SYLLABUS WINTER SCHOOL 2017

FOCUS ON COMPUTER SCIENCE, INFORMATION TECHNOLOGY AND ELECTRICAL ENGINEERING

1. Facts and figures

Main emphasis: Computer science, electrical engineering and information technology

Duration: January 23rd – February 12th 2017

Course language: English

Academic supervisor: Prof. Bernd Radig, TUM´s Emeritus of Excellence

Credits: Technical workshops, lectures, seminars: 4 ECTS credits

German language course: 2 ECTS credits

2. Program description

The three-week program at the Technical University of Munich is delivered in English and introduces students to the latest breakthroughs in electrical engineering, computer science and information technology. The program combines a series of lectures held by outstanding scientists of TUM with guest speakers from industry. As part of a group of young students, they are given the opportunity to familiarize themselves with current trends in German research and exchange experience with fellow participants. Study of the German language, cultural immersion in everyday life in Germany and visits to high-tech locations in and around Munich (e.g. Siemens, BMW or Audi) round off the program.

3. Workshops and lectures (may be subject to changes):

3.1 Technical components

Topics: The lectures and workshops deal with the following research topics:

- Model-Based Image Interpretation
- Objective Functions, Learning Objective Functions
- Face Detection, Face Model Fitting, Head Tracking
- Facial Expression Recognition, Emotion Recognition
- Person Localization, Person Tracking
- Driver Assistant Systems
- Multi-Robot Coordination
- Artificial Intelligence
- Big data
- IT-Security
- Autonomous systems

Required texts: Course-packet provided in class

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Course goals
This course will introduce students to the rapidly developing field of computer sciences, electrical engineering and information technology.

Participants will be offered:

- Visits to laboratories (e.g. robotics laboratories)
- Insights into current research projects at TUM (e.g. "Cognition for Technical Systems" CoTeSys)
- Industry excursions to production locations such as BMW or KUKA Robotics

The course is expected to appeal to students from the relevant fields with a strong interest in the mentioned research fields. The scientific lecture will consist of 50-60 total lecture hours.

Prerequisites:
Students should have completed the first year of their Bechelor´s study.

Detailed course topics (changes may occur):

Autonomous Systems: A Machine Learning Perspective

This workshop focuses on the topic of autonomous systems, a technological trend to the future. General concepts and some state of the arts research are introduced from a machine learning perspective. Some concrete concepts of reinforcement learning will be particularly articulated and demonstrated. Furthermore, some current efforts towards the subject at the Technische Universität München, including both teaching and research, will be also introduced.

Business models for inner-city mobility services

Urbanization is one of the megatrends of our time. In 2050, more than 70% of the world population will live in cities. In order to face this growth, new concepts for inner-city mobility are necessary. The aim of this workshop is to develop ideas and business models for inner-city mobility services. First, students brainstorm on possible problems of city mobility and are then introduced to the concepts of crowdsourcing and smart city. Afterwards, they form groups and try to identify further problems based on their cultural background. The idea of a collaborative mobility data platform is presented to the students and then, they are encouraged to develop ideas and business models how

these problems of city mobility could be solved through services that are provided by such a platform.

Technical guided tour at Deutsches Museum with a special focus on Computer science

The technical guided tour at Deutsches Museum, the world's largest museum of technology and science, is structured around a thematic priority, Computers and Microelectronics, and serves to illuminate specific exhibits and sections in the museum related to this topic. As part of the cultural program, it complements the workshops.

Supercomputing

This workshop gives an introduction to the architecture and programming of supercomputers. It will explain why supercomputing is needed and discusses areas of application. It gives an introduction to the architecture of supercomputers and to the current research projects at the Institute for Supercomputing. The workshop is complemented with a tour at the Leibniz Supercomputing Center which provides IT services to the academic and scientific communities in Munich.

Munich Center for Technology in Society

During a workshop students will be introduced to the current research at Munich Center for the Technology in Society and they will be given an overview about how the various technologies influence our societies.

Project “Mudis”:

Since existing methods for human-machine interaction are often unintuitive, a lot of time is required for humans to adapt to the operation of a specific machine. In contrast, the MuDiS project aims at granting machines the ability to adapt to typical human behavior. The goal of the project is the development of a multimodal dialog system that considers various human communication channels such as facial expressions, spoken language and gestures for human-machine interaction. We perform experiments to determine the requirements for robots to interact with humans in an intuitive way. Insights gained from these human-human experiments are applied to the human-machine interface to grant robots the capability of participating in simple, every-day dialogs in various environments. To tackle this challenge, we unite researchers from diverse scientific areas, such as computer science, electrical engineering and psychology to reflect the interdisciplinary character of the project.

Project: Face Image Analysis:

As robots emerge from their classical domain - factories - to be included in every day life, they need to gain new abilities besides those needed in manufacturing. They need not only to support humans, but also be able to socialize with their users to enhance the interactant experience and allow for social bonding. Recent progress in the field of Computer Vision allows intuitive interaction via gesture or facial expressions between humans and technical systems. Recent research aims at enabling machines to utilize communication channels natural to human beings, such as gesture or facial expressions. Humans interpret emotion from video and audio information and heavily rely on this information during every-day communication. Therefore, knowledge about human behavior, intention, and emotion is necessary to construct convenient human-machine interaction mechanisms. The human face provides much of the information that is passed between humans in every-day communication. Although most of this information is passed on a subconscious level, we still rely on the interaction partner's facial expression to determine emotional state or attention to form a prediction of his or her reaction.

Project: CoTeSys

How must technical systems be equipped to have abilities, similar to those of humans, in order to learn from observations and realize their environment? How can a robot interact with persons and objects and adapt to unknown situations? These challenging scientific questions are investigated in CoTeSys. The Cluster of Excellence coordinated by Technische Universität München is a close collaboration between scientists from various disciplines connecting neurocognitive and neuro-biological foundations to engineering sciences at leading research institutions in Munich: besides Technische Universität München, scientists from Ludwig-Maximilians-Universität München, Universität der Bundeswehr, Max-Planck Institute of Neurobiology and German Aerospace Agency DLR are involved.

CoTeSys investigates cognition for technical systems such as vehicles, robots, and factories. Cognitive technical systems are equipped with artificial sensors and actuators, integrated and embedded into physical systems, and act in a physical world. They differ from other technical systems in that they perform cognitive control and have cognitive capabilities. By cognitive capabilities we mean information processing algorithms such as perception, attention, memory, action, learning, and planning. The aim of CoTeSys is to get technical systems that "know what they are doing" - so to speak.

3.2 German language course

Course title: German language and culture

Catalog description: The ability to use German for communicative purposes provides students with a greater access to German culture. A comfortable working knowledge of German and a familiarity with German culture prepare the students for an increasingly international working environment.

Required texts: text books provided in class.

Course goals: German language

The intensive language course includes a total of about 35 lecture hours. In addition to the language, the participants get insight into German culture. In the beginning of the course, the students take a placement test, according to which they will be placed in the right level.

In the beginners' language course **(Elementary I/ - A1/1**), students learn to communicate in basic German about topics such as introducing themselves, talking about their families and their home country, as well as their studies and hobbies. They also learn to read short authentic texts in German from newspapers and books and to write e-mails. They learn to understand and use familiar everyday expressions and very basic phrases aimed at the satisfaction of needs of a concrete type.

More advanced learners (**Elementary II - A1/2)** are trained to participate in discussions about topics of their choice and to read longer news articles. They deepen their knowledge of the German grammar and learn to write texts about different topics. They are introduced to German culture, history and everyday life by reading and discussing these topics. They practice to introduce themselves and others and to ask and answer questions about personal details such as where you live, people they know and things they have. They learn to interact in a simple way provided the other person talks slowly and clearly and is prepared to help.

Depending on the knowledge of the participants, we will offer more advanced levels as well.

Prerequisites:
none

Homework assignments: written assignments and articles for course diary

Grades:
Written and oral exam
Participation

Course objectives:
Depending on the course level, s/he should be able to e.g.:

Level A1

- understand and use familiar everyday expressions and very basic phrases aimed at the satisfaction of needs of a concrete topic.

- introduce him/herself and others and ask and answer questions about personal details such as where he/she lives, people he/she knows and things he/she has.

- interact in a simple way provided the other person talks slowly and clearly and is prepared to help

4. Class Schedule/Hours per Day:

Workshops, seminars, lab and on-site visits in the field of: computer science, electrical engineering and information technology
4 hours per day, a total of approximately 60 hours tuition, worth 4 credits, ECTS

An intensive German language course
2,5 hours per day, a total of approximately 35 hours tuition, worth 2 credits ECTS

5. Course examination requirements to obtain credits

Workshops:
Course attendance, participation, final test

Language Class:
Course attendance, participation in class, presentations, final tests (midterm and end term), homework