# Vienna Deep Learning Meetup

7 June 2018 @ A1 Telekom Austria

# Vienna Deep Learning Meetup

## The Organizers:

Thomas Lidy
Musimap

Jan Schlüter
OFAI

Alex Schindler
AIT & TU Wien

# Vienna 19th Deep Learning Meetup

**Agenda:**

- Welcome (Thomas Lidy, VDLM; Mario Meir-Huber, A1)
- Intro: Visual Computing: Then and Now - Alexander Schindler, AIT
- **Fast, Accurate And Customized Visual Similarity Search On Real-world Images**
  - Enes Deumić & Vedran Vekić, Data Scientists at Styria.ai
- Announcements
  - *30 minutes break*
- **Mon Style - Machine Learning in the Fashion Domain**
  - Alexander Schindler, AIT and Matthias Hecker, CTO at Mon Style
- Hot Topics & Latest News - Rene Donner, CTO at Contextflow
- Networking and Discussions

# Announcements

# AI AUSTRIA

AUSTRIAN SOCIETY FOR ARTIFICIAL INTELLIGENCE

TALENT

TECHNOLOGY

NETWORKING

COOPERATION

COMMUNITY

EDUCATION

GRANTS

www.aiaustria.com

# Supporters & Partners

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AUSTRIAN SOCIETY FOR ARTIFICIAL INTELLIGENCE

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Head of the Austrian Research Institute
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**Alois Saria**
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Education Program in the Human
Brain Project (HBP) at Medical
University Innsbruck

**Sepp Hochreiter**
Head of the AI Lab at Johannes
Kepler University Linz,
AI Pioneer

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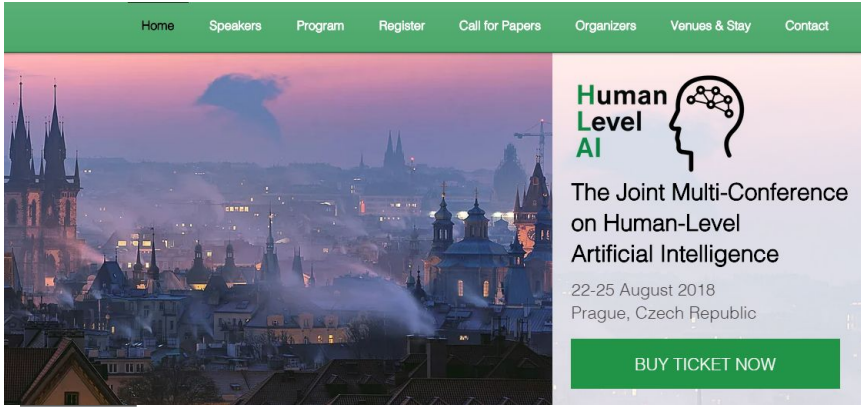
CONDA

# Human Level AI Conference 2018

**22 - 25 August, Prague**

- **3 day academic conference**
  - Who's it for: researchers
- **2 day Future of AI Track**
  - Who's it for: technology enthusiasts, researchers and anyone wanting to learn more about AI!
- Speakers from: Facebook AI Research, Microsoft, Uber AI Labs, Google DeepMind and more.




10% discount for Vienna Deep Learning community using code:
**VDL-HLAI18**

GoodAI

https://www.hlai-conf.org/

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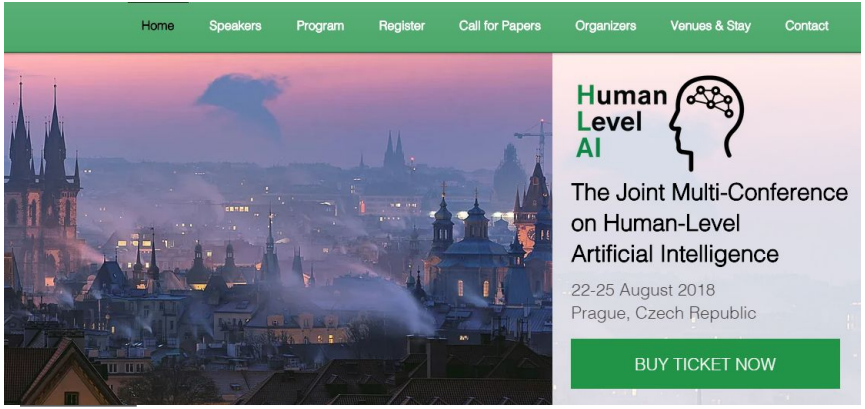



**Win 1 of 2 free tickets:**

https://goo.gl/yvu2Rb
(till June 17th)

GoodAI

# Job Announcements

St. Pölten University of Applied Sciences

www.fhstp.ac.at

/fh///
st.pölten

Hiring **deep learning enthusiasts** at pre-doc and post-doc level!

- Junior Researcher (m/f) in Computer Vision
- Researcher (m/f) in Computer Vision

https://www.fhstp.ac.at/de/offene-stellen-karriere/junior-researcher-m-f-in-computer-vision-patt-304543
https://www.fhstp.ac.at/de/offene-stellen-karriere/researcher-m-f-in-computer-vision-pattern-rec-304544

Applications until July 1, 2018 to: bewerbungen@fhstp.ac.at

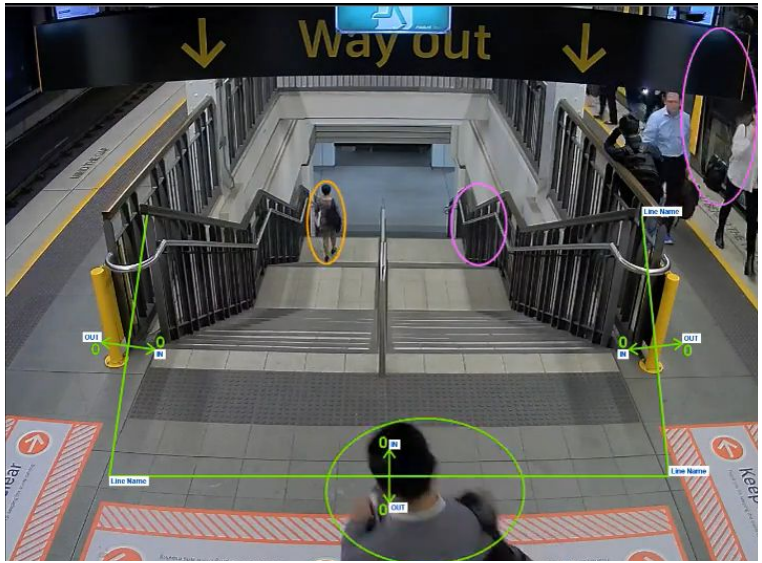
If you have questions, just send an informal mail to Matthias Zeppelzauer
m.zeppelzauer@fhstp.ac.at or just call: +43 2742 313228 652

Looking forward to hearing from you! ☺

# Machine Learning for video surveillance

More-than-real-time requirement
Performance optimization
Challenging image quality

→ **job@kiwisecurity.com**




Deep learning for counting in crowded scenes

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- Networking and Discussions

# Hot Topics & Latest News

a short block at every meetup
to briefly present recent papers and news

Send us contributions (tom.lidy@gmail.com)
or come with slides to do a short block yourself!

# Hot Topics & Latest News

- **ICLR – International Conference on Learning Representations**
  April 30 - May 3, Vancouver
  iclr.cc
- **ICML – International Conference on Machine Learning**
  July 10 - July 15, Stockholm
  icml.cc
- **NIPS – Neural Information Processing Systems**
  December 3 - December 8, Montreal
  nips.cc
- CVPR, ECCV, …

# Main Deep Learning Conferences 2018

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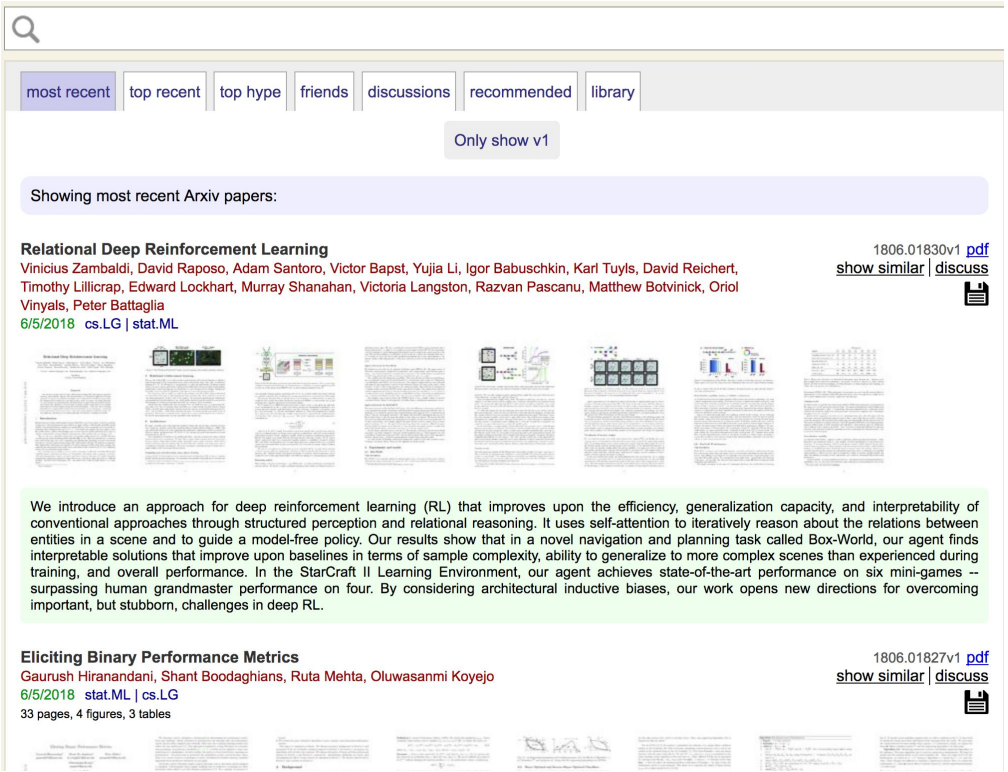
# The Life of a DL Publication

- Arxiv.org
  - Arxiv-sanity.com
- Openreview.net
- Conference Proceedings



# Spherical CNNs

*Taco S. Cohen, Mario Geiger, Jonas Köhler, Max Welling*

15 Feb 2018 (modified: 25 Feb 2018) ICLR 2018 Conference Blind Submission readers: everyone Show Bibtex Revisions

**Abstract:** Convolutional Neural Networks (CNNs) have become the method of choice for learning problems involving 2D planar images. However, a number of problems of recent interest have created a demand for models that can analyze spherical images. Examples include omnidirectional vision for drones, robots, and autonomous cars, molecular regression problems, and global weather and climate modelling. A naive application of convolutional networks to a planar projection of the spherical signal is destined to fail, because the space-varying distortions introduced by such a projection will make translational weight sharing ineffective.

In this paper we introduce the building blocks for constructing spherical CNNs. We propose a definition for the spherical cross-correlation that is both expressive and rotation-equivariant. The spherical correlation satisfies a generalized Fourier theorem, which allows us to compute it efficiently using a generalized (non-commutative) Fast Fourier Transform (FFT) algorithm. We demonstrate the computational efficiency, numerical accuracy, and effectiveness of spherical CNNs applied to 3D model recognition and atomization energy regression.

**TL;DR:** We introduce Spherical CNNs, a convolutional network for spherical signals, and apply it to 3D model recognition and molecular energy regression.

**Keywords:** deep learning, equivariance, convolution, group convolution, 3D, vision, omnidirectional, shape recognition, molecular energy regression

**14 Replies**

## Equivariance under non-linearity

*(anonymous)*

19 Apr 2018 ICLR 2018 Conference Paper615 Public Comment readers: everyone

**Comment:** The paper nicely and theoretically propose an equivariant spherical cross-correlation for the rotation group. But it is not clear how the equivariance maintains in multiple layers with ReLU and BN inserted in between as the authors did in the experiments?

Sec 5.1 also shows that adding ReLU increase the difference by a large magnitude.

### Good point

*ICLR 2018 Conference Paper615 Authors*

21 Apr 2018 ICLR 2018 Conference Paper615 Official Comment readers: everyone

**Comment:** This is a good point. The network is equivariant if all the layers are equivariant, so that is what we must show. It was shown in the paper "Group Equivariant Networks" (section 6.2) that arbitrary pointwise nonlinearities are equivariant to the action of the group. This is true for the so-called regular representations, which act by permuting the neurons, whereas other (steerable / induced) representations may require special equivariant nonlinearities.

The regular representation is what we denote by L_R in this paper:
L_R f = f R^{-1},
where juxtaposition means composition. Applying a pointwise nonlinearity s to a feature map f can be written mathematically as:
C_s f = s f

Since L_R acts by composing on the right and C_s acts by composing from the left, we have:
L_R C_s f = L_R (s f) = (s f) R^{-1} = s (f R^{-1}) = C_s L_R f.
That is, the regular representation L_R and the nonlinear operator C_s commute.

# Paper for Today

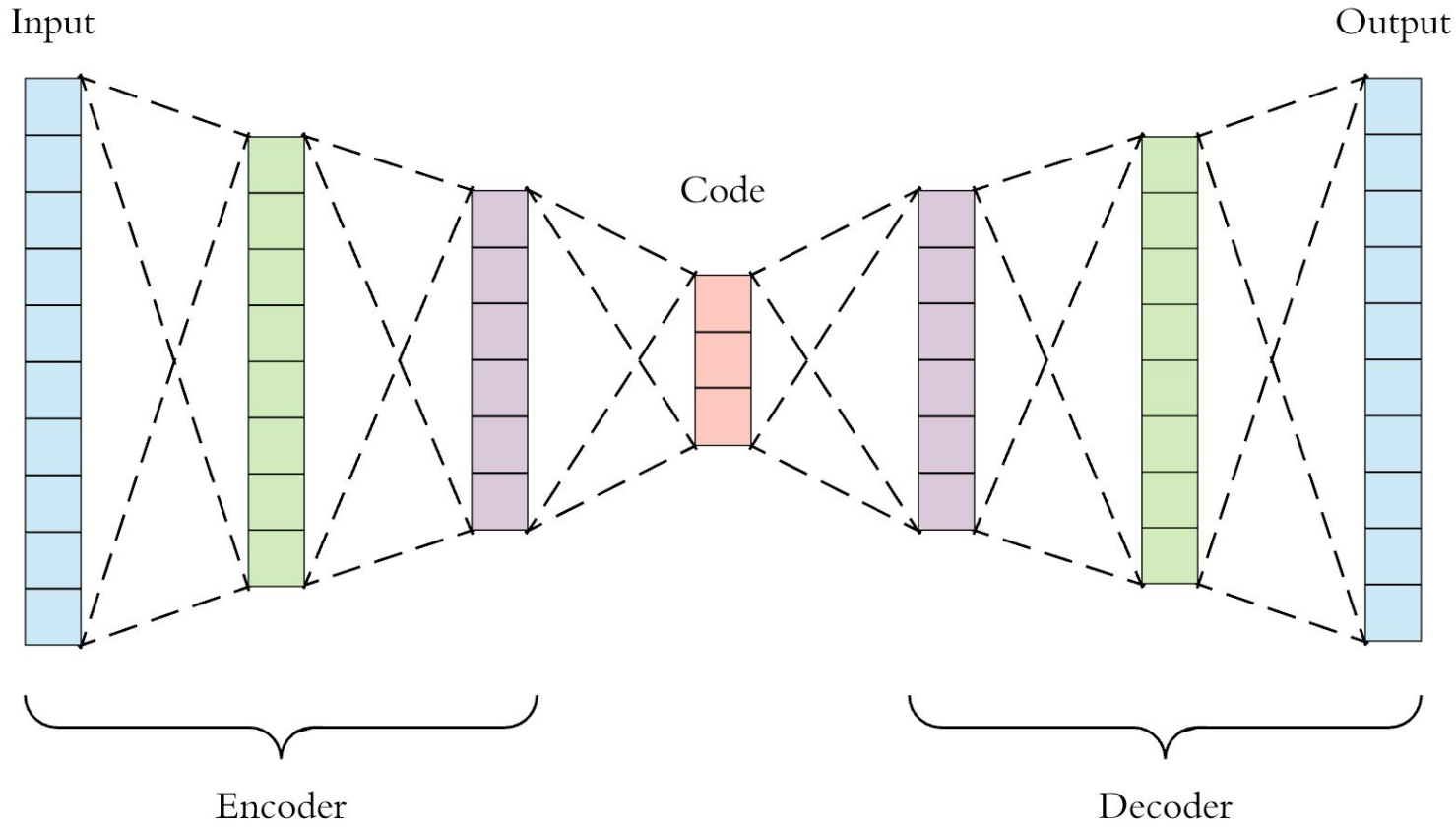
- Progressive Growing of GANs
  https://openreview.net/forum?id=Hk99zCeAb
- Multi-Scale Dense Networks for Resource Efficient Image Classification
  https://openreview.net/forum?id=Hk2aImxAb
- Shifting Mean Activation Towards Zero with Bipolar Activation Functions
  https://openreview.net/forum?id=B1XqwdoIz

# Progressive Growing of GANs

# Progressive Growing of GANs

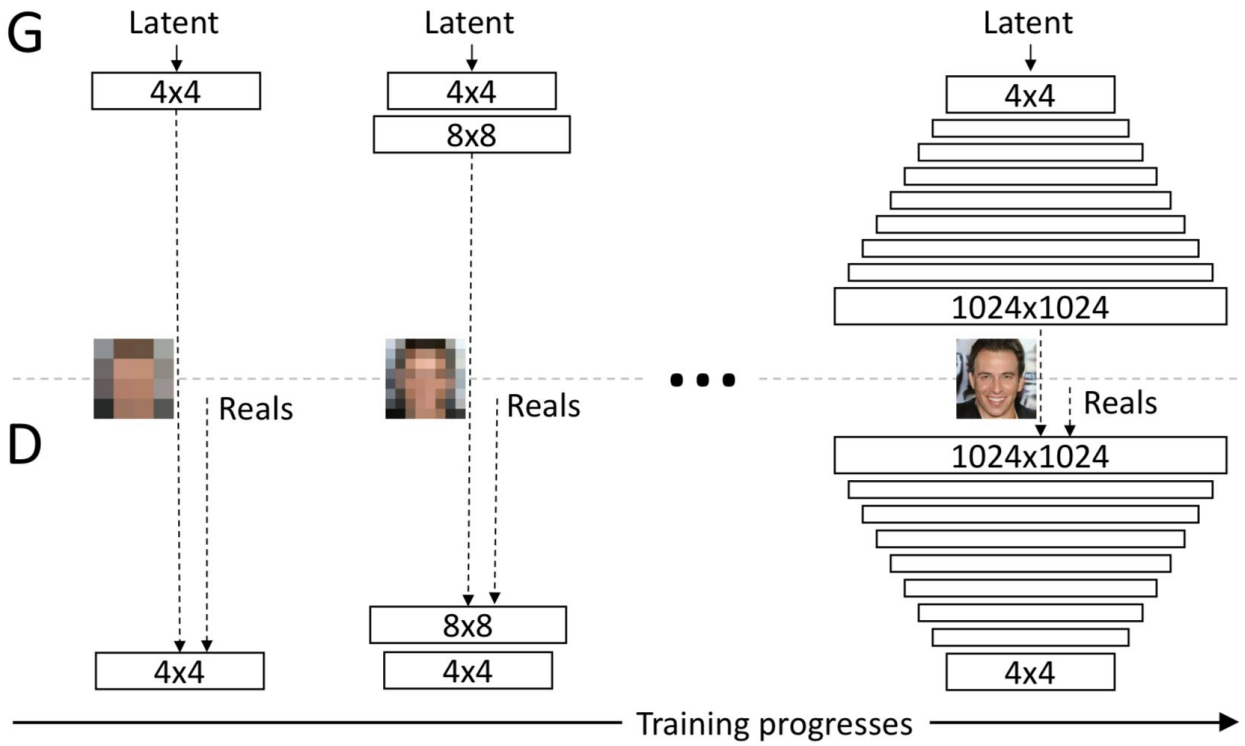
- New training methodology
  - start at low resolution
  - add new layers that model increasingly fine details as training progresses
- speeds up the training and greatly stabilizes it
- CELEBA images at 1024 x 1024

# Related: Auto-Encoders – Greedy Pretraining



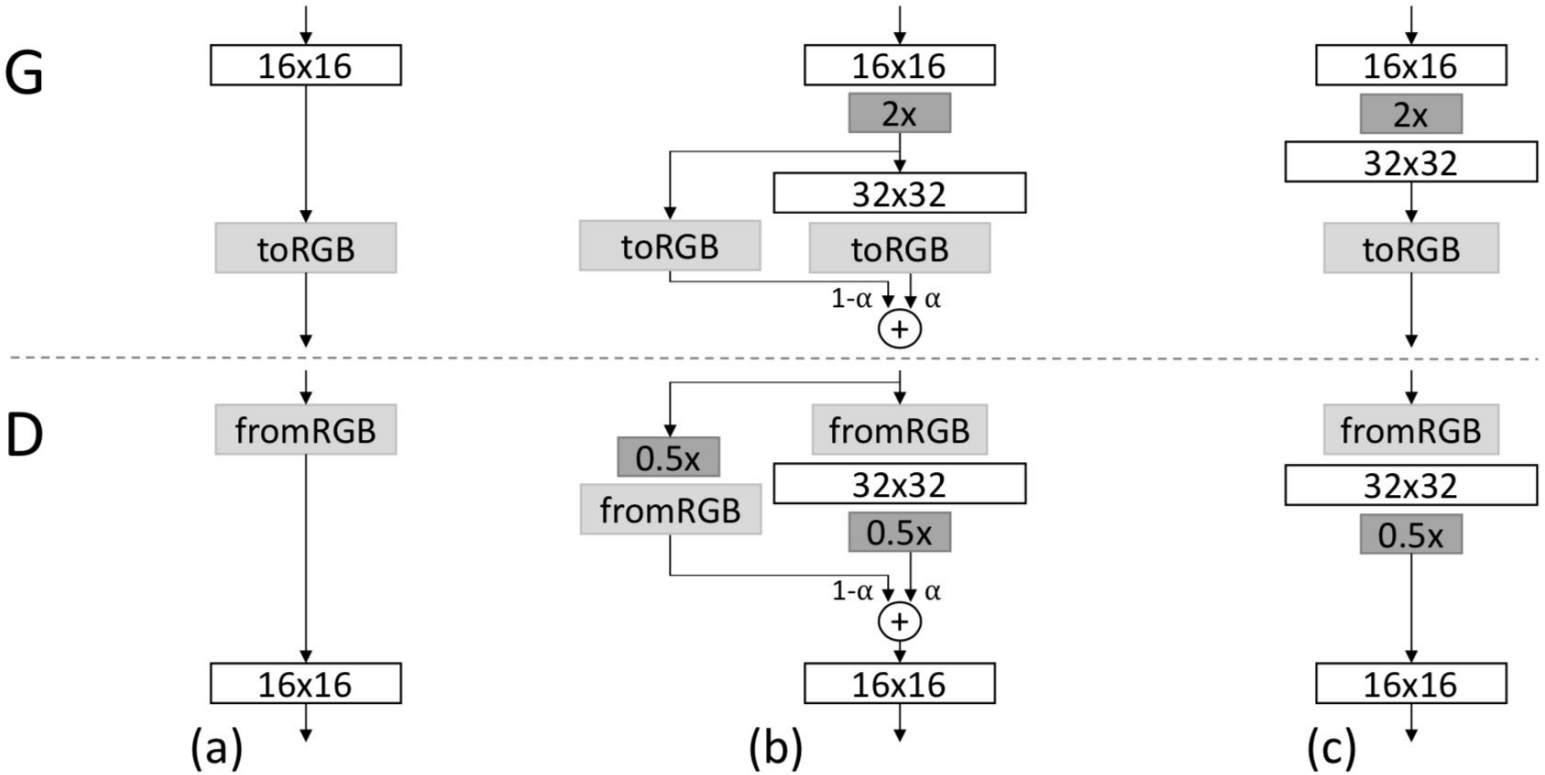

https://towardsdatascience.com/applied-deep-learning-part-3-autoencoders-1c083af4d798

# Progressive Growing of GANs




https://openreview.net/forum?id=Hk99zCeAb

# Smooth Fade-In of New Layers




https://openreview.net/forum?id=Hk99zCeAb

https://openreview.net/forum?id=Hk99zCeAb

# Results

There is also a Video!


https://openreview.net/forum?id=Hk99zCeAb

# Multi-Scale Dense Networks for Resource Efficient Image Classification

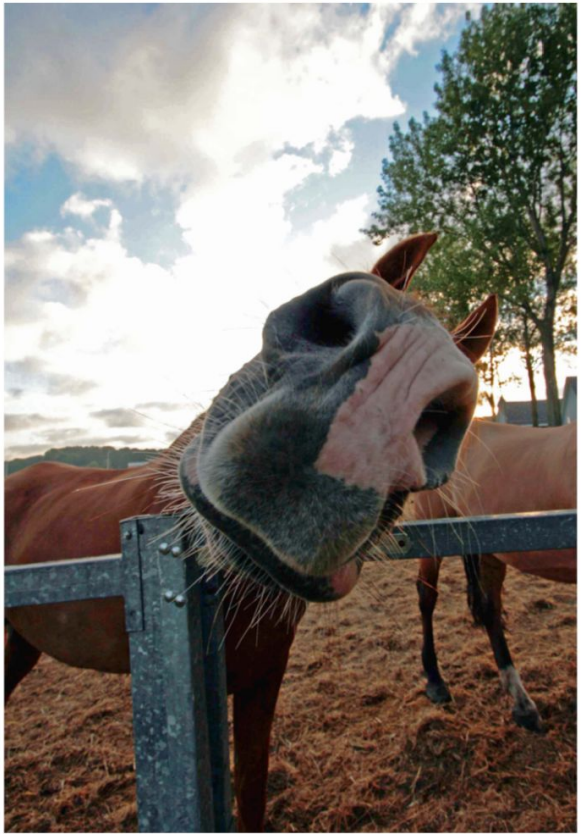
# Multi-Scale Dense Networks For Resource Efficient Image Classification

- Computational resource limits at test time

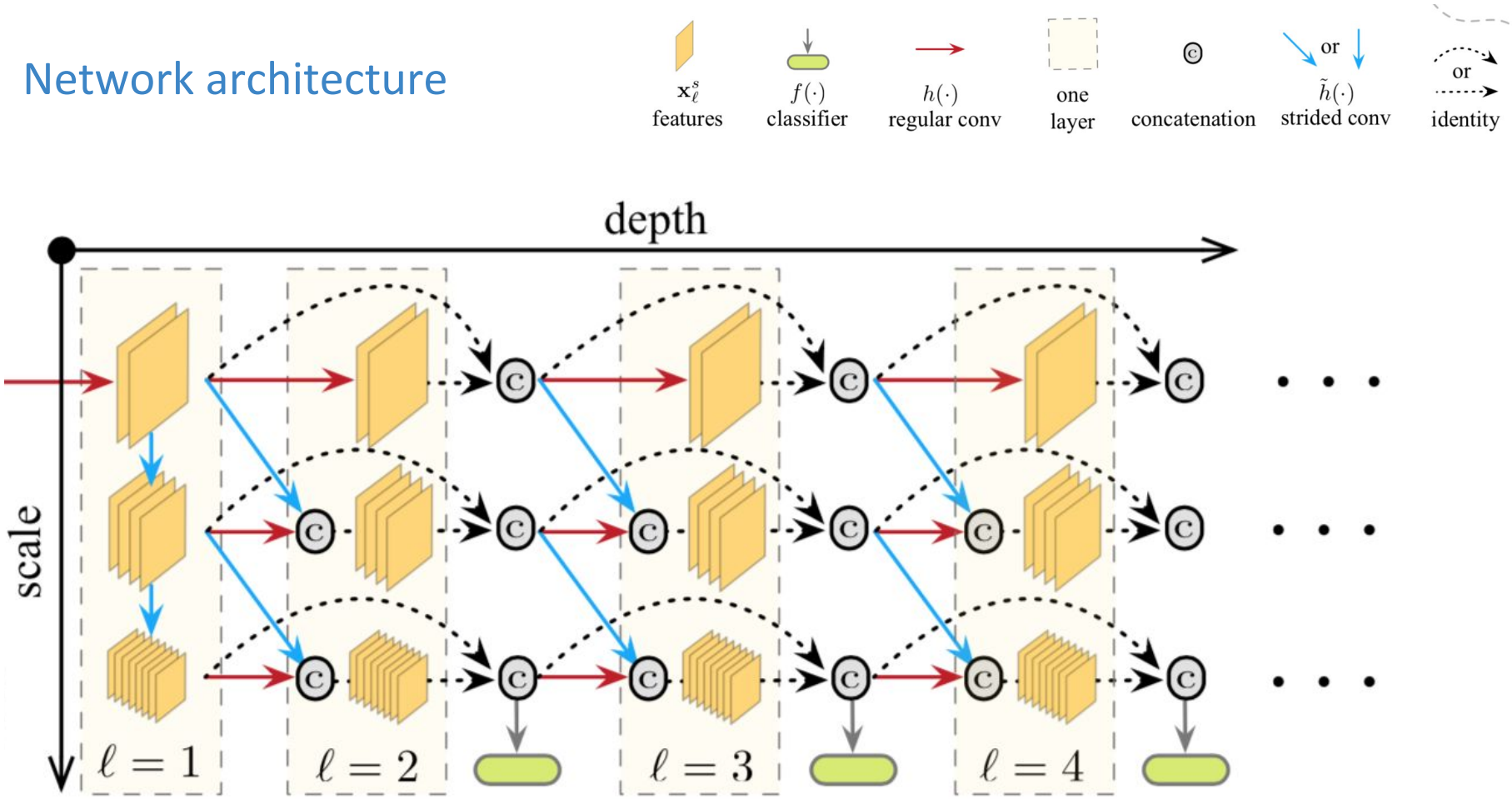
- **anytime classification**
  - prediction for a test example is progressively updated
  - output of a prediction at any time

- **budgeted batch classification**
  - Fixed compute budget
  - can be spent unevenly across “easier” and “harder” inputs

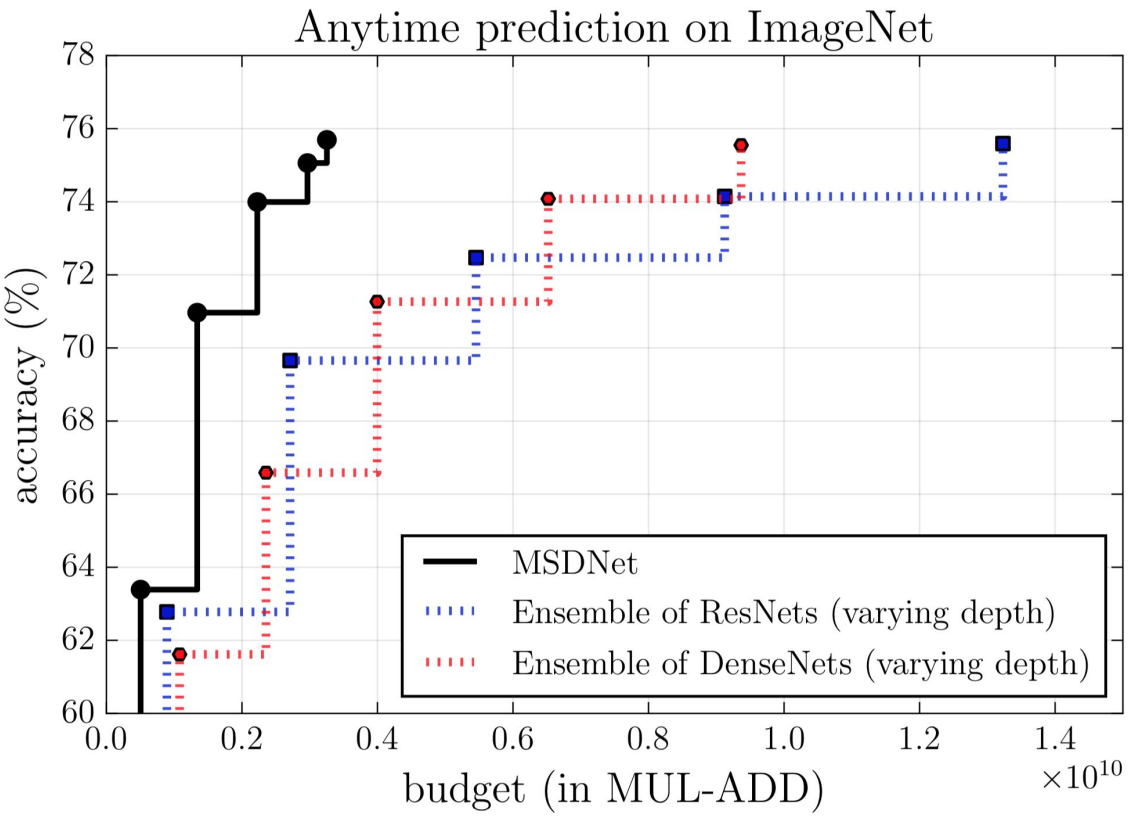
# Easy and Difficult Examples



# Network architecture



# Accuracy vs Compute Budget



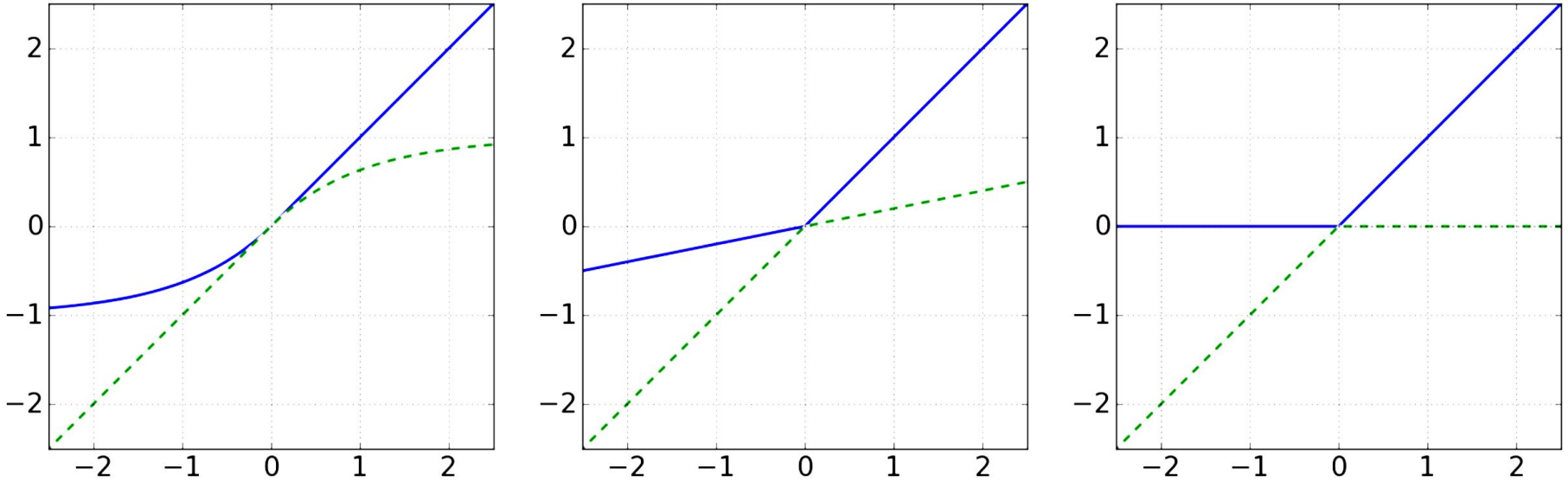
# Shifting Mean Activation Towards Zero With Bipolar Activation Functions

# Shifting Mean Activation Towards Zero With Bipolar Activation Functions

- ReLU: non-zero mean activations, evergrowing varianc
- BatchNorm for mitigation, normalize mean/var at each layer
  - ‘End-of-pipe’ solution

- **Key idea:**
  - Invert every second activation function!
    - Zero mean, slowly growing variance
    - Fixes the underlying problem
- Faster convergence, stable training, higher accuracy

# Blue: ELU – Leaky ReLU – RELU



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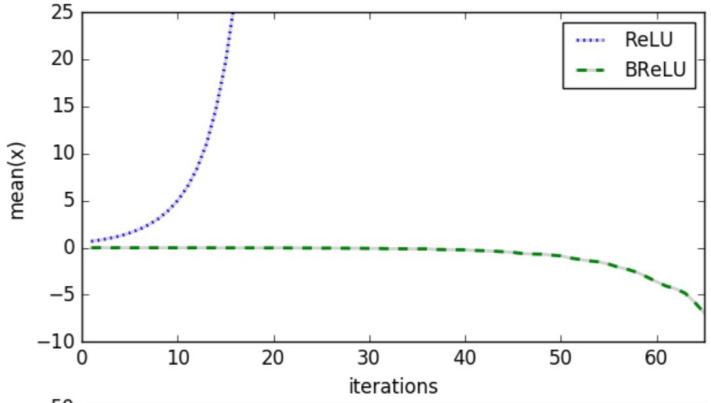
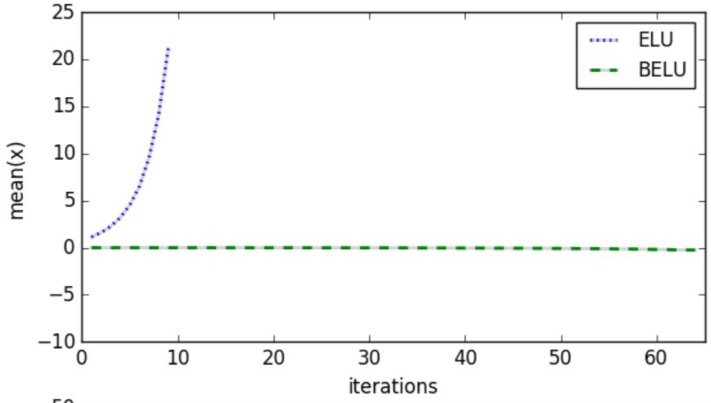
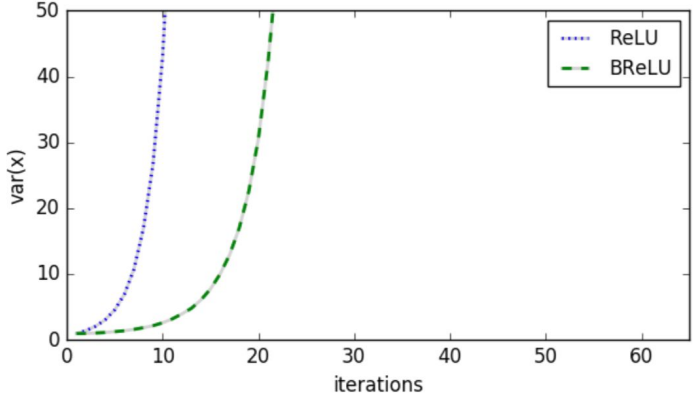
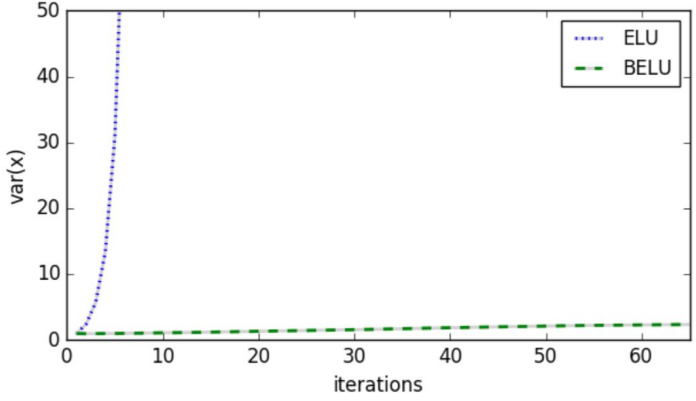
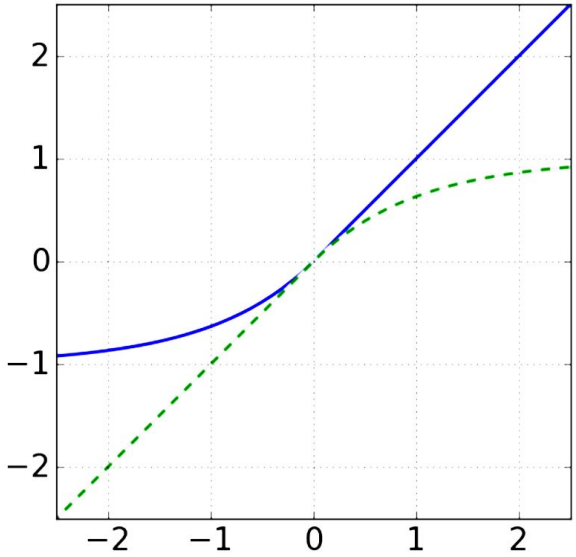


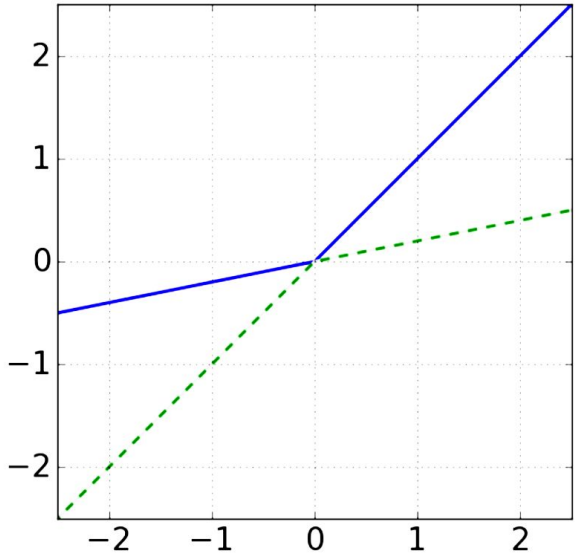



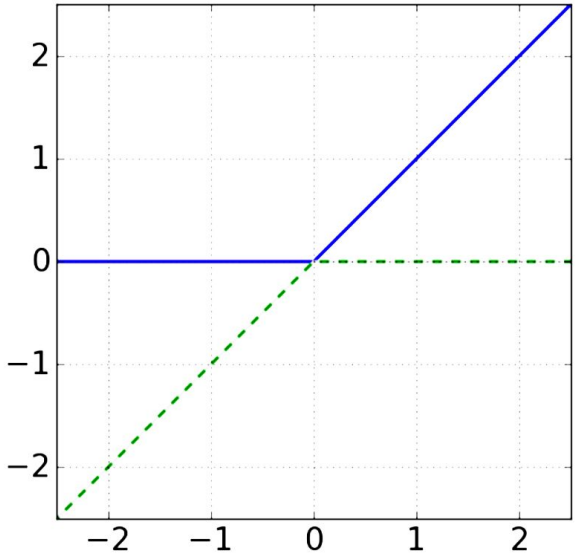



# ELU – Leaky ReLU – RELU, and Bipolar Versions

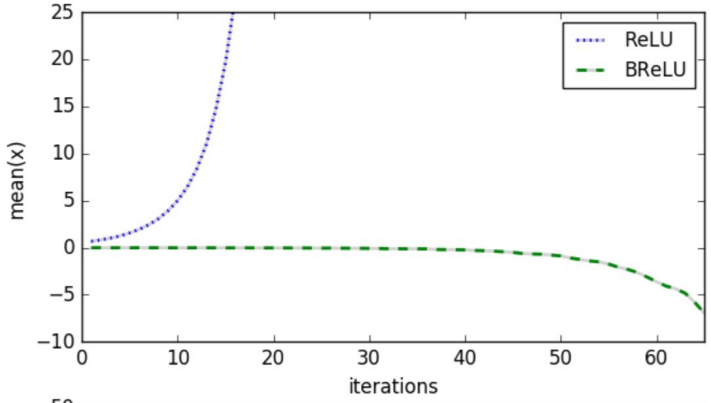


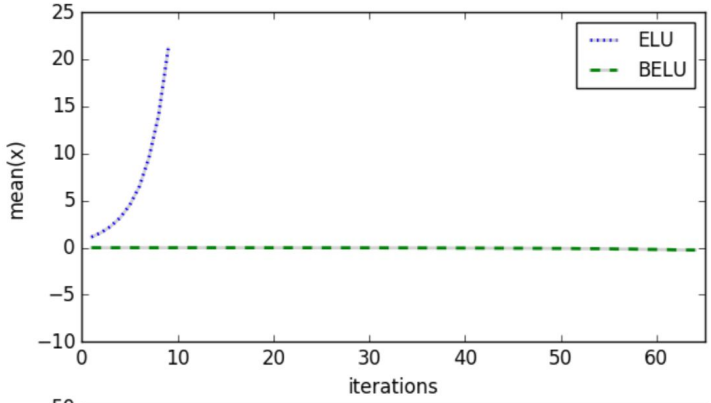



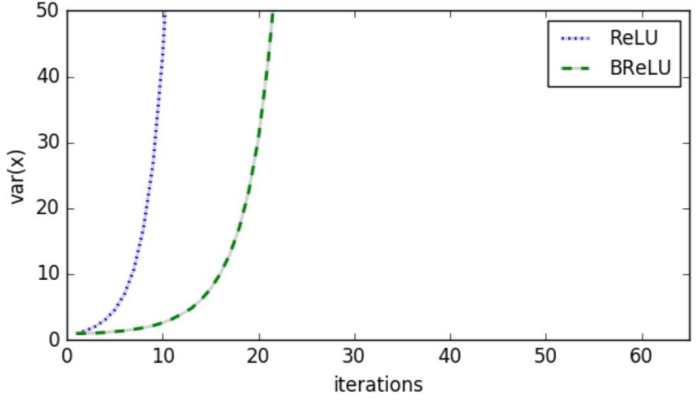



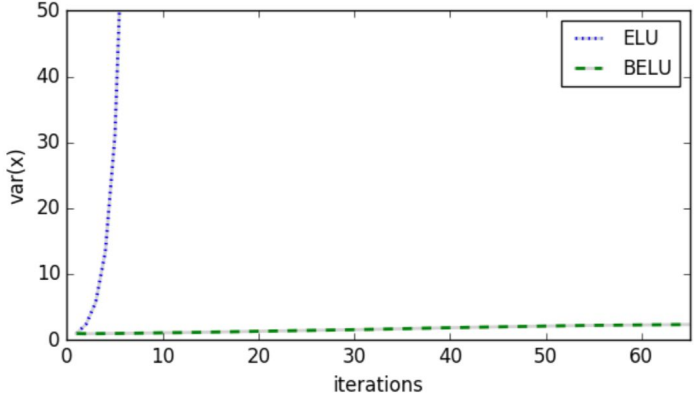

$$f_B(x_i) = \begin{cases} f(x_i), & \text{if } i \bmod 2 = 0 \\ -f(-x_i), & \text{if } i \bmod 2 \neq 0 \end{cases}$$

# Shifting Mean Activation Towards Zero with Bipolar Activation Functions

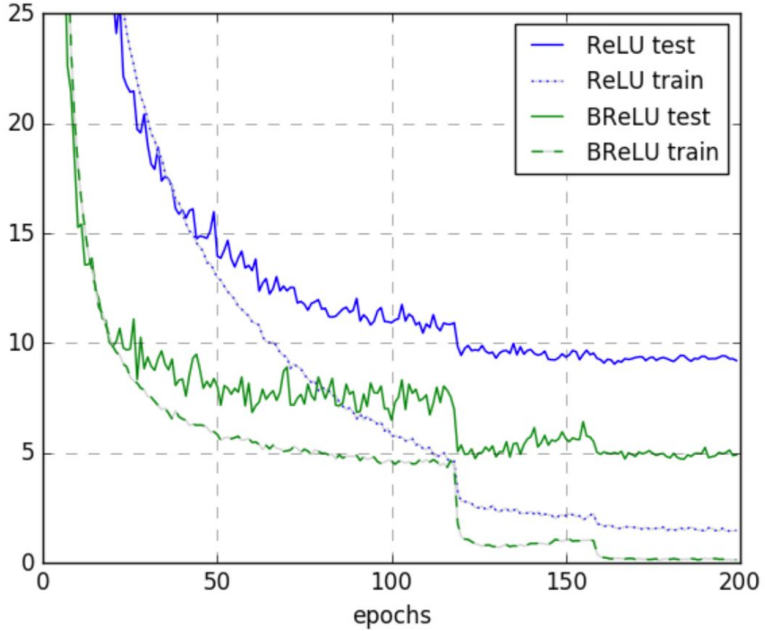


# Faster Training / Great Results without BatchNorm



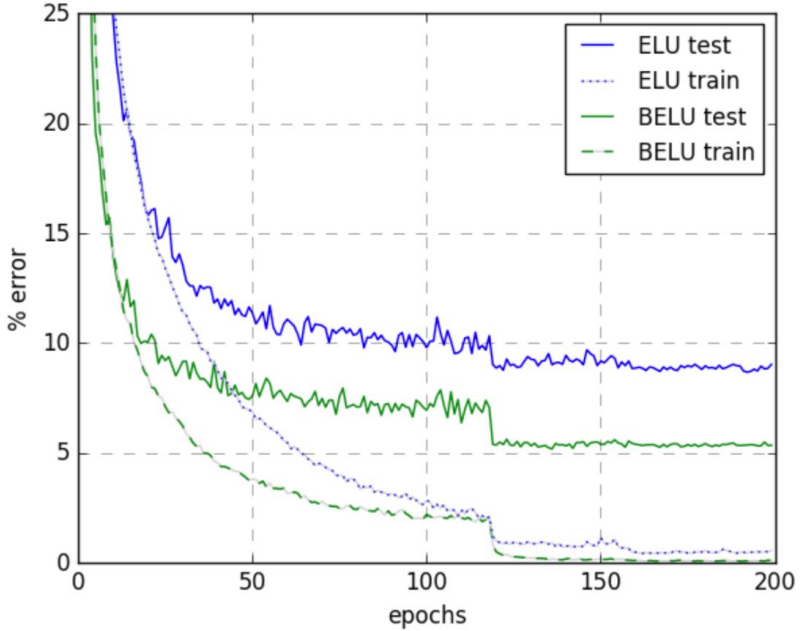




Table 5: CIFAR-10 test error with moderate data augmentation [%]

| Network | ReLU | BReLU | ELU | BELU |
|---|---|---|---|---|
| OrientedResponseNet-28 (no BN, 30% dropout) | 9.20 | 4.91 | 9.03 | 5.35 |
| WideResNet-28 (no BN, 30% dropout) | 9.78 | 6.03 | 7.69 | 6.12 |

# Hot Topics & Latest News

a short block at every meetup
to briefly present recent papers and news

Send us contributions (tom.lidy@gmail.com)
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Next Meetup: September