Deep Learning, Deepfakes, and Introductory Forensic Multimedia Analysis

Course Description: Students learn the fundamentals of deep learning AI with special attention on its use to manipulate and spontaneously create multimedia. Course will discuss the creation of deepfakes, their limitations, as well as detection techniques. Basic multimedia authentication analysis will be described and practiced.

Previous experience/formal training with digital evidence is recommended.

*Please note that some of the methods and software discussed and presented may only be available for demonstration purposes and/or to law enforcement agencies.

Course Outcomes:

KNOWLEDGE
Students will:
- Gain new perspectives to understand:
  - Principles in deep learning
  - Creation and limitations in creating deepfakes
  - Forensic techniques, emerging science, and limitations of the forensic expert
  - Fundamental multimedia analysis
- Acquire knowledge which either enhances or is not covered in scientific literature.

SKILLS
Students will:
- Take entrance and exit exams to gauge course’s effectiveness while informing student regarding the advancement of their knowledge.
- Understand the questions that they shall be able to answer as a forensic expert.
- Understand how digital evidence can be manipulated.
- Be introduced to techniques for forensic video/audio authentication.
- Demonstrate a familiarity with general topics related to forensic audio and video.

DISPOSITIONS
Students will:
- Gain an appreciation for issues in forensic imaging and audio.
- Be able to critically evaluate different forensic audio and image equipment, software, and methods.
- Enhance awareness of needs and opportunities in the field of digital audio and imaging.
Course Schedule:

1. Principles of AI and Deep Learning
   1.1. Introductory Machine Learning
   1.2. Deep Neural Networks
       1.2.1. Autoencoders
       1.2.2. Generative Adversarial Networks
       1.2.3. Convolutional Neural Networks
2. Deepfakes Creation and imitations
   2.1. Face Detection and Recognition
   2.2. Deepfakes Faceswap
   2.3. Deepvoice
   2.4. Spontaneous Imagery
3. Introductory Multimedia Authentication
   3.1. Video Analysis
       3.1.1. Structure and Format Analysis
       3.1.2. Frame Level Analysis
       3.1.3. Pixel Level Analysis
   3.2. Audio Analysis
       3.2.1. Structure and Format Analysis
       3.2.2. Lossy Compression Analysis
       3.2.3. Copy-Insert (Clone) Detection