

Universität



Potsdam



Introduction to  
Deep Learning



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Deep Learning

# Course Introduction

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# Introductions

# “Living Stats”

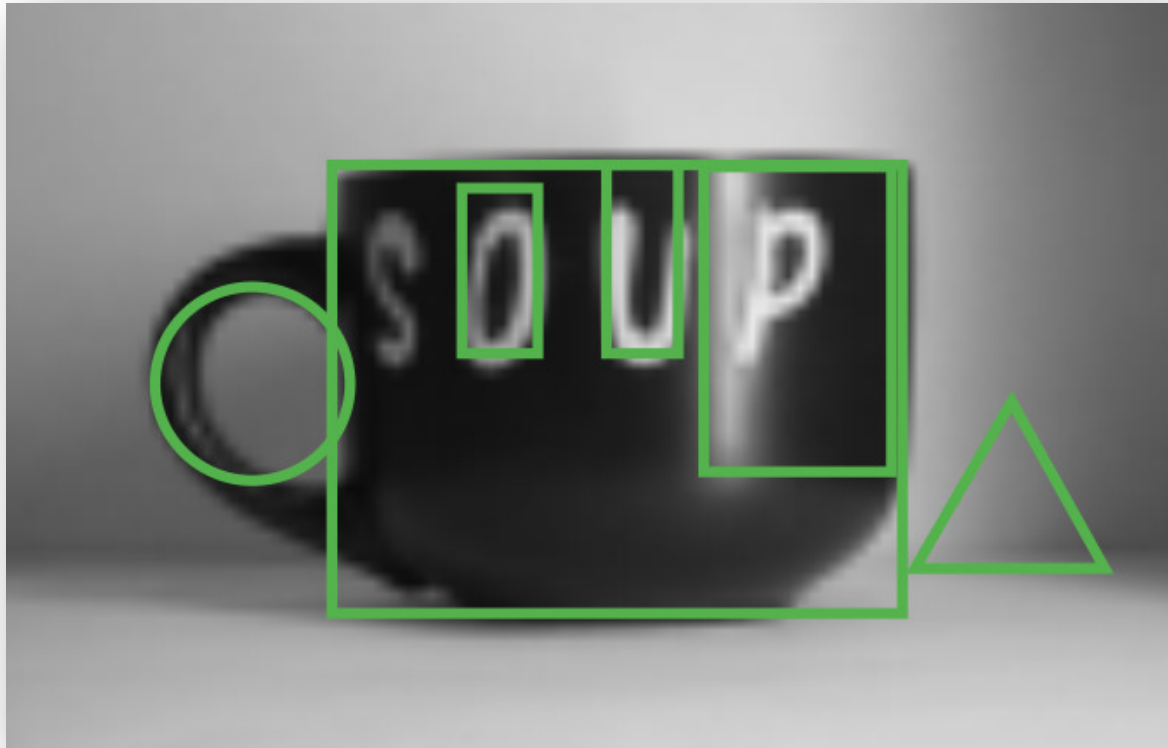
- How far away from home are you?
- How long have you studied already?
- How experienced are you in ML?
- How experienced are you in DL?

A Brief Intro to

# Deep Learning

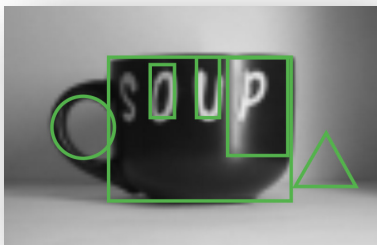
# My 1<sup>st</sup> ML Project

- A coffee mug through the “eyes” of a road-sign detector in 2003:

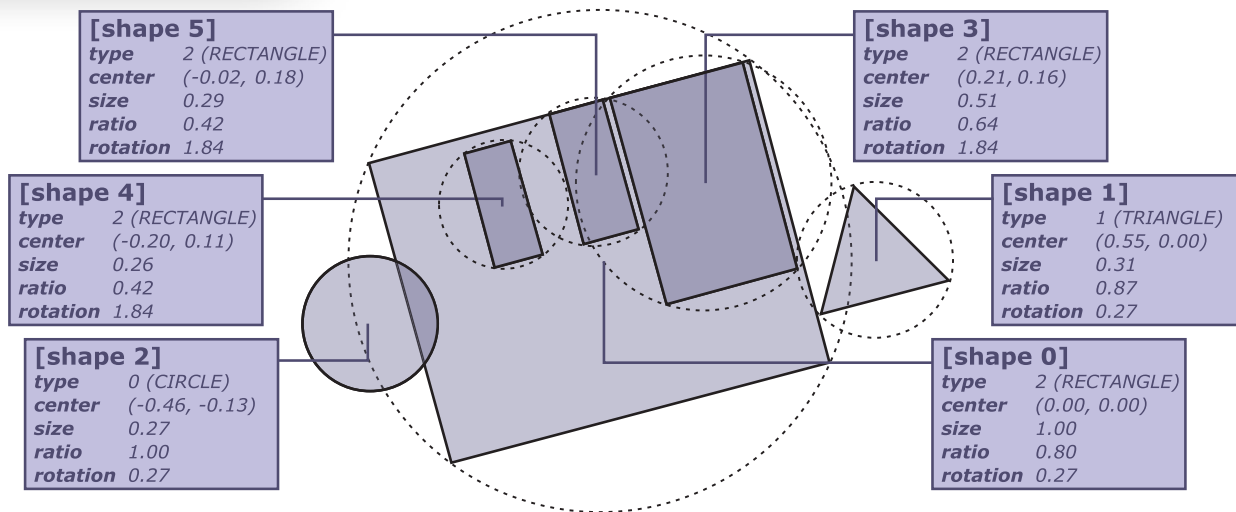


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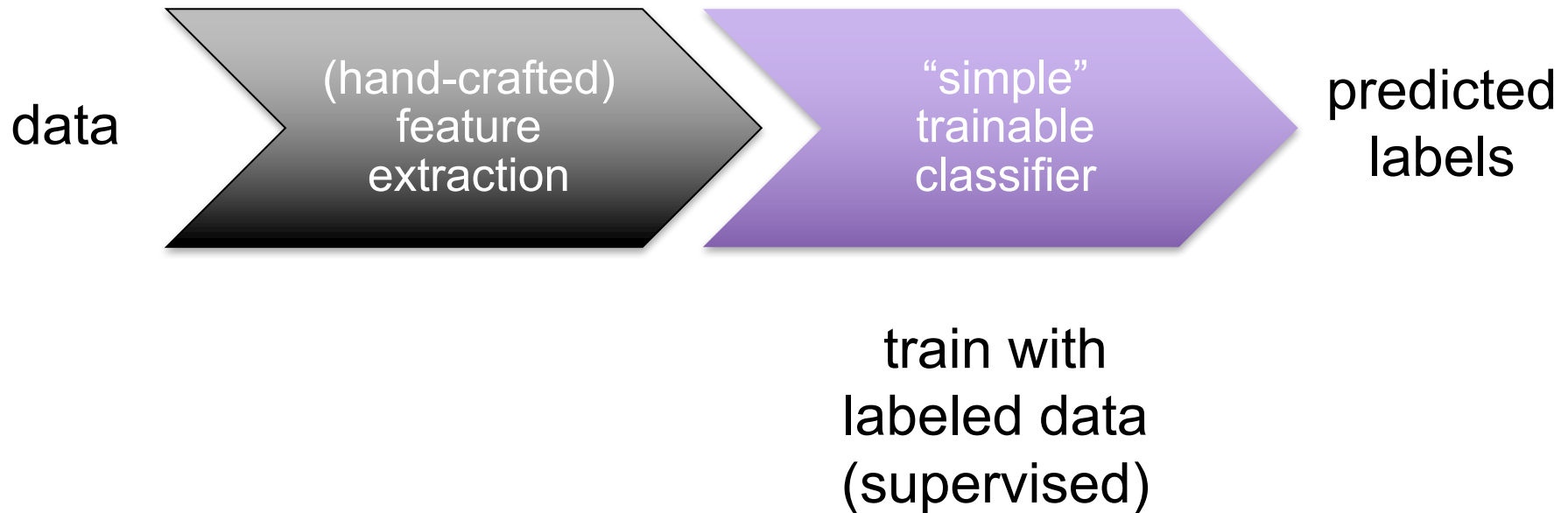


representation  
to be used by classifier



# Typical Machine Learning Workflow (for Classification)

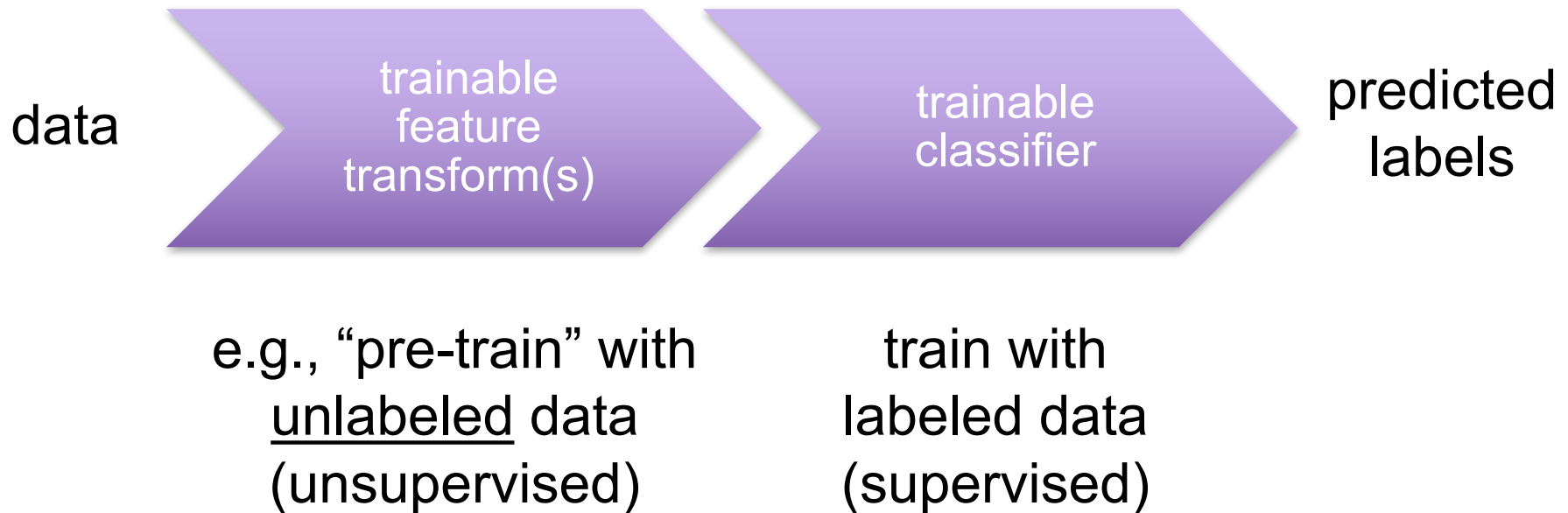
make use of domain  
knowledge from experts

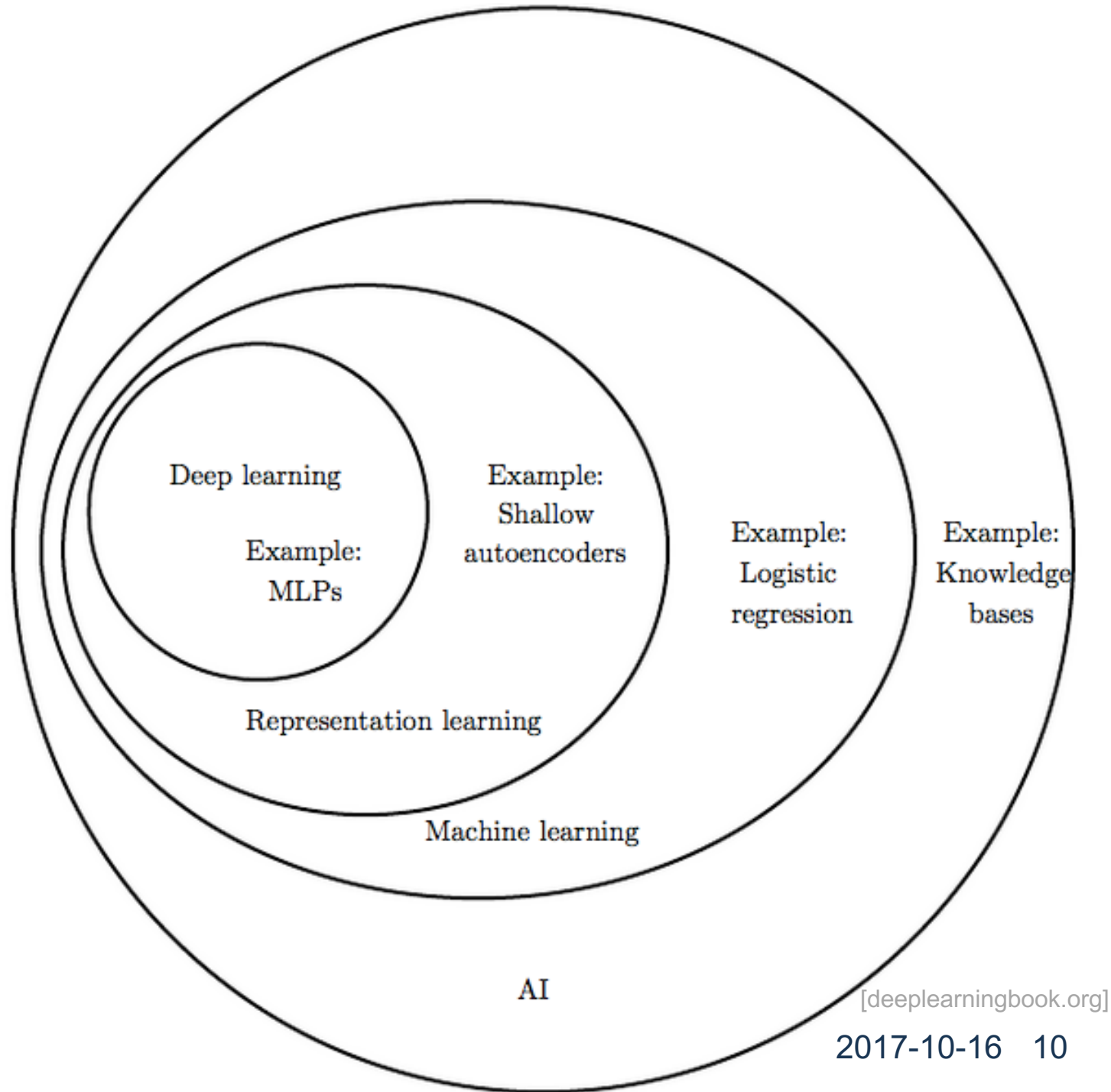


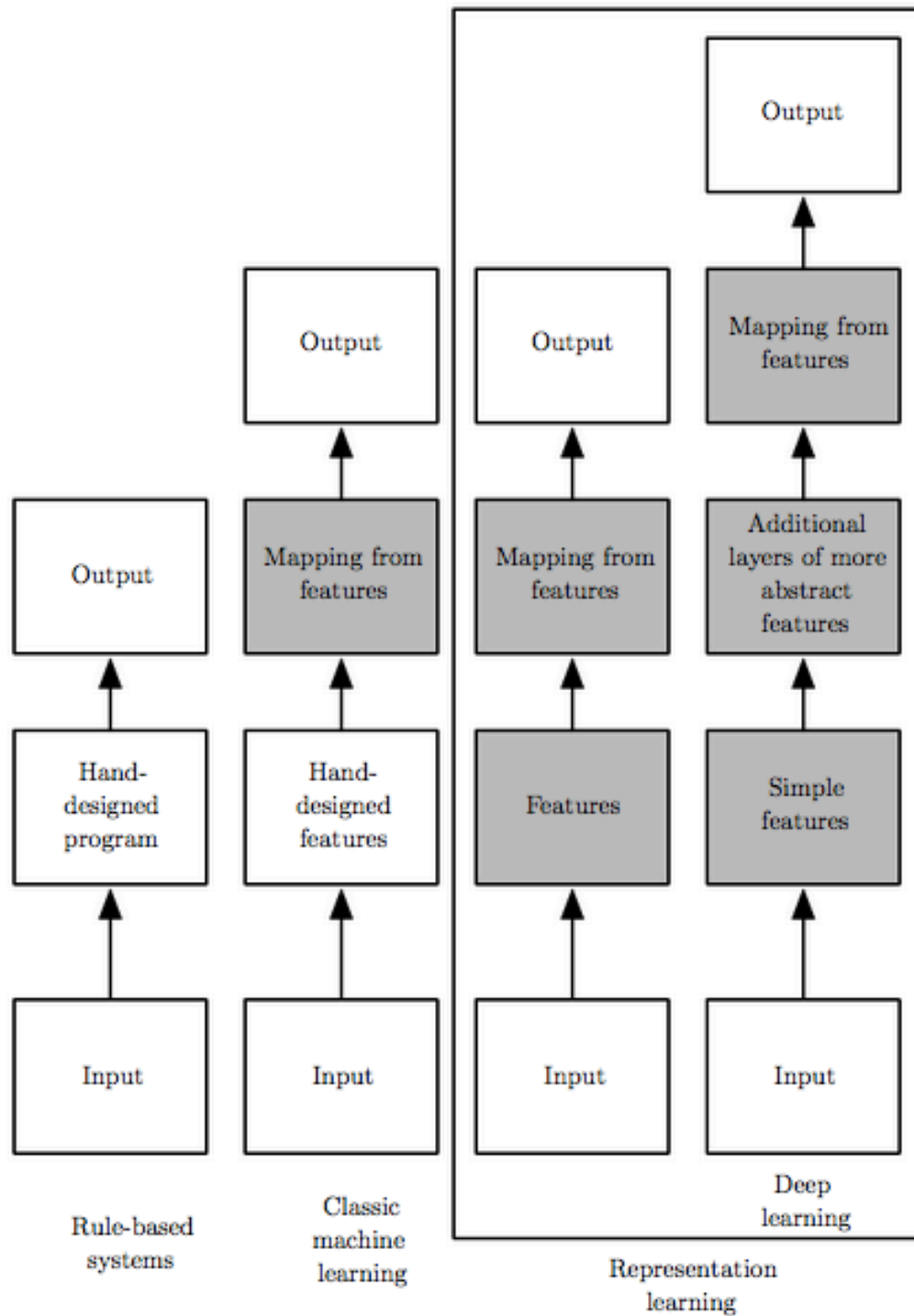


# Typical Deep Learning Workflow (for Classification)

make use of abundant data  
and (GPU) compute power





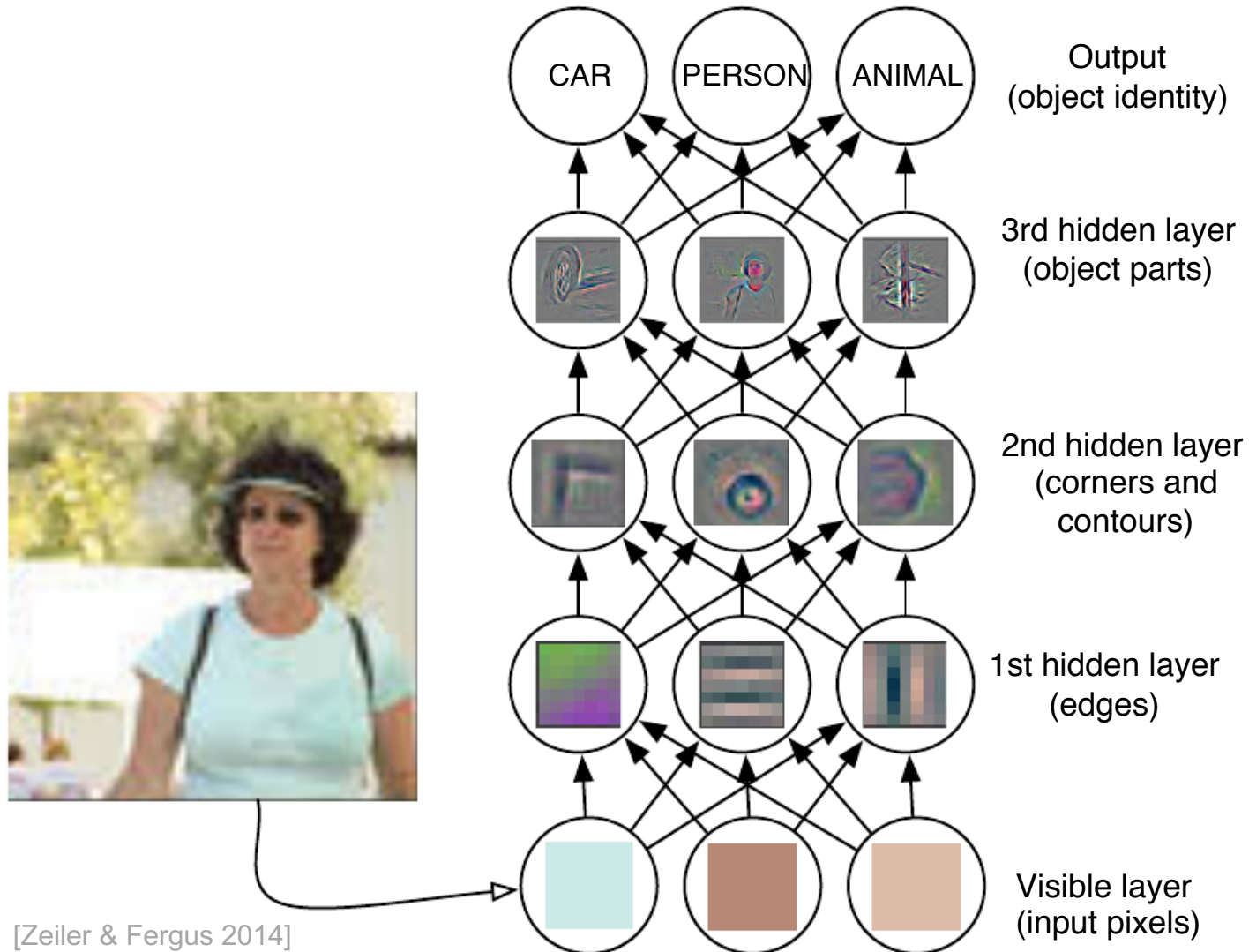


[deeplearningbook.org]

# The Promise of Deep Learning

- learn suitable feature representations along with the actual learning task
- using a general-purpose learning procedure

# An Example Deep Net



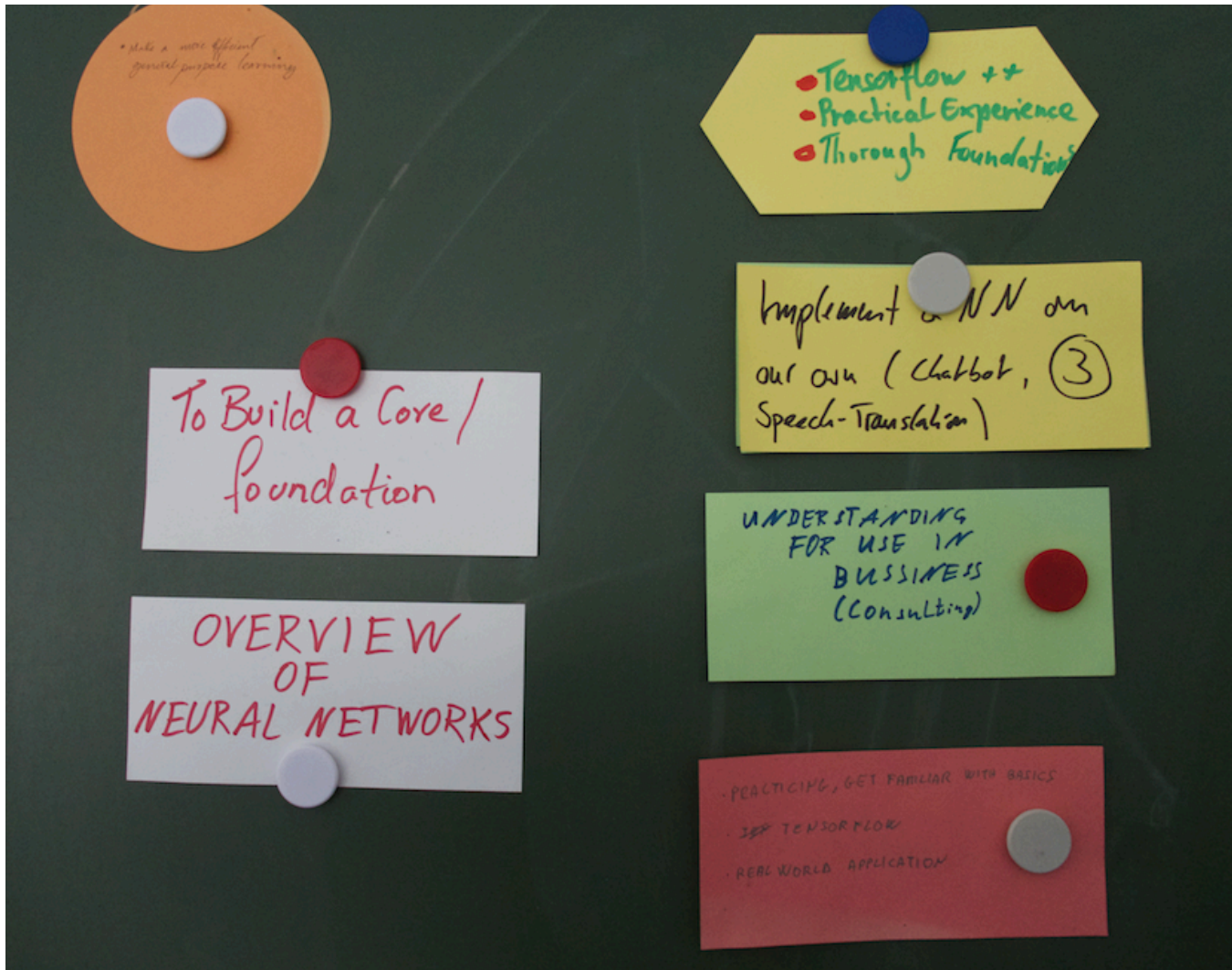
# Course Rationale & Design

# Learning Goals

- Think – Pair – Share
  1. Think about your personal learning goals for this course!
  2. Discuss with your neighbors & create a ranking!
  3. Name your most important one!



# Learning Goals





# Overall Learning Goals

- At the end of the course, you are able to ...
  - **confidently** apply DL techniques to develop a solution for a given problem
  - follow recent DL publications and **critically** assess their contributions
  - formulate **hypotheses** and design & conduct DL experiments to **validate** them
  - **document** progress & design decisions for **reproducibility** and transparency

*Please add your goals!*

# Disclaimer



HERE BE DRAGONS!

WELL, NOT REALLY. WE WERE JUST  
TOO LAZY TO LIST THE HAZARDS, AND  
THIS IS MORE ACCURATE THAN NOTHING AT ALL

this course may not be  
suitable for ...

- mere credit collectors
- passive attendees
- remote students
- the lighthearted ;-)

*end of withdrawal period:  
November 20, 2017*

# No Free Lunch!

This is **not** how  
you will learn...

you will need to  
**\*participate\***



The Nuremberg Funnel (1647)

# Course Design

## Preparation

(session summary)

reading

- book chapters
- papers
- blogs

channel discussions

weekly blog posts

- new insights
- hints, tricks & hacks
- open questions

3-6h per week

## In Class

“last episode on IDL”  
(3-min summary)

literature  
discussion / Q&A  
small-group activity  
(25-60 min)

project / assignments  
discussion / Q&A  
(25-60 min)

150h total

## Practical Work

weekly exercise  
assignments  
(until Christmas)

channel discussions

course project  
working in teams

- 2-4 team members
- scrum-style  
weekly sprints
- team progress blog

3-6h per week

grading: \*oral exam (20min)

# Topics (Tentative)

- MLPs, Gradient Descent & Backpropagation
- Convolutional Neural Networks
- Recurrent/Recursive Neural Networks
- Auto-Encoders
- Regularization Techniques
- Advanced Regularization Techniques
- Introspection & Inception
- Optimization Techniques
- Advanced Training Strategies
- Deep Reinforcement Learning

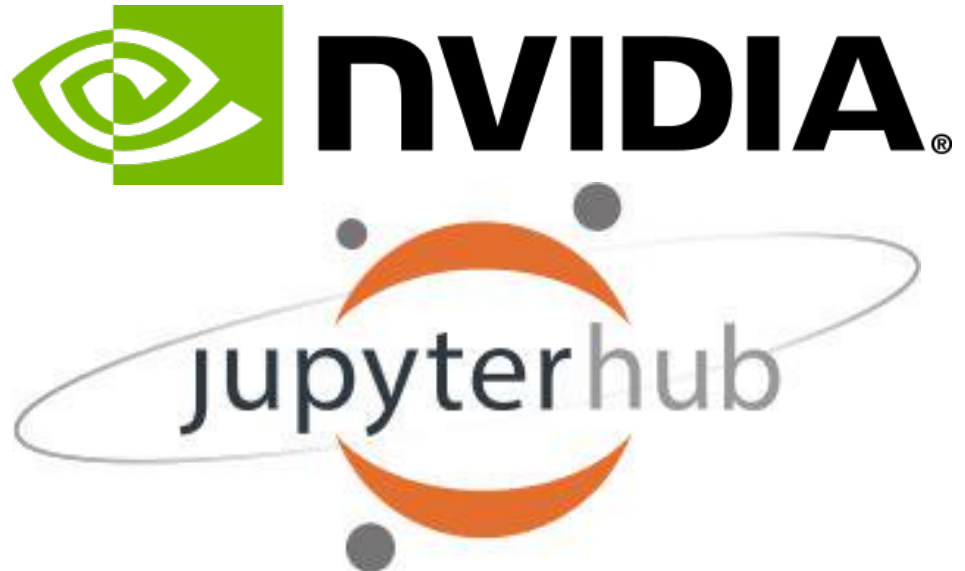
# Online Tools

- Mattermost (~Slack) channel  
+ Campus.UP workspace
  - channels / blogs (course / personal / team)
  - forum
  - wiki
  - messaging
- GPU compute environment (starting Jan.)
  - shell access & jupyterhub for notebooks

# GPU Compute Servers

## 10 GPU Compute Servers

- 8 Pascal Geforce 1080 Ti GPUs
- 256 GB RAM
- 24 CPU cores
- jupyterhub server for notebooks
- fully dockerized
- ... more infos later



<https://jupyter.org/>



# Jupyterhub

The screenshot shows a Jupyter Notebook running on a local host. The browser address bar indicates the URL is localhost:8000/user/stober/notebooks/notebooks/berlin\_mhd2016/Train.ipynb. The notebook title is "jupyter Train" and it shows the last checkpoint was 21 hours ago. The interface includes a menu bar (File, Edit, View, Insert, Cell, Kernel, Help) and a toolbar with various icons. The main content area displays the following code and output:

```
logging.basicConfig(level=logging.INFO)
loop.run()

Training status:
  batch_interrupt_received: False
  epoch_interrupt_received: False
  epoch_started: False
  epochs_done: 99
  iterations_done: 15741
  received_first_batch: True
  resumed_from: None
  training_started: True
Log records from the iteration 15741:
  time_read_data_this_epoch: 0.077024936676
  time_read_data_total: 7.7109246254
  time_train_this_epoch: 16.7325439453
  time_train_total: 1656.00861263
  train_decoder_cost_cost: 7.31601667404
  train_total_gradient_norm: 3.01435232162

Epoch 99, step 159 | Elapsed Time: 0:00:17
```

In [13]:

```
for k,v in model.get_parameter_values().items():
    print k, v.shape, v.mean()

/decoder/generator/readout/bias.b (11343,) -0.368705
/decoder/generator/readout/merge/transform_states.W (500, 11343) -0.0048978
/decoder/generator/with_fake_attention/conditionedrecurrent/transition.W (500, 500) 0.000432439
/decoder/generator/with_fake_attention/conditionedrecurrent/transition.initial_state (500,) 0.00145349
/encoder/linear_0.b (500,) 0.000179575
/encoder/linear_0.W (200, 500) 0.00113562
/decoder/generator/fork/fork_inputs.b (500,) 7.72142e-05
/decoder/generator/fork/fork_inputs.W (500, 500) -9.32707e-05
/decoder/generator/readout/feedback/lookuptable.W (11343, 500) 2.83346e-05
```

In [14]:

```
from blocks.filter import VariableFilter
from blocks.search import BeamSearch
```

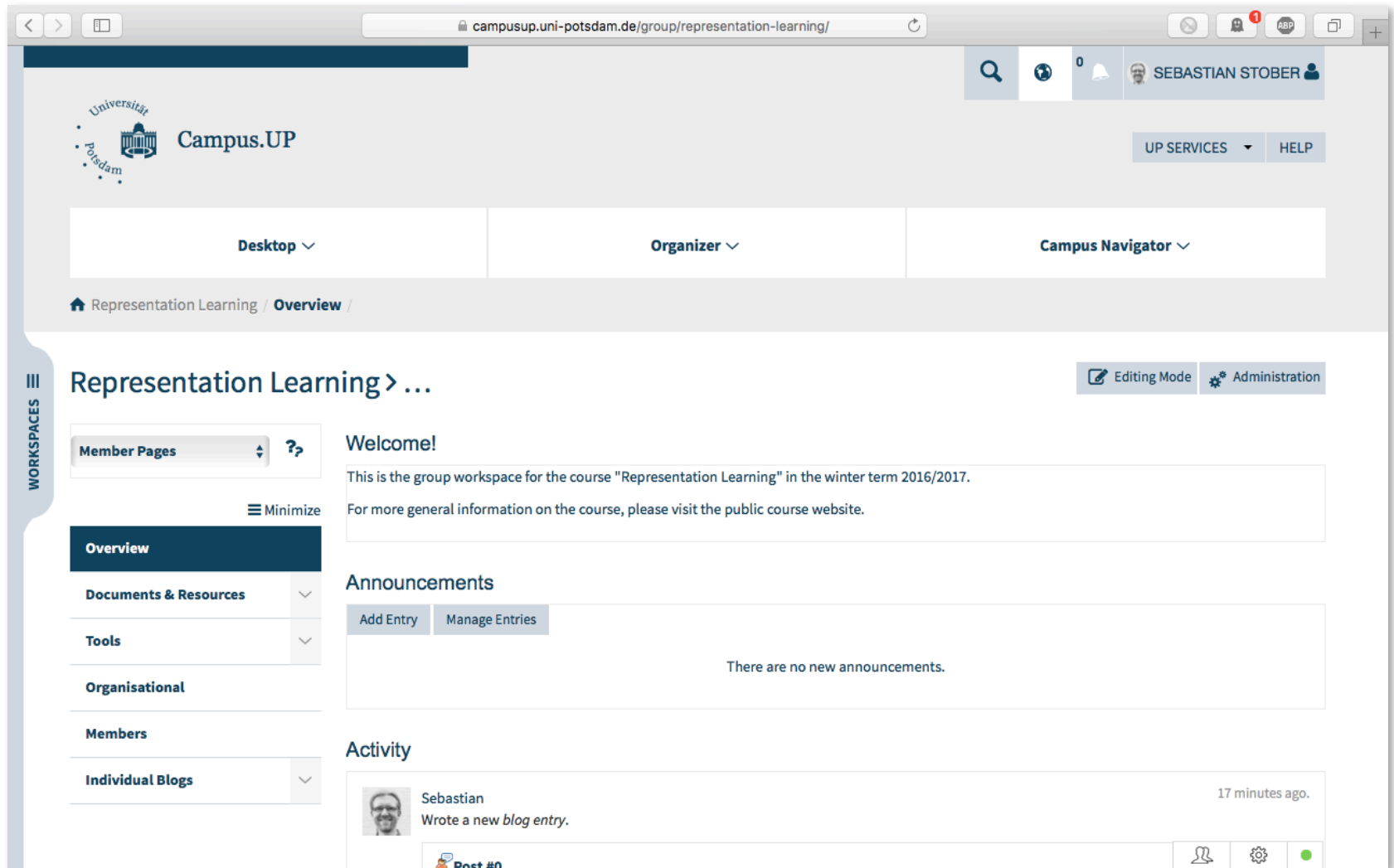




# Mattermost Channel

The screenshot shows a Mattermost channel interface. On the left is a dark sidebar with navigation options: ID (IDL 20...), ML (MLCog), UP (UPrac...), and a plus sign. Below these are sections for PUBLIC CHANNELS (Deep Learning News, Off-Topic, Q & A, Town Square), PRIVATE CHANNELS, and DIRECT MESSAGES (ankrug). The main area shows the channel 'Town Square' with a description 'Add a channel description'. A welcome message reads: 'Welcome to Town Square! Post messages here that you want everyone to see. Everyone automatically becomes a permanent member of this channel when they join the team.' Below this are three system messages: 'sstoer has joined the channel.' (Tue, Sep 26, 2017), 'jens has joined the channel.' (Wed, Sep 27, 2017), and 'ilia has joined the channel.' (Thu, Sep 28, 2017). At the bottom is a text input field 'Write a message...' and a 'Help' link.

# Campus.UP Workspace



The screenshot shows a web browser window with the URL `campusup.uni-potsdam.de/group/representation-learning/`. The interface includes a top navigation bar with the University of Potsdam logo, the text 'Campus.UP', and user information for 'SEBASTIAN STOBER'. Below this is a secondary navigation bar with 'UP SERVICES' and 'HELP' buttons. The main content area is divided into three sections: 'Desktop', 'Organizer', and 'Campus Navigator'. A breadcrumb trail shows 'Representation Learning / Overview'. On the left, a 'WORKSPACES' sidebar lists 'Member Pages', 'Overview' (selected), 'Documents & Resources', 'Tools', 'Organisational', 'Members', and 'Individual Blogs'. The main content area features a 'Welcome!' message, an 'Announcements' section with 'Add Entry' and 'Manage Entries' buttons, and an 'Activity' section showing a recent blog entry by Sebastian.

# Session Summaries

last episode on  
“Introduction to Deep Learning”

...

- rotating job!  
(2 persons per session,  
assignment by poll)

- short summary blog post (in course blog)  
+ 3-min intro recap at next session
  - key topics
  - results of the discussion
  - optional photos

# Your Personal Channel

- document your learning / project progress
  - one post per week
  - share your experiences!
  - visible only to course participants
- examples:
  - <https://deeperandommumbling.wordpress.com/>
  - <http://bartvanmerrienboer.nl/#blog>
- guidelines:
  - <https://www2.uwstout.edu/content/profdev/rubrics/blogrubric.html>

# Q & A Channel

- guide for what is covered in class  
deadline: Monday morning 7am
- do not hesitate to post questions!  
(If you got one, you are probably not the only one!)
- post a comment if you know the answer

# Contribute!

- ask – in your channel and Q&A
- comment / like / rate
- answer
- document
  - hints, tricks & hacks
- recommend
  - additional readings (papers, blogs, etc.)
- give (constructive) feedback

# Course Project

# Course Project

- vision: speech-base interaction

real systems:

- Siri (Apple)
- Alexa (Amazon)
- Cortana (Microsoft)
- Google Home
- Skype Translate
- ...

fictional characters:

- J.A.R.V.I.S. (Iron Man)
- Samantha (Her)
- Jane (Ender's Game)
- ...



# Course Project

- Automatic Speech Recognition (ASR)
  - Beat the baseline system!

J. Kunze; L. Kirsch; I. Kurenkov; A. Krug; J. Johannsmeier & S. Stober. **Transfer Learning for Speech Recognition on a Budget**. In: *2nd Workshop on Representation Learning for NLP at the Annual Meeting of the Association for Computational Linguistics (ACL'17)*, 2017.

<https://arxiv.org/abs/1706.00290>

<https://github.com/transfer-learning-asr/transfer-learning-asr>

# Course Project

- collaborative effort
- “coopetition” (cooperative + competition)
- multiple teams of 2-4 students:
  - discuss ideas and form team in December
  - self-organized (heterogeneous if possible)
  - scrum-like approach
  - focus on different goals / aspects / strategies

# Team Channels (January/February)

- weekly progress reports for course project
  - similar to scrum
  - compare original goals with outcomes
    - What has worked well?
    - What did not work / had to be changed?
  - outline plan for next week
    - What would you like to try / investigate next?
- can be written up by one designated team member or in turns