KMUTNB
INVENTION TO INNOVATION
KING MONGKUT'S UNIVERSITY OF TECHNOLOGY NORTH BANGKOK
มหาวิทยาลัยเทคโนโลยีพระจอมเกล้าพระนครเหนือ

2025

Object Detection & Segmentation

Ai Innovator 2025

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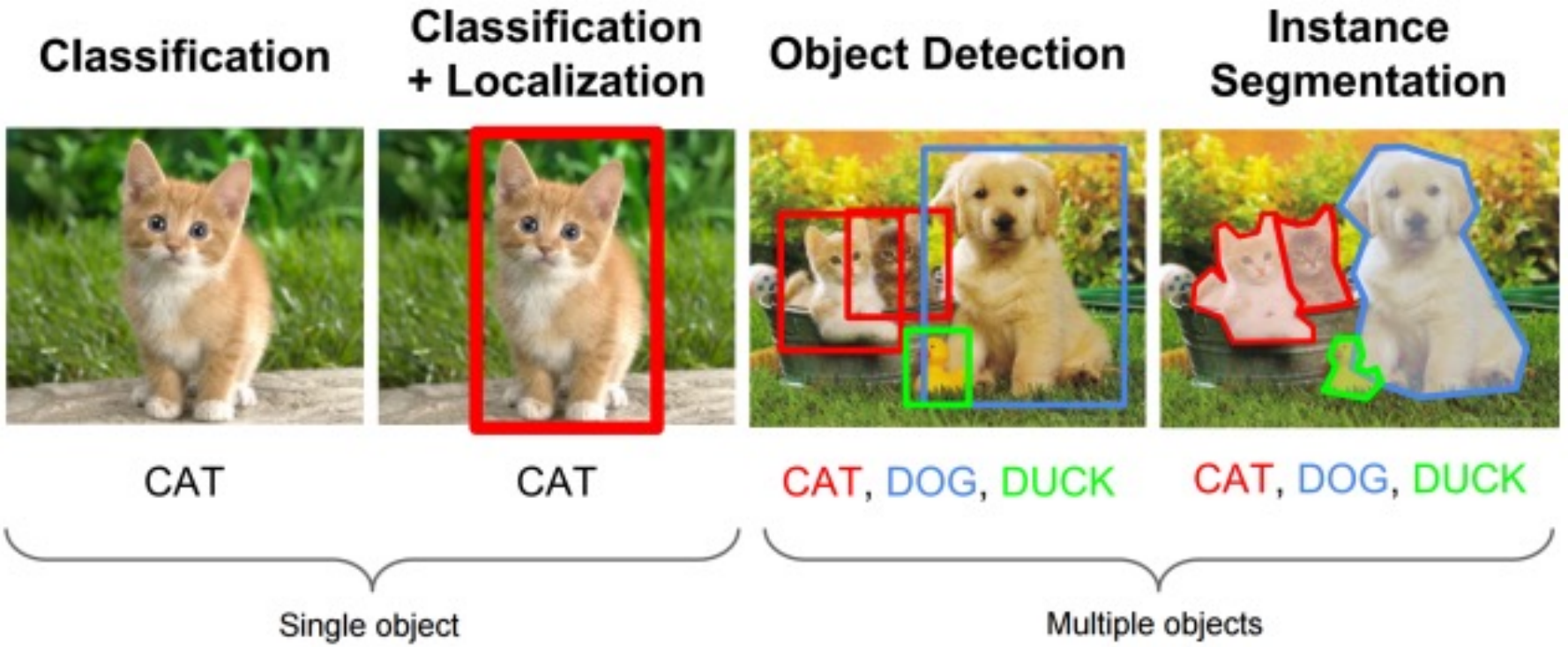
Object detection & Segmentation



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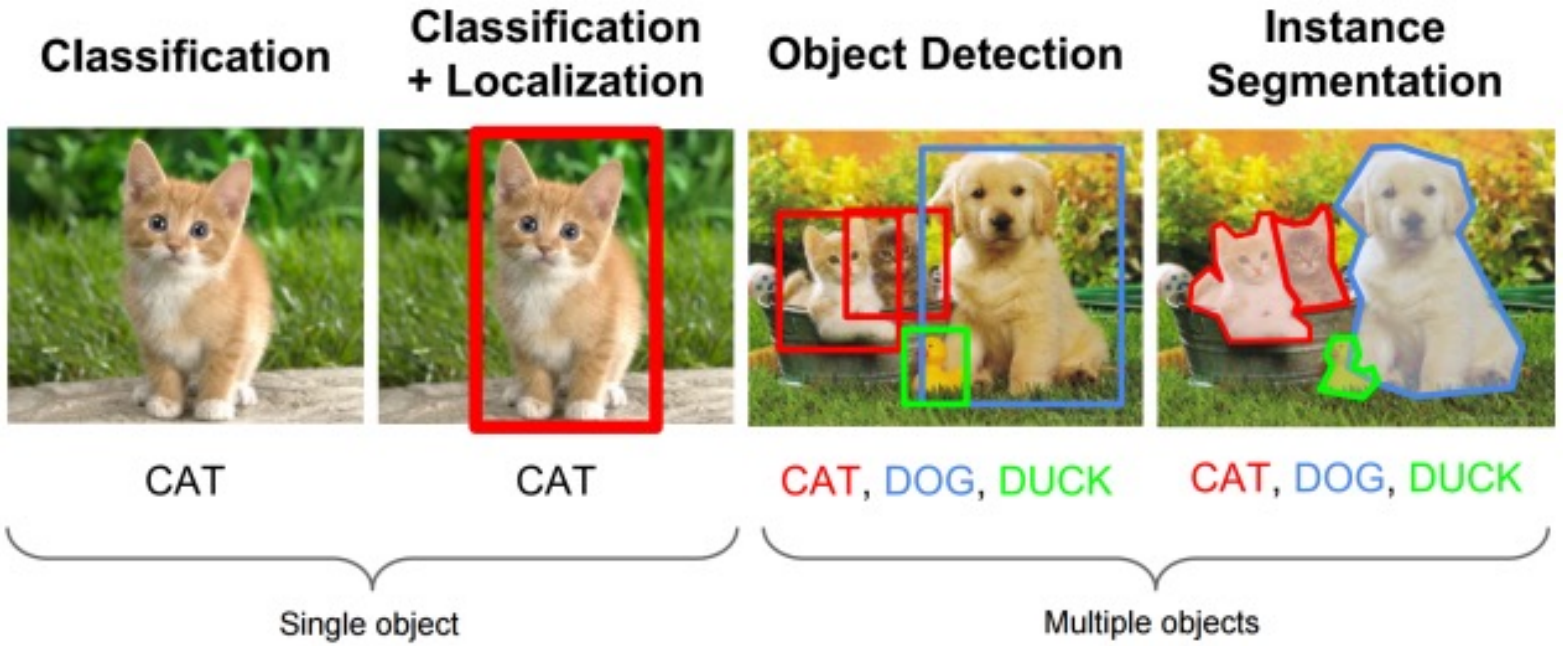
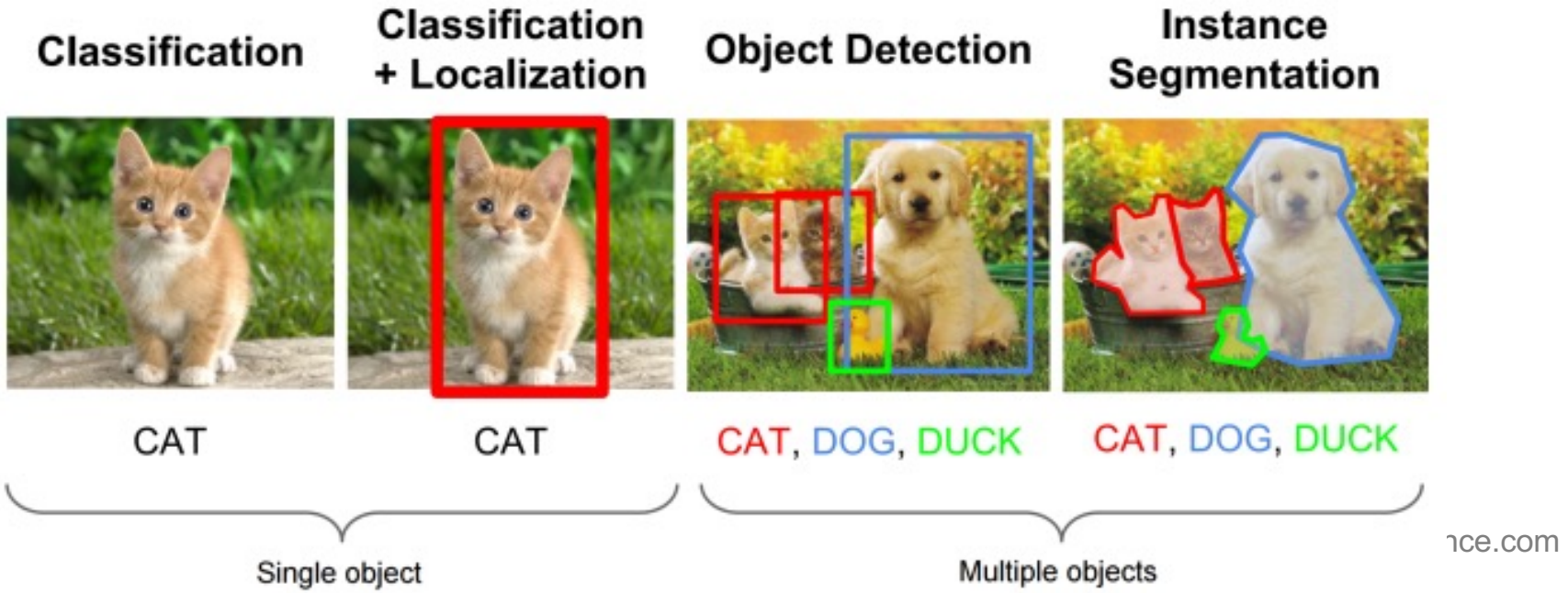
Object Classification

- Goal: To assign a single label to an image, identifying the main object or scene in the image.
- Example: Classifying an image as "cat," "dog," "car," or "beach."
- Output: A single label or class probability for the entire image.



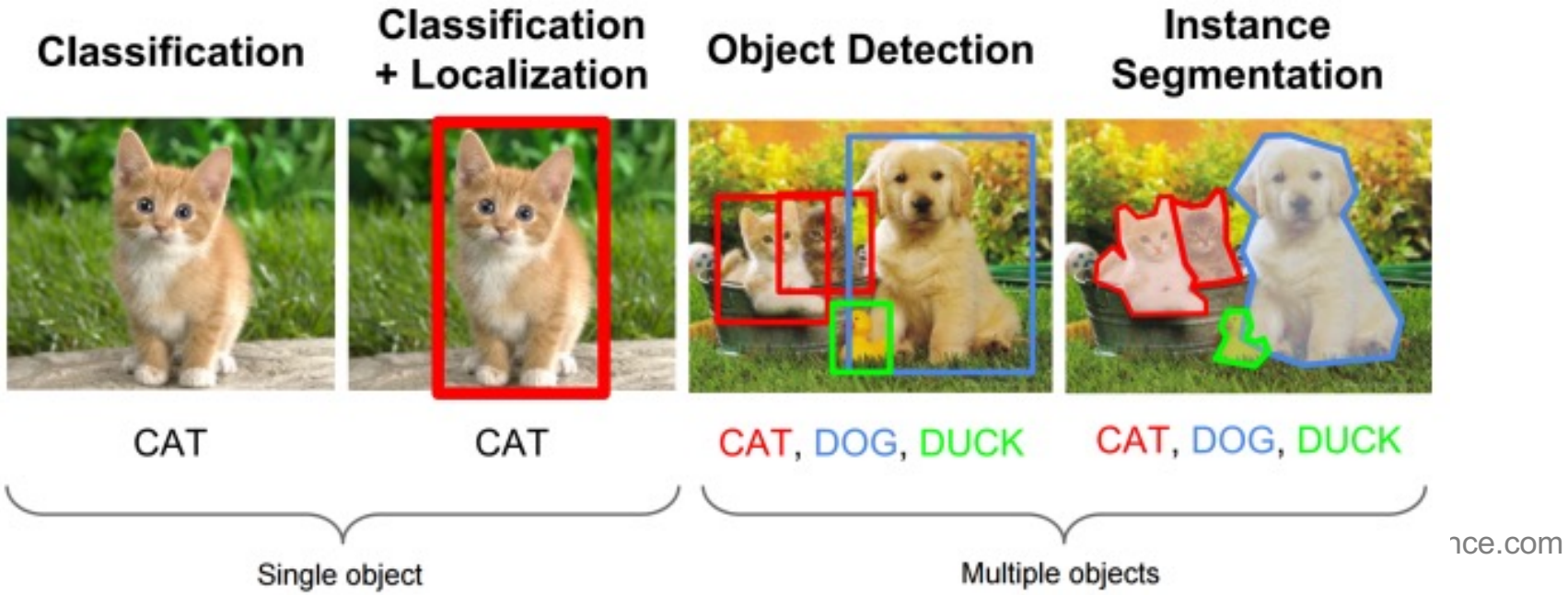
Object Detection

- Goal: To identify multiple objects within an image and draw bounding boxes around them.
- Example: Detecting multiple dogs, cats, cars, pedestrians, and traffic lights in a street scene.
- Output: Bounding boxes for each detected object, along with their class labels and confidence scores.



Segmentation

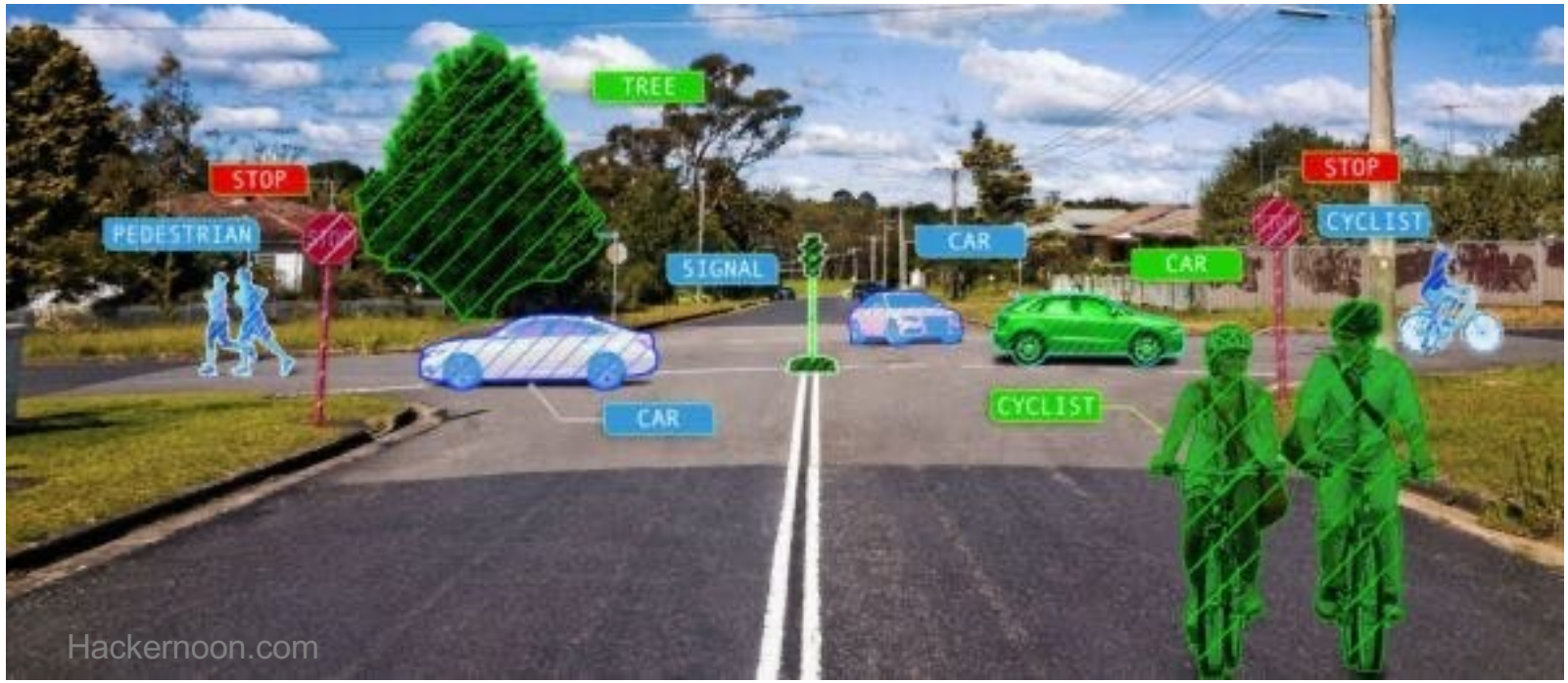
- Goal: To create a pixel-level mask for each object in an image, delineating the exact boundaries of the objects.
- Types:
- Semantic Segmentation: Assigns a class label to each pixel in the image, without distinguishing between instances of the same class.
- Instance Segmentation: Assigns a unique label to each instance of an object, even if they belong to the same class.
- Example: Creating a mask for each person in a crowd, or for each car in a parking lot.
- Output: A pixel-level mask for each object in the image, identifying which pixels belong to which object.



use cases:

Autonomous Vehicles

- Precise Object Identification: allows self-driving cars to not only detect objects like cars, pedestrians, and cyclists but also to distinguish between individual instances.
- Tracking the movement of individual vehicles and pedestrians.
- Predicting their trajectories.
- Making informed decisions to avoid collisions.



use cases:

Robotics

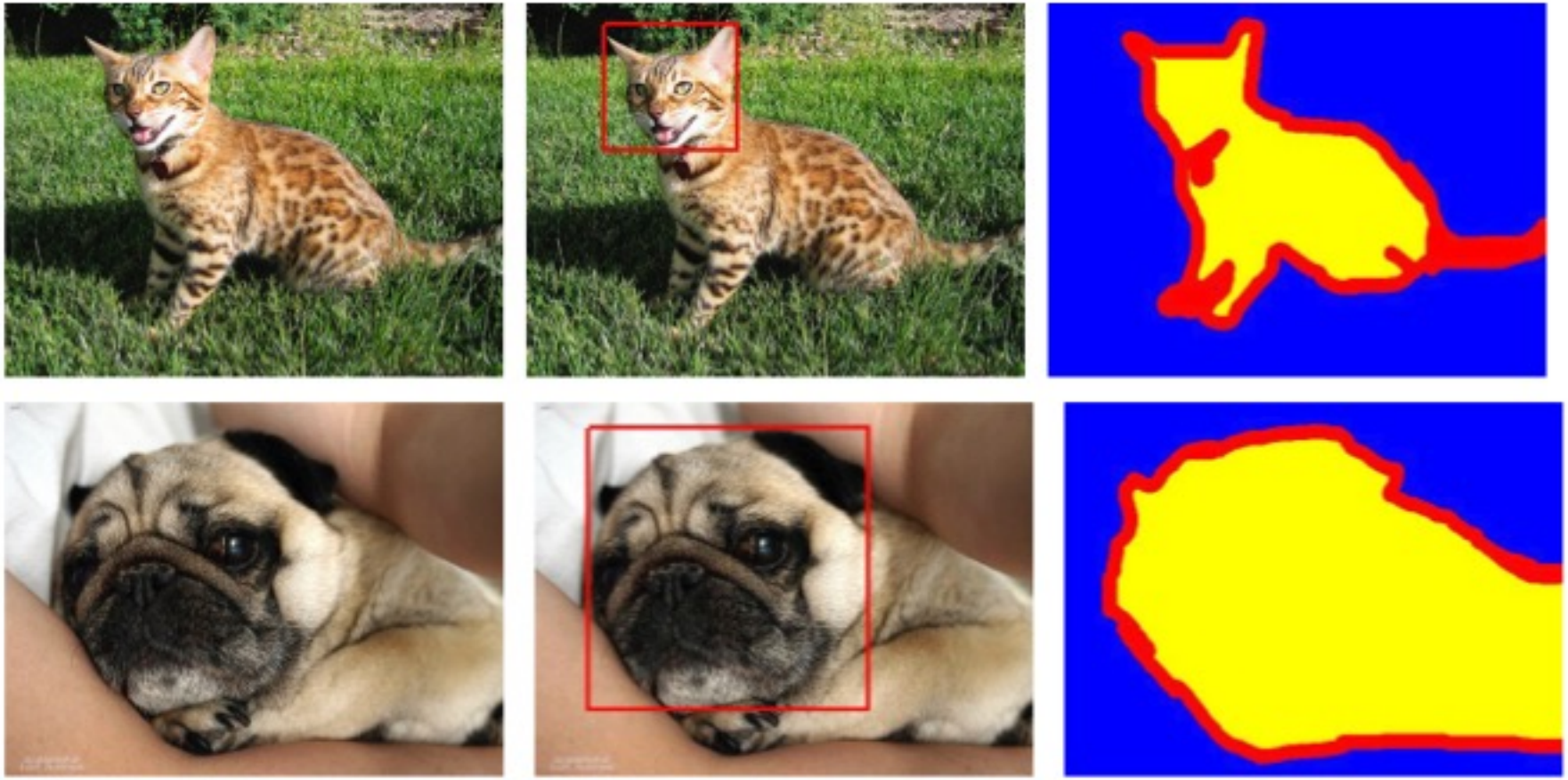
- Object Manipulation: Robots can use instance segmentation to accurately identify and grasp individual objects, even in cluttered environments.
- Picking and placing items in warehouses or factories.
- Performing surgery or other delicate tasks.
- Interacting with objects in unstructured environments.



labs.utdallas.edu/irvl/research

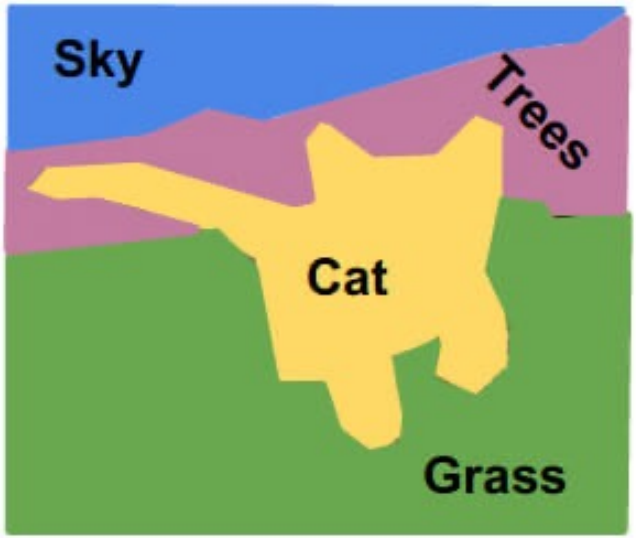
Segmentation:

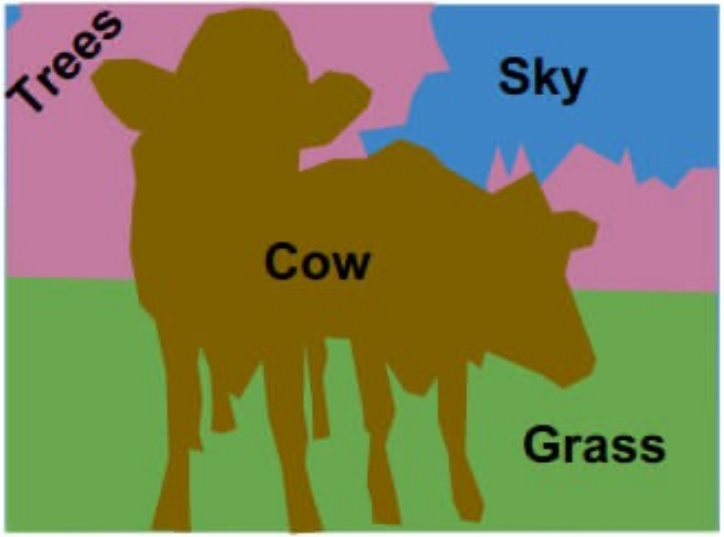
https://www.robots.ox.ac.uk/~vgg/data/pets/



https://colab.research.google.com/github/keras-team/keras-io/blob/master/examples/vision/ipynb/oxford_pets_image_segmentation.ipynb

Semantic Segmentation:





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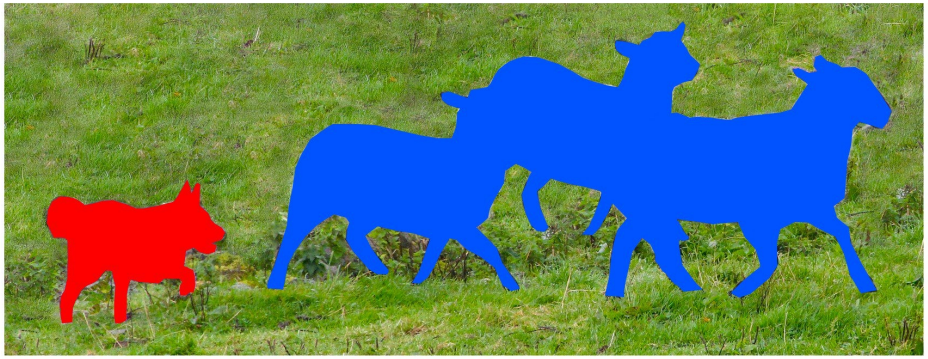
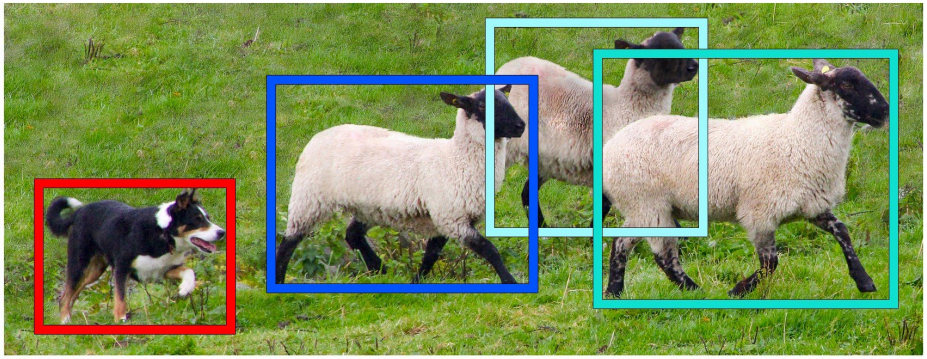
Segmentation:

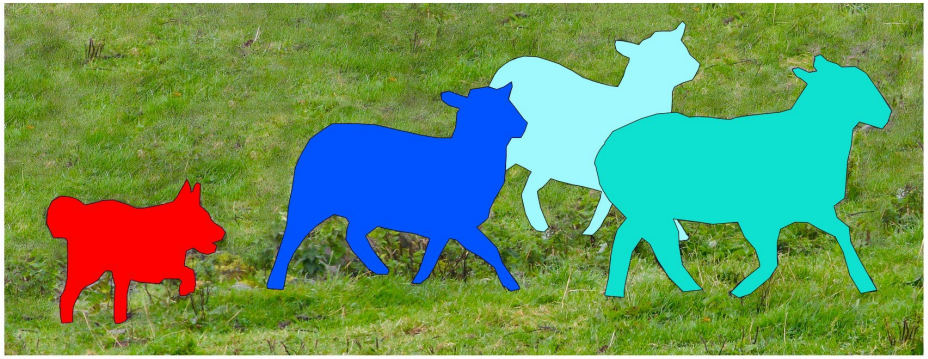
Image Recognition



Semantic Segmentation



Object Detection



Instance Segmentation

https://manipulation.csail.mit.edu/

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Recurrent Neural Network
RNN

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Recurrent neural network (RNN)

- artificial neural networks designed for processing **sequential data**, such as text, speech, and time series, where the order of elements is important. เช่น แดงตีดำ ดำตีแดง
- Unlike feedforward neural networks, which process inputs independently,
- RNNs utilize recurrent connections, where the output of a neuron at one time step is fed back as input to the network at the next time step.

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RNN

Applications:

1.Natural Language Processing (NLP):

•**Language Modeling:** predict the next word in a sentence, text generation and autocomplete.

•**Machine Translation**: translation tasks, decoding it in the target language.

•**Sentiment Analysis**: analyze text sentiment by capturing contextual information in a sequence.

2. **Speech Recognition and Synthesis:**

•**Speech-to-Text:** convert spoken language into written text, making them the backbone of speech recognition systems.

•**Text-to-Speech**: generate human-like speech from text input, improving voice assistants and accessibility tools.

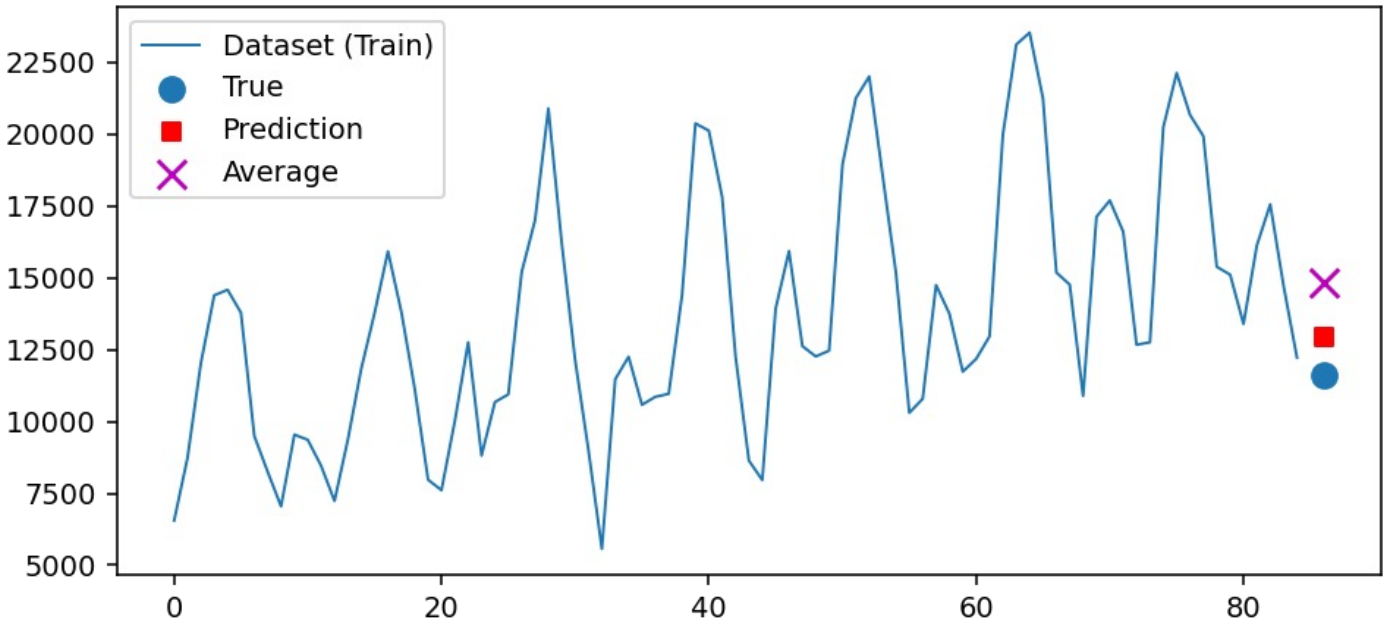
3. **Time-Series Analysis and Forecasting:**

•**Financial Forecasting**: predict stock prices, currency exchange rates, and other financial variables.

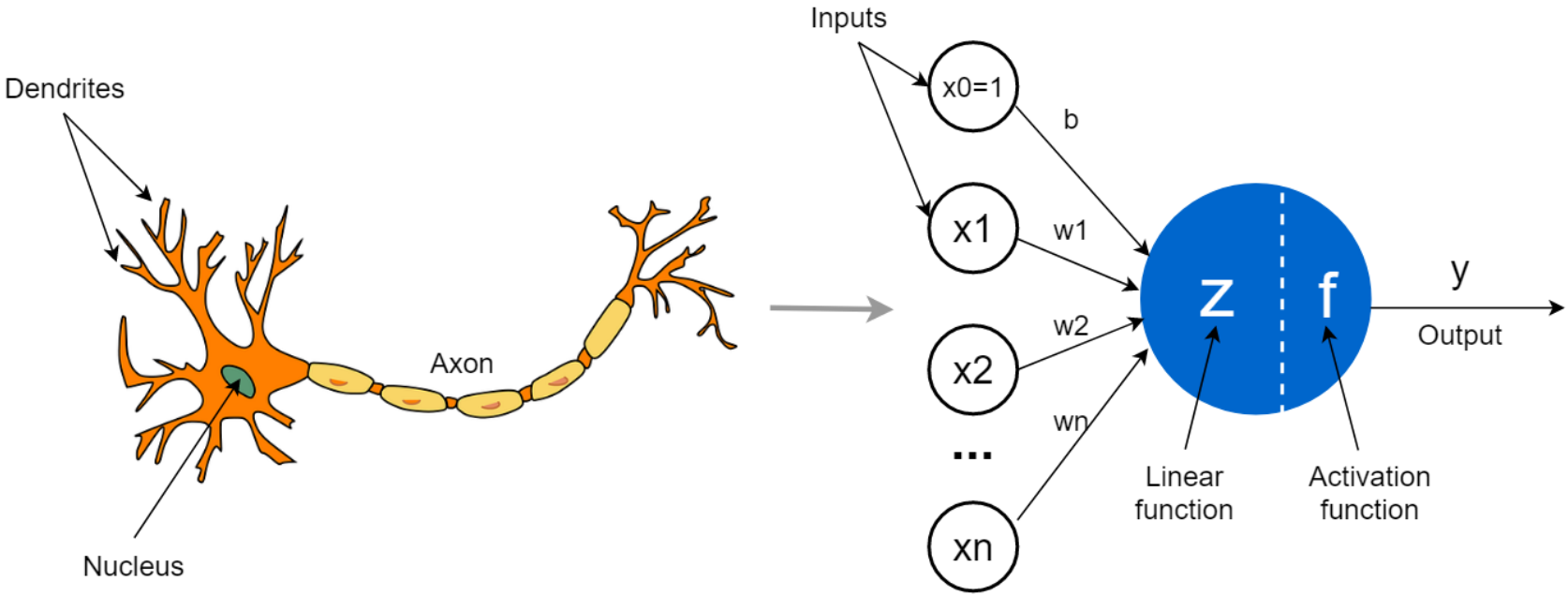
•**Weather Prediction:** analyze historical weather data to forecast future weather conditions.

RNN

- Time-series Future prediction



NN and RNN



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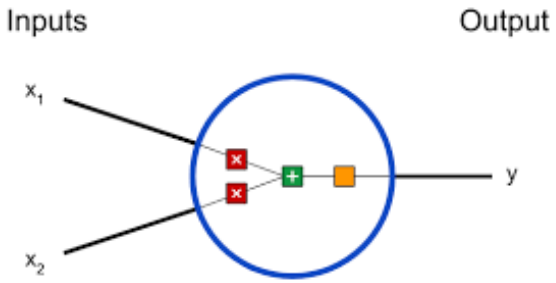
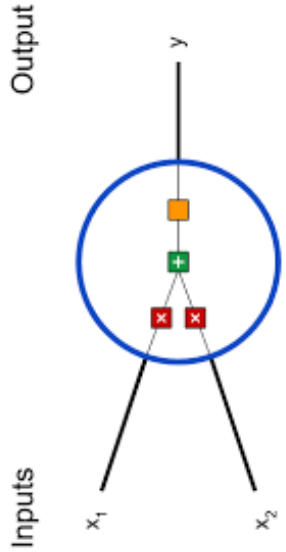
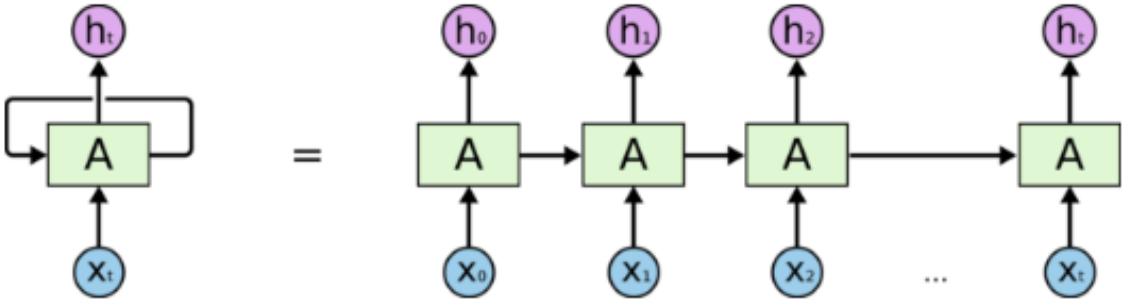
NN and RNN







An unrolled recurrent neural network.

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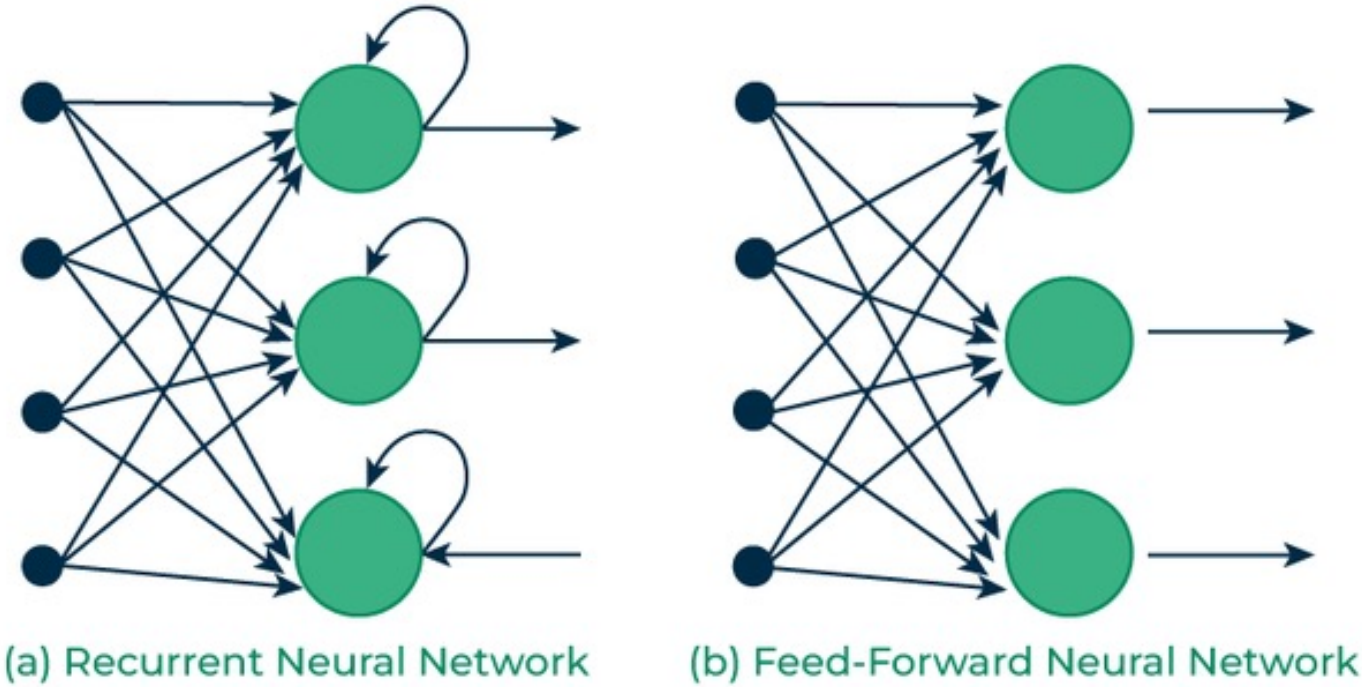
RNN



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RNN

Recurrent Neural Network

We can process a sequence of vectors **x** by applying a **recurrence formula** at every time step:

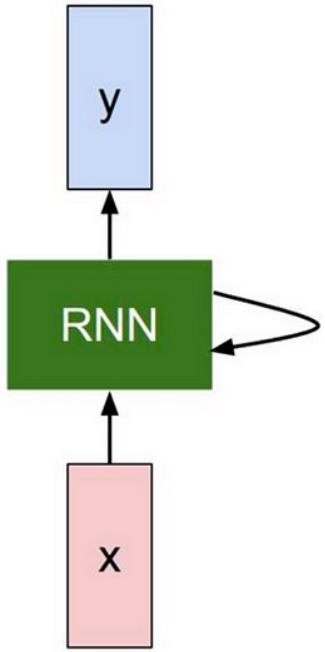
$$h_t = f_W(h_{t-1}, x_t)$$

new state

old state

input vector at some time step

some function with parameters W



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- Thank you