CV / VLMs

Unit 5: State-of-the-Art Object Detection Techniques

5.1.3

Diving Deeper into Neural Networks

Capsule Networks

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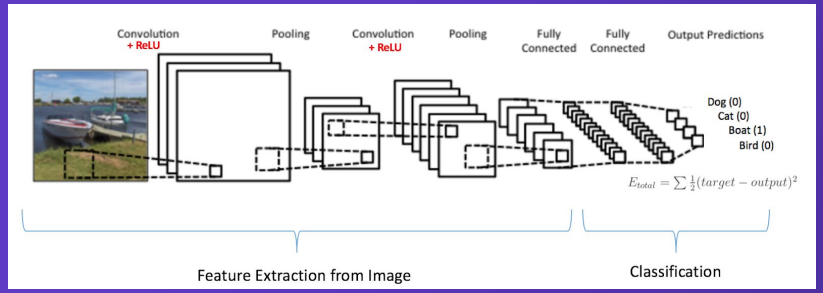
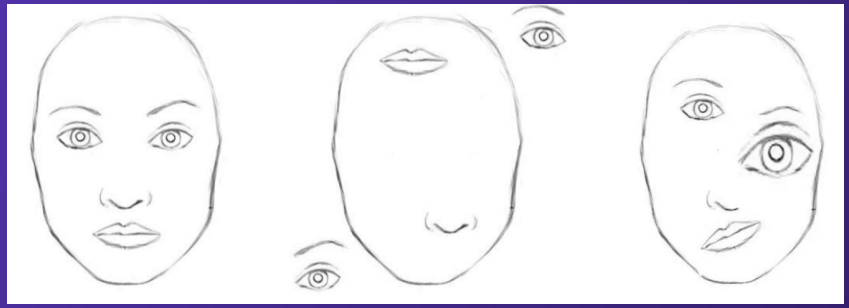
Capsule Networks - Why

CNNs are not perfect. When fed with images of different orientations and sizes, they may fail.



While CNN layers work well as a feature extractors (edge, pattern, objects), there is no means of encoding spatial information/transformation within.



(top) CNNs would classify all 3 images as faces due to lack of spatial and scale information

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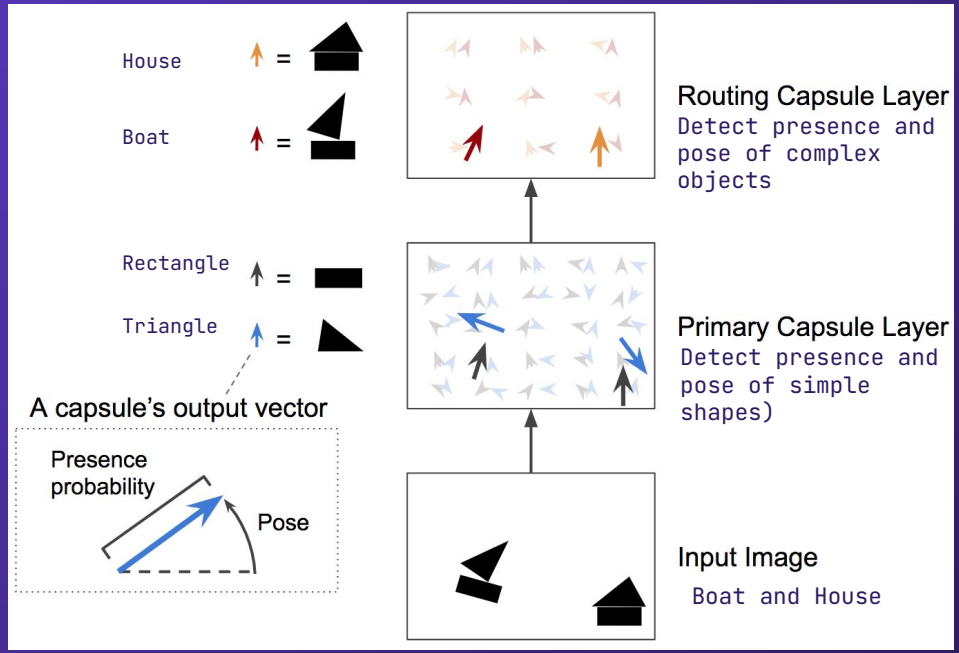
Capsule Networks - How

CapsNet is composed of capsules (special neurons) that learns how to detect a particular object (e.g., a rectangle) within a given region of the image, and it outputs a vector, which encapsulates:

- **Value** - the probability of the presence of the object.
- **Object's Orientation parameters** (e.g., precise position, rotation, etc.).



Capsule Networks - Pros

Capsule networks consider the orientation of the object in an image as a key part of data analysis via vectors. It ecodes:

- Spatial relation
- Orientation

This allows Capsule networks to examine the hierarchical relationship to better identify images.

- It enjoys an accuracy boost in image operations, which is beneficial in tackling real world computer vision applications.

- Introducing capsule networks – O'Reilly (oreilly.com)
- Introduction to Capsule Networks | Paperspace Blog
- Capsule Networks: The New Deep Learning Network | by Aryan Misra | Towards Data Science

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Capsule Networks - Cons

Despite all their good qualities, CapsNets are still far from perfect.

- For now, they don’t perform as well as CNNs on larger images datasets such as CIFAR10 or ImageNet.

- They are computationally intensive.

- Often fail to detect two objects of the same type when they are too close to each other (a.k.a. the “crowding problem”)

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