Karlsruhe Institute of Technology

CDNC

nanomat

PSE - Introduction – Neural Network based Image Classification on Heterogeneous Platforms

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Organisational Matters

- Enrollment:

QISPOS: (SPO 2008)

- zu TSE (Nr. 455) anmelden
- zu PSE (Nr. 529) anmelden

Campus: (SPO 2015)

1. TSE (Nr. 7500075) zu überfachlichen Qualifikationen hinzufügen
2. zu TSE (Nr. 7500075) anmelden
3. zu PSE (Nr. 7500076) anmelden

Organisational Matters

- Not all mandatory grades?

fehlende Noten?

Falls Noten noch nicht eingetragen sind oder Nachprüfungen anstehen:

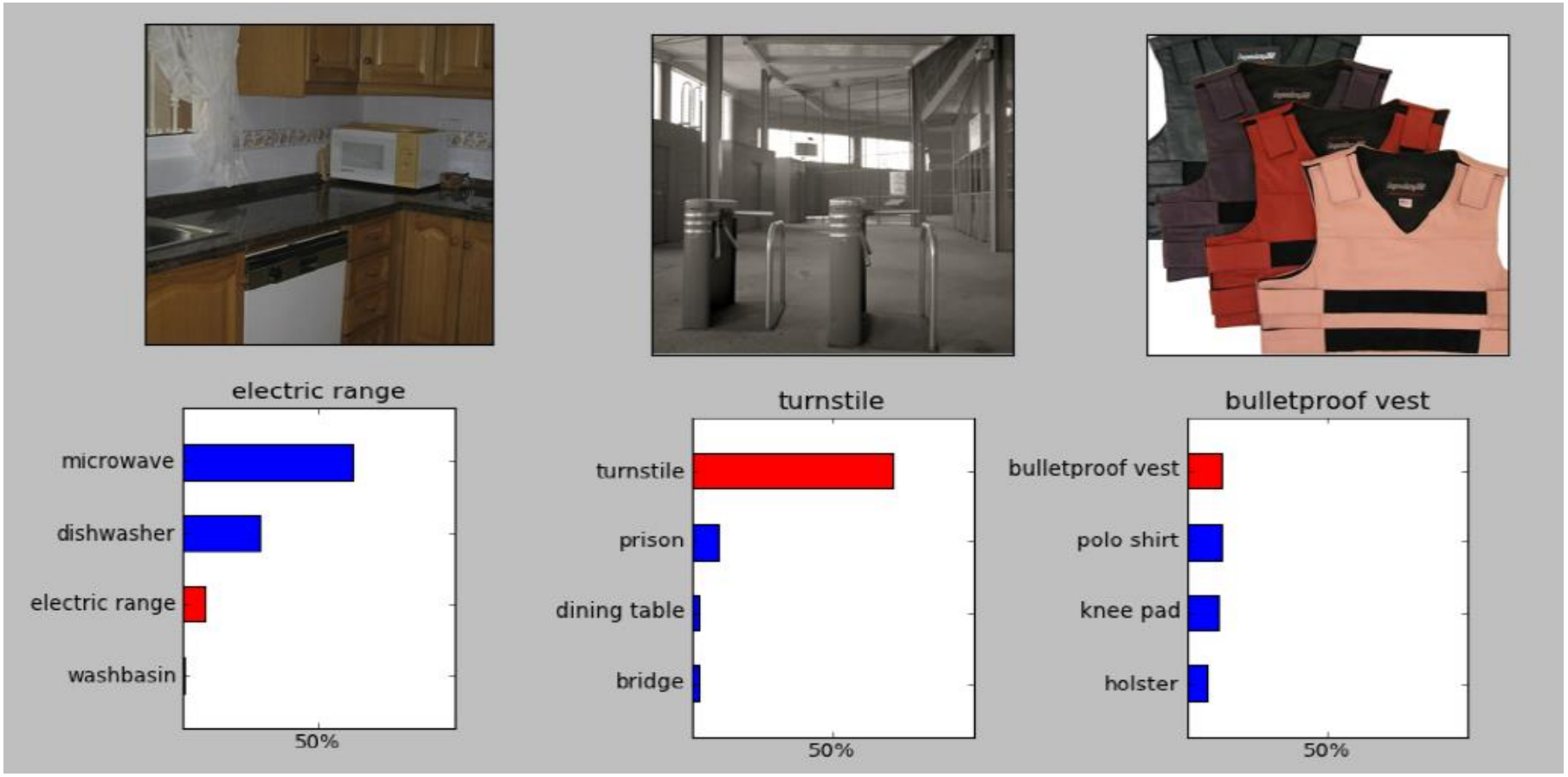
1. Auf jeden Fall in Odyssee anmelden
2. Beim ersten Treffen Notenauszug mitbringen
3. QISPOS/Campus-Anmeldung schnellstmöglich nachholen

Motivation

- Neural Networks (NN) are deployed for
  - **Classification**
  - Prediction
  - Function Approximation
  - Recognizing Patterns e.g. objects in real scenes
- Neural Networks Applications
  - Autonomous Driving
  - **Face Recognition**
  - Natural Language Processing
  - Gesture Recognition

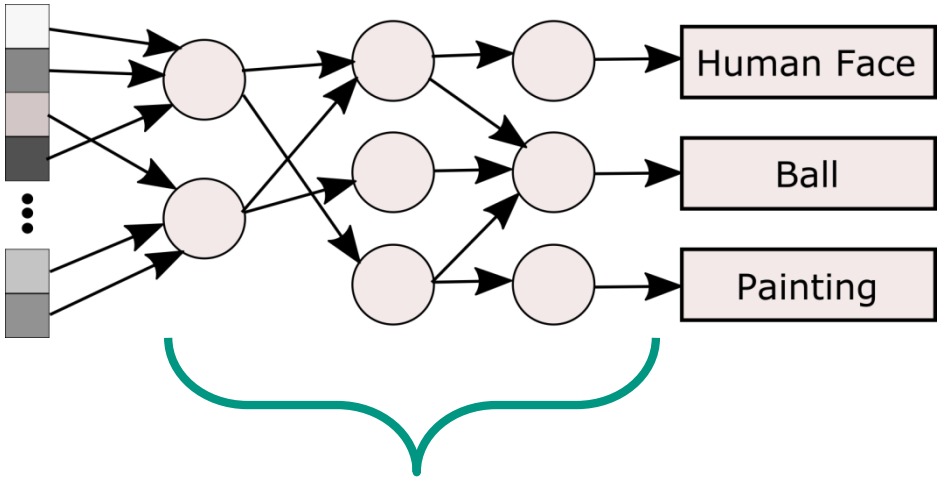
Image Classification

- Classification results: Probabilistic

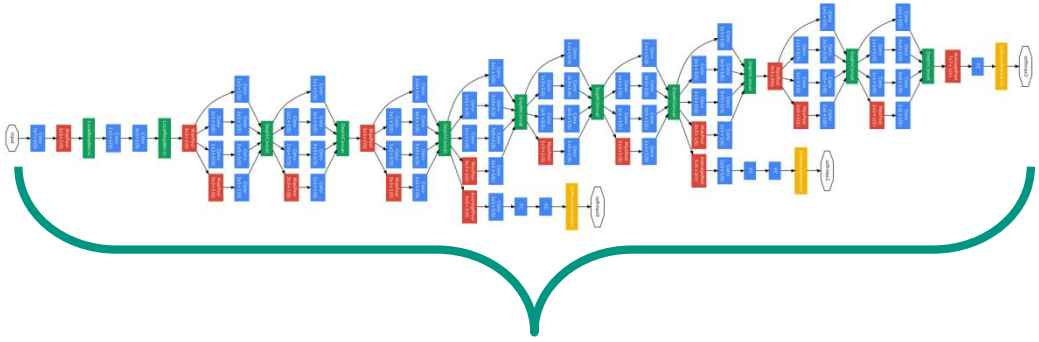


Neural Network Models

- Back-Propagation
- Boltzman Machines
- Deep Neural Networks
- …



3-layer Neural Network

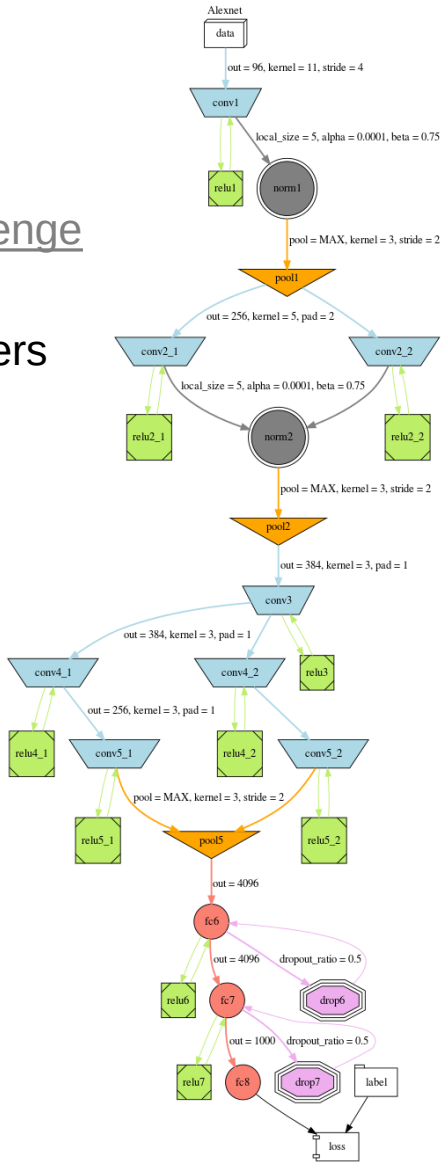


Googlenet:
50-layer Deep Neural Network
(with Inception layers)

Deep Neural Network Example: AlexNet

- AlexNet
  - Convolutional Neural Network
  - Winner of the ImageNet Large Scale Visual Recognition Challenge 2012
  - Consists of 8 layers: 5 convolutional and 3 fully-connected layers

- NN properties:
  - Topology of the Net (Number of Layers, Activation Functions)
  - Learning Rule
  - Objective Function
  - Learning Parameters



Deep Neural Network – Pros and Cons

- Advantages
  - + Massive Parallelism
  - + Unsupervised Learning Possible
- Disadvantages
  - – Huge Data Set needed for Training (Unsupervised Learning)
  - – Very Compute Intensive
  - – High Computationally Costs: learning/classification time, power consumption
- Problem solution
  - Heterogeneous Platforms: CPUs, GPUs, FPGAs, ASICs

Heterogeneous Platforms

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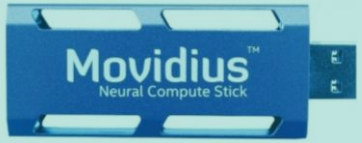
- CPU:
  - \+ Good performance for a wide range of computations: integer operations, floating point operations
  - − Instructions run sequential thus bad performance for complex neural network computations

- GPU
  - \+ Single Instruction Multiple Data Units (SIMD), parallel computing of geometric problems as vector operations, convolutions etc.
  - \+ High Performance
  - − High Energy Consumption
  - − Good performance only for specific kind of calculations (vector operations)

- FPGA
  - \+ Semi-customized architecture thus tailor made designs
  - \+ Parallelism, Pipelining, Multiple Instructions Multiple Data (MIMD)
  - \+ Low Power Consumption
  - − High Design Cycles using conventional programming schemes like VHDL (several month)

- ASICs
  - \+ Very high performance, very low power consumption
  - − Must be manufactured



Roadmap

Phase	von – bis	Dauer
Auftaktveranstaltung	18.10.	
Anmeldung/Einteilung	18.10. – 25.10.	
Erstes Gruppentreffen	28.10. – 31.10.	
Pflichtenheft	04.11. – 22.11.	3 Wochen
Entwurf	25.11. – 20.12.	4 Wochen
Weihnachtspause	23.12. – 06.01.	
Implementierung	07.01. – 31.01.	4 Wochen
z.B. Klausurpause	03.02. – 14.02.	
Qualitätssicherung	17.02. – 06.03.	3 Wochen
interne Abnahme	09.03. – 13.03.	
Abschlusspräsentation	16.03. – 20.03.	

Responsible persons

- 1 responsible persons for each phase

Phase	Anteil
Pflichtenheft	10%
Entwurf	30%
Implementierung	30%
Qualitätssicherung	20%
Abschlusspräsentation	10%

Weekly Meetings

- Project duration: October 2019 – March 2020
- Working Effort: 2 days/week
- Weekly Group Meetings with Advisors
  - Proposal: Friday morning

Recommended Materials

- Book: “Neural Networks for Pattern Recognition” – Christopher M. Bishop
- Neural Network Online Courses
  - https://www.coursera.org/learn/neural-networks
- OpenCL
  - https://www.khronos.org/opencl/
- Intel (Altera) OpenCL SDK
  - https://software.intel.com/en-us/intel-opencl
- FPGA SoC (OpenCL compatible) – DE1SoC (F-type)
  - http://www.terasic.com.tw/cgi-bin/page/archive.pl?Language=English&CategoryNo=205&No=836&PartNo=4
- Intel Movidius Neural Compute Stick
  - http://developer.movidius.com