

A collage of surveillance camera images with a cloudy sky background. The cameras are mounted on poles and are positioned at different angles, some looking directly at the viewer and others looking to the side. The sky is filled with various shades of blue and white clouds.

AI Individual Project

MULTI-CAMERA PERSON SEARCHING

Thanh Vu



PROBLEM STATEMENT

- **Background:**

- Lafayette College wants to strengthen its security to account for on-campus criminal incidents

- **Project goal:**

- given an image of a person X
- automatically search for X across multiple camera views



CONSTRAINTS/CHALLENGES

- Complex variations:
 - Camera viewpoints,
 - Body poses,
 - Illumination,
 - Occlusions,
 - Background clutter,
 - Image resolution, etc.
- Little or no clear view of the suspect's face



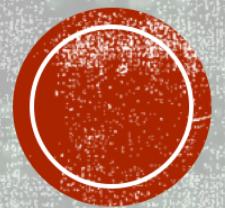
ASSUMPTIONS

- The input image is a full-body image of the suspect
- The suspect's outfit remains the same





PERSON RE-IDENTIFICATION



PERSON RE-IDENTIFICATION

- **Input:**

- A gallery of image $G \rightarrow$ sequences of camera frames
- An image of person $X \rightarrow$ the suspect

- **Output:**

- Occurrences of person X in gallery $G \rightarrow$ identify the suspect at a different location and/or time.



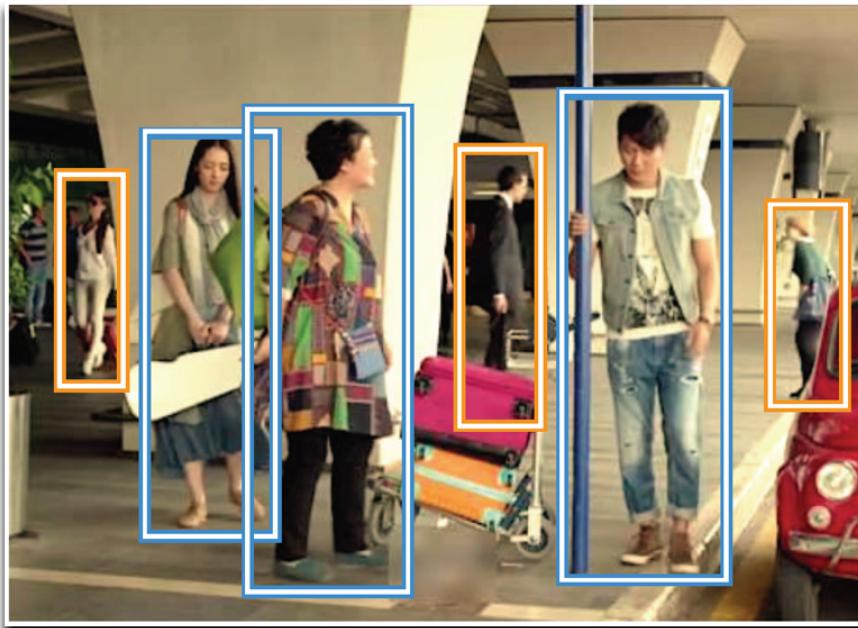
PERSON RE-IDENTIFICATION



Pedestrian Detection



PERSON RE-IDENTIFICATION



Pedestrian Detection



Identity Matching



ALGORITHM SELECTION

- **Traditional approaches**
 - Focus on identification
 - Example algorithms: JLML,^[1] Similarity Learning,^[2] CSBT^[3]



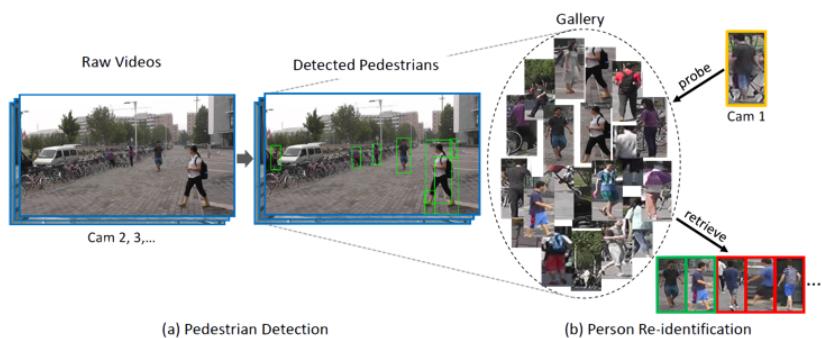
ALGORITHM SELECTION

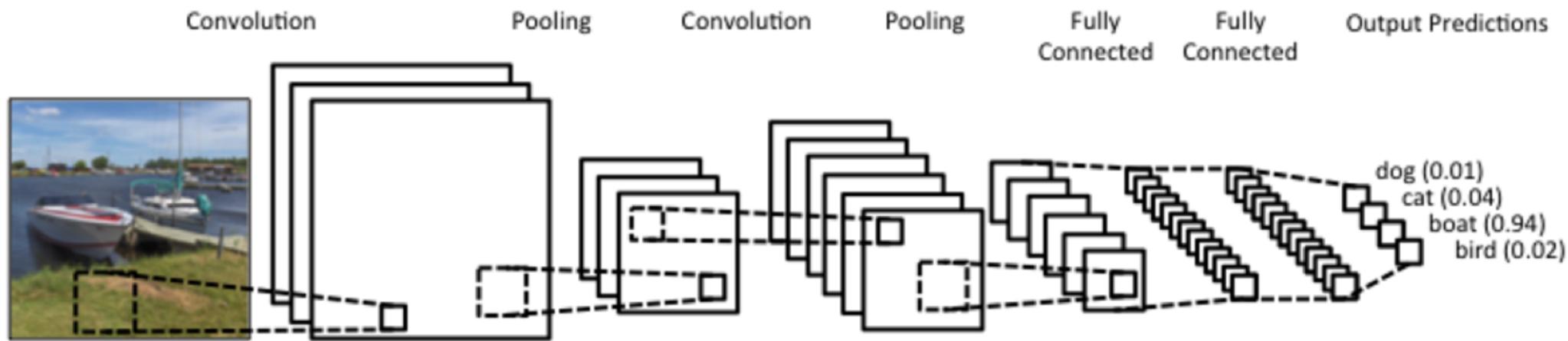
- **Traditional approaches**

- Focus on identification
- Example algorithms: JLML,^[1] Similarity Learning,^[2] CSBT^[3]

- **End-to-end systems**

- Joint Detection & Identification for re-ID^[5] (DIID)





FINAL ALGORITHM: DID



WHAT WE SEE

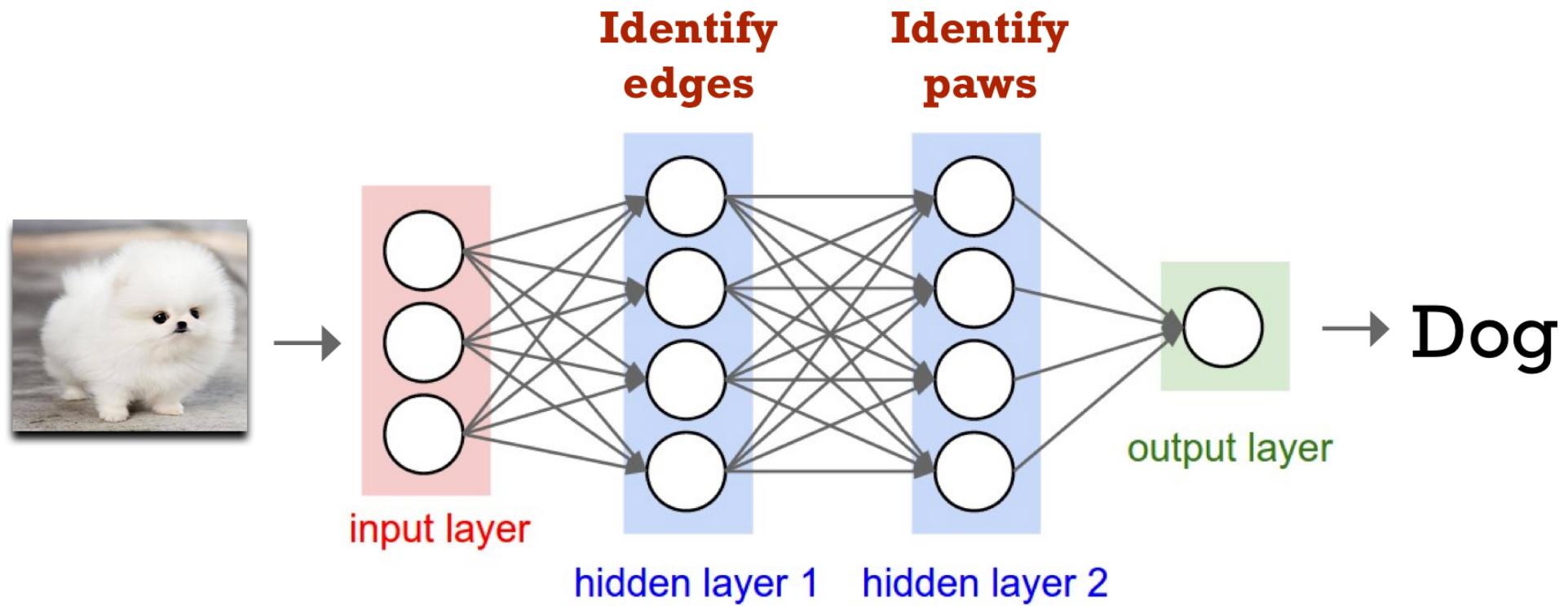


WHAT OUR LAPTOPS SEE

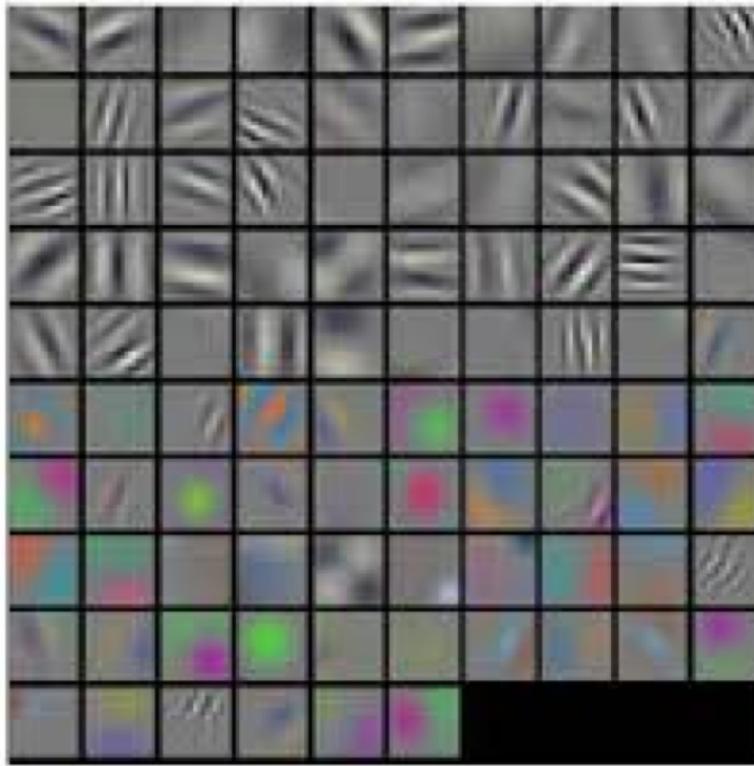
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253	62	235	82	16	142	34	20	32	206	12	73	225	51	30	147	20	186	20	32	227	242	154	34	112	24	34	200	159	92	79
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CONVOLUTIONAL NEURAL NETWORK



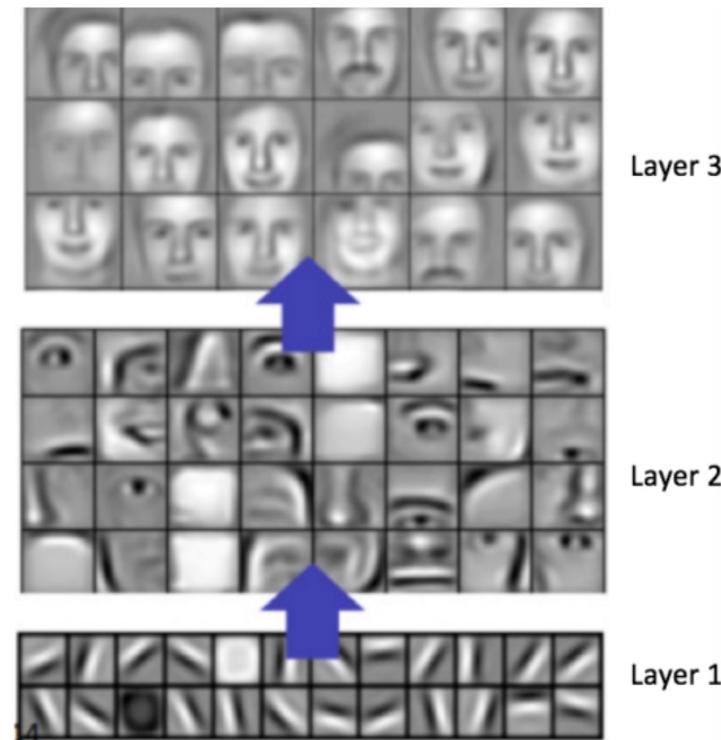
CONVOLUTIONAL NEURAL NETWORK



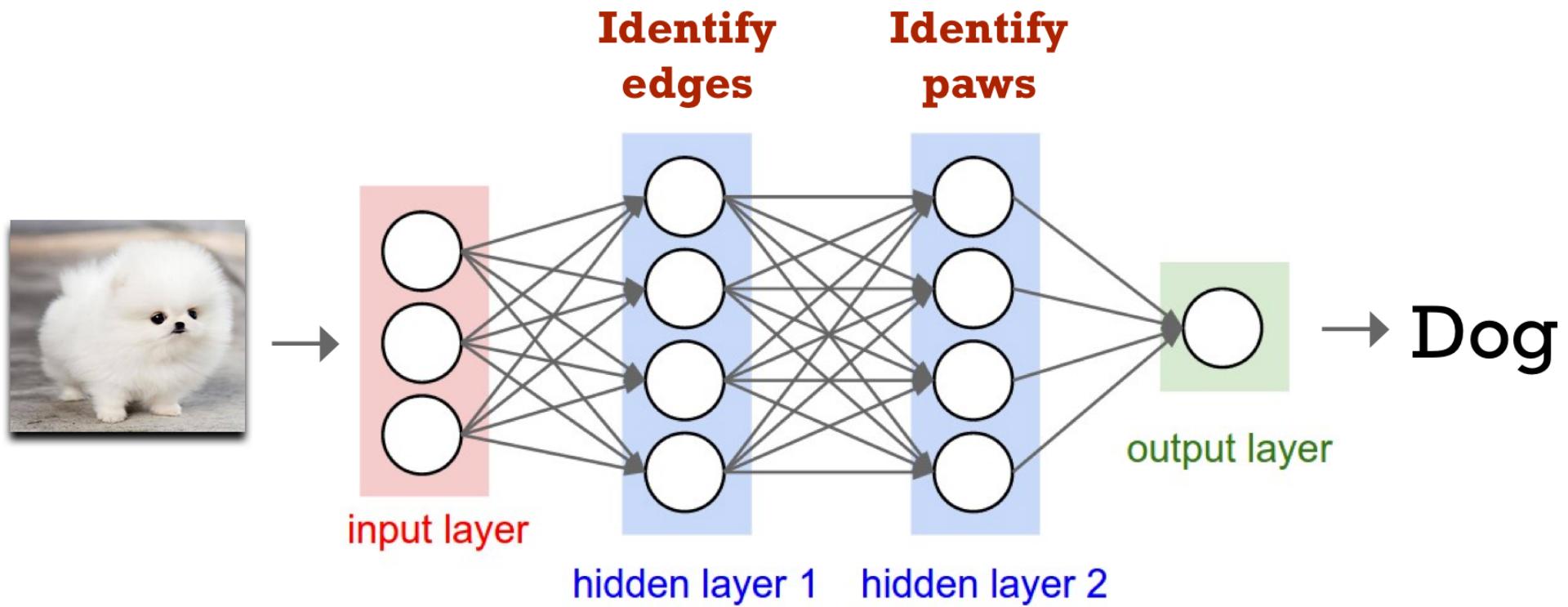
Visualization of
filters/neurons



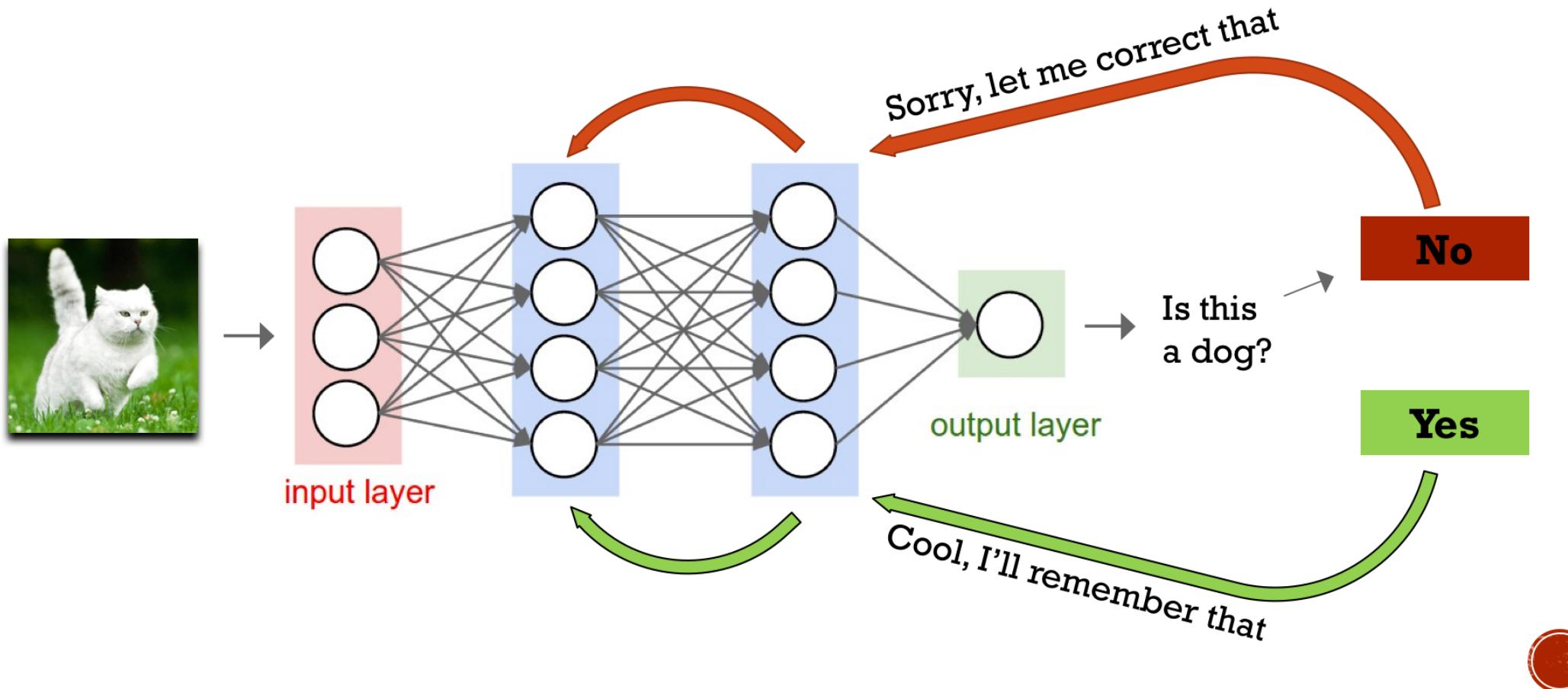
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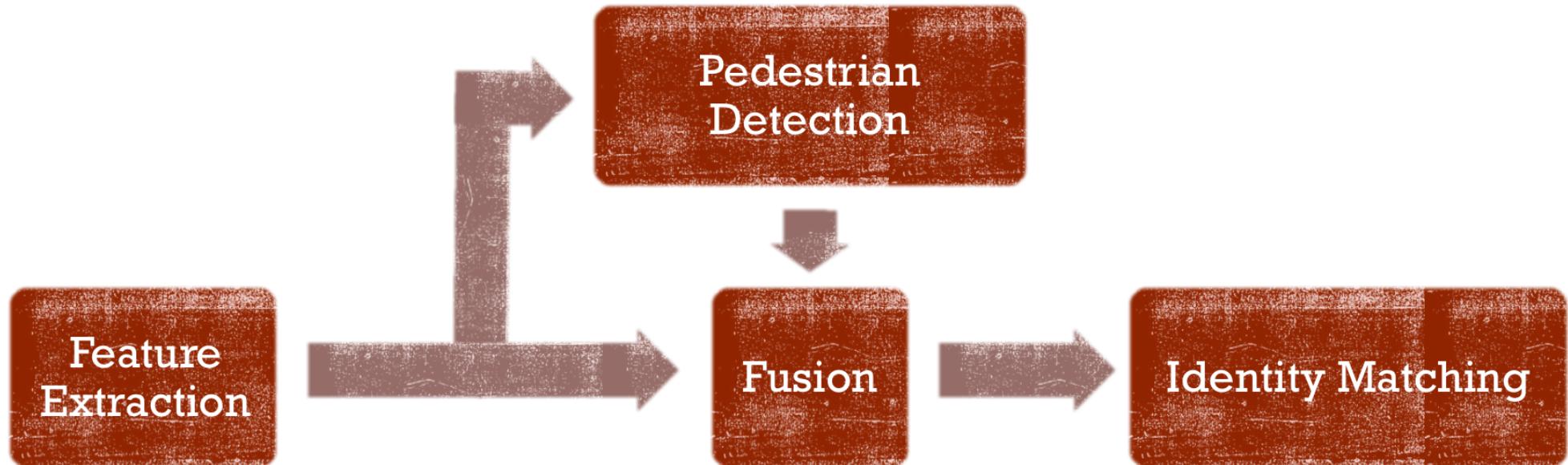
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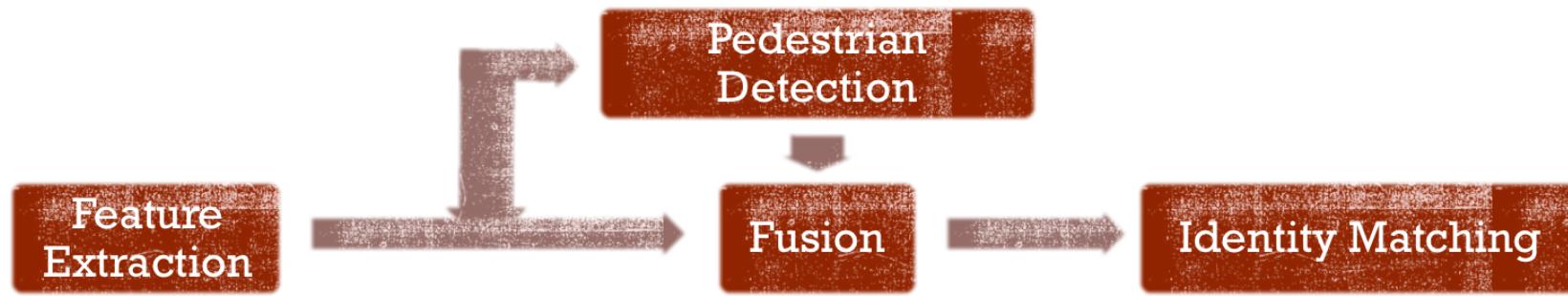
CONVOLUTIONAL NEURAL NETWORK



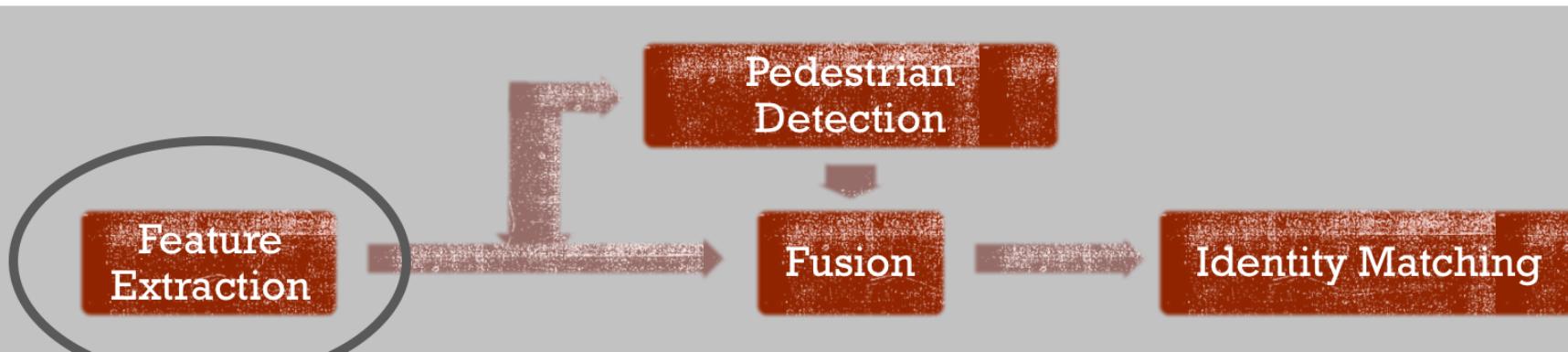
DIID ARCHITECTURE



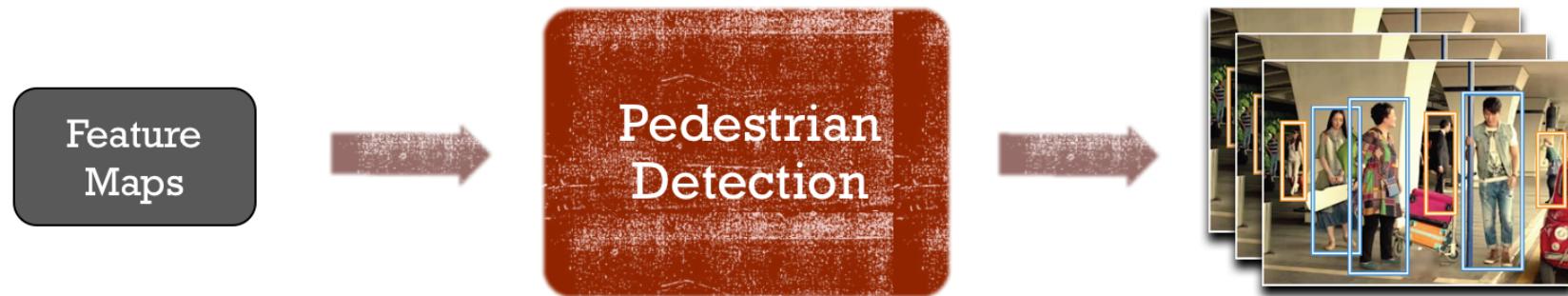
DIID ARCHITECTURE



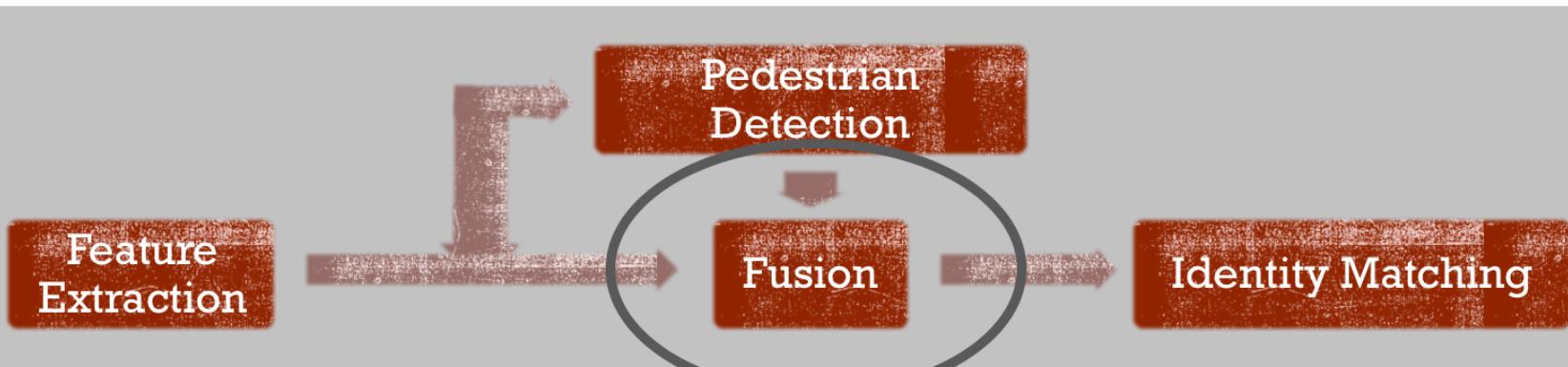
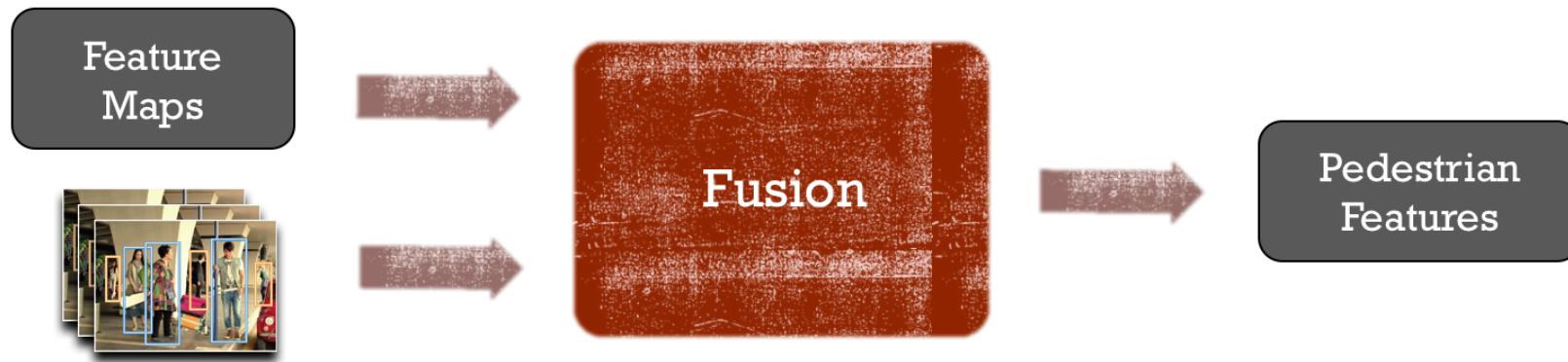
FEATURE EXTRACTION



PEDESTRIAN DETECTION



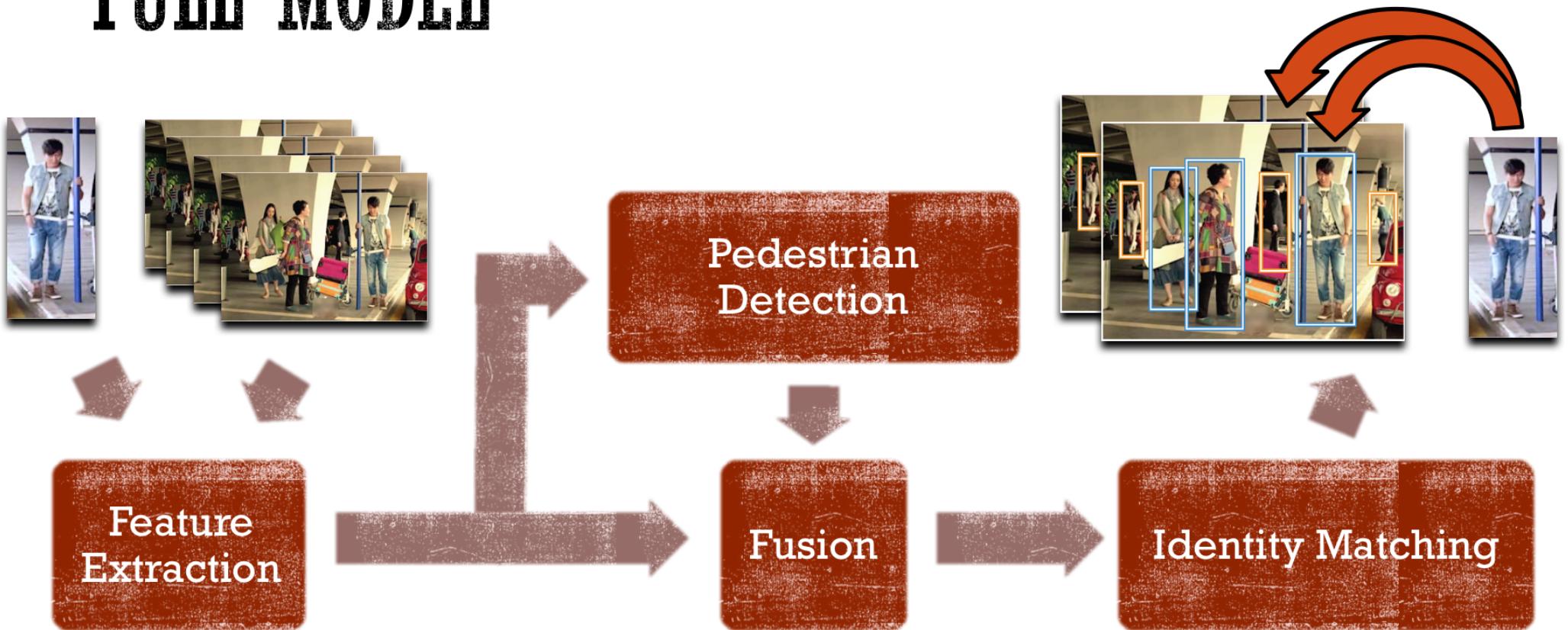
FUSION LAYER



IDENTITY MATCHING



FULL MODEL



FULL MODEL

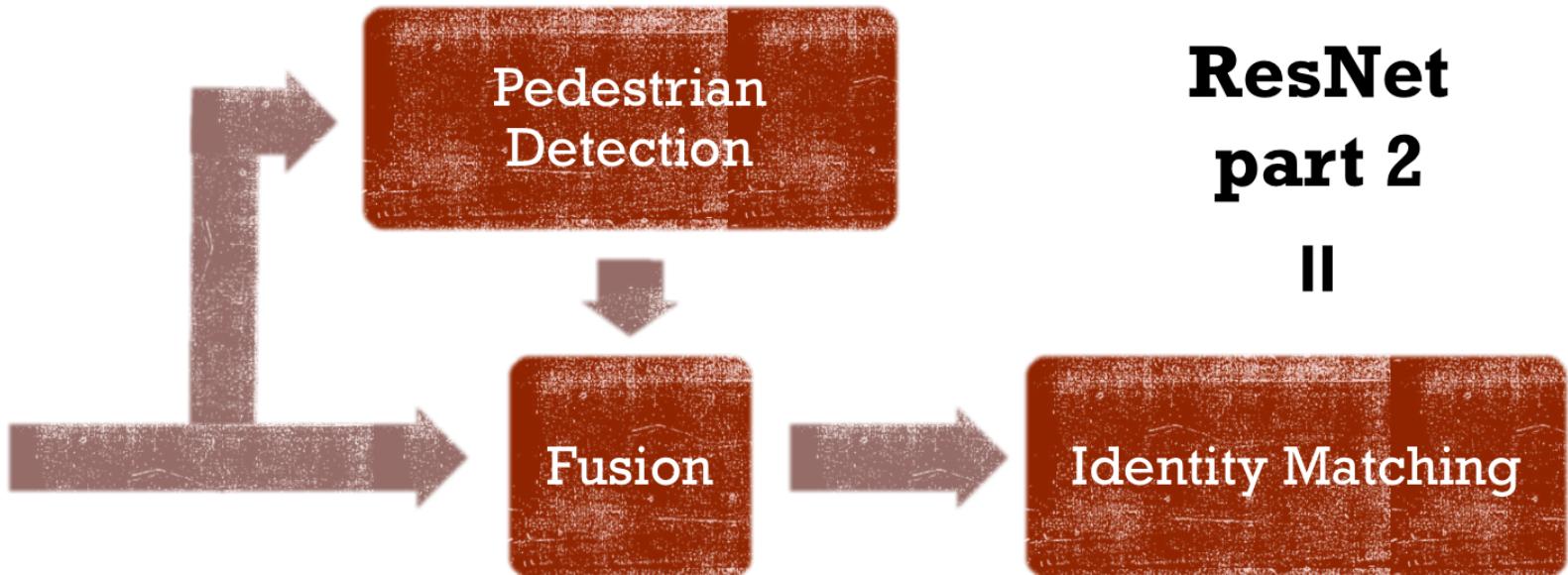
Region Proposal Network (RPN)

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ResNet part 1

||

Feature
Extraction



ResNet part 2

||

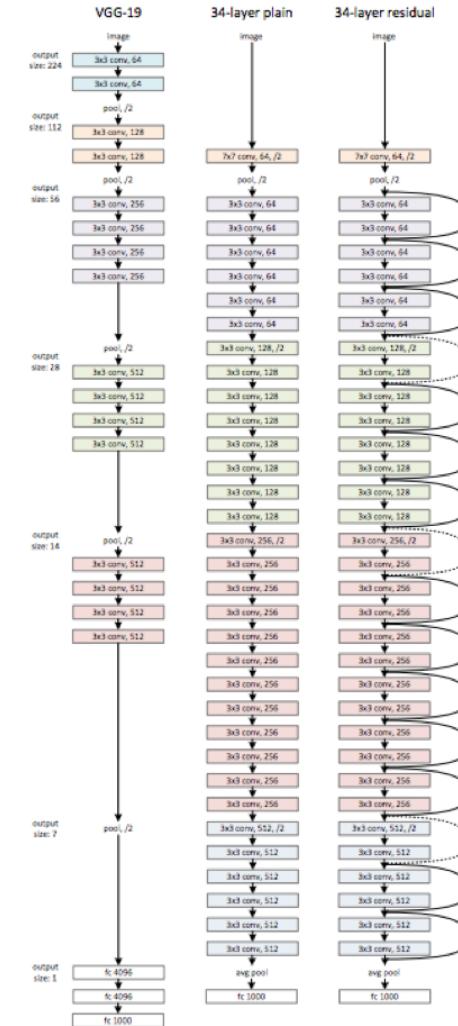
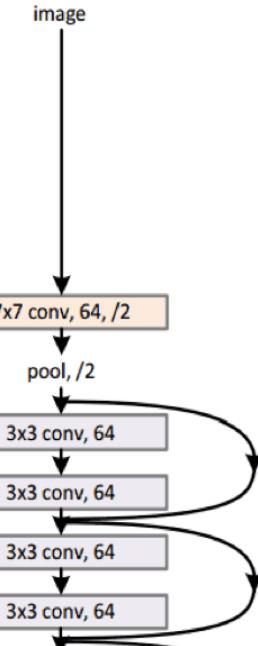
Identity Matching



RESNET

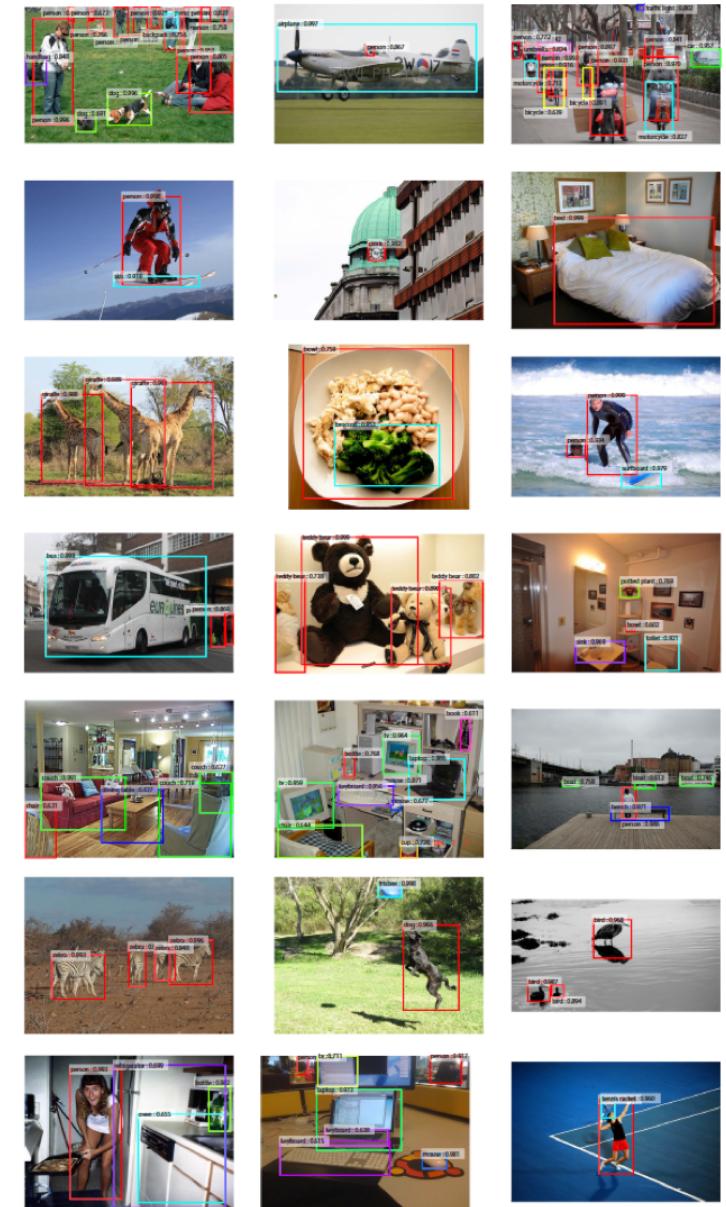
- Up to 152 layers
 - (One of) The best CNN we currently have

34-layer residual



RPN

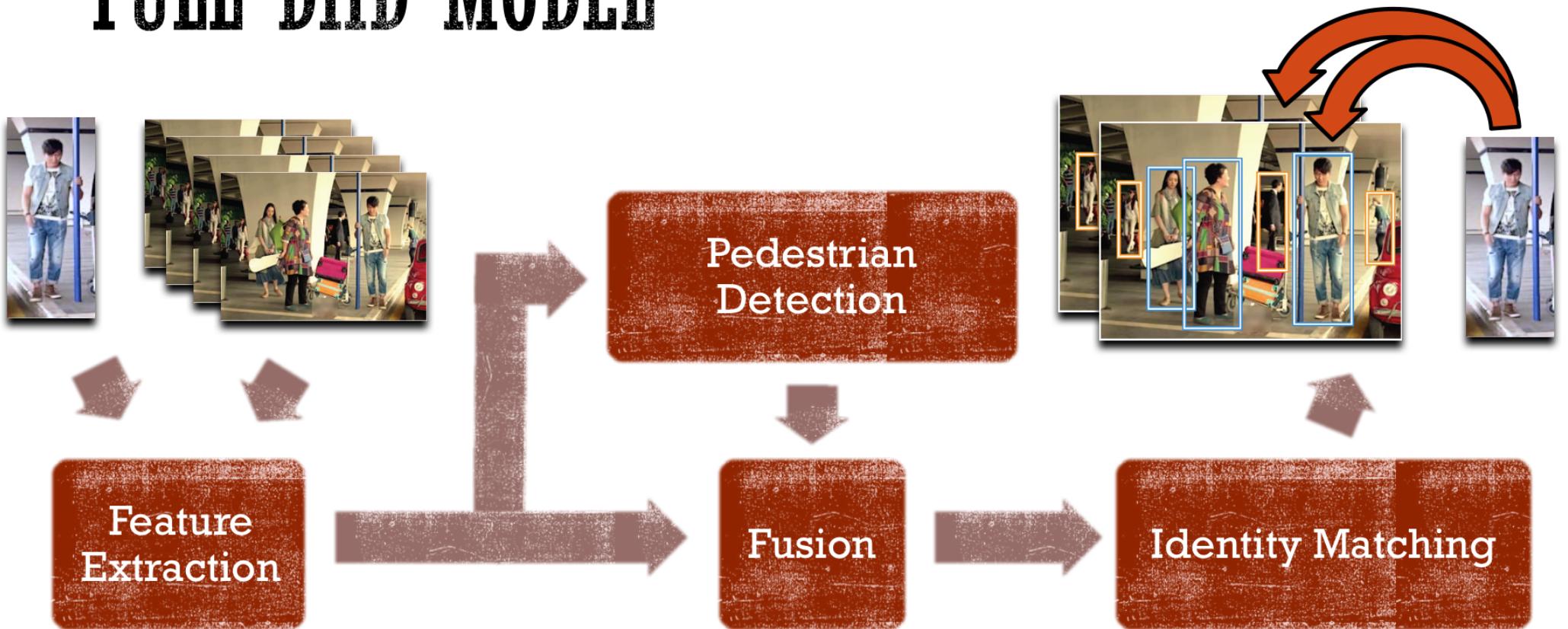
- Region Proposal Network
- State-of-the-art, fast algorithm for predicting object locations
- Runs at near real-time frame rates



- **ResNet:**
 - Deep residual learning for image recognition. K. He et al. CVPR. 2016. ^[6]
- **RPN:**
 - Faster r-cnn: Towards real-time object detection with region proposal networks. S. Ren et al. NIPS 2015. ^[7]



FULL DIID MODEL



QUESTIONS?



REFERENCES

- [1] Person Re-Identification by Deep Joint Learning of Multi-Loss Classification. Wei Li et al. IJCAI. 2017.
- [2] Large scale similarity learning using similar pairs for person verification. Yang Yang et al. AAAI. 2016.
- [3] Fast Person Re-Identification via Cross-Camera Semantic Binary Transformation. Jiaxin Chen et al. CVPR. 2017.
- [4] Person Re-Identification in the Wild. Liang Zheng et al.. CVPR. 2017.
- [5] Joint Detection and Identification Feature Learning for Person Search. Tong Xiao et al. CVPR. 2017.
- [6] Deep residual learning for image recognition. K. He et al. CVPR. 2016.
- [7] Faster r-cnn: Towards real-time object detection with region proposal networks. S. Ren et al. NIPS 2015.

