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Pattern Analysis & Machine Intelligence

Praktikum: MLPR-19

Week 1: Introduction



Lecture requirements

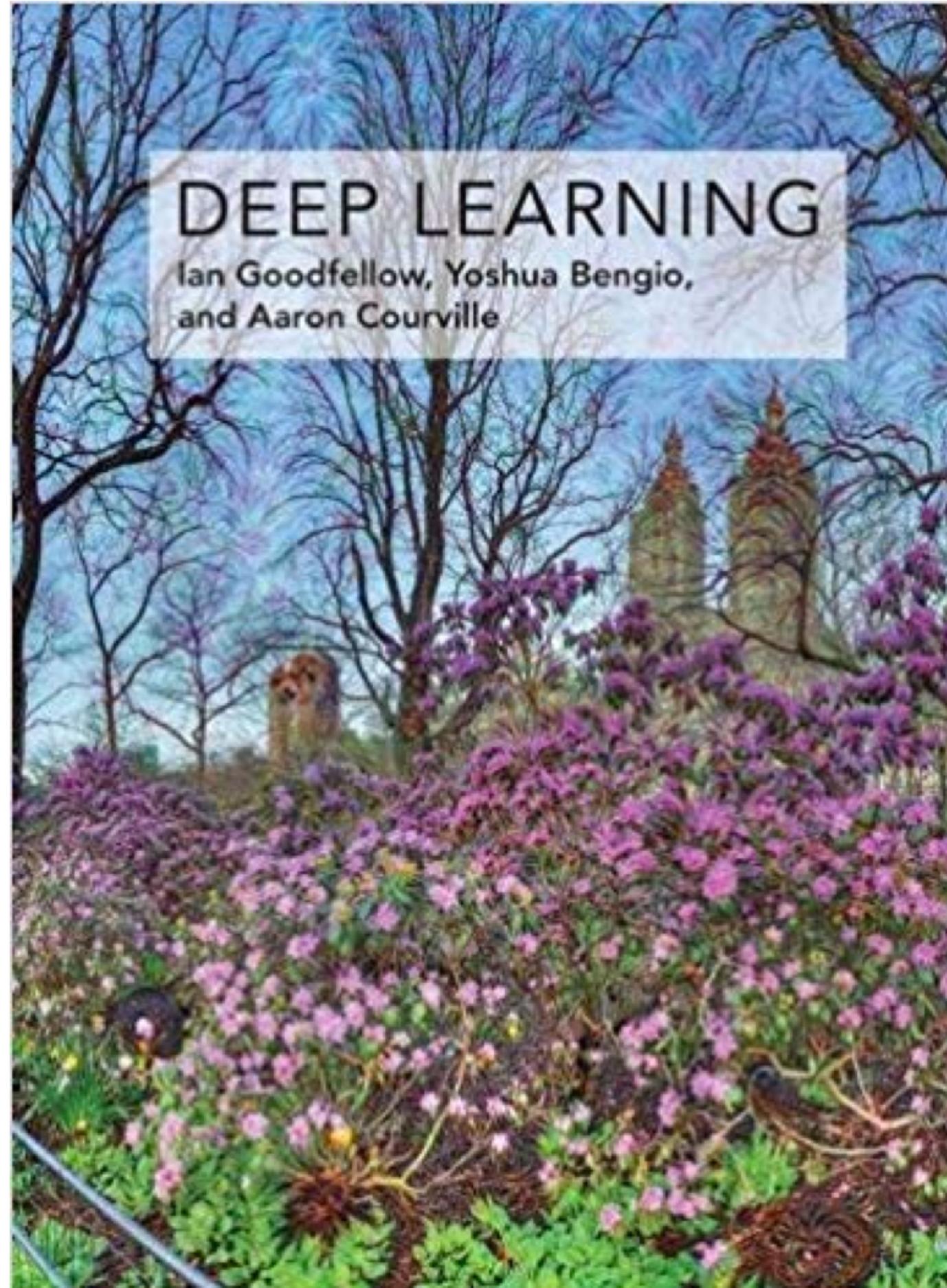
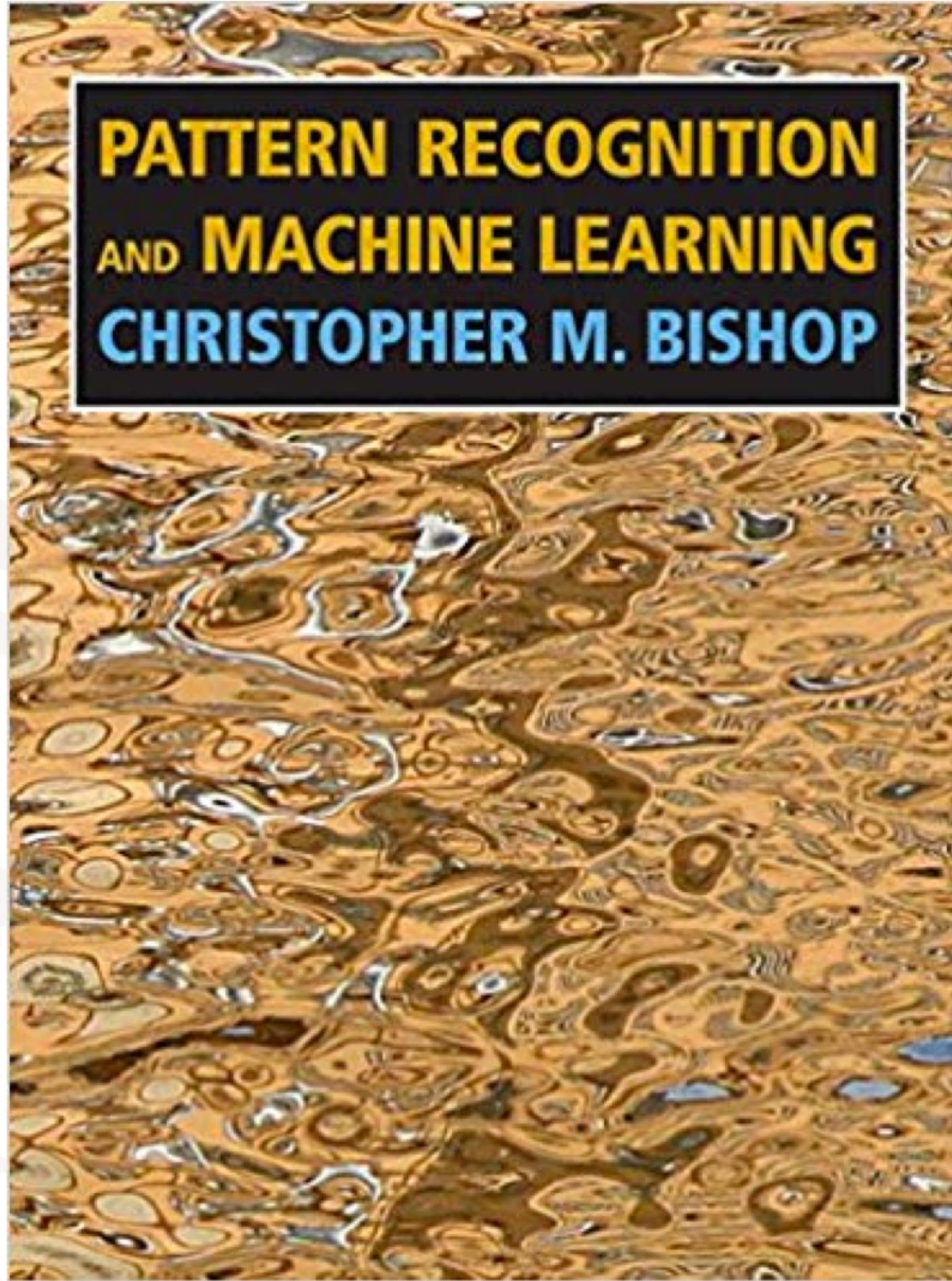
- 4 hours per week
 - 8 credit points
 - Final class group projects
 - Attend the class
-
- Bring a laptop
 - Each session is going to start with a small lecture
 - Jupyter notebooks will be used for practical content
 - We will use Google's Collaboratory for cloud computation
 - If you want to execute the notebooks locally, we advise a Linux or Mac OS
-
- Lecture materials will be shared on GitHub: <https://github.com/MrtnMndt/mlpr19>

Tentative schedule

- Week 1: 15.04 – Intro Jupyter & Colab notebooks, Python review, version-control & documentation
- Week 2: 22.04 – Easter holiday
- Week 3: 29.04* – Regression and gradient descent (Kaggle Titanic dataset)
- Week 4: 06.05 – Random forests (Sklearn intro & San Francisco Crime Challenge)
- Week 5: 13.05 – Intro to unsupervised learning (K-means or PCA)
- Week 6: 20.05 – Basic neural networks (Multi-layer perceptron on FashionMNIST)
- Week 7: 27.05 – Convolutional neural networks & frameworks (PyTorch, Revisiting FashionMNIST)
- Week 8: 03.06* – Unsupervised NNs (autoencoders, image generation - variational autoencoders)
- Week 9: 10.06 – Pfingsten
- Week 10: 17.06 – Intro to basic reinforcement learning (Cart-pole)
- Week 11: 24.06 – Reinforcement learning: Q-Learning and QNN (some game)
- Week 12: 01.07 – Neural sequence models (Recurrent neural networks, text classification)
- Week 13: 08.07 – Neural sequence models (long-short-term memory, poetry generation)
- Week 14: 15.07 – State of the art outlook, project pitches and discussion (3 slide pitches)

* Suggested longer sessions to compensate for weeks 2 and 9

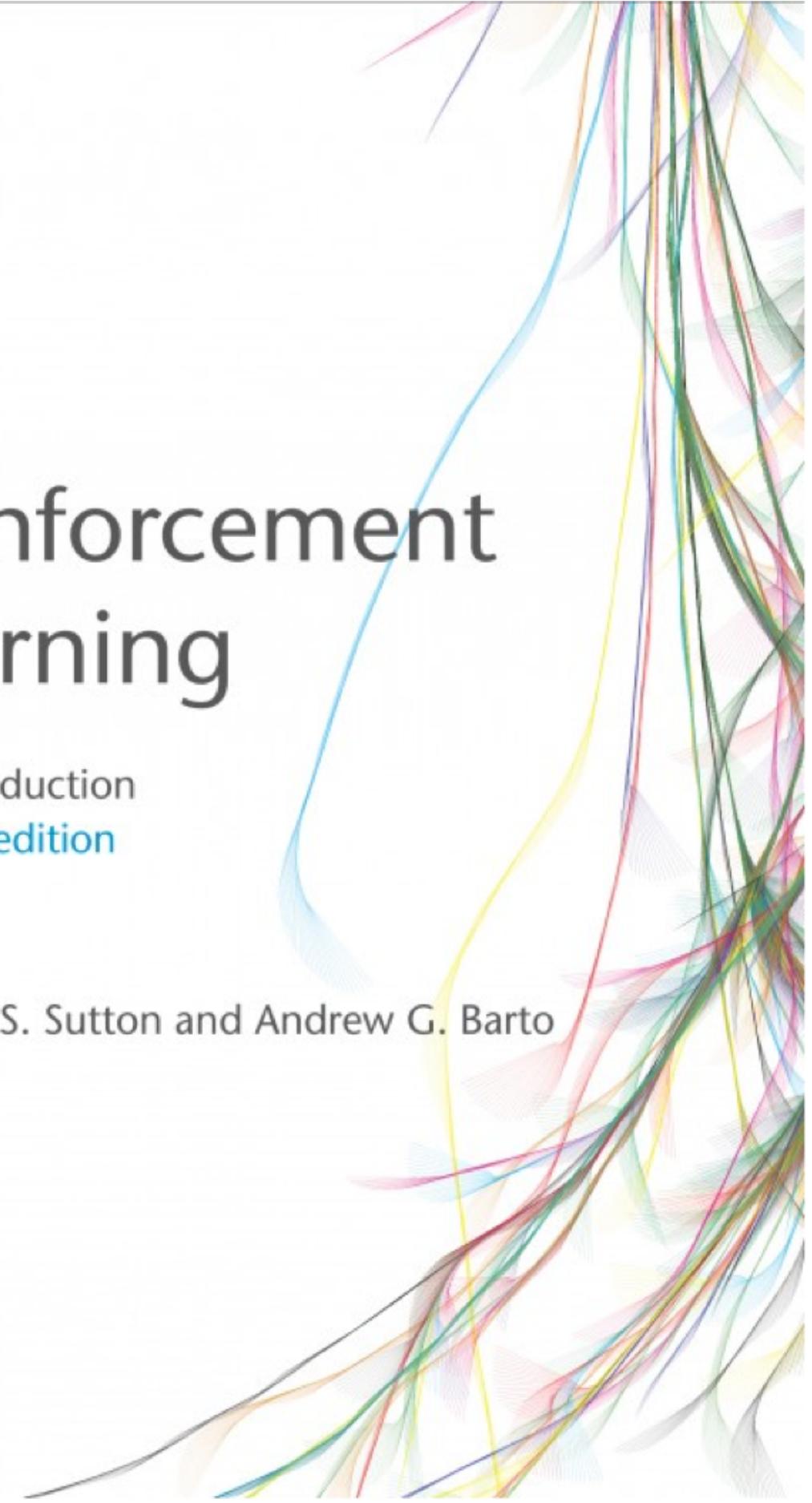
Literature



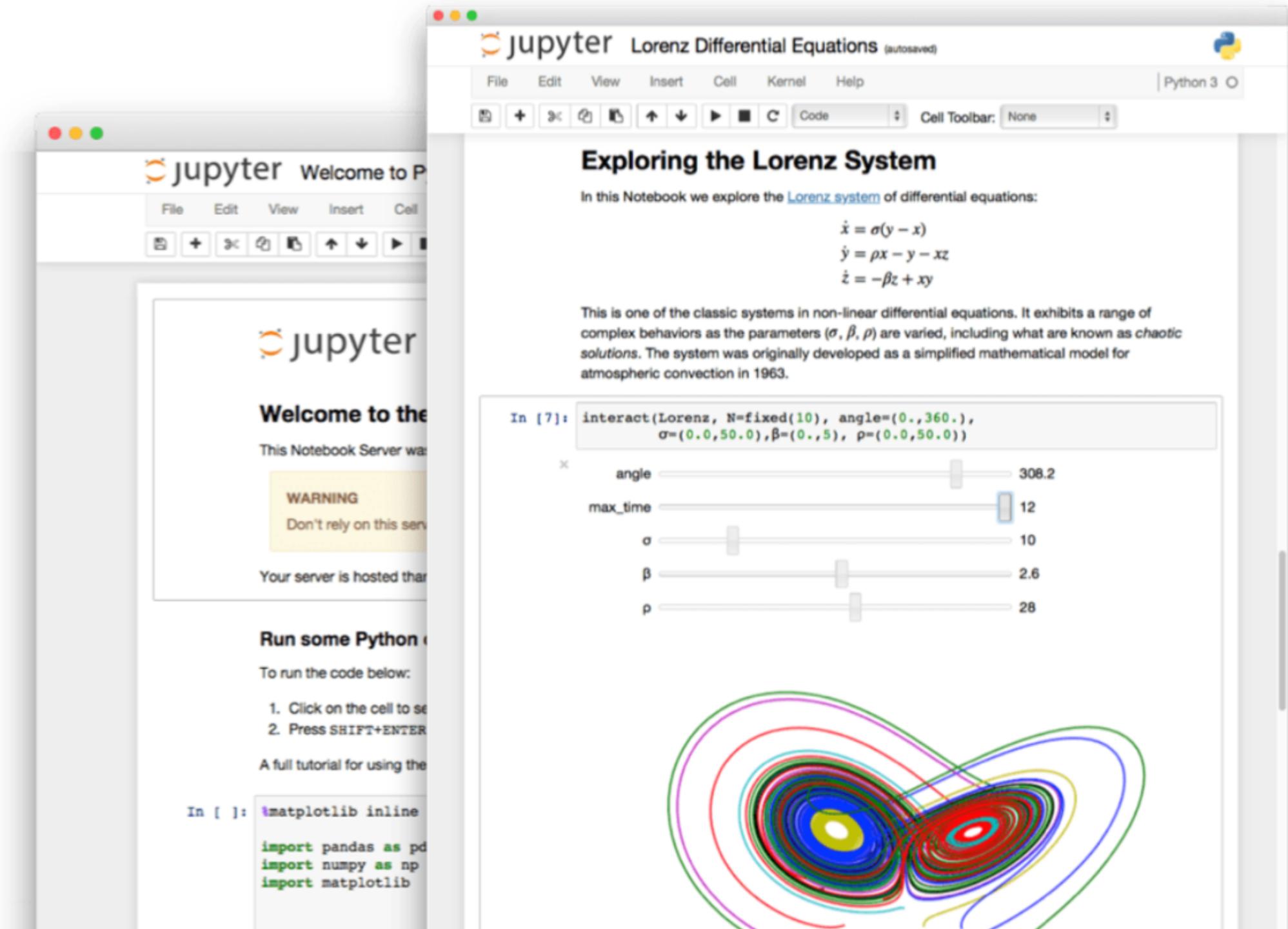
Reinforcement Learning

An Introduction
second edition

Richard S. Sutton and Andrew G. Barto



Jupyter notebooks: <https://jupyter.org/>



The screenshot shows the Jupyter Notebook interface. On the left, there's a sidebar with the Jupyter logo, a 'Welcome to the Notebook' message, and a 'Run some Python code' section. The main area displays a notebook titled 'Exploring the Lorenz System'. It contains the Lorenz differential equations:

$$\begin{aligned}\dot{x} &= \sigma(y - x) \\ \dot{y} &= \rho x - y - xz \\ \dot{z} &= -\beta z + xy\end{aligned}$$

A text block explains the system is one of the classic systems in non-linear differential equations, exhibiting chaotic behavior. Below this is an 'In [7]' cell containing Python code for an interactive plot:

```
interact(Lorenz, N=fixed(10), angle=(0.,360.),  
        sigma=(0.0,50.0),beta=(0.,5),rho=(0.0,50.0))
```

The cell also includes four sliders for 'angle', 'max_time', 'sigma', 'beta', and 'rho'. At the bottom of the cell is a colorful 3D plot of the Lorenz attractor.

The Jupyter Notebook

The Jupyter Notebook is an open-source web application that allows you to create and share documents that contain live code, equations, visualizations and narrative text. Uses include: data cleaning and transformation, numerical simulation, statistical modeling, data visualization, machine learning, and much more.

[Try it in your browser](#) [Install the Notebook](#)

Google Colab: <https://colab.research.google.com/>

The screenshot shows the Google Colab interface with the title "Overview of Colaboratory Features". The left sidebar contains a table of contents with various sections like "Cells", "Code cells", "Text cells", etc. The main content area is expanded to show the "Cells" section, which includes a description of what a notebook is, a subsection on "Code cells", and a preview of a code cell with the code "a = 10".

File Edit View Insert Runtime Tools Help

SHARE

CODE TEXT CELL CELL COPY TO DRIVE CONNECT EDITING

Table of contents Code snippets Files X

Cells

- Code cells
- Text cells
- Adding and moving cells
- Working with python
- System aliases
- Magics
- Tab-completion and exploring code
- Exception Formatting
- Rich, interactive outputs
- Integration with Drive

Cells

A notebook is a list of cells. Cells contain either explanatory text or executable code and its output. Click a cell to select it.

Code cells

Below is a **code cell**. Once the toolbar button indicates CONNECTED, click in the cell to select it and execute the contents in the following ways:

- Click the **Play icon** in the left gutter of the cell;
- Type **Cmd/Ctrl+Enter** to run the cell in place;
- Type **Shift+Enter** to run the cell and move focus to the next cell (adding one if none exists); or
- Type **Alt+Enter** to run the cell and insert a new code cell immediately below it.

There are additional options for running some or all cells in the **Runtime** menu.

```
[ ] 1 a = 10  
2 a
```

10



Machine
learning in our
daily lives

Recommender systems

Medicine/Pharma

Finance

Smart homes

Video games

Customer support, chat bots

Machine translation

Smart cars

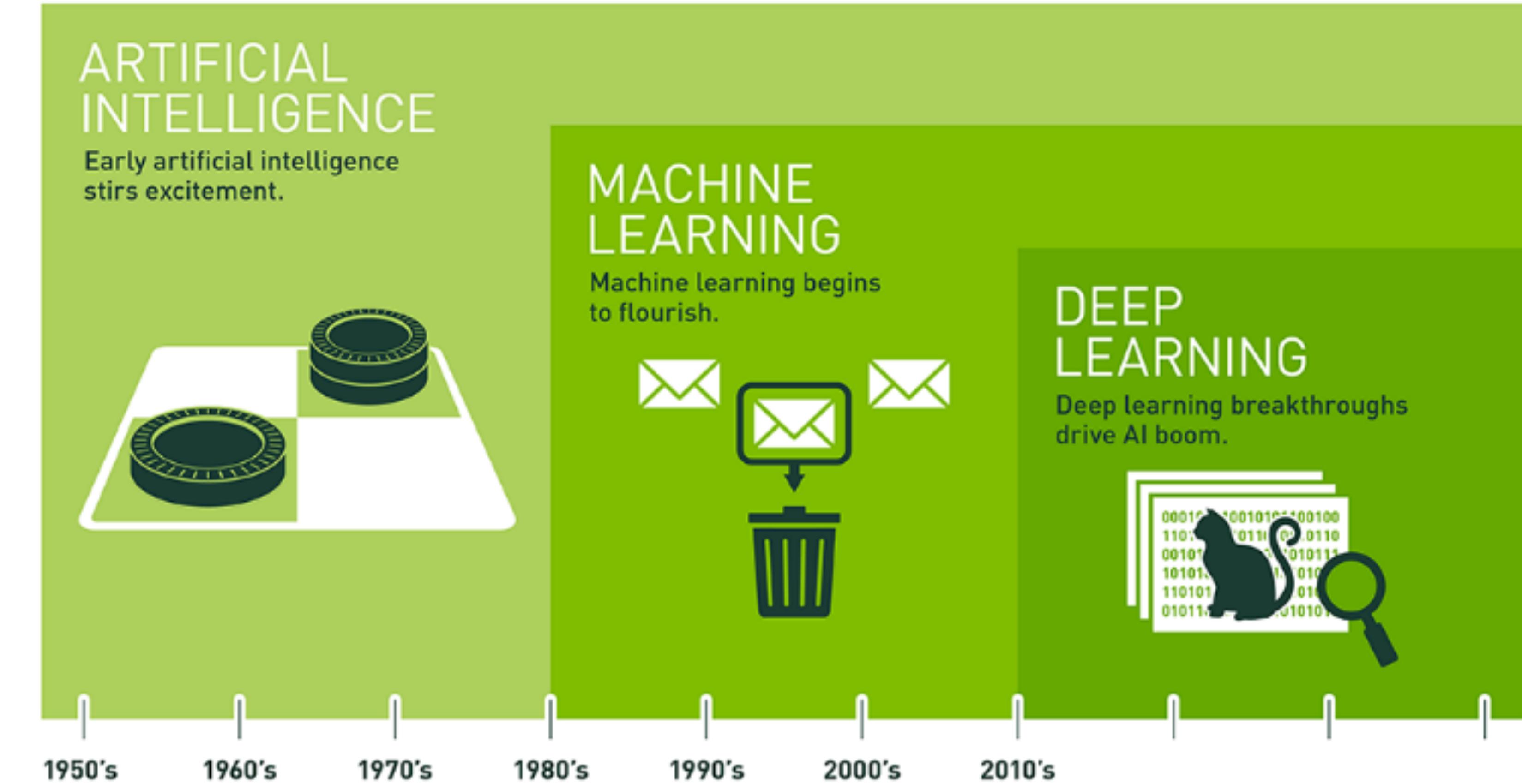
Surveillance, security

Recruiting, job market

Robot control

Art

Terminology

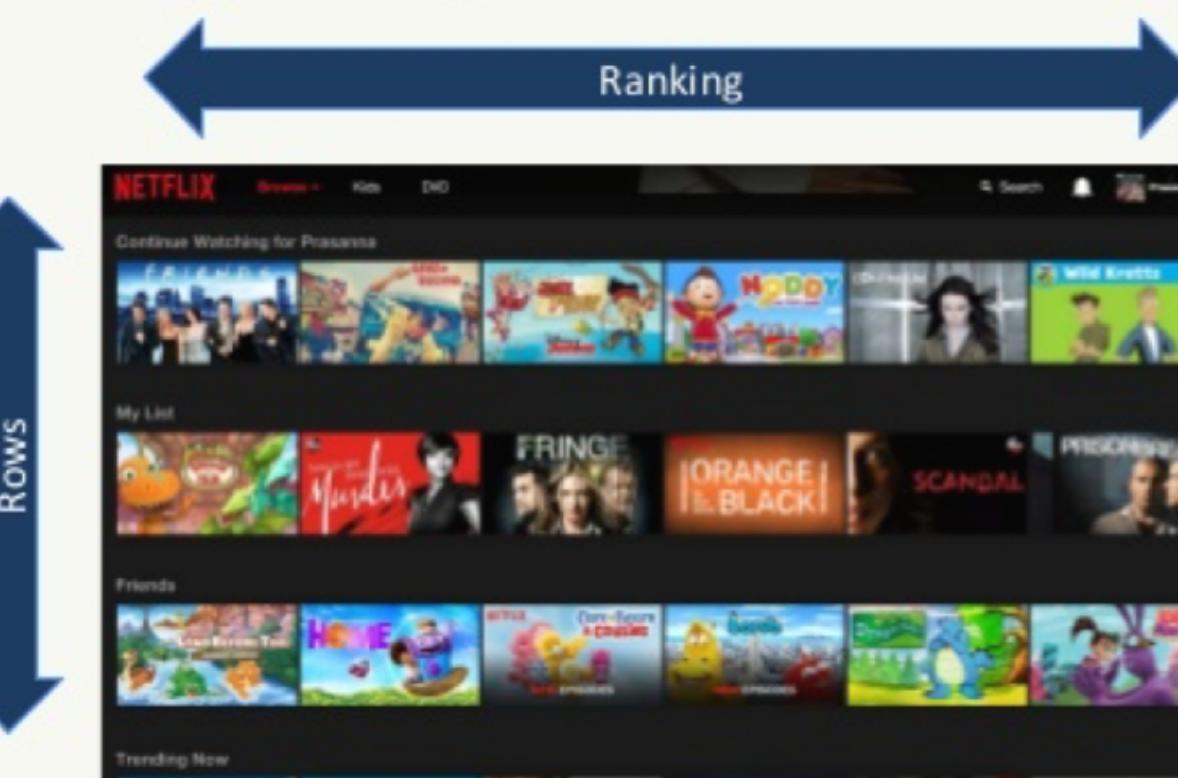


Since an early flush of optimism in the 1950s, smaller subsets of artificial intelligence – first machine learning, then deep learning, a subset of machine learning – have created ever larger disruptions.

Recommender Systems

CASSANDRA SUMMIT 2016

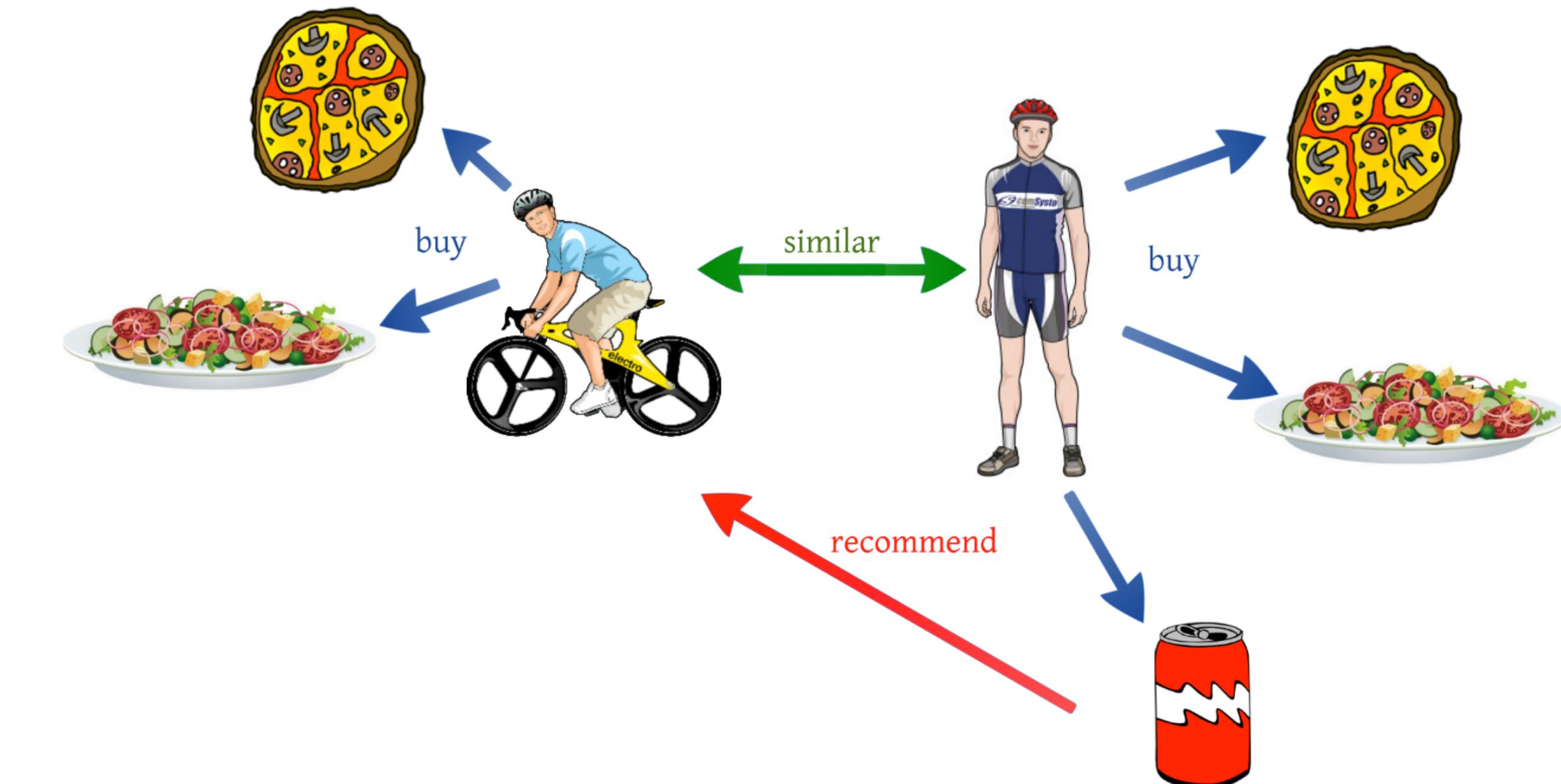
Everything is a Recommendation



NETFLIX

Over 80% of what members watch comes from our recommendations

Recommendations are driven by Machine Learning Algorithms

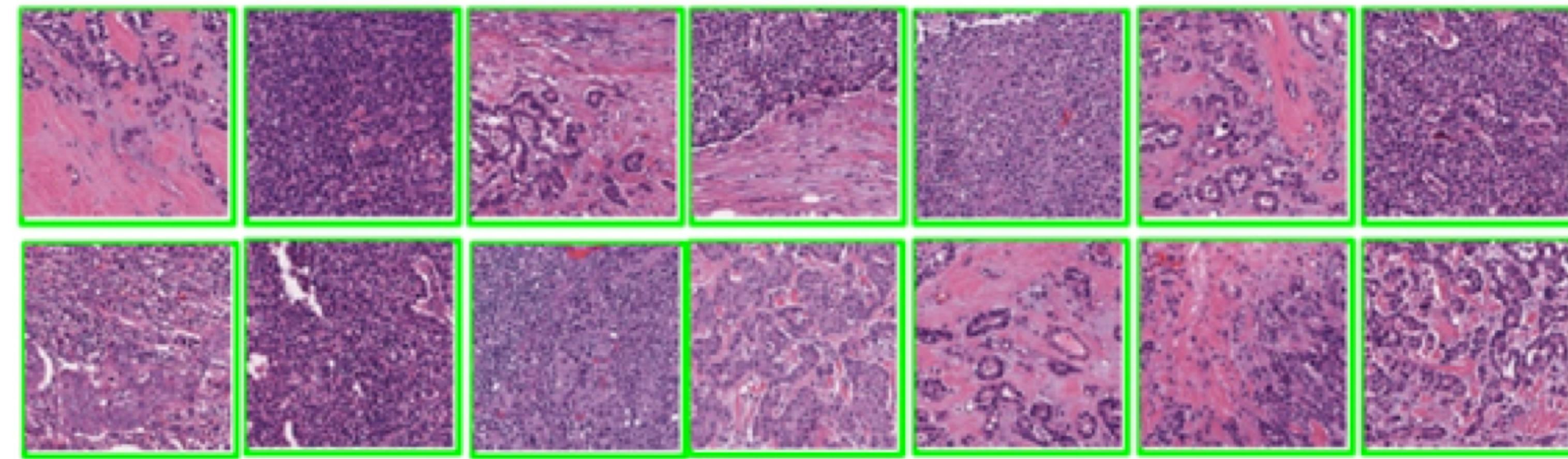


[<https://www.slideshare.net/DataStax/netflix-recommendations-using-spark-cassandra>]

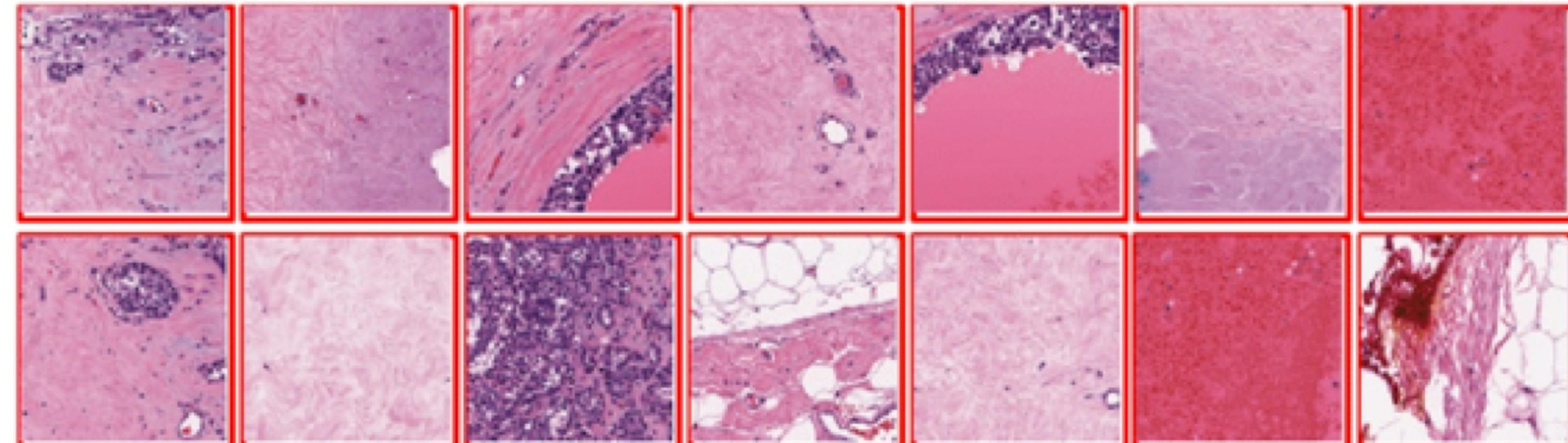
[<https://blog.soton.ac.uk/smallworld/2015/04/25/game-theory-and-recommendation-systems/>]

Medical Diagnosis

Positive examples (IDC tissues)



Negative examples (healthy or not invasive tumor tissues)



<https://doi.org/10.1111/12.2043872>

Personal Assistants – Natural Language Processing

The image displays two screenshots of the Google Assistant app interface.

Screenshot 1 (Left): The title bar reads "Google Assistant Preview Edition". The time is "TODAY • 3:59 PM". A "News" button is visible. The assistant says "Here are the top stories". It shows two news cards: one about an airline weighing passengers to American Samoa, and another about Yahoo being scanned by US authorities. A "Send me daily" button is present. Below the cards are buttons for "Cancel", "7am", "9am", "11am", "12:30pm", and "3pm", along with a "Say something..." input field and a microphone icon.

Screenshot 2 (Right): The title bar reads "Google Assistant Preview Edition". The user asks "what's the weather like there?". The assistant replies "It looks pleasant outside". It shows the weather in San Francisco: "65°F in San Francisco" with "Partly Cloudy - High: 66° Low: 54°" and a sun icon. A link "More on weather.com" is provided. The time is "TODAY • 3:24 PM". The user asks "Show me pictures I took in Colorado". The assistant replies "I found this in your Google Photos" and shows two photos of a landscape with mountains and green fields.

Smart Home



<http://blog.airpatrol.eu/wp-content/uploads/2016/10/bigstock-Smart-Home-103718372-1200x800.jpg>



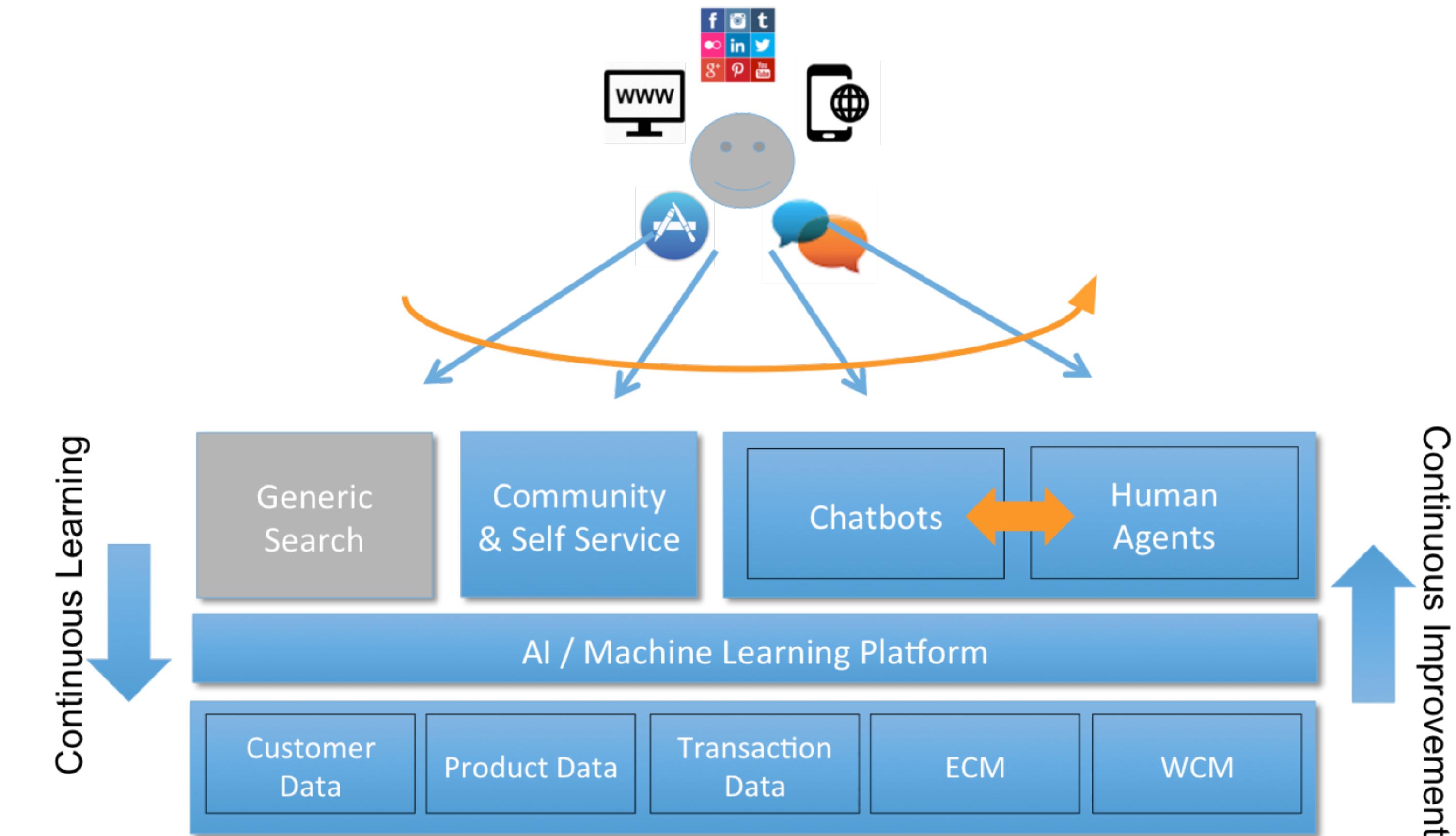
Video Games

DEBUG MODE:

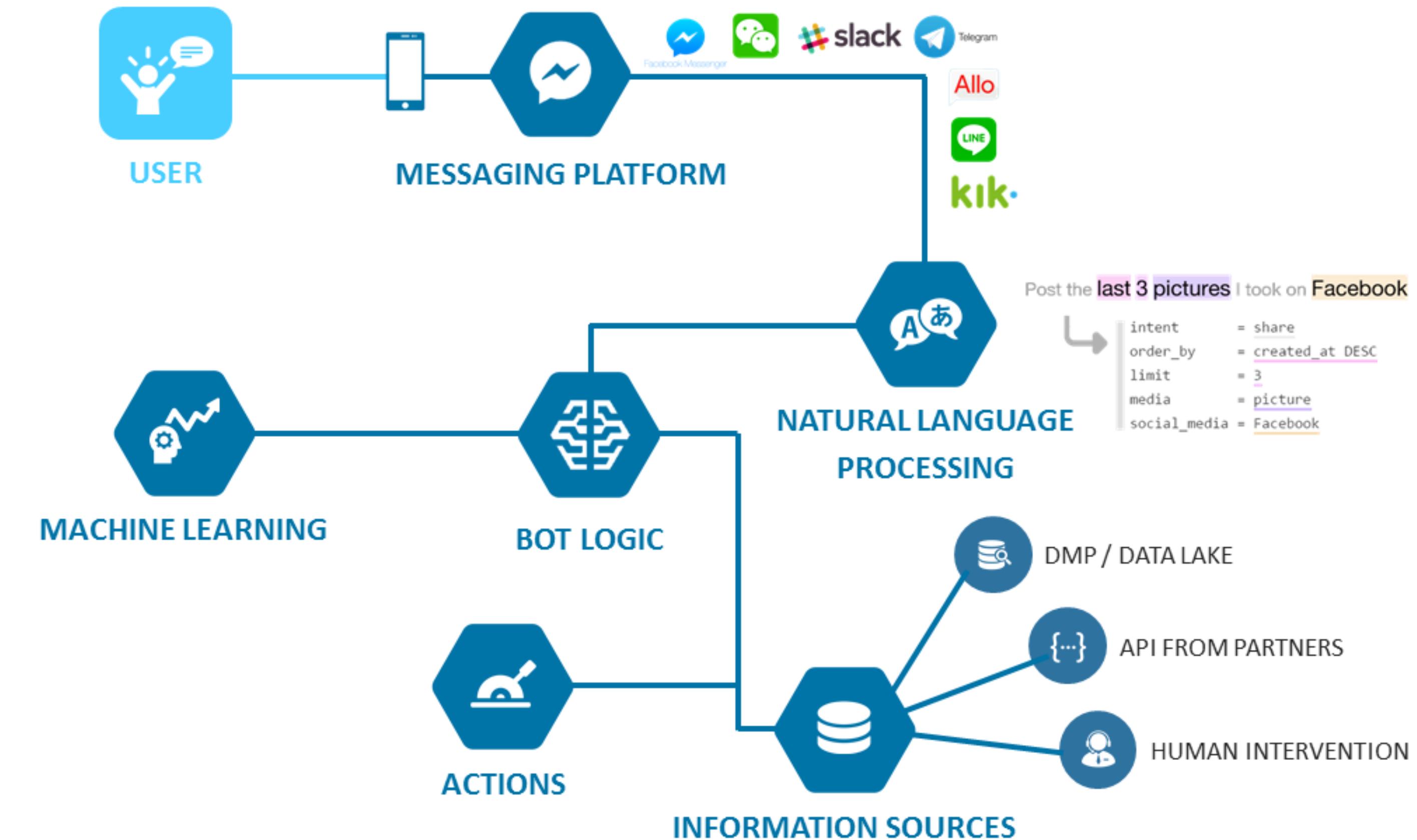
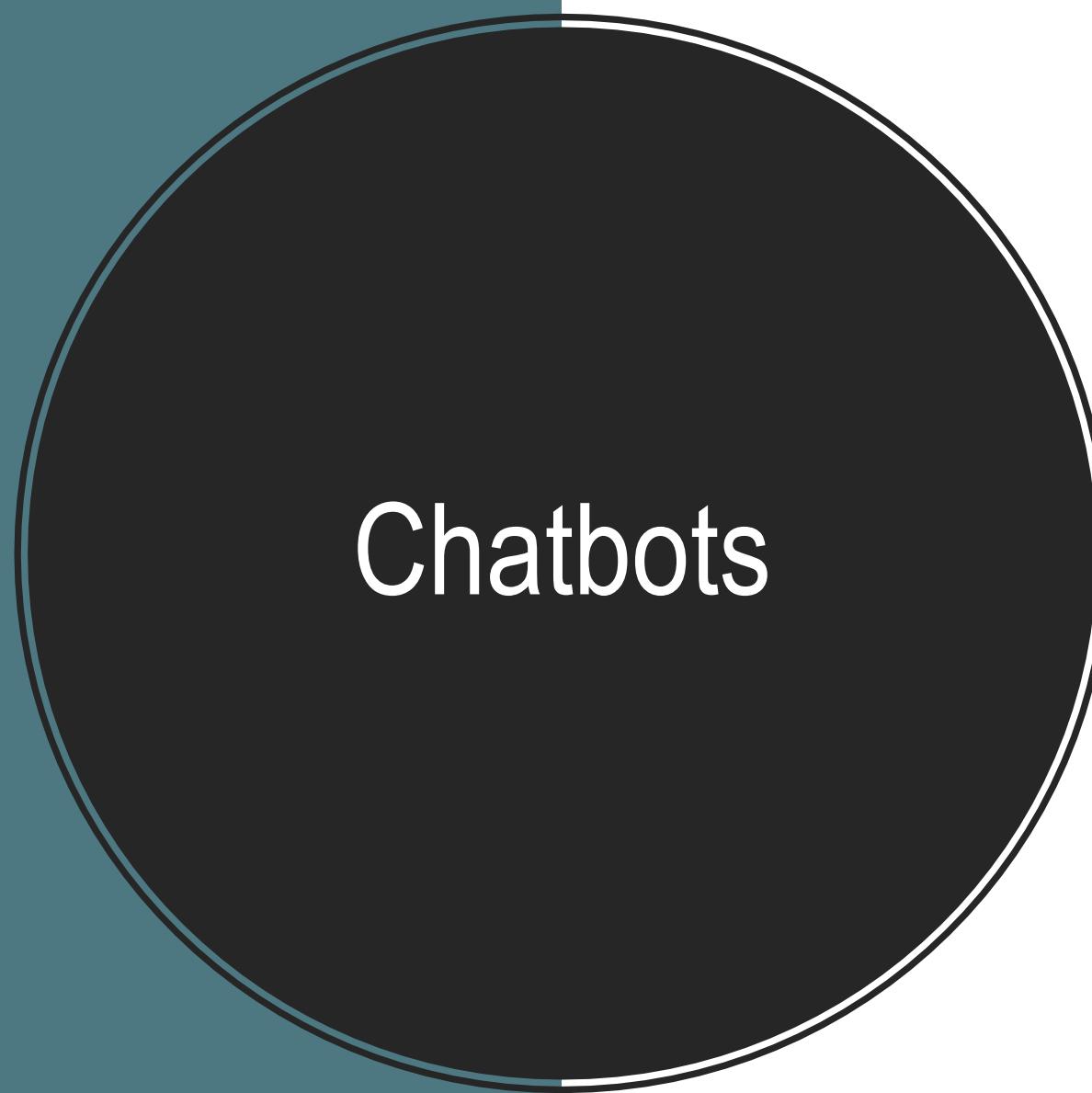
SHOW THE AI PERFORMS THE SEARCH.

Video at this link <https://www.youtube.com/watch?v=36cKiPPrGho>

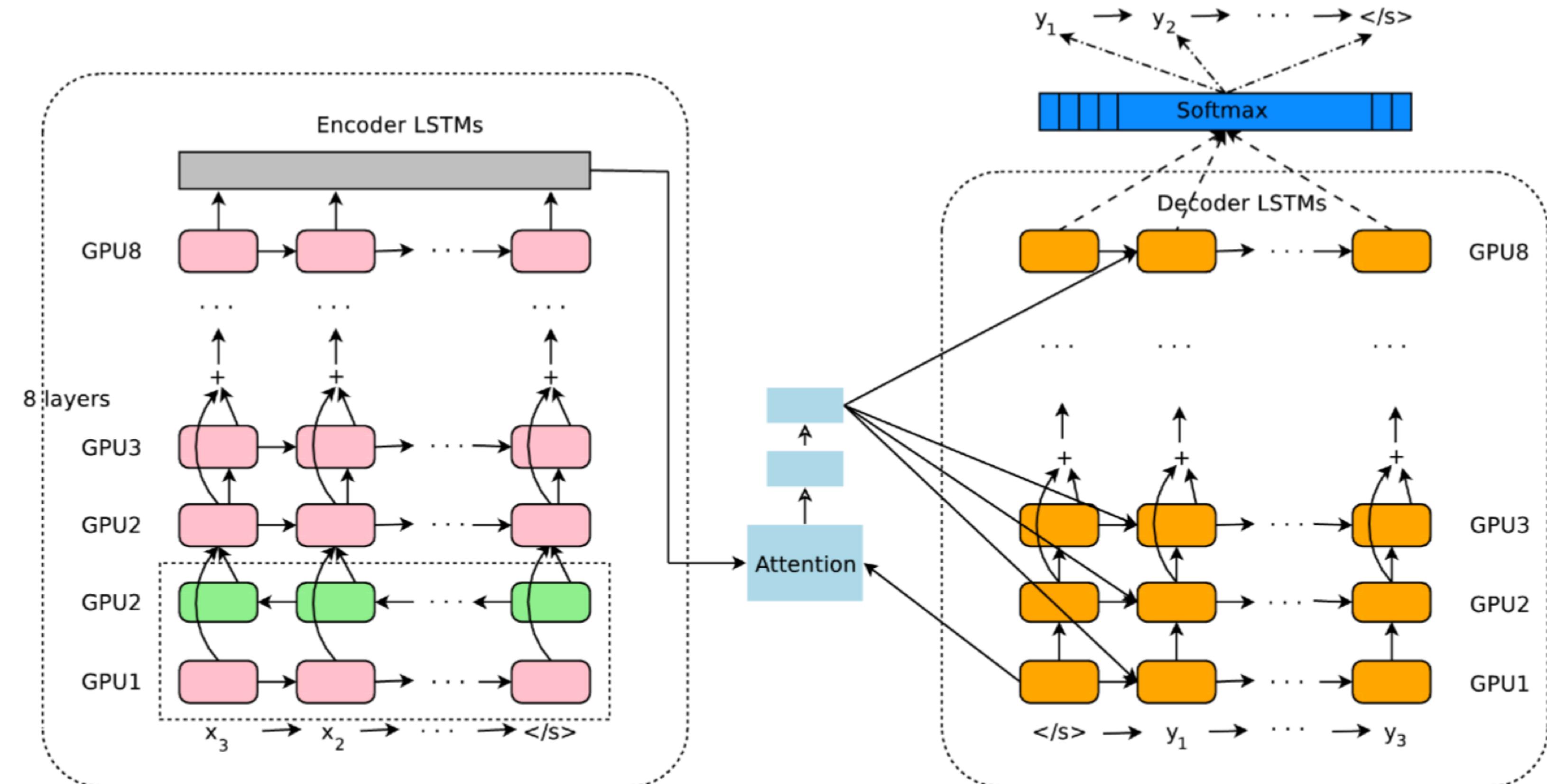
Customer Service Infrastructure



<http://www.epikonic.com/wp-content/uploads/Customer-Service-Infrastructure.png>



Machine Translation



[From Google's Neural Machine Translation System: Bridging the Gap between Human and Machine Translation]

Autonomous driving

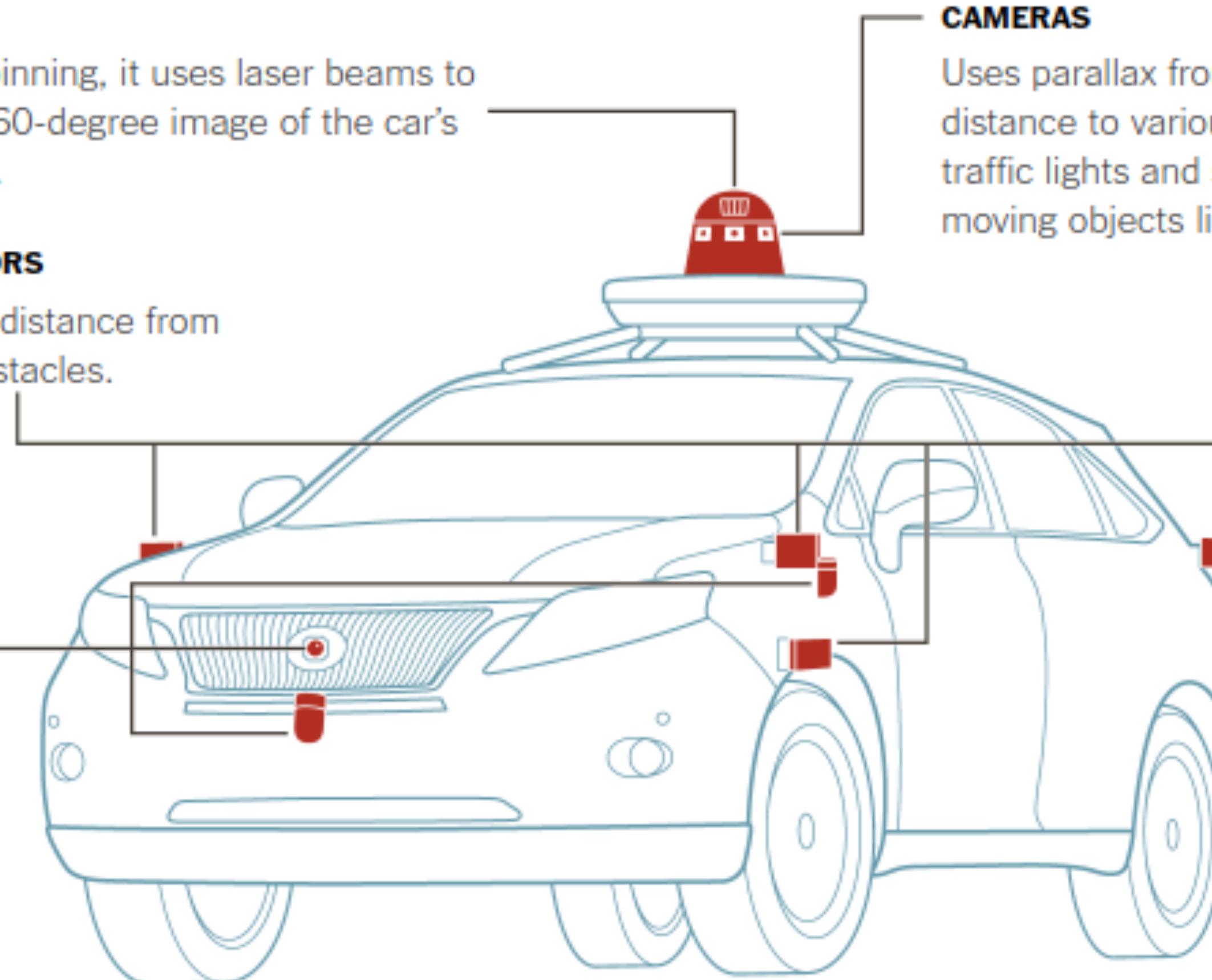
LIDAR UNIT

Constantly spinning, it uses laser beams to generate a 360-degree image of the car's surroundings.

RADAR SENSORS

Measure the distance from the car to obstacles.

ADDITIONAL LIDAR UNITS



CAMERAS

Uses parallax from multiple images to find the distance to various objects. Cameras also detect traffic lights and signs, and help recognize moving objects like pedestrians and bicyclists.

By Guilbert Gates | Source: Google | Note: Car is a Lexus model modified by Google.

Autonomous driving



Collision avoidance

Radar-, laser-, or camera-based systems warn of an impending collision, and can automatically apply the brakes in some cases.



Drifting warning

If a car begins to deviate from its lane, some systems alert the driver and apply a small counter-steering force.



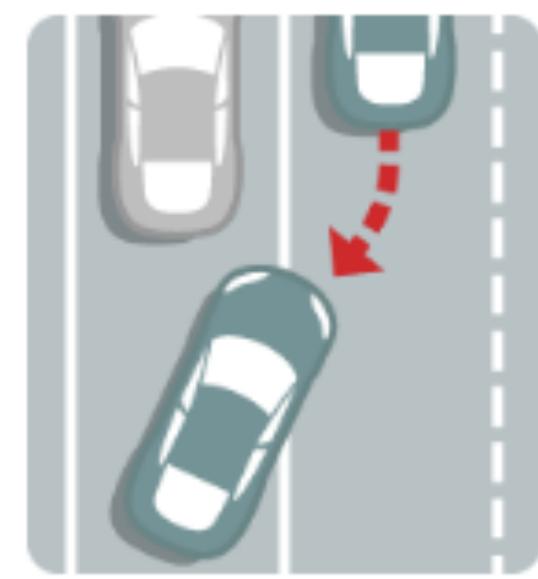
Blind-spot detectors

Cameras or radar can detect vehicles in the driver's blind spot and then alert the driver with sounds or warning lights.



Enhanced cruise control

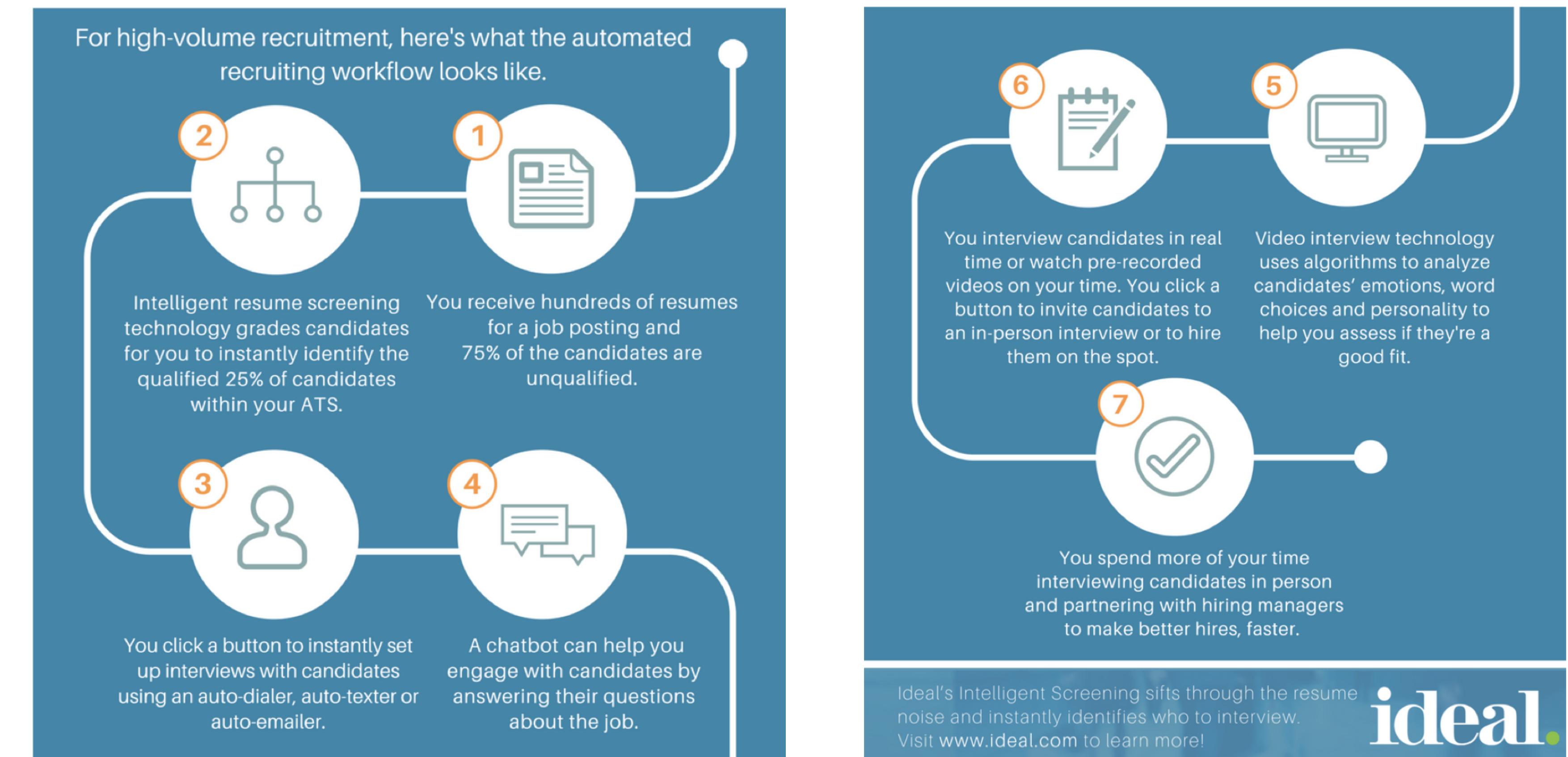
A predefined distance can be maintained to the vehicle ahead. If it slows, your car also slows.



Self parking

The car maneuvers itself into a parking spot using cameras or sonar. But the driver usually has to brake and follow commands.

Recruiting





Art

1

Upload photo

The first picture defines the scene you would like to have painted.



2

Choose style

Choose among predefined styles or upload your own style image.



3

Submit

Our servers paint the image for you. You get an email when it's done.



<https://deepart.io/>

Sketching

sketch-rnn mosquito predictor.

clear drawing mosquito random predict

https://magenta.tensorflow.org/assets/sketch_rnn_demo/img/multi_sketch_mosquito.gif

Photography



<https://www.fastcompany.com/90247454/the-pixel-3-puts-googles-extraordinary-ai-in-your-pocket>