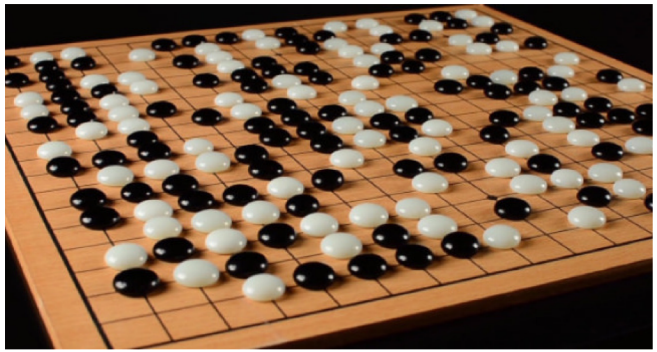
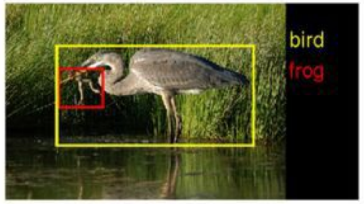
Data Science and AI from bench to workbench

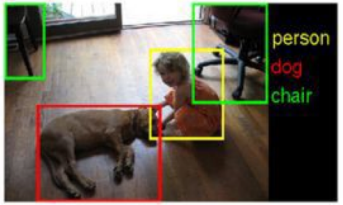
Prof. Jaak Vilo
Head of Institute of Computer Science
University of Tartu

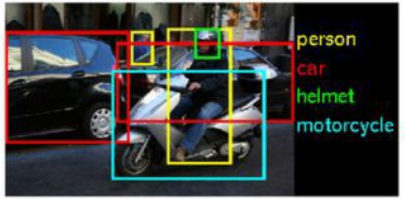
AI beats humans

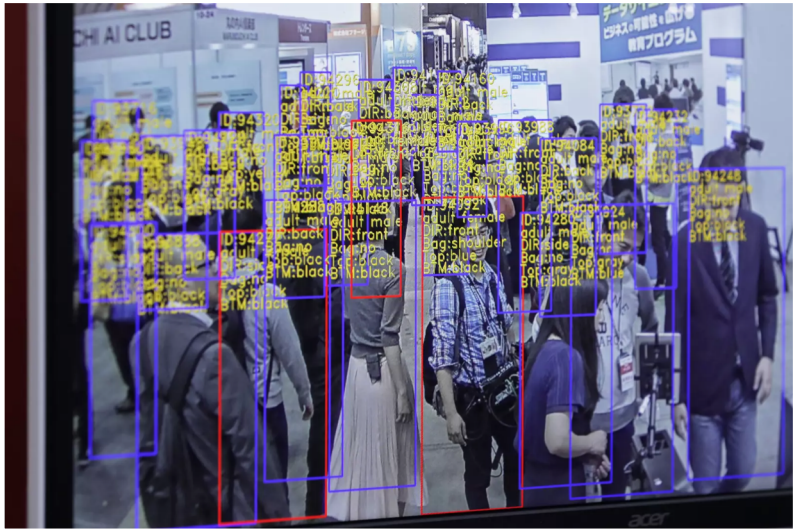


Voice assistants, automated callers, etc.





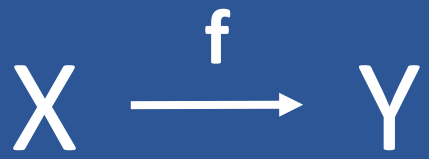




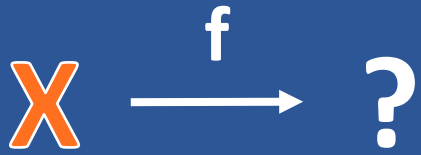
Boston Dynamics

ZenRobotics

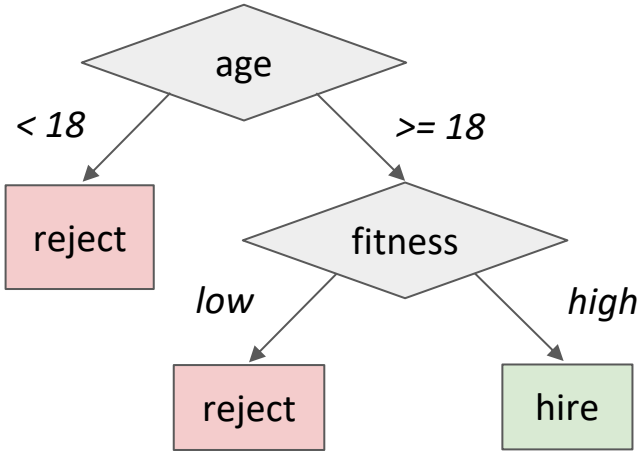
Input
Program
Output


f
X
Y

X, Y
f


f
X
?

f as ML “model”



Decision tree

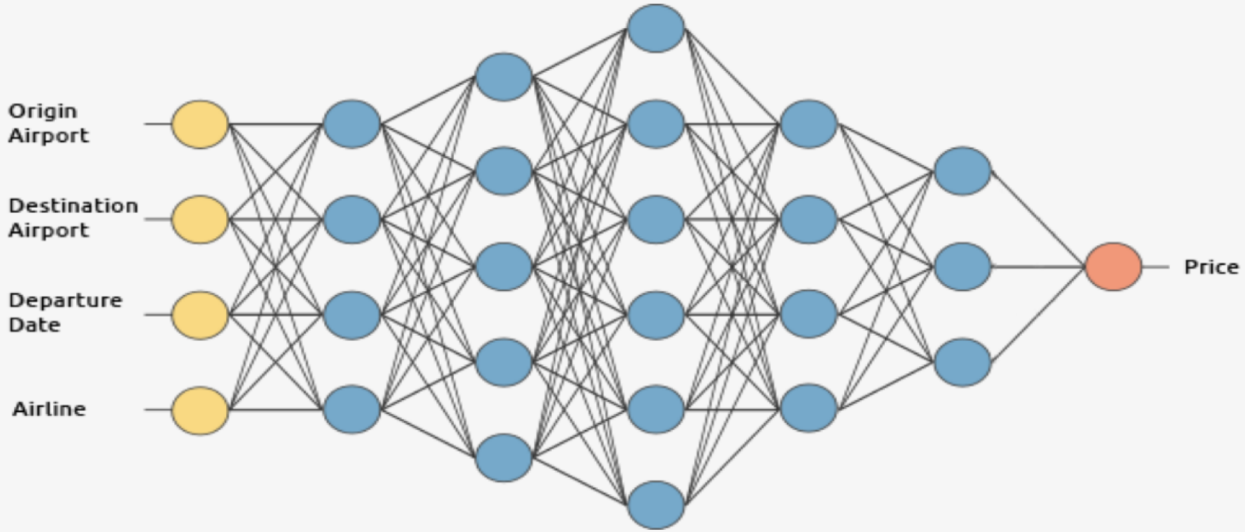
$$f = 0.2 * age + 0.9 * fitness + 2$$

If f > 25
then hire
else reject

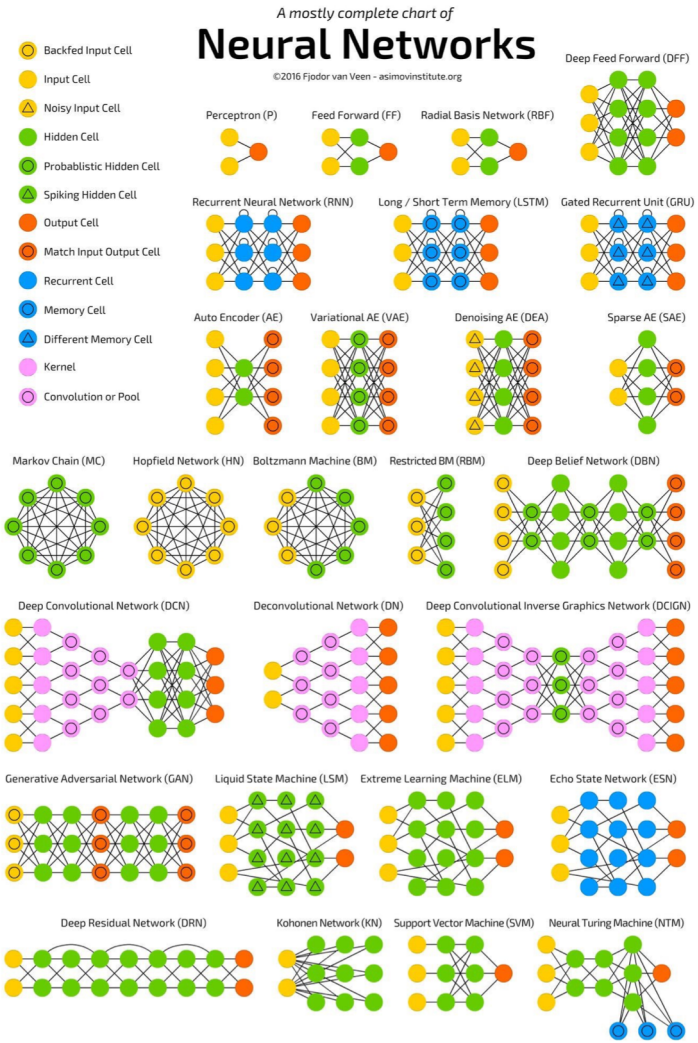
Linear regression

Neural Networks

By Kimberly Cook |Email | Apr 3, 2019 | 9567 Views



Deep Learning, Artificial Intelligence (AI) and Machine Learning (ML) are some of the hottest topics right now.


A mostly complete chart of
Neural Networks
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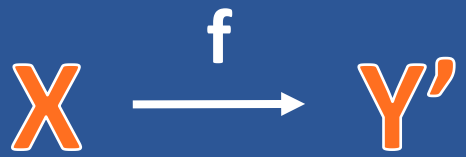
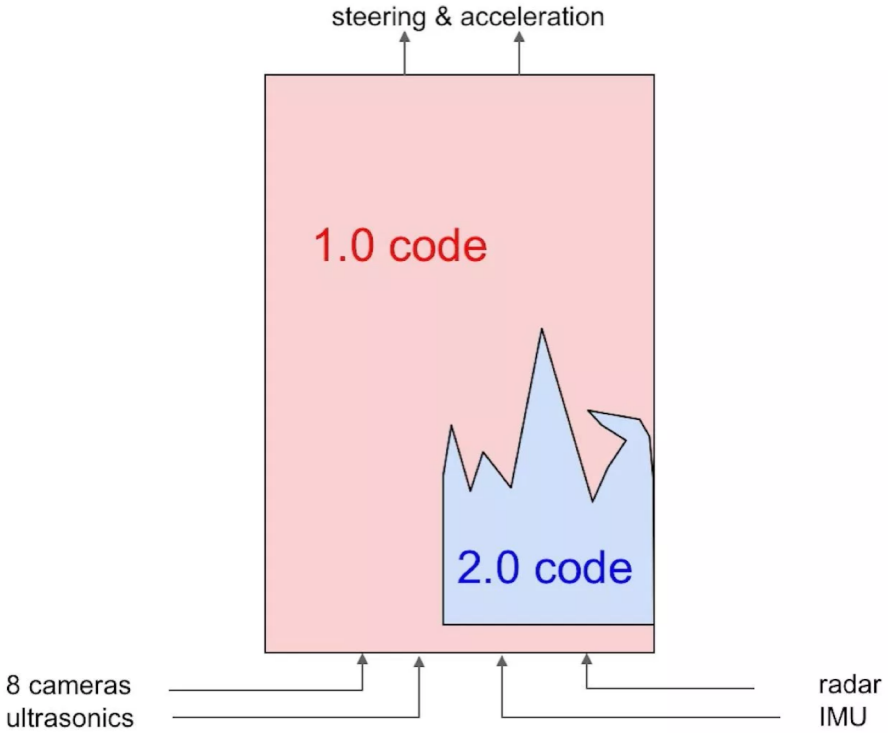
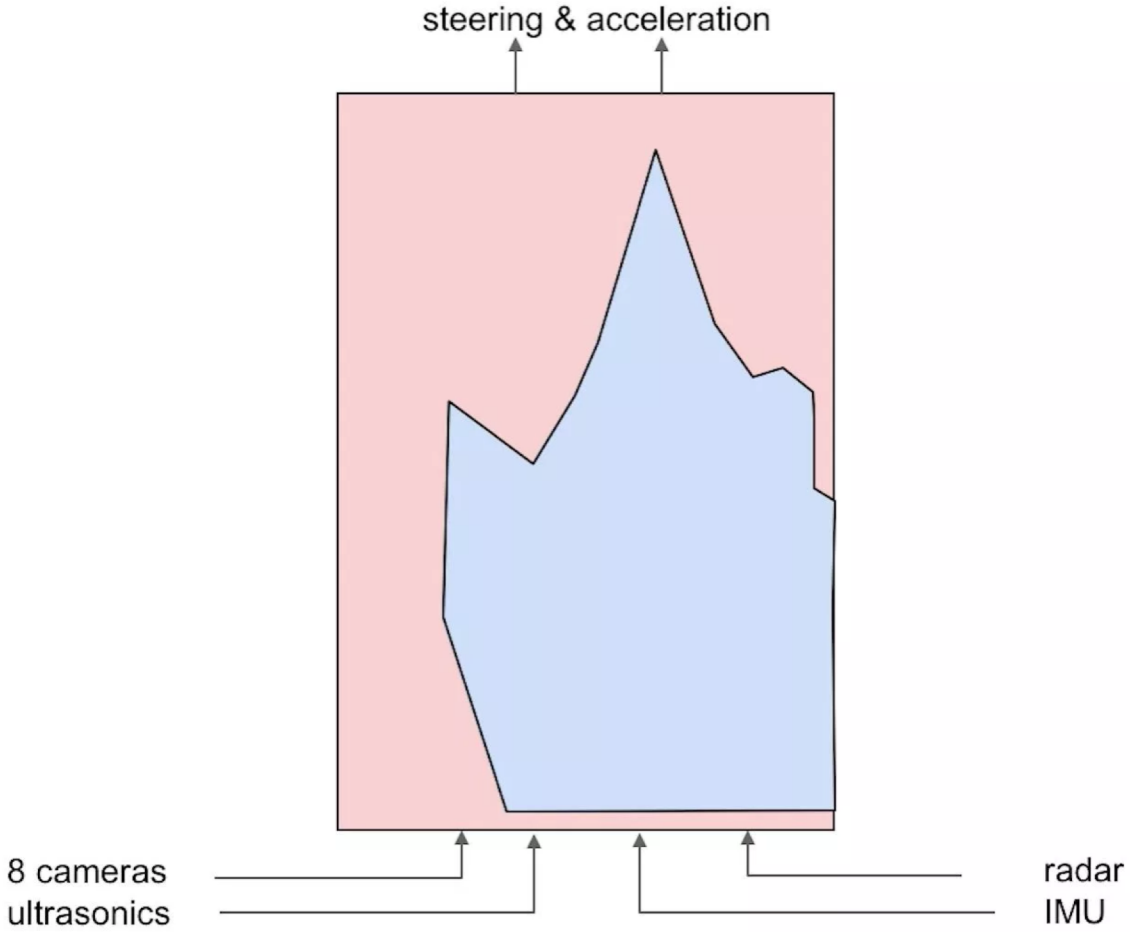
Backfed Input Cell
Input Cell
Noisy Input Cell
Hidden Cell
Probablistic Hidden Cell
Spiking Hidden Cell
Output Cell
Match Input Output Cell
Recurrent Cell
Memory Cell
Different Memory Cell
Kernel
Convolution or Pool
Perceptron (P)
Feed Forward (FF)
Radial Basis Network (RBF)
Deep Feed Forward (DFF)
Recurrent Neural Network (RNN)
Long / Short Term Memory (LSTM)
Gated Recurrent Unit (GRU)
Auto Encoder (AE)
Variational AE (VAE)
Denoising AE (DEA)
Sparse AE (SAE)
Markov Chain (MC)
Hopfield Network (HN)
Boltzmann Machine (BM)
Restricted BM (RBM)
Deep Belief Network (DBN)
Deep Convolutional Network (DCN)
Deconvolutional Network (DN)
Deep Convolutional Inverse Graphics Network (DCIGN)
Generative Adversarial Network (GAN)
Liquid State Machine (LSM)
Extreme Learning Machine (ELM)
Echo State Network (ESN)
Deep Residual Network (DRN)
Kohonen Network (KN)
Support Vector Machine (SVM)
Neural Turing Machine (NTM)



Y’ vs Y

Software 2.0 - example of Tesla (A. Karpathy)




steering & acceleration
8 cameras
ultrasonics
radar
IMU

Artificial “Intelligence”

1. Needs (a lot of) training data from the same context where it is applied
    - Collect all relevant data that is potentially useful
2. Requires the other part of software where it is “plugged in”
3. Should be applied to gain competitive advantage
    - Appropriate context and sub-tasks

Vehicle routing

Assign the delivery order of vehicles more efficiently.

Users

Supermarkets & retail stores

Freight transportation

Buses, taxi's & airlines

Technicians on the road

VehicleRouting benchmark (Belgium datasets)	Average	Min/Max	# datasets	Biggest dataset
Driving time	-15%	-9% -18%	5	2750 deliveries 55 vehicles

OptaPlanner versus traditional algorithm with domain knowledge

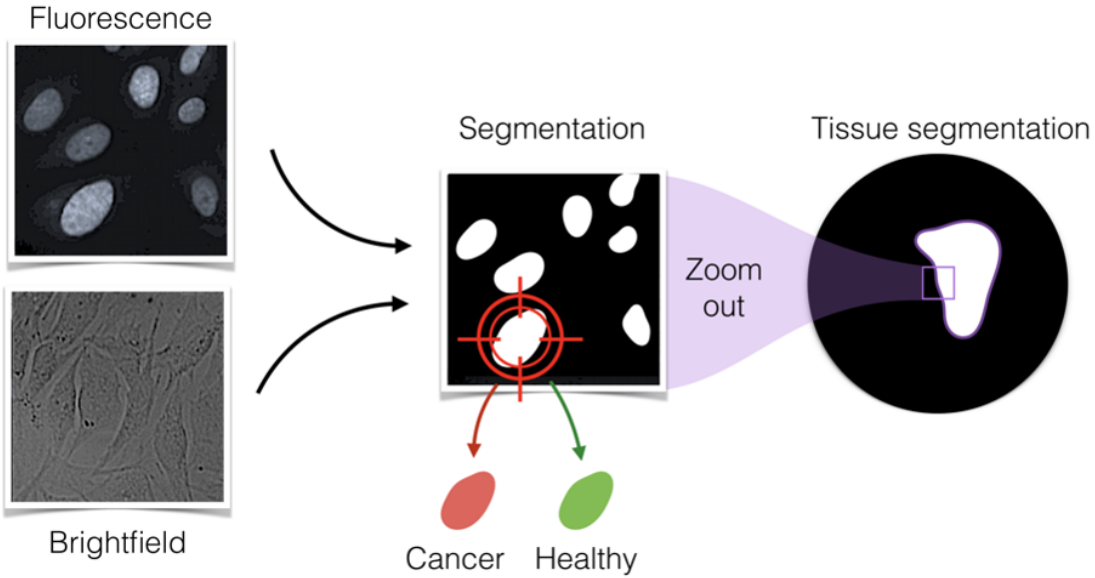
5 mins Late Acceptance Nearby vs First Fit Decreasing

Don't believe us? Run our open benchmarks yourself: http://www.optaplanner.org/code/benchmarks.html

Expertise of the Institute of Computer Science

Joint R&D projects

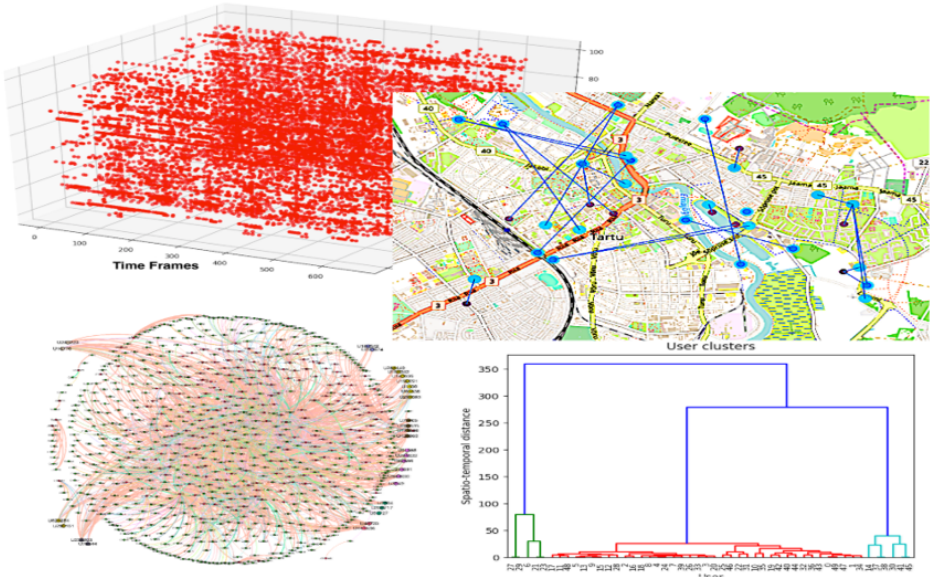
Software for analyzing cells on microscopy images



PerkinElmer
For the Better

Methods and algorithms for advanced urban mobility platform

Population movement analytics, monitoring and prediction



MOONCASCADE

Remote sensing control, security system sensors and software algorithms for remote-controlled vehicles

MILREM ROBOTICS

University-industry collaboration

Industrial Master’s in IT

Delta Sandbox

DIH Tartu

University-industry collaboration

Industrial Master's in IT

Delta Sandbox

DIH Tartu

A unique programme in Estonia that offers students and companies the opportunity to collaborate throughout the curriculum in a form of an internship, practical course assignments, and Master's thesis while performing tasks that are relevant both to the company and the academic curriculum.

UNIVERSITY OF TARTU
Institute of Computer Science

University-industry collaboration

Industrial Master's in IT

Delta Sandbox

DIH Tartu

Digital product innovation programme and space for experimentation for industry partners in collaboration with interdisciplinary Master's student teams.

Delta Sandbox is a member of Design Factory Global Network (dfgn.org).

UNIVERSITY OF TARTU
Institute of Computer Science

University-industry collaboration

Industrial Master's in IT

Delta Sandbox

DIH Tartu

Supporting the digitalisation of Estonian industry by mapping the needs and ambitions of Estonian companies and creating necessary services and network for adopting innovative digital technologies.

By working together with other digital innovation hubs in Baltic Sea Region, DIH Tartu learns from digitally more mature countries and introduces methods and tools in Estonia by customising these based on the needs of the local industry.

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EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND
InnoCAPE

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