



Chair for Computer Aided Medical Procedures (CAMP)  
Master Praktikum on  
**Machine Learning in Medical Imaging**

Dr. Seong Tae Kim, Dr. Shahrooz Faghi Roohi, Azade Farshad, Ashkan Khakzar  
Prof. Dr. Nassir Navab

# Chair for Computer Aided Medical Procedures & Augmented Reality



# Team



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**Course Regulations**



# Basic Info about the course

- **Type:** Master Practical Course Module (IN2016)
- **Language:** English
- **SWS:** 6
- **ECTS:** 10 Credits
- **Webpage:**
  - <http://campar.in.tum.de/Chair/TeachingWs20MLMI> (files are password-protected)
- **Time:**
  - Thursdays, 16-18
- **Location:**
  - Virtual Meeting Room (Zoom)
  - ~~CAMP Seminar Room (03.13.010)~~
- **Requirements:**
  - Background in machine/deep learning
  - Knowledge of software engineering principles (eg. version control, ...)
  - Python programming



# Objective

- Learn through practice:
  - Solving problems in Medical Imaging using machine learning methods
- The course is divided into:
  - A few introductory lectures on machine/deep learning and its application in different problems involving medical imaging
  - A number of hands-on sessions to apply these methods to a given dataset, and
  - A project involving a machine learning solution to a medical imaging problem



# Schedule

Example from last semester

| Date       | Topic                               | By            | Slides                 |
|------------|-------------------------------------|---------------|------------------------|
| 30.01.2020 | Preliminary meeting                 | Ashkan, Azade | <a href="#">Slides</a> |
| 07.05.2020 | Intro to DL                         | Shadi         |                        |
| 14.05.2020 | Neural Networks                     | Roger         |                        |
| 28.05.2020 | CNNs, Interpretability              | Ashkan        |                        |
| 04.06.2020 | Generative Models                   | Azade         |                        |
| 18.06.2020 | <b>Intermediate presentation</b>    | All tutors    |                        |
| 25.06.2020 | Graph Neural Networks               | Anees         |                        |
| 02.07.2020 | Robustness                          | Magda         |                        |
| 09.07.2020 | ML for Medical Image Reconstruction | Shahrooz      |                        |
| 30.07.2020 | <b>Final Presentation</b>           | All tutors    |                        |



# Projects

Structure:

- 5 Groups of 4 students (max. 20 students)
- Weekly meeting with your supervisor

Example: (Previous semester)

| Project  | Tutor       | Group I | Group II | Material                            |
|--|-------------|---------|----------|-------------------------------------|
| Beyond U-Net: Learning Medical Image Segmentation from Few Labels                                  | Jan Kukačka |         |          | <a href="#">Project Description</a> |
| Hyperparameter optimization using meta-heuristic approaches  | Azade       |         |          | <a href="#">Project Description</a> |
| Dropout in Skip-Autoencoders for Unsupervised Anomaly Detection in Brain MRI                       | Christoph   |         |          | <a href="#">Project Description</a> |
| <a href="#">EfficientNet?</a> with Robust Training: Team for MICCAI Skin Cancer Analysis Challenge | Seong Tae   |         |          | <a href="#">Project Description</a> |
| Multi-channel MR Image Reconstruction Using Deep Learning  | Shahrooz    |         |          | <a href="#">Project Description</a> |
| How Good are 3D Segmentation Models?   | Roger       |         |          | <a href="#">Project Description</a> |



# Examples of Projects in Previous Semester

EfficientNet with Robust Training: MICCAI ISIC challenge

## Introduction: SIIM-ISIC Melanoma Classification Challenge

Society for Imaging Informatics in Medicine (SIIM)  
+  
International Skin Imaging Collaboration (ISIC)

### Goal:

Develop computer vision algorithms to help with the classification of dermoscopic images of skin lesions



MICCAI Skin Cancer Analysis, SS 2020

June 18, 2020 Slide 4

# Examples of Projects in Previous Semester

## Problem Statement

**Melanoma** is the least common skin cancer, but also the most serious type. It is responsible for **75%** of skin cancer deaths



**benign**



**malignant**

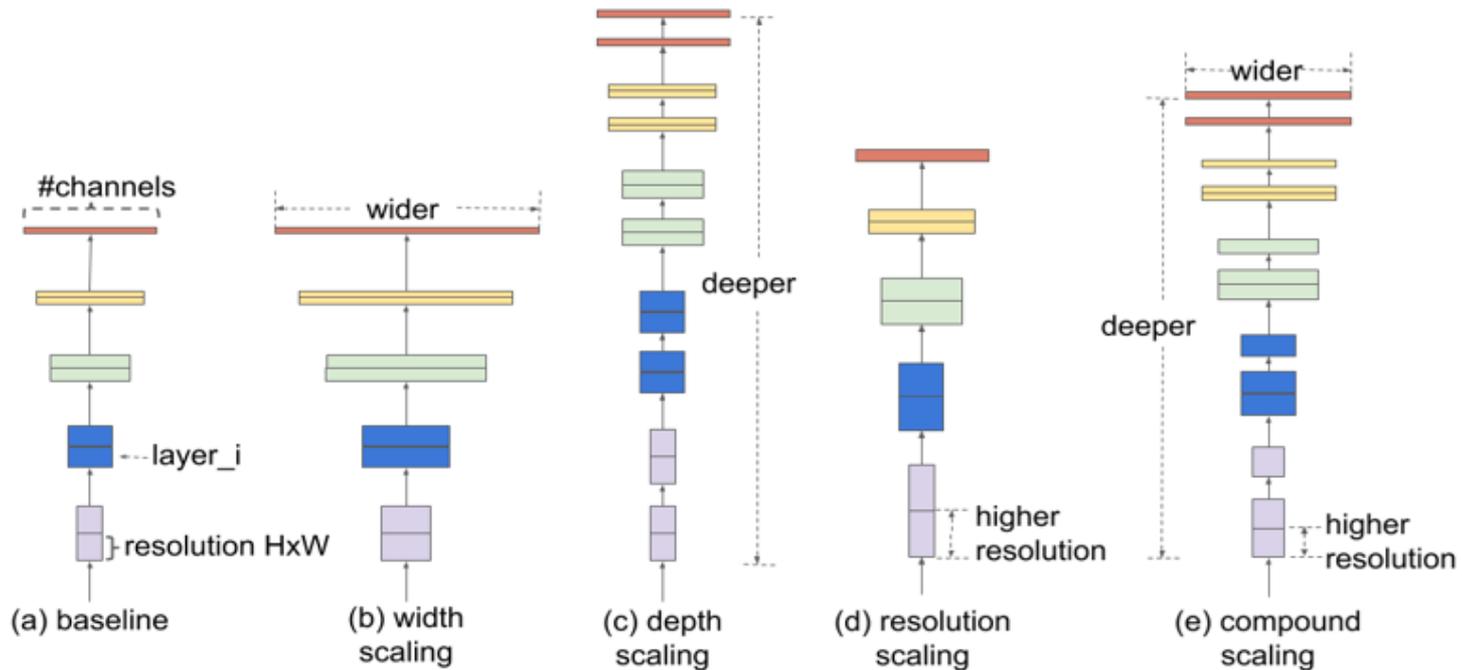
**Goal:** Using images within the same patient, determine which are likely to represent a melanoma



# Examples of Projects in Previous Semester

## EfficientNet [2]: Compound Scaling and AutoML

- Neural architecture search to develop the baseline network
- **Compound scaling** to scale the model structurally in all dimensions

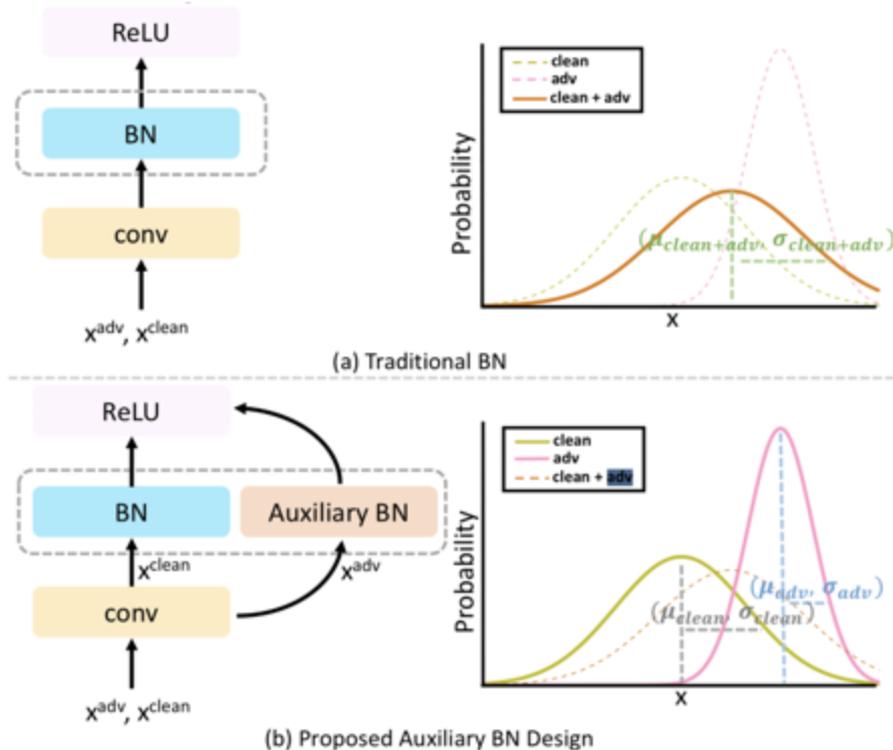


[2] Tan, M. and Le, Q.V., 2019. Efficientnet: Rethinking model scaling for convolutional neural networks. ICML

# Examples of Projects in Previous Semester

## AdvProp [3]: Approach

- Using **auxiliary batch norm** to disentangle mixed distribution



[3] Xie, C., Tan, M., Gong, B., Wang, J., Yuille, A. L., & Le, Q. V. (2020). Adversarial examples improve image recognition. In Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (pp. 819-828)



# Examples of Projects in Previous Semester

## RandAugment<sup>[4]</sup> for learning better augmentations

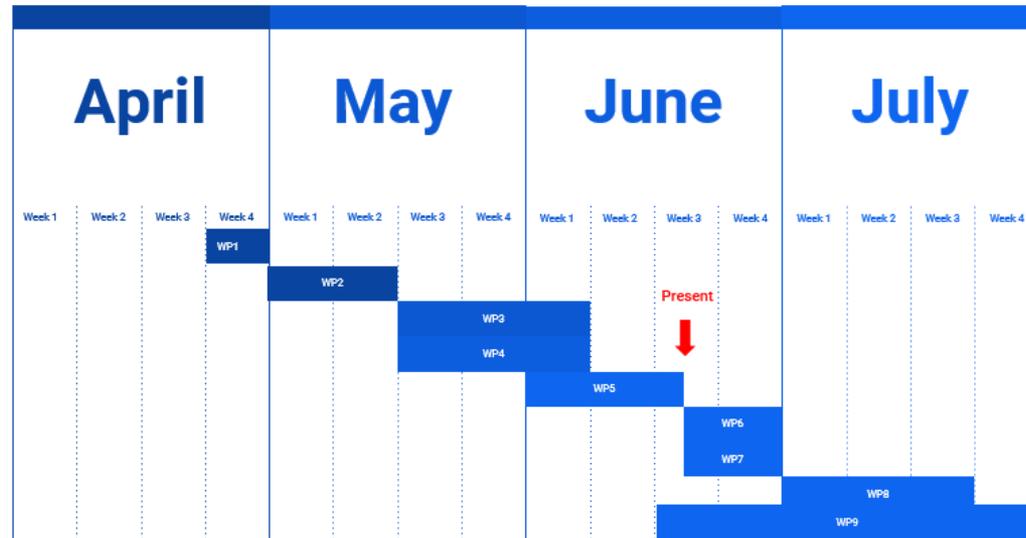
- Using Data Augmentations increase performance but finding proper set of augmentations requires expertise and domain knowledge
- Learning policies for choosing data augmentations on a proxy (smaller) task (AutoAugment)<sup>[7]</sup> is not always scalable to the task at hand.
- **RandAugment** proposes to simply **find a set of transformations and the corresponding magnitude through Grid Search** on the main task.

[4] CVPRW2020: Cubuk, E. D., Zoph, B., Shlens, J., & Le, Q. V. (2020). Randaugment: Practical automated data augmentation with a reduced search space. In Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition Workshops (pp. 702-703)

[7] Cubuk, Ekin D., et al. "Autoaugment: Learning augmentation strategies from data." Proceedings of the IEEE conference on computer vision and pattern recognition. 2019.



# Examples of Projects in Previous Semester



## WP 1 Read and Familiar with Literature

- Getting familiar with Tensorflow

## WP 3 Understanding and Implementation of Adversarial Propagation

## WP 5 Familiar with clinical data (challenge dataset)

- Implementing data reading
- Data pre-processing

## WP 2 Understanding the EfficientNet

- Getting familiar with pretrained models
- Tried and failed with Tensorflow version, started to use PyTorch

## WP 4 Understanding and Implementation of RandAugment

## WP 6 Implement and evaluate WP3 on challenge dataset

- Adversarial Propagation

## WP 8 Evaluation on validation set

- Optimization of models

## WP 7 Implement and Evaluate WP4 on challenge dataset

- Rand Augment

## WP 9 Challenge Submission

- Test set results
- Documentation



# Evaluation

## Project: 100%

- **Progress: 60%**
  - Weekly supervision sessions with the tutors
  - Define a list of ToDo's
  - Share a code repository
  - Student's contribution will be monitored on LRZ Git
  - Evaluated by the tutor
- **Presentation: 40%**
  - Intermediate Presentation (10 mins + 3 mins. Q&A)
  - Final Presentations (20 mins + 5 mins. Q&A)
  - Evaluated by the all tutors



# How can you apply?

- Submit the registration form in: <https://wiki.tum.de/pages/viewpage.action?pageId=559285259>

## MLMI Registration

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Student Name

\*

Email

\*

Master's Program

\*

Current Semester

\*

Related Courses

\*

If passed, mention the grades

Resume (max 150 words)

\*

max 150 words (if exceeded, your application will be discarded) You may talk about your related projects - publications/competitions/github repositories - work experience, ...

**Deadline for the registration form: 21.07.2020, 11:59 pm**



# Important Dates

**Deadline for submitting the registration form:**

**21.07.2020, 11:59 pm**

You can find these slides and other info on the course website:

<http://campar.in.tum.de/Chair/TeachingWs20MLMI>

**Don't forget to register at TUM matching system**

Register via [matching.in.tum.de](http://matching.in.tum.de)

**16.07 to 21.07.2020**

