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

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Chair for Computer Aided Medical Procedures & Augmented Reality

Team

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Course Regulations

Technische Universität München

JOHNS HOPKINS
WHITING SCHOOL
of ENGINEERING

Basic Info about the course

- **Type**: Master Practical Course Module (IN2016)
- **Language**: English
- **SWS**: 6
- **ECTS**: 10 Credits
- **Webpage**:
  - https://wiki.tum.de/display/mlmi/MLMI%3A+Winter+2021-2021
- **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

Content

Lectures on

- DL for Medical Image Diagnosis and Segmentation
- DL for Medical Image Reconstruction
- Explainable DL
- Generative Models
- Graph Neural Networks
- Robustness

Projects

Structure:

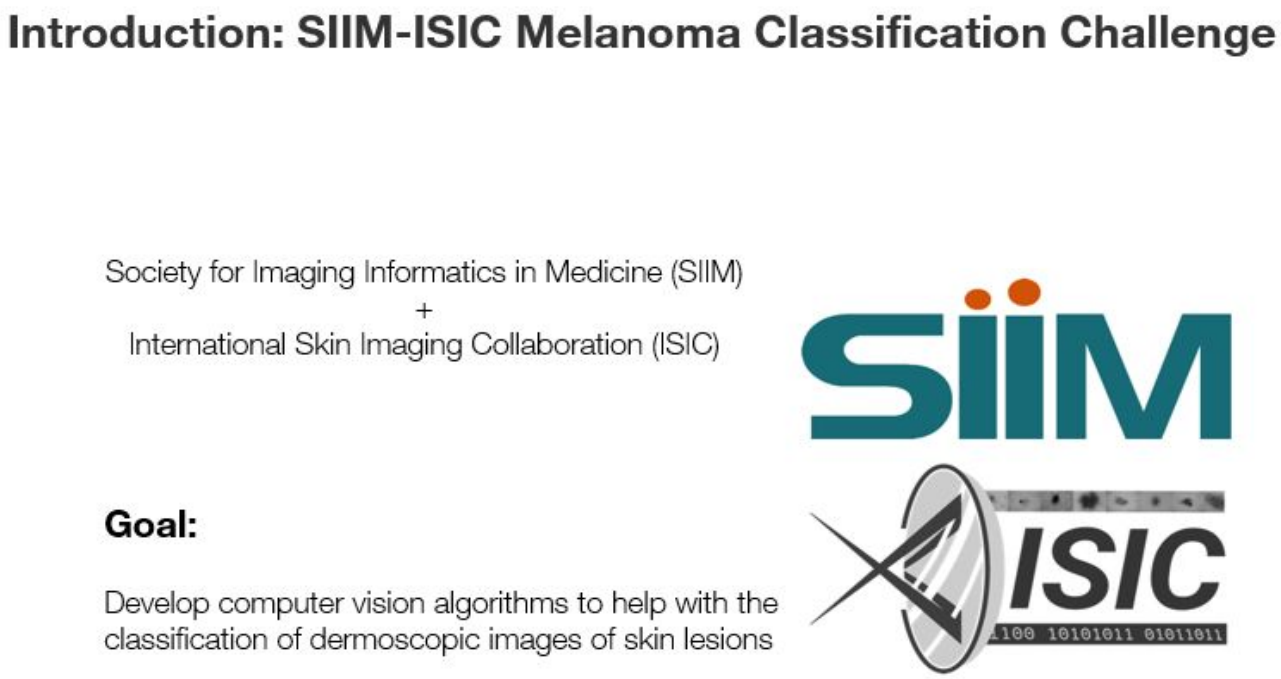
- 5 Groups of 4 students (max. 20 students)
- Weekly meeting with your supervisor

Example: (Previous semester)

ID	Project	Tutor
	Dissection of Covid-19 Prediction Models	Ashkan, Seong Tae
	Interpreting Covid-19 Prediction Models using Information Bottleneck	Ashkan, Seong Tae
	AutoML? in Federated Learning	Azade, Yousef
	Unsupervised multimodal image registration using generative networks between imbalanced domains	Farid
	Brain signal analysis using graph convolutional networks	Anees, Shahrooz

Examples of Projects in Previous Semester

EfficientNet with Robust Training: MICCAI ISIC challenge



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

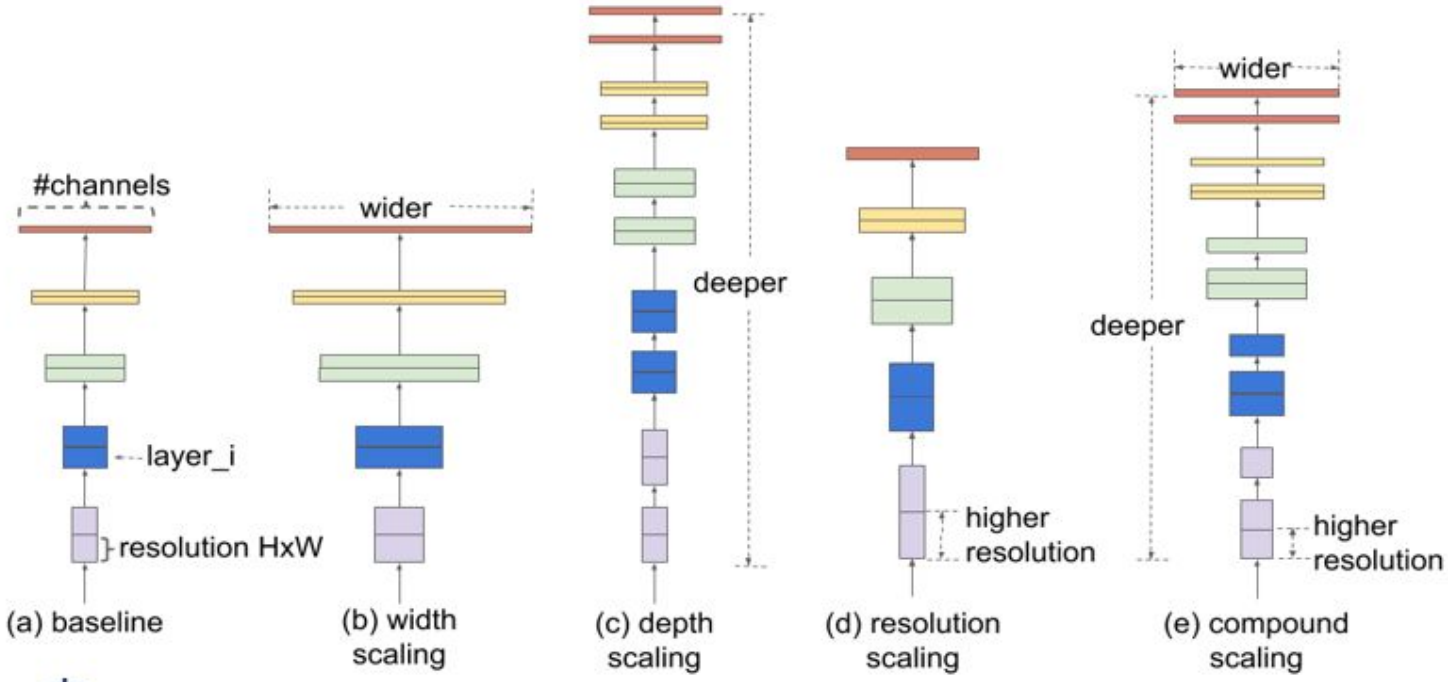
malignant

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

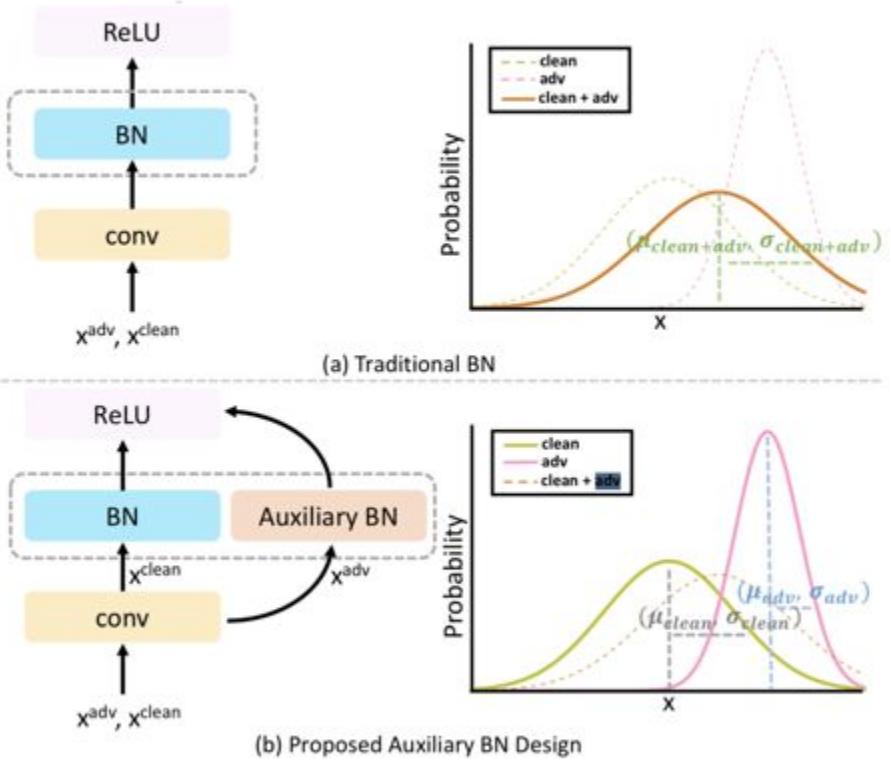


[2] Tan, M. and Le, Q.V., 2019. Efficientnet: Rethinking model scaling for convolutional neural networks. ICML

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[4] for learning better augmentations

- Using Data Augmentations increase performance but finding proper set of augmentations requires expertise and domain knowledge

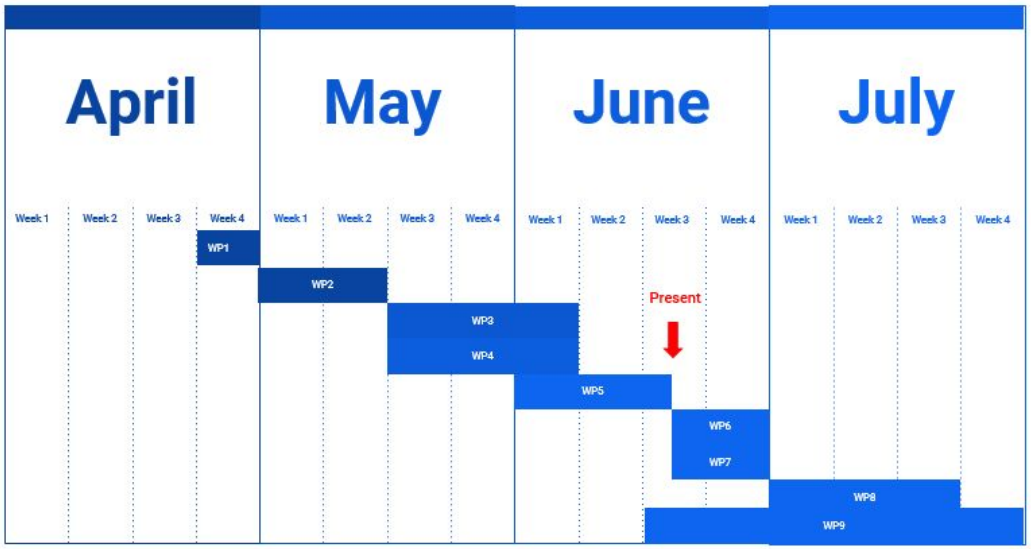
- Learning policies for choosing data augmentations on a proxy (smaller) task (AutoAugment)[7] is not always scalable to the task at hand.

- **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 2 Understanding the EfficientNet

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

WP 3 Understanding and Implementation of Adversarial Propagation

WP 4 Understanding and Implementation of RandAugment

WP 5 Familiar with clinical data (challenge dataset)

- Implementing data reading
- Data pre-processing

WP 6 Implement and evaluate WP3 on challenge dataset

- Adversarial Propagation

WP 7 Implement and Evaluate WP4 on challenge dataset

- Rand Augment

WP 8 Evaluation on validation set

- Optimization of models

WP 9 Challenge Submission

- Test set results
- Documentation

Evaluation

Project: 100%

- **Progress: 50%**
  - 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: 50%**
  - 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 (on course webpage)

MLMI Registration

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: 20.07.2020, 11:59 pm

Important Dates

Deadline for submitting the registration form:

20.07.2020, 11:59 pm

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

https://wiki.tum.de/display/mlmi/MLMI%3A+Summer+2021

Don’t forget to register at TUM matching system

Register via matching.in.tum.de

15.07 to 20.07