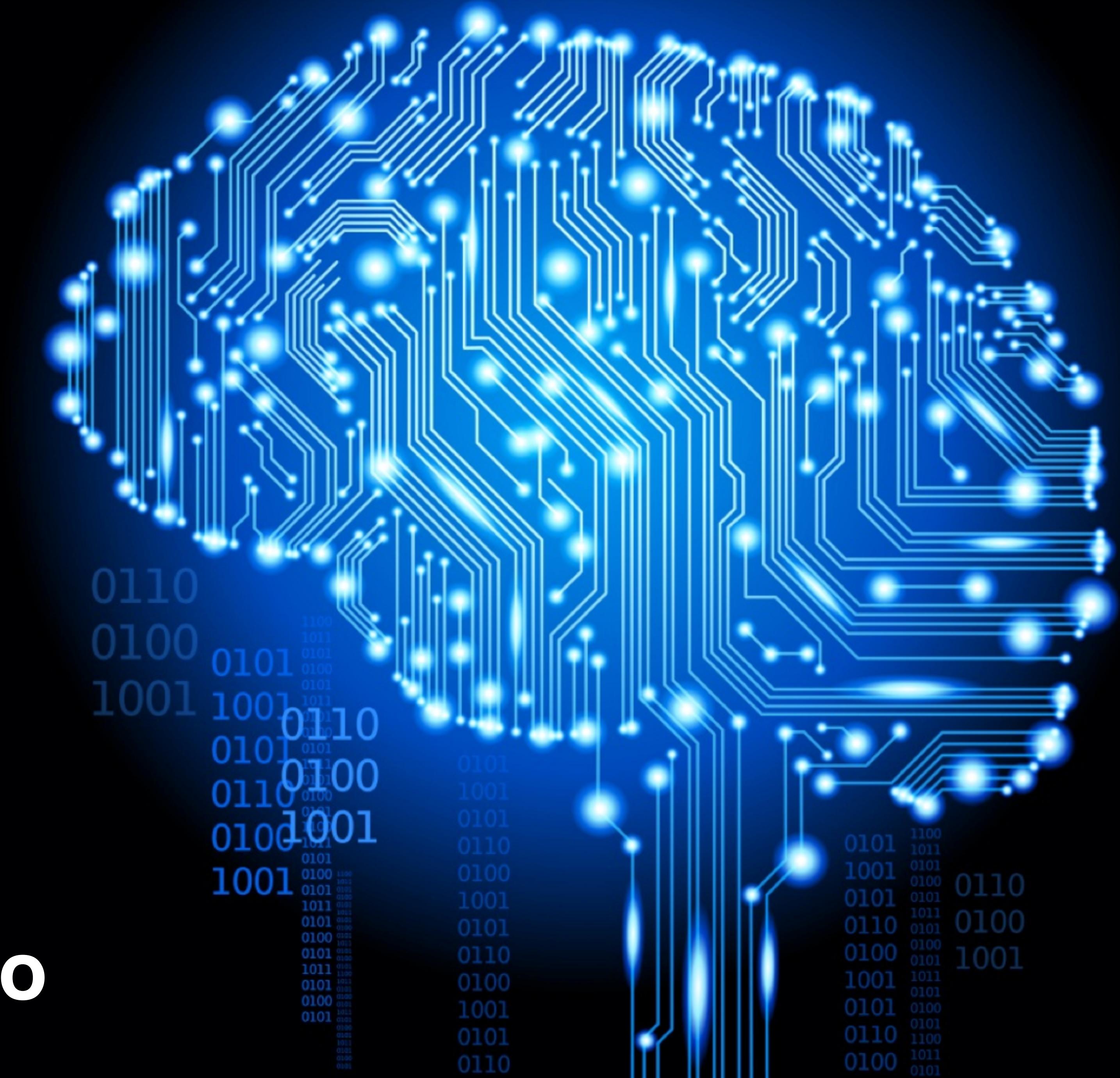


Deep Learning

professor
Eugenio Culurciello



GOAL



How do we perceive the world, learn about the world, operate intelligently in the world to increase our collective benefit

GOAL



*Introduce complex visual capabilities in
computers, appliances, mobiles, applications*

WHAT IS MACHINE LEARNING?

What is Machine Learning?

- a branch of AI
- new capability for computers

Examples:

Database mining

Large datasets from growth of automation/web

E.g., Web click data, medical records, biology, engineering

Applications can't program by hand.

E.g., Autonomous helicopter, handwriting recognition, most of Natural Language Processing (NLP), Computer Vision.

Self-customizing programs

E.g., Amazon, Netflix product recommendations

Understanding human learning (brain, real AI).

Machine Learning definition

- Arthur Samuel (1959). Machine Learning: Field of study that gives computers the ability to learn without being explicitly programmed.
- Tom Mitchell (1998) Well-posed Learning Problem: A computer program is said to learn from experience E with respect to some task T and some performance measure P, if its performance on T, as measured by P, improves with experience E.

“A computer program is said to learn from experience E with respect to some task T and some performance measure P, if its performance on T, as measured by P, improves with experience E.”

Suppose your email program watches which emails you do or do not mark as spam, and based on that learns how to better filter spam. What is the task T in this setting?

- 1- Classifying emails as spam or not spam.
- 2- Watching you label emails as spam or not spam.
- 3- The number (or fraction) of emails correctly classified as spam/not spam.
- 4- None of the above—this is not a machine learning problem.

When to apply machine learning

- Human expertise is absent (e.g. Navigating on Mars)
- Humans are unable to explain their expertise (e.g. Speech recognition, vision, language)
- Solution changes with time (e.g. Tracking, temperature control, preferences)
- Solution needs to be adapted to particular cases (e.g. Biometrics, personalization)
- The problem size is too vast for our limited reasoning capabilities (e.g. Calculating webpage ranks, matching ads to Facebook pages)

Machine learning algorithms:

- Supervised learning

Mushroom

Any of various fleshy fungi of the subdivision Basidiomycota consisting of a cap at the end of a stem arising from an underground mycelium

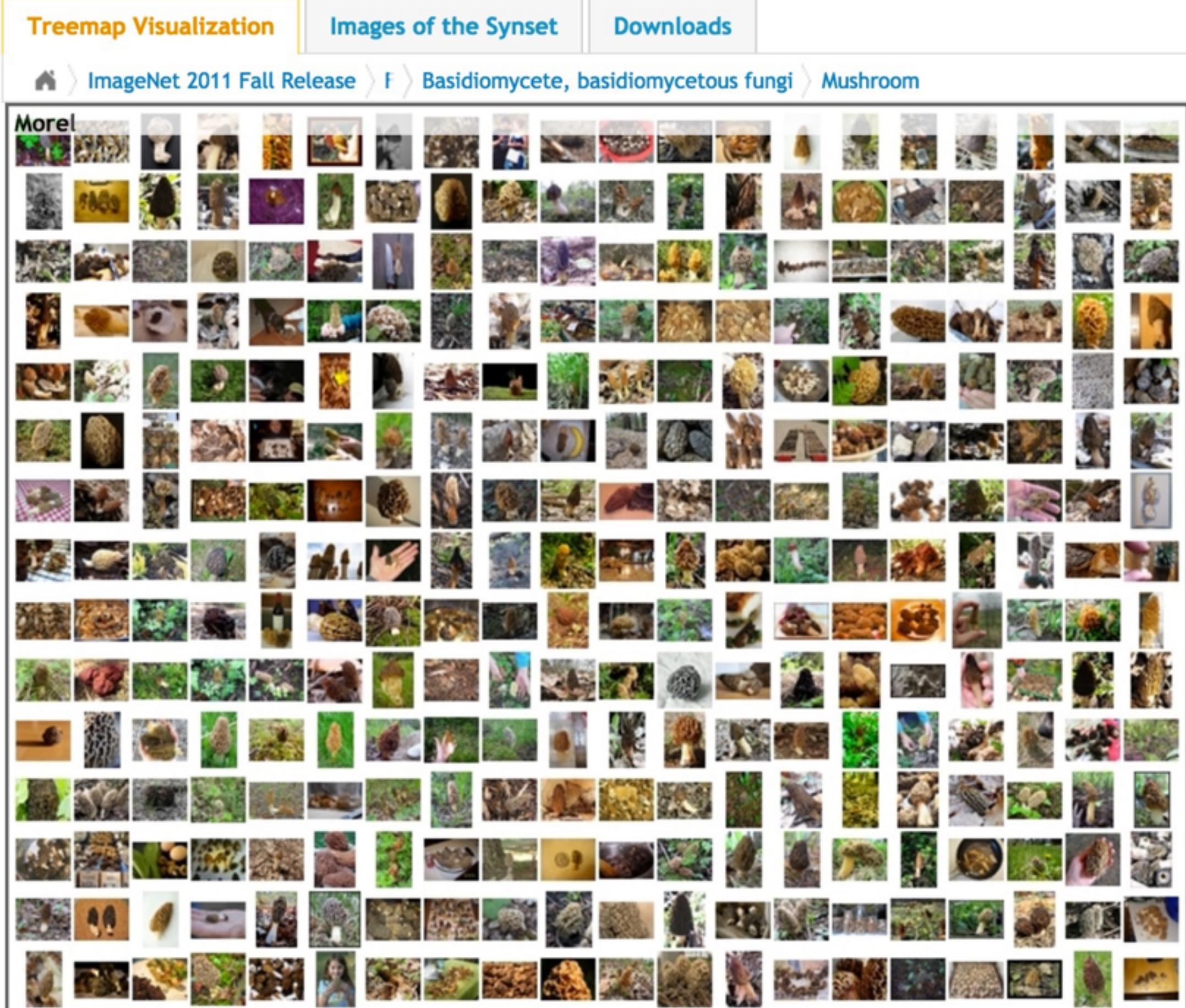
1406 pictures

84.32%
Popularity
Percentile

 Wordnet
IDs

Numbers in brackets: (the number of synsets in the subtree).

- ImageNet 2011 Fall Release (32326)
 - plant, flora, plant life (4486)
 - geological formation, formation (17)
 - natural object (1112)
 - sport, athletics (176)
 - artifact, artefact (10504)
 - fungus (308)**
 - false morel (6)
 - pythium (1)
 - truffle, earthnut, earth-ball (0)
 - candida (1)
 - shiitake, shiitake mushroom, Chi
 - sac fungus (0)
 - lichen (11)
 - brown root rot fungus, Thielavia
 - dry rot (0)
 - white fungus, Saprolegnia ferax
 - mildew (5)
 - earthball, false truffle, puffball, l
 - yeast (2)
 - bird's-nest fungus (0)
 - green smut fungus, Ustilaginoid
 - hen-of-the-woods, hen of the w
 - verticillium (0)
 - scaly lentinus, Lentinus lepideus
 - monilia (0)
 - pink disease fungus, Corticium s
 - jelly fungus (5)
 - blastomycete (0)
 - Dutch elm fungus, Ceratostome
 - stalked puffball (0)



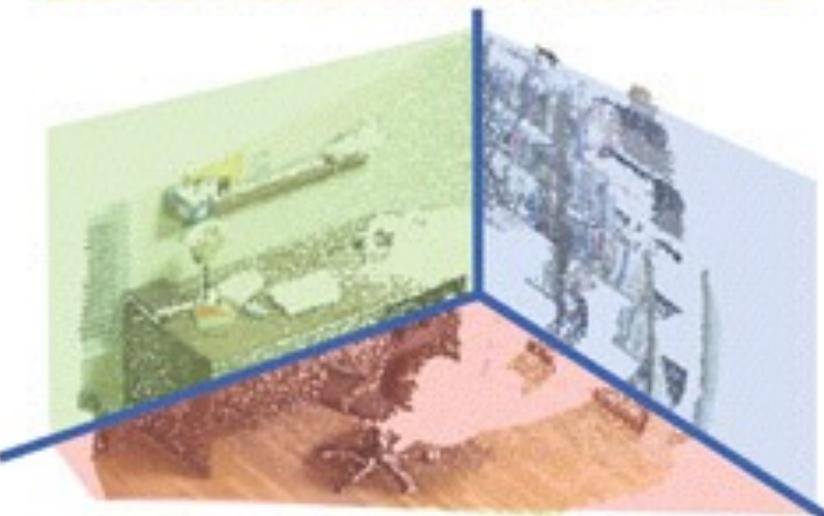
Machine learning algorithms:

- Supervised learning

Scene Classification



Semantic Segmentation



Room Layout

Detection and Pose

Home » Examples

Examples

Cityscapes Dataset: Example Cologne



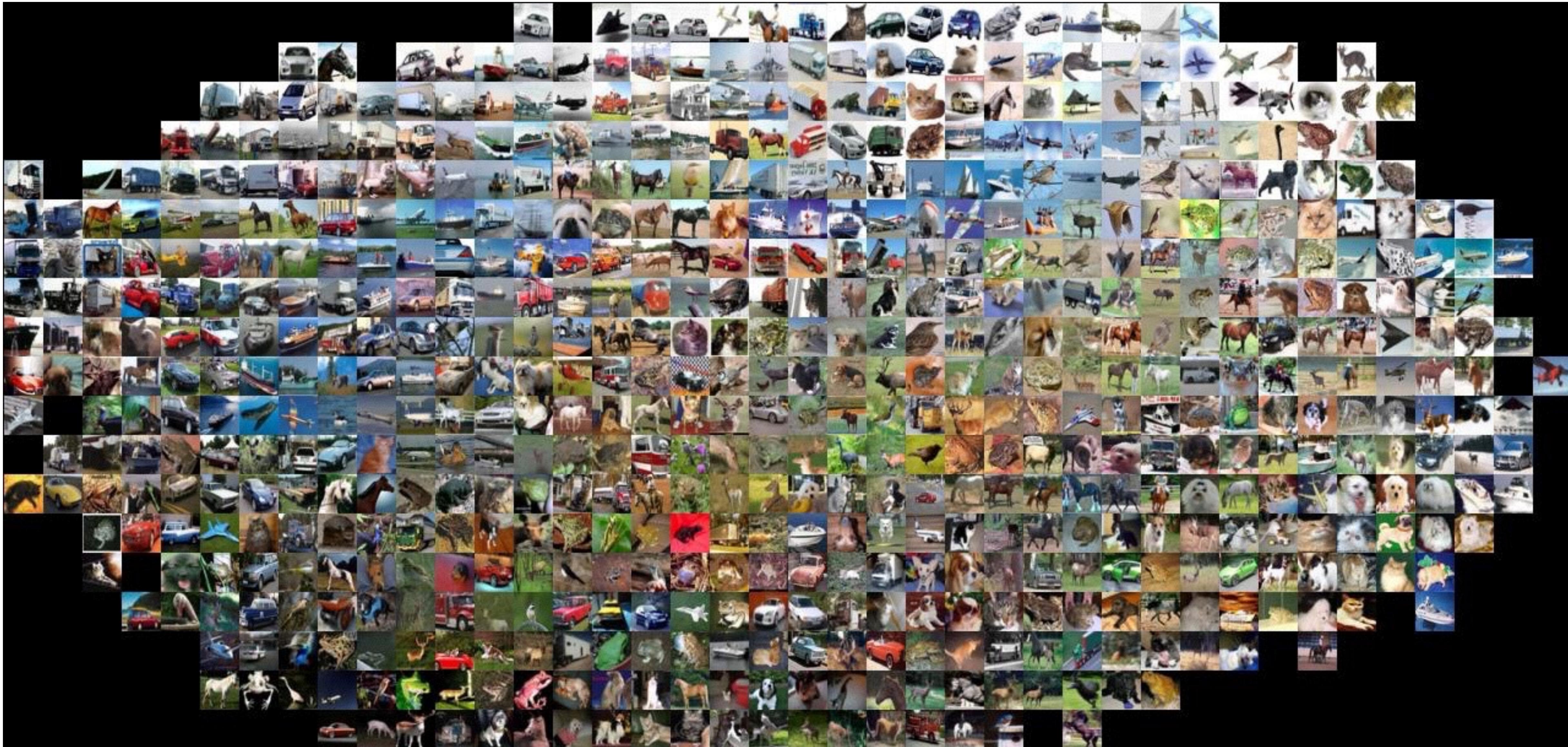
Machine learning algorithms:

- Unsupervised learning



Machine learning algorithms:

- Unsupervised learning



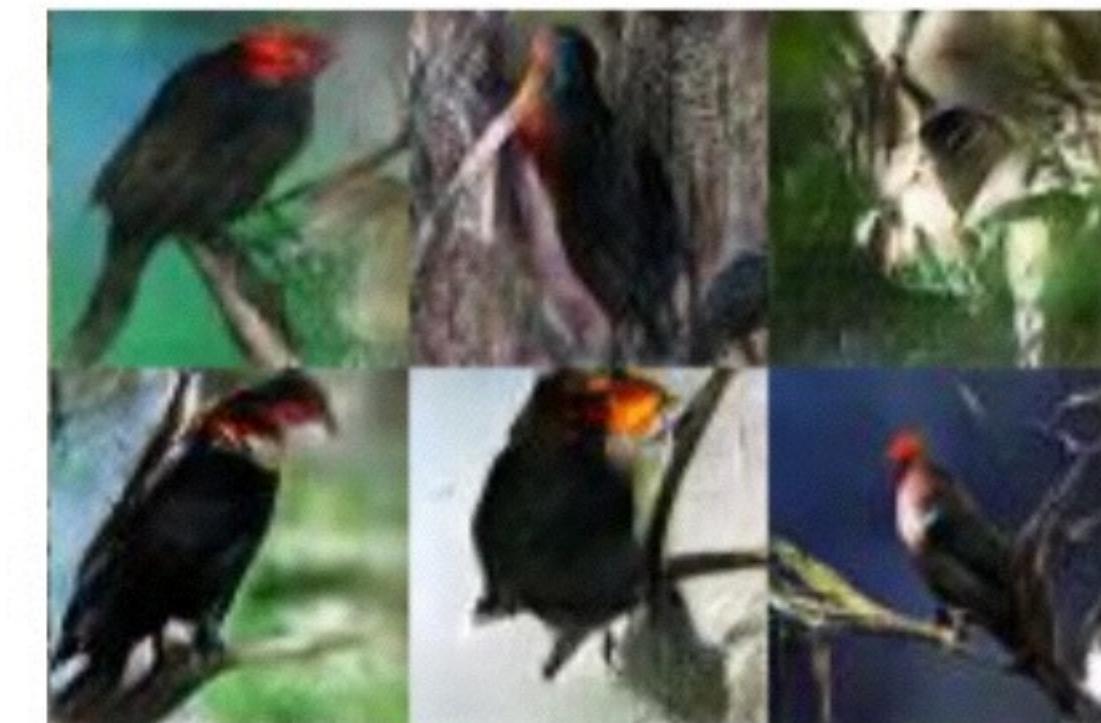
Machine learning algorithms:

- Unsupervised learning

this small bird has a pink breast and crown, and black primaries and secondaries.



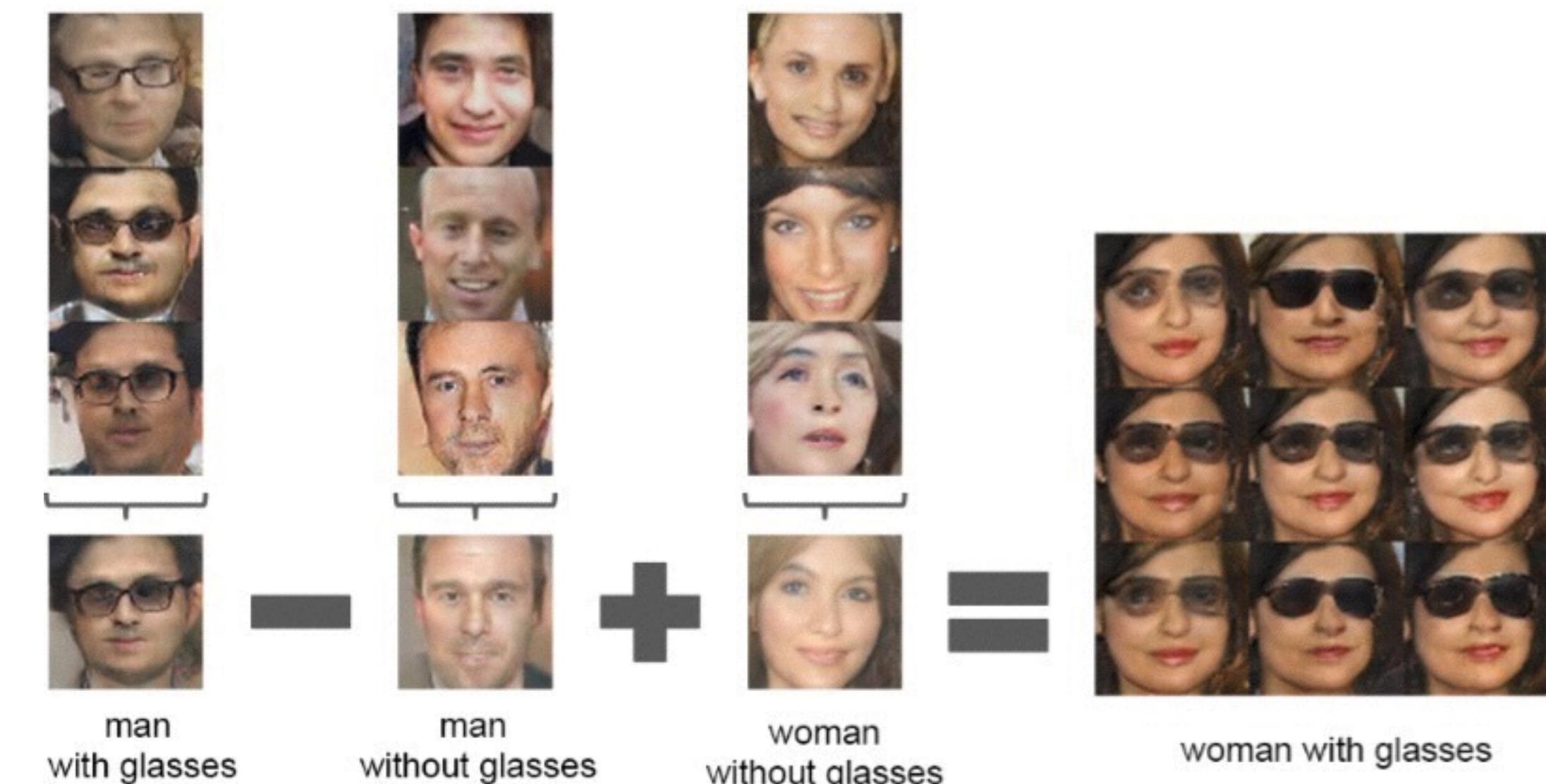
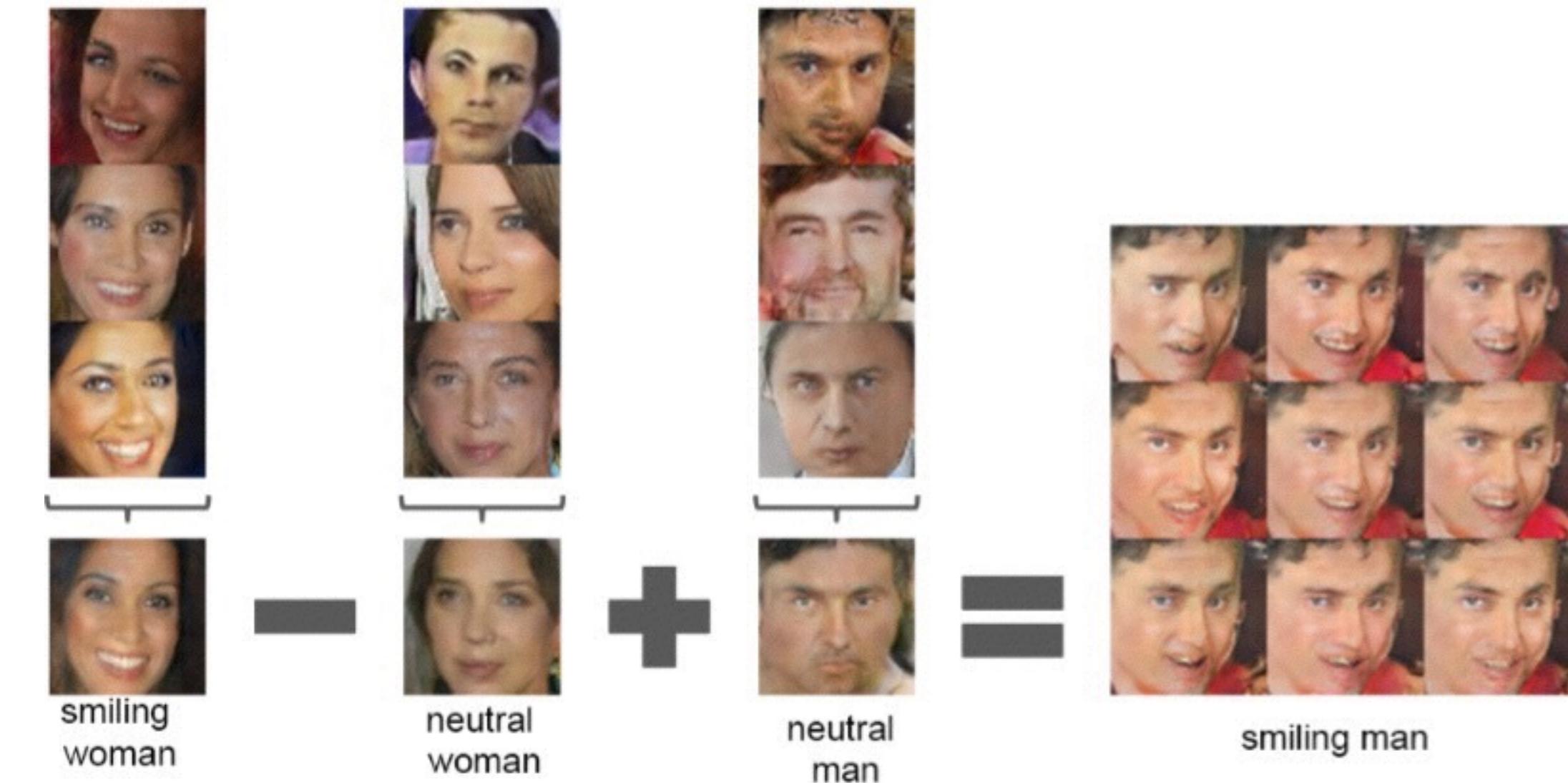
this magnificent fellow is almost all black with a red crest, and white cheek patch.



the flower has petals that are bright pinkish purple with white stigma

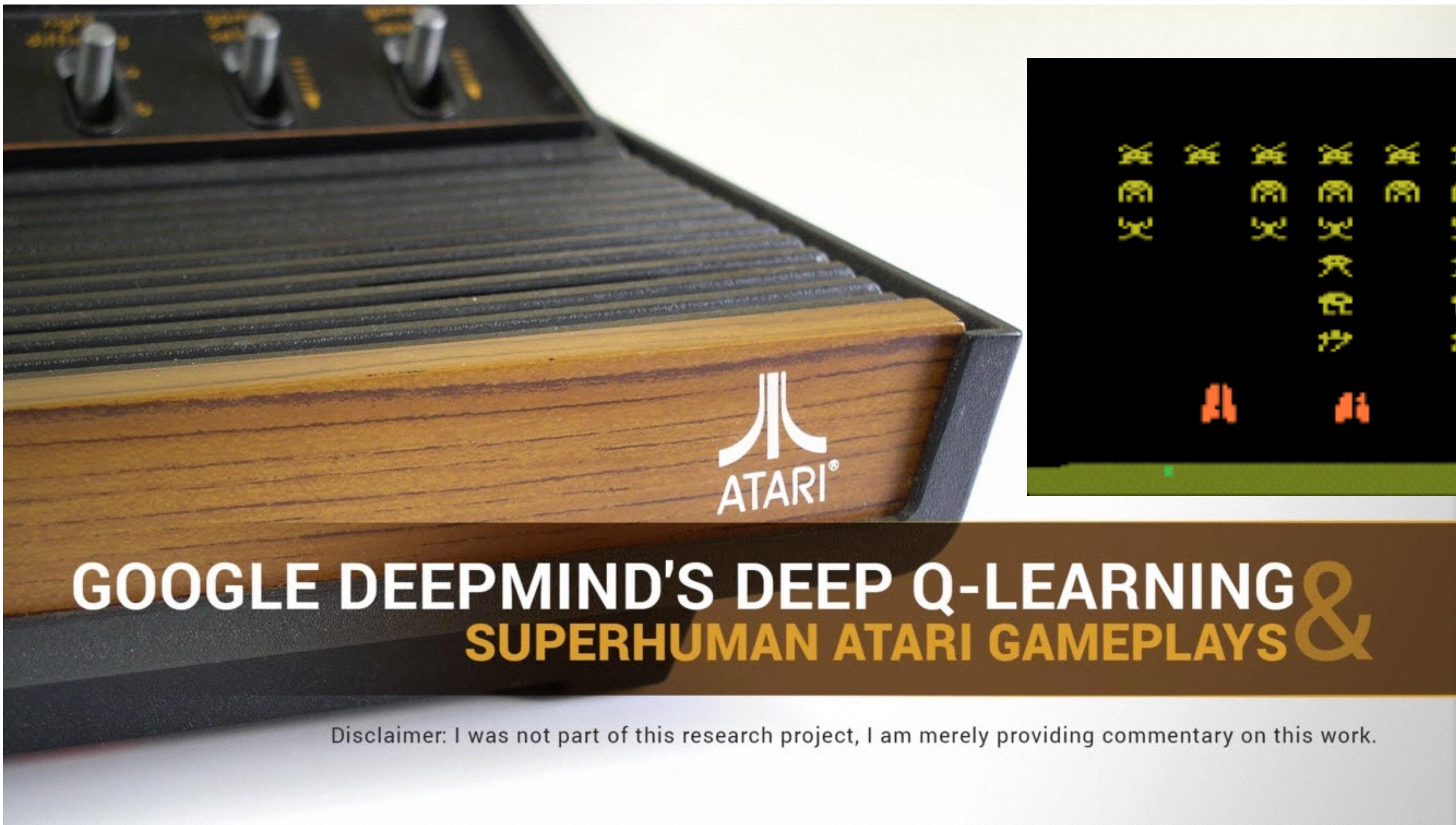
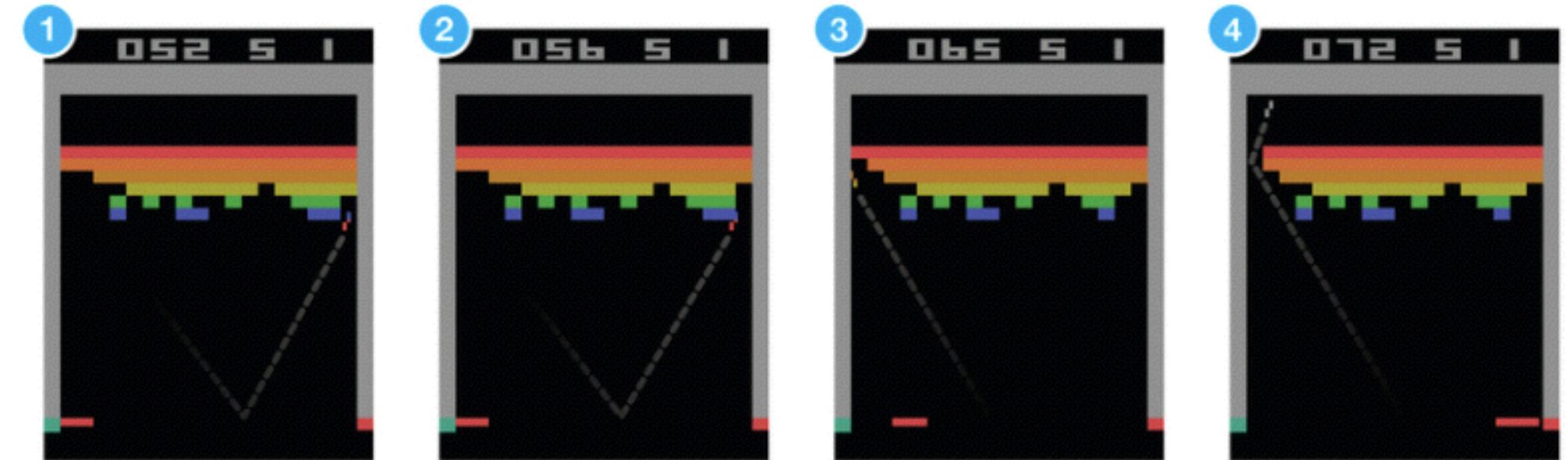


this white and yellow flower have thin white petals and a round yellow stamen



Machine learning algorithms:

- Reinforcement learning

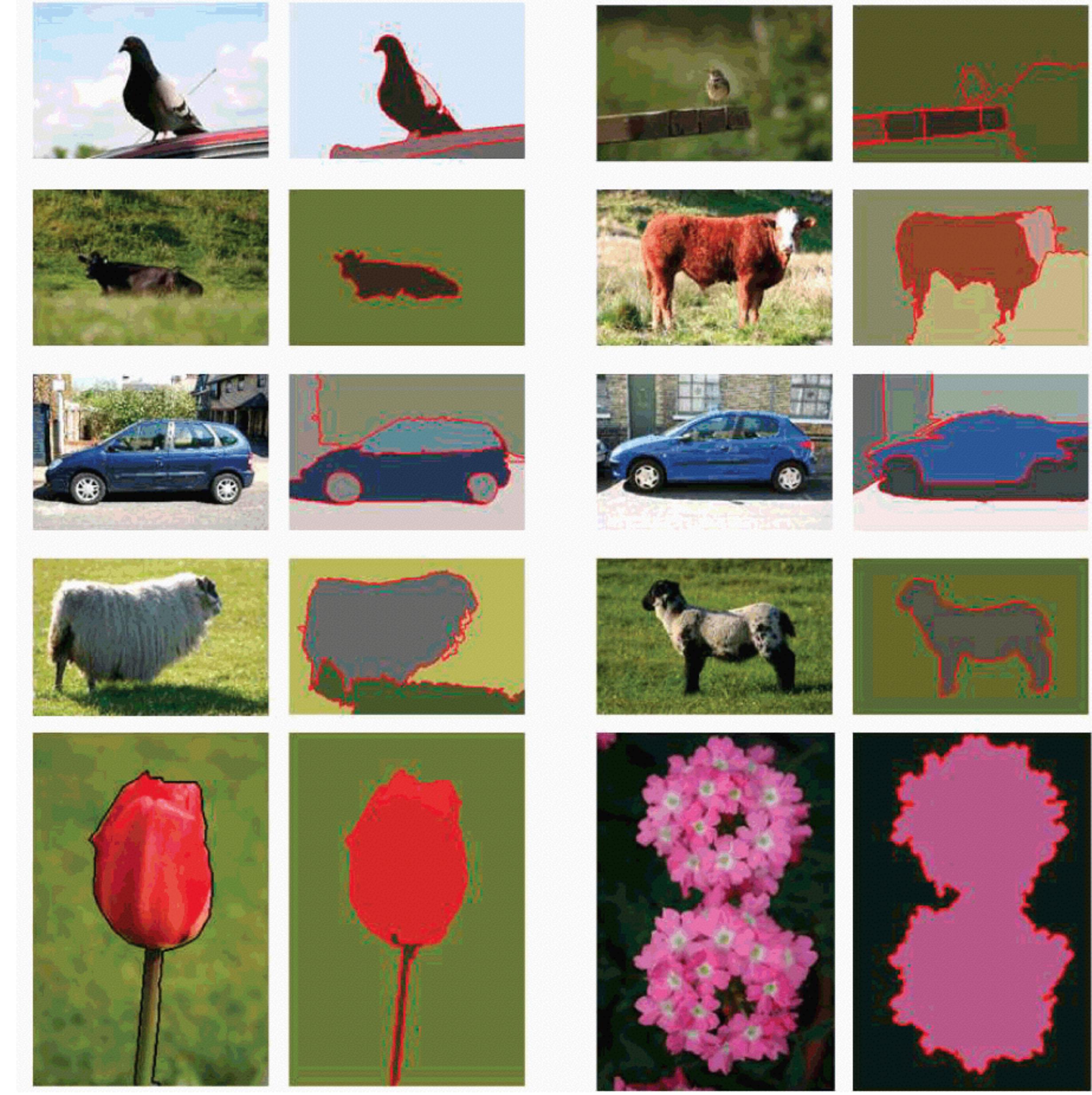
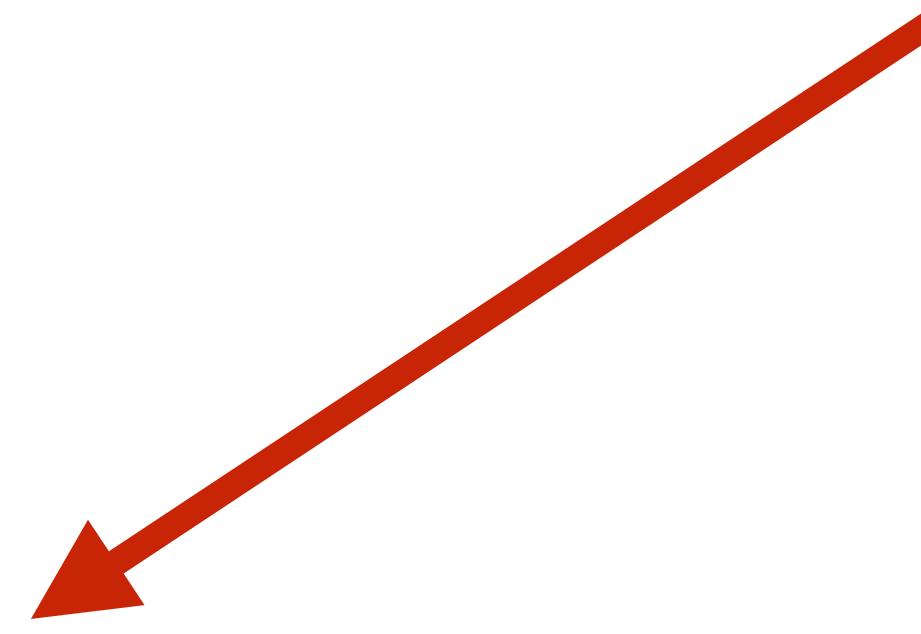
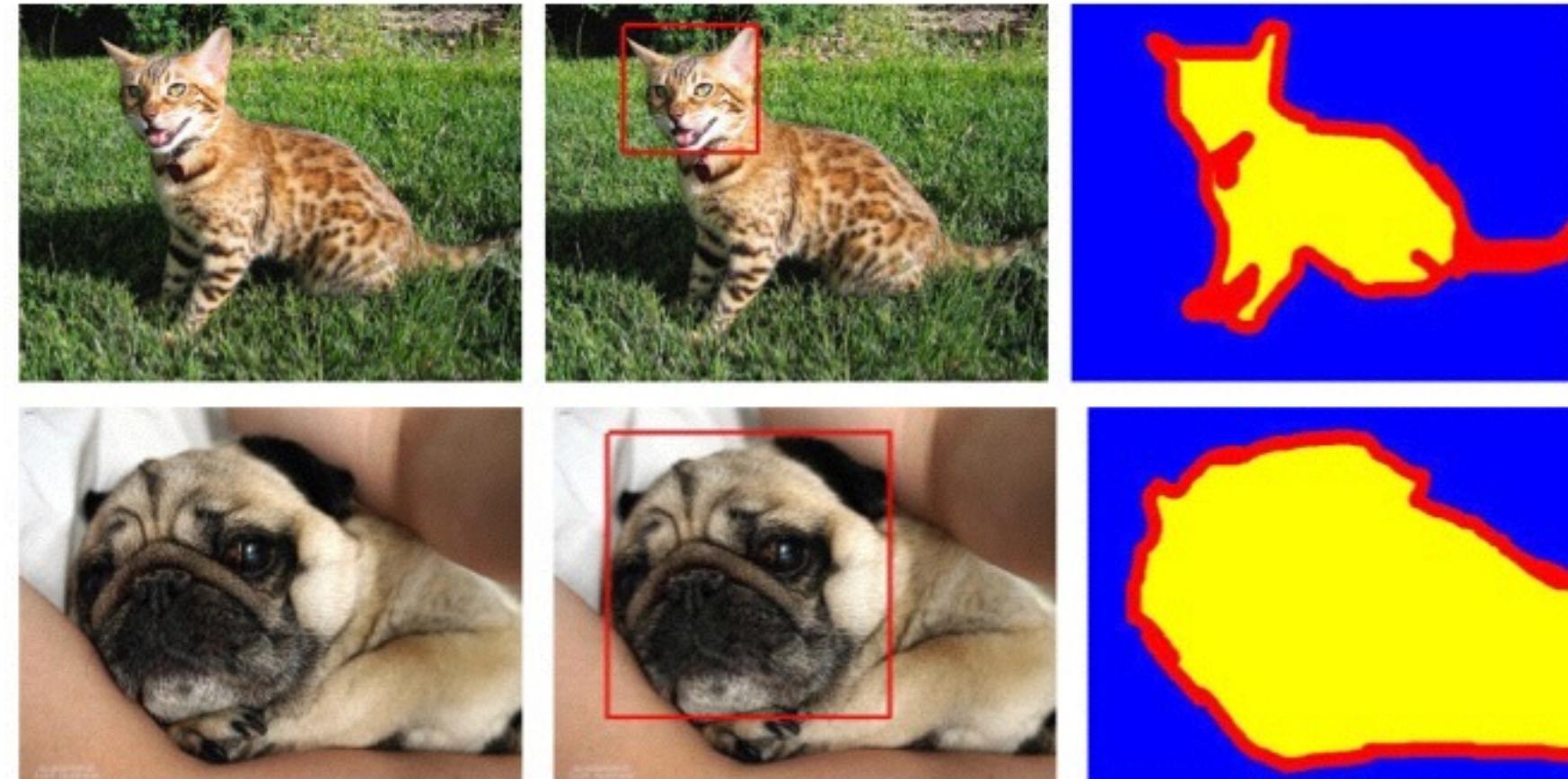


GOOGLE DEEPMIND'S DEEP Q-LEARNING &
SUPERHUMAN ATARI GAMEPLAYS &

Disclaimer: I was not part of this research project, I am merely providing commentary on this work.

Machine learning algorithms:

- Transfer learning



Machine learning algorithms:

- Transfer learning

- you learned to repair car engines
- you learned to design model airplanes

Now can you learn to repair real airplanes?

Intelligence == solving new problems with knowledge developed solving other previous problems

A path to AI

Machine learning and Data

- **data is needed**
- **data is king:** dictates model and algorithm to use
- data decides what problems you can solve
- problems also require the right data
- more data is generally better than more complex algorithms
- a lot of data, and simple algorithms scale to large problems
- there are problems we cannot solve because we do not have data to solve them (understanding actions, physics, the environment from video)
- **labeling data is costly ==> unsupervised technique needed!**