supercomputing systems

22\textsuperscript{nd} IEEE Real Time Conference

AI: A gentle introduction for «smart dummies»

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AI: May the force be with you …
supercomputing systems: one slide profile

founded in 1993 by prof. dr. anton gunzinger

≈130 employees

service provider for industry & academics

ips go to customer

our origin
ai: where are we?

frankenstein 1818

ex machina 2015

thalamocortical system

«ai enables machines to mimic human behavior»
frontiers in ai: where are we?

reality

marketing
ai: the rise of deep learning

break through of dl: 2012

facts of dl

• today’s state-of-art ml methods
  - ≥ human accuracy in many tasks
    - image recognition
    - med. diagnostic
    - nlp
    - games
dl: what is deep learning?

brain $\Leftrightarrow$ neural network

brain vs. dnn
$\approx 100b$ neurons
$\approx 100m$
$\approx 200^+$ layers

dl $\approx$ deep neural nets + big data + efficient algorithms
dl: what is deep learning?

artificial neural network

neurobiology inspired
• net of interconnected neurons
• building block (neuron/perceptron)

learning ⇒ adjusting weights ($\omega_i$)
how do nn's learn?

neural net: learning

forward path

• input data to net:
  o images, movies
  o voice
  o text ..

• propagate data through net
how do nn's learn?

neural net : learning

backward path

• back-propagate loss
  ⇒ prediction - truth
• adjust weights ($\omega$)
  ⇒ gradient descent
• learning ⇒ adjusting weights ($\omega$) & min. loss
how d-neural nets see ...

from detail to whole

hierarchical features

low level
⇒ edges, corners

mid level
⇒ circles, rectangles

high level
⇒ face, flower ...

learning abstractions

Feature visualization of convolutional net trained on ImageNet from [Zeiler & Fergus 2013]
**how good are dnns?**

**ImageNet** - huge image pool

- automobile
- bird
- cat
- deer
- dog
- frog
- horse

classify challenge

14 mio images

20k image categories

- human, cat, dog
- plane, car, knife
- ...

SCS super computing systems
how good are dnn's?

break through of dl: 2012

classify challenge

- 14 mio images IMAGENET
- 20k image categories
- nn surpass humans in 2015
- but ...
ai conclusion: programming becomes training
ai: a word of caution ...

deep neural nets

are powerful ... but ...

😊 non-linear modeling

😢 discovering concepts

😭 mimicking the brain

... at all!

... it’s often a branding term

https://www.pinterest.ch/pin/377950593709450799/
selected customer projects
case: patient monitoring system

icu: intensive care unit

icu-cockpit: its focus

high-resolution raw data for medical research

robustness & safety

partner e. keller, usz zürich, eth - & uni zürich
case: patient monitoring system

key functionalities
- data visualization
- build-up research db
- alarm handling
  - set thresholds
  - classify
  - motion detection
  ⇒ reduced false alarms …

partner  e. keller, usz zürich, eth - & uni zürich
case: patient monitoring system (prelim. results)

predict brain hypoxia

- deep architecture
  - lstm, transfer, multi-task
- gt ⇒ pbt0₂

results

ROC

false alarms ⇒ false positive rate

mean alarm probability

minutes before incident

partner: e. keller, usz zürich, eth & uni zürich
case: deep eye ophthalmology

optical coherence tomography

segment the eye

the oct microscope

• michelson interferometer

• 3d-imaging @ μm

partner dr. peter m. maloca - iob in basel
case: deep eye ophthalmology

segment the eye

solution

convolutional neural net

cnn \Rightarrow u\text{-net}

train \Rightarrow

\Rightarrow \text{f}_1\text{score} \quad \text{vitr.} \text{ & retina} \approx 98\%

choroid \approx 92\%

partner  
dr. peter m. maloca - institute of molecular and clinical ophthalmology in basel
case: deep eye ophthalmology

segment the eye

solution

convolutional neural net

cnn $\Rightarrow$ u-net

train $\Rightarrow$

$\Rightarrow f_{1\text{score}}$ tumor $\approx 65\%$

note: very small gt-set!

partner dr. peter m. maloca - institute of molecular and clinical ophthalmology in basel
case: deep eye ophthalmology

machine better than experts?

reading center retina experts

results & answer

cnn vs. expert ophthalmologists

- our net performs on-par with experienced experts

⇒ paper published ✓

partner: dr. peter m. maloca - institute of molecular and clinical ophthalmology in basel
case: ai-assisted hip screening

from analog to digital

we have a dream ...
ai-assisted hip screening

ai-approaches

$\alpha, \beta \Rightarrow$ lines $\Rightarrow$ landmarks $\Rightarrow$ end-2-end

angle detection via

- lines
- landmarks
- bone segm.
- angles

partner  dr. med. st. essig (svupp), dr. med. th. baumann (smopp)
ai-assisted hip screening

results

<table>
<thead>
<tr>
<th>detection method</th>
<th>α</th>
<th>β</th>
<th>mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>end-2-end: direct angle</td>
<td>2.7</td>
<td>2.8</td>
<td>2.8</td>
</tr>
<tr>
<td>landmark</td>
<td>3.7</td>
<td>4.2</td>
<td>4.0</td>
</tr>
<tr>
<td>line</td>
<td>3.9</td>
<td>4.0</td>
<td>3.9</td>
</tr>
<tr>
<td>bone segmentation [1]</td>
<td>4.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>simon et al. [2]</td>
<td>3.15</td>
<td>6.1</td>
<td>4.6</td>
</tr>
</tbody>
</table>

best deep approaches

- u-net + psp & resNet50
- learning direct angle for α

u-net achieves expert accuracy with end-2-end


partner dr. med. st. essig (svupp), dr. med. th. baumann (smopp)
happy experimenting with ai-tools

«labelling cats & dogs»

http://ai-demo.scs.ch
ai: a gentle introduction

«gentle introduction to ai»

Thank you

q & a ?