Career Paths for Researchers and Becoming a Research Scientist in AI

Teerapong Panboonyuen

https://kaopanboonyuen.github.io

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7. https://medium.com/@aryanjadon/image-classification-using-few-shot-learning-286572222b2d
8. https://www.thoughtco.com/scientific-method-p2-373335

Quick Dive Overview

- About Me
- My Journey into AI Research
- Balancing Academia and Industry
- The Cool Factor in Research
- Highlighted Publications
- Key Trends in AI Research

Slides: Career Paths for Researchers

You can download the slides
https://kaopanboonyuen.github.io/blog/2024-09-01-career-paths-for-ai-research-scientist/

Introduction

Teerapong Panboonyuen (Kao)

ธีรพงศ์ ปานบุญยืน (เก้า)

Education:

Ph.D. in Computer Engineering,

Chulalongkorn University

Current Positions:

Senior AI Research Scientist at MARS

Postdoctoral Fellow at Chulalongkorn University

About Me

Education and Career Path:

- Master's in Computer Engineering from Chulalongkorn University at age 24
- Ph.D. in Computer Engineering from Chulalongkorn University at age 27
- Postdoctoral Fellow in AI research from age 27 to the present, 31, focusing on innovative AI solutions.

Dual Career Path:

- ***Academic Side:*** Postdoctoral Fellow at Chulalongkorn University
- ***Industrial Side:*** Senior AI Research Scientist at MARS

scholar.google.co.th/citations?user=myy0qDgAAAAJ&hl=en

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Teerapong Panboonyuen

FOLLOW

Other names

Senior Research Scientist at MARS, Post-doc at Chula
Verified email at chula.ac.th - Homepage

AI Human-AI Interaction Pattern Recognition Computer Vision Remote Sensing

TITLE	CITED BY	YEAR
Road segmentation of remotely-sensed images using deep convolutional neural networks with landscape metrics and conditional random fields T Panboonyuen, K Jitkajornwanich, S Lawawirojwong, P Srestasathiern, ... Remote Sensing 9 (7), 680	137	2017
Semantic segmentation on remotely sensed images using an enhanced global convolutional network with channel attention and domain specific transfer learning T Panboonyuen, K Jitkajornwanich, S Lawawirojwong, P Srestasathiern, ... Remote Sensing 11 (1), 83	108	2019
An enhanced deep convolutional encoder-decoder network for road segmentation on aerial imagery T Panboonyuen, P Vateekul, K Jitkajornwanich, S Lawawirojwong Recent Advances in Information and Communication Technology 2017 ...	48	2018
Transformer-based decoder designs for semantic segmentation on remotely sensed images T Panboonyuen, K Jitkajornwanich, S Lawawirojwong, P Srestasathiern, ... Remote Sensing 13 (24), 5100	47	2021
Object detection of road assets using transformer-based YOLOX with feature pyramid decoder on thai highway panorama T Panboonyuen, S Thongbai, W Wongweeranimit, P Santitamnont, ... Information 13 (1), 5	20	2021

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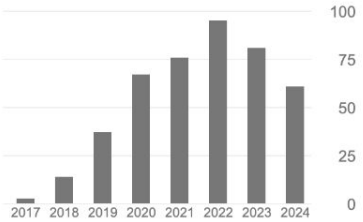

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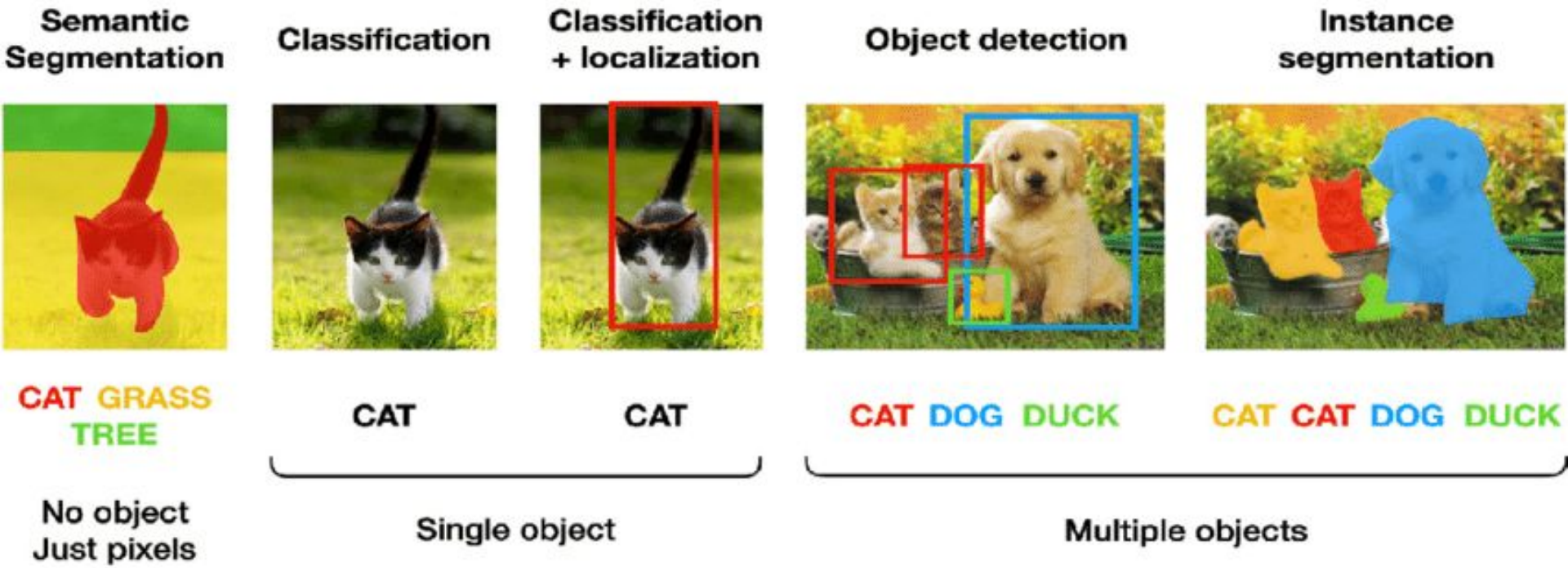
What Is Computer Vision? [Basic Tasks & Techniques]

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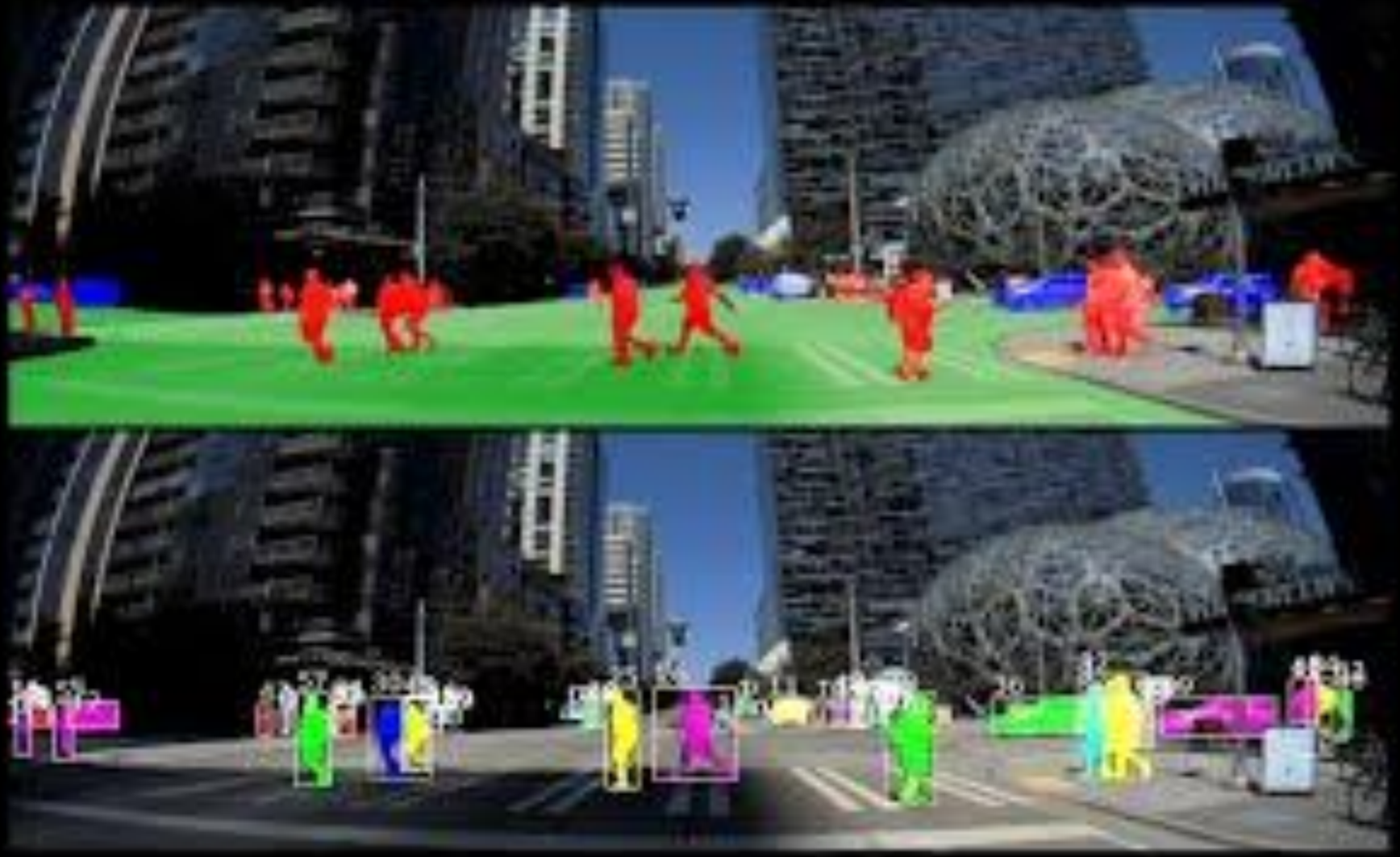


Passion for Both Worlds

“ Theoretical charm of academia meets the practical impact of industry”
“The synergy between theory and deployment creates more impactful solutions”

Kao Panboonyuen

Why I Chose AI Research

Passion for AI: Fascination with how AI can transform industries and enhance human capabilities.

Areas of Interest: Remote Sensing and Computer Vision.

Personal Enjoyment: Researching AI keeps me engaged and passionate because of the constantly evolving challenges and opportunities.

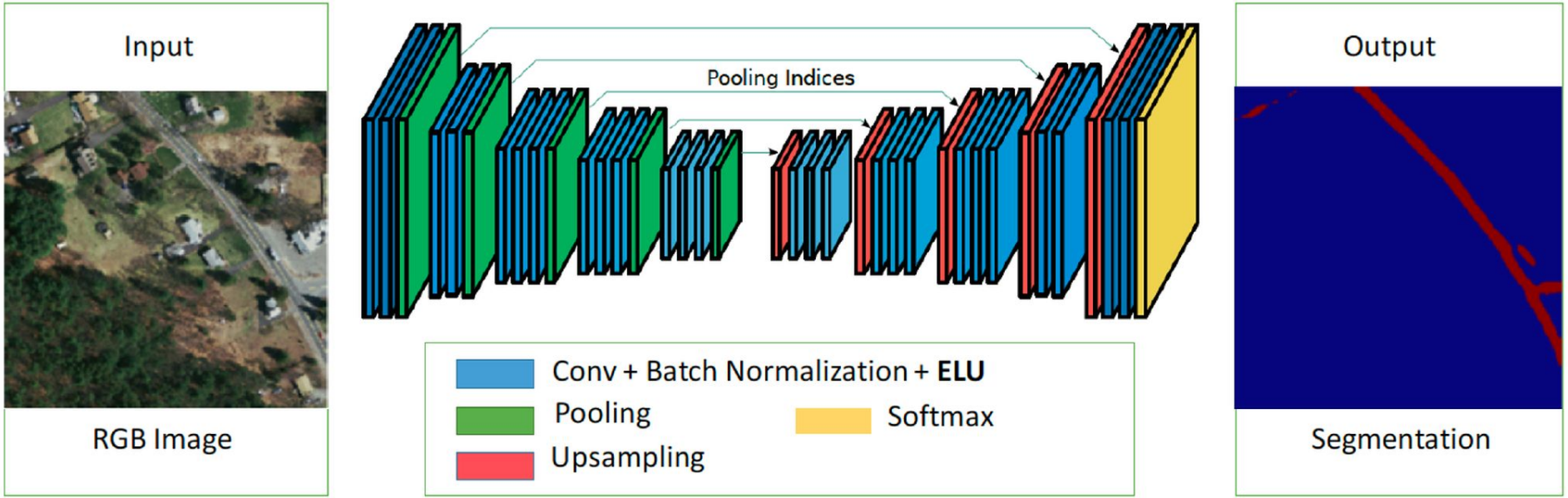
The Charm of AI in Remote Sensing

Definition: Using AI to analyze satellite imagery for valuable insights.

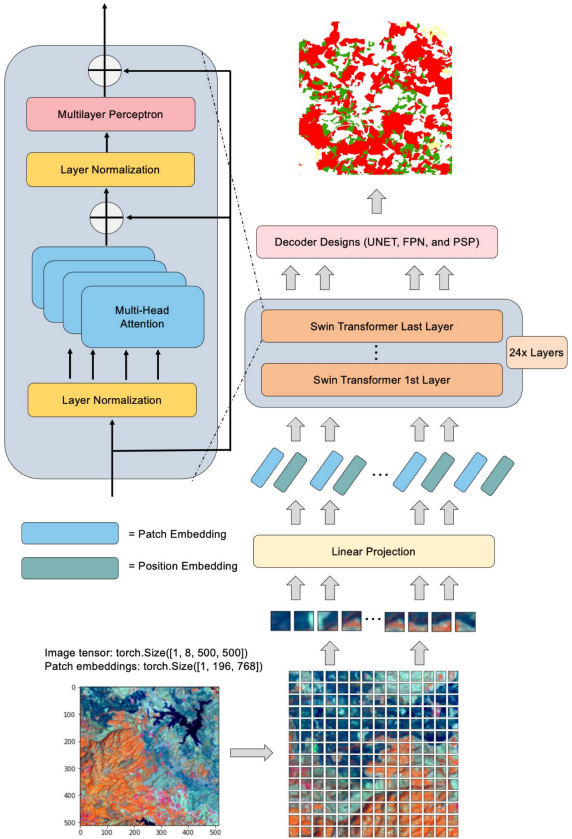
Example: Land Use/Land Cover (LULC) analysis for agriculture in Thailand.

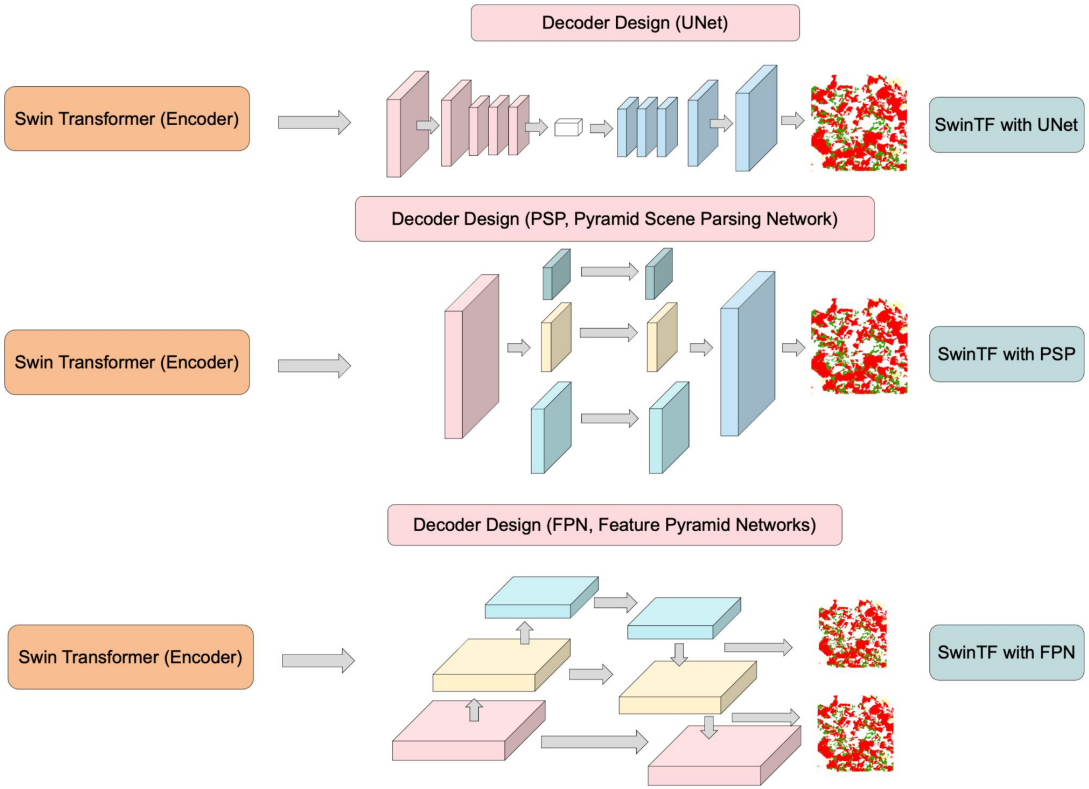
Impact: Transforming how we manage natural resources and monitor environmental changes.

Panboonyuen, Teerapong, et al. **"Road segmentation of remotely-sensed images using deep convolutional neural networks with landscape metrics and conditional random fields."** Remote Sensing 9.7 (2017): 680.



Panboonyuen, Teerapong, et al. **"Transformer-based decoder designs for semantic segmentation on remotely sensed images."** Remote Sensing 13.24 (2021): 5100.





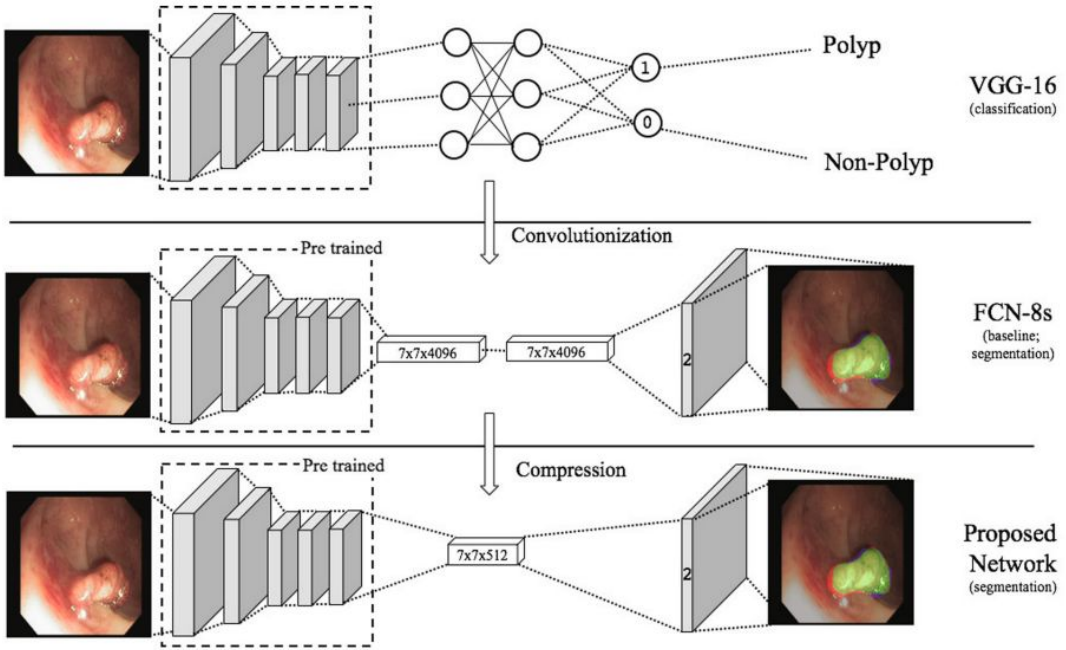
The Charm of AI in Medical Applications

Example: Using AI to assist in medical imaging, such as detecting polyps in colonoscopy images.

Benefits: Enhancing accuracy beyond current standards, providing life-saving early detection.

Humanitarian Aspect: AI helps save lives and improve healthcare outcomes.

Wichakam, I., **Panboonyuen, T.,** Udomcharoenchaikit, C., & Vateekul, P. (2018). **Real-time polyps segmentation for colonoscopy video frames using compressed fully convolutional network.** In MultiMedia Modeling: 24th International Conference, MMM 2018, Bangkok, Thailand, February 5-7, 2018, Proceedings, Part I 24 (pp. 393-404). Springer International Publishing.



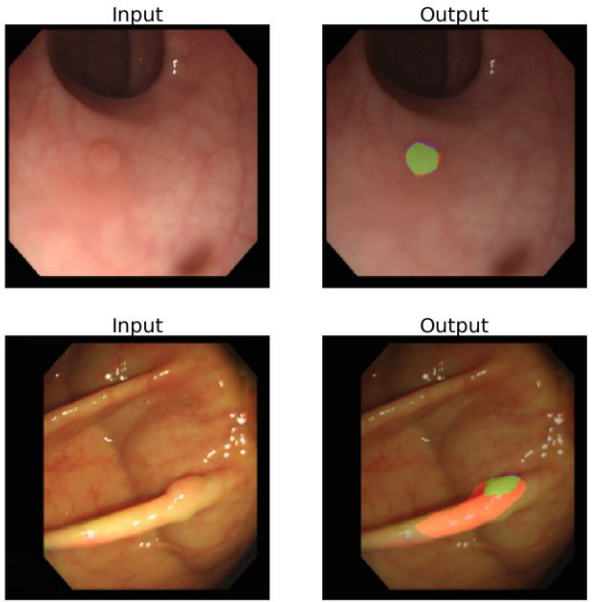


Fig. 1. Overview of our compressed network which is compressed from the original FCN-8s [8] based on VGG-16 [4] architecture.

Thitisiriwech, K., **Panboonyuen, T.**, Kantavat, P., Iwahori, Y., & Kijsirikul, B. (2022). **The Bangkok Urbanscapes Dataset for Semantic Urban Scene Understanding Using Enhanced Encoder-Decoder With Atrous Depthwise Separable A1 Convolutional Neural Networks.** IEEE Access, 10, 59327-59349.

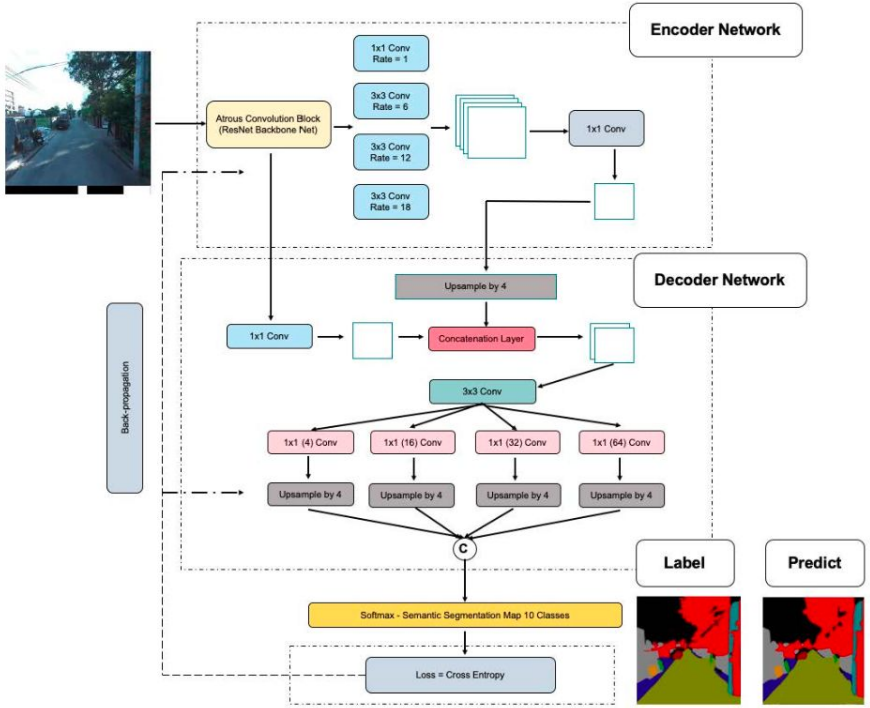
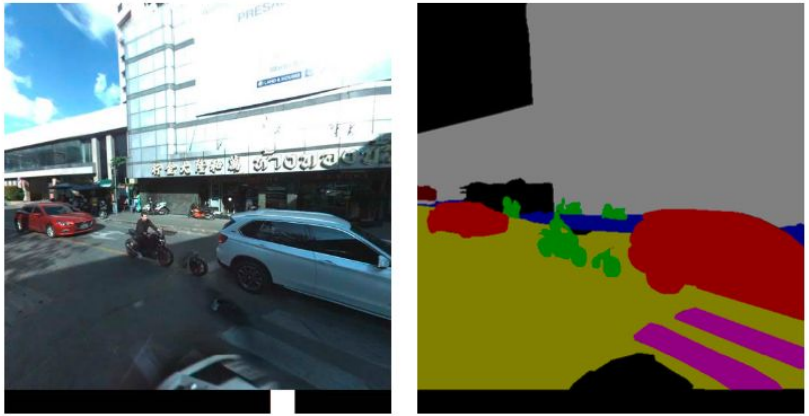


FIGURE 6. An overview of enhanced DeepLab-V3+ (Encoder-Decoder with atrous separable convolutional for semantic segmentation [15]) with ResNet-101 backbone [41] (DeepLab-V3-A1-ResNet-101).



(a) (b)

FIGURE 8. Sample 1: The example of Sukhumvit's large road from the training set of the Bangkok Urbanscapes dataset. The input image is shown in (a), and the ground truth is shown in (b).

FIGURE 3. The semantic color codes of the CamVid dataset. Each color is encoded with respect to the semantic class in the ground truth images.

https://www.marssolution.io/

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มาร์สสามารถเชื่อมโยงธุรกิจในหลากหลายอุตสาหกรรมกับผู้ใช้รถยนต์ให้เกิดความสะดวกและรวดเร็วยิ่งขึ้น มาร์สหรือ MARS (Motor AI Recognition Solution) เป็นแอปพลิเคชันที่ปลดล็อกการตรวจสภาพรถยนต์แบบเดิมๆ ด้วยเทคโนโลยี AI แบบครบวงจรที่มาร์สได้คิดค้นและพัฒนาขึ้นมาเพื่อช่วยให้ธุรกิจของคุณลดต้นทุนด้านบุคลากร ลดขั้นตอนการทำงาน เพิ่มความรวดเร็วและแม่นยำในการตรวจสอบและจัดเก็บข้อมูล

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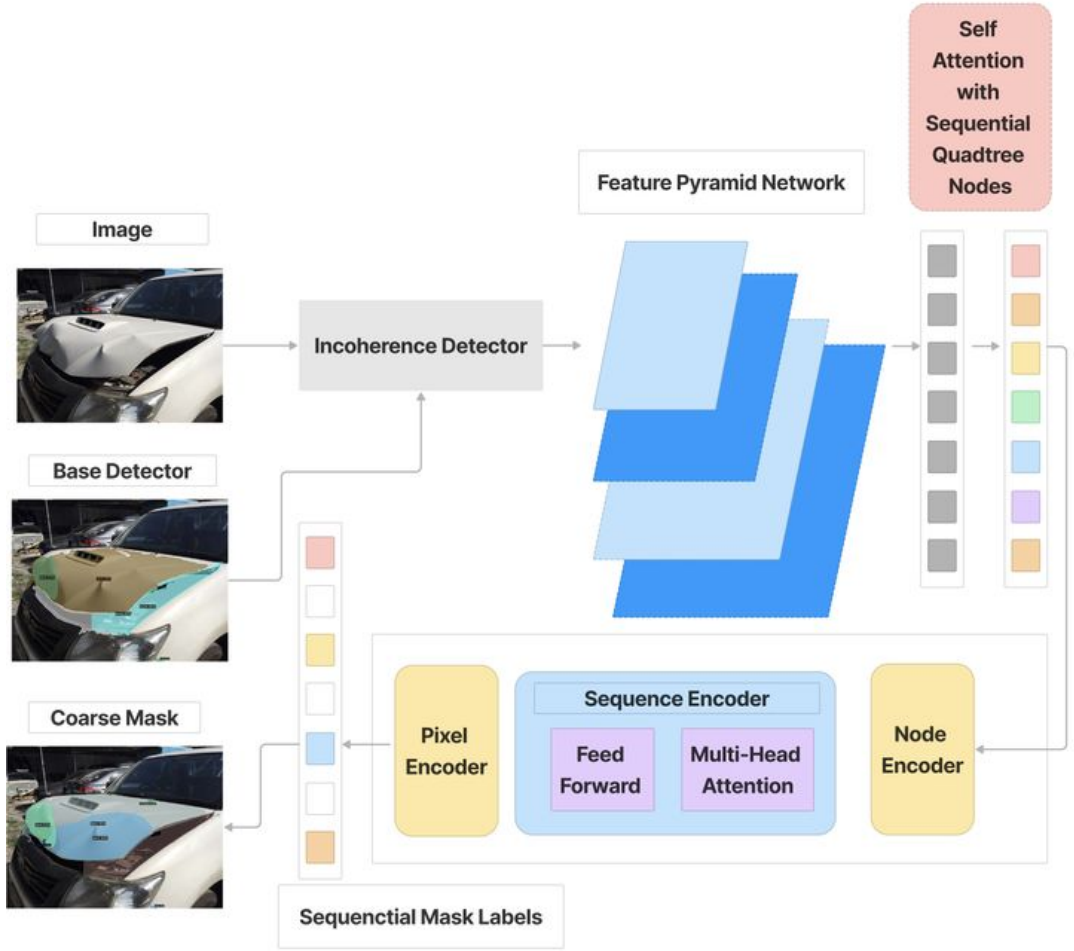
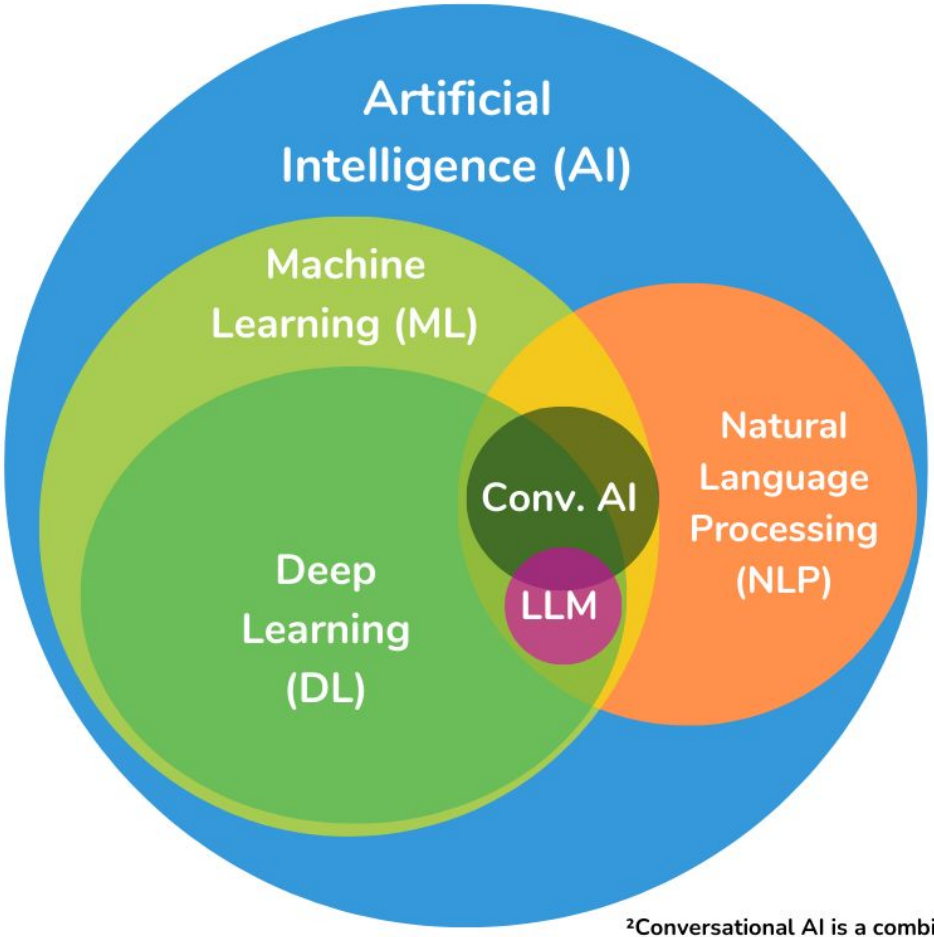
Panboonyuen, Teerapong, et al. ***"MARS: Mask Attention Refinement with Sequential Quadtree Nodes for Car Damage Instance Segmentation."*** *International Conference on Image Analysis and Processing*. Cham: Springer Nature Switzerland, 2023.





- Artificial Intelligence (AI)
- Machine Learning (ML)
- Deep Learning (DL)
- Natual Language Processing (NLP)
- Large Language Model (LLM)[1]
- Conversational AI (Conv. AI)[2]

[1]LLM is an intersection of DL and NLP

[2]Conversational AI is a combination of ML and NLP. It may include DL and LLM, but that isn't always the case.

Machine Learning

Narrow Artificial Intelligence (ANI)

Stage One: Machines imitate human behavior, specializing in one area to solve a problem.

i.e. Siri, ChatGPT, Alexa

Machine Intelligence

Artificial General Intelligence (AGI)

Stage Two: Machines can continuously learn and are as smart as humans.

Machine Consciousness

Artificial Super Intelligence (ASI)

Stage Three: Machines that are smarter than humans across the board.

https://viso.ai/deep-learning/artificial-intelligence-types/

Starting a Research Project

Step 1: Choose a "cool" and compelling topic.

Importance: Passion for the topic keeps you motivated and engaged.

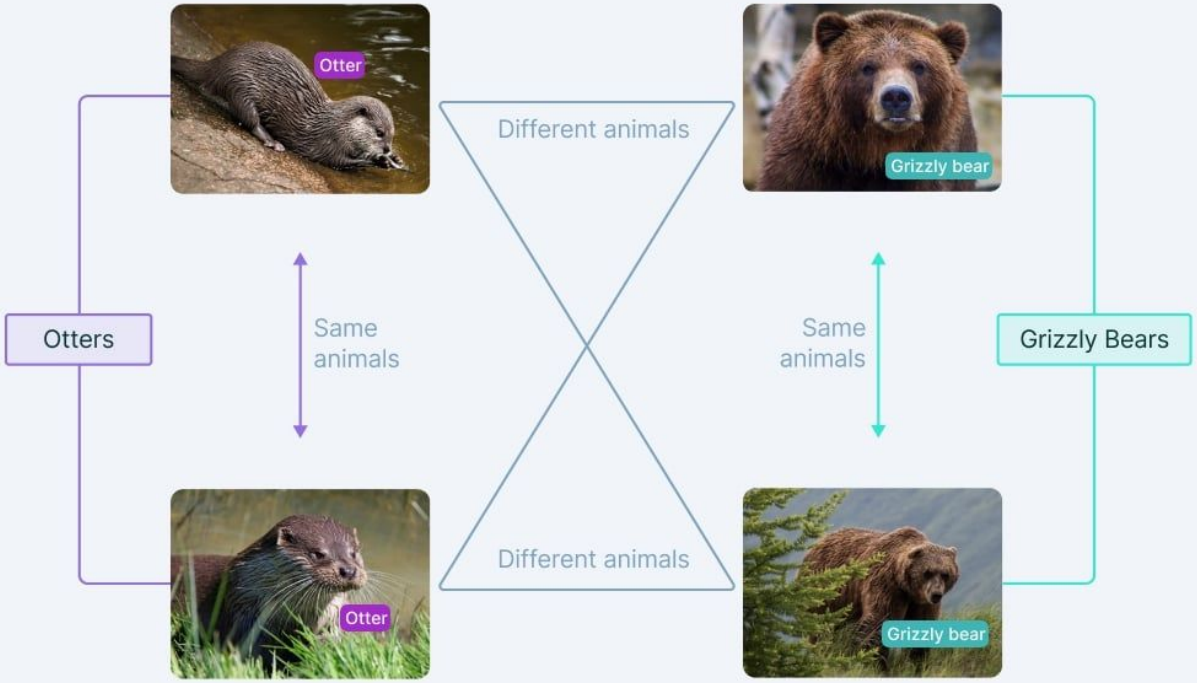
Examples: Applying AI to solve real-world problems in agriculture or healthcare.

Examples of 'Cool' and Compelling Topics (1)

Advancements in **Self-Supervised Learning** for Computer Vision

Overview: Examine recent developments in self-supervised learning techniques that leverage unlabeled data to improve computer vision models. Explore innovations like contrastive learning and predictive modeling that enhance feature extraction and representation.

Research Focus: Analyze the effectiveness of self-supervised methods compared to traditional supervised learning in tasks such as image classification and object detection. Investigate applications in areas where labeled data is scarce.



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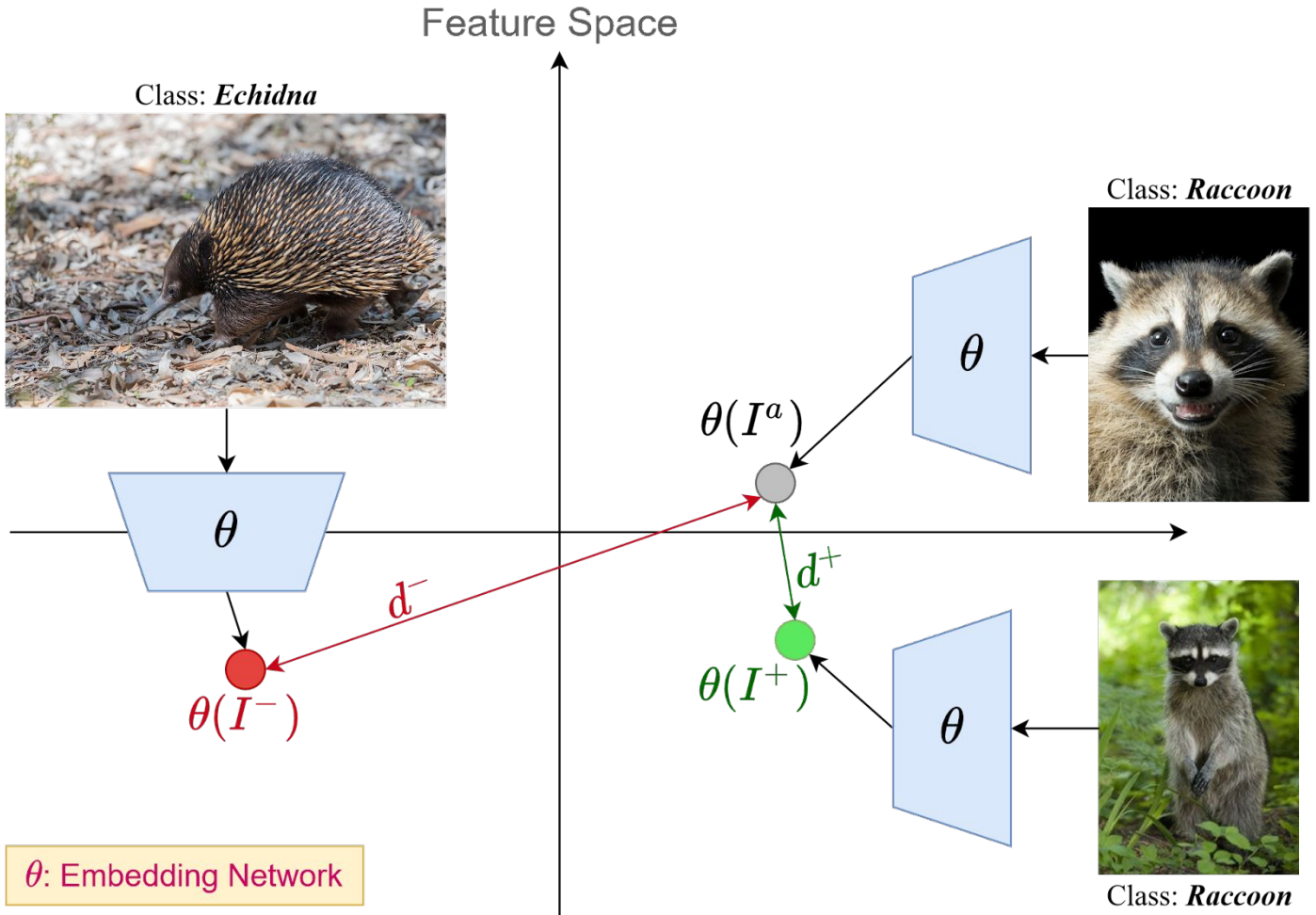


https://www.v7labs.com/blog/contrastive-learning-guide

Examples of 'Cool' and Compelling Topics (2)

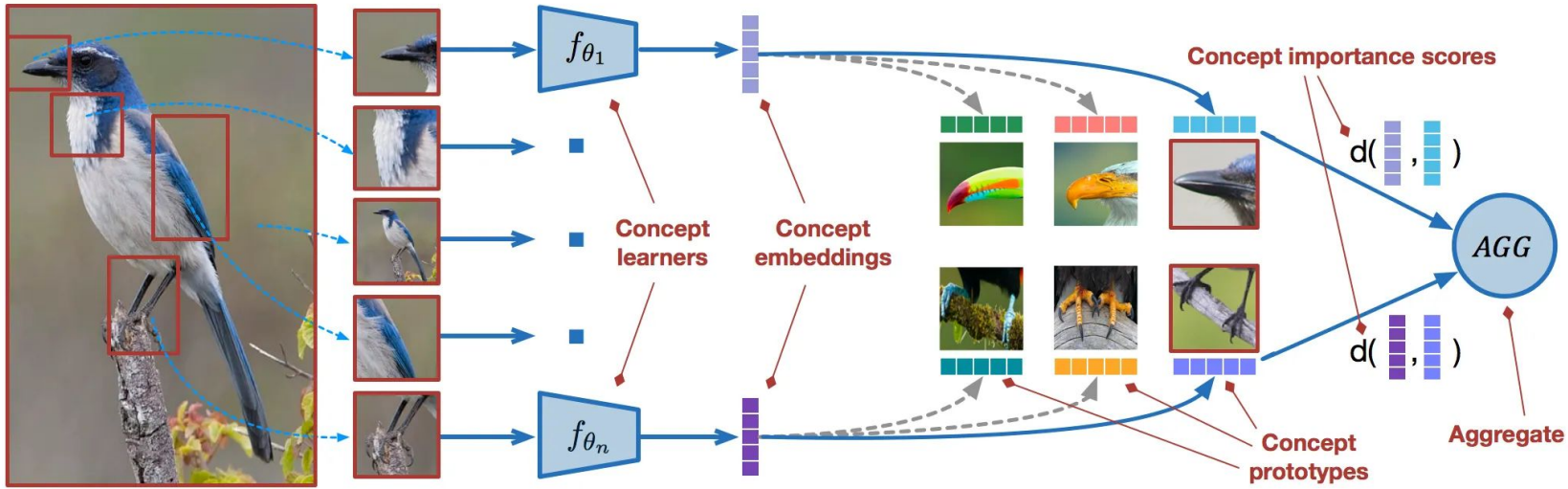
Exploring the Frontiers of **Few-Shot Learning** in NLP

Overview: Investigate the latest advancements in few-shot learning approaches for natural language processing (NLP). Focus on methods that enable models to generalize from a limited number of examples, such as meta-learning and prompt-based techniques.

Research Focus: Assess the impact of few-shot learning on language model performance, particularly in scenarios involving diverse and rapidly evolving linguistic tasks. Evaluate the potential for scaling these approaches to broader NLP challenges.

Few-shot learning

A sub-area of machine learning. It involves categorizing new data when there are only a few training samples with supervised data. With only a small number of training examples, a computer vision model can perform pretty well.



https://medium.com/@aryanjadon/image-classification-using-few-shot-learning-286572222b2d

Examples of 'Cool' and Compelling Topics (3)

Innovations in **Transformer Architectures** for **Multimodal AI Systems**

Overview: Delve into the development of transformer architectures tailored for multimodal AI systems that integrate text, image, and audio data. Explore advancements in model design, attention mechanisms, and cross-modal learning.

Research Focus: Investigate how novel transformer variants improve multimodal representation learning and performance across tasks like image captioning, audio-visual scene understanding, and cross-modal retrieval. Consider implications for building more cohesive and versatile AI systems.

Understanding Multimodal

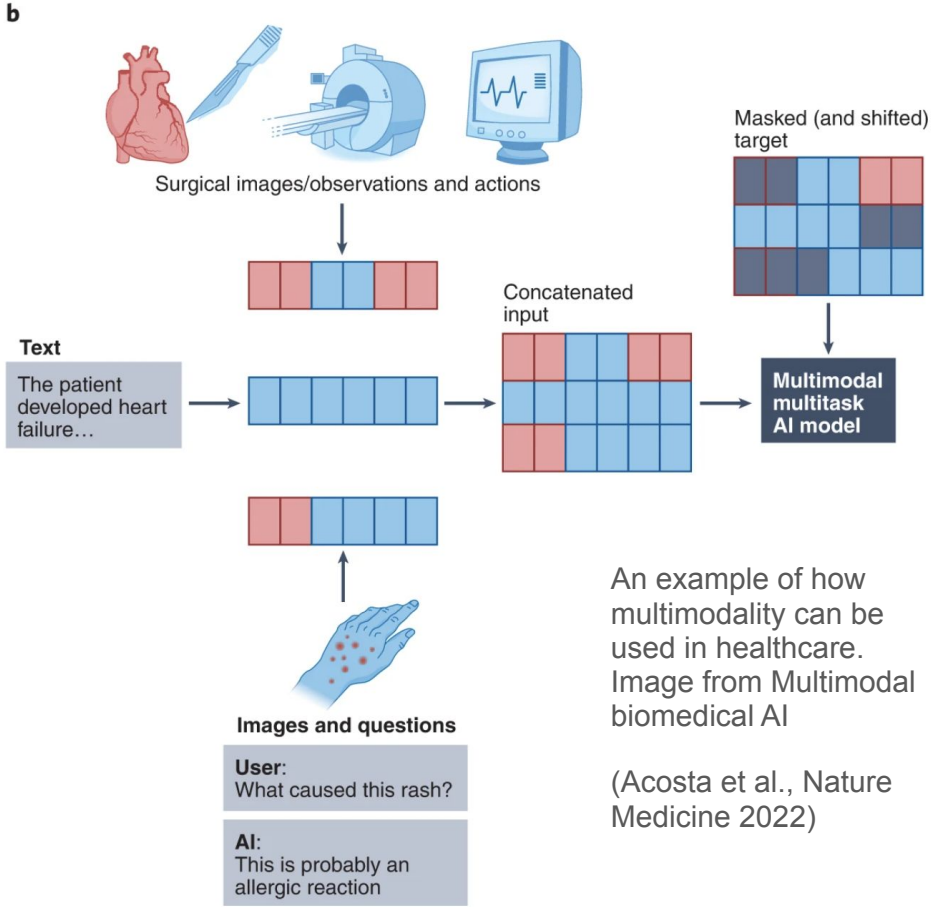
Chip Huyen
@chipro

New blog post: Multimodality and Large Multimodal Models (LMMs)

Being able to work with data of different modalities -- e.g. text, images, videos, audio, etc. -- is essential for AI to operate in the real world.

This post covers multimodal systems in general, including Large Multimodal Models. It consists of 3 parts.

* Part 1 covers the context for multimodality.
* Part 2 discusses how to train a multimodal system, using the architectures of CLIP and Flamingo, and examples from GPT-4V.
* Part 3 discusses some active research areas for LMMs, including generating multimodal outputs.



An example of how multimodality can be used in healthcare. Image from Multimodal biomedical AI

(Acosta et al., Nature Medicine 2022)

https://huyenchip.com/2023/10/10/multimodal.htm
https://twitter.com/chipro/status/1711970025874321479/photo/1

Steps of the Scientific Method

Observation

Question

Hypothesis

Results

Conclusion

ThoughtCo.

Literature Survey

Purpose: Understand what has already been done in your area of interest.

Approach: Identify gaps in existing research.

Tools: Use academic databases, research papers, and conference proceedings.

Developing the Research Methodology

Step 1: Decide on building an off-the-shelf model or developing a new architecture.

Step 2: Choose appropriate datasets and tools.

Step 3: Design experiments and evaluation metrics.

Implementing the Model

Tools: PyTorch, TensorFlow, Keras. (Python)

Techniques: GANs, Vision Transformers, Self-Supervised Learning.

Focus: Experiment, iterate, and refine the model to achieve desired outcomes.

Evaluating Results

Metrics: Accuracy, precision, recall, F1-score.

Comparison: Benchmark against state-of-the-art models.

Analysis: Understand the strengths and limitations of your model.

Publishing Your Research

Platforms: Journals (e.g., IEEE Transactions), conferences (e.g., CVPR).

Steps: Write a compelling paper, follow submission guidelines, peer review.

Goal: Share findings with the research community and gain feedback.

Career Paths for AI Researchers

Academia: Becoming a professor, leading research labs.

Industry: Working for tech companies, research scientist roles.

Entrepreneurship: Starting AI-focused startups, consulting.

Inspiring the Next Generation

Find what excites you and pursue it with passion.

Advice: **Stay curious**, keep learning, and don't fear failure.

Opportunity: The field of AI is vast; there's a place for every aspiring researcher.

Forward-Forward Algorithm: Will it replace Backpropagation?

The Forward-Forward Algorithm: Some Preliminary Investigations

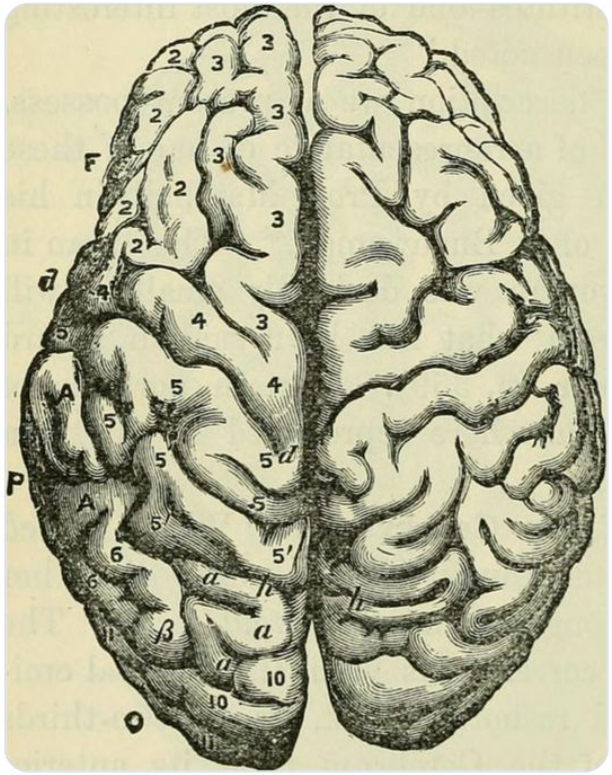
Geoffrey Hinton
Google Brain
geoffhinton@google.com

Abstract

The aim of this paper is to introduce a new learning procedure for neural networks and to demonstrate that it works well enough on a few small problems to be worth serious investigation. The Forward-Forward algorithm replaces the forward and backward passes of backpropagation by two forward passes, one with positive (*i.e.* real) data and the other with negative data which could be generated by the network itself. Each layer has its own objective function which is simply to have high goodness for positive data and low goodness for negative data. The sum of the squared activities in a layer can be used as the goodness but there are many other possibilities, including minus the sum of the squared activities. If the positive and negative passes can be separated in time, the negative passes can be done offline, which makes the learning much simpler in the positive pass and allows video to be pipelined through the network without ever storing activities or stopping to propagate derivatives.

Martin Görner @martin_gorner · Dec 5, 2022

I seems very unlikely that the human brain uses back propagation to learn. There is little evidence of backprop mechanics in biological brains (no error derivatives propagating backwards, no storage of neuron activities to use in a packprop pass, ...).



Martin Görner
@martin_gorner

Also, the brain can learn from a continuous stream of incoming data and does not need to stop to run a backprop pass. Yes, sleep is beneficial for learning somehow, but we can learn awake too.

How to Get Started in AI Research

Step 1: Gain foundational knowledge in AI and Machine Learning.

Step 2: Participate in AI-related projects or internships.

Step 3: Pursue advanced studies or certifications in AI.

AI Ethics and Responsibility

Ethical Considerations: Privacy, fairness, bias in AI.

Researcher's Role: Ensure ethical use of AI, transparency in research.

Impact: Building AI that benefits society as a whole.

Future of AI Research

Trends: Quantum computing, Generative AI, Explainable AI, AI in neuroscience.

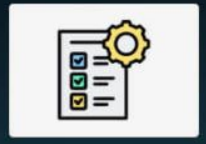
Opportunities: New fields and applications emerging.

Vision: AI as a tool to solve global challenges (e.g., climate change, healthcare).

Top Generative AI Trends

- Multimodal Generative AI
- Opensource Wave in GenAI
- GenAI Adhering to Strong Regulatory Guidelines
- Bring Your Own AI
- AI-Augmented Apps and Services





- AI for Creativity
- GenAI for Hyper-Personalization
- Conversational AI
- GenAI for Scientific Research
- Human in the GenAI Loop





Conclusion

Summary: Key takeaways about pursuing a career in AI research.

Encouragement: The future of AI is bright, and the next generation will shape it.

Call to Action: Start exploring, learning, and contributing to AI research.

Q&A

Thank You!

Contact: panboonyuen.kao@gmail.com