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Pattern Analysis & Machine Intelligence
Praktikum: MLPR-WS19/20

Week 1: Introduction

Lecture requirements

- 4 hours per week, 8 credit points -> attend the class!
- Final class group projects. Will start at the end of the lecture period with presentations at the end of the semester (we will choose a date together later).

- Bring a laptop with WiFi access to the university network (Flughafen, eduroam etc.).
- Each session is going to start with a roughly 30-60 minute lecture.
- Online notebooks will be used for the 3 hour long practical sessions.
- We will use Google's Colaboratory for cloud computation. If you have a Gmail, android etc. account, then it is the same account you already have.
- If you don't want to use Colab (because you don't want a google account), you can execute the notebooks locally, we advise a Linux or Mac OS (and will provide no Windows support). Please be reminded that some of the later deep learning content will be difficult to setup/run on your local laptops (unless they have a GPU) as we will use Google Colab's free GPU instances.

- **All lecture materials will be shared on GitHub: https://github.com/ccc-frankfurt/Practical_ML_WS19**

Schedule

Introduction:

Week 1: 14.10 – Introduction, python tools review, software management (version-control & documentation)

Week 2: 21.10 – Ideas behind ML, gradient descent on functions, logistic regression -> Kaggle Titanic dataset

Block 1 - Supervised Learning:

Week 3: 28.10 – Random forests from scratch -> Revisiting Titanic

Week 4: 04.11 – Random forests application, intro to sklearn -> San Francisco crime challenge

Week 5: 11.11 – Basic neural networks from scratch -> Multi-layer perceptron for classification of fashion images

Week 6: 18.11 – Introduction to PyTorch, deep learning, convolutional neural networks -> Reading traditional Japanese characters (Kuzushiji)

Week 7: 25.11 – Neural sequence models, recurrent neural networks -> Shakespeare poetry text generation

Schedule

Block 2 - Unsupervised Learning:

Week 08: 02.12 – Unsupervised learning: k-means clustering and principal component analysis -> self-generated known data distributions

Week 09: 09.12 – Unsupervised neural networks, autoencoders (representation learning/unsupervised pre-training) -> Revisiting fashion and Kuzushiji images

Week 10: 16.12 – Generative models: variational autoencoders -> handwriting generation

Week 11: 13.01 – Generative models: generative adversarial networks -> Face generation

Block 3 – Reinforcement Learning

Week 12: 20.01 – Classic Q-learning -> Q-learning

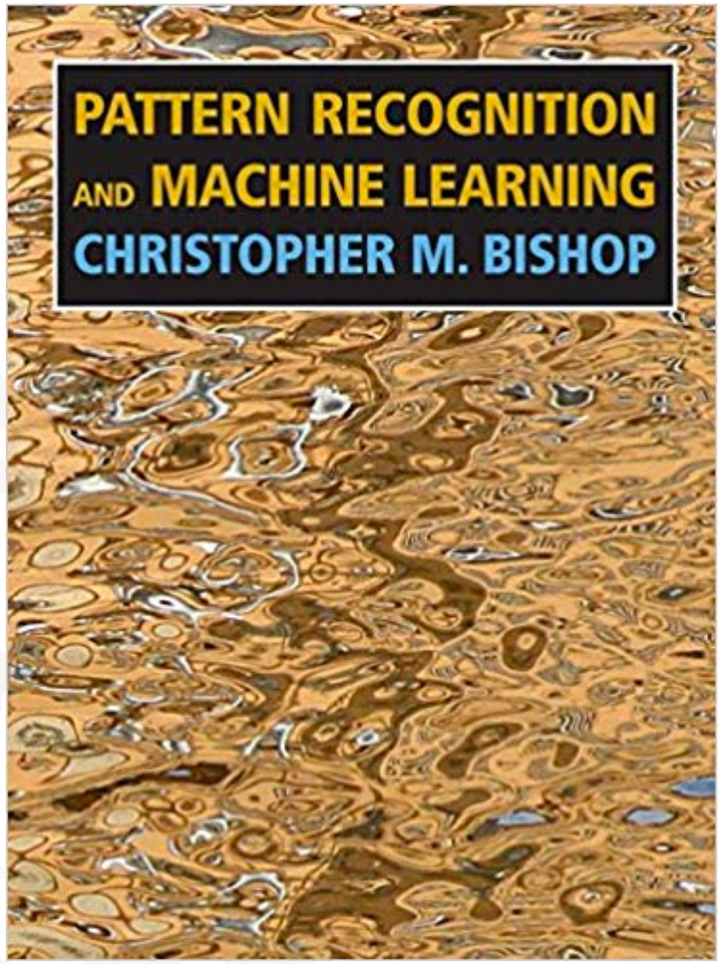
Week 13: 27.01 – Deep reinforcement learning, QNN -> Taxi driver

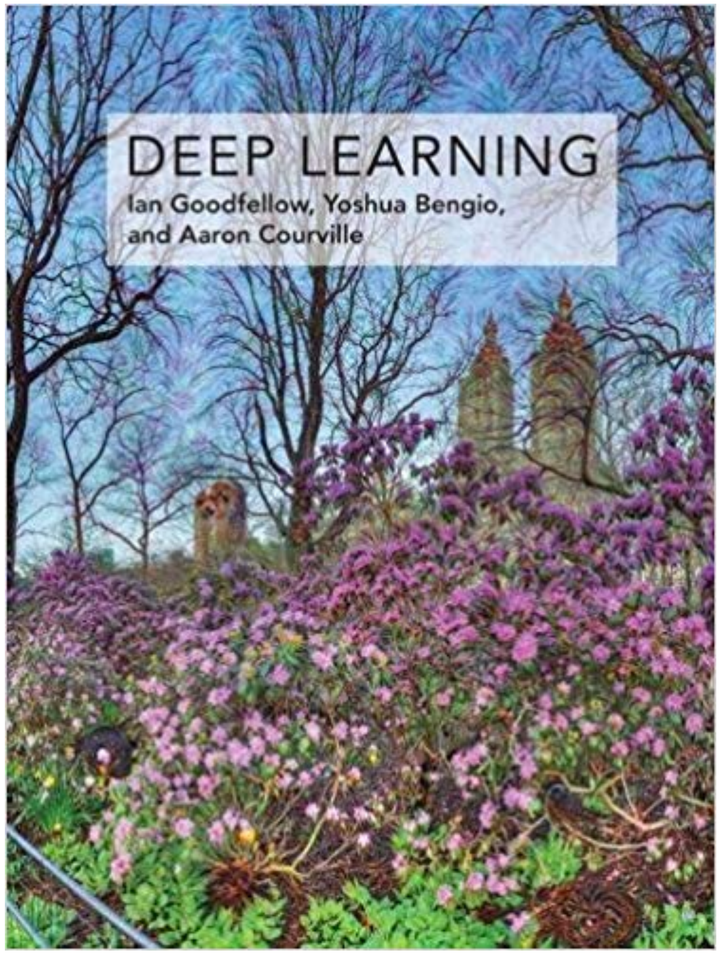
Week 14: 03.02 – Reinforce algorithm -> Robotic application (walking/grasping)

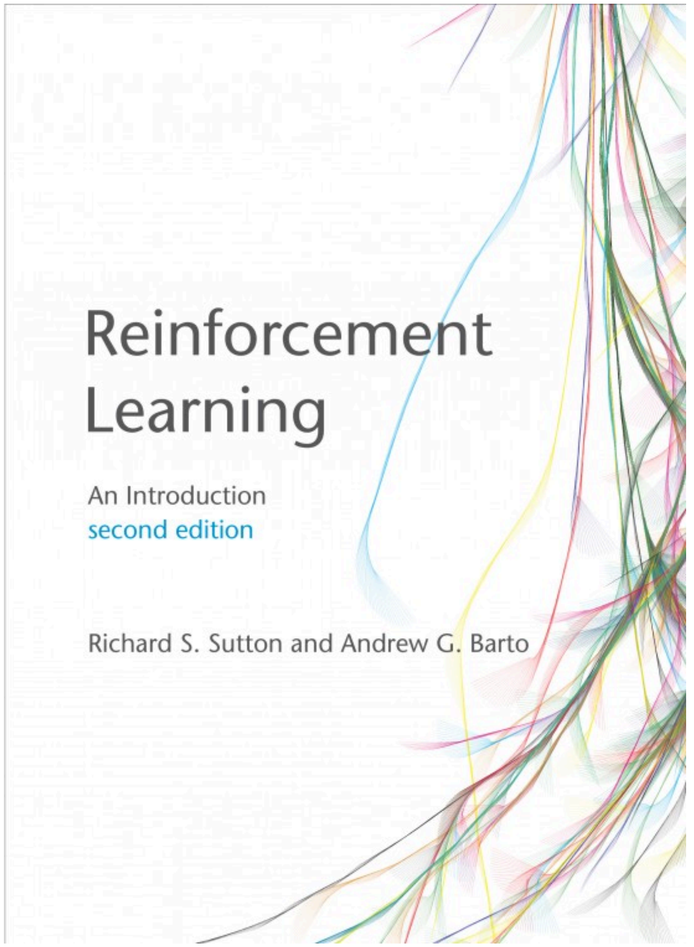
Project planning:

Week 15: 10.02 – State-of-the-art, open questions and existing issues -> Project pitches (3 slides per person)

Literature


PATTERN RECOGNITION
AND MACHINE LEARNING
CHRISTOPHER M. BISHOP


DEEP LEARNING
Ian Goodfellow, Yoshua Bengio,
and Aaron Courville

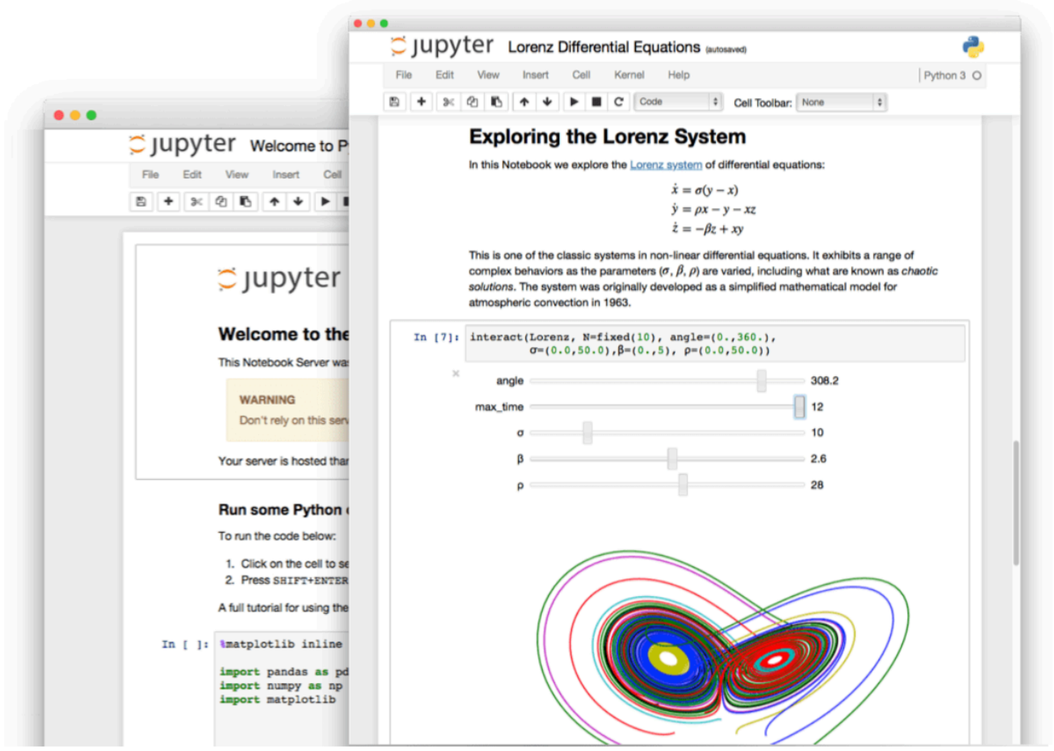

Reinforcement
Learning
An Introduction
second edition
Richard S. Sutton and Andrew G. Barto

Jupyter notebooks: https://jupyter.org/

- Execution of python code in cells
- We will provide step-by-step notebooks where sections are missing and need to be filled in

jupyter

Install About Us Community Documentation NBViewer JupyterHub Widgets Blog



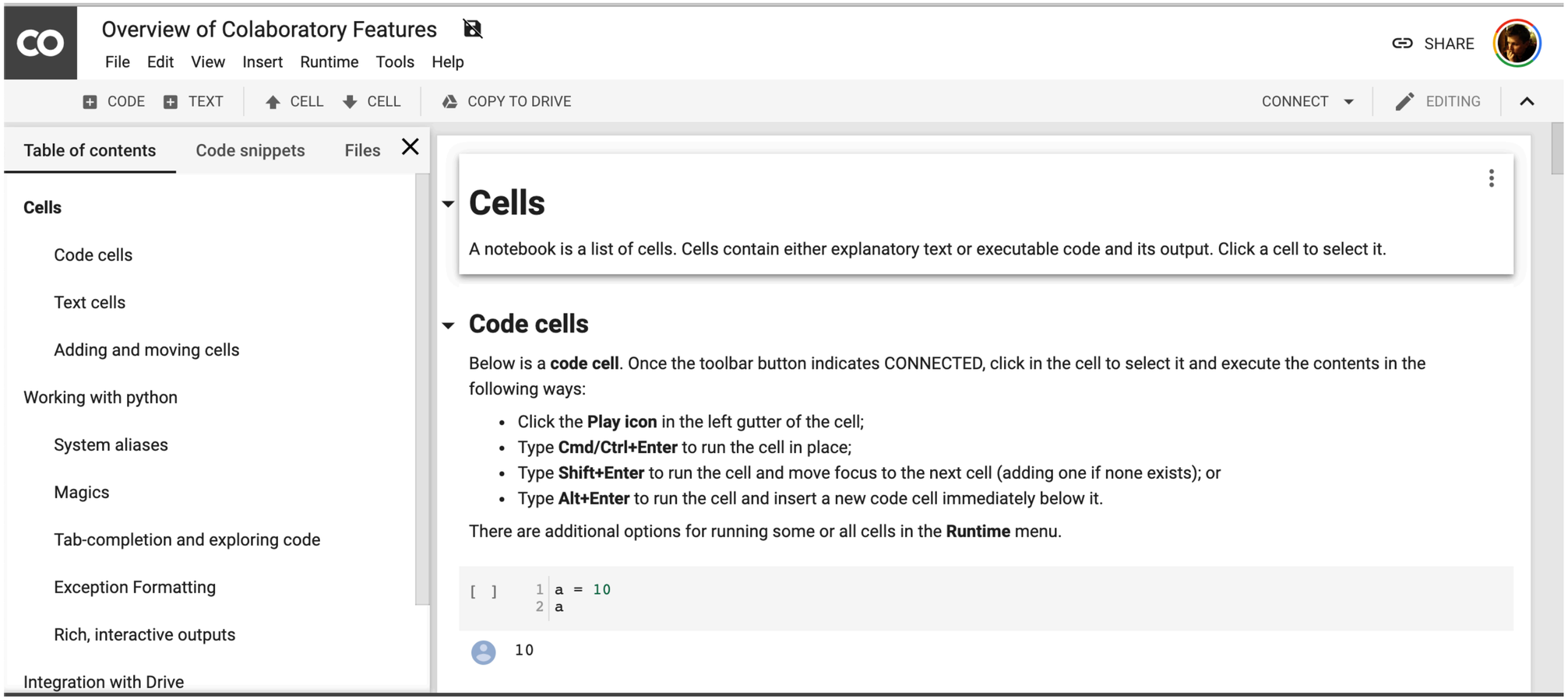
The Jupyter Notebook

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/

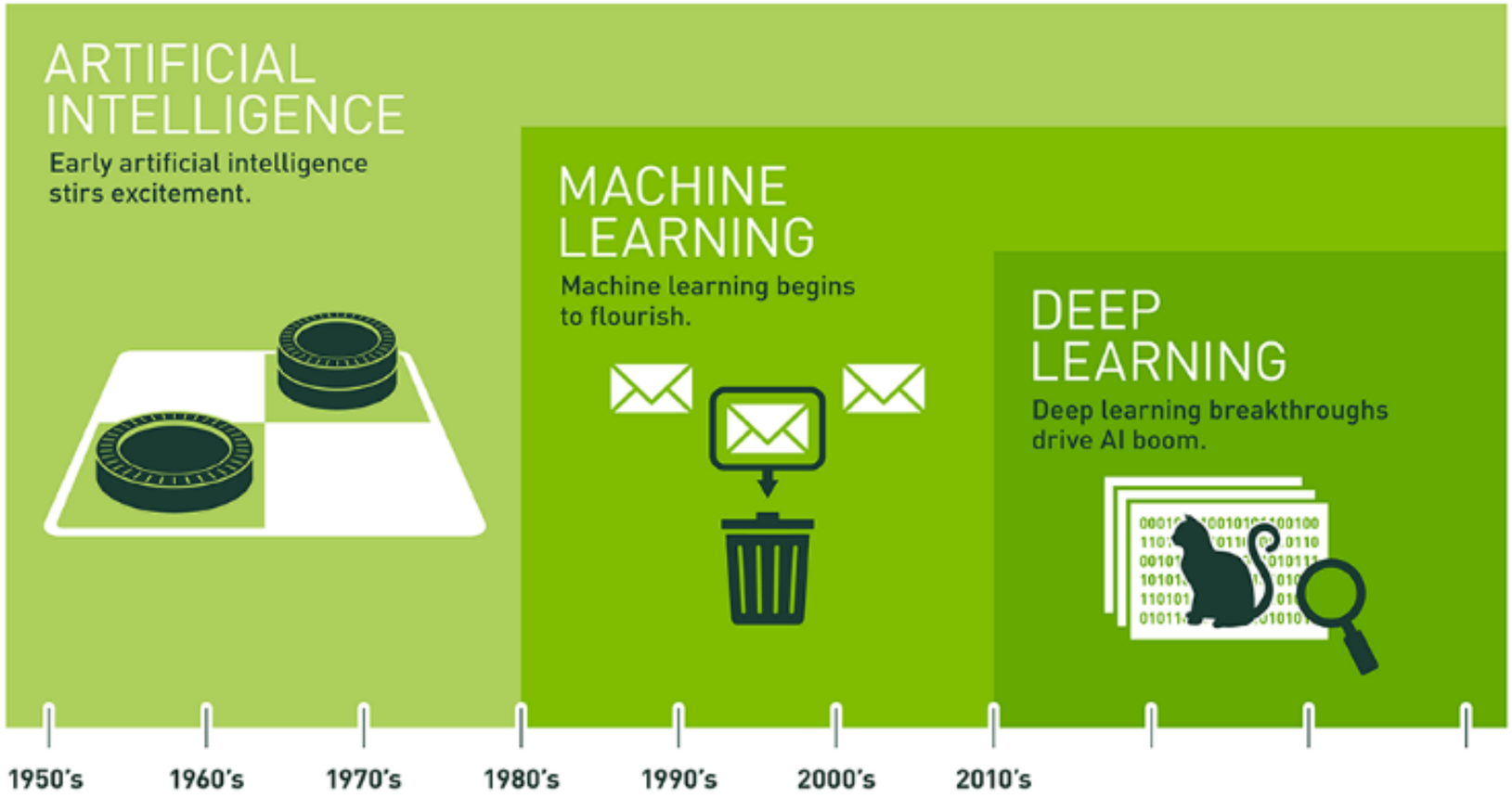
- Google Colab allows execution of notebooks in the cloud from a browser
- GPU/TPU instances are free with an execution time-out after 1 hour (enough for our purposes)



Machine learning in our lives: some examples

- Medicine/Pharma
- Finance
- Smart homes
- Video games
- Customer support, chat bots
- Machine translation
- Smart cars
- Surveillance, security
- Recruiting, job market
- Robot control
- Art

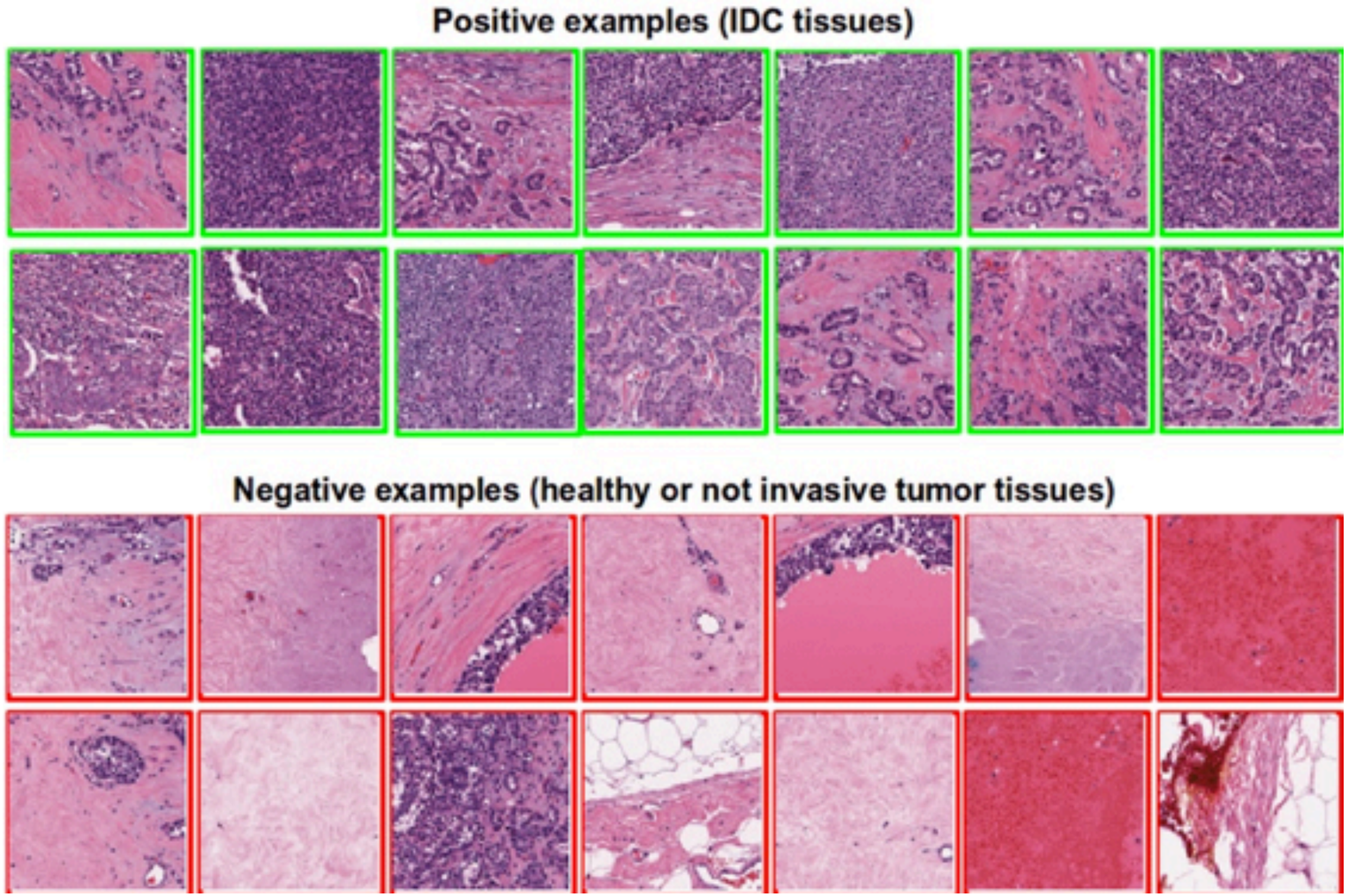
Terminology



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.

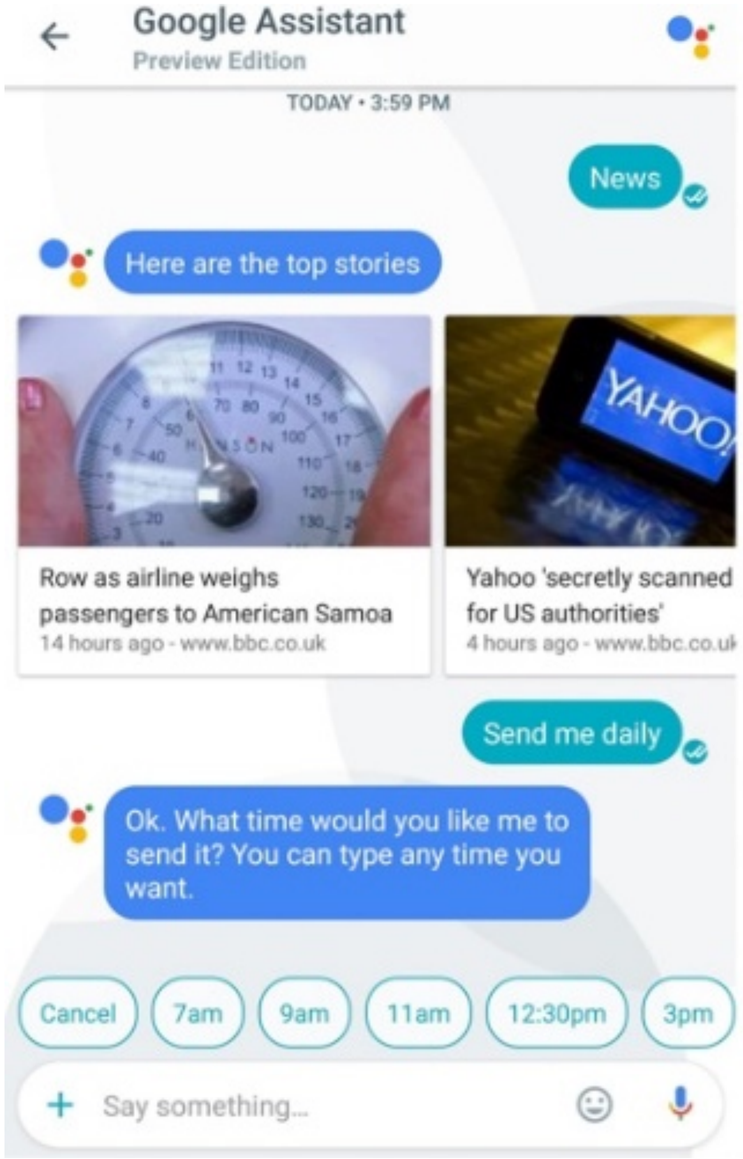
https://blogs.nvidia.com/blog/2016/07/29/whats-difference-artificial-intelligence-machine-learning-deep-learning-ai/

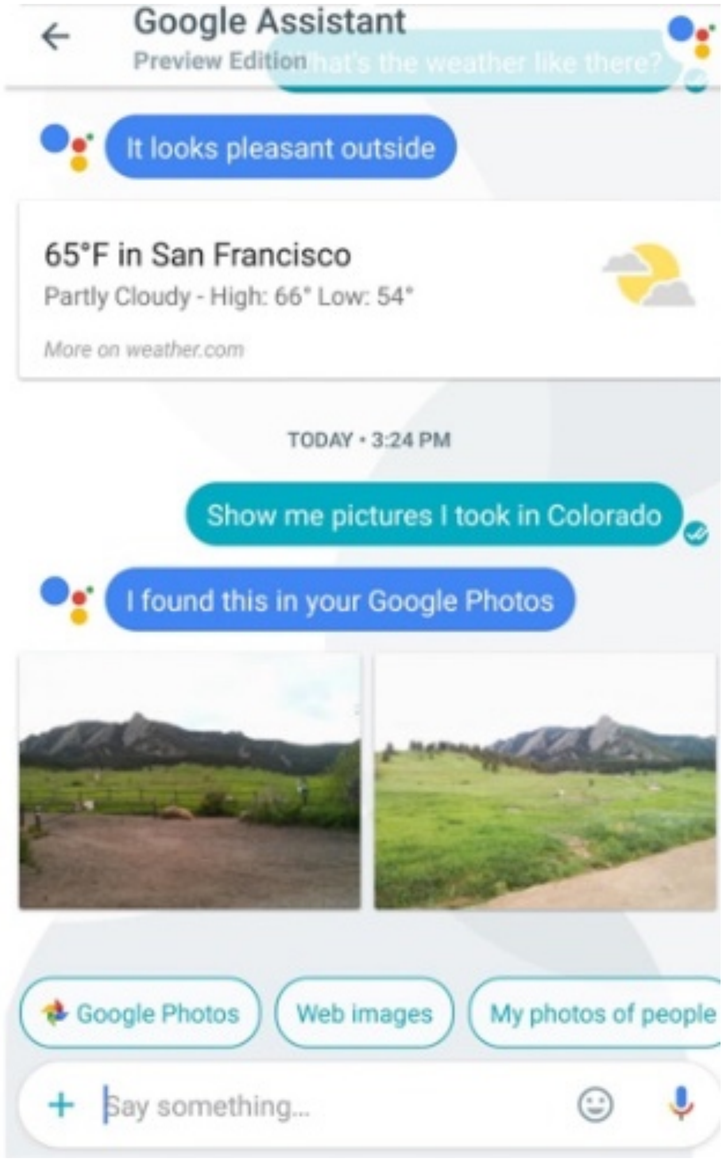
Medical Diagnosis



https://doi.org/10.1117/12.2043872

Personal Assistants – Natural Language Processing





https://www.fudzilla.com/news/41763-google-assistant-uses-ai-machine-learning-to-become-people-friendly

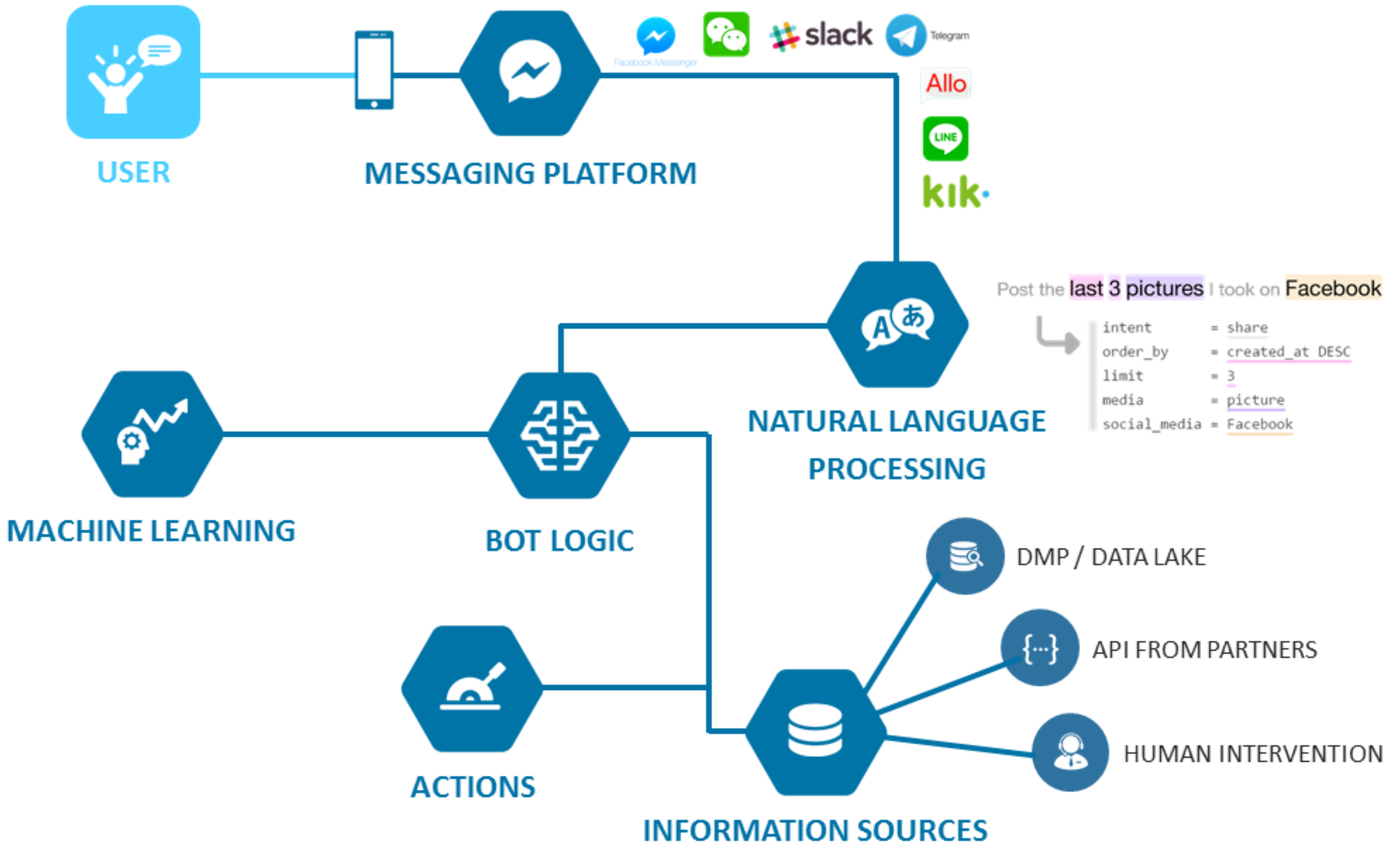
Smart Home

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

Video Games

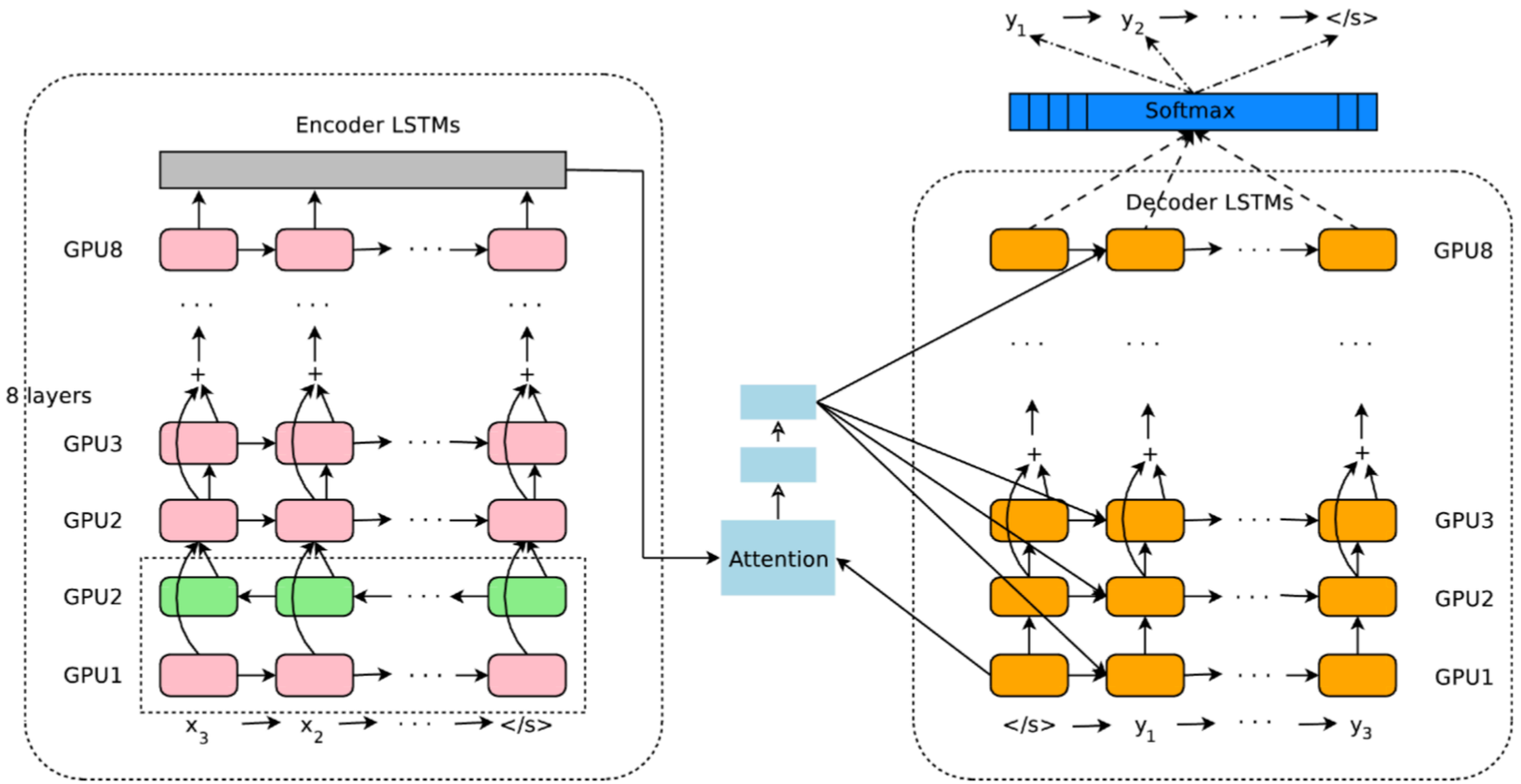
Video at this link https://www.youtube.com/watch?v=36cKiPPrGHo

Chatbots



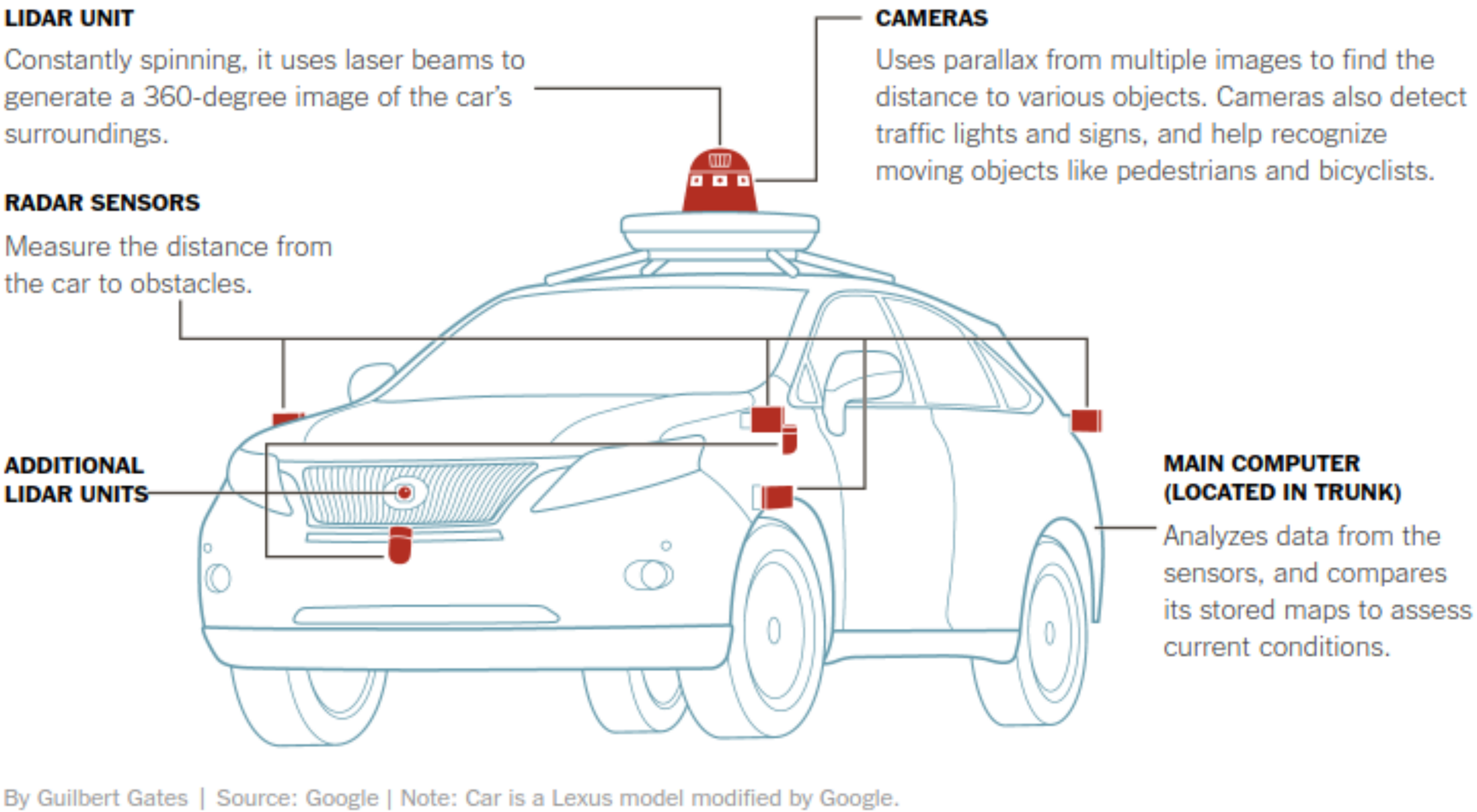
https://chatbotsmagazine.com/the-ultimate-guide-to-designing-a-chatbot-tech-stack-333eceb431da

Machine Translation



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

Autonomous driving



https://www.nytimes.com/interactive/2016/12/14/technology/how-self-driving-cars-work.html?_r=0

Autonomous driving

Collision avoidance

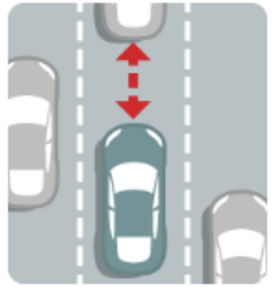
Radar-, laser-, or camera-based systems warn of an impending collision, and can automatically apply the brakes in some cases.

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

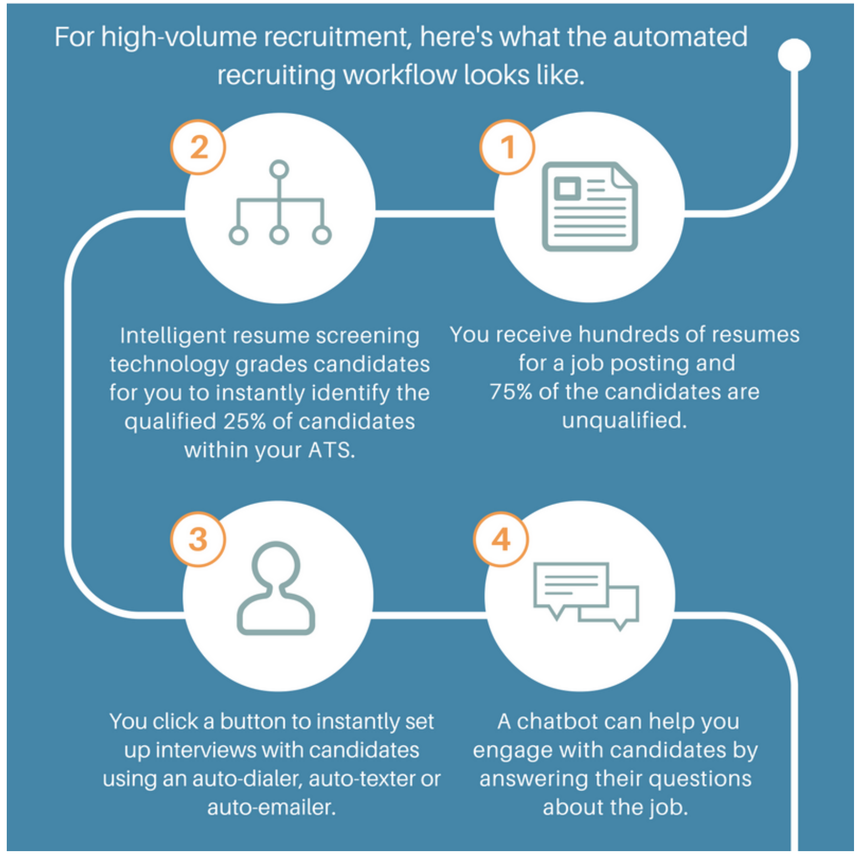
A predefined distance can be maintained to the vehicle ahead. If it slows, your car also slows.

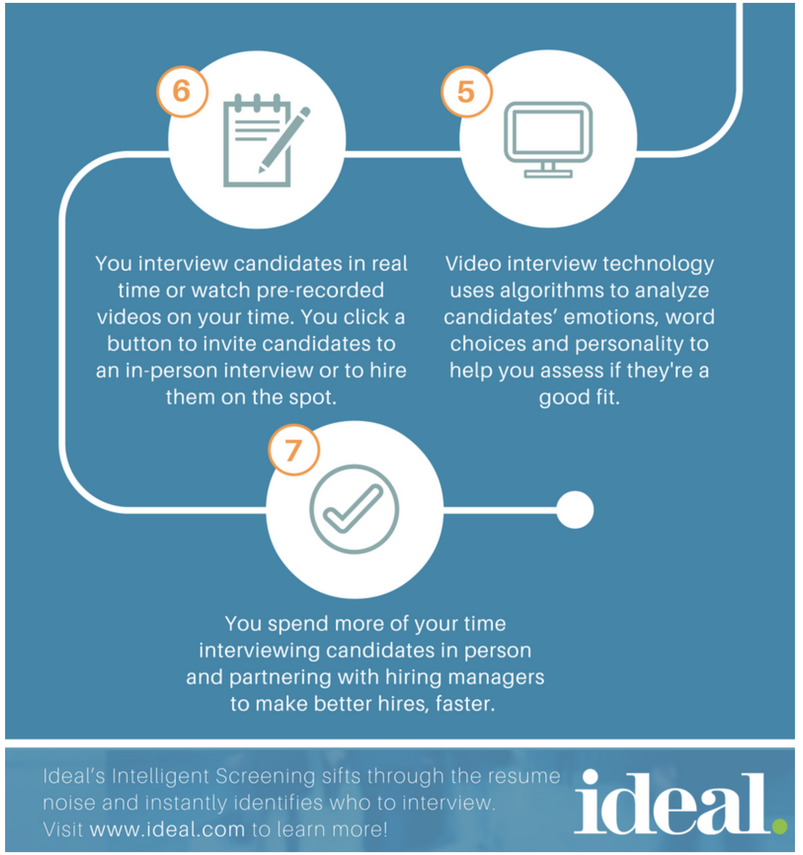
Self parking

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

https://www.nytimes.com/interactive/2016/12/14/technology/how-self-driving-cars-work.html?_r=0

Recruiting





http://www.hrmblogs.com/2018/01/17/ai-recruitment-the-future-of-automated-recruiting/

Art

1 Upload photo

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

2 Choose style

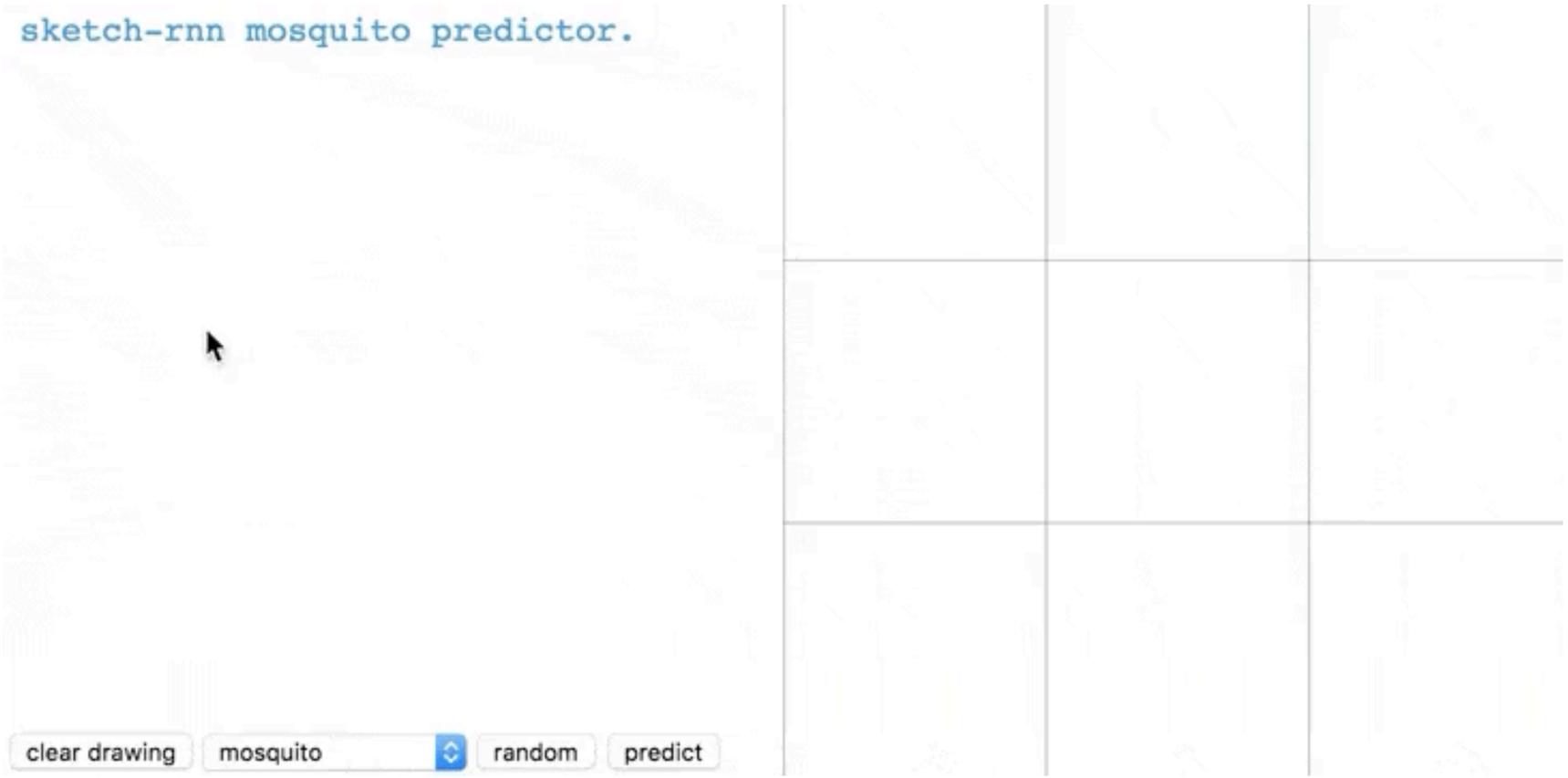
Choose among predefined styles or upload your own style image.

3 Submit

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

https://deepart.io/

Sketching



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

Photography: night mode

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