Disclaimer

A.I.#210 is an introductory level course.

It aims to provide overview and to demystify topics for general audience on this discipline. If you love technical challenges, please come to M.L. #510.

• • •

We are from various background. Let's fly low and slow together on topics even pros sometimes get confused.

Ture intelligence is bestowed upon men and women so that they might come to God and reason with him on, right and wrong, good and evil, true and false.

TIMELINE

1. 3:30~ 3:42pm History/Concepts/Ideas/Individuals
2. 3:42~4:02pm Real-life and industry applications
3. 4:03~4:13pm Restroom break & M.L.#510 Teaser
4. 4:14~4:34pm CNN/RNN/KNN/DNN, Visual, Voice recognition, NLP
5. 4:35~4:45pm Know the unknown/ Failsafe/ Stability issue
6. 4:45~5:00pm Q & A, A.I. efforts in GEA Service Technology

Mute your phone plz, Shh…

A.I. #210

How AI is reshaping manufacturing industry

EWOL Presentation

Wei Zhou Ph.D.
GEA Service Technology
GE Appliance Park, Louisville KY

Artificial Intelligence Presentation

EWOL Notes

Section 1: History, individuals, and idea evolution

Reading into history can be boring. It's like looking into the far end of a winding road in a rear-view mirror.

12m

Important Individuals

Julian Offray de La Mettrie

Man a Machine

La Mettrie believed that man, body and mind, worked like a machine.

Charles Babbage

The First Mechanical Computer

Separate data/program memory, instructional operation, control unit makes conditional jumps, and separate I/O.

John von Neumann

The Computer and The Brain

Brain can be viewed as a computing machine, differences between brains and computers.

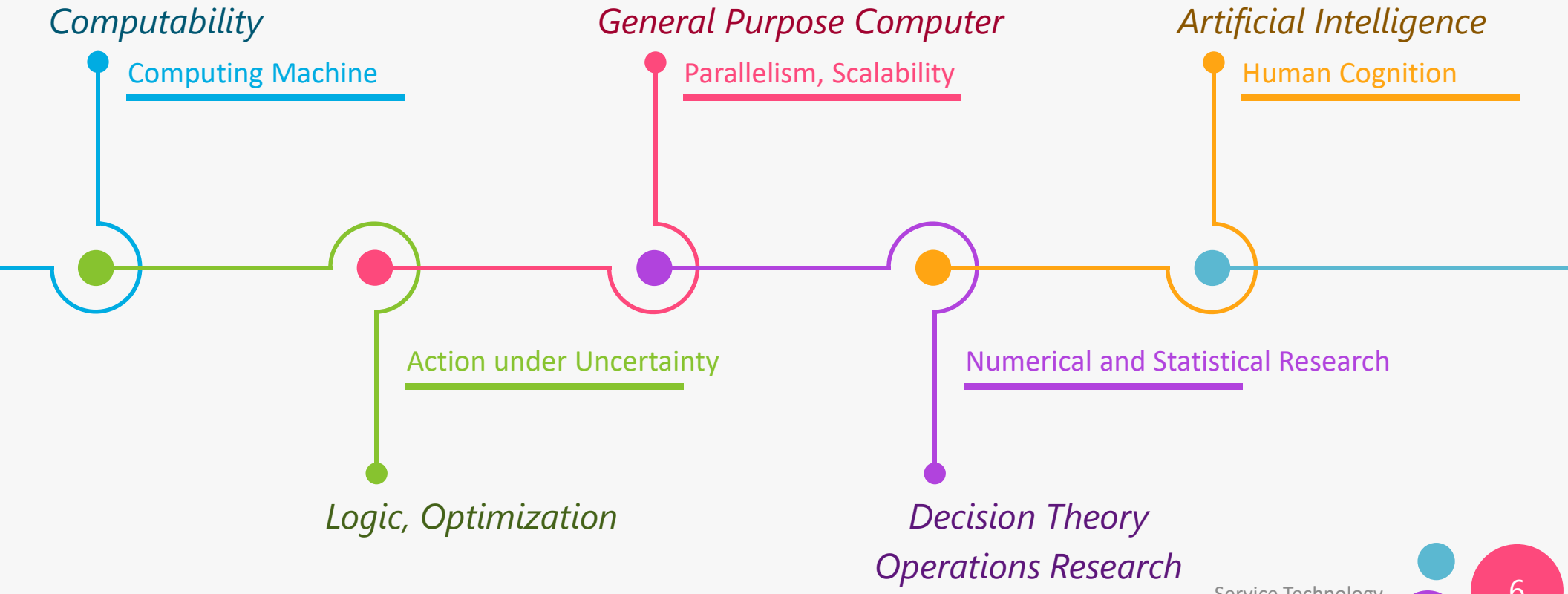
Herb. Simon & Allen Newell

A.I. Theorists

Use production rules for simulating human's problem solving behavior.

Computability, Decision science and A.I.

Evolution of AI from general purpose computer



Major Shift in Paradigms

Mission and Vision of AI Shift from Computation, Decision Science/Operation Research

Computer, Decision Theory, O.R.

- Computability
- Parallelism, Scalability, Computing power
- Decision Science
- Operational Research
- Optimization

Artificial Intelligence

- Perception
- Learning
- Reasoning
- NLP

Major Areas of Efforts

Major Efforts determined from Dartmouth Conference

Planning

Temporal and Spatial Planning
Unmanned Vehicle, Drones
Starship "Avalon" in Passengers Movie

Robotics

Simulated Robotics
Intelligent Diagnostics and Control
Simulation, Games

Machine Learning/Deep Learning

Deep Learning Framework
Search Engine
Intelligent User Interfaces
E-commerce, Business, Finance, Medicine, Law

Vision, Speech Recognition

Facial Recognition
Video Object Tracking
Speech to Text

Natural Language Processing

Text to Speech
Translation
Simulated conversation
Knowledge representation
Cortana, Siri, Alexa .....

IoT/ Ubiquitous Computing

Internet of Things
Consumer Behavior Modeling

Quiz time

3-minute "Short Break"

Q.1 **A.I.** puts major efforts in following areas, except…

A. Visual/Audio Recognition **B**. Deep Learning **C**. Deepsea Fishing **D**. Temporal and Spatial Planning **E.** Reasoning

Q.2 Speech Recognition and NLP, which statement below is incorrect…*

A. S.R. focus on recognition techniques **B**. They all deal with human languages

C. NLP extracts info from contents **D**. NLP converts my voicemail to text msg.

Q.3 Autonomous Vehicle, Unmanned Drone utilize the following tech., except..

A. Visual Tracking **B**. Black Magic **C**. Temporal and Spatial Planning **D**. Machine Learning

Artificial Intelligence Presentation

EWOL Notes

Section 2: Real Life and Industry Applications

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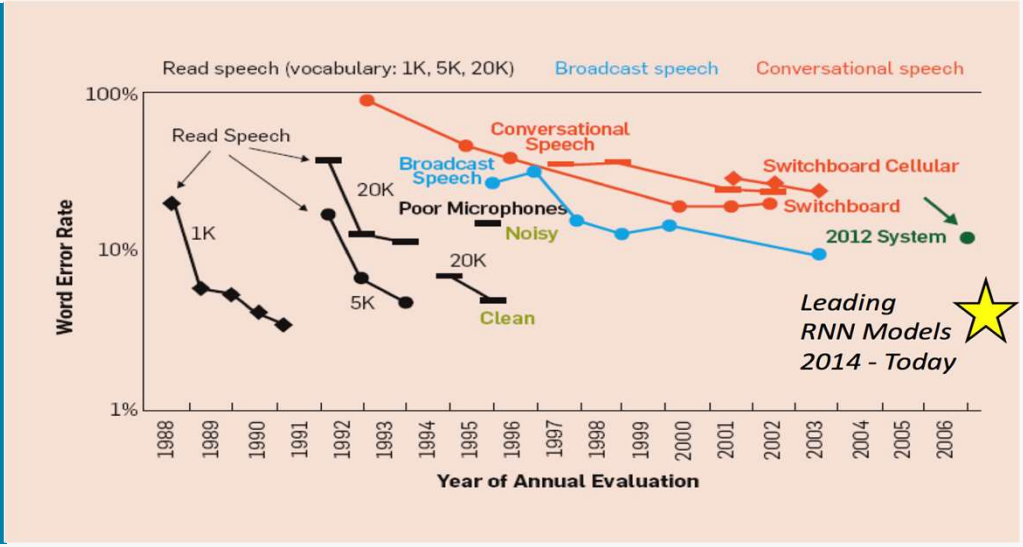
Voice/Speech Recognition

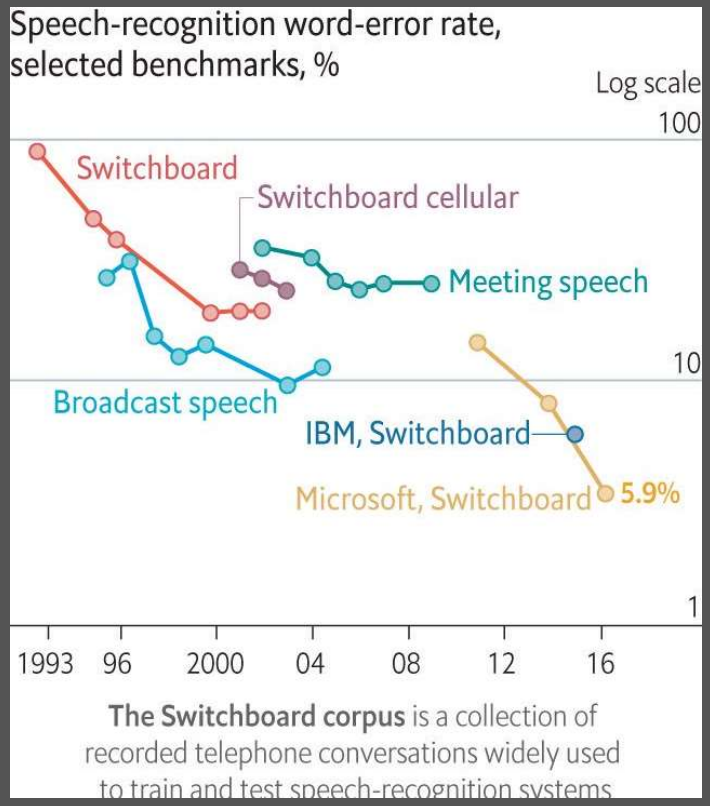
Speech Recognition

Conventional approach vs Introduction of DLA

- Error Rate
- Conventional Approach
- Plateau in Performance
- Introduction of Deep Learning Application



Benefited greately from development in deep learning application, Speech Recognition has seen remarkable progress.

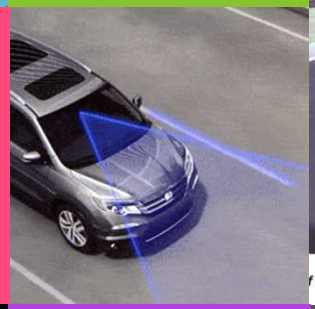


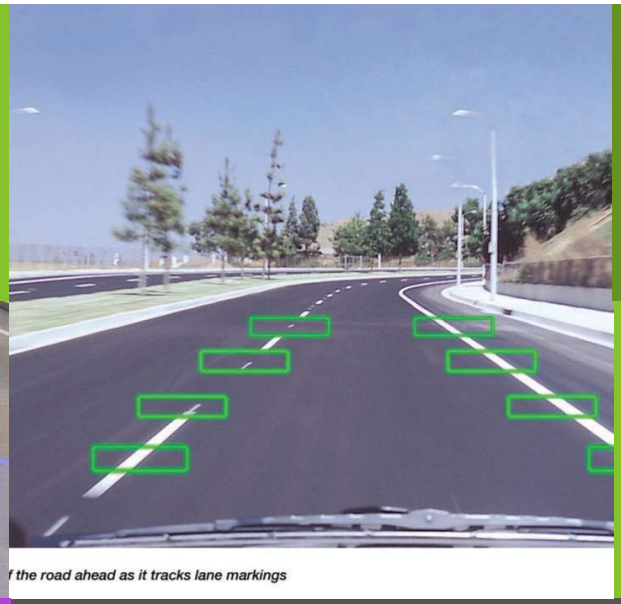
Major Players' Performance

Early 2017, Google announced its speech recognition technology has reached a whopping **4.9%** word error rate in Switchboard recognition.

***Lower** than human error rate 5.3%.

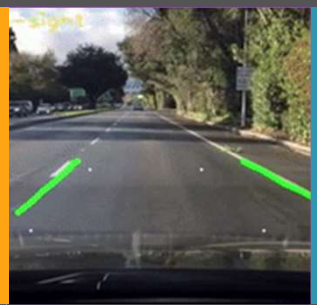
*__Switchboard__ text: Recorded Telephone Conversations.

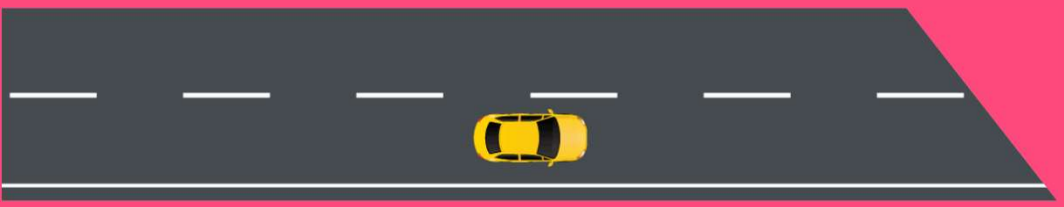




Vehicle Safety

Safety Systems that Save Lives





Lane Departure Warning System

Lane Keep Assist System

Two Active Safety Systems

To avoid or mitigate a crash

Lane-departure Warning

Active Monitoring and Warning System

LDW System

Features

LDW system sends visual, audible, and/or tactile warnings—such as steering wheel or seat vibrations—alert the driver when the car crosses lane markings.

- Continuous Monitoring
- Realtime Warning
- Driver Attention Detection**

Pros & Cons

Avoid at least one crash 12%

Strongly favors 80%

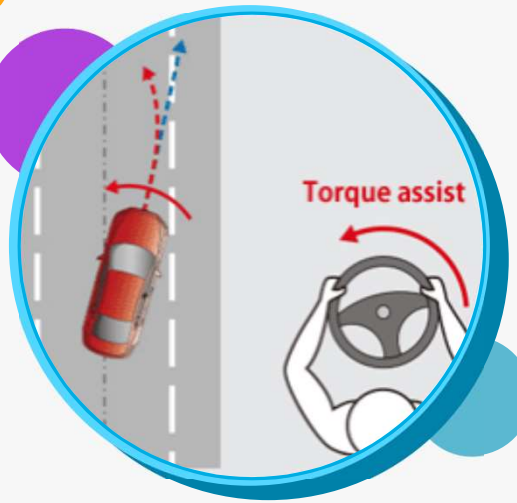
At least one false warning 41%

Finds system annoying 19%

*https://www.consumerreports.org/car-safety/lane-departure-warning-lane-keeping-assist-guide/
**Some systems combine Driver hand/eye attention detection functions.

Lane-keeping Assist

Active Responsive Safety System



LKA System

Features

Continuous active steering to stay in between lanes (active steer, autosteer, etc.)

- Continuous Monitoring
- Active Steering
- Oversteering Correction

Pros & Cons

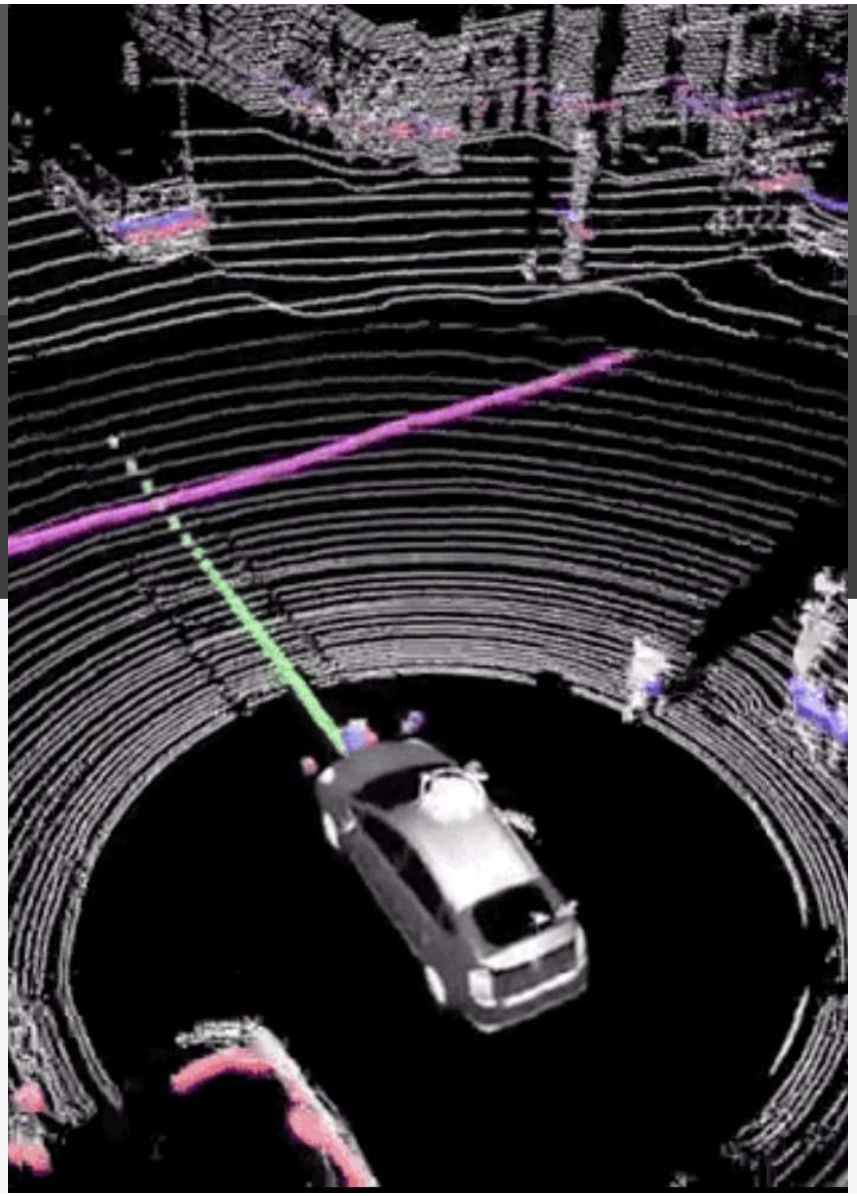
Avoid at least one crash 7%

Very happy and satisfied 70%

Think it is incorrect 9%

Unhappy or neutral 30%

*https://www.consumerreports.org/car-safety/lane-departure-warning-lane-keeping-assist-guide/



Autonomous Vehicle

LIDAR System, Dynamic Spatial Planning, … etc.

Six Levels of Autonomy

SAE Categorization "Level 0" is no Automation

1 Shared Vehicle Control

Regulated System

Human control/operation with machine assist.

2 Partially Automated w/Vigilant Monitoring

Automation with human intervention during exceptions.

3 Conditional Fully Automated w/o Monitoring

Human intervention by design

Human intervention upon request

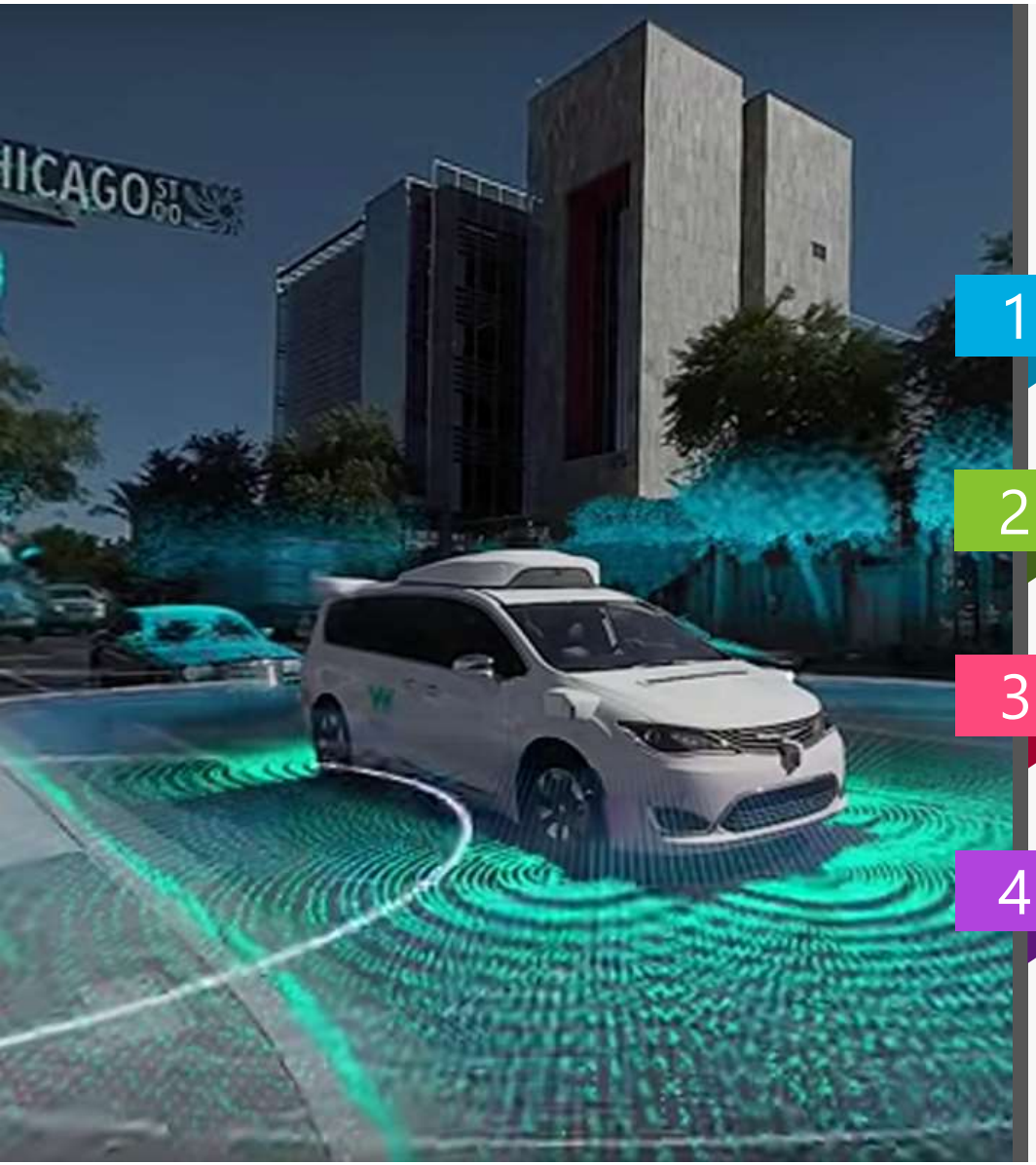
4 Highly Automated with Self-docking

No human intervention needed after vehicle take over control.

Vehicle can do self-dock/self parking.

5 Fully Automated

No human intervention at all.



Waymo Driverless Car

A Google Driverless Vehicle Company

1 **Hi-Def LIDAR System**

360 degree laser view from 5 LIDAR devices

2 **Short-wave Radar System**

Detects distance and relative speed of surrounding objects

3 **Hi-Def Camera**

Traffic light recognition

4 **Process/Predict/Plan Control System**

Process Lidar/Radar/Visual data

Predict surrounding objects' trajectory

Plans its route

Quiz time

3-minute "Short Break"

Q.1 About Speech recognition, all of the followings statements is true, except…

A. A.I. studies human language B. A.I. will outperform human C. S.R. error rates will continue to decline

D. S.R. secretly relies on telepathy

Q.2 Visual Tracking/Recognition, which of the following is incorrect.

A. V.R. uses shadow for tracking B. Day light could be irrelevant C. Visual Recognition can be trained to identify anything

Q.3 Driverless Vehicle utilizes the following technology, except…

A. Laser Technology B. Visual Recognition C. Wheels D. Radar Technology E. Torpedoes

F. Deep Learning models for Planning

4:10-4:20 Restroom Break

Take a break, be right back.

Welcome back

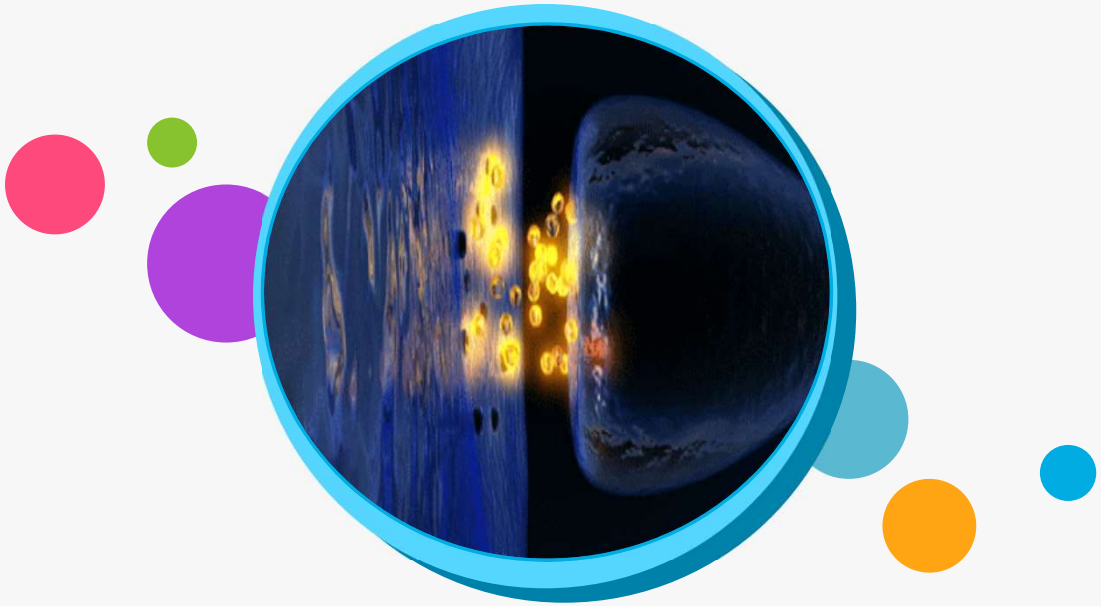
About to start…

Artificial Intelligence Presentation

EWOL Notes

Section 3: Neural Networks and Some How to Examples

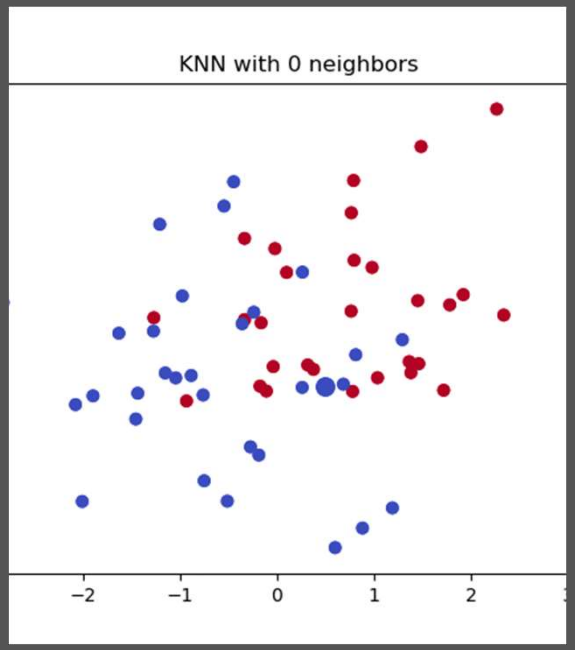
20m



Understand 4 Major Neural Networks

KNN DNN CNN RNN

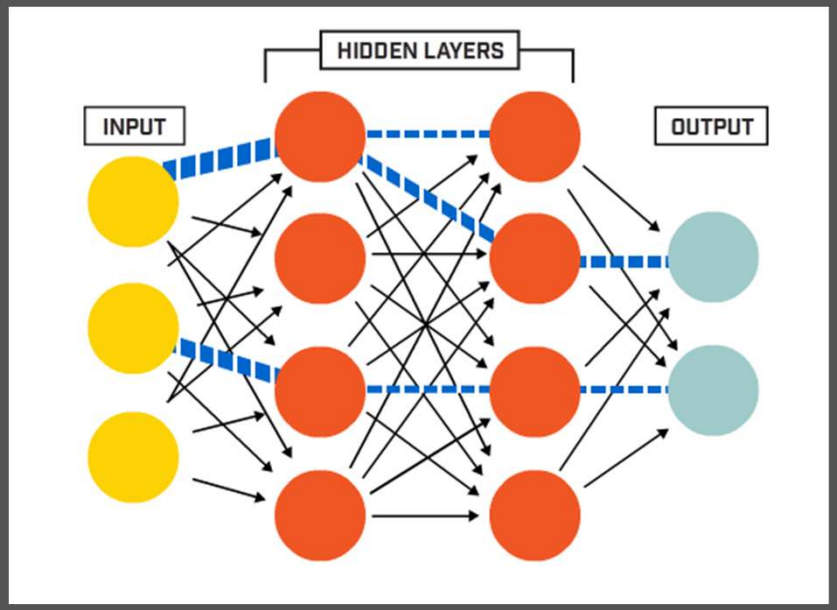
Artificial Neural Network / Feed-forward, Propagation / Back Propagation / Gradient Descent



KNN – Kth Nearest Neighbors

Simplest NN
Lazy Algo (No generalization/inference)
Widely used Classification Algorithm by MFI
Least Calculation Time

- Image Classification
- Credit Rating/Underwriting
- Political Science



DNN – Deep Neural Network

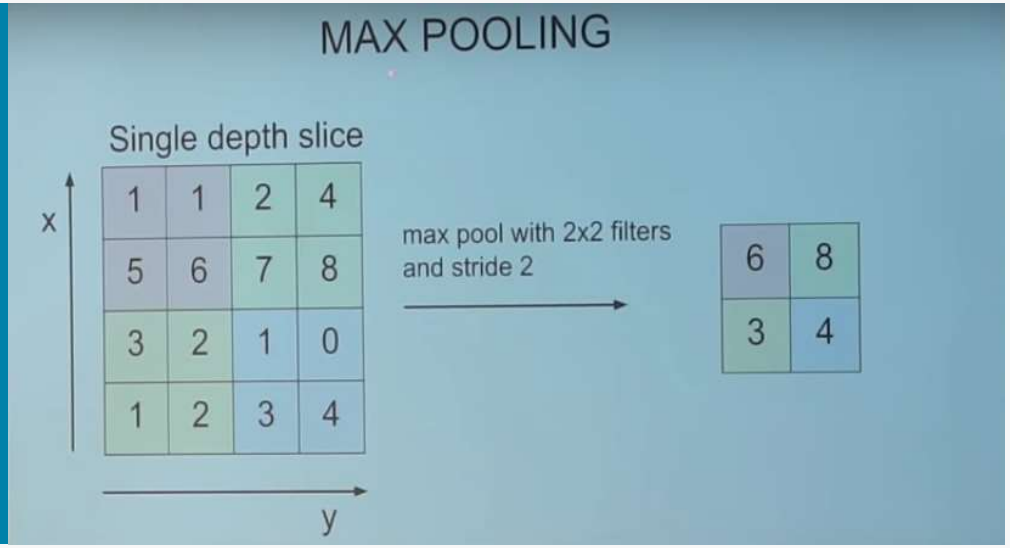
Feed-forward
More than 1 “Hidden” Layer
Back propagation is optional

- Regression
- Classification
- Pattern Study

Side note: Pooling

Vital piece in CNN

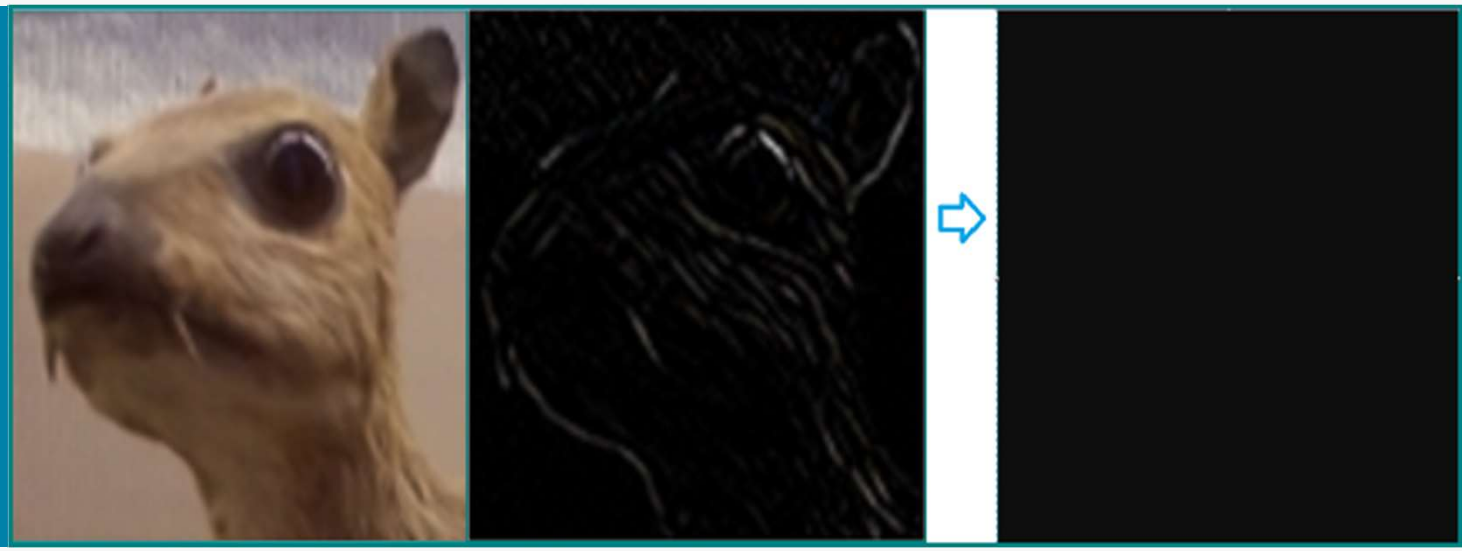
- Reduce resolution
- Reduce parameters
- Retain features
- Improve performance



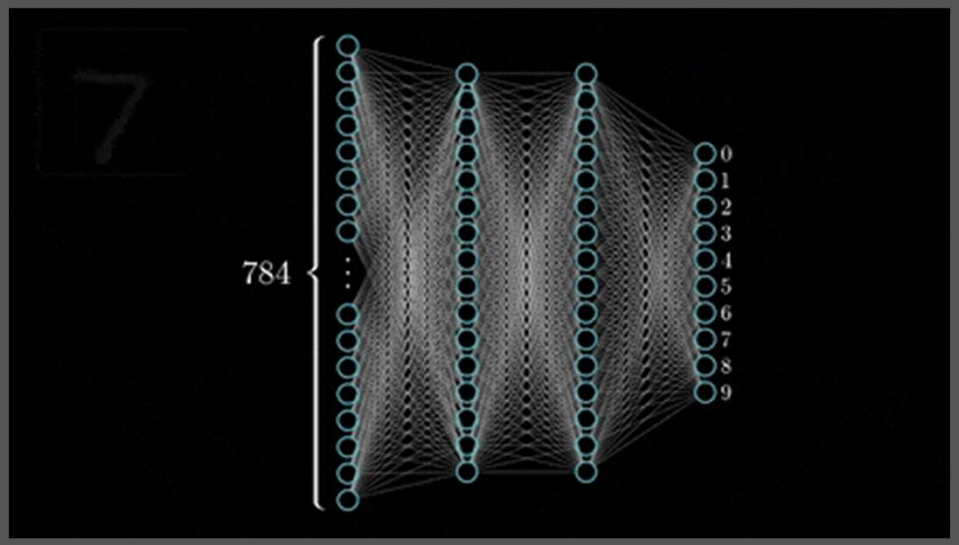
Side note: Vanishing Gradient

Big concern in all Deep Neural Networks

- Deep vs Normal NN



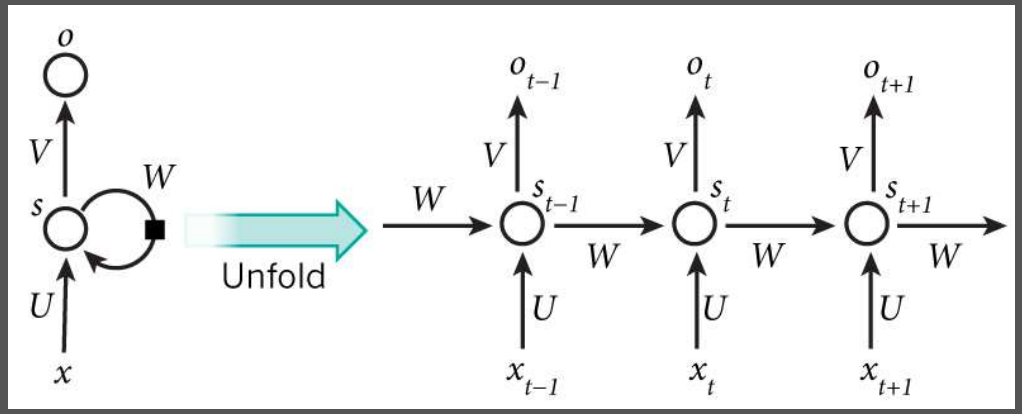
Overtime, NN could not have more than 2 layers due to this problem.



CNN – Convolutional Neural Network

Very Effective NN for V.R.
Convolution
Pooling
Classification

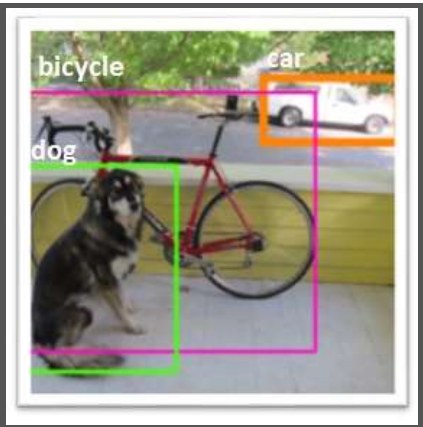
- Image Classification
- Visual Recognition, Visual Tracking
- iPhone FaceID
- NLP



RNN – Recurrent Neural Network

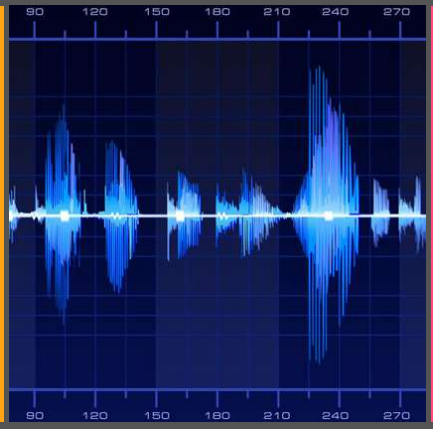
Dynamic Model
Persistent memory of Network
Static Parameters over Time

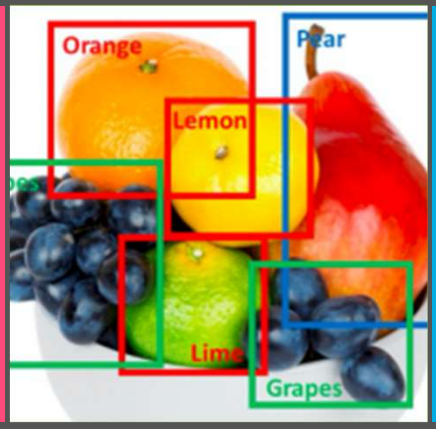
- Time Series Analysis
- Stock Price Movement
- Temporal and Spatial Planning
- Speech Recognition
- Machine Translation
- Next Word Prediction



Visual & Speech Recognition

"How To.." Examples

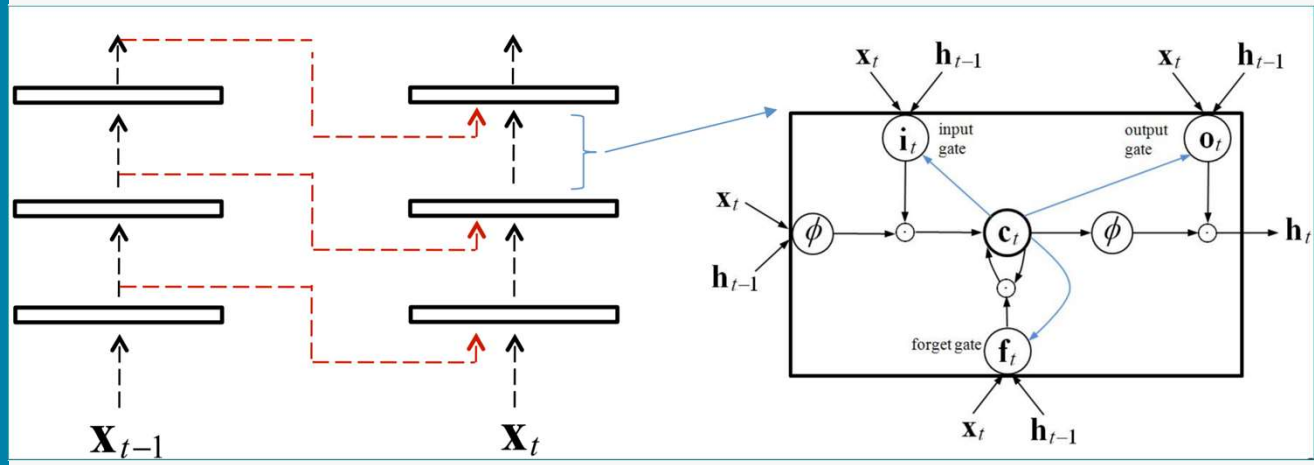




LSTM and CTC for Speech Recognition

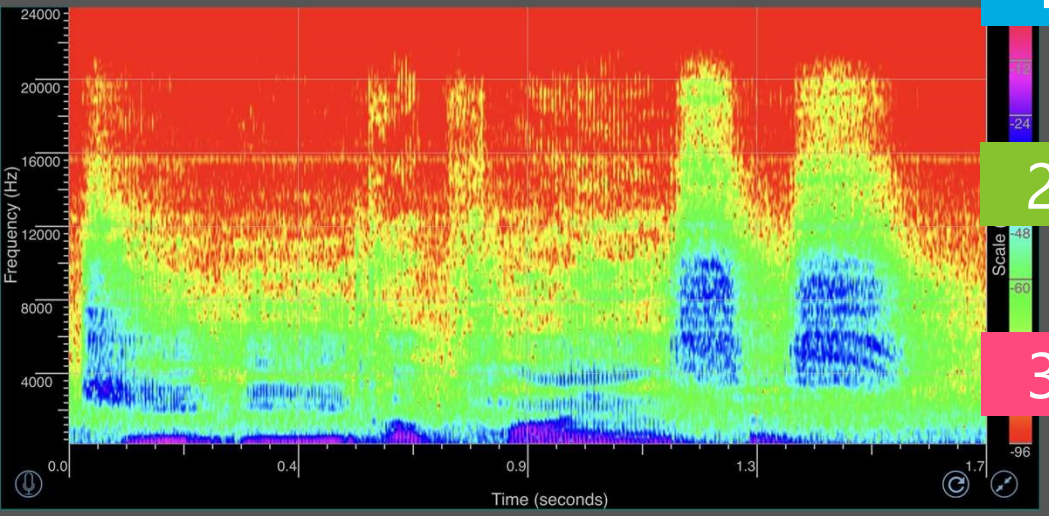
Long Short-term Memory, Connectionist Temporal

A special RNN



LSTM for Speech Recognition

How to do Speech Recognition using RNN



1 **Sample into small chunks**

20ms, 50ms or 100ms

2 **Fourier transformation into Spectrogram**

Energy level of every sample in each chunk

3 **Train RNN with transformed samples**

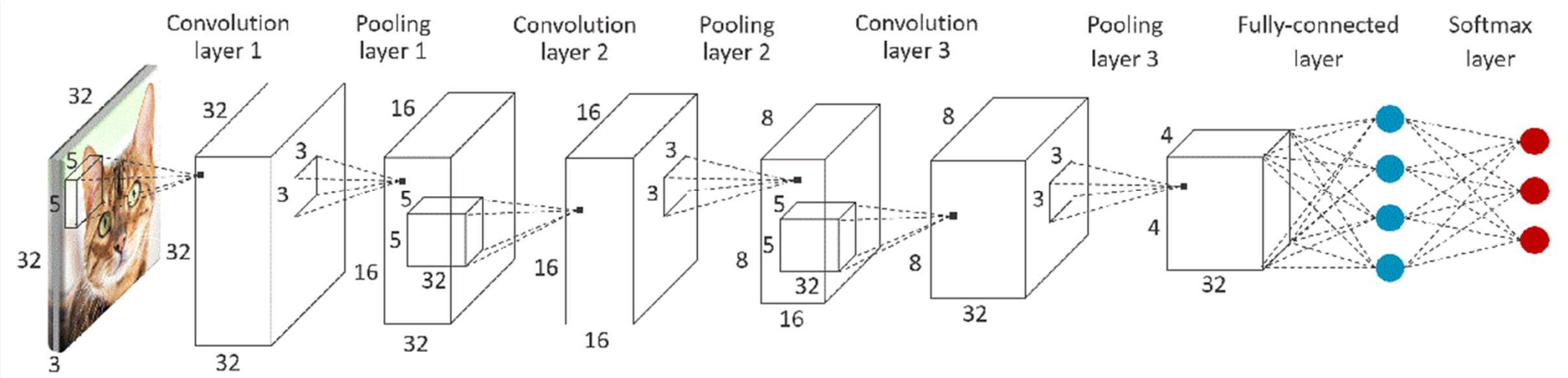
GGGEEE AAPPPLLLLLIIIIAAANNNNNCCCEEEESSSSS

4 **Transcription Clensing**

GEE APPLIANCES

CNN for Visual Recognition

Visual Classification Explained

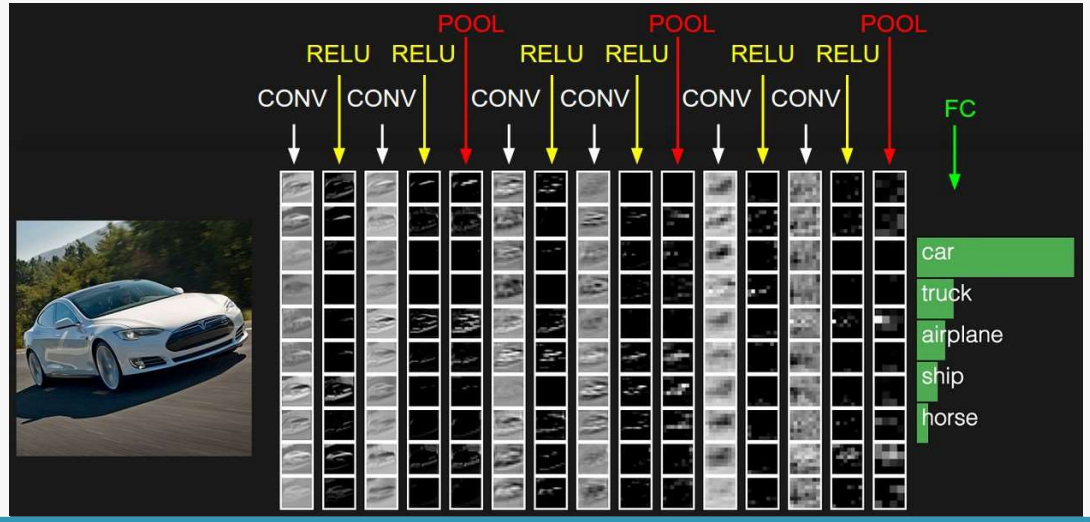


Convolution Mechanism

3-layer convolution network

CNN for Visual Recognition

Visual Classification Explained



Feature Maps from Layers

Artificial Intelligence Presentation

EWOL Notes

Section 4: Conversation about Uncertainty, Stability, and Failsafe

5m

2:3

Frame Problem of A.I.

Conceptual questions regards logical representation

Qualification Question

All background understood?

All preconditions considered?

All data available?

Scope?

Ramification Question

All effects of action understood?

All possibilities considered?

How faithful is the design?

Accurate behavior with constrains?

Know the Unknowns

Algorithms/Model Bank

More insights

Extended real-world experiment

Failsafe Design

A.I. + Human

Q & A

Would you mind sending me your comments and suggestions?

Please email me to request for manuscript.

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Thank you for coming!

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