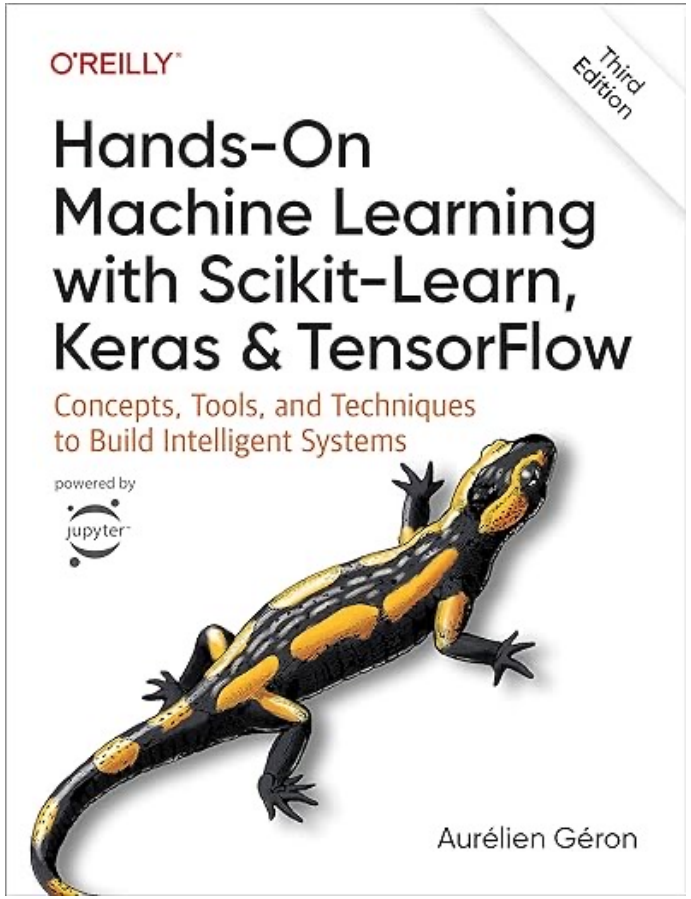
Source: https://www.amazon.com/Generative-AI-LangChain-language-ChatGPT/dp/1835083463

Aurélien Géron (2022),

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

Concepts, Tools, and Techniques to Build Intelligent Systems,

3rd Edition, O'Reilly Media



https://github.com/ageron/handson-ml3

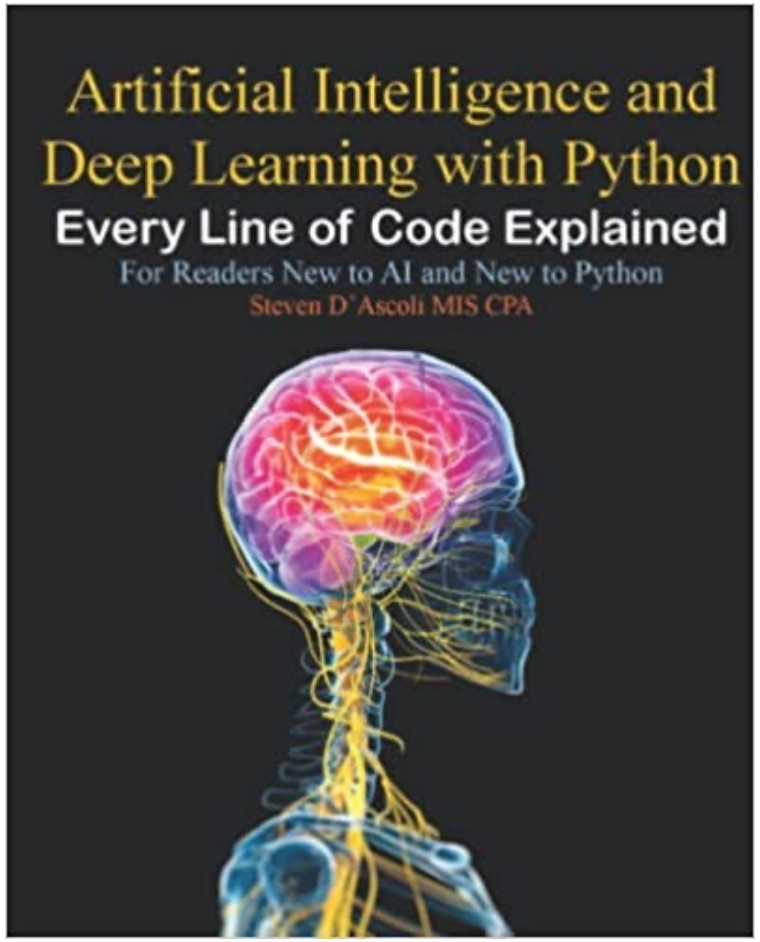
Source: https://www.amazon.com/Hands-Machine-Learning-Scikit-Learn-TensorFlow/dp/1098125975

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/

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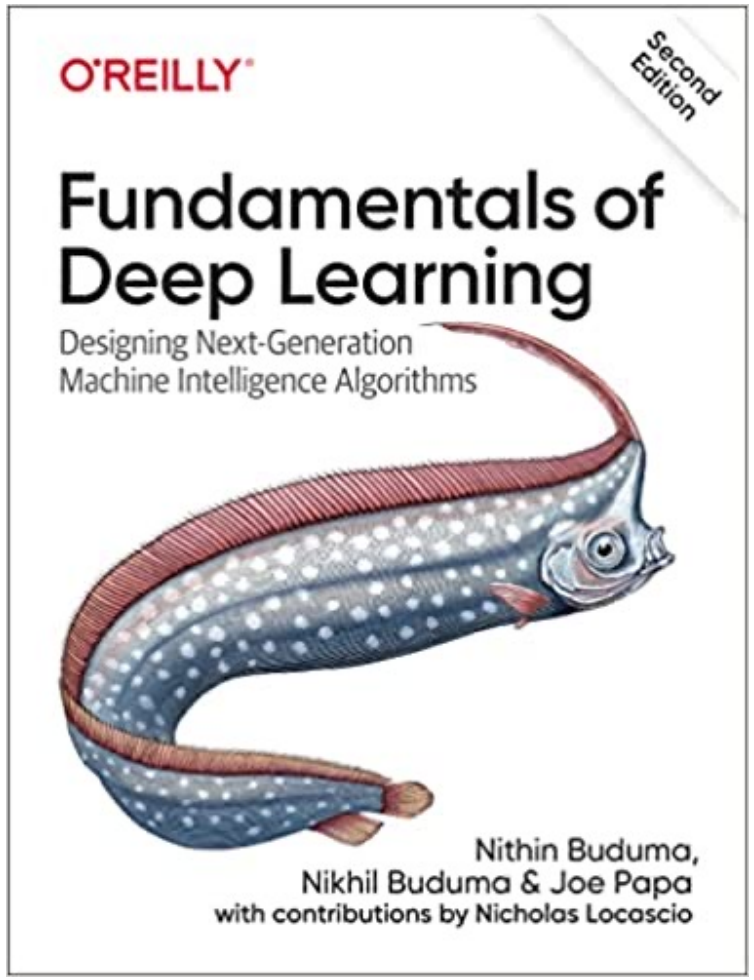
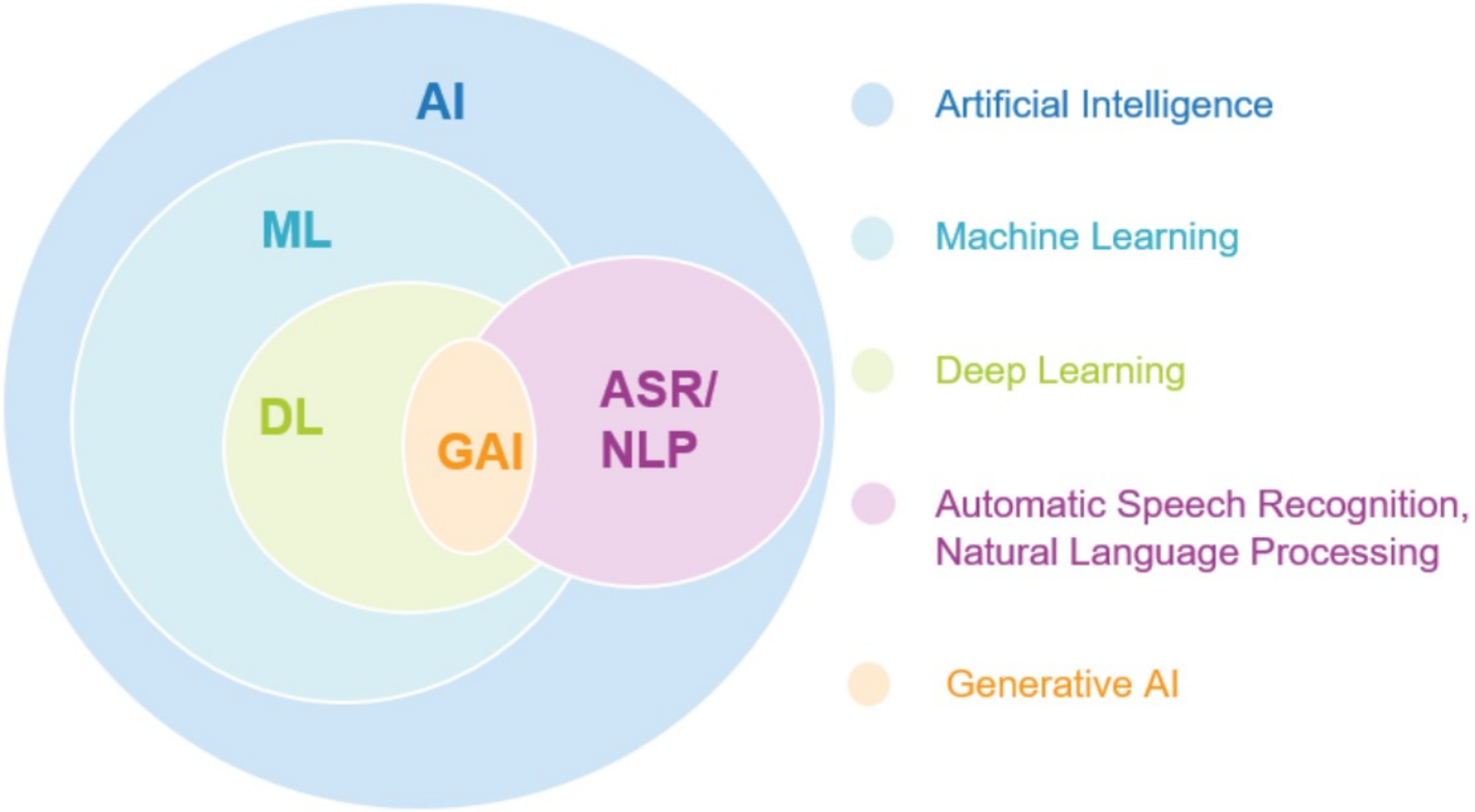


Source: https://www.amazon.com/Fundamentals-Deep-Learning-Next-Generation-Intelligence/dp/149208218X/

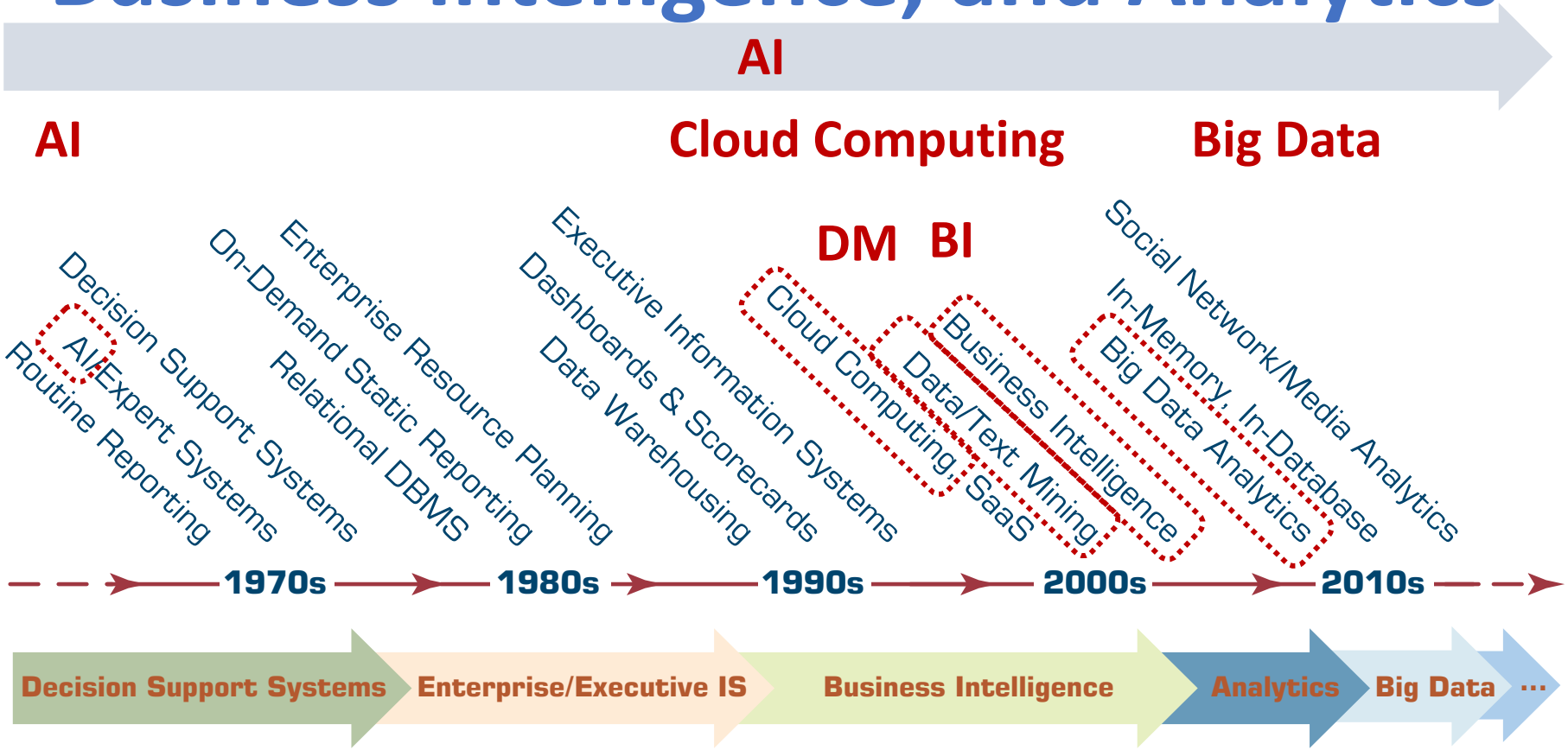
Artificial Intelligence (AI)

AI, ML, DL, Generative AI



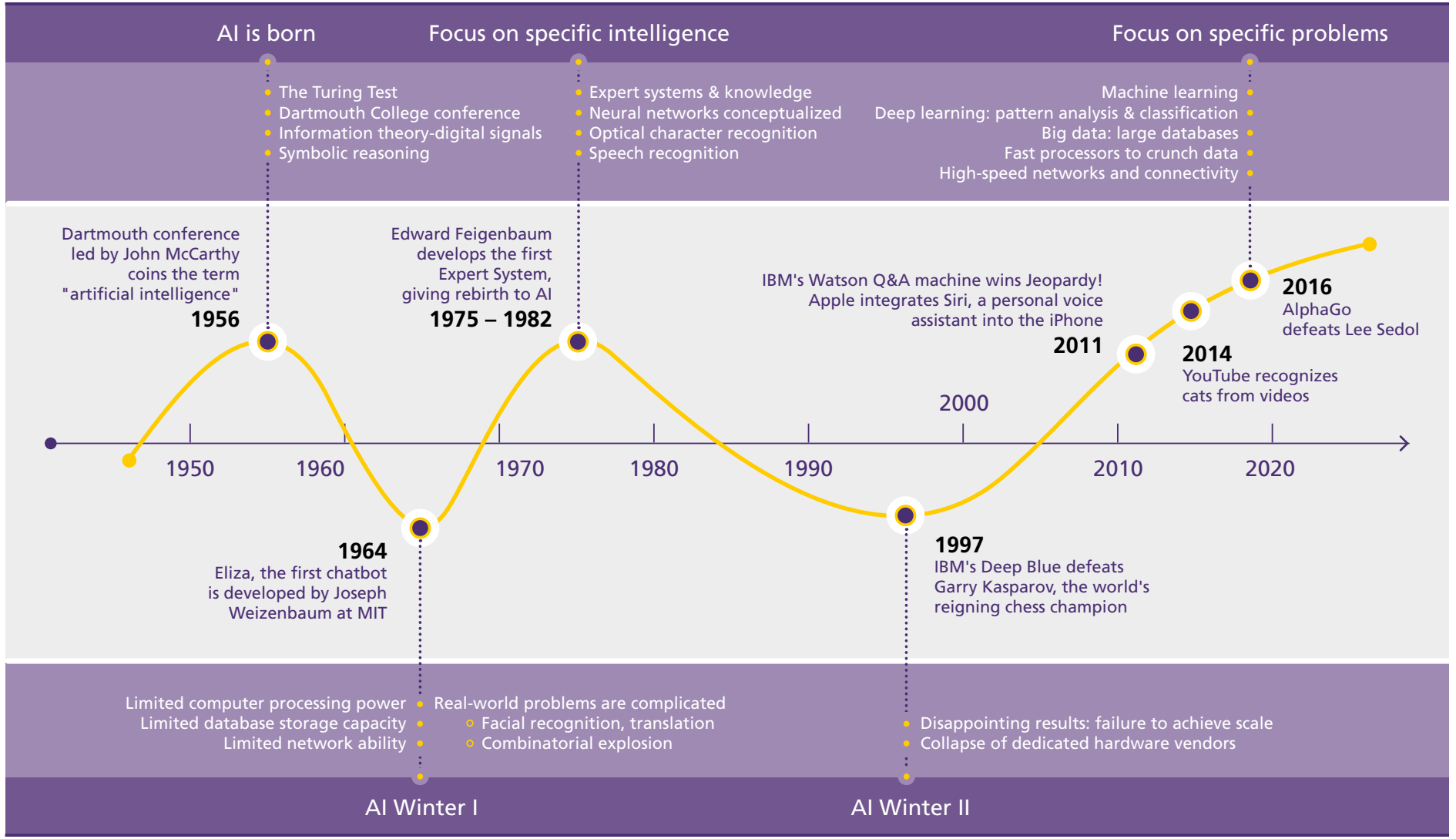
Source: Jeong, Cheonsu. "A Study on the Implementation of Generative AI Services Using an Enterprise Data-Based LLM Application Architecture." arXiv preprint arXiv:2309.01105 (2023).

AI, Big Data, Cloud Computing
Evolution of Decision Support, Business Intelligence, and Analytics



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

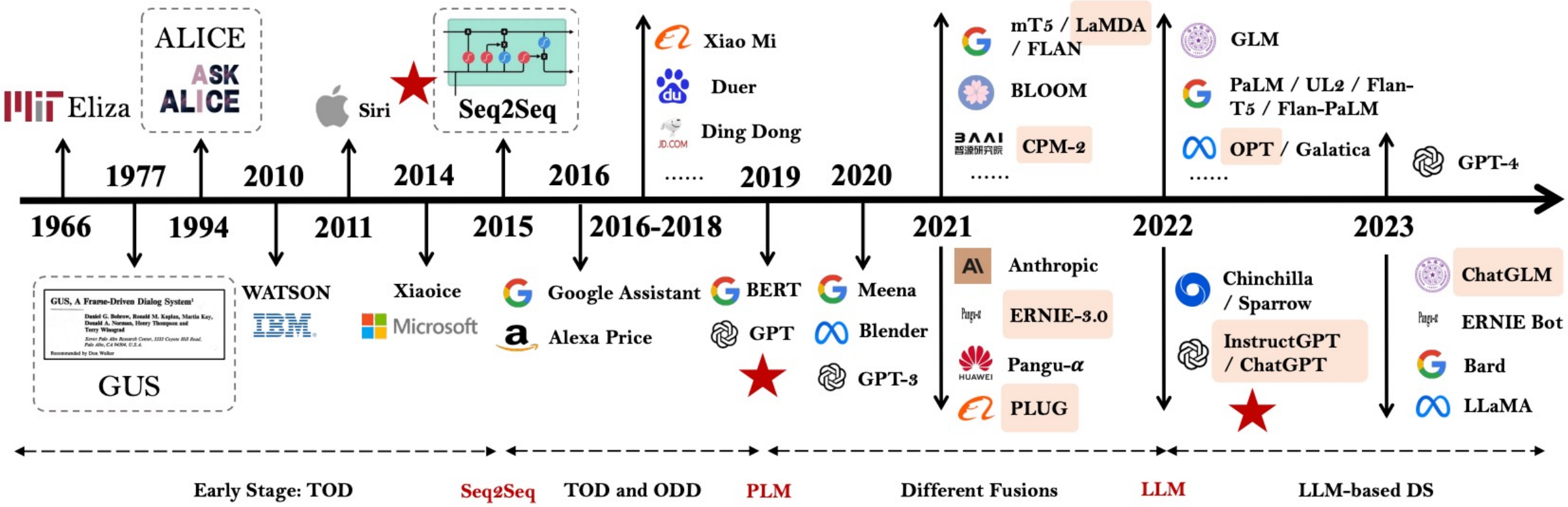
The Rise of AI



Source: DHL (2018), Artificial Intelligence in Logistics, http://www.globalhha.com/doclib/data/upload/doc_con/5e50c53c5bf67.pdf/

The Development of LM-based Dialogue Systems

1) Early Stage (1966 - 2015)
2) The Independent Development of TOD and ODD (2015 - 2019)
3) Fusions of Dialogue Systems (2019 - 2022)
4) LLM-based DS (2022 - Now)



Task-oriented DS (TOD), Open-domain DS (ODD)

Source: Wang, Hongru, Lingzhi Wang, Yiming Du, Liang Chen, Jingyan Zhou, Yufei Wang, and Kam-Fai Wong. "A Survey of the Evolution of Language Model-Based Dialogue Systems." arXiv preprint arXiv:2311.16789 (2023).

Definition of Artificial Intelligence (A.I.)

Artificial Intelligence

"… the science and engineering of making intelligent machines"

(John McCarthy, 1955)

Source: https://digitalintelligencetoday.com/artificial-intelligence-defined-useful-list-of-popular-definitions-from-business-and-science/

Artificial Intelligence

“… technology that thinks and acts like humans”

Source: https://digitalintelligencetoday.com/artificial-intelligence-defined-useful-list-of-popular-definitions-from-business-and-science/

Artificial Intelligence

"… intelligence exhibited by machines or software"

Source: https://digitalintelligencetoday.com/artificial-intelligence-defined-useful-list-of-popular-definitions-from-business-and-science/

4 Approaches of AI

Thinking Humanly	**Thinking Rationally**
Acting Humanly	**Acting Rationally**

Source: Stuart Russell and Peter Norvig (2020), Artificial Intelligence: A Modern Approach, 4th Edition, Pearson

4 Approaches of AI

2. **Thinking Humanly:** **The Cognitive Modeling Approach**	**3.** **Thinking Rationally:** **The "Laws of Thought" Approach**
1. **Acting Humanly:** **The Turing Test Approach (1950)**	**4.** **Acting Rationally:** **The Rational Agent Approach**

Source: Stuart Russell and Peter Norvig (2020), Artificial Intelligence: A Modern Approach, 4th Edition, Pearson

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

Source: Stuart Russell and Peter Norvig (2020), Artificial Intelligence: A Modern Approach, 4th Edition, Pearson

Artificial Intelligence: A Modern Approach

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

Source: Stuart Russell and Peter Norvig (2020), Artificial Intelligence: A Modern Approach, 4th Edition, Pearson

Artificial Intelligence: Intelligent Agents

Artificial Intelligence:
2. Problem Solving

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

Source: Stuart Russell and Peter Norvig (2020), Artificial Intelligence: A Modern Approach, 4th Edition, Pearson

Artificial Intelligence:
3. Knowledge and Reasoning

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

Source: Stuart Russell and Peter Norvig (2020), Artificial Intelligence: A Modern Approach, 4th Edition, Pearson

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

Source: Stuart Russell and Peter Norvig (2020), Artificial Intelligence: A Modern Approach, 4th Edition, Pearson

Artificial Intelligence:
5. Machine Learning

- Learning from Examples
- Learning Probabilistic Models
- Deep Learning
- Reinforcement Learning

Source: Stuart Russell and Peter Norvig (2020), Artificial Intelligence: A Modern Approach, 4th Edition, Pearson

Artificial Intelligence:

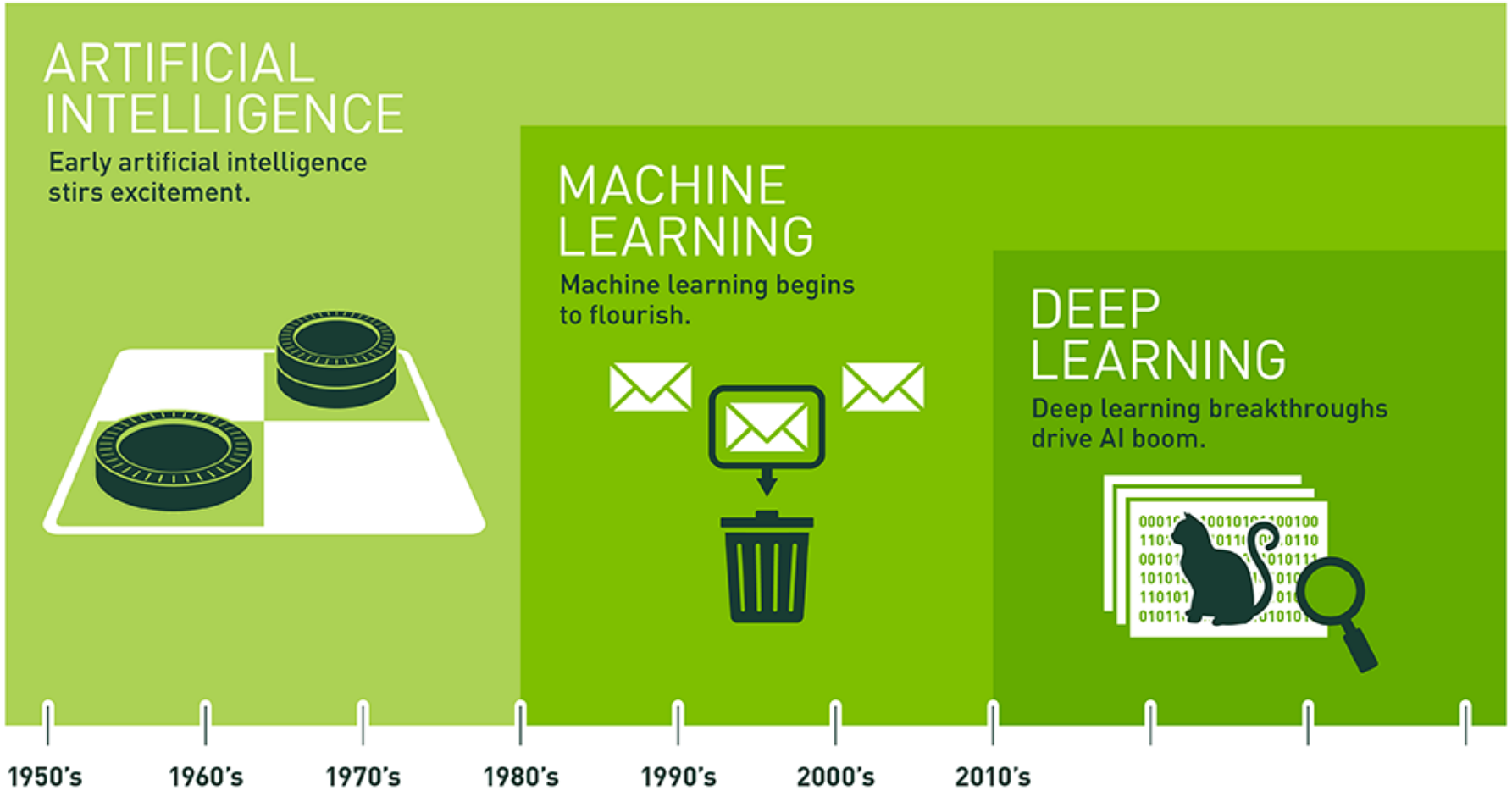
6. Communicating, Perceiving, and Acting

- **Natural Language Processing**
- **Deep Learning for Natural Language Processing**
- **Computer Vision**
- **Robotics**

Source: Stuart Russell and Peter Norvig (2020), Artificial Intelligence: A Modern Approach, 4th Edition, Pearson

Artificial Intelligence:
Philosophy and Ethics of AI
The Future of AI

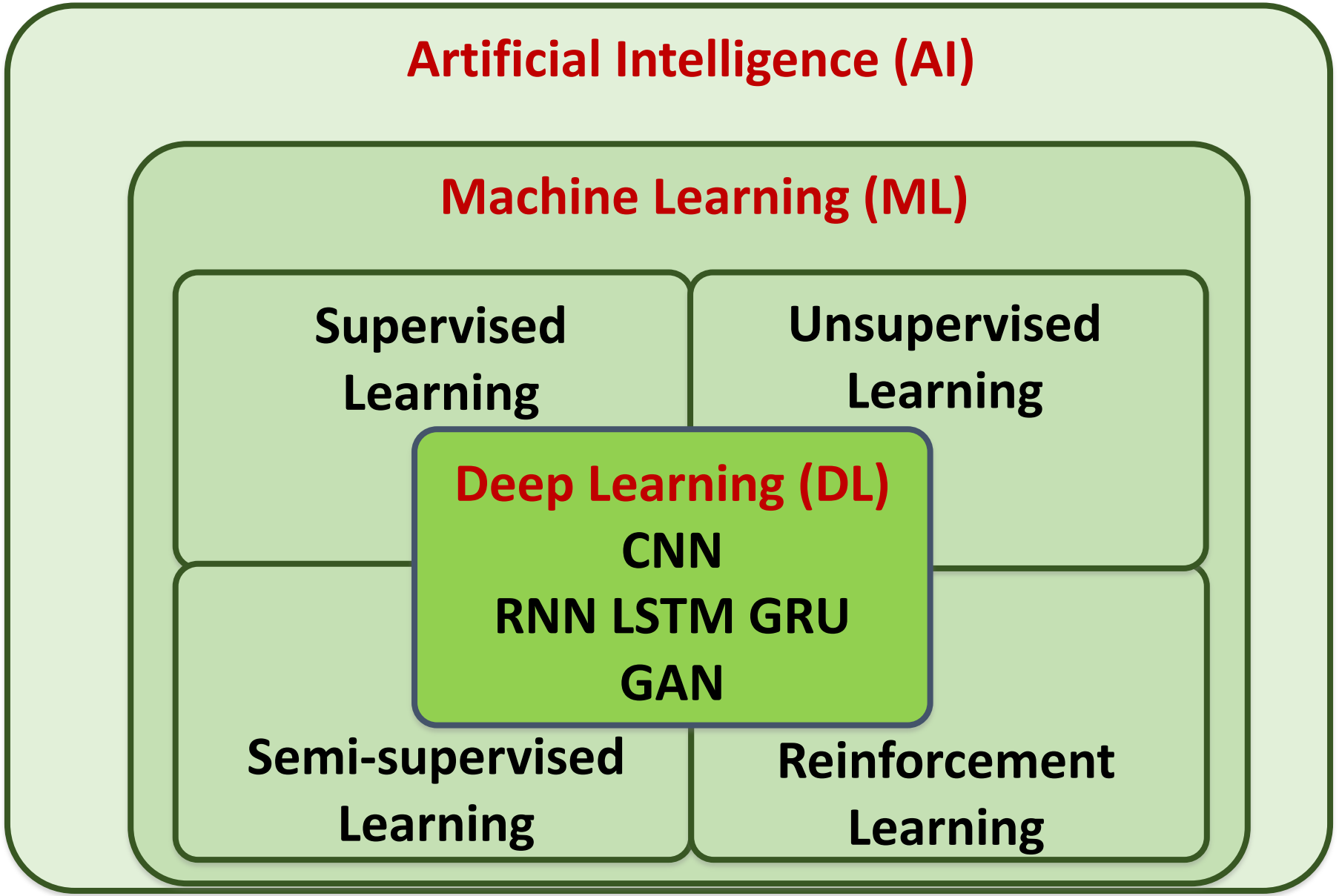
Artificial Intelligence
Machine Learning & Deep Learning



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.

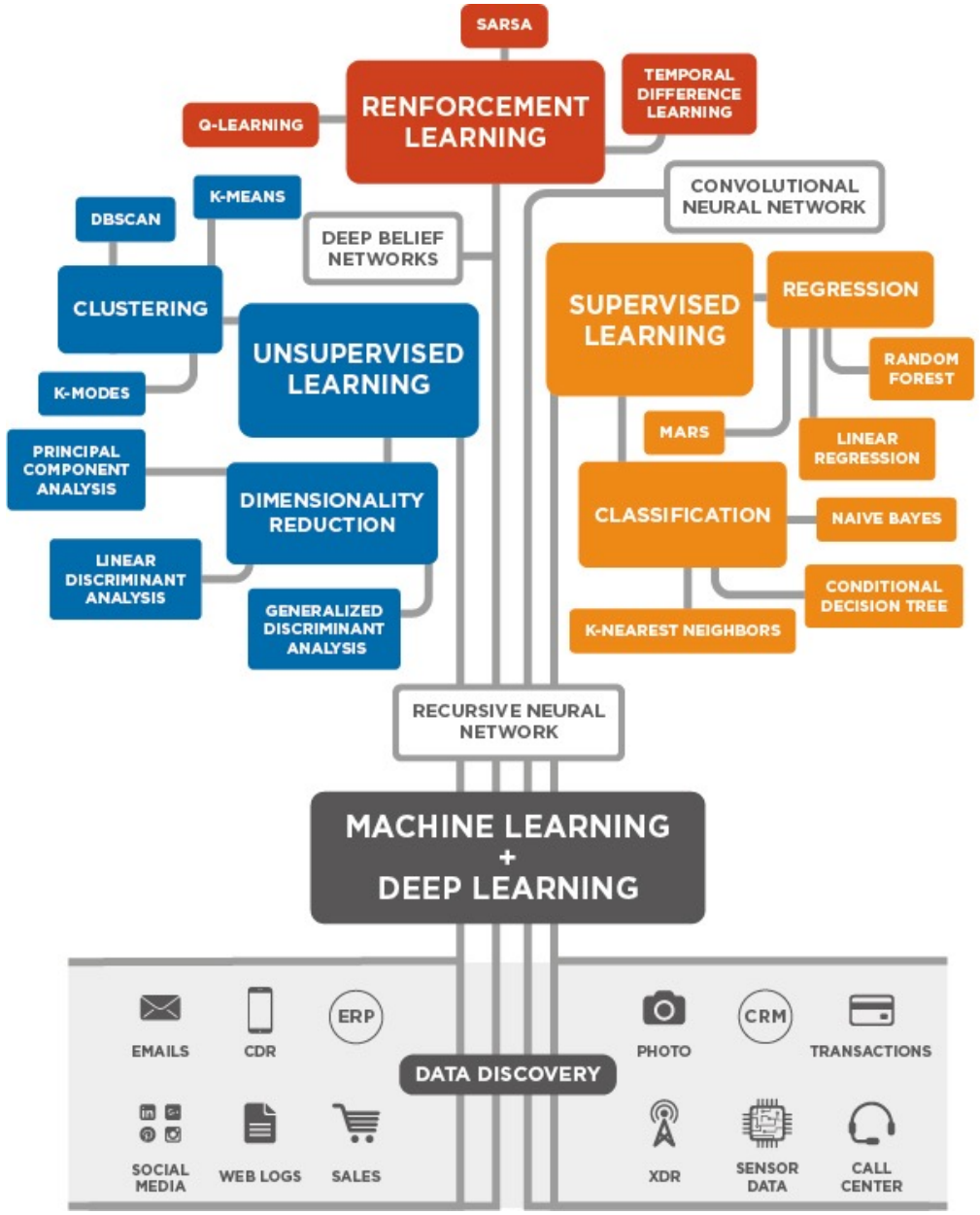
Source: https://blogs.nvidia.com/blog/2016/07/29/whats-difference-artificial-intelligence-machine-learning-deep-learning-ai/

AI, ML, DL



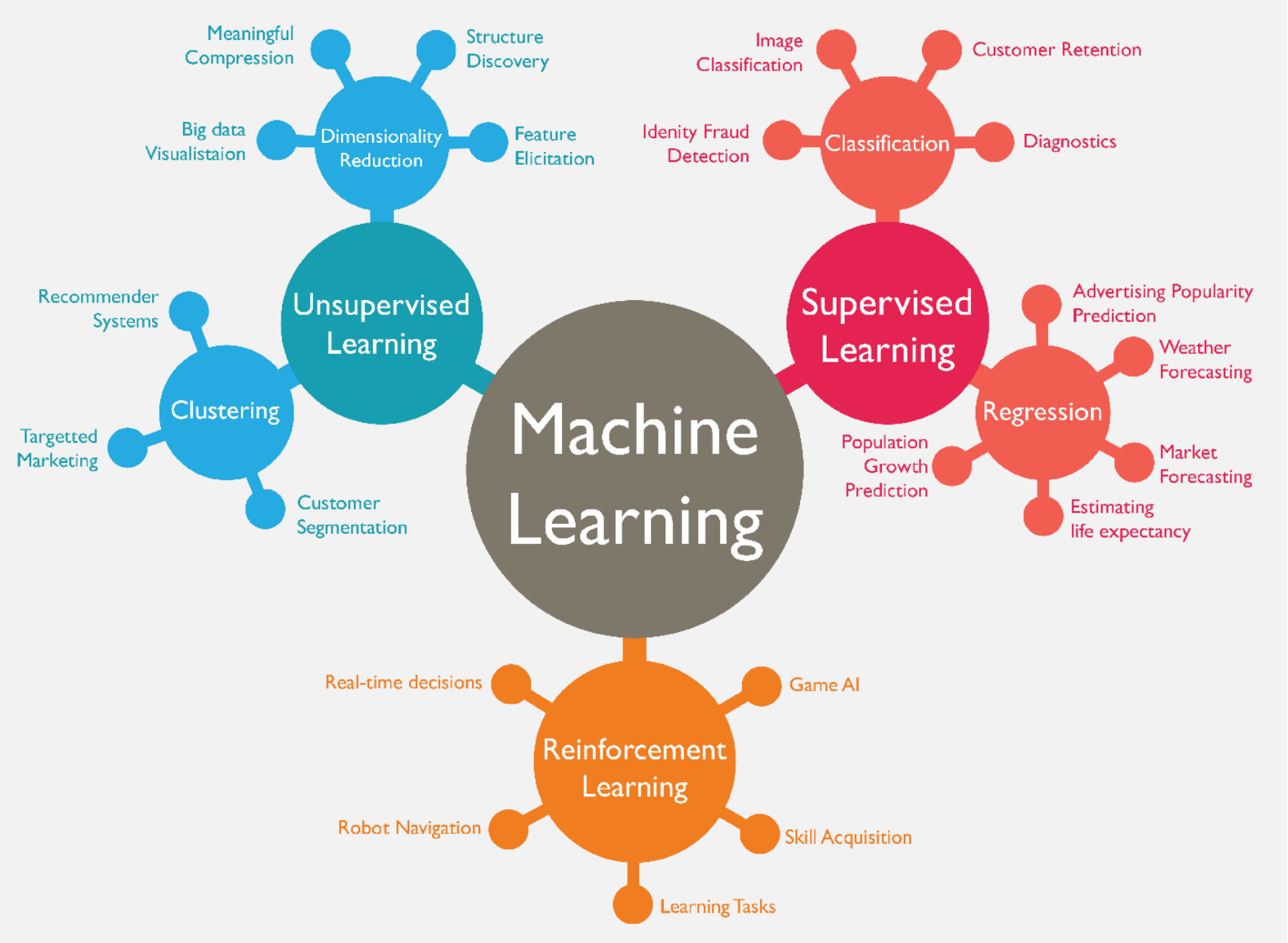
Source: https://leonardoaraujosantos.gitbooks.io/artificial-inteligence/content/deep_learning.html

3 Machine Learning Algorithms



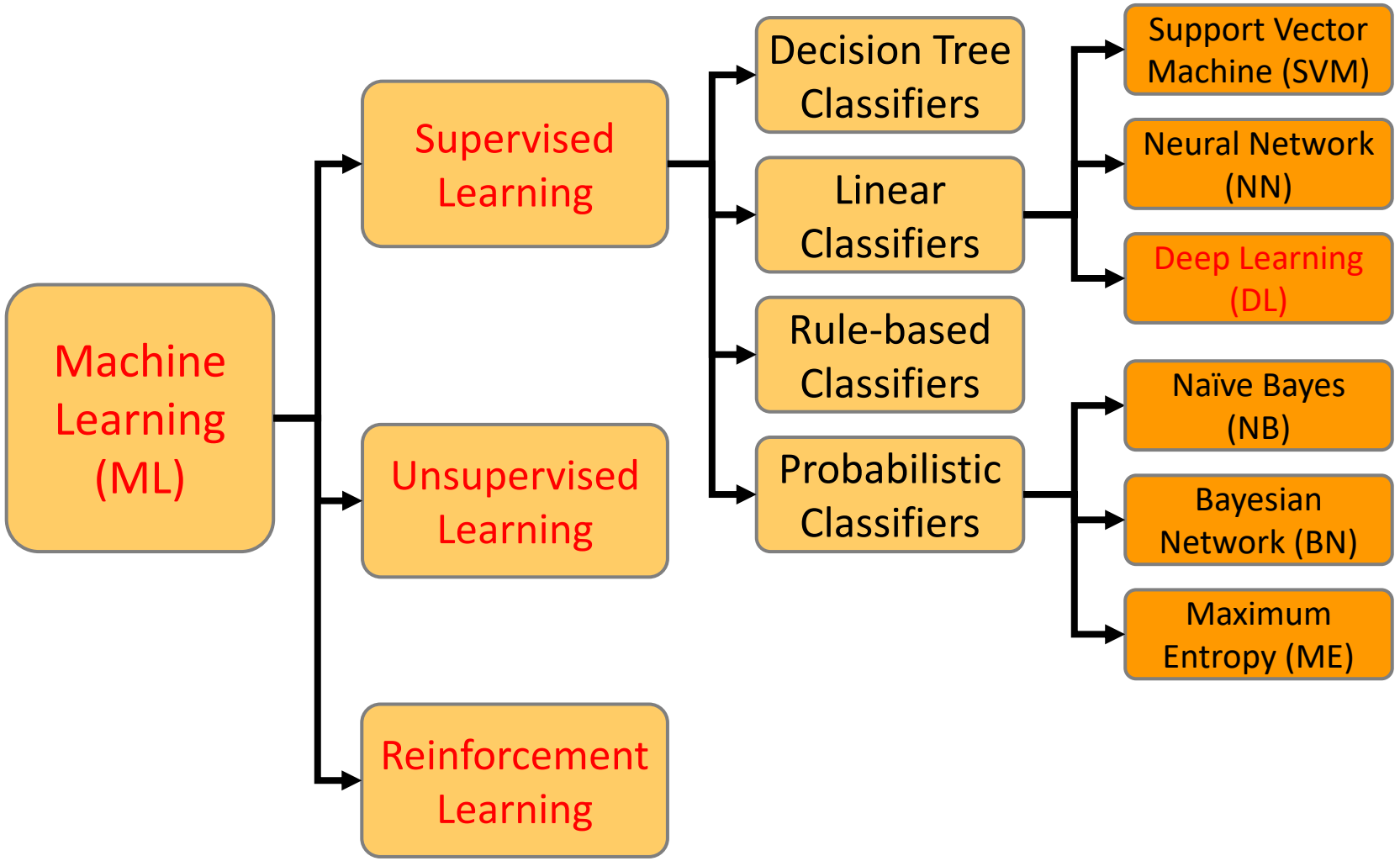
Source: Enrico Galimberti, http://blogs.teradata.com/data-points/tree-machine-learning-algorithms/

Machine Learning (ML)



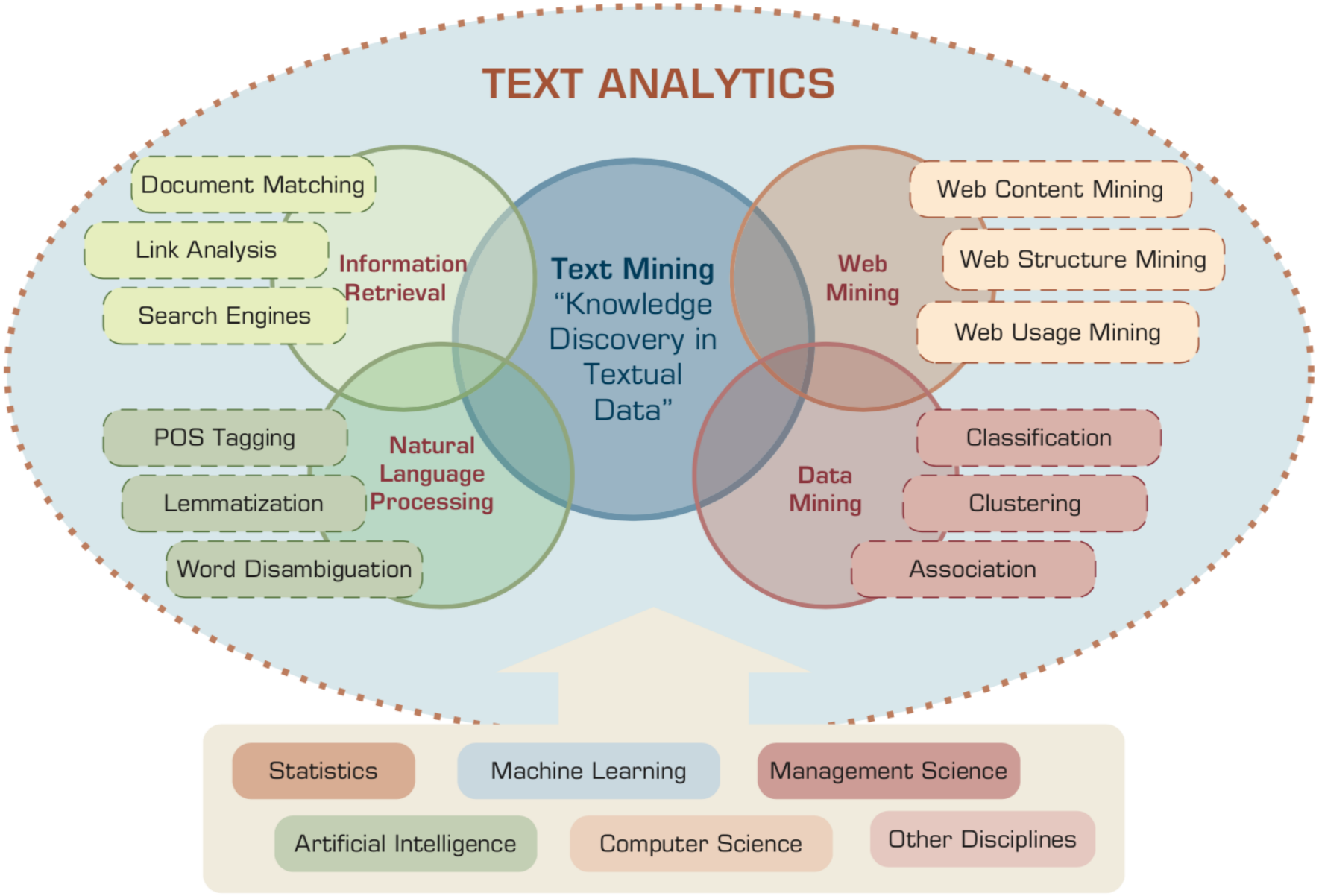
Source: https://www.mactores.com/services/aws-big-data-machine-learning-cognitive-services/

Machine Learning (ML) / Deep Learning (DL)



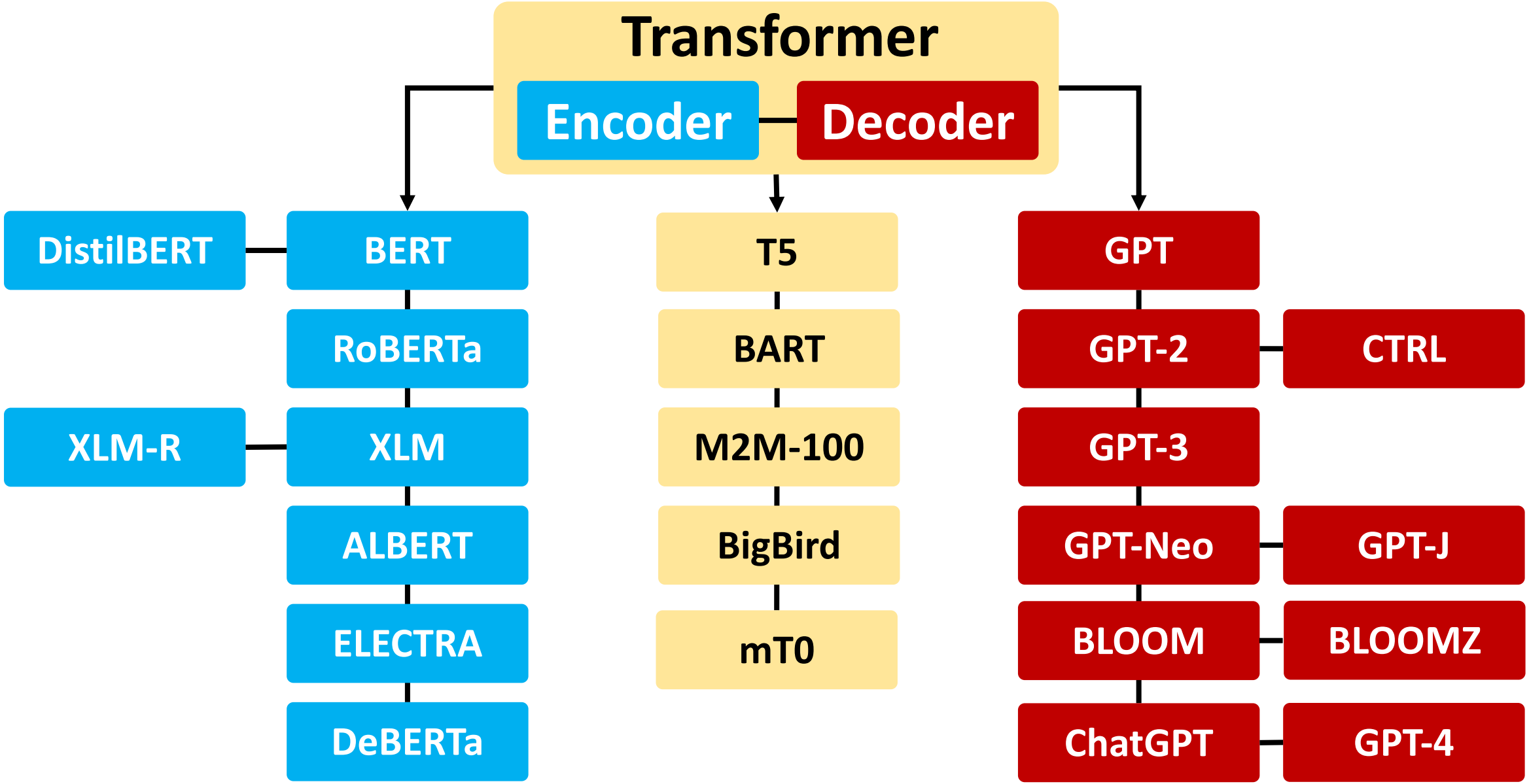
Source: Jesus Serrano-Guerrero, Jose A. Olivas, Francisco P. Romero, and Enrique Herrera-Viedma (2015), "Sentiment analysis: A review and comparative analysis of web services," Information Sciences, 311, pp. 18-38.

AI for Text Analytics



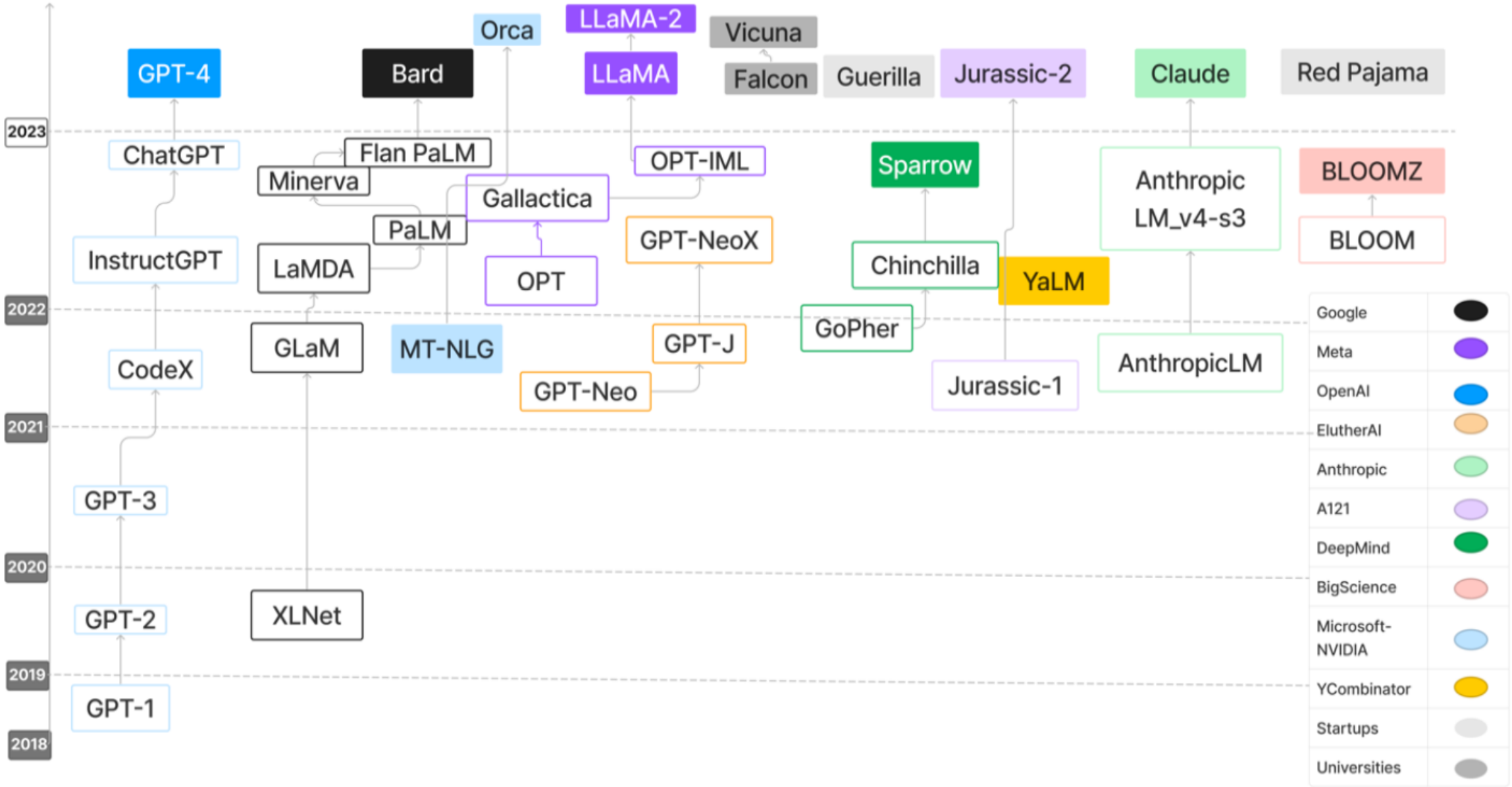
Source: Ramesh Sharda, Dursun Delen, and Efraim Turban (2017), Business Intelligence, Analytics, and Data Science: A Managerial Perspective, 4th Edition, Pearson

Transformer Models



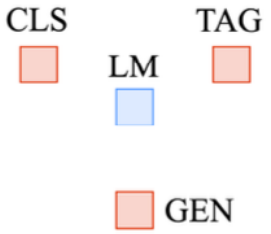
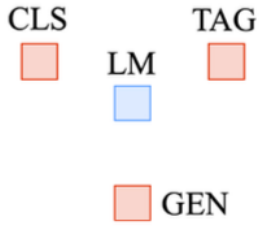
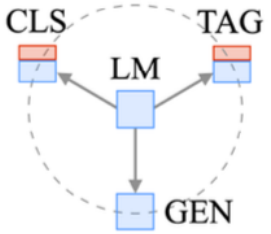
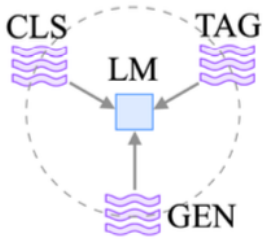
Source: Lewis Tunstall, Leandro von Werra, and Thomas Wolf (2022), Natural Language Processing with Transformers: Building Language Applications with Hugging Face, O'Reilly Media.

Large Language Models (LLMs)



Source: Hadi, Muhammad Usman, Rizwan Qureshi, Abbas Shah, Muhammad Irfan, Anas Zafar, Muhammad Bilal Shaikh, Naveed Akhtar, Jia Wu, and Seyedali Mirjalili. "Large language models: a comprehensive survey of its applications, challenges, limitations, and future prospects." Authorea Preprints (2023).

Four Paradigms in NLP (LM)

Paradigm	Engineering	Task Relation
a. Fully Supervised Learning (Non-Neural Network)	Feature (e.g. word identity, part-of-speech, sentence length)	
b. Fully Supervised Learning (Neural Network)	Architecture (e.g. convolutional, recurrent, self-attentional)	
Transfer Learning: Pre-training, Fine-Tuning (FT) c. Pre-train, Fine-tune	Objective (e.g. masked language modeling, next sentence prediction)	
GAI: Pre-train, Prompt, and Predict (Prompting) d. Pre-train, Prompt, Predict	Prompt (e.g. cloze, prefix)	

Source: Pengfei Liu, Weizhe Yuan, Jinlan Fu, Zhengbao Jiang, Hiroaki Hayashi, and Graham Neubig. (2023) "Pre-train, prompt, and predict: A systematic survey of prompting methods in natural language processing." ACM Computing Surveys 55, no. 9 (2023): 1-35.

Generative AI

Text, Image, Video, Audio Applications

Comparison of Generative AI and Traditional AI

Feature	Generative AI	Traditional AI
Output type	New content	Classification/Prediction
Creativity	High	Low
Interactivity	Usually more natural	Limited

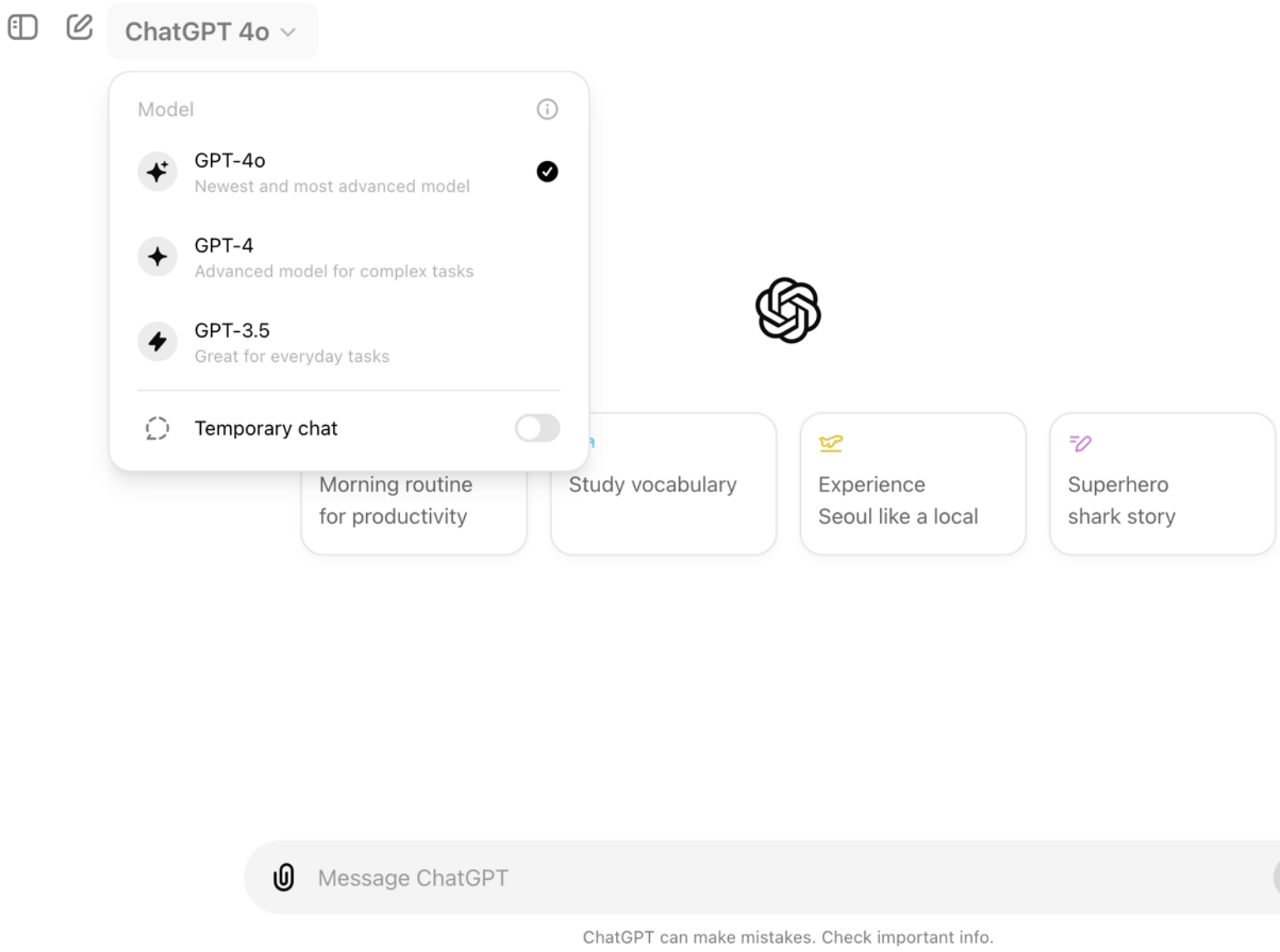
Generative AI

- **Generative AI: The Art of Creation**
- **Definition: AI systems capable of creating new content**
- **Characteristics: Creativity, interactivity**

Popular Generative AI

- OpenAI ChatGPT (GPT-4o, GPT-4)
- Claude.ai (Claude 3.5)
- Google Gemini
- Chat.LMSys.org
- Perplexity.ai
- ChatPDF
- Stable Diffusion
- Video: D-ID, Synthesia
- Audio: Speechify

OpenAI ChatGPT (GPT-4o, GPT-4)



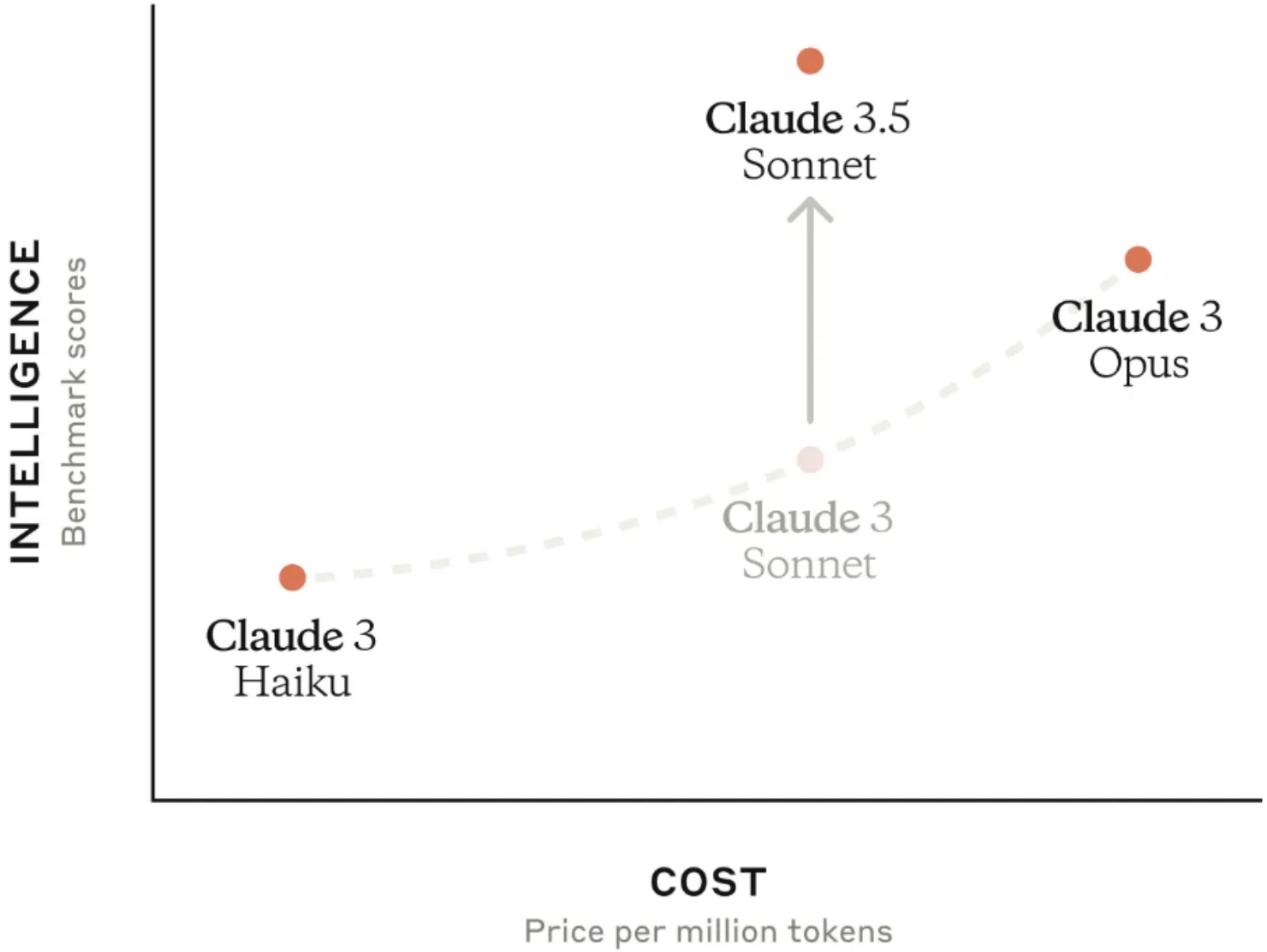
https://chat.openai.com/

OpenAI ChatGPT (GPT-4) DALL·E 3

Vector graphic of a flowchart depicting the integration of generative AI in the education process, from content creation to virtual experiments, personalized learning, and innovative learning.

https://chat.openai.com/

Claude 3.5 Sonnet



Source: https://www.anthropic.com/news/claude-3-5-sonnet

Claude 3.5, GPT-4o, Gemini 1.5 Pro

	Claude 3.5 Sonnet	Claude 3 Opus	GPT-4o	Gemini 1.5 Pro	Llama-400b (early snapshot)
Graduate level reasoning *GPQA, Diamond*	59.4%* 0-shot CoT	50.4% 0-shot CoT	53.6% 0-shot CoT	—	—
Undergraduate level knowledge *MMLU*	88.7%** 5-shot 88.3% 0-shot CoT	86.8% 5-shot 85.7% 0-shot CoT	— 88.7% 0-shot CoT	85.9% 5-shot —	86.1% 5-shot —
Code *HumanEval*	92.0% 0-shot	84.9% 0-shot	90.2% 0-shot	84.1% 0-shot	84.1% 0-shot
Multilingual math *MGSM*	91.6% 0-shot CoT	90.7% 0-shot CoT	90.5% 0-shot CoT	87.5% 8-shot	—
Reasoning over text *DROP, F1 score*	87.1 3-shot	83.1 3-shot	83.4 3-shot	74.9 Variable shots	83.5 3-shot Pre-trained model
Mixed evaluations *BIG-Bench-Hard*	93.1% 3-shot CoT	86.8% 3-shot CoT	—	89.2% 3-shot CoT	85.3% 3-shot CoT Pre-trained model
Math problem-solving *MATH*	71.1% 0-shot CoT	60.1% 0-shot CoT	76.6% 0-shot CoT	67.7% 4-shot	57.8% 4-shot CoT
Grade school math *GSM8K*	96.4% 0-shot CoT	95.0% 0-shot CoT	—	90.8% 11-shot	94.1% 8-shot CoT

* Claude 3.5 Sonnet scores 67.2% on 5-shot CoT GPQA with maj@32
** Claude 3.5 Sonnet scores 90.4% on MMLU with 5-shot CoT prompting

Source: https://www.anthropic.com/news/claude-3-5-sonnet

Claude 3.5 Sonnet State-of-the-art vision

	Claude 3.5 Sonnet	Claude 3 Opus	GPT-4o	Gemini 1.5 Pro
Visual math reasoning *MathVista (testmini)*	**67.7%** 0-shot CoT	**50.5%** 0-shot CoT	**63.8%** 0-shot CoT	**63.9%** 0-shot CoT
Science diagrams *AI2D, test*	**94.7%** 0-shot	**88.1%** 0-shot	**94.2%** 0-shot	**94.4%** 0-shot
Visual question answering *MMMU (val)*	**68.3%** 0-shot CoT	**59.4%** 0-shot CoT	**69.1%** 0-shot CoT	**62.2%** 0-shot CoT
Chart Q&A *Relaxed accuracy (test)*	**90.8%** 0-shot CoT	**80.8%** 0-shot CoT	**85.7%** 0-shot CoT	**87.2%** 0-shot CoT
Document visual Q&A *ANLS score, test*	**95.2%** 0-shot	**89.3%** 0-shot	**92.8%** 0-shot	**93.1%** 0-shot

Source: https://www.anthropic.com/news/claude-3-5-sonnet

Google Gemini

Largest and most capable AI model
Making AI more helpful for everyone

Source: https://blog.google/technology/ai/google-gemini-ai

LMSYS Chatbot Arena Leaderboard

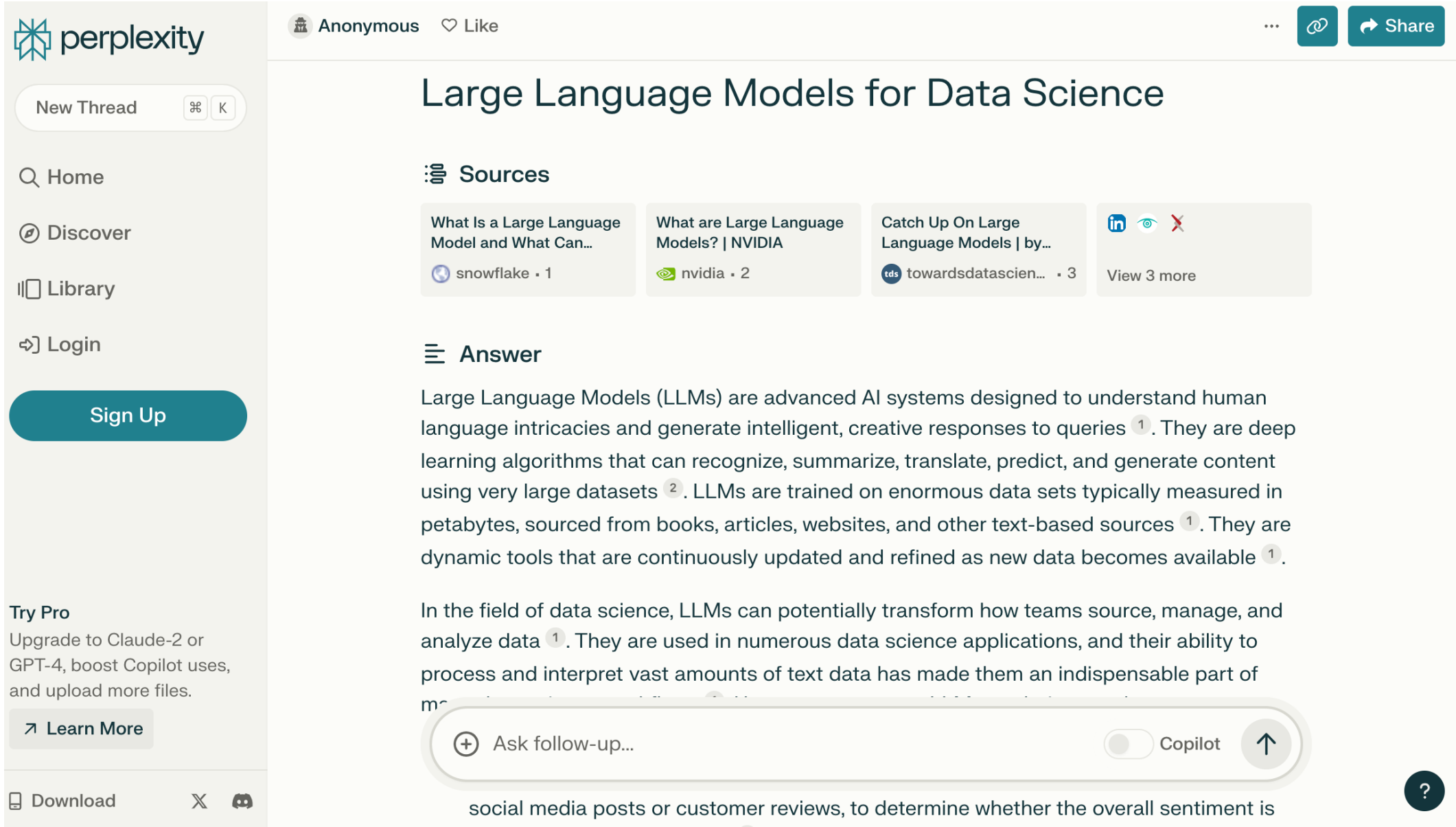
GPT-4o

Claude 3.5

Rank* (UB)	Model	Arena Score	95% CI	Votes	Organization	License	Knowledge Cutoff
1	ChatGPT-4o-latest (2024-08-08)	1316	+4/-4	24358	OpenAI	Proprietary	2023/10
2	Gemini-1.5-Pro-Exp-0827	1301	+5/-5	19976	Google	Proprietary	2023/11
2	Gemini-1.5-Pro-Exp-0801	1298	+4/-3	25471	Google	Proprietary	2023/11
2	Grok-2-08-13	1295	+4/-6	10170	xAI	Proprietary	2024/3
5	GPT-4o-2024-05-13	1286	+3/-3	83181	OpenAI	Proprietary	2023/10
6	GPT-4o-mini-2024-07-18	1274	+4/-4	23318	OpenAI	Proprietary	2023/10
6	Gemini-1.5-Flash-Exp-0827	1270	+7/-6	6610	Google	Proprietary	2023/11
6	Claude 3.5 Sonnet	1270	+3/-3	53610	Anthropic	Proprietary	2024/4
6	Gemini Advanced App (2024-05-14)	1266	+3/-3	52225	Google	Proprietary	Online
6	Grok-2-Mini-08-13	1266	+6/-6	10939	xAI	Proprietary	2024/3
7	Meta-Llama-3.1-405b-Instruct	1266	+3/-4	24855	Meta	Llama 3.1 Community	2023/12
7	GPT-4o-2024-08-06	1262	+7/-5	14960	OpenAI	Proprietary	2023/10
10	Gemini-1.5-Pro-001	1259	+3/-3	74909	Google	Proprietary	2023/11

https://lmarena.ai/

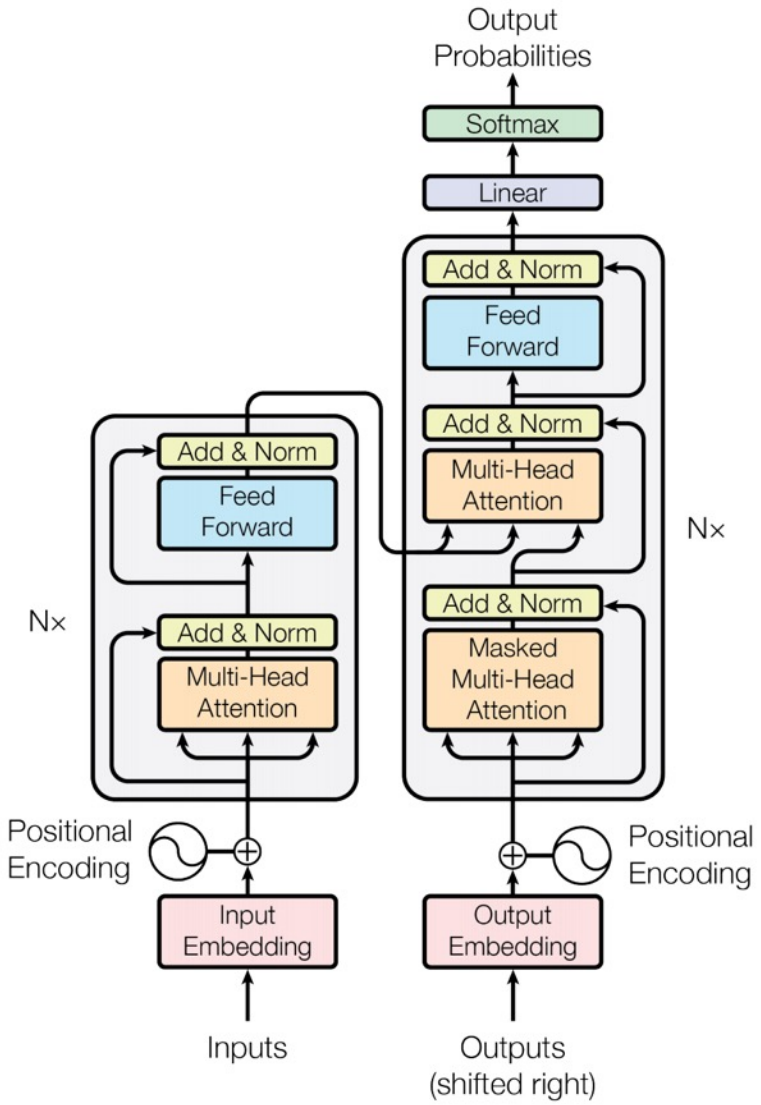
Perplexity.ai



https://www.perplexity.ai/

Transformer (Attention is All You Need)

(Vaswani et al., 2017)

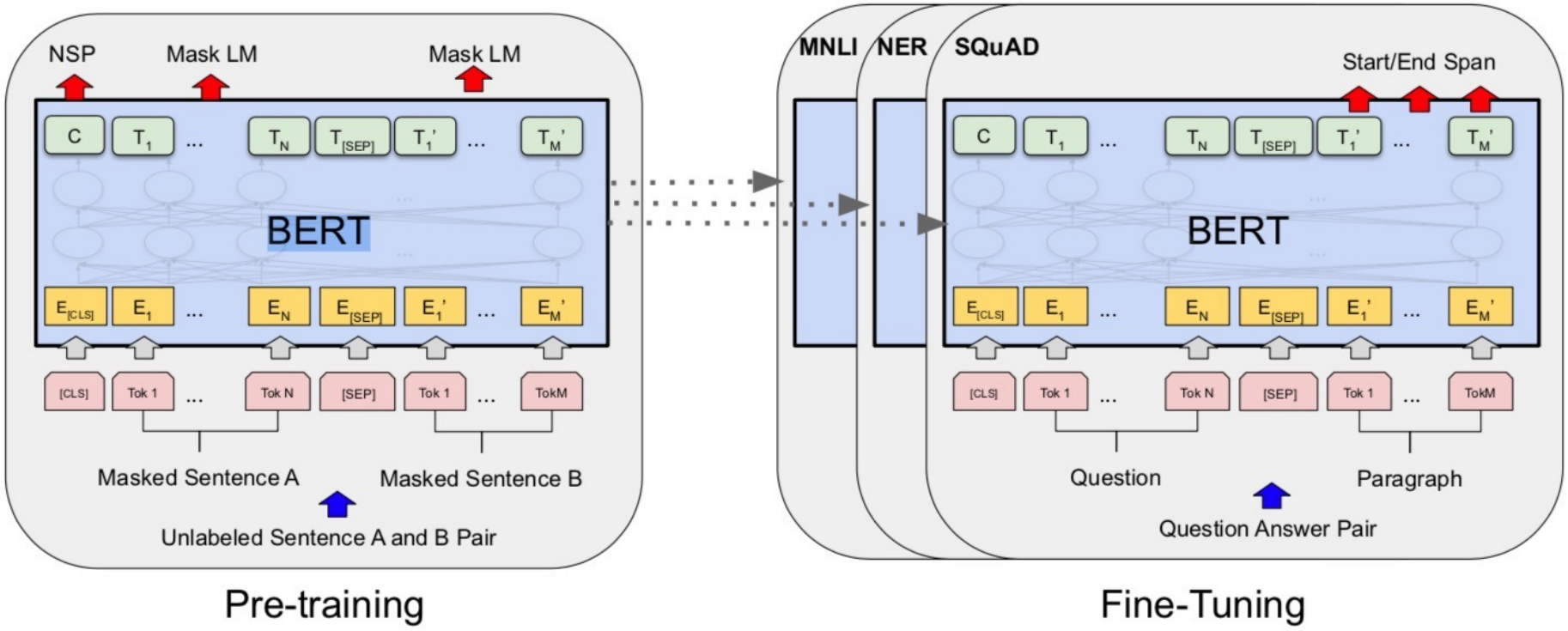


Source: Vaswani, Ashish, Noam Shazeer, Niki Parmar, Jakob Uszkoreit, Llion Jones, Aidan N. Gomez, Łukasz Kaiser, and Illia Polosukhin. "Attention is all you need." In *Advances in neural information processing systems*, pp. 5998-6008. 2017.

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

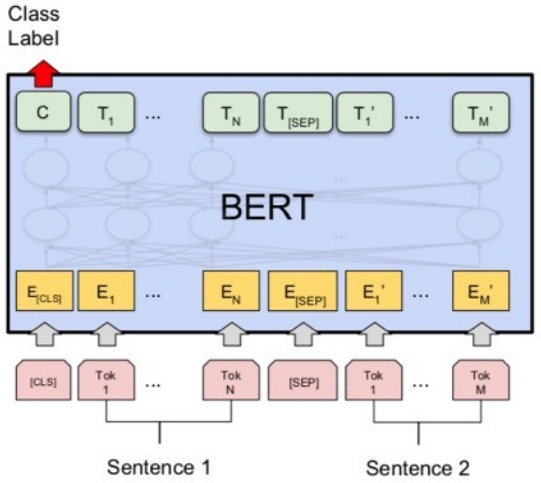
BERT (Bidirectional Encoder Representations from Transformers)

Overall pre-training and fine-tuning procedures for BERT

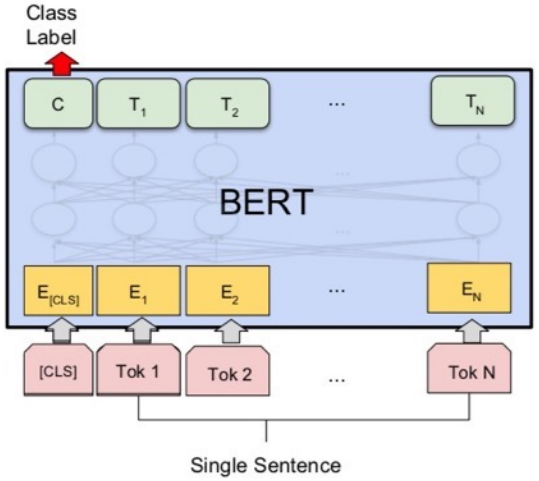


Source: Devlin, Jacob, Ming-Wei Chang, Kenton Lee, and Kristina Toutanova (2018). "Bert: Pre-training of deep bidirectional transformers for language understanding." arXiv preprint arXiv:1810.04805.

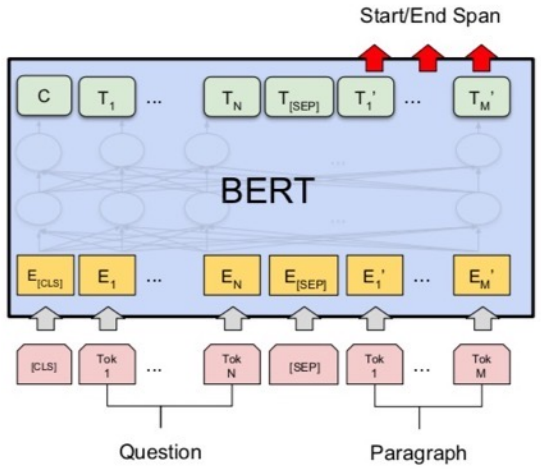
Fine-tuning BERT on Different Tasks



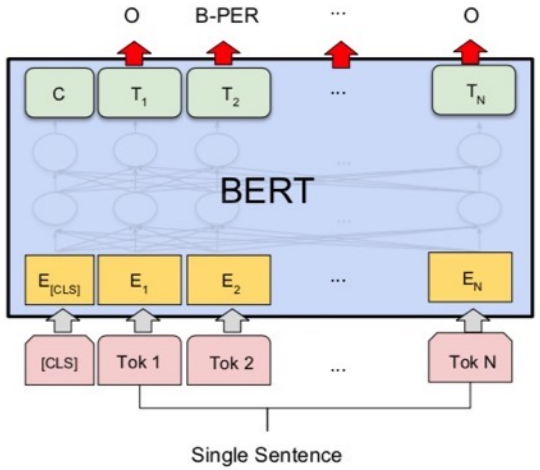
(a) Sentence Pair Classification Tasks: MNLI, QQP, QNLI, STS-B, MRPC, RTE, SWAG



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



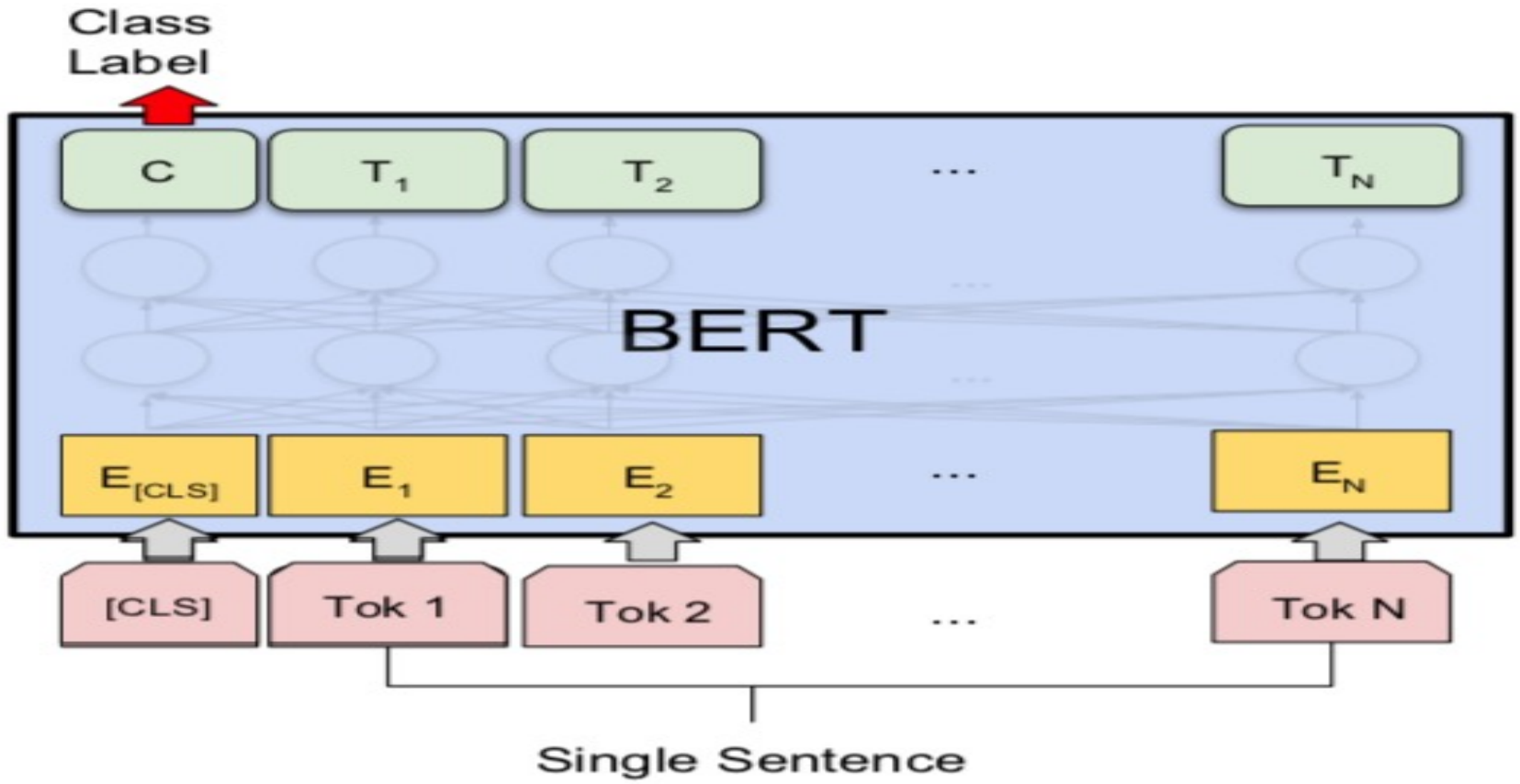
(c) Question Answering Tasks: SQuAD v1.1



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

Source: Devlin, Jacob, Ming-Wei Chang, Kenton Lee, and Kristina Toutanova (2018). "Bert: Pre-training of deep bidirectional transformers for language understanding." arXiv preprint arXiv:1810.04805.

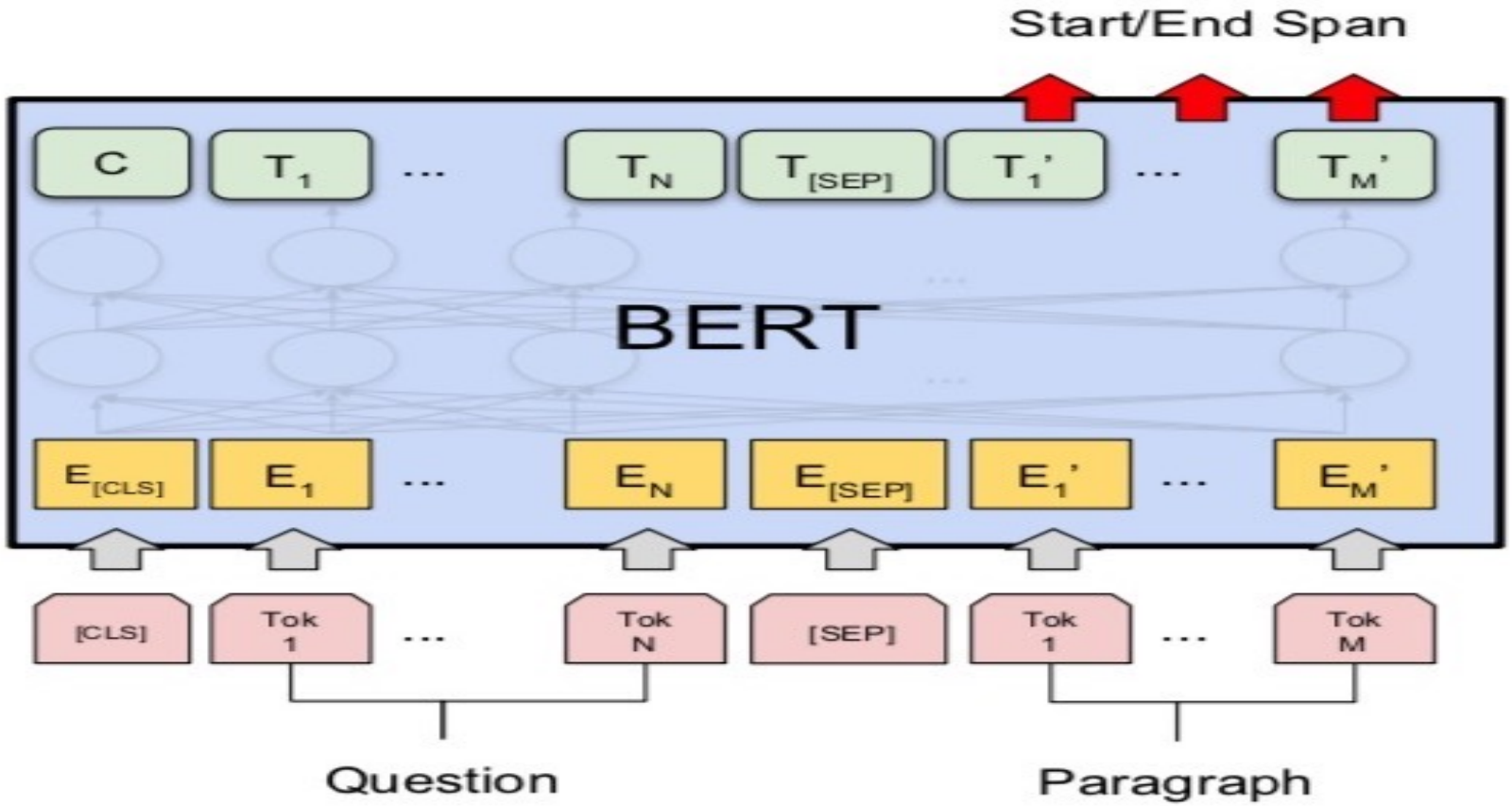
Sentiment Analysis: Single Sentence Classification



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

Source: Devlin, Jacob, Ming-Wei Chang, Kenton Lee, and Kristina Toutanova (2018). "BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding." arXiv preprint arXiv:1810.04805

Fine-tuning BERT on Question Answering (QA)

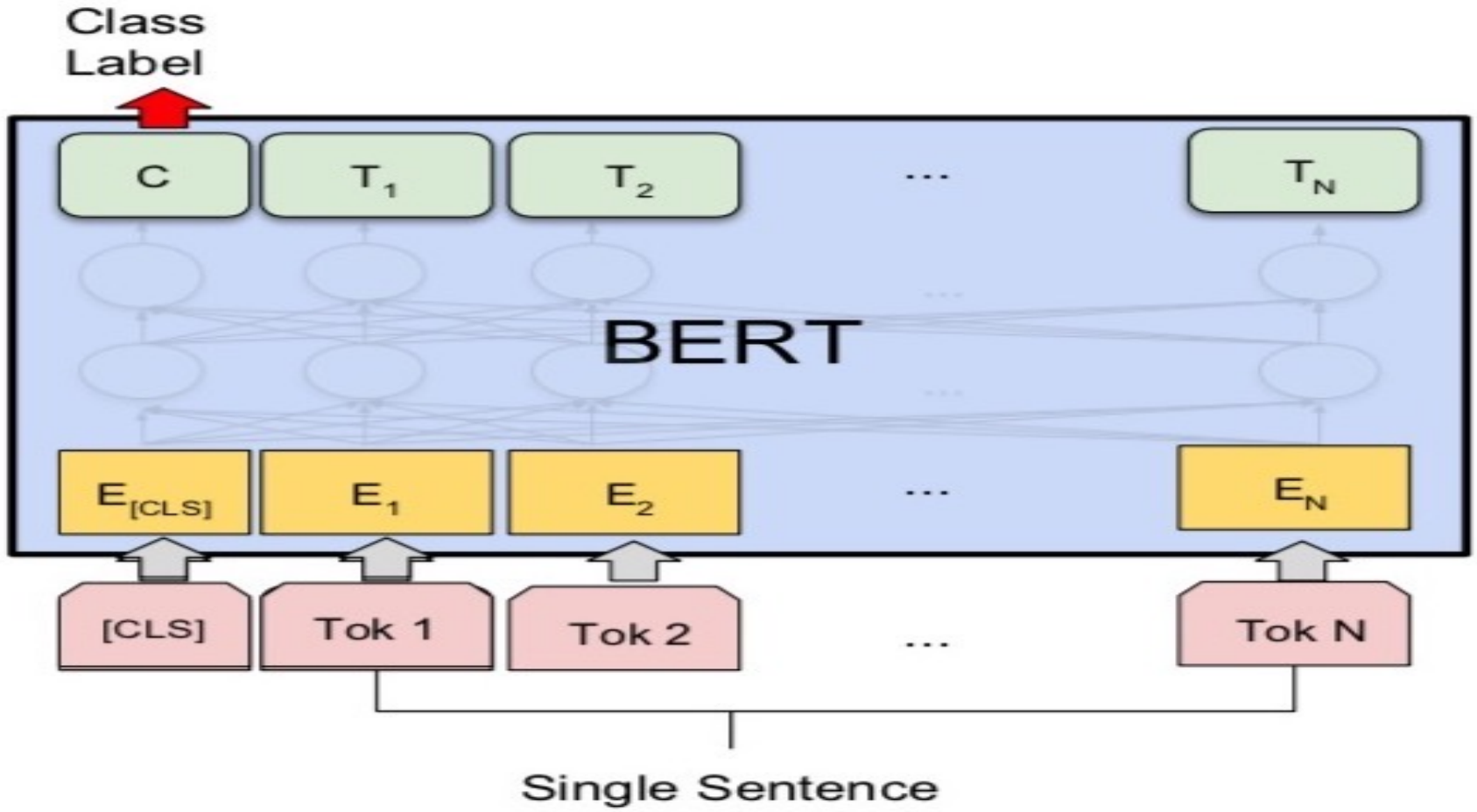


(c) Question Answering Tasks: SQuAD v1.1

Source: Devlin, Jacob, Ming-Wei Chang, Kenton Lee, and Kristina Toutanova (2018). "Bert: Pre-training of deep bidirectional transformers for language understanding." arXiv preprint arXiv:1810.04805.

Fine-tuning BERT on Dialogue

Intent Detection (ID; Classification)

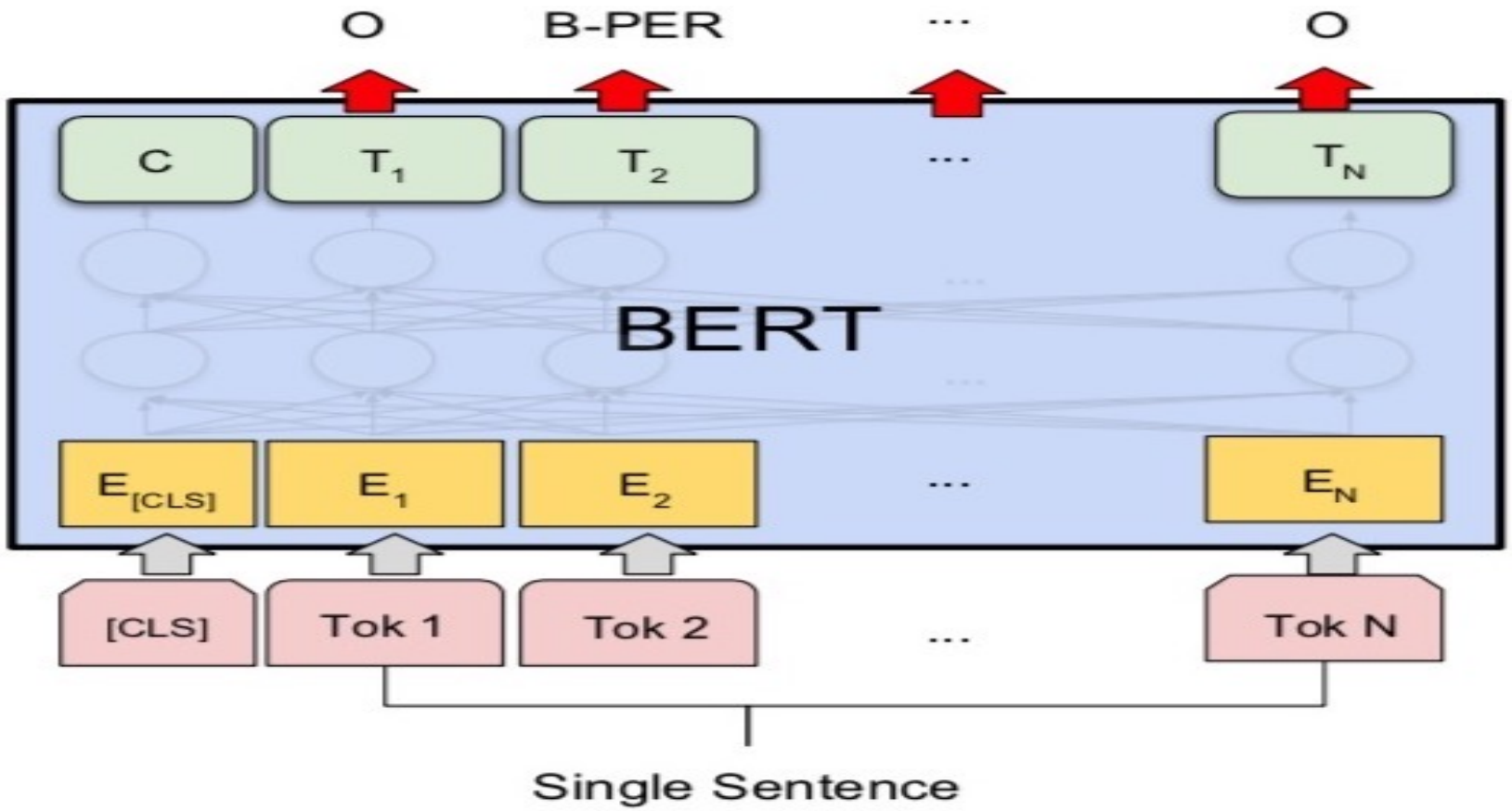


(b) Single Sentence Classification Tasks: SST-2, CoLA

Source: Devlin, Jacob, Ming-Wei Chang, Kenton Lee, and Kristina Toutanova (2018). "Bert: Pre-training of deep bidirectional transformers for language understanding." arXiv preprint arXiv:1810.04805.

Fine-tuning BERT on Dialogue

Slot Filling (SF)

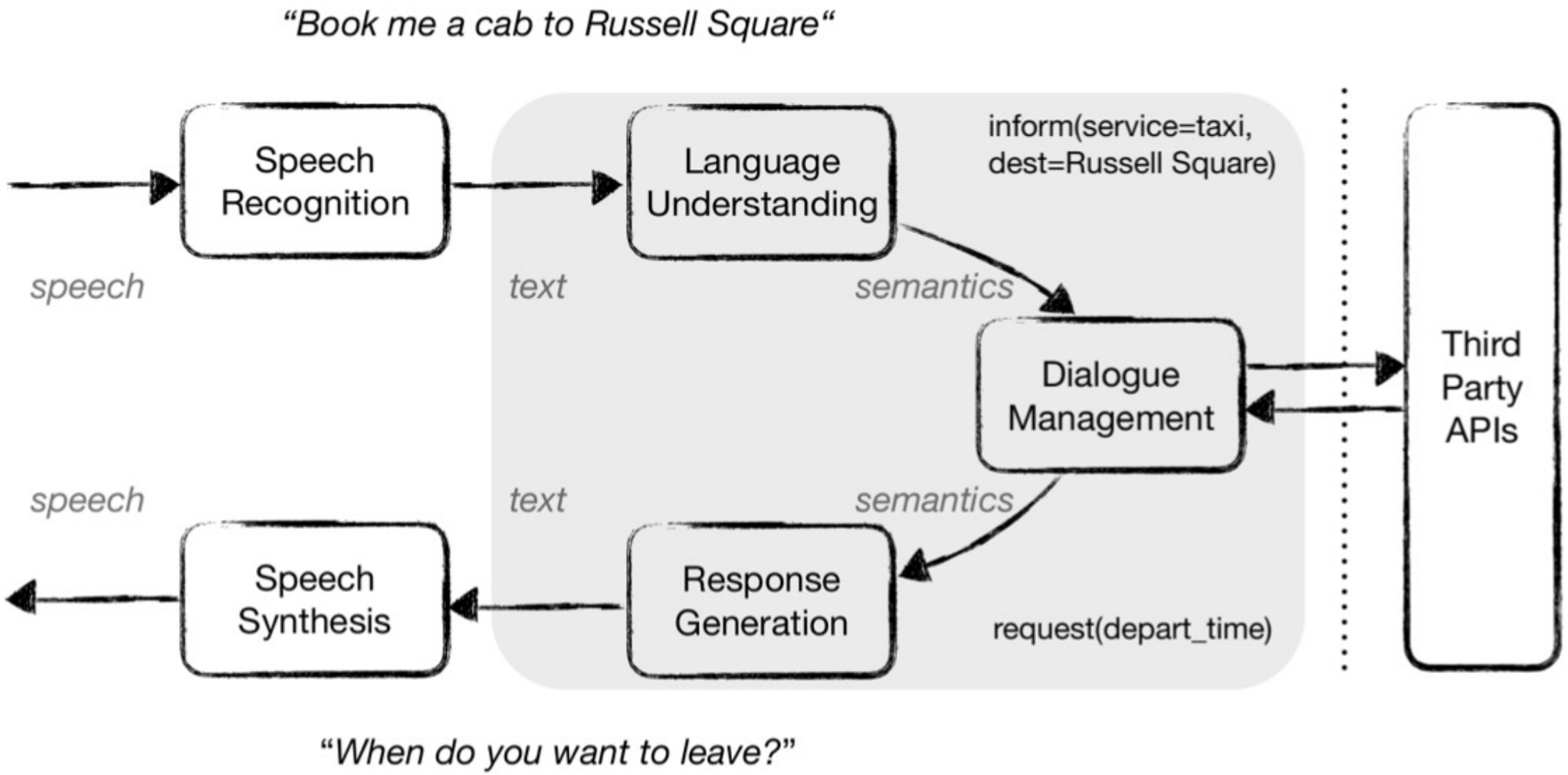


(d) Single Sentence Tagging Tasks: CoNLL-2003 NER

Source: Devlin, Jacob, Ming-Wei Chang, Kenton Lee, and Kristina Toutanova (2018). "Bert: Pre-training of deep bidirectional transformers for language understanding." arXiv preprint arXiv:1810.04805.

Task-Oriented Dialogue (ToD) System

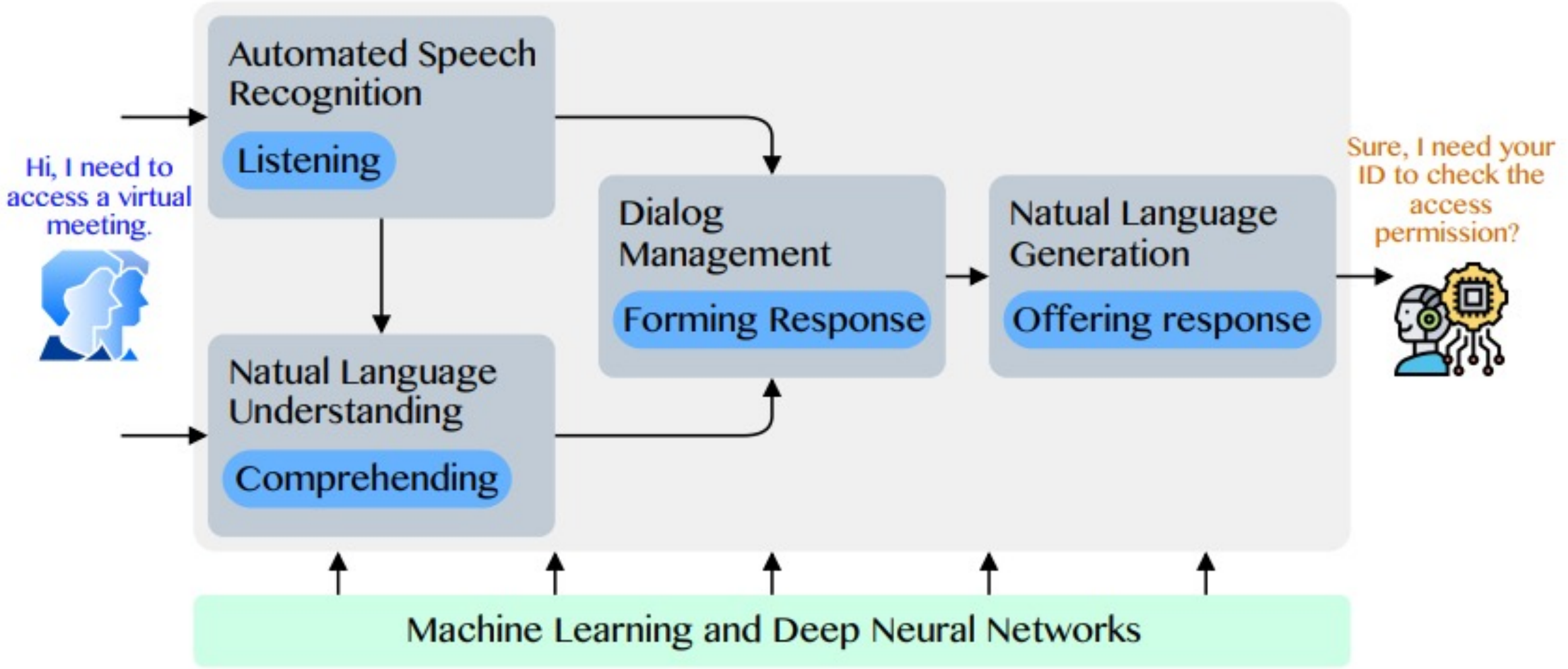
Speech, Text, NLP



Source: Razumovskaia, Evgeniia, Goran Glavas, Olga Majewska, Edoardo M. Ponti, Anna Korhonen, and Ivan Vulic. "Crossing the conversational chasm: A primer on natural language processing for multilingual task-oriented dialogue systems." Journal of Artificial Intelligence Research 74 (2022): 1351-1402.

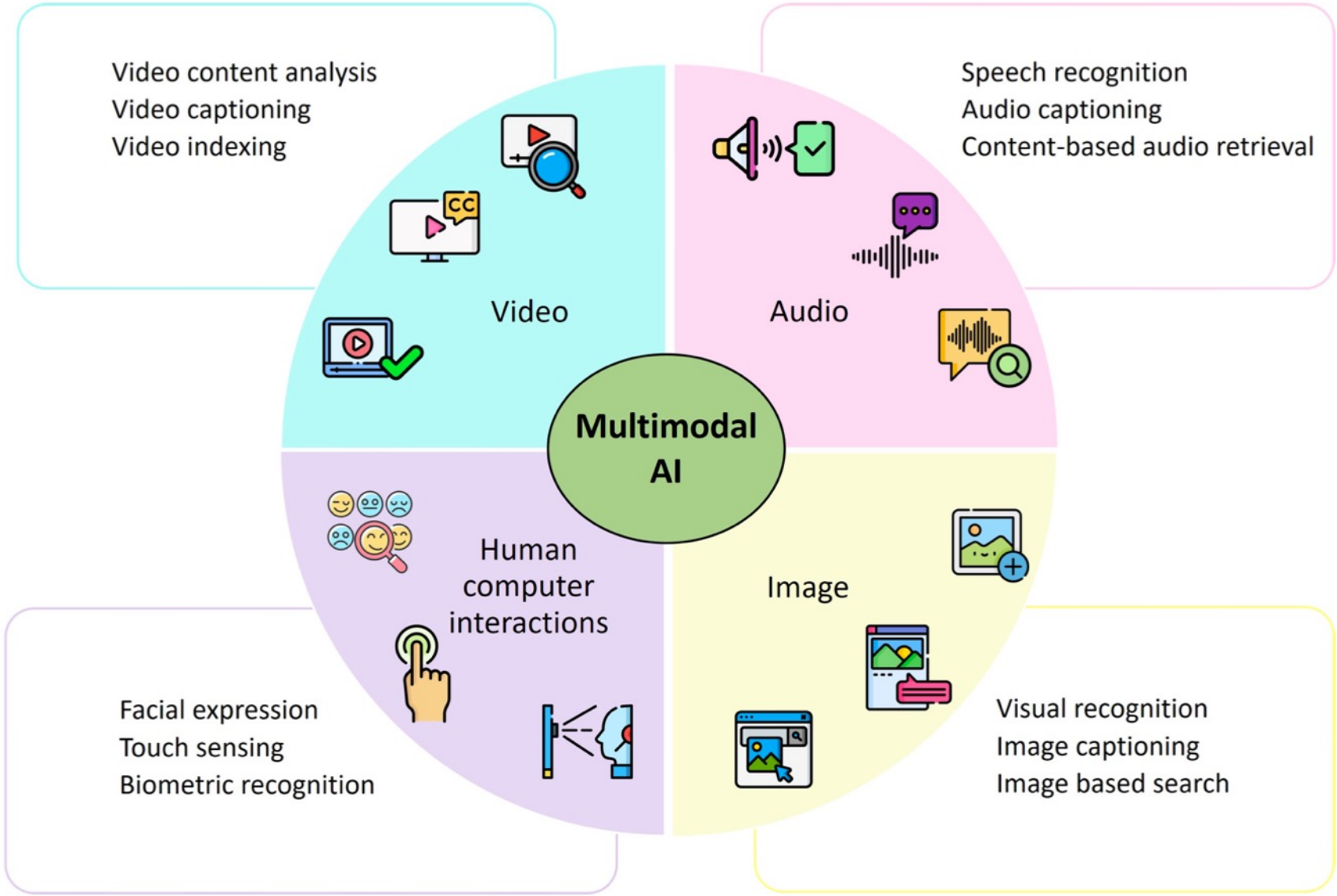
Conversational AI

to deliver contextual and personal experience to users



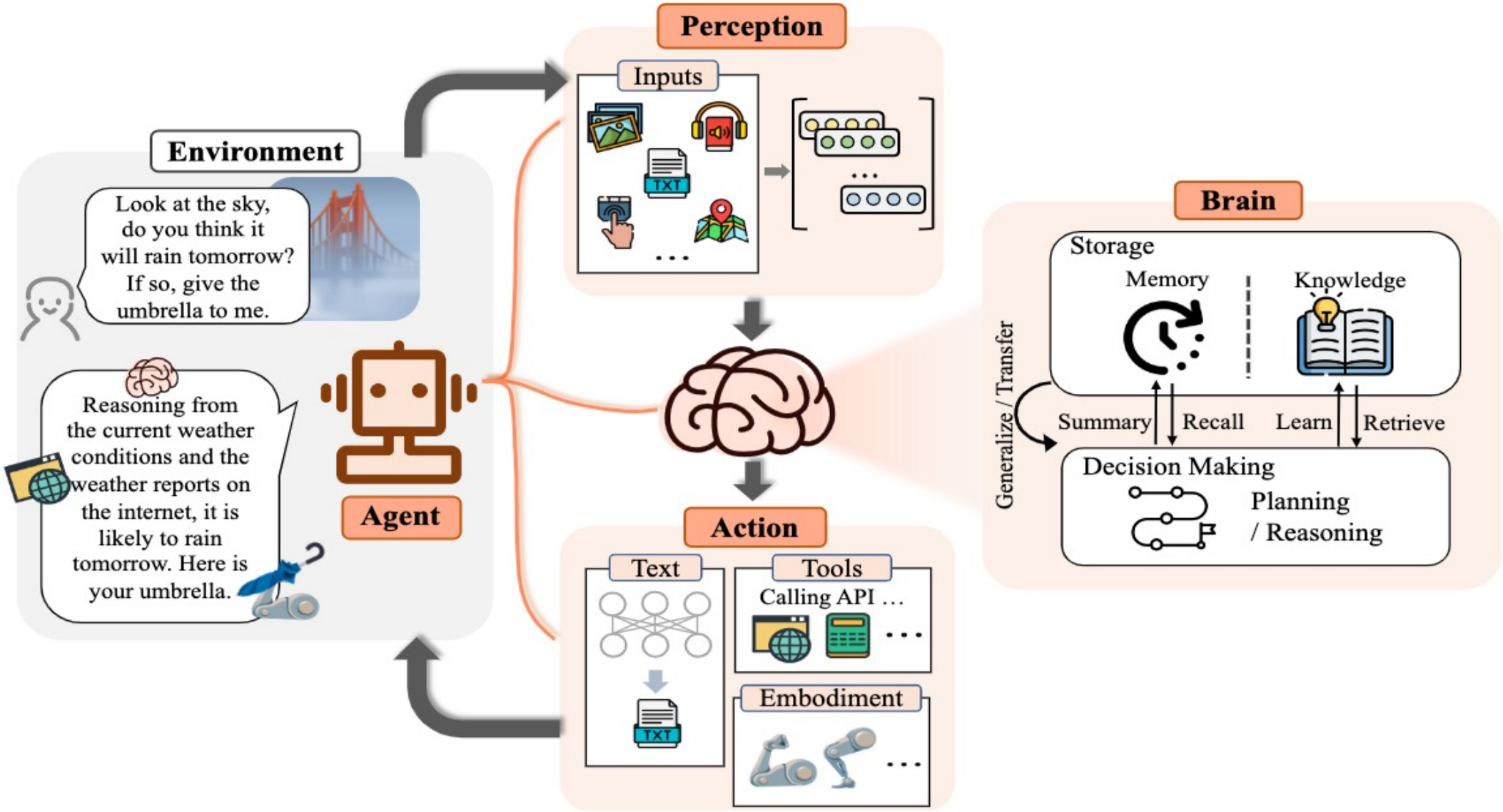
Source: Huynh-The, Thien, Quoc-Viet Pham, Xuan-Qui Pham, Thanh Thi Nguyen, Zhu Han, and Dong-Seong Kim (2022). "Artificial Intelligence for the Metaverse: A Survey." arXiv preprint arXiv:2202.10336.

Technological Integration for Multimodal AI



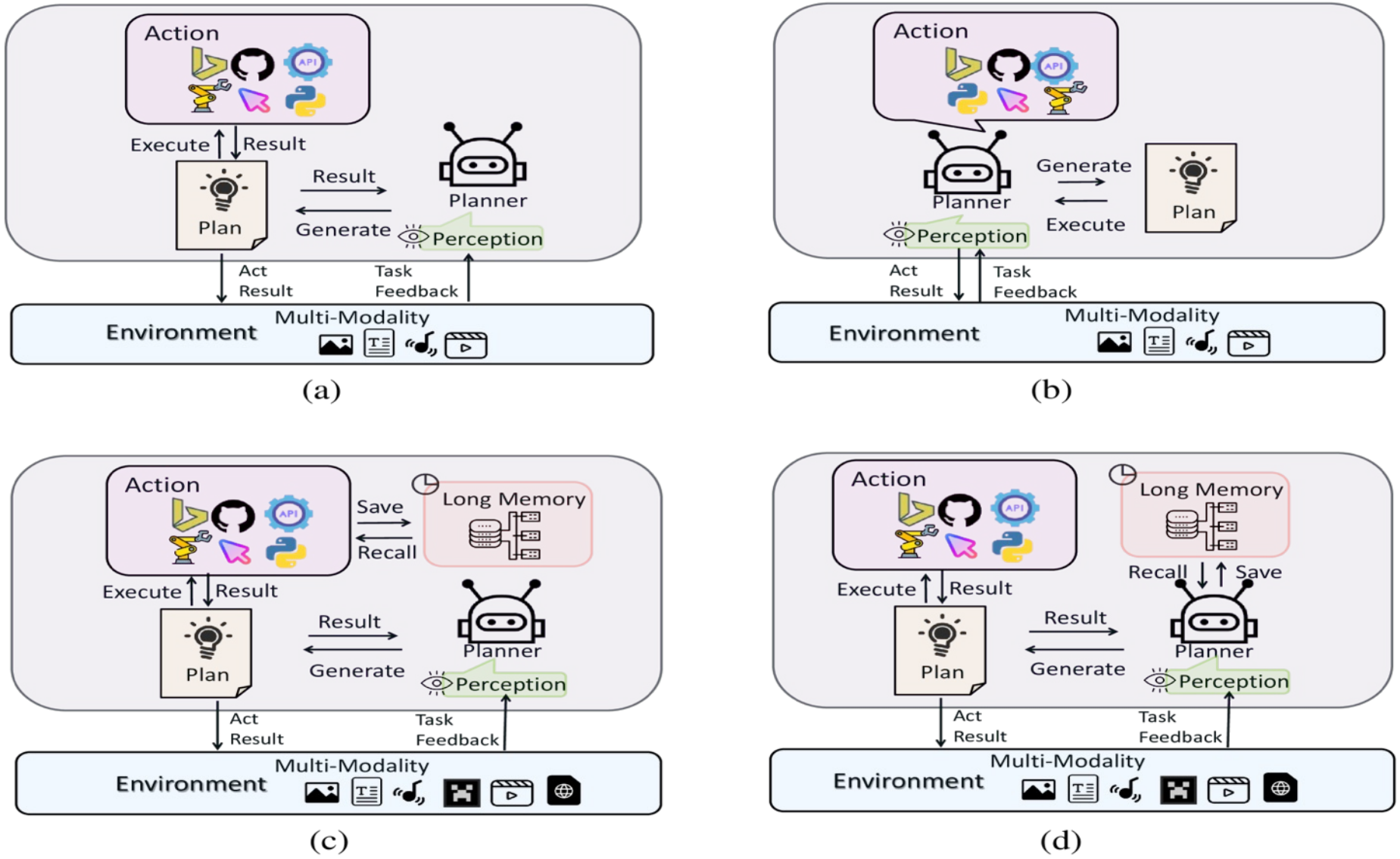
Source: Sohail, Shahab Saquib, Faiza Farhat, Yassine Himeur, Mohammad Nadeem, Dag Øivind Madsen, Yashbir Singh, Shadi Atalla, and Wathiq Mansoor. "The Future of GPT: A Taxonomy of Existing ChatGPT Research, Current Challenges, and Possible Future Directions." Current Challenges, and Possible Future Directions (April 8, 2023) (2023).

Large Language Model (LLM) based Agents



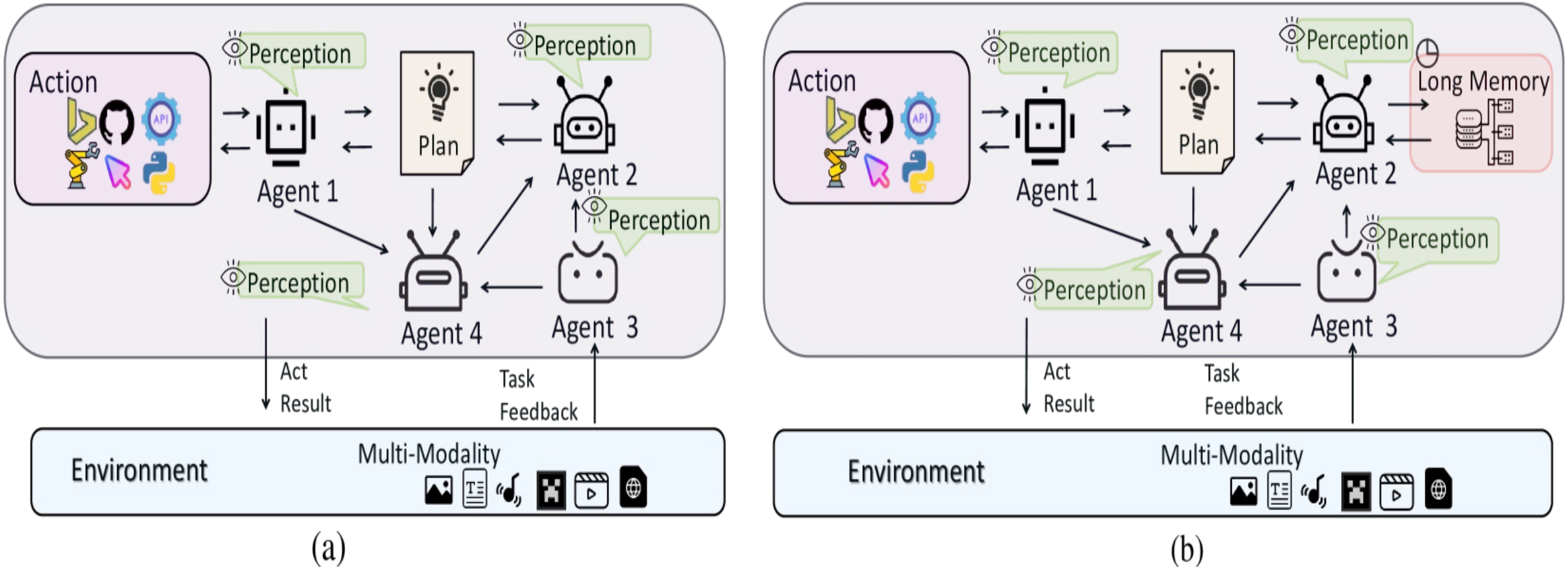
Source: Xi, Z., Chen, W., Guo, X., He, W., Ding, Y., Hong, B., ... & Gui, T. (2023). The rise and potential of large language model based agents: A survey. arXiv preprint arXiv:2309.07864.

Large Multimodal Agents (LMA)



Source: Xie, J., Chen, Z., Zhang, R., Wan, X., & Li, G. (2024). Large Multimodal Agents: A Survey. ArXiv, abs/2402.15116.

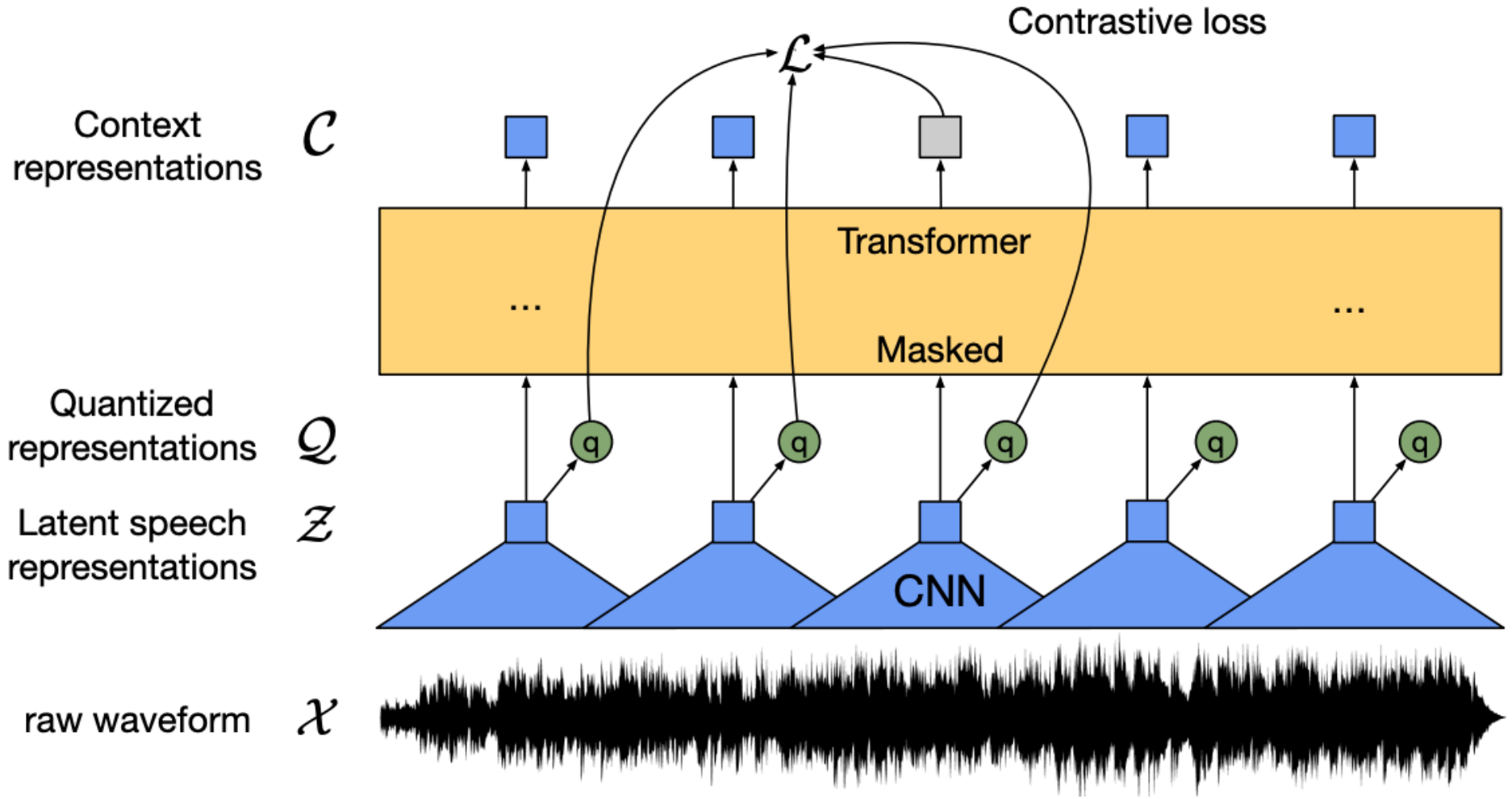
Large Multimodal Agents (LMA)



Source: Xie, J., Chen, Z., Zhang, R., Wan, X., & Li, G. (2024). Large Multimodal Agents: A Survey. ArXiv, abs/2402.15116.

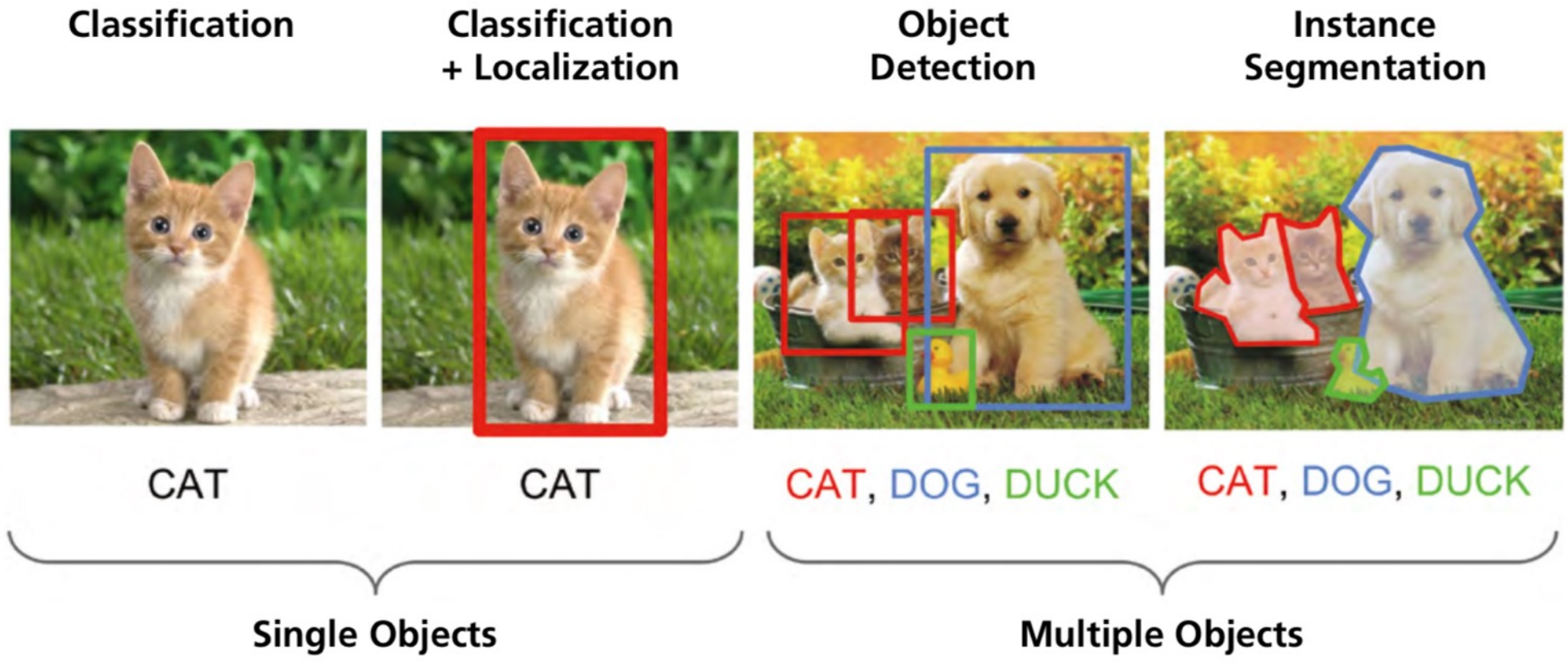
wav2vec 2.0:

A framework for self-supervised learning of speech representations



Source: Baevski, Alexei, Yuhao Zhou, Abdelrahman Mohamed, and Michael Auli.
"wav2vec 2.0: A framework for self-supervised learning of speech representations." Advances in Neural Information Processing Systems 33 (2020): 12449-12460.

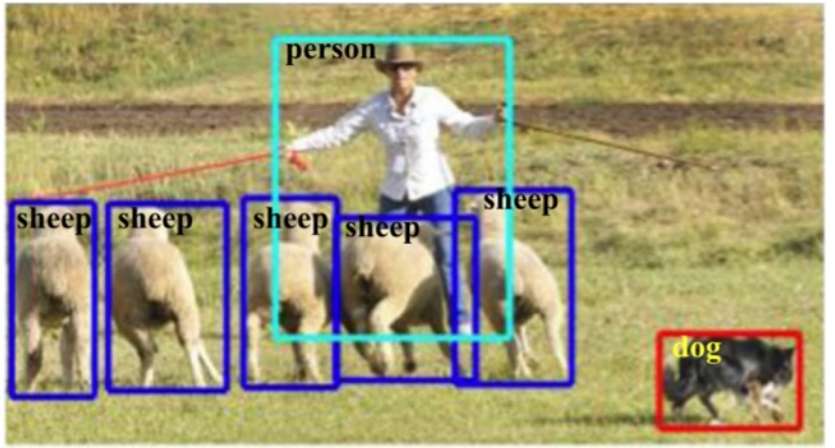
Computer Vision:
Image Classification, Object Detection, Object Instance Segmentation



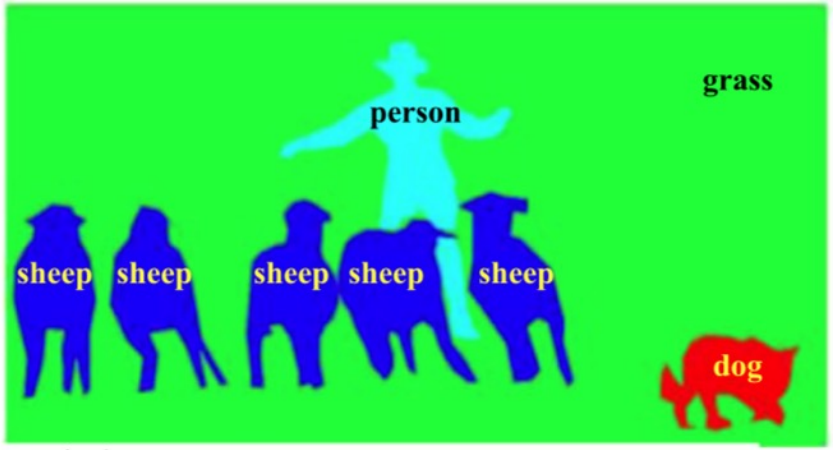
Source: DHL (2018), Artificial Intelligence in Logistics, http://www.globalhha.com/doclib/data/upload/doc_con/5e50c53c5bf67.pdf/

Computer Vision: Object Detection

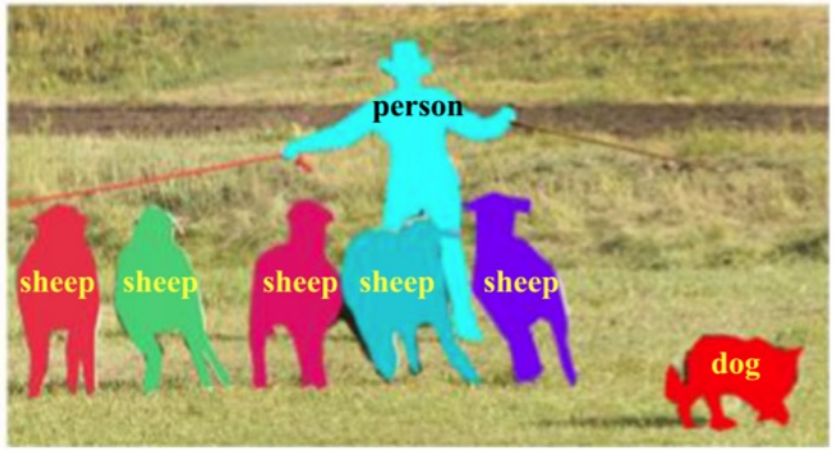
(a) Object Classification



(b) Generic Object Detection (Bounding Box)



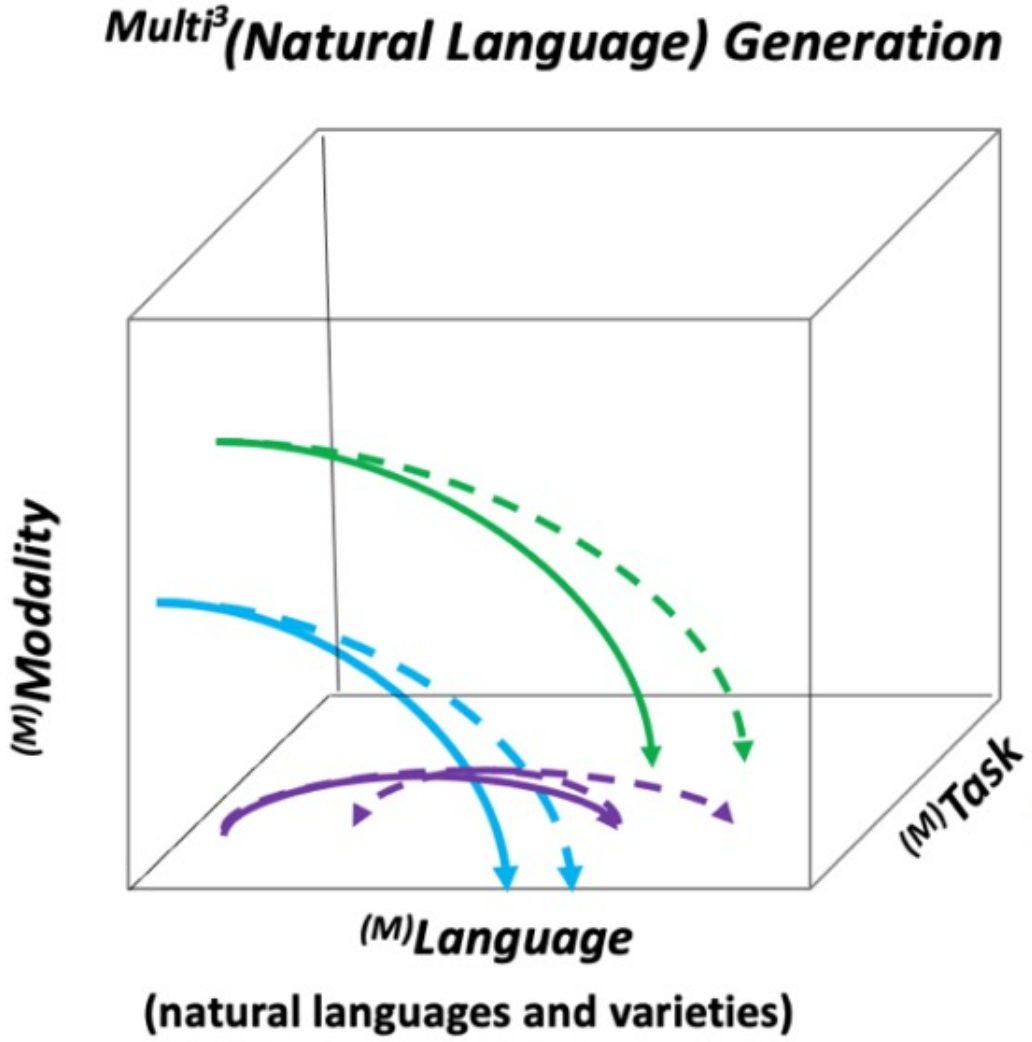
(c) Semantic Segmentation



(d) Object Instance Segmetation

Source: Li Liu, Wanli Ouyang, Xiaogang Wang, Paul Fieguth, Jie Chen, Xinwang Liu, and Matti Pietikäinen. "Deep learning for generic object detection: A survey." International journal of computer vision 128, no. 2 (2020): 261-318.

NLG from a Multilingual, Multimodal and Multi-task perspective

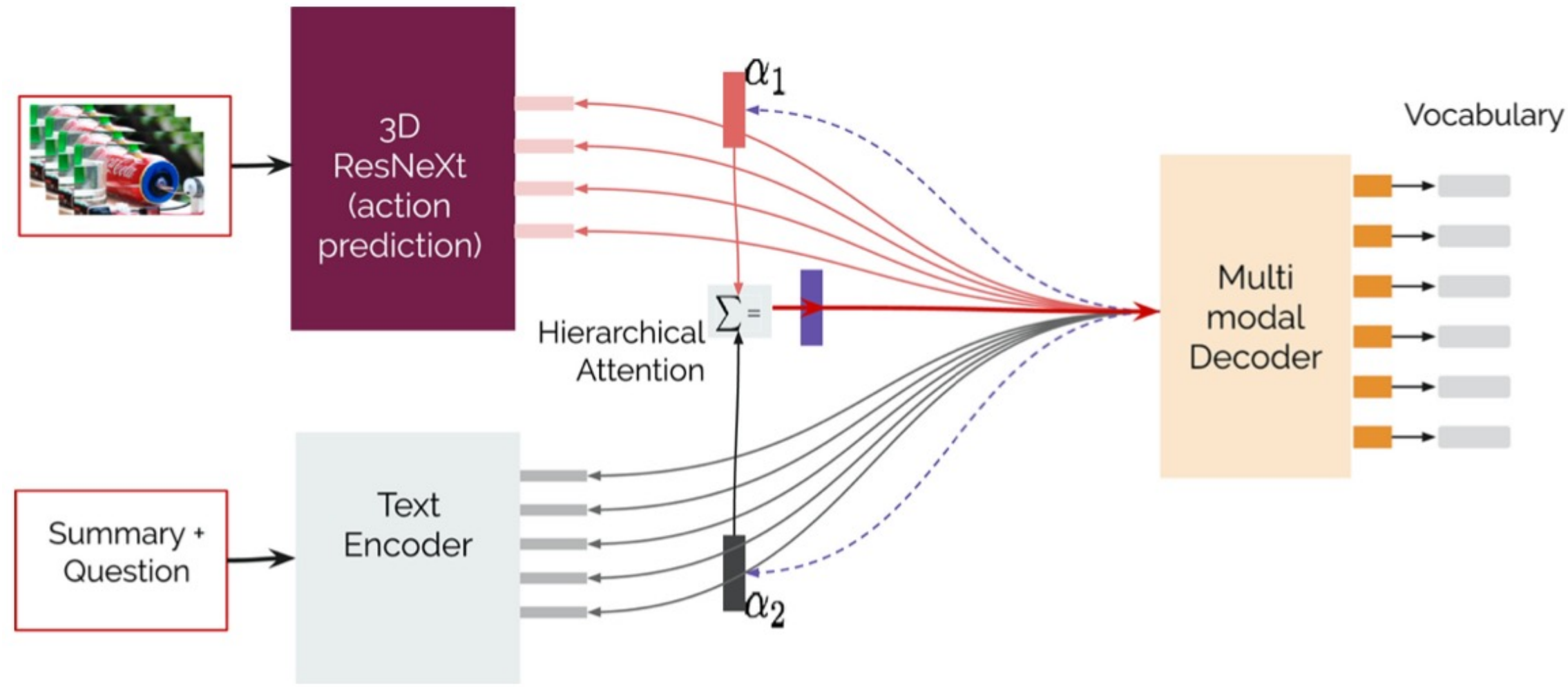


- Text
- Speech
- Vision

- 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, …)

Source: Erdem, Erkut, Menekse Kuyu, Semih Yagcioglu, Anette Frank, Letitia Parcalabescu, Barbara Plank, Andrii Babii et al. "Neural Natural Language Generation: A Survey on Multilinguality, Multimodality, Controllability and Learning." Journal of Artificial Intelligence Research 73 (2022): 1131-1207.

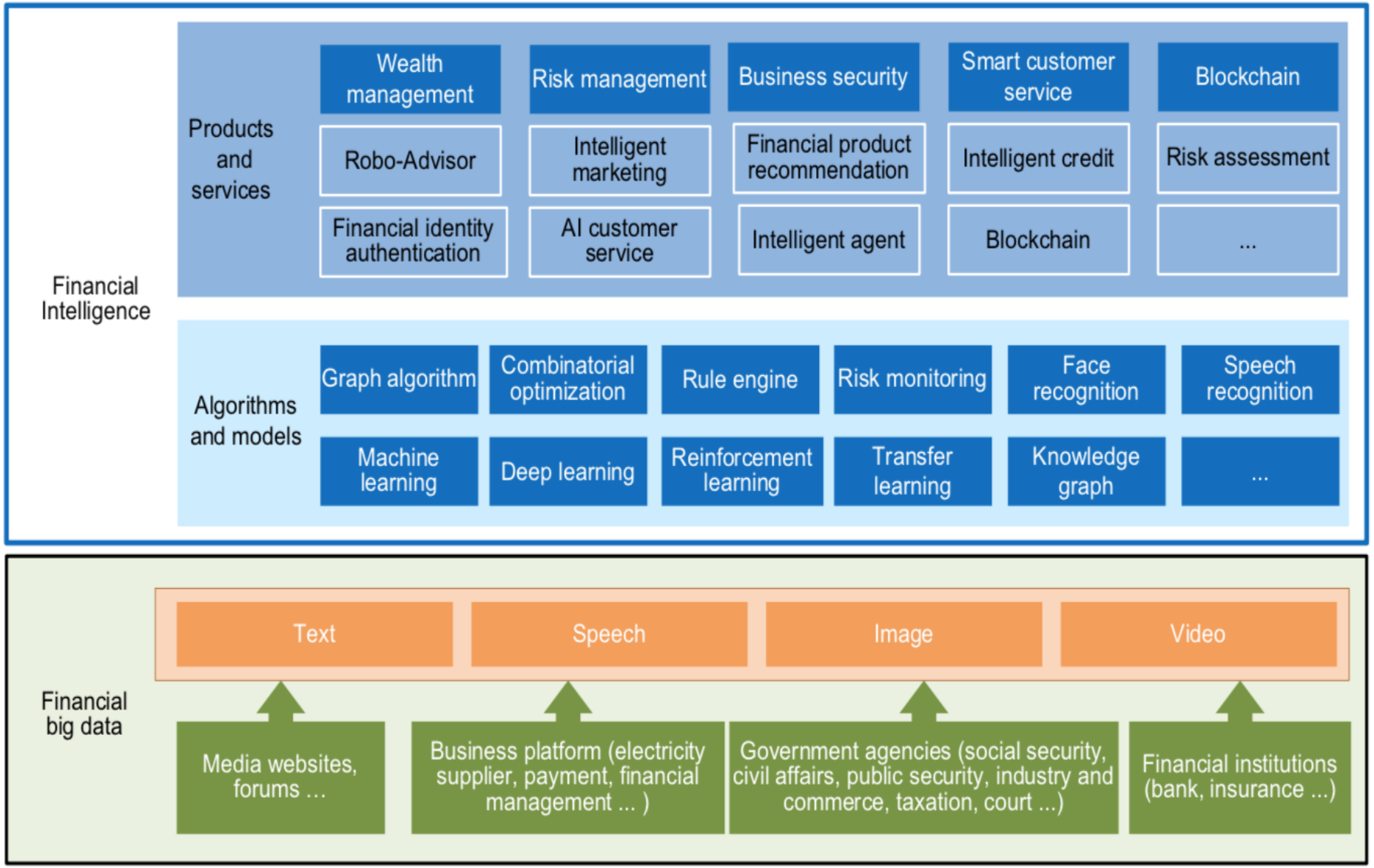
Text-and-Video Dialog Generation Models with Hierarchical Attention



Source: Erdem, Erkut, Menekse Kuyu, Semih Yagcioglu, Anette Frank, Letitia Parcalabescu, Barbara Plank, Andrii Babii et al. "Neural Natural Language Generation: A Survey on Multilinguality, Multimodality, Controllability and Learning." Journal of Artificial Intelligence Research 73 (2022): 1131-1207.

FinBrain: when Finance meets AI 2.0

(Zheng et al., 2019)



Source: Xiao-lin Zheng, Meng-ying Zhu, Qi-bing Li, Chao-chao Chen, and Yan-chao Tan (2019), "Finbrain: When finance meets AI 2.0." Frontiers of Information Technology & Electronic Engineering 20, no. 7, pp. 914-924

Technology-driven Financial Industry Development

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

Source: Xiao-lin Zheng, Meng-ying Zhu, Qi-bing Li, Chao-chao Chen, and Yan-chao Tan (2019), "Finbrain: When finance meets AI 2.0." Frontiers of Information Technology & Electronic Engineering 20, no. 7, pp. 914-924

Deep learning for financial applications: A survey

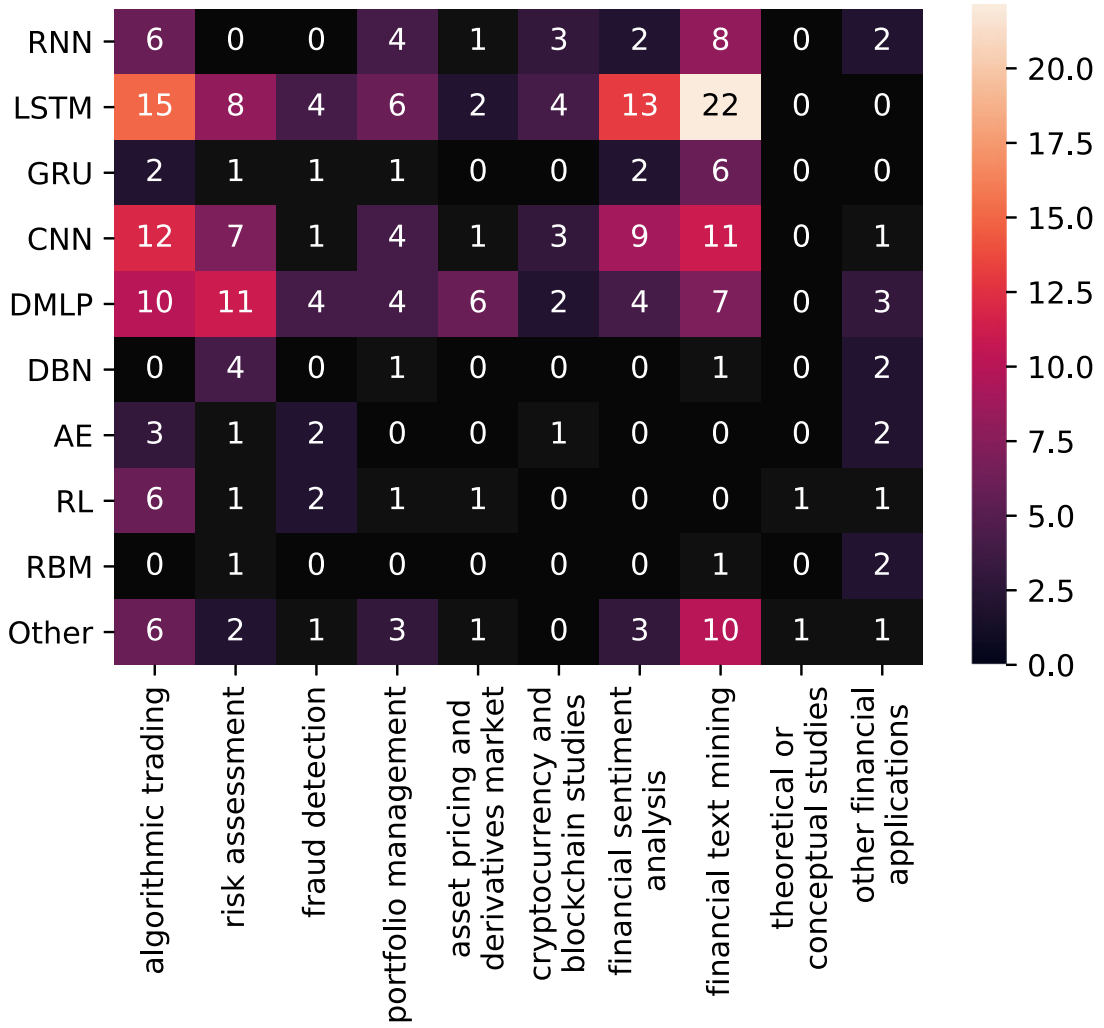
Applied Soft Computing (2020)

Source:
Ahmet Murat Ozbayoglu, Mehmet Ugur Gudelek, and Omer Berat Sezer (2020). "Deep learning for financial applications: A survey."
Applied Soft Computing (2020): 106384.

Financial time series forecasting with deep learning: A systematic literature review: 2005–2019 Applied Soft Computing (2020)

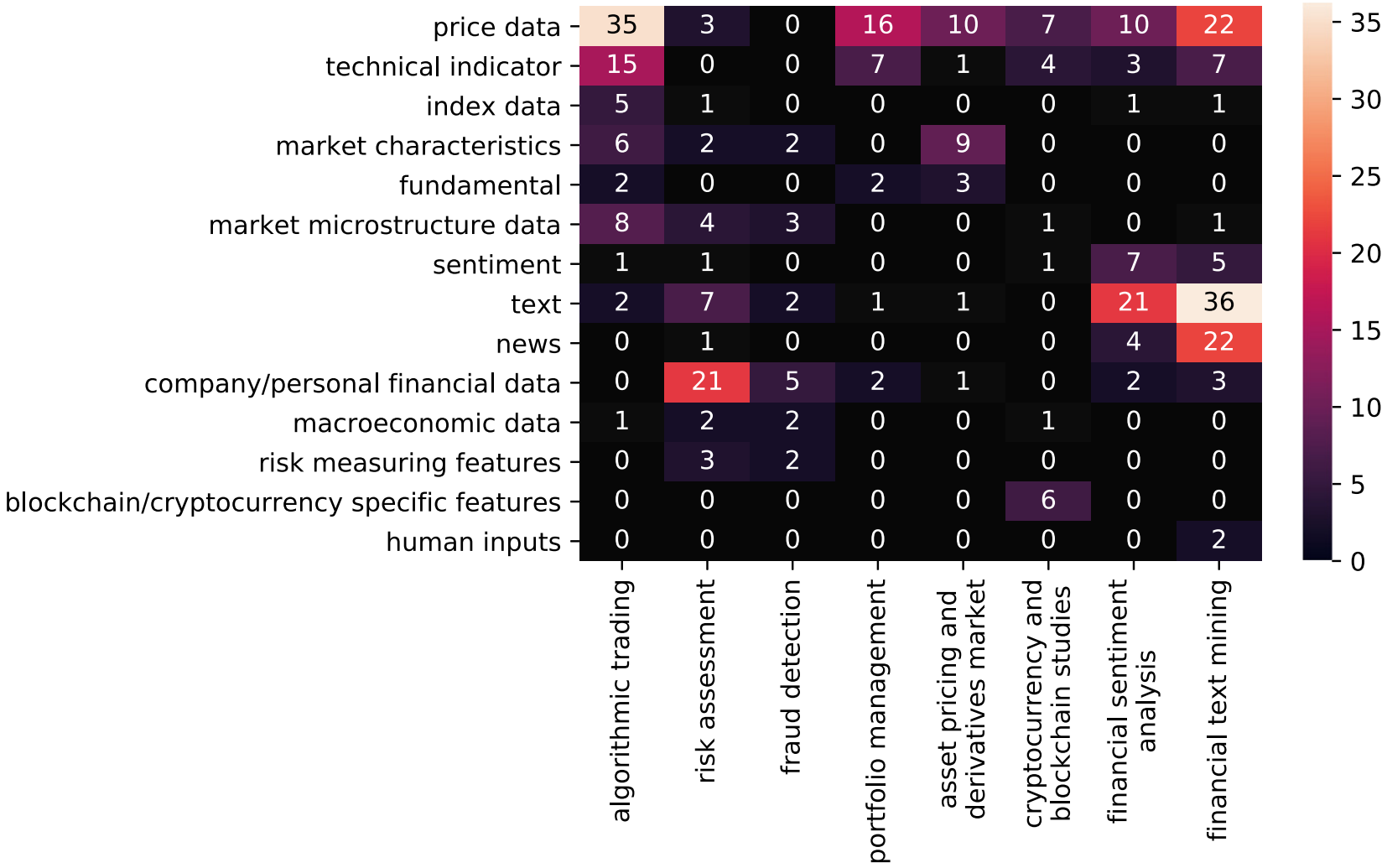
Source:
Omer Berat Sezer, Mehmet Ugur Gudelek, and Ahmet Murat Ozbayoglu (2020), "Financial time series forecasting with deep learning: A systematic literature review: 2005–2019." Applied Soft Computing 90 (2020): 106181.

Deep learning for financial applications: Topic-Model Heatmap



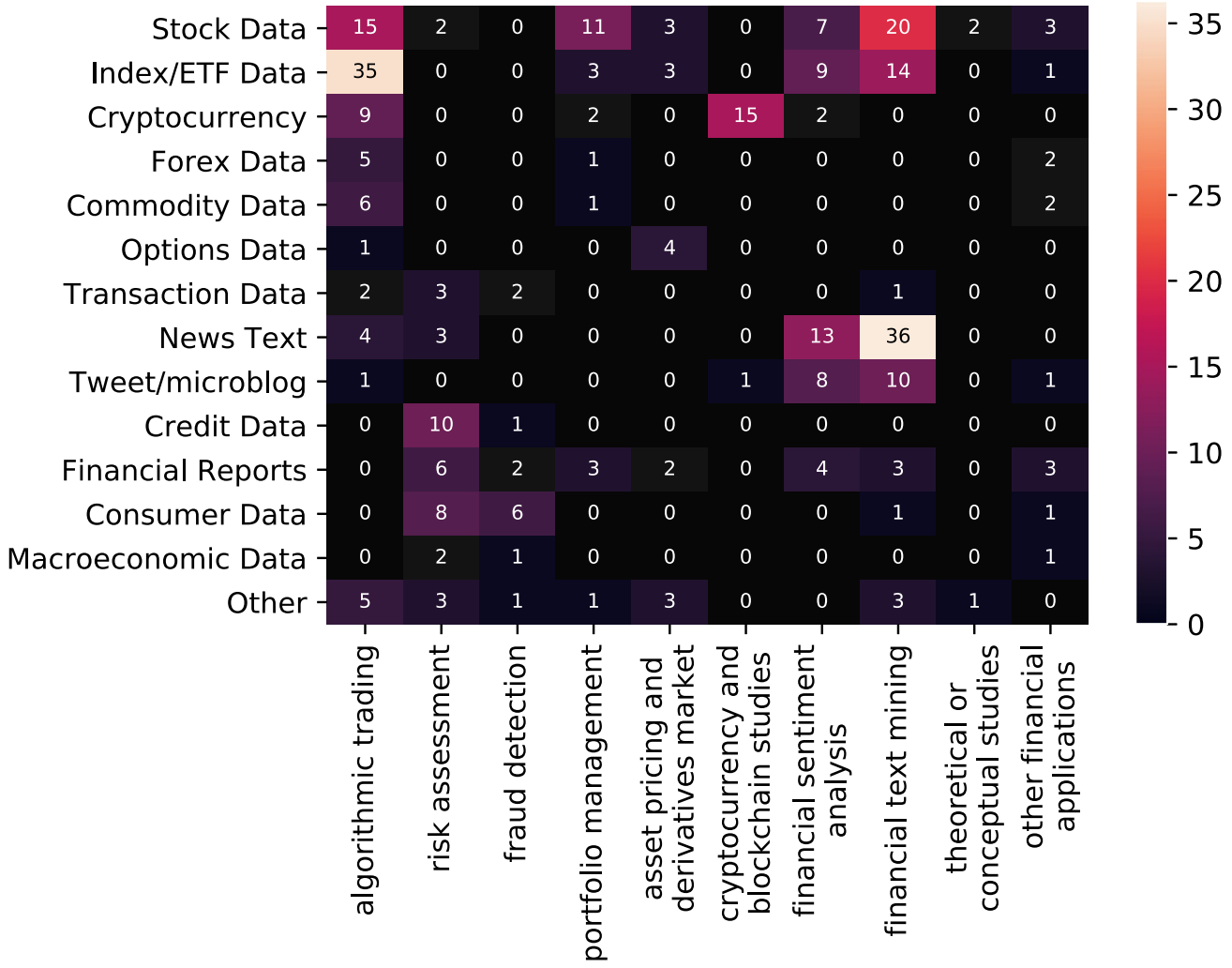
Source: Ahmet Murat Ozbayoglu, Mehmet Ugur Gudelek, and Omer Berat Sezer (2020). "Deep learning for financial applications: A survey." Applied Soft Computing (2020): 106384.

Deep learning for financial applications: Topic-Feature Heatmap



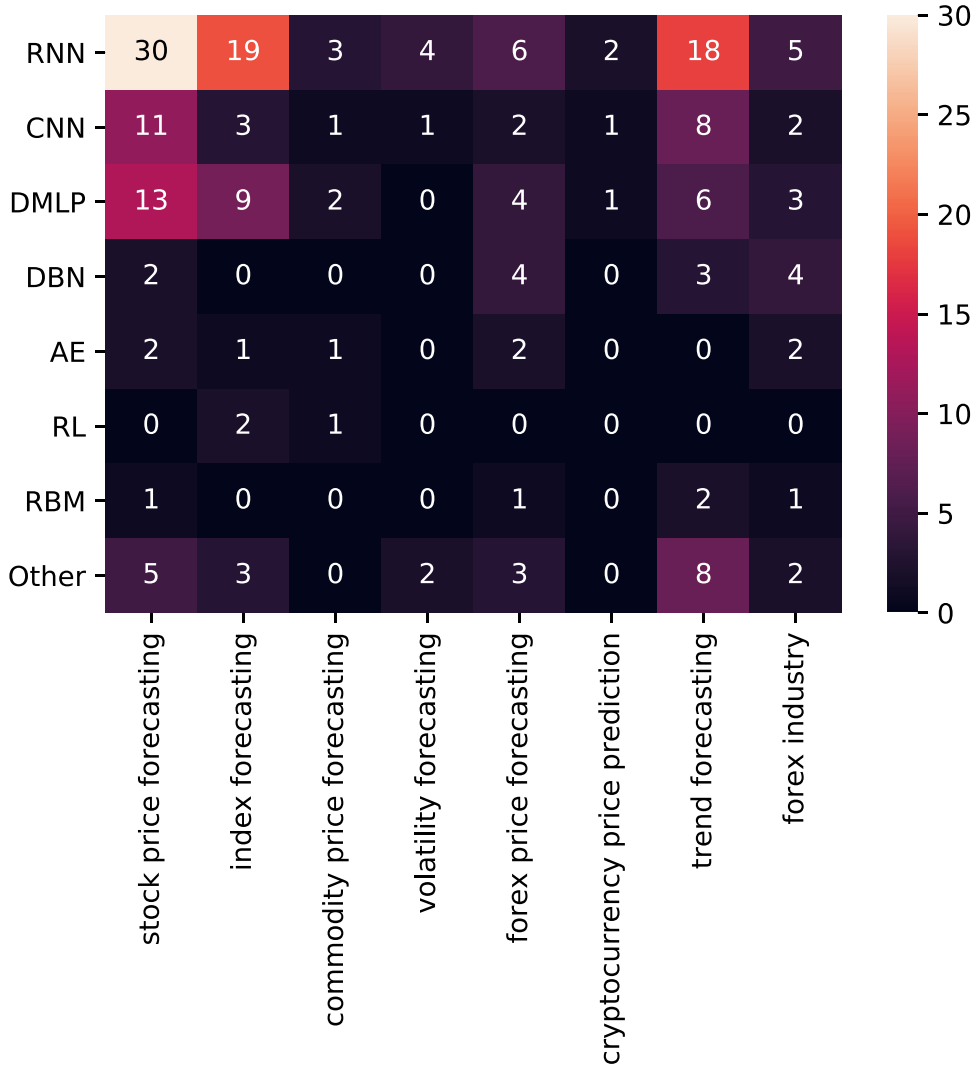
Source: Ahmet Murat Ozbayoglu, Mehmet Ugur Gudelek, and Omer Berat Sezer (2020). "Deep learning for financial applications: A survey." Applied Soft Computing (2020): 106384.

Deep learning for financial applications: Topic-Dataset Heatmap



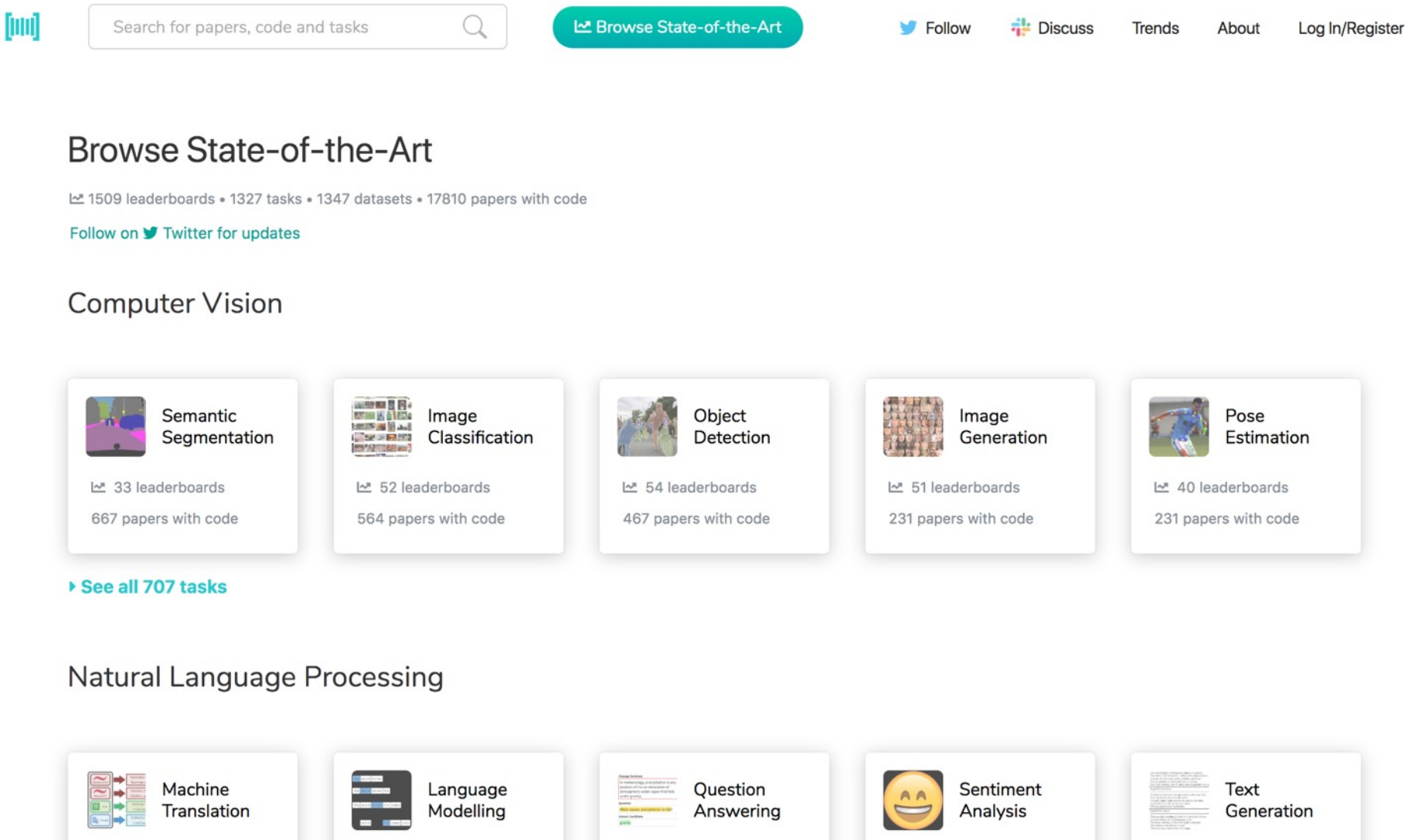
Source: Ahmet Murat Ozbayoglu, Mehmet Ugur Gudelek, and Omer Berat Sezer (2020). "Deep learning for financial applications: A survey." Applied Soft Computing (2020): 106384.

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



Source: Omer Berat Sezer, Mehmet Ugur Gudelek, and Ahmet Murat Ozbayoglu (2020), "Financial time series forecasting with deep learning: A systematic literature review: 2005–2019." Applied Soft Computing 90 (2020): 106181.

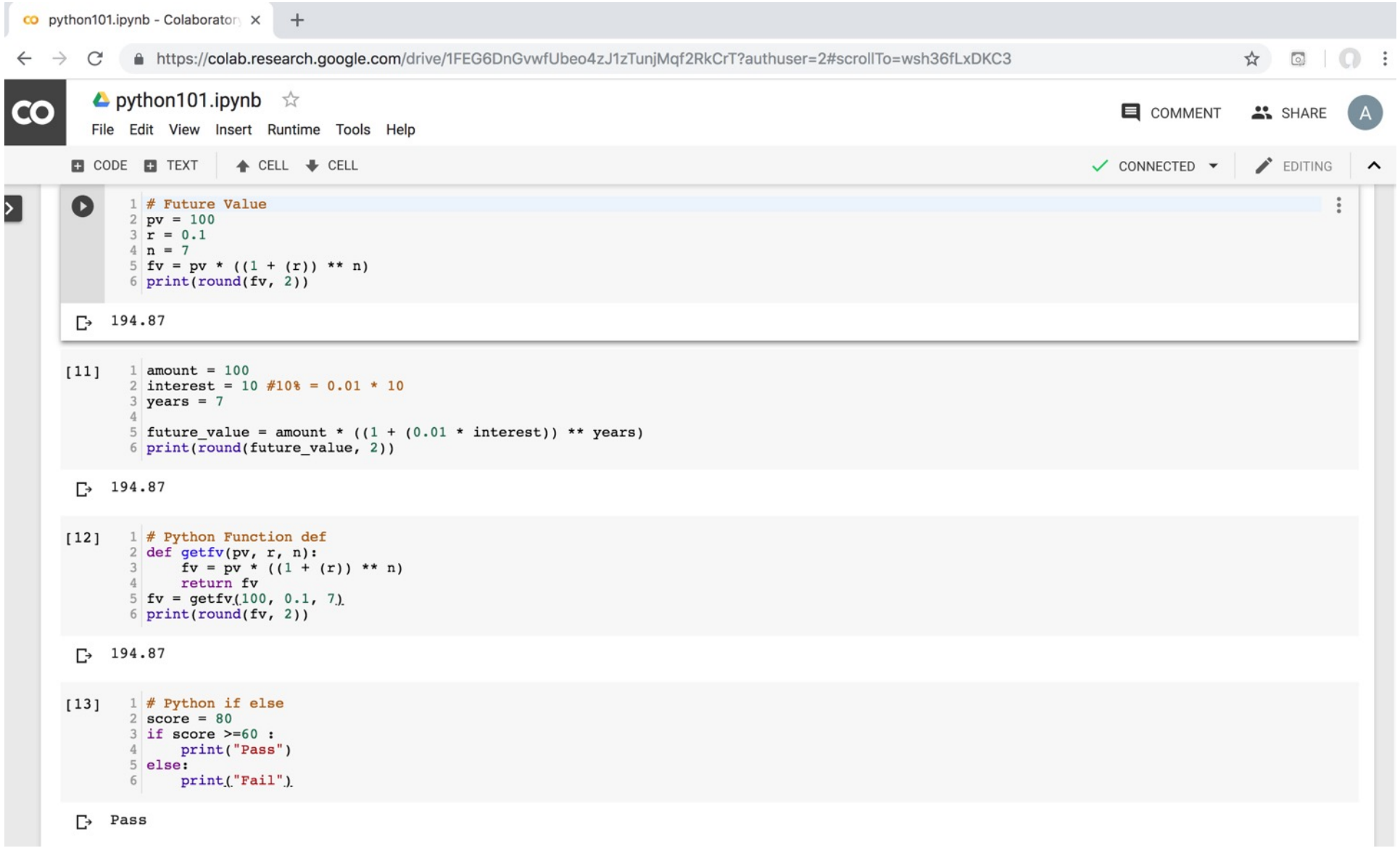
Papers with Code
State-of-the-Art (SOTA)



https://paperswithcode.com/sota

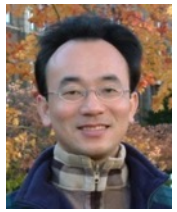
Python in Google Colab (Python101)

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



https://tinyurl.com/aintpupython101

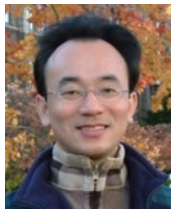
Teaching



- **Artificial Intelligence**
  - Spring 2021, Fall 2022, Fall 2024
- **Sustainability and ESG Data Analytics**
  - Spring 2024, Fall 2024
- **Big Data Analytics**
  - Fall 2020, Spring 2023, Spring 2024
- **Software Engineering**
  - Fall 2020, Fall, 2021, Spring 2022, Spring 2023, Spring 2024
- **Artificial Intelligence in Finance and Quantitative**
  - Fall 2021, Fall 2022, Fall 2023
- **Artificial Intelligence for Text Analytics**
  - Spring 2022, Fall 2023
- **Python for Accounting Applications**
  - Fall 2023, Fall 2024
- **Foundation of Business Cloud Computing**
  - Spring 2021, Spring 2022, Spring 2023, Spring 2024

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

Research Projects



1. **Fintech Green Finance for Carbon Market Index, Corporate Finance, and Environmental Policies.**
   Carbon Emission Sentiment Index with AI Text Analytics
   - NTPU, 113-NTPU_ORDA-F-003, 2023/01/01~2024/12/31
2. **Digital Support, Unimpeded Communication: The Development, Support and Promotion of AI-assisted Communication Assistive Devices for Speech Impairment (2/3).**
   Multimodal Cross-lingual Task-Oriented Dialogue System for Inclusive Communication Support
   - NSTC 113-2425-H-305-002-, 3 Years (2023/05/01-2026/04/30) Year 1: 2024/05/01~2025/04/30
3. **Research on speech processing, synthesis, recognition, and sentence construction of people with language disabilities.** Multimodal Cross-lingual Task-Oriented Dialogue System
   - NTPU, 113-NTPU_ORDA-F-004, 2023/01/01~2025/12/31
4. Metaverse AI Multimodal Cross-Language Task-Oriented Dialogue System
   - ATEC Group, Fintech and Green Finance Center (FGFC, NTPU), NTPU-112A413E01, 3 Years (2023/05/01~2026/04/30)
5. Generative AI-Driven ESG Report Generation Technology
   - Industrial Technology Research Institute (ITRI), Fintech and Green Finance Center (FGFC, NTPU), NTPU-113A513E01, 2024/03/01~2024/12/31
6. **Establishment and Implement of Smart Assistive Technology for Dementia Care and Its Socio-Economic Impacts (3/3).** Intelligent, individualized and precise care with smart AT and system integration
   - NSTC, 113-2627-M-038-001-, 2024/08/01~2025/07/31
7. Prospective longitudinal study on peri-implant bone loss associated with peri-implantitis
   - USTP (NTPU, TMU), USTP-NTPU-TMU-113-03, 2024/01/01~2024/12/31

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
  5. Uncertain Knowledge and Reasoning
  6. Machine Learning: Supervised and Unsupervised Learning
  7. The Theory of Learning and Ensemble Learning
  8. Deep Learning and Reinforcement Learning
  9. Deep Learning for Natural Language Processing
  10. Computer Vision and Robotics
  11. Generative AI, Philosophy and Ethics of AI and the Future of AI
  12. Case Study on AI

Artificial Intelligence

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國立臺北大學
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2020 Cohort

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Associate

aws certified
Cloud Practitioner

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