



Chair for Computer Aided Medical Procedures (CAMP)
Master Seminar on
Deep Learning for Medical Applications

Slides by:

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Chair for Computer Aided Medical Procedures & Augmented Reality



Team



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Course Regulations



Basic Info about the course

- **Type:** Master Seminar (IN2107)
- **Language:** English
- **SWS:** 2
- **ECTS:** 5 Credits
- **Webpage:**
 - <http://campar.in.tum.de/Chair/TeachingSs20DLMA> (files are password-protected)
- **Time:**
 - Thursdays, 12:30-14:30
- **Location:**
 - CAMP Seminar Room (03.13.010)
- **Requirements:**
 - Background in Machine/Deep Learning methods.



Objective

- Learn through **read, understand, present, and discuss** many challenges present in Medical Applications of Deep learning:
 - Understanding and Interpreting Predictive Models → Interpretable ML
 - Handling few amount of labeled data → Transfer Learning, Semi-/Weakly- Supervised Learning, Meta-Learning
 - Handling class Imbalance → Special loss functions
 - Handling Multi-Modal Data → Graph Convolutional Networks
 - Handling Intra/Inter-Scanners Variability → Domain Adaptation
 - Incorporating Prior Knowledge → Shape Models/Geometric Constraints
 - Uncertainty of Predictive Models
 - Deep Generative Models
 - Security of Predictive Models → Adversarial examples
 - ...



Discussed Papers Examples

Topic	No	Title	Conference/Journal
Supervised Learning	1	Cardiac Phase Detection in Echocardiograms with Densely Gated Recurrent Neural Networks and Global Extrema Loss	TMI
	2	Fully Convolutional Architectures for Multiclass Segmentation in Chest Radiographs	TMI
	3	Task-Agnostic Meta-Learning for Few-Shot Learning	CVPR
Self/Semi/Weakly Supervised Learning	4	Collaborative Learning of Semi-Supervised Segmentation and Classification for Medical Images	CVPR
	5	Self-supervised learning for medical image analysis using image context restoration	MedIA
	6	FickleNet Weakly and Semi Supervised Semantic Image Segmentation Using Stochastic Inference	CVPR
Interpretable ML (Session 1)	7	Explainable cardiac pathology classification on cine MRI with motion characterization by semi-supervised learning of apparent flow	MedIA
	8	Visual Explanation by Interpretation: Improving Visual Feedback Capabilities of Deep Neural Networks	ICLR
	9	Interpretability Beyond Feature Attribution: Quantitative Testing with Concept Activation Vectors (TCAV)	ICML
Interpretable ML (Session 2)	10	Disentangled representation learning in cardiac image analysis	MedIA
	11	Understanding Impacts of High-Order Loss Approximations and Features in Deep Learning Interpretation	ICML
	12	This Looks Like That: Deep Learning for Interpretable Image Recognition	NeurIPS
	13	Are Disentangled Representations Helpful for Abstract Visual Reasoning?	NeurIPS
Misc. Topics: Domain adaptation - Uncertainty	14	Unsupervised domain adaptation for medical imaging segmentation with self-ensembling	NeuroImage
	15	Transfusion: Understanding Transfer Learning for Medical Imaging	NeurIPS
	16	Learning From Noisy Labels By Regularized Estimation Of Annotator Confusion	CVPR
	17	Can You Trust Your Model's Uncertainty? Evaluating Predictive Uncertainty Under Dataset Shift	NeurIPS
Misc. Topics: Meta Learning - Graph Convolutions	18	Learning to Learn How to Learn: Self-Adaptive Visual Navigation Using Meta-Learning	CVPR
	19	Automatic multi-organ segmentation on abdominal ct with dense v-networks	TMI
	20	Exploiting Edge Features in Graph Neural Networks	CVPR
Spatio-Temporal Learning	21	Prediction of Disease Progression in Multiple Sclerosis Patients using Deep Learning Analysis of MRI Data	MIDL
	22	Predicting Alzheimer's disease progression using multi-modal deep learning approach	Nature



Conferences & Journals

- MICCAI: Medical Image Computing and Computer Assisted Intervention
- CVPR: Conference on Computer Vision and Pattern Recognition
- ICLR: International Conference on Learning Representations
- ICML: International Conference on Machine Learning
- Nature: world's leading multidisciplinary science journal
- ECCV/ICCV: European/International Conference on Computer Vision
- TMI: IEEE Transaction on Medical Imaging
- MedIA: Medical Image Analysis (Elsevier)
- TPAMI: IEEE Transactions on Pattern Analysis and Machine Intelligence
- BMVC: British Machine Vision Conference
- MIDL: Medical Imaging with Deep Learning
- NeurIPS: Neural Information Processing Systems



Schedule

Tentative

Date	Session: Topic	Slides	Students
30.01.2020	Preliminary Meeting		
Online	Paper Assignment		
23.04.2020	No Class		
30.04.2020	No Class		
07.05.2020	Presentation Session 1: Supervised and Unsupervised Learning		
14.05.2020	Presentation Session 2: Semi/Weakly/Webly-Supervised Learning		
28.05.2020	Presentation Session 3: Interpretability of Deep Learning Models		
04.06.2020	Presentation Session 4: Deep Generative Models		
18.06.2020	Presentation Session 5: Selected topics (Domain Adaptation / Meta Learning / Uncertainty)		
25.06.2020	Tentative		
02.07.2020	No Class		
09.07.2020	No Class		



Evaluation

Presentation 45%

- 20 minutes + 10 minutes Q&A
- Slides (Powerpoint, Latex, see website for templates)
- They should cover all relevant aspects of the paper
 - Motivation
 - Methodology
 - Experimental results
 - Take Home Message
 - Discussion
- Self-contained (review of state of the art is necessary!)
- Presentation guidelines will be released later.
- **All students are expected to attend all presentations and interact during Q&A**



Evaluation

Blog Post (45%)

- Blog post explaining the main ideas of the paper.
 - Motivation + Contributions (25%)
 - Methodology (50%)
 - Results & Discussion (25%)
- You can refer to <https://bair.berkeley.edu/blog/> to get ideas for how a quality blog post summarising a paper should look like.
- Students will be requested to comment on each other's blog posts.
- The website where the posts will be uploaded is [1].
- You can later privately share your blog posts in other websites as well (eg Medium).

Attendance (10%)



[1] <https://wiki.tum.de/display/dlma/>

How can you apply?

- Send us a motivation e-mail with the title “**DLMA_Application**”
- Send the e-mail to: dlma@mailnavab.informatik.tu-muenchen.de
- **Template** for e-mail:
 - Name:
 - Master's program:
 - Current Semester:
 - Related courses (if passed, mention the grade):
 - Short Motivation (**Max 3 sentences**. It should include related projects/ publications/competitions/github repositories):

Deadline for motivation e-mails: 12.02.2020, 11:59 pm



Important Dates

Deadline for motivation e-mails:

12.02.2020, 11:59 pm

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

<http://campar.in.tum.de/Chair/TeachingSs20DLMA>

Don't forget to register at TUM matching system

Register via matching.in.tum.de

07.02 to 12.02.2020

