Dr. Yelena Yesha
KNIGHT FOUNDATION CHAIR OF DATA SCIENCE AND AI
IDSC Innovation Officer | Head, International Relations
Director, IDSC AI + Machine Learning Program

Dr. Mitsunori Oghihara
DIRECTOR OF WORKFORCE DEVELOPMENT AND EDUCATION, IDSC

CARTA – MIAMI CAPABILITIES AND ACCOMPLISHMENTS

Digital Health
- Software as a Device
- Healthy Aging
- Digital Therapeutics
- Music for Dementia
- Smart Homes with Health Nexus

Cyber Analytics
- Zero Trust Supply Chains
- Trusted Execution Environments
- Smart Contracts
- Blockchain-Powered Secure Data Exchange

Working on problems of national significance that have commercial value
Empowering Innovation
NSF's Role in Softhread Inc.’ start up journey

Dr. Yelena Yesha
UNIVERSITY OF MIAMI • Frost Institute for Data Science and Computing (IDSC)
Knight Foundation Endowed Chair of Data Science and AI
Building a Modular, Reliable, Scalable, and Secure Internet of Things Infrastructure

• Supported by: NSF PFI Award 1919159, NSF CARTA Phase 1

• Goals: Develop Chios and ChiosEdge for cost-effective, secure IoT infrastructure and establish a blockchain system enhancing data privacy as solution for various industries.

• Impact: The research has led to innovative IoT and blockchain solutions and the formation of Softhread Inc.

• Softhread, Inc.
  • Focused on deploying Chios™, a blockchain-powered and AI-enabled platform that enhances operational efficiency and data security.
  
  • The company’s technologies: Combines blockchain, federated learning, and edge computing, Generative AI.

  • Ensures decentralized confidentiality and robust intrusion tolerance.

  • Chios™ is not just a blockchain platform but a comprehensive ecosystem designed for scalability and security in IoT and healthcare.

  • IP and Patents: Robust portfolio including systems for secure blockchain infrastructure and precision medicine data exchanges.
Technological Breakthroughs with Chios, ChiosEdge

**Chios:** an innovative permissioned blockchain platform specifically designed to enhance the security, scalability, and reliability of Internet of Things (IoT) infrastructures

**ChiosEdge:** Advanced IoT framework with Byzantine Fault Tolerance, ensuring secure data replication.

**Translational Research to Product:** Translation of research into Softhread products, with collaborations enhancing real-world applicability.
Softhread: From Research to Commercialization

Overview: Softhread utilizes Chios™ for secure data management across IoT and healthcare.

Product Portfolio: Includes Zero Trust Data Exchange and e-Consenting Tools, emphasizing privacy and security.

Market Impact:
- Addressed vital needs in data management, security, and interoperability across various industries including healthcare, energy, and more.
- Enhanced ROI through innovations like zero-trust solutions and federated learning models.

Competitive Edge and Partnerships: Partnerships with IBM, Intel, and NSF have positioned Softhread at the forefront of industry solutions.

Collaborations: With industry giants like IBM, Intel, and academic institutions to foster further innovation.

Impact and Success of Chios in Patient Consent

- 3 Maryland Innovation awards (TEDCO)
- Supported by: **SBIR 1 and SBIR 2**
- Case Studies: Highlight Chios in applications like end-of-life consent and medical data exchanges.
- Achievements: Showcases improvements in data integrity, security enhancements, and operational efficiencies.
NASA Year 1: Blockchain Distributed Ledger for Space Resource Access Control

- Leverage **blockchain** technology to enhance security in inter-satellite communication network.
- Pioneer a secured decentralized communication network.
- Fortify blockchain applications in the space industry to withstand cyberattacks.
- Implement Off-chain storage for large datasets.
• Implement a blockchain network that empowers zero-trust cybersecurity measures for safeguarding data access and secure message exchange
• Develop a permissioned blockchain and Access Control to enhance security for device registration.
• Build a virtual Twin Layer for data simulation and real-time decision-making
Neural Encoding of Music Familiarity

• Team: Ogihara (CS), Andrew Dykstra (BME), Brian Manolovitz (CS)
• Member: Legacy Research Institute
• Background: Up to 25% of patients with disorders of consciousness are estimated to have residual awareness
  • Command following (“imagine playing tennis”)
  • fMRI can provide neural evidence for residual awareness
• Goal: Determine whether familiar music is encoded more strongly than unfamiliar music
  • Ultimately, use findings to develop methods for treating neurodegenerative diseases
• Approach: Subjects listen to playlists of familiar and unfamiliar music
  • Unfamiliar music is given multiple times
  • Collect EEG during the listening and resting times
  • Develop individual models for classification
AI-based Risk Assessment for BZD Usage

- Team: Yelena Yesha (CS), Phuong Nguyen (CS), Smriti Prathapan (IDSC)
- Member: The Rockefeller Institute at West Virginia University
- Goals:
  - Symptoms of BZD use, tapering, and discontinuation
  - Identify patient subgroups who are vulnerable to getting addicted
  - Risk assessment based on withdrawal symptoms
- Approach:
  - Neural Architecture Search (NAS) and evaluate and compare with Random Forest, XGBoost, Bayesian optimization neural architecture search algorithm
  - Predict risk of hospital visit for overdose started at 3 months before the first BZD prescription and continue to 12-mo follow up and or confirm BZD positive in lab tests.
  - Input variables: patient information, medications, hospital services, and lab tests (~34 factors).
- Results
  - Predict Substance use risk as a binary classification problem
  - BZD and/or combined with other substances (opioid, alcohol, cannabis, cocaine, nicotine, and other psychoactive substances)
  - Reasons to visit as a multi-class classification problem
  - Predicted prolonged or short-term addiction

<table>
<thead>
<tr>
<th>Machine Learning Model</th>
<th>Accuracy (%)</th>
<th>Area Under Curve (AUC)</th>
<th>PPV* Precision</th>
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<tbody>
<tr>
<td>AdaBoostM1</td>
<td>71.9</td>
<td>0.7</td>
<td>0.69</td>
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<td>Logistic Regression</td>
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<td>Feed Forward Neural Network</td>
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<td>Random Forest (TP rate 0.95, FP rate 0.08)</td>
<td>95.9</td>
<td>0.97</td>
<td>0.96</td>
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</tbody>
</table>
Permissioned Blockchain for Efficient Image Sharing & Exchange

Team: Yusen Wu (IDSC), Phuong Nguyen (CS), Yelena Yesha (CS), Mitsu Ogihara (CS)

Member: Neurotargeting

Advantages:

- **Security and Privacy**: The inherent security features of blockchain can protect sensitive patient data.
- **Interoperability**: A blockchain network can act as a standardized integrative platform, facilitating easier sharing and access.
- **Immutability**: After recording, data is recorded on a blockchain, making it tamper-proof.
- **Traceability**: Every transaction on the blockchain can be traced, creating a clear audit trail and providing the provenance of medical images.
- **Efficiency**: Blockchain can automate the sharing process through smart contracts, reducing administrative overhead.
- **IPFS Storage**: Integrating with decentralized storage systems like IPFS (InterPlanetary File System) and Filecoin can further enhance the efficiency of storage and retrieval of large image files.
Genotype-aware Consumer Product Recommendation System

- Team: Vanessa Aguiar-Pulido (CS), Mitsu Ogihara (CS), Jerry Bonnell (IDSC)
- Member: GenRecSys / YE Ventures
- Goal: Develop
  - A recommender system for inferring the likelihood of matches between consumer products and individuals that possess genetic data
  - An AI-based approach to extract non-trivial relationships in highly dimensional data that will be used to inform the recommender
- Results:
  - Direct access to subject-level genotype data (e.g., GWAS case-control cohorts) is a lengthy, cumbersome process
  - Data often aggregated to eliminate the possibility for re-identification of subject
  - Crucial to collaborate with partners that are readily able to access genetic data
  - It is possible to develop a learning-based method that features interpretability, high accuracy when retrieving, signatures in high-dimensional data, Patterns discovered can be incorporated to refine the recommender system
CARTA Miami Experts (Core Members)

Mitsu Ogiehara
mogihara@miami.edu

Yelena Yesha
yelena.yesha@cs.miami.edu

Stephen Dennis
sxd1415@miami.edu

Phuong Nguyen
pxn208@med.miami.edu

Vanessa Aguiar-Pulido
vanessa@cs.miami.edu

Yusen Wu
yxw1259@miami.edu

Jerry Bonnell
j.bonnell@miami.edu

Smriti Prathapan
smritip1@umbc.edu