



International Center

TUM Practical Research Experience Program (TUM PREP)

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PREP student in the lab (Image: Benz/TUM)

Project Overview		Project Code: IN 07	
Project name	Uncertainty in Deep Learning Model of Proximal Femur Fractures		
TUM Department	Computer Science/ Informatics		
TUM Chair / Institute	I16, Computer Aided Medical Procedures		
Research area	Machine Learning, Deep Learning, Medical Applications		
Student target group (departments, disciplines)	Computer Science, Electrical and Computer Engineering, Biomedical Engineering		
Project supervisor(s) – Name	Prof. Dr. Nassir Navab, Dr. Shadi Albarqouni		
Project supervisor(s) – Contact Details	E-mail:	Nassir.navab@tum.de Shadi.albarqouni@tum.de	Phone: +49 89 289 19405



Project Description

Fracture of the human skeleton, especially of the long bones, are among the most common reasons why patients visit the emergency room. Initial diagnostics include X-rays of the affected bone, mostly from two orthogonal projections. X-rays are evaluated then by either expert radiologists and/or trauma surgeons for the classification of the fracture, resulting in different treatment options.

Accurate fracture classification requires years of experience, as reflected by the reported inter-observer variability, which is as low as 66% for residents and 71% for experts. The aim of our project is, therefore, to predict the fracture type on the basis of digital radiographs to assist physicians especially young residents and medical students. We primarily focus on predicting fracture type of the proximal femur according to the AO classification, for which a good reproducibility was published.

Task #1: The student is kindly asked to develop a predictive model based on the DenseNet architecture [1] and compare it with our previous baseline model [2].

Task #2: Model the uncertainty using the recently proposed Monte-Carlo Dropout [3] in both baseline and developed models to report the uncertainty in predictive classes.

[1] Huang, G., Liu, Z., Van Der Maaten, L. and Weinberger, K.Q., 2017, July. Densely Connected Convolutional Networks. In *CVPR* (Vol. 1, No. 2, p. 3).

[2] Kazi, A., Albarqouni, S., Sanchez, A.J., Kirchhoff, S., Biberthaler, P., Navab, N. and Mateus, D., 2017, September. Automatic Classification of Proximal Femur Fractures Based on Attention Models. In *International Workshop on Machine Learning in Medical Imaging* (pp. 70-78). Springer, Cham.

[3] Gal, Y. and Ghahramani, Z., 2016, June. Dropout as a Bayesian approximation: Representing model uncertainty in deep learning. In *international conference on machine learning* (pp. 1050-1059).

Working hours per week planned (Mon-Fri, max. 40 hrs.)	40 hrs.
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Prerequisites

Level (at the time of arrival)	<input type="checkbox"/> Undergraduate (3 rd Year)	<input checked="" type="checkbox"/> Senior Undergraduate (4 th Year) or Graduate	<input type="checkbox"/> Both
Prerequisites – Subject-related	Firm knowledge of Machine/Deep Learning Good programming skills Python, Scikit-learn, Pytorch and/or Tensorflow Practical Experience with ML/DL techniques.		