DEPARTMENT OF
COMPUTER SCIENCE

TEXAS TECH
Whitacre College of Engineering

Knowledge Graphs and AI for Cyber Threat Intelligence and Critical Infrastructure Security

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Engineering Center Room 205

Abstract: As cyber threats continue to grow in scale and sophistication, defenders require tools that can synthesize information, detect complex attack behaviors, and support timely decision-making. Traditional cybersecurity systems often generate alerts in isolation, lacking the contextual understanding necessary to interpret and respond to advanced threats. This talk presents a knowledge-graph–driven approach that integrates open cybersecurity ontologies, threat intelligence feeds, and system-level observations to enable more coherent, explainable, and automated cyber defense.

We introduce the Unified Cybersecurity Knowledge Graph (UCKG), a semantic framework that fuses standardized cybersecurity vocabularies such as CVE, CWE, CAPEC, CPE, MITRE ATT&CK and D3FEND into a single interoperable representation. The UCKG provides the foundation for advanced threat analytics, enabling automated reasoning, relationship inference, and context-aware detection. The presentation highlights two current research and development projects at Angelo State University: (1) Cyber Threat Intelligence Using Knowledge Graphs and Generative AI, and (2) Critical Infrastructure Security with Knowledge Graphs and Explainable AI. We discuss system architecture, ontology design, AI reasoning methods, and preliminary results, including student research contributions and multi-institution collaboration supported by the U.S. Army Research Laboratory. The talk concludes with opportunities for operational deployment and future research in neuro-symbolic and explainable cybersecurity systems.

Bio: Dr. Erdogan Doğdu is a Professor of Computer Science at Angelo State University and principal investigator on multiple cybersecurity research projects supported by the U.S. Department of Defense and the Army Research Laboratory. His research focuses on knowledge graphs, AI/ML applications in cybersecurity, and intelligent data management systems. He has co-authored a textbook, Python Programming and Problem Solving, and leads research groups in Cyber Threat Intelligence and Critical Infrastructure Security. Dr. Doğdu has also supervised numerous graduate student theses and undergraduate research projects, and has been active in curriculum development, including the creation of new AI and cybersecurity degree programs at ASU. His recent work on unified cybersecurity knowledge graph received the Best Paper Award at the Southwest Data Science Conference in 2024.