Master technology, create technology
Toyohashi Tech

Last updated in November 2024

Course description at Toyohashi University of Technology
- 3rd semester -

■ Compulsory Courses

Ethics for Researchers (2 ECTS)

Course instructor: e-learning and Supervisors at TUT

Aims:

To support graduate students in their research activities and to promote understanding of the ethical problems involved; to lead students to independent thinking and normative awareness of research ethics through ethics education in research, in accordance with the goals of scientific education and research and the characteristics of individual research specialties.

Content:

1st - 6th week: Modules in e-learning
- Research Misconduct
- Ethical Issues in the Management of Data in Engineering Research
- Responsible Authorship
- Ethical Issues in the Peer Review and Publication of Engineering Research
- Collaborative Research in Engineering Fields
- Whistleblowing and the Obligation to Protect the Public
- Managing Public Research Funds

After completing the e-learning course, students must submit the e-learning Certificate.
7th week: Discussion with the supervisor
8th week: Report writing

Link:

https://kyomu.office.tut.ac.jp/Portal/Public/Syllabus/DetailMain.aspx?lct_year=2024&lct_cd=D5002001c&je_cd=1

Japanese Communication Theory (4 ECTS)
(Non-TUT students)

Course instructor: Chikako Ishikawa

Aims: The purpose of this course is to learn new Japanese grammar/expression and how to use them to communicate with Japanese people in Japanese. After having successfully taken this course, the student can give a presentation in Japanese.

Content :

1. Introduction
2. Lesson 1 Review of Vocabulary, Grammar and Conversation
3. Lesson 2 Review of Vocabulary, Grammar and Conversation
4. Lesson 3 Review of Vocabulary, Grammar and Conversation
5. Lesson 4 Review of Vocabulary, Grammar and Conversation
6. Lesson 5 Review of Vocabulary, Grammar and Conversation
7. Lesson 6 Review of Vocabulary, Grammar and Conversation
8. Presentation & Discussion
9. Lesson 7 Review of Vocabulary, Grammar and Conversation

10. Lesson 8 Review of Vocabulary, Grammar and Conversation
11. Lesson 9 Review of Vocabulary, Grammar and Conversation
12. Lesson 10 Review of Vocabulary, Grammar and Conversation
13. Lesson 11 Review of Vocabulary, Grammar and Conversation
14. Lesson 12 Review of Vocabulary, Grammar and Conversation
15. Lesson General review
16. Exam (Presentation & Discussion)

Course material:

GENKI Ⅱ: An Integrated Course in Elementary Japanese Vol.2 [Third Edition]
初級日本語げんきⅡ[第 3 版] (Japanese Edition), Japan Times, ISBN: 978-4-7890-1732-9

Amazon:
https://www.amazon.com/GENKI-Integrated-Course-Elementary-Japanese-ebook/dp/B08L5W9B88/ref=sr_1_7?dchild=1&keywords=genki&qid=1626082661&s=digital-text&sr=1-7

Amazon Japan:
https://www.amazon.co.jp/GENKI-Integrated-Elementary-Japanese-%E5%88%9D%E7%B4%9A%E6%97%A5%E6%9C%AC%E8%AA%9E%E3%81%92%E3%82%93%E3%81%8D/dp/478901732X/ref=sr_1_2?__mk_ja_JP=%E3%82%AB%E3%82%BF%E3%82%AB%E3%83%8A&crid=38TCUMJ8MH8ZZ&dchild=1&keywords=%E3%81%92%

Link:
https://kyomu.office.tut.ac.jp/Portal/Public/Syllabus/DetailMain.aspx?lct_year=2024&lct_cd=M40030110&je_cd=1

Data Science and Analysis (4 ECTS)

1st quarter

Course instructor: Assoc. Prof. Tomoyoshi Akiba

Aims:

Important topics on statistical natural language processing will be discussed by focusing on statistical machine translation.

Content:

1. Introduction
2. Lecture (Basic of Probability and Statistics, Recent Trends in Machine Translation)
3. Presentation & Discussion (Statistical Method for Machine Translation)
4. Presentation & Discussion (Language Models)
5. Presentation & Discussion (Translation Models)
6. Presentation & Discussion (Parameter Estimation)
7. Presentation & Discussion (EM Algorithm)
8. Presentation & Discussion (Advanced methods in SMT)

Link:

https://kyomu.office.tut.ac.jp/Portal/Public/Syllabus/SyllabusSearchStart.aspx?lct_year=2024&lct_cd=M43610080&je_cd=1

2nd quarter

Course instructor: Assoc. Prof. Michele Dall'Arno

Aims:

The course will provide an introduction to selected topics in classical and quantum data science, specifically

Bayesian inference, decision theory, and statistical sufficiency. Alongside standard applications such as classical and quantum hypothesis testing, the guesswork with classical side information, Blackwell theorem, and the Alberti-Ulhmann criterion, the course will showcase results that are at the forefront of current research, such as the Bayesian inference of quantum measurements and the guesswork with quantum side information. Numerous examples and exercises, including research projects, will complement the discussion.

Content:

1. Introduction: from classical probability distributions to quantum density matrices
2. Bayesian inference I: Occam's razor and clustering
3. Bayesian Inference II: inference of quantum measurements and John's minimum volume enclosing ellipsoids
4. Decision theory I: classical and quantum hypothesis testing
5. Decision theory II: guesswork with classical and quantum side information
6. Statistical sufficiency I: Blackwell theorem
7. Statistical sufficiency II: Alberti-Ulhmann criterion
8. Exam

Link:
https://kyomu.office.tut.ac.jp/Portal/Public/Syllabus/SyllabusSearchStart.aspx?lct_year=2024&lct_cd=M43610090&je_cd=1

Advanced Research Methods (4 ECTS)

Course instructor: Supervisors at TUT (literature review at lab)

Aims:

The course is intended for students to study basic materials in depth, related to his/her research topics through the lab works. It is also aimed for students to acquire various skills, required in general research work, such as those for literature review, oral presentation, and technical discussion and writing.

Content:

While specific contents depend on the research topics students are involved in, it is usually the case for students to read relevant textbooks/research papers and report on them, as well as to present and discuss on the research work of their own.

Link:
https://kyomu.office.tut.ac.jp/Portal/Public/Syllabus/SyllabusSearchStart.aspx?lct_year=2024&lct_cd=M43610070&je_cd=1

Case Study in Imaging and Light and XR (8 ECTS)

Course instructor: Supervisors at TUT (project work at Laboratory)

Aims:

As a stepping stone to a Master's research, a preliminary project involving measurement experiments or system development is carried out under the supervision of a supervisor. After a necessary and sufficient survey of the relevant research, students define the research question, consider the appropriate research methods, and discuss the impact of the results obtained. A presentation opportunity is given at the end of the semester to exchange the ideas among other students and supervisors. Master's research may be carried out by improving/expanding the project.

Content:

The project theme is initially presented as a candidate by the supervisors and is finally decided through discussion with the students.

Link:
https://kyomu.office.tut.ac.jp/Portal/Public/Syllabus/DetailMain.aspx?lct_year=2024&lct_cd=M43610060&je_cd=1

■ Elective Courses

Note: From starting with 2025 intake, students are able to choose 8ECTS from the following 4 classes. This change is due to the integration of lighting and Imaging courses from 2025 onwards.

Human Sensation & Perception (4 ECTS)

1st quarter
Course instructor: Prof. Shigeki Nakauchi
Aims:
1st quarter of this course is designed to introduce students to the scientific study of human nature. Students will learn why and how scientists ask question about the sensation and perception and the relation of brain and behavior. Students will also learn about the research methods to measure the perception and cognition used in the field of psychology and cognitive science. Finally, students will be able to create their own experiments using the '*OpenSesame*', worldwide well-known software for creating experiments for psychology, cognitive science, neuroscience and experimental economics.

Content:
1. Introduction to "Science of Human Sensation and Perception" 1
2. Introduction to "Science of Human Sensation and Perception" 2
3. Measuring Perception – research methodology 1
4. Measuring Perception – research methodology 2
5. Workshop for creating experiments using "OpenSesame"
6. Perform experiment and analyze your own data
7. Perform experiment and analyze your own data
8. Wrap up the course

Link:
https://kyomu.office.tut.ac.jp/Portal/Public/Syllabus/SyllabusSearchStart.aspx?lct_year=2024&lct_cd=M23620090&je_cd=1

2nd quarter
Course instructor: Assoc. Prof. Kowa Koida
Aims:
After the course, students will be able to understand the structure and function of the sensory systems and how sensation and perception work together to help us to guide our behavior. Students will be able to utilize psychophysical methods to measure the perception, and data analysis theory as well.

Content:
1. Visual sensor
2. Auditory sensor
3. Tactile and chemical sensors

4. Cognition and brain function
5. Behavior
6. Reading Kandel, chapter 1
7. Reading Kandel, chapter 2

Link:
https://kyomu.office.tut.ac.jp/Portal/Public/Syllabus/SyllabusSearchStart.aspx?lct_year=2024&lct_cd=M23630370&je_cd=1

X Reality and Psychology (4 ECTS)

1st quarter
Course instructor: Prof. Michiteru Kitazaki
Aims:
Upon completion of the course, students will demonstrate an understanding of the principles of X reality (cross reality or extended reality: XR), including Virtual Reality (VR), Mixed Reality (MR), and Augmented Reality (AR), at the psychological, physiological, and functional levels. Additionally, they will be able to evaluate the potential benefits and challenges of VR/MR/AR/XR on future societies.

Content:
X Reality including Virtual Reality, Mixed Reality, and Augmented Reality will be explained about its mechanisms and functions not only in the engineering perspective but also psychological perspective. The final part of the class is composed of students' presentations of their original application, device or idea on X Reality and the discussion on it.

1. Introduction to XR and Psychology
2. Two Components of Reality
3. Virtual Reality, Mixed Reality, and Augmented Reality
4. Multi- and Cross-modality Phenomena
5. Embodied Cognition and the Augmented Human
6. Exploring Cyberspace
7. Student Presentations and Discussion
8. Student Presentations and Discussion

Link:
https://kyomu.office.tut.ac.jp/Portal/Public/Syllabus/SyllabusSearchStart.aspx?lct_year=2024&lct_cd=M23630360&je_cd=1

2nd quarter
Course instructor: Prof. Tetsuto Minami / Assoc. Prof. Kazumasa Uehara

Aims:
After the course, students will understand the principles of virtual reality (VR), mixed reality (MR), augmented reality (AR), and X reality (cross reality: XR), on psychological, physiological, and functional levels. They will also be able to understand the benefits and challenges of VR/MR/AR/XR on the future society.

Content:
1. Introduction
2. Methods of X Reality and Psychology
3. Sensation and perception
4. Object recognition
5. Sensorimotor control

6. Emotion
7. EEG
8. EEG analysis

Link:
https://kyomu.office.tut.ac.jp/Portal/Public/Syllabus/SyllabusSearchStart.aspx?lct_year=2024&lct_cd=M23630400&je_cd=1

Robotic Perception and Human-Robot Interaction (4 ECTS)

1st quarter
Course instructor: Prof. Jun Miura
Aims:
Fundamental and advanced issues in intelligent robotics will be discussed. Topics included are: statistical sensor fusion with Bayes filters, object tracking and identification, robotic mapping and localization, observation planning, human detection and identification, and task-oriented human-robot interaction.
Content:
1. Introduction, probability basics, and sensor fusion by Bayesian inference
2. Object tracking by Bayesian filters
3. Mobile robot localization
4. Mapping and SLAM (simultaneous localization and mapping)
5. Observation planning
6. Human detection and identification
7. Task-oriented human-robot interaction
8. Presentation of assignment

Link:
https://kyomu.office.tut.ac.jp/Portal/Public/Syllabus/DetailMain.aspx?lct_year=2024&lct_cd=M43630480&je_cd=1

2nd quarter
Course instructor: Assoc. Prof. Ren Omura
Aims:
The aim of this course is to utilize tools and platforms to construct human-robot affective communication in a real-world scenario.

Content:
1: Building interactive sociable robots of the future
2-3: Real-time multimodal processing for constructing sociable robot's conversation system
4: Network services for sociable robot manipulation
5: 3D robot printing technology
6-8: Final assignment (project work: proposing and prototyping sociable robots of the future), evaluation and review

Link:
https://kyomu.office.tut.ac.jp/Portal/Public/Syllabus/DetailMain.aspx?lct_year=2024&lct_cd=M23630410&je_cd=1

3D Vision Computation (4 ECTS)

1st quarter
Course instructor: Assoc. Prof. Yasushi Kanazawa

Aims:
This course involves fundamentals and advanced issues on 3D reconstruction from images based on geometry.
Content:
1. Introduction and Projective Geometry
2. Epipolar Geometry
3. 3D reconstruction from Two Views
4. Affine Projection
5. Uncalibrated Stereo
6. Structure from Motion
7. Robust Estimation in Computer Vision
8. Presentation and Discussion

Link:
https://kyomu.office.tut.ac.jp/Portal/Public/Syllabus/SyllabusSearchStart.aspx?lct_year=2024&lct_cd=M2362 0170&je_cd=1

2nd quarter
Course instructor: Assoc. Prof. Yasuyuki Sugaya
Aims:
This course will introduce camera calibration methods and AR applications with various markers, including a famous AR marker, a circular marker, and natural points and lines features. Students develop an AR application based on the studied knowledge and discuss the performance of it.
Content:
1. Introduction and camera projection
2. Fundamental of camera calibration
3. AR applications
4. Camera pose estimation by a rectangular marker
5. Camera pose estimation by a circular maker
6-1. Experiment and discussion
6-2. Camera pose estimation by 2-D textures
7. Camera pose estimation by lines
8. Experiment and discussion

Link:
https://kyomu.office.tut.ac.jp/Portal/Public/Syllabus/SyllabusSearchStart.aspx?lct_year=2024&lct_cd=M2362 0180&je_cd=1