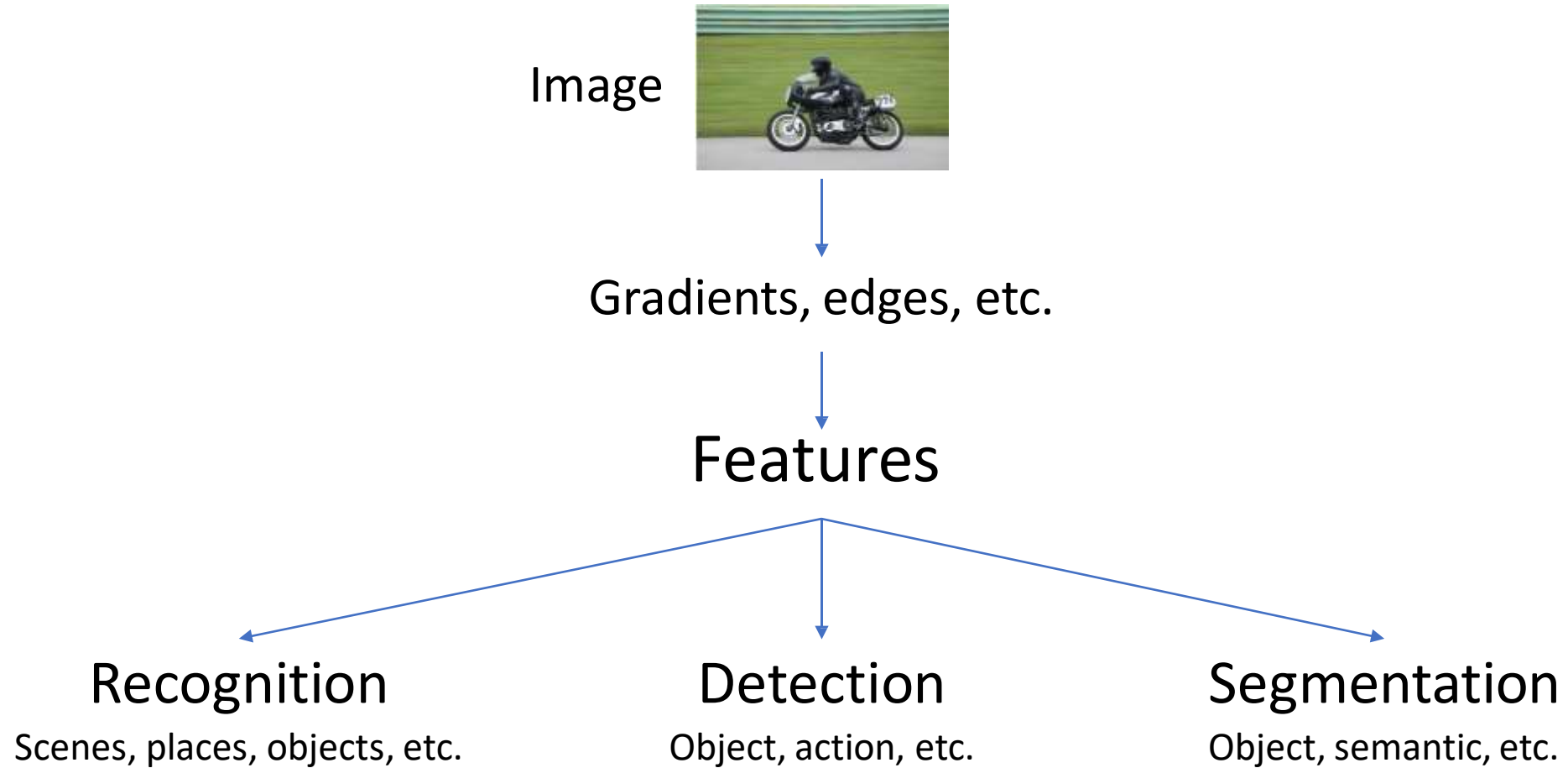


Today topics:

The motivation of Neural networks:

- Feature Learning
- Dataset Split
- idea Label
- Learning vs Testing
- Machine Learning Framework

Where to go from edges?



Our goal in object classification

Our goal in object classification

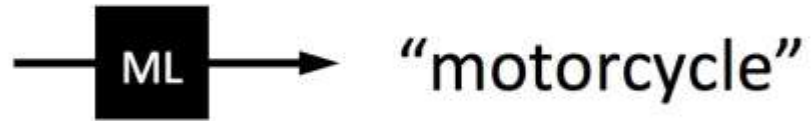


Our goal in object classification



— ML

Our goal in object classification



Why is this hard?

You see this:



Why is this hard?

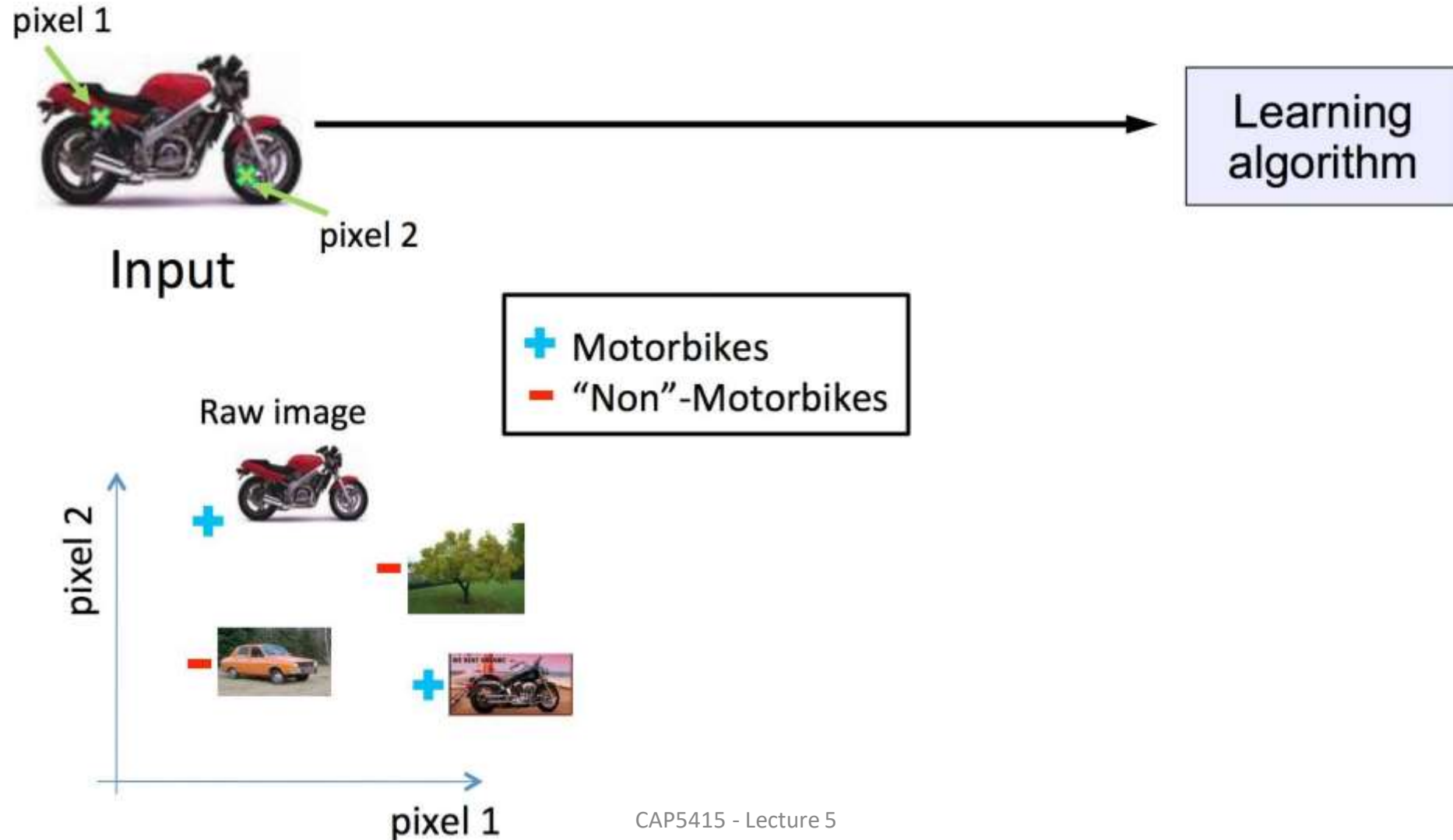
You see this:



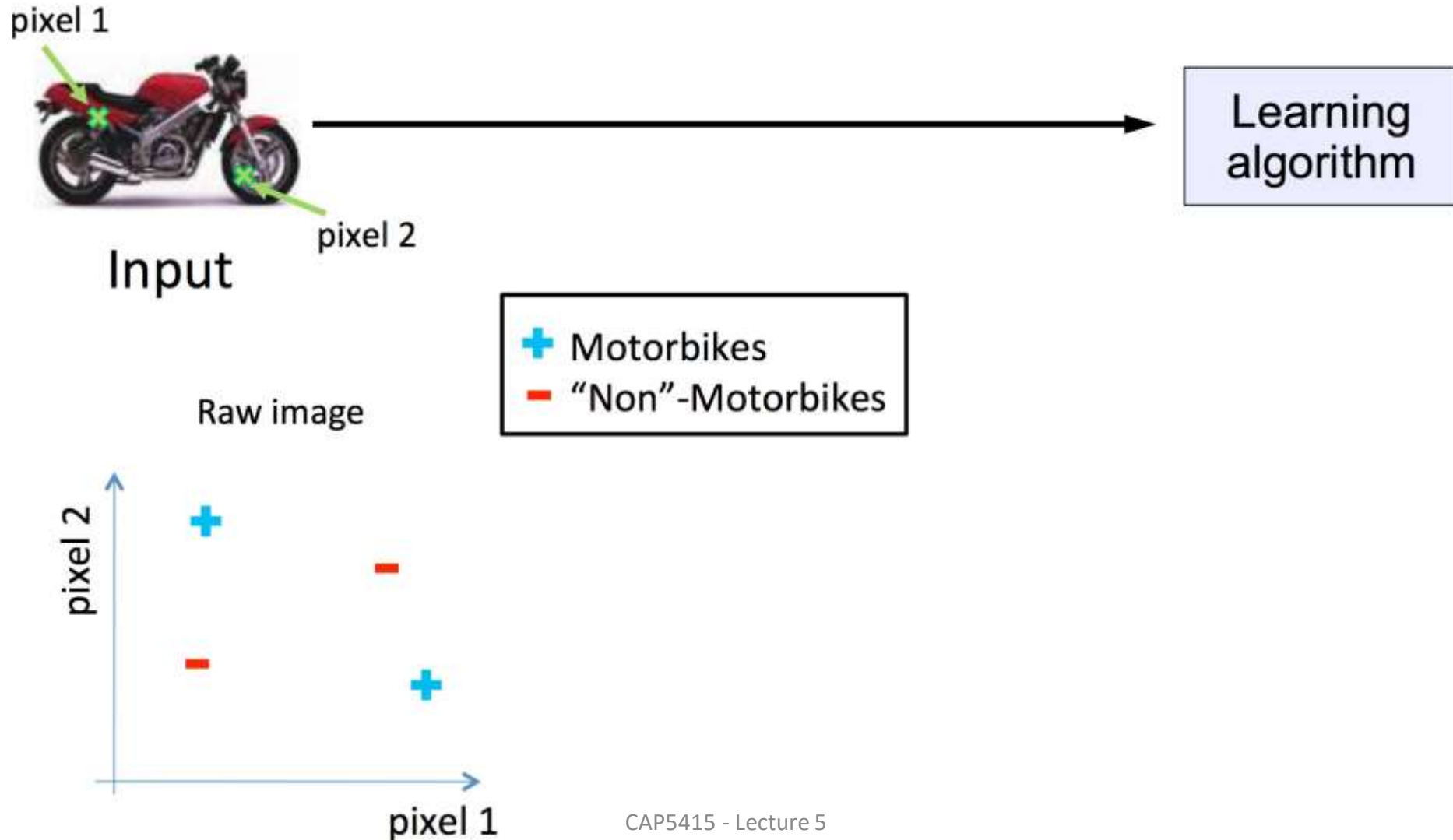
But the camera sees this:

194	210	201	212	199	213	215	195	178	158	182	209
180	189	190	221	209	205	191	167	147	115	129	163
114	126	140	188	176	165	152	140	170	106	78	88
87	103	115	154	143	142	149	153	173	101	57	57
102	112	106	131	122	138	152	147	128	84	58	66
94	95	79	104	105	124	129	113	107	87	69	67
68	71	69	98	89	92	98	95	89	88	76	67
41	56	68	99	63	45	60	82	58	76	75	65
20	43	69	75	56	41	51	73	55	70	63	44
50	50	57	69	75	75	73	74	53	68	59	37
72	59	53	66	84	92	84	74	57	72	63	42
67	61	58	65	75	78	76	73	59	75	69	50

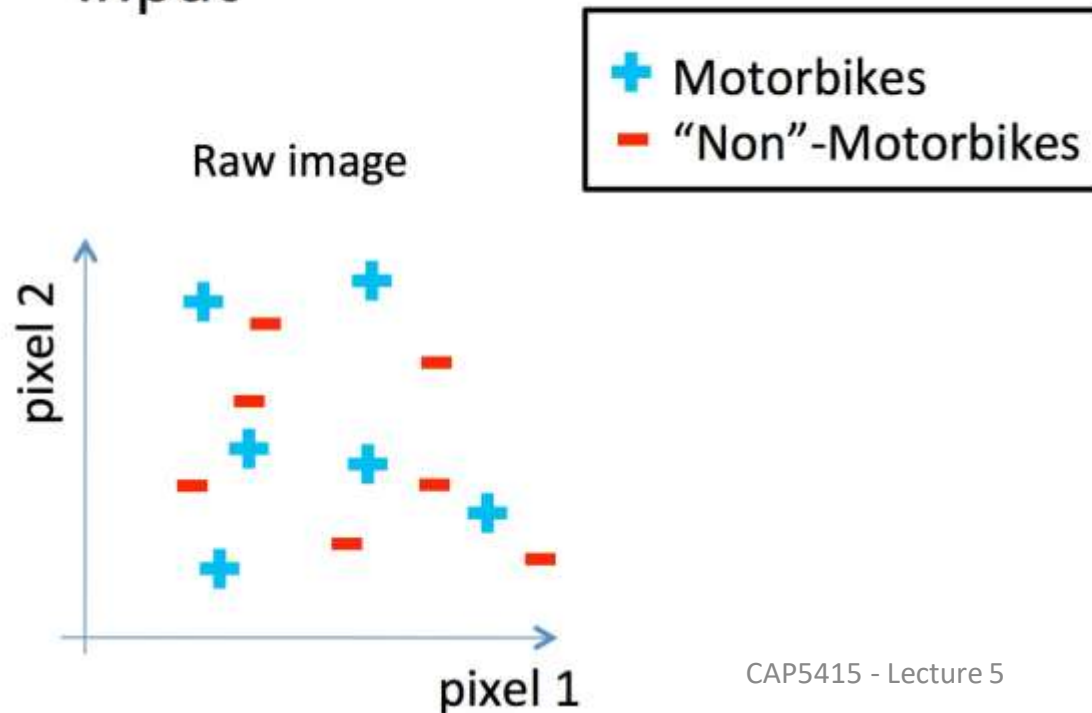
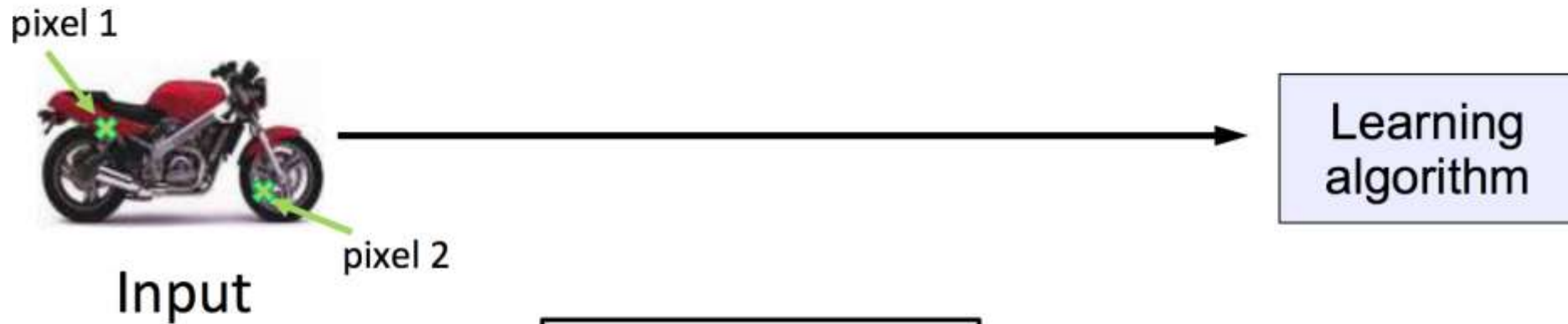
Pixel-based representation



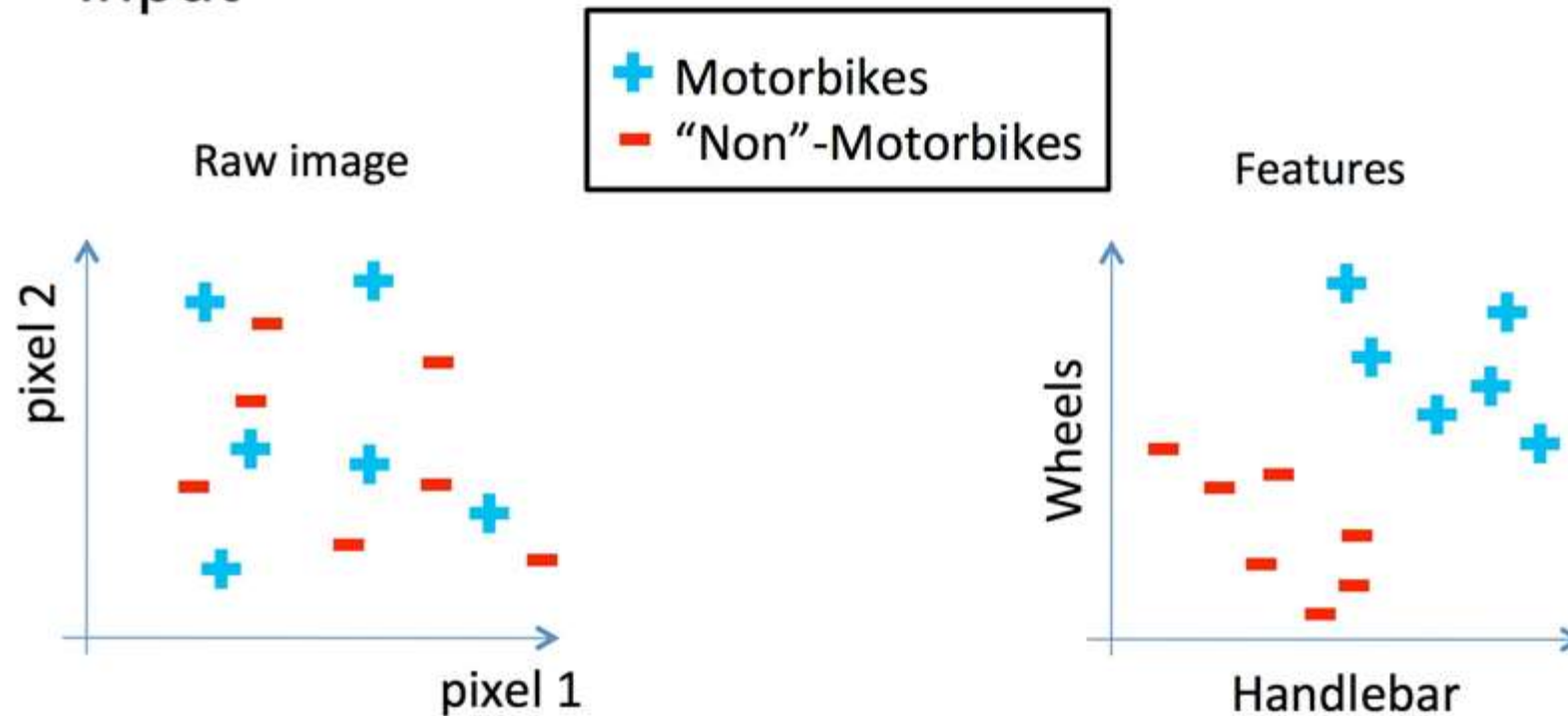
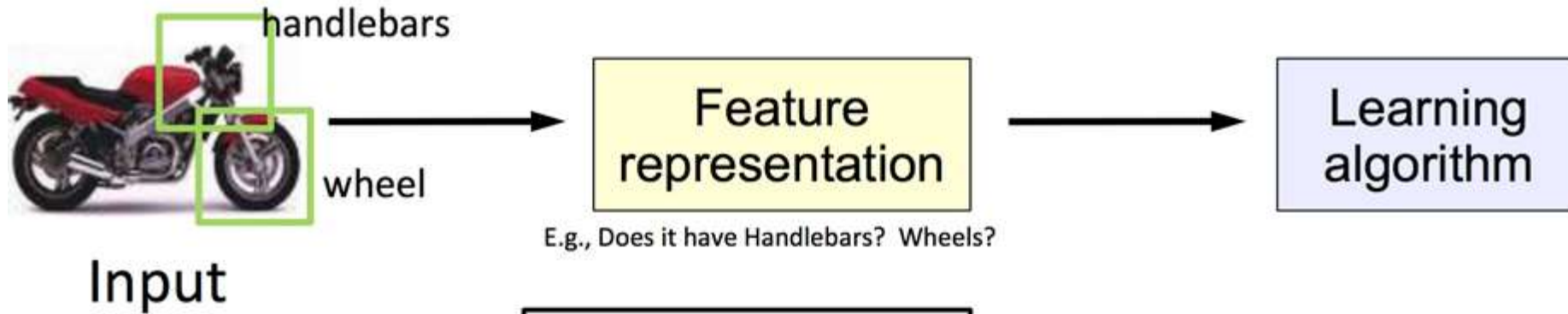
Pixel-based representation



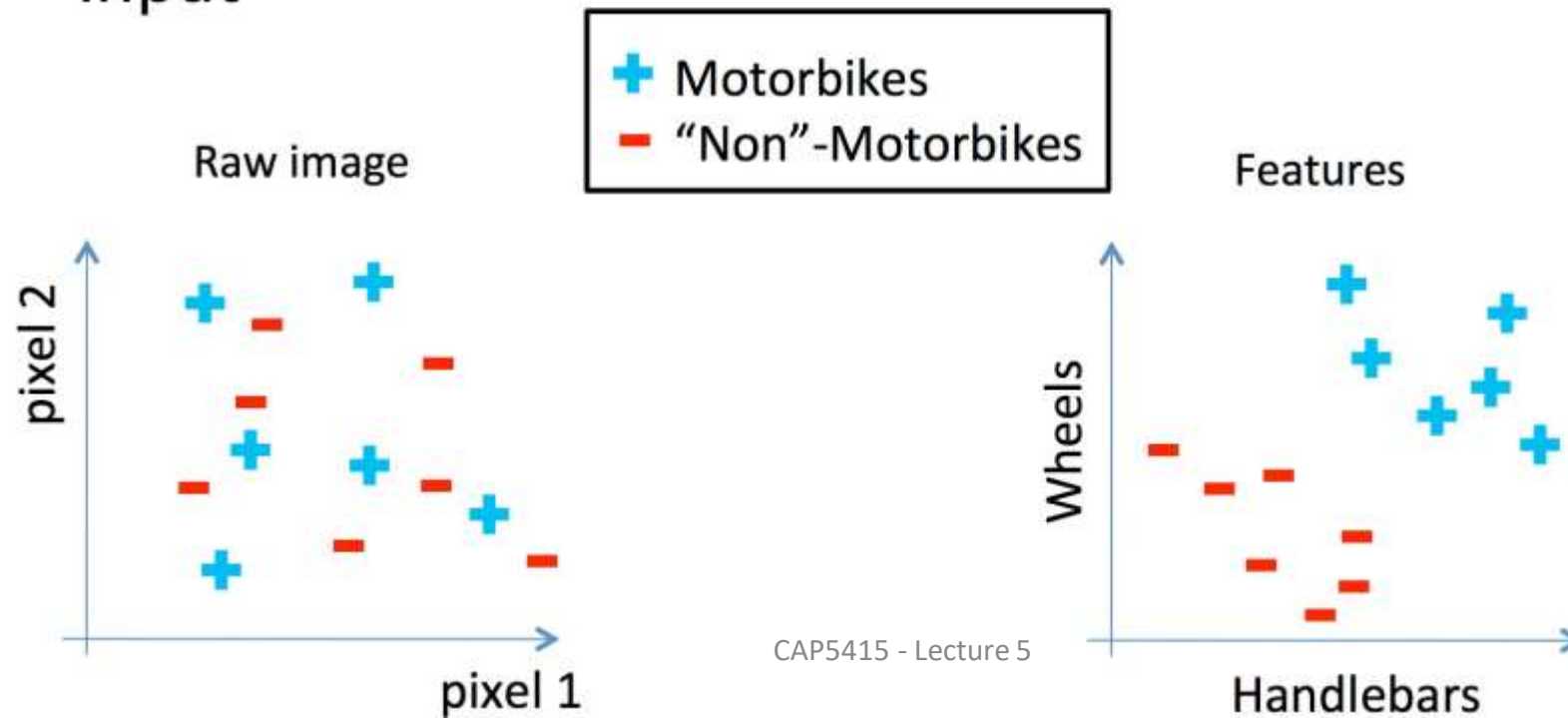
Pixel-based representation



What we want



What we want



Classical feature extraction algorithms:

- HoG
- SIFT
-

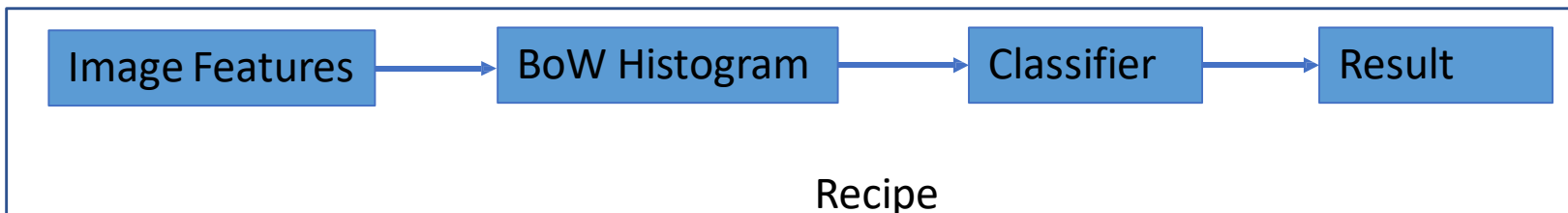
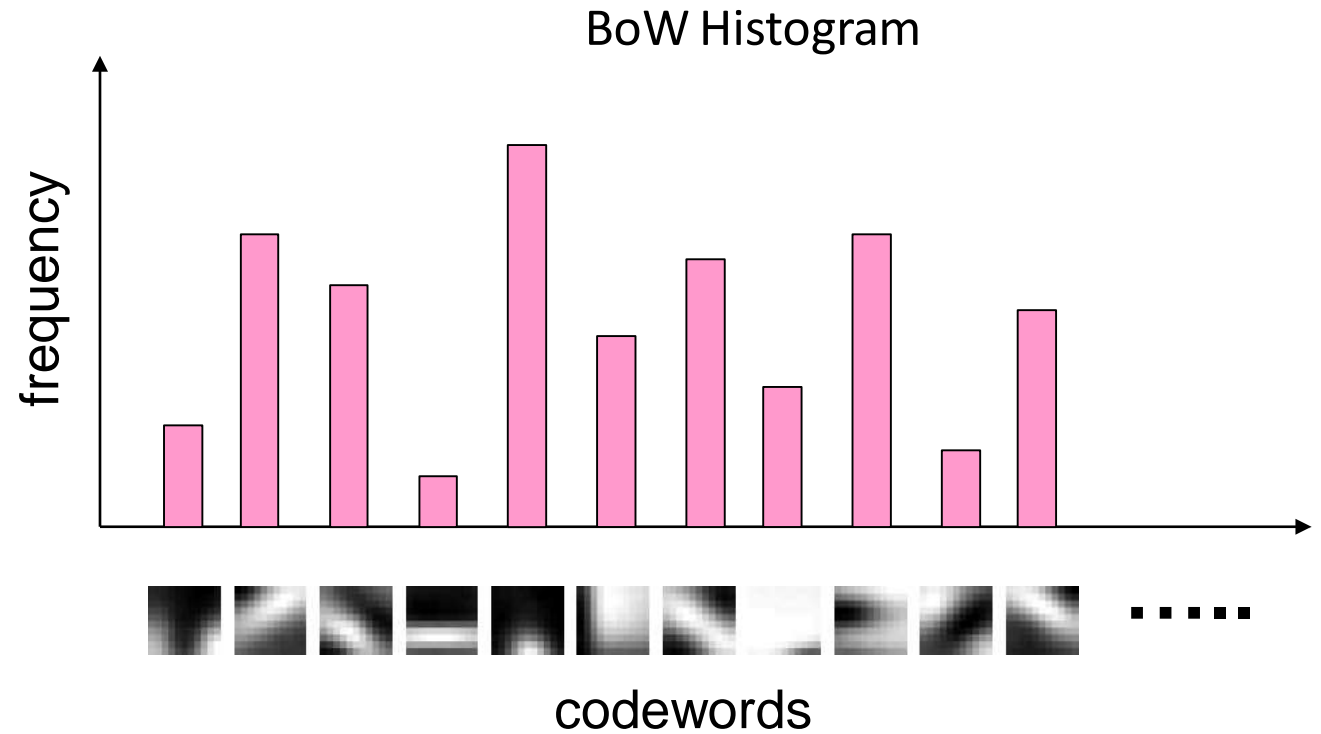
There is a wide range of algorithms that do so for us

Coming up with features is often difficult, time-consuming, and requires expert knowledge.

“Bag-of-Words” (BoW) Histograms



Image



Today

Feature engineering

Expert knowledge

->

Feature learning

Data

Image classification - ImageNet

- Images for each category of WordNet
- 1000 classes
- 14M images
- 100K test



Dataset split

Training
Images



- Train classifier

Validation
Images



- Measure error
- Tune model hyperparameters

Testing
Images

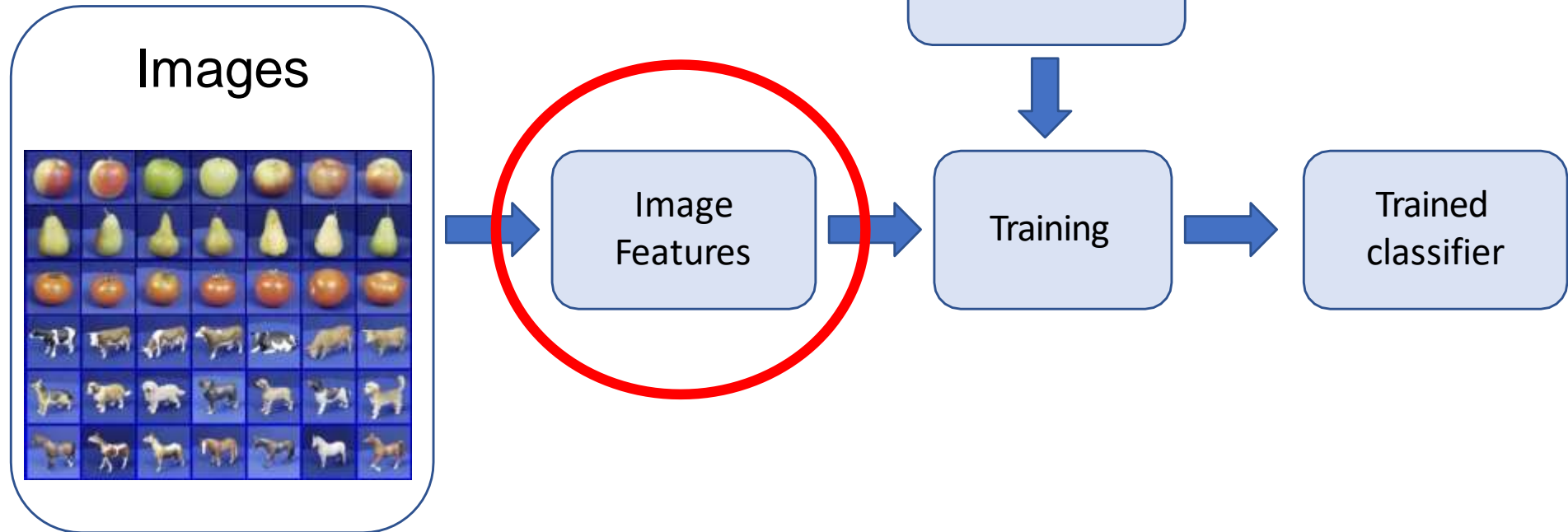


- Secret labels
- Measure error

Random train/validate splits = cross validation

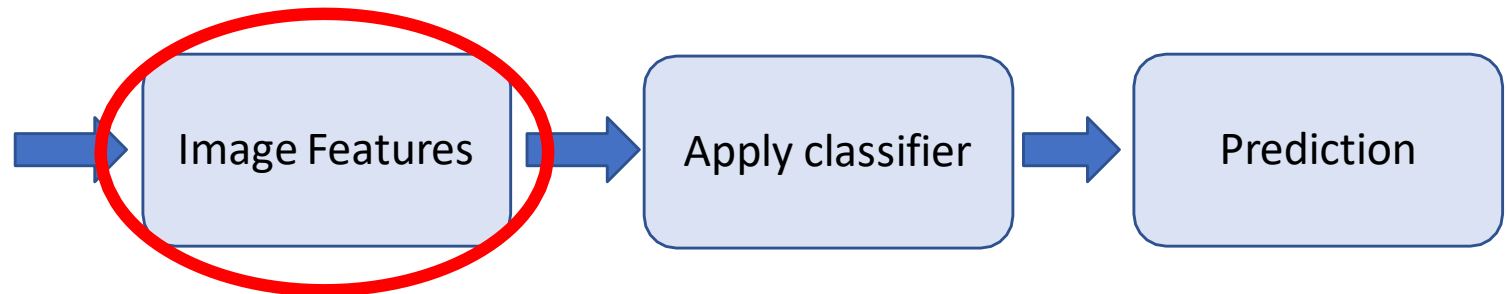
Learning phases

Training



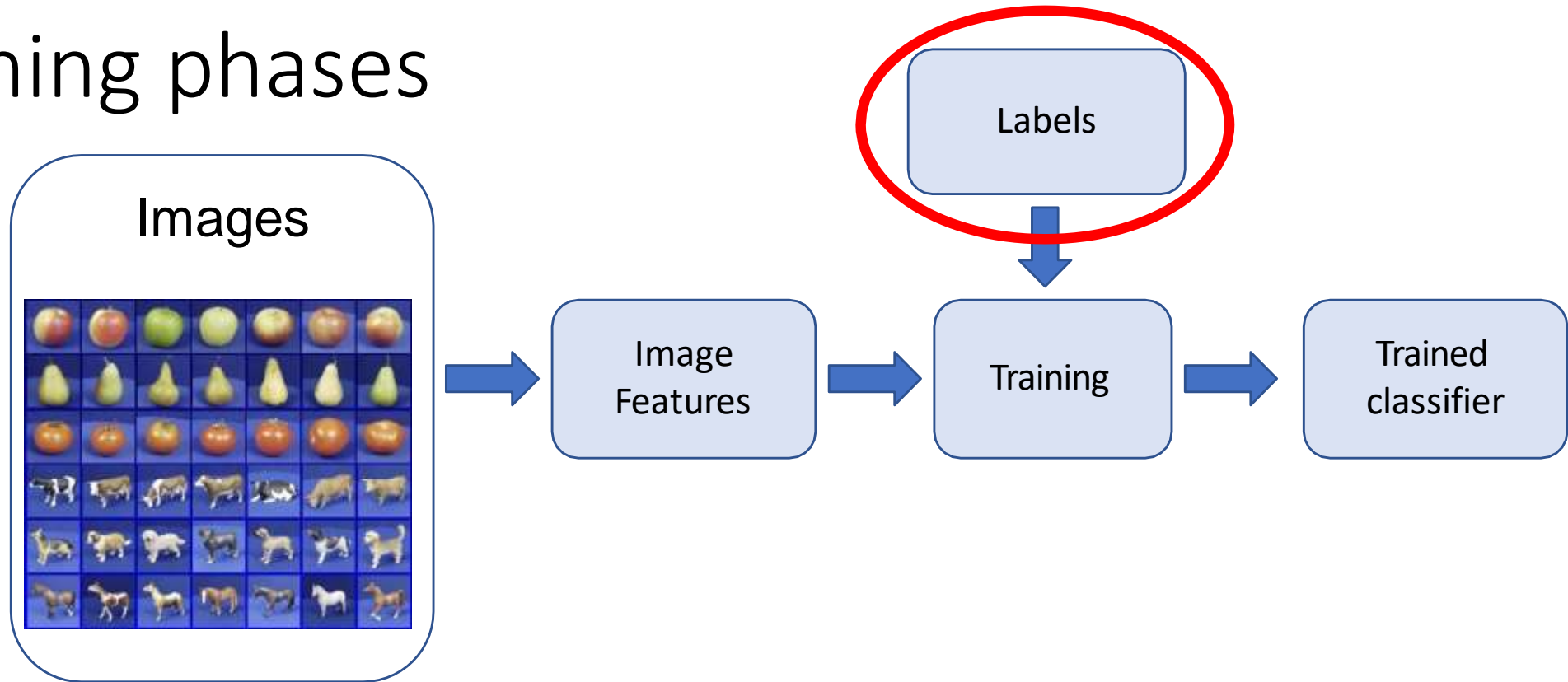
Testing

Image
not in
training set

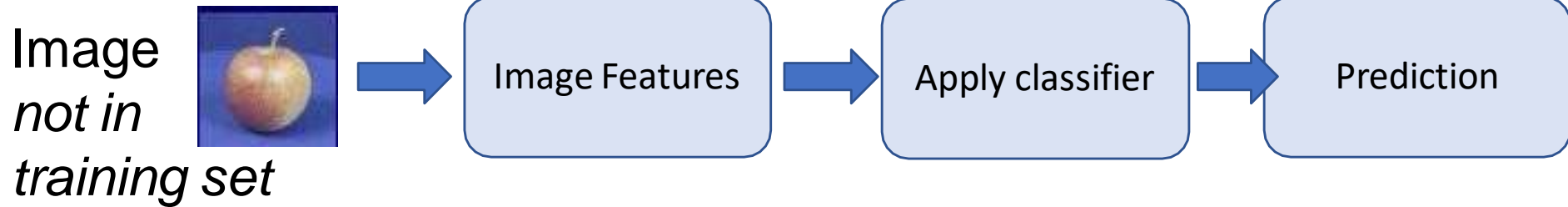


Learning phases

Training



Testing





Recognition task and supervision

What are all the possible supervision ('label') *types* to consider?



Contains a motorbike



Recognition task and supervision

What are all the possible supervision ('label') *types* to consider?

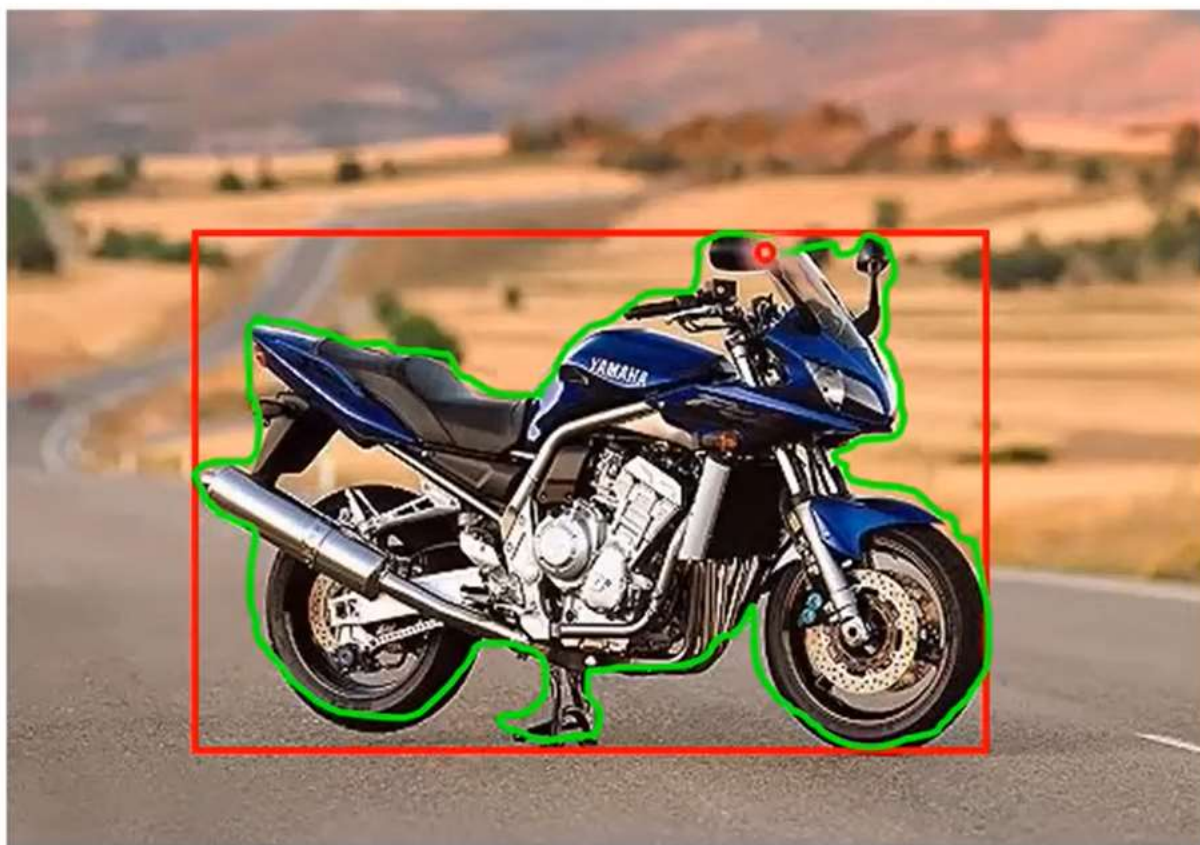


Contains a motorbike



Recognition task and supervision

What are all the possible supervision ('label') *types* to consider?



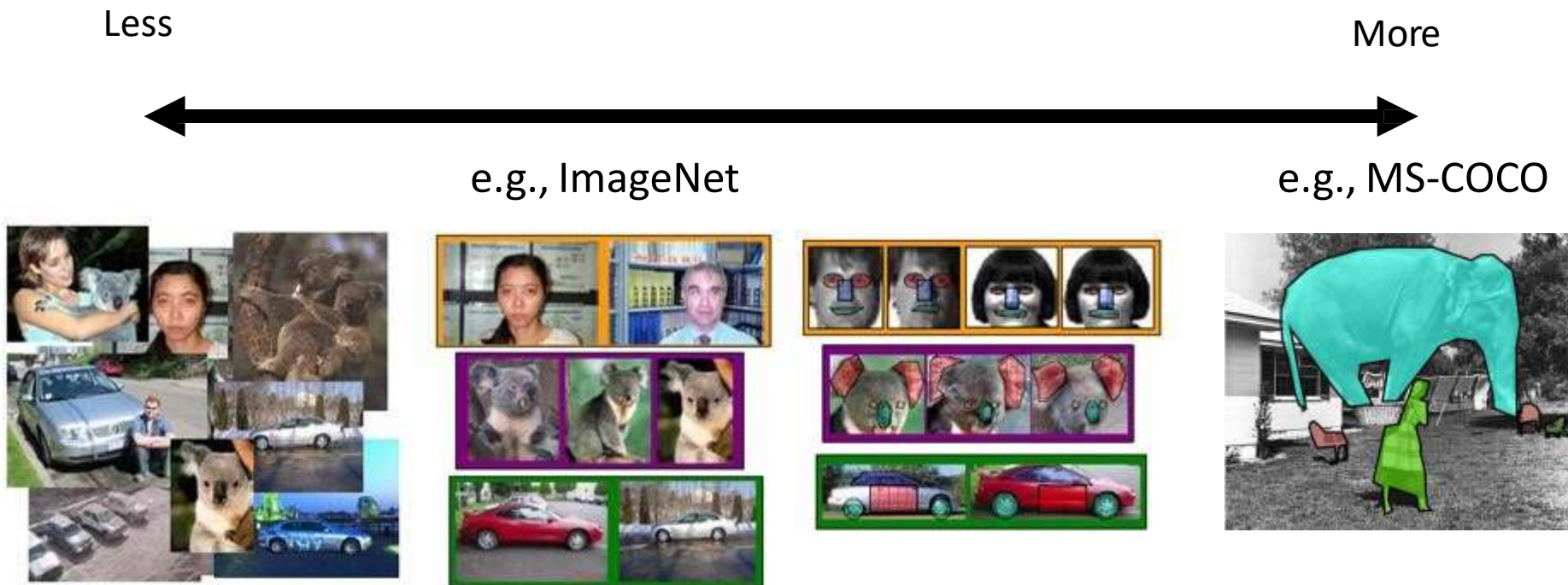
Contains a motorbike



Spectrum of supervision

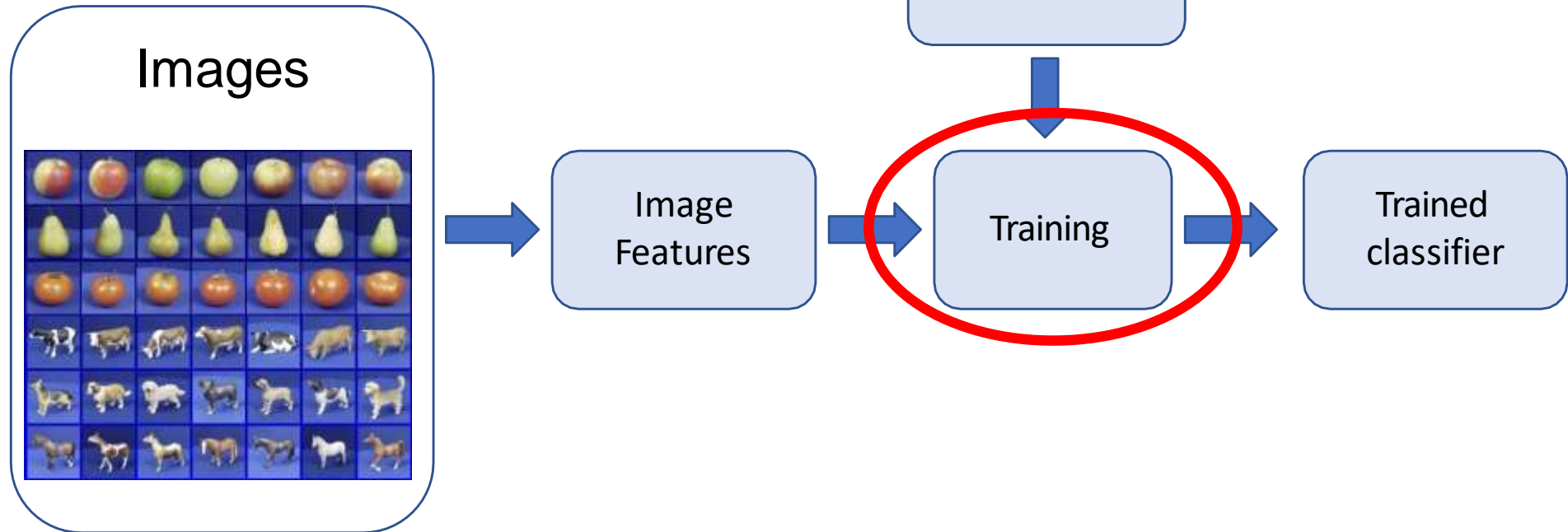
Less

More

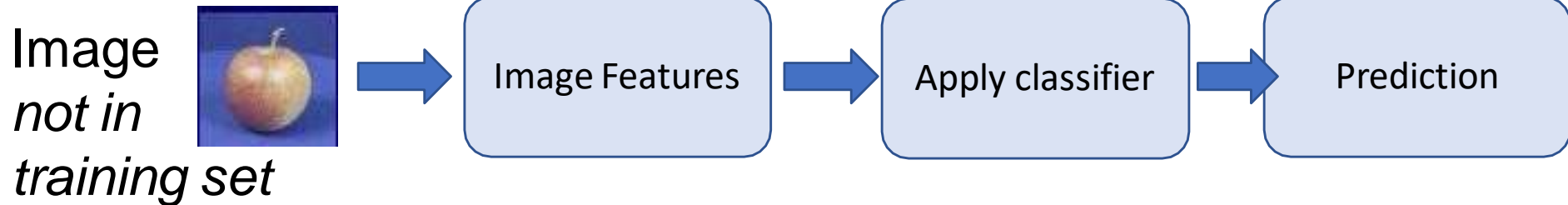


Learning phases

Training



Testing



The machine learning framework

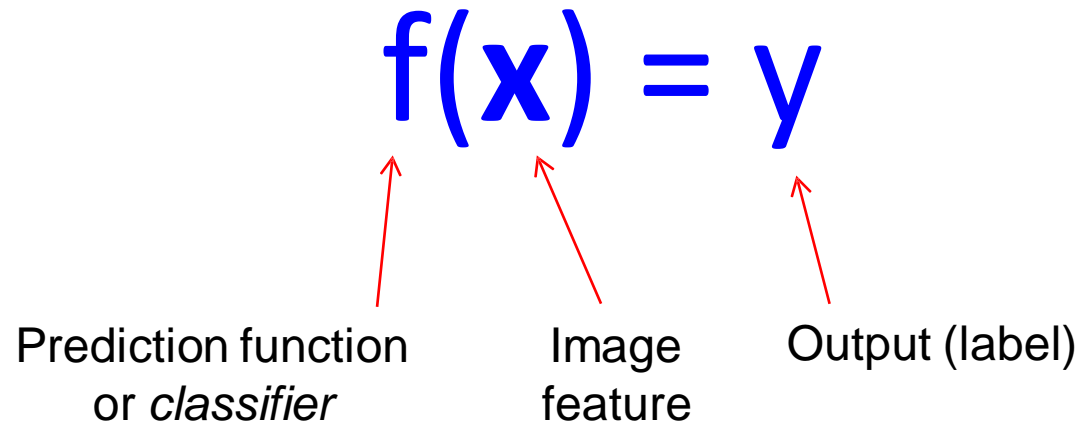
- Apply a prediction function to a feature representation of the image to get the desired output:

$f(\text{apple image}) = \text{"apple"}$

$f(\text{tomato image}) = \text{"tomato"}$

$f(\text{cow image}) = \text{"cow"}$

The machine learning framework



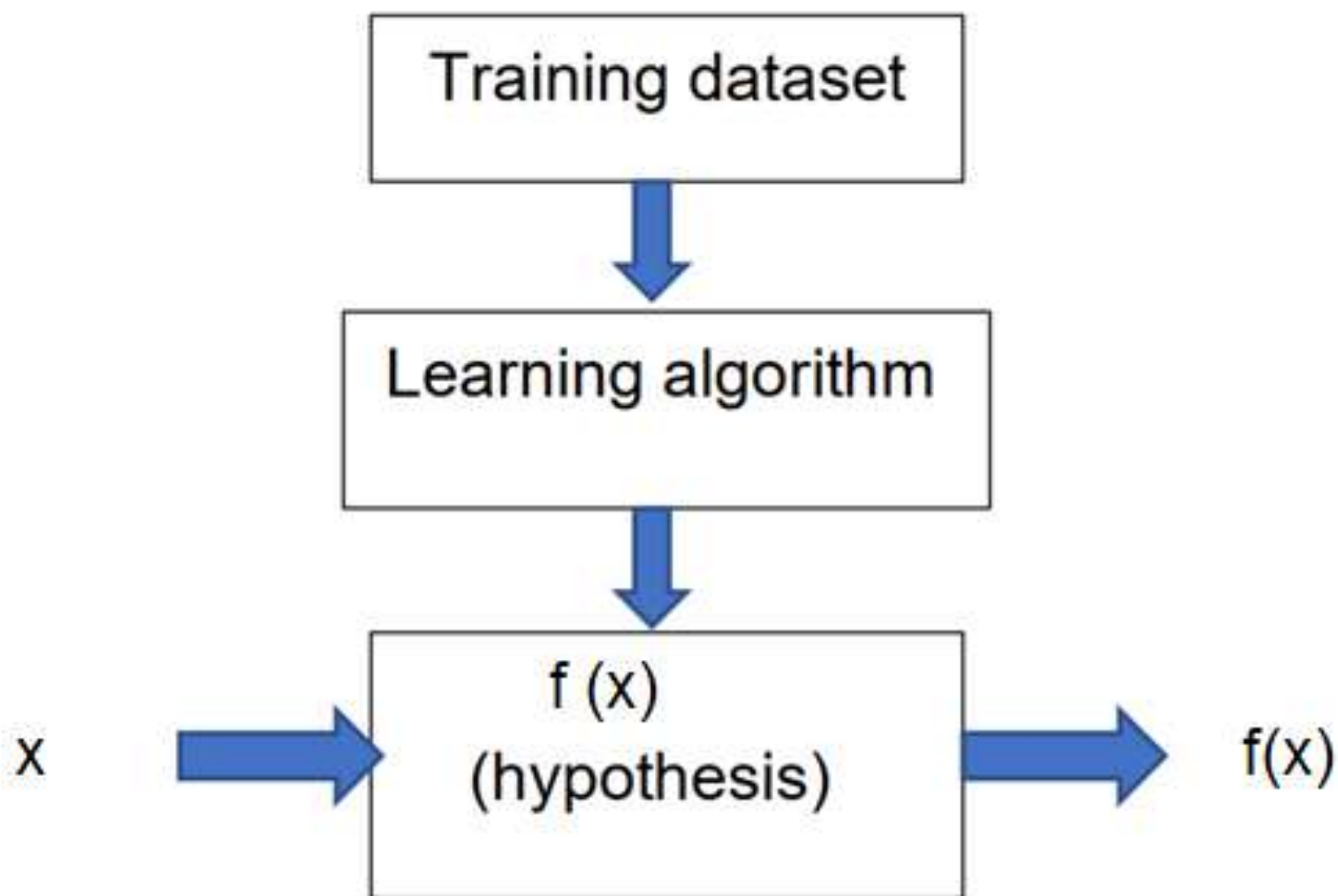
Training: Given a *training set* of labeled examples:

$$\{(\mathbf{x}_1, y_1), \dots, (\mathbf{x}_N, y_N)\}$$

Estimate the prediction function f by minimizing the prediction error on the training set.

Testing: Apply f to an unseen *test example* \mathbf{x}_u and output the predicted value $y_u = f(\mathbf{x}_u)$ to *classify* \mathbf{x}_u .

how the supervising algorithm works:



Source: CAP5415 Computer Vision

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HEC-241