

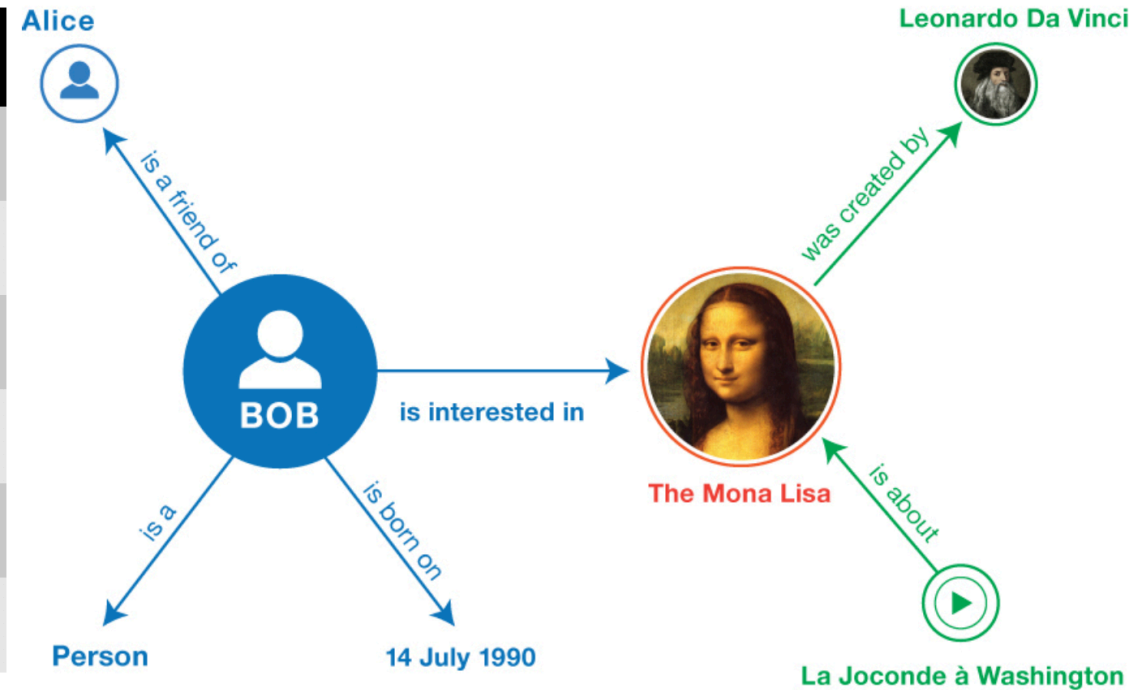
On the Role of Knowledge Graphs in Explainable Machine Learning

On the Role of Knowledge Graph in Explainable AI - under open review at the Semantic Web Journal -
<http://www.semantic-web-journal.net/content/role-knowledge-graphs-explainable-ai>

Knowledge Graph (1)

- Set of (*subject*, *predicate*, *object* — **SPO**) **triples** - *subject* and *object* are **entities**, and *predicate* is the **relationship** holding between them.
- Each SPO **triple** denotes a **fact**, i.e. the existence of an actual relationship between two entities.

subject	predicate	object
<i>Bob</i>	<i>is interested in</i>	<i>The Mona Lisa</i>
<i>Bob</i>	<i>is a friend of</i>	<i>Alice</i>
<i>The Mona Lisa</i>	<i>was created by</i>	<i>Leonardo Da Vinci</i>
<i>Bob</i>	<i>is a</i>	<i>Person</i>
<i>La Joconde à W.</i>	<i>is about</i>	<i>The Mona Lisa</i>
<i>Bob</i>	<i>is born on</i>	<i>14 July 1990</i>



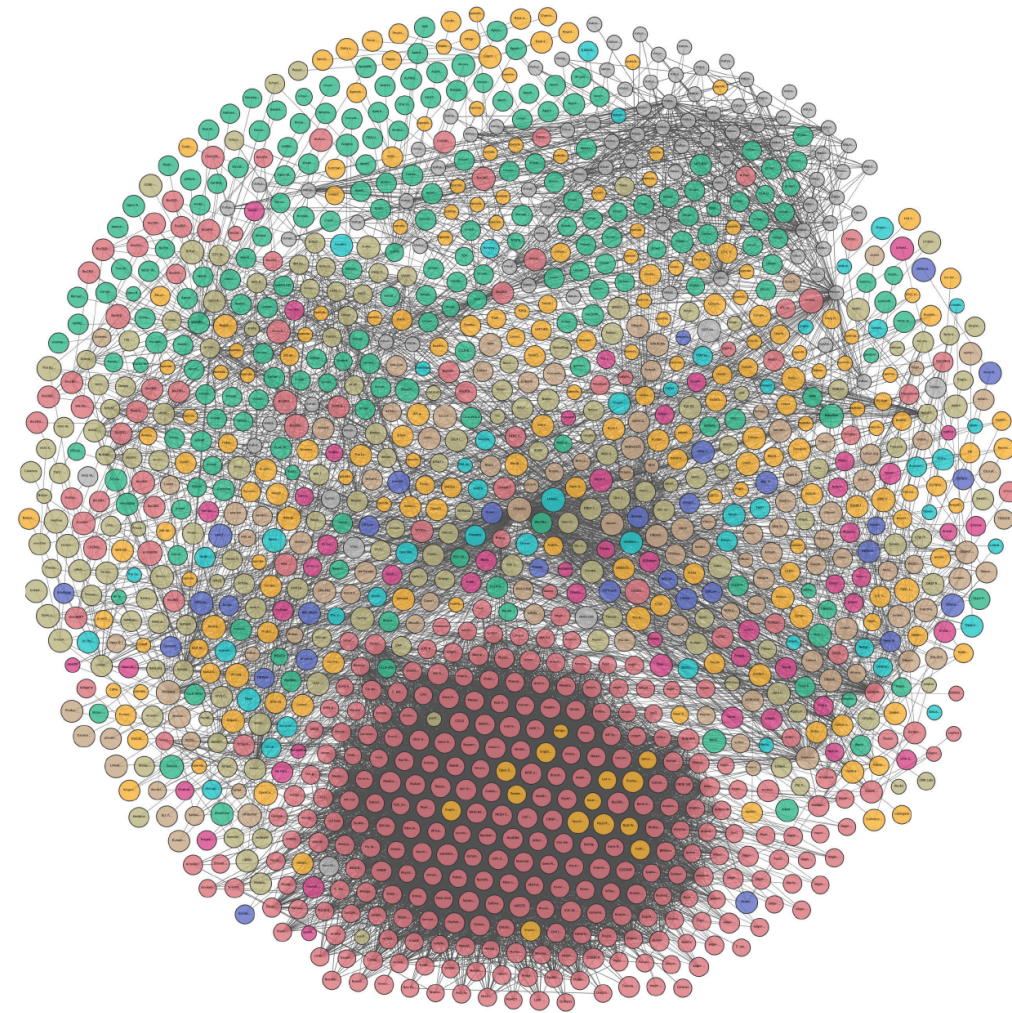
Knowledge Graph (2)

Name	Entities	Relations	Types	Facts
Freebase	40M	35K	26.5K	637M
DBpedia (en)	4.6M	1.4K	735	580M
YAGO3	17M	77	488K	150M
Wikidata	15.6M	1.7K	23.2K	66M
NELL	2M	425	285	433K
Google KG	570M	35K	1.5K	18B
Knowledge Vault	45M	4.5K	1.1K	271M
Yahoo! KG	3.4M	800	250	1.39B

- **Manual Construction** - curated, collaborative
- **Automated Construction** - semi-structured, unstructured

Right: **Linked Open Data cloud** - over 1200 interlinked KGs encoding more than 200M facts about more than 50M entities.

Spans a variety of domains - Geography, Government, Life Sciences, Linguistics, Media, Publications, Cross-domain..



Knowledge Graph Construction

Knowledge Graph construction methods can be classified in:

- **Manual** — curated (e.g. via experts), collaborative (e.g. via volunteers)
- **Automated** — semi-structured (e.g. from infoboxes), unstructured (e.g. from text)

Coverage is an issue:

- **Freebase** (40M entities) - 71% of persons without a birthplace, 75% without a nationality, even worse for other relation types [Dong et al. 2014]
- **DBpedia** (20M entities) - 61% of persons without a birthplace, 58% of scientists missing why they are popular [Krompaß et al. 2015]

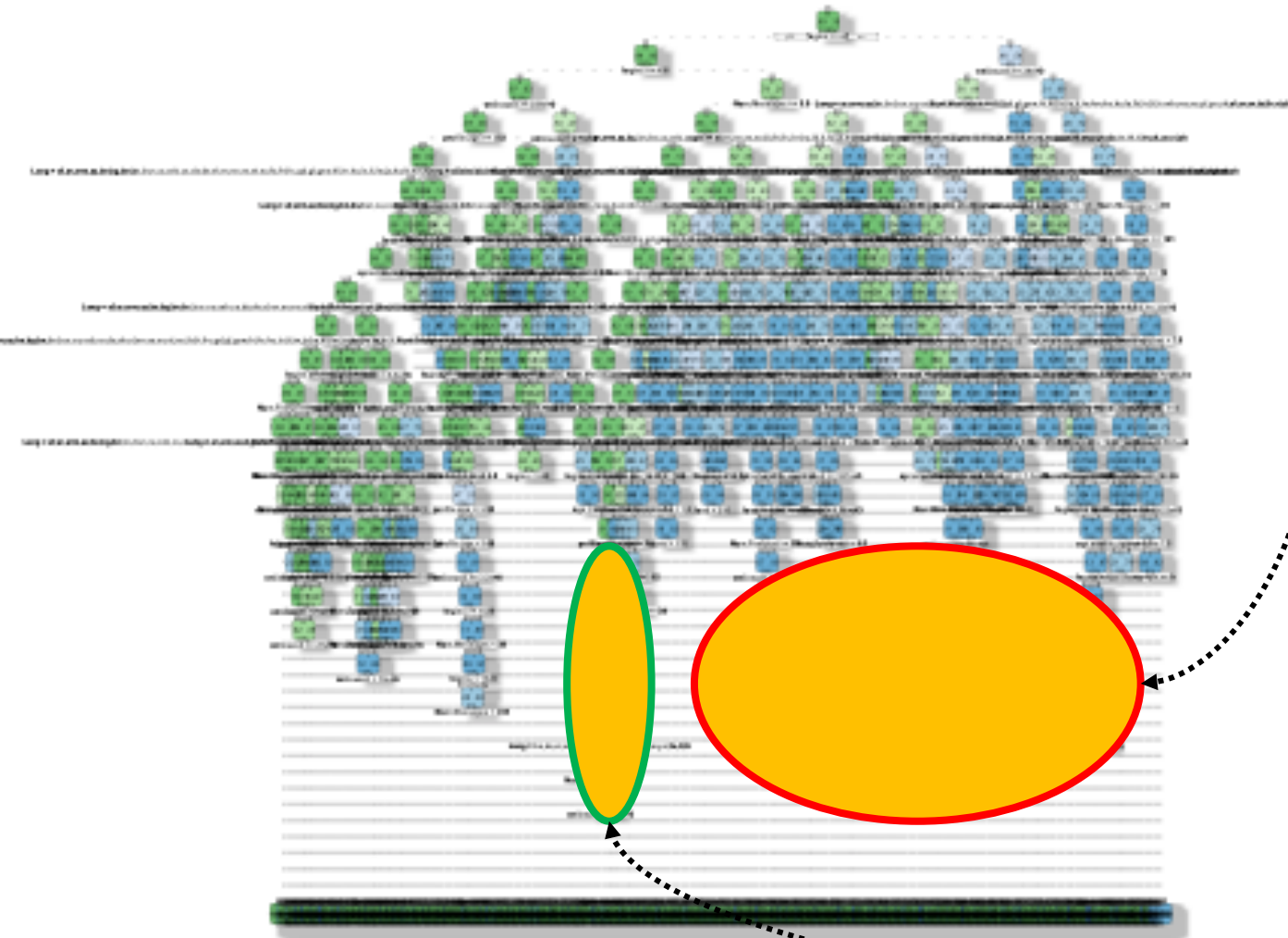
Relational Learning can help us overcoming these issues.

Knowledge Graph Embeddings in Machine Learning



<https://stats.stackexchange.com/questions/230581/decision-tree-too-large-to-interpret>

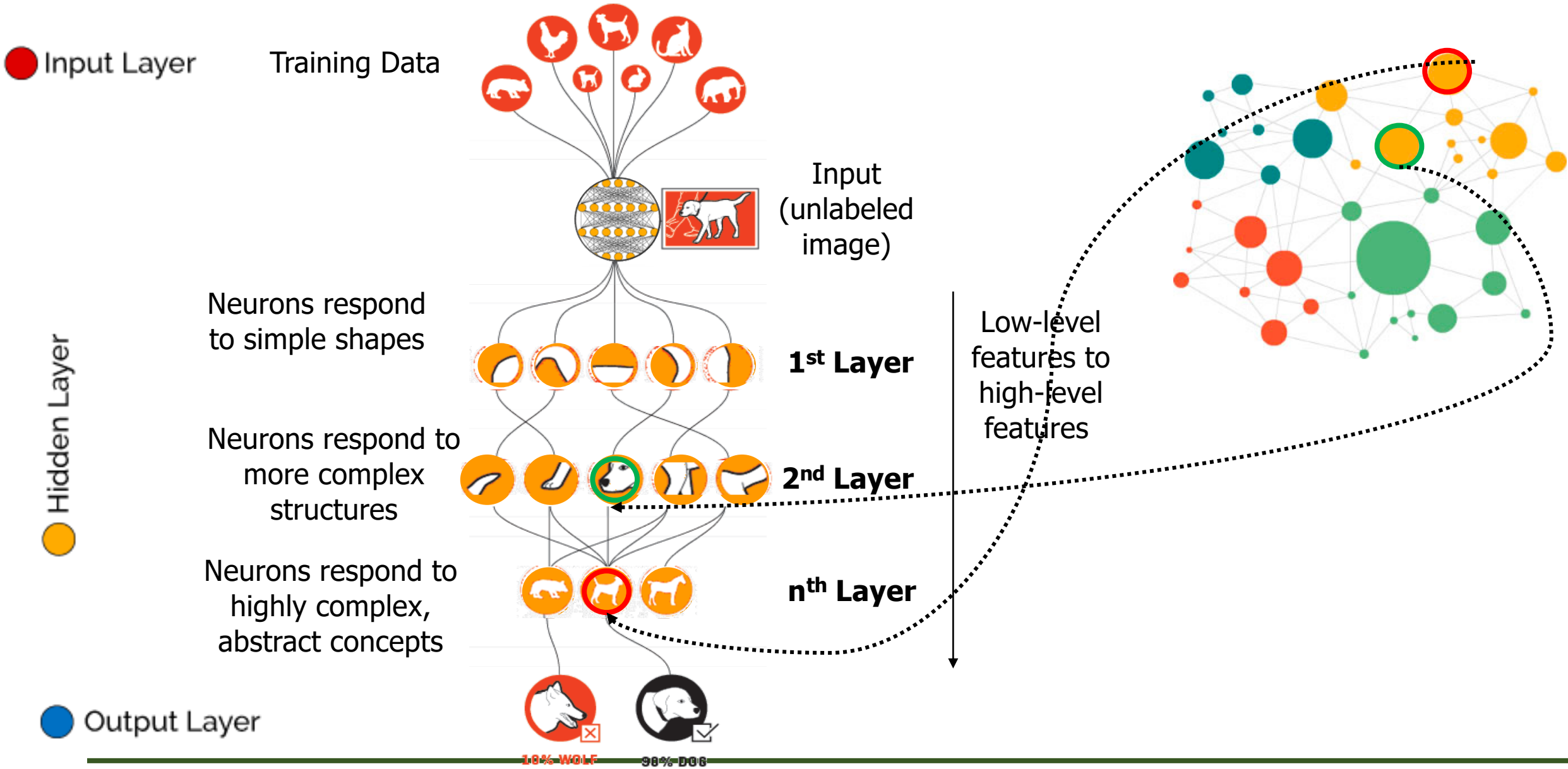
Knowledge Graph for Decision Trees



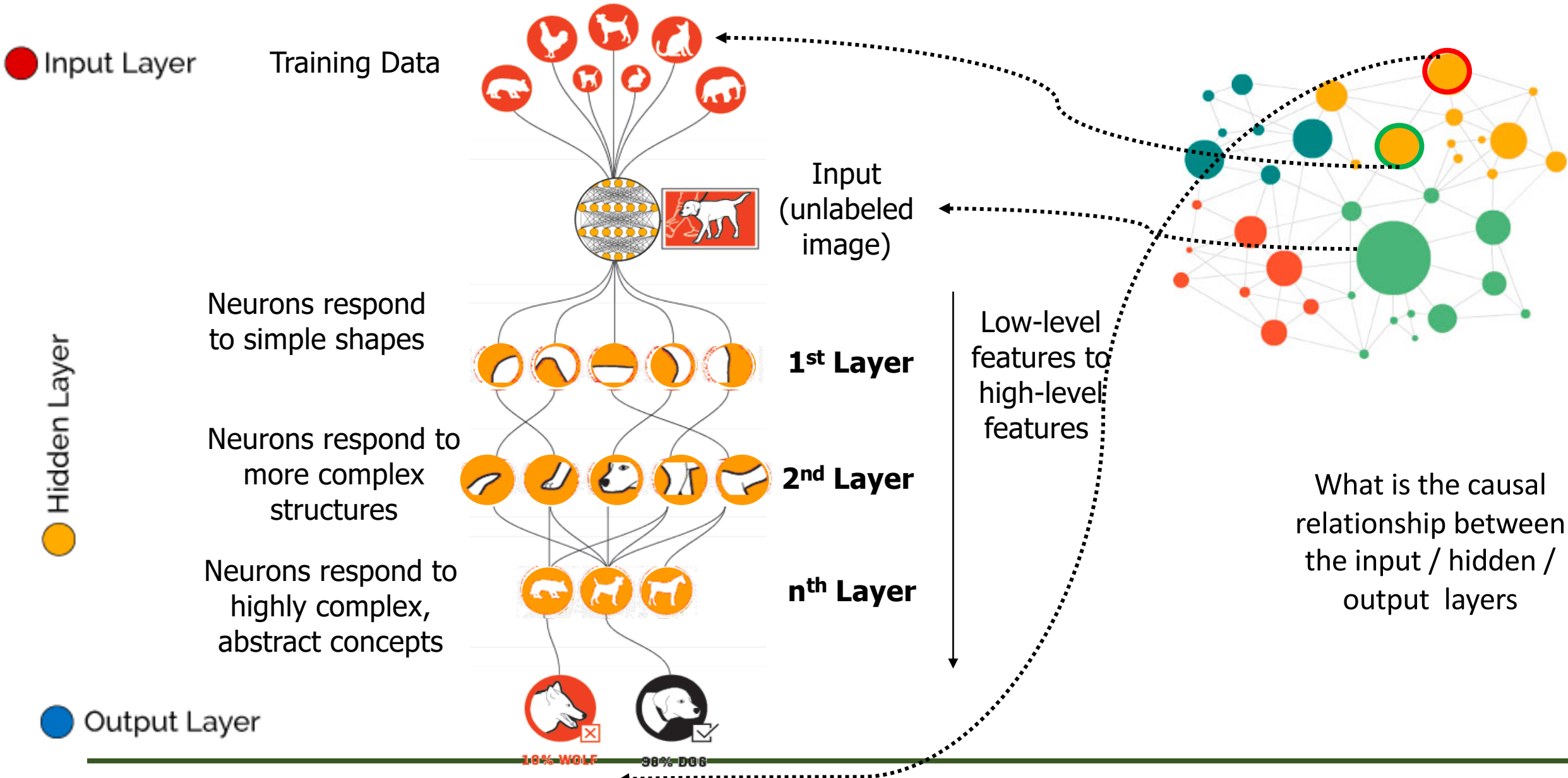
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<https://stats.stackexchange.com/questions/230581/decision-tree-too-large-to-interpret>

Knowledge Graph for Deep Neural Network (1)



Knowledge Graph for Deep Neural Network (2)



Knowledge Graph for Personalized XAI



Description 1: This is an orange train accident

Description 2: This is an train accident between two speed merchant trains of characteristics X43-B and Y33-C in a dry environment

Description 3: This is a public transportation accident

Knowledge Graph for Explaining Transfer Learning

“How to explain transfer learning with appropriate knowledge representation?”

Proceedings of the Sixteenth International Conference on Principles of Knowledge Representation and Reasoning (KR 2018)

Knowledge-Based Transfer Learning Explanation

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