1. **AI in Robotics**

PUT:

1.1. Introduction to Robotics
1.2. Robot Operating System – software architecture and tools
1.3. Robot Operating System – robots programming
1.4. Foundations of kinematics – coordinate systems and transformations
1.5. Kinematics of robotic manipulator, Robot kinematics in practical examples
1.6. Sensors and perception of robots
1.7. Advanced robot simulation in ROS 2 with MoveIt

UEC: Fundamental Robotics and Applications (tentative)

1.8. Medical Robotics
1.9. Bio-inspired Legged Robots
1.10. Micro Electro Mechanical Systems (MEMS)
1.11. Human Robot Interface
1.12. Robotic Manipulation
1.13. Human-Robot Interaction
1.14. Environmentally Harmonized Robotics

2. **Cybersecurity**

UEC: (Prof. Yuntao WANG)

2.1. An Introduction to Post-Quantum Cryptography (PQC): Research Background and Standardization Trends
2.2. PQC Cryptographic Schemes (1): LWE-Based Cryptosystems and Ring-LWE-Based Key Exchange
2.3. PQC Cryptographic Schemes (2): CRYSTALS-Kyber and Its Mathematical Background
2.4. PQC Cryptographic Schemes (3): Lattice-based Signatures
2.5. PQC Cryptographic Analysis (1): Lattice Enumeration and Lattice Reduction Algorithms
2.6. PQC Cryptographic Analysis (2): An Overview of Lattice Sieving and G6K
2.7. PQC Cryptographic Analysis (3): Mathematical Structure of Lattice Sieving and Its Applications to 2.14 Lattice Reduction Algorithms

PUT: (Prof. Mariusz Głąbowski)

2.8. Foundations of Cybersecurity: Concepts, Threats and Defense Models
2.9. Modern Malware and Ransomware: Techniques, Analysis and Mitigation
2.10. Identity and Access Management: Authentication, Authorization and Federation
2.11. Network Security: From Firewalls and VPNs to Zero-Trust Architectures
2.12. Security of IoT, Industrial Control Systems and Critical Infrastructure
2.13. Incident Detection and Response: SOC Operations and Digital Forensics
2.14. Security Economics, Cyber Risk Management and Security Governance for Organizations

3. Hyper-connected world: Network infrastructure in HCW

PUT: Architectures and Performance Evaluation for HCW/Foundations and Network Design for HCW (Prof. Maciej Sobieraj)

3.1. Architectures of telecommunication networks in the hyper-connected world
3.2. Next-generation optical networks for HCW
3.3. Packet, wavelength switching and SDN in HCW infrastructure
3.4. Analytical performance modeling of networks in the hyper-connected world
3.5. Simulation of telecommunication and optical networks for HCW
3.6. Integration of heterogeneous access technologies in HCW
3.7. Intelligent network management and automation in the hyper-connected world

UEC: Optimization for HCW (Prof. Nattapong Kitsuwan)

3.8. Introduction and Basic problems for communication networks, algorithm for shortest path routing
3. 9. Algorithm for max flow and minimum-cost flow problems
3.10. Disjoint path routing (Edge-disjoint, Vertex-Disjoint)
3.11. Linear Programming basics and applications
3.12. Introduction to Linear Programming solving software, GLPK (GNU Linear Programming Kit)
3.13. Basic problems solved by Linear Programming
3.14. Optimization for wavelength assignment and routing, and traffic-demand model

4. Hyper-connected world: Monitoring/automation/management in HCW

PUT: (Prof. Aleksandra Wojewoda)

4.1. DevOps Fundamentals and First Steps with Git
4.2. Repository Management ~~and Cloud Platforms~~ (GitHub/GitLab)
4.3. Collaborative Workflow: Pull Requests, Labels, and Releases
4.4. Introduction to Containerization: Docker Basics
4.5. Docker in Practice: Volumes and Networking
4.6. Process Automation: CI/CD Pipelines
4.7. Application Lifecycle: Artifacts and Deployment

UEC: (Prof. Hiroki Takahashi, Prof. Lu JIN)

4.8. ...

5. Edge-cloud continuum computing

UEC: (Zhi LIU) First half of the course at PUT (3rd week September)

5.1. Session 1: Introduction (U1) - Basic concepts of optimization and an overview of the edge-cloud continuum.
5.2. Session 2: Convex Sets and Convex Functions (U2) - Mathematical foundations of optimization: Properties of convex sets and convex functions.
5.3. Session 3: Convex Optimization Problems: Basic Concepts and Examples (U3) - Fundamental concepts and formulation of various optimization problems.
5.4. Session 4: Convex Optimization Problems: Solutions and Duality (U4) - Solution processes and the theory of dual problems.
5.5. Session 5: KKT Conditions and CVX: Introduction and Programming (U5) - Understanding optimality conditions and programming using optimization tools.
5.6. Session 6: Approximation, Fitting, and Application Cases (U6) - Approximation methods and common use cases for optimization.
5.7. Session 7: Markov Decision Process (MDP) and Its Applications (U7) - Foundations and applications of dynamic decision-making models.

PUT: (Prof. Norbert Langner)

5.8. Introduction to configuration management (Ansible, bash recap)
5.9. Introduction to Containerization (Docker, Podman)
5.10. Container orchestration (Kubernetes)
5.11. Public cloud computing basics
5.12. Infrastructure as Code (with Terraform)
5.13. Application architecture review (monolith, microservices)
5.14. Research Challenges in Edge to Cloud Continuum