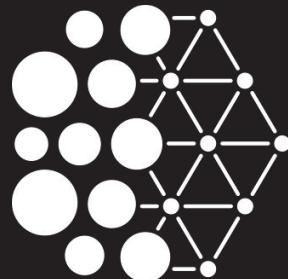


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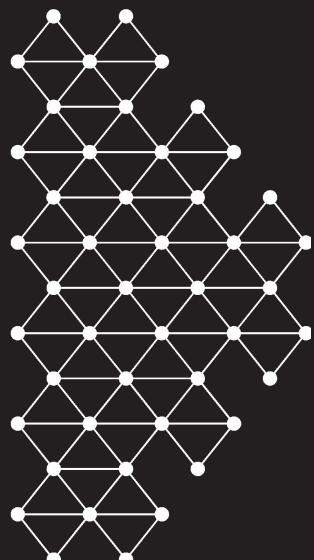
Introduction to Deep Learning

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Intuition

Simple question: what is a chair?

Definition (Merriam-Webster):
a seat typically having four legs
and a back for one person.

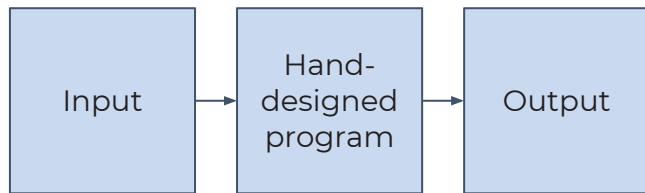
How to code a program that
recognizes chair in images?



Source: Wikimedia commons

History of ML

Rule-based
System



Example: what is a chair?

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a seat typically having four legs
and a back for one person.

How to code a program that
recognizes a chair in an image?

Feature extraction:

- Does it have four legs?
- Does it have a back?
- Can we seat on it?



Source: Wikimedia commons

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Source: Holger.Ellgaard - Own work, CC BY-SA 3.0,
<https://commons.wikimedia.org/w/index.php?curid=2815995>

Example: what is a chair?

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a seat **typically** having four legs
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recognizes a chair in an image?

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Source: Sailko, Wikimedia commons

Example: what is a chair?

The features must be robust to the factors of variation of a chair.



Example: what is a chair?

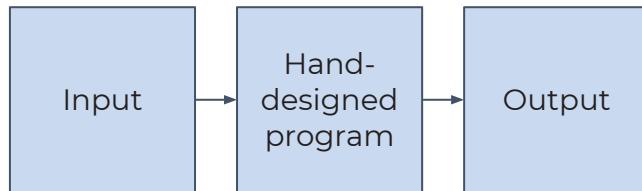
The features must be robust to the factors of variation of a chair and its surroundings.



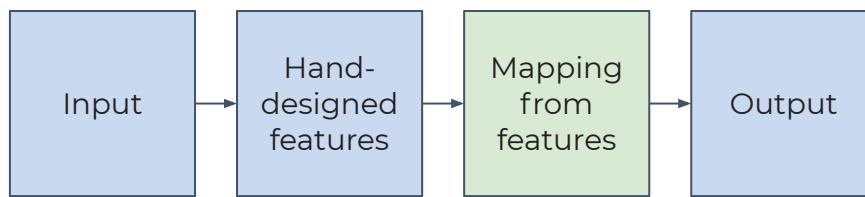
Source: Kelly Miller, Unsplash

History

Rule-based
System



Classic ML



How to build these features?

Pattern Recognition

We know this is a chair.



Is it a chair?



Source: Kelly Miller, Unsplash

How to build these features?

Pattern Recognition

We extract a pattern.



Is it a chair?

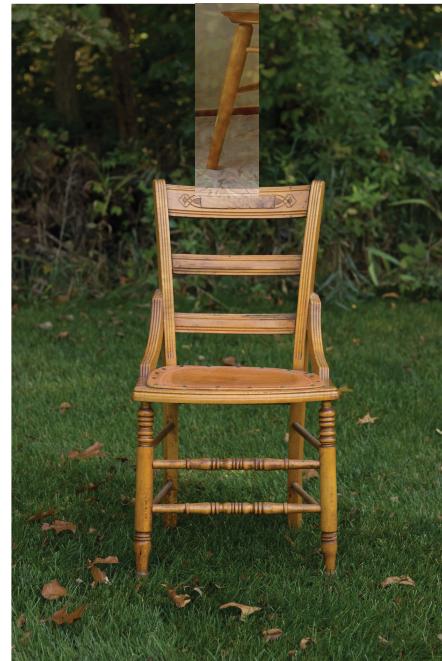


Source: Kelly Miller, Unsplash

How to build these features?

Pattern Recognition

Is the pattern here? No (0.1)



How to build these features?

Pattern Recognition

Is the pattern here? Maybe (0.5)



How to build these features?

Pattern Recognition

Is the pattern here? Probably (0.75)



Pattern recognition

- We compare many patterns with the data.
- Each comparison has a score indicating if the pattern matches the data.
- These scores are the new features representing the data.



Source: Kelly Miller, Unsplash

Pattern recognition

Why did we use only a small part of the original image as a pattern?



Pattern recognition

Why did we use only a small part of the original image as a pattern?

Because sub-parts are more “simple” than the whole and so, it correlates more easily.



Pattern recognition

Compositionality principle:

The **whole** is made only from its **parts**.

The compositionality principle can apply to multiple scales.



Source: Alphacolor, Unsplash

Deep learning

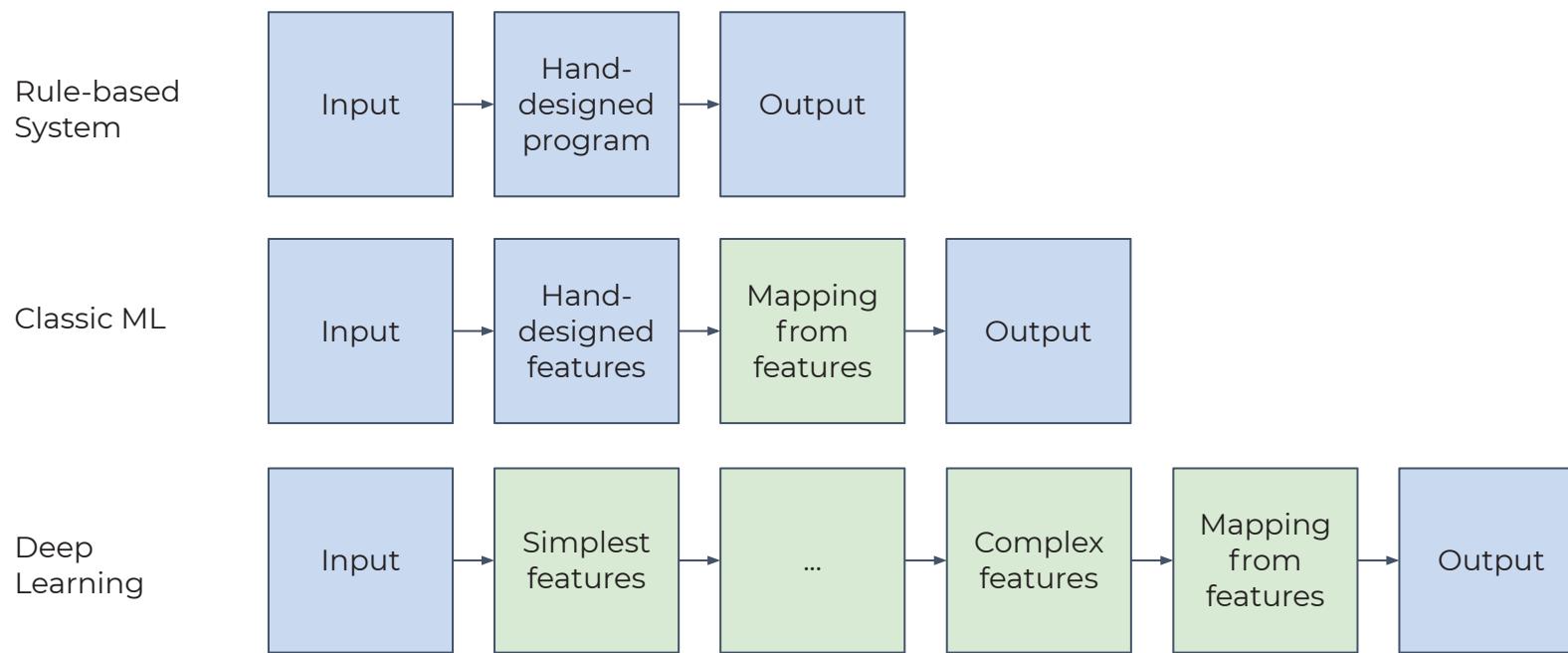
Can we learn automatically the patterns at different scales with supervised learning?

Yes, this is deep learning!



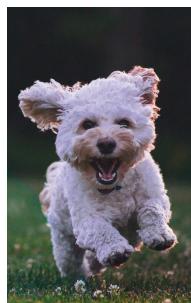
Source: Alphacolor, Unsplash

History



What are good representations?

Source: Edgar Edgar, Unsplash



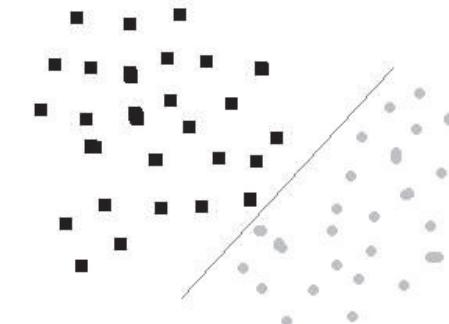
Input



...



Source: Wikimedia, commons



Representations that
are linearly separable

Source: Joe Caione, Unsplash