

Course Number: 28628

Course Name: Social and Cognitive Robotics

Course Type: Theory
Prerequisite: ---
Level: Graduate Students
Group: Applied Mechanics

Type & Max Unit: Constant 3
Corequisite: ---
First Presentation: 1400-1
Last Edition: 1400

Objectives:

Introduction to Human-Robot Interaction (HRI), artificial intelligence, and design and assessment of interventions in social robotics studies.

Topics:

1- Introduction, definitions, and basic concepts (1 week)

- Social and cognitive robots
- Human-Robot Interaction (HRI)
- Human-Robot Collaboration (HRC)
- Position, necessity, and orientation of social and cognitive robotics in Iran and the world

2- Design and interaction perspective of social and cognitive robots (1-1.5 weeks)

- Required components (hardware and software) in social and cognitive robots
- Basics of verbal, nonverbal, emotional, and face-to-face interactions for social robots
- Features of social robots (e.g. introducing Arash, RASA, Apo, Maya, Taban, Armin, and RoMa Robots, designed/fabricated in the Social and Cognitive Robotics Lab., Sharif University of Technology).

3- Cognitive architectures in the field of social and cognitive robotics (1-1.5 weeks)

4- Artificial intelligence in social and cognitive robotics (9 weeks)

- Implementing a gaze control and proximity system on a social robot in multi-person interactions (based on social cues)
- Convolutional Neural Networks (CNN) (with the applications in image processing, users' facial expressions recognition, and time series analysis)
- Long Short-Term Memory (LSTM) (with the applications in speech recognition, videos, and time series analysis)
- Learning from Demonstration (LfD) in social robots
- Adaptive teaching/rehabilitation in social robots

5- Designing human-robot interactions, evaluating interventions, and applications (4 weeks)

- Designing human-robot interactions in social robotics studies (research questions and hypotheses, participants, experimental setup, Wizard of Oz, data collection, ethical considerations, consent forms, etc.)
- Statistical tools needed to evaluate interventions (questionnaires, t-test, analysis of variance, non-parametric tests, etc.)
- Applications of using social robots (in various fields of education, rehabilitation, entertainment, etc. for typically developing people and individuals with special needs).

6- Other topics (if there is time):

- Comparison of fictional and real social and cognitive robots
- Ethics in robotics (RoboEthics)
- Virtual Reality Robots systems
- The future of robotics and the social needs ahead

References:

1. Bartneck, C., Belpaeme, T., Eyssel, F., Kanda, T., Keijsers, M., & Šabanović, S. (2020). **Human-robot interaction: An introduction**. Cambridge University Press.
2. Samani, H. (Ed.). (2015). **Cognitive robotics**. CRC Press.
3. Kanda, T., & Ishiguro, H. (2017). **Human-robot interaction in social robotics**. CRC Press.
4. Nørskov, M. (2017). **Social robots: boundaries, potential, challenges**. Taylor & Francis.
5. Goodfellow, I., Bengio, Y., & Courville, A. (2016). **Deep learning**. MIT press.
6. Calinon, S. (2018). **Robot learning with task-parameterized generative models**. In Robotics Research (pp. 111-126). Springer, Cham.