ECE 480A6: Optical Computing

IN

Logic Gates and Microprocessors

- Basic knowledge of electronic logic gates and microprocessors. Knowledge of electromagnetic waves is an asset in this course.

Computer Programming

- Basic knowledge of programming

Machine Learning and AI

- Basic knowledge of Machine Learning and Artificial Intelligence (these materials will be reviewed through the course)

Pre-requisites

- ECE102 with a minimum grade of C; ECE311 with a minimum grade of C; MATH340 with a minimum grad of C

Concepts:

- Introduction to Optics and Photonics
- Fundamentals of Bulk Optics and Free Space Optics
- Computing with Bulk Optics and Free Space Optics
- Fundamentals of Integrated Optics - Silicon Photonics
- Fundamentals of Integrated Optics - III-V materials
- Computing using Integrated Optics
- Optical Accelerators for Machine Learning and AI
- Optics for Multiply Accumulate (MAC) Operations
- Optical Memories
- Optical Logic Gates
- Optics for Encryption and Security I- Physical Unclonable Functions
- Optics for Encryption and Security II- Quantum Key Distribution
- Introduction to Quantum Computing
- Optical Hardware for Quantum Computing

Applications:

- Optical Computing in Datacenters
- Optical Computing for ML and AI
- Optics for Security
- Quantum Computing

Tools:

- Ansys Lumerical INTERCONNECT simulator

OUT

Optical Computing for Data Centers

- Understand how optical computing contributes to energy-efficient computation in data centers.

Optical Computing for ML and AI

- Understand the application of optical computing in ML and AI.
- Design an optical processor for energy-efficient AI training.

Optics for Security

- Exploit optics for security through photonic physical unclonable keys.
- Analyze quantum key distribution as a state-of-the-art network security communication method.

Optical Quantum Computing

- Learn the main advantages of quantum computing compared to classical computing.
- Analyze different types of quantum processors.