**Undergraduate Research MENTOR Registration**

Please tell us about your research and what qualifications you are looking for:

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CHAIR: Mark Thompson

PROJECT TITLE AND DESCRIPTION:   
Provide a brief description of the proposed area of research/creative activity perhaps  
including the goals, purpose and methods used to accomplish the project objectives. \*

**This is an NSF funded research project called:**

**CRII:SHF: A New Foundation for Attack Trees Based on Monoidal Categories.**

**Description:**

**Attack trees are a modeling tool used to assess the threat potential of a security critical system. They have been used to analyze the threat potential of the cybersecurity of power grids, wireless networks, and many others. Attack trees for real-world security scenarios can grow to be quite complex and manipulating such large and complex trees without a formal semantics can be dangerous. The intellectual merits of the research are twofold: 1) It develops, using the power of linear logic and category theory, a new mathematical semantics of attack trees that is more general than existing models; 2) It designs a new domain-specific programming language for conducting threat analysis using attack trees. The language is specifically designed for not only the construction and manipulation of attack trees, but also for the ability to verify properties of attack trees. The project's broader significance and importance are improvement of security and reliability of software, training of a diverse group of undergraduate students at Augusta University in principles of programming languages and security, and exposing them to research.**

**The project's first step is to give attack trees a categorical semantics in symmetric monoidal categories. Then based on this semantics, and the connection between linear logic and symmetric monoidal categories, the project develops a new  
statically-typed linear functional programming language called Lina (Linear Threat Analysis). Types in Lina correspond to attack trees, and programs between attack trees correspond to semantically valid transformations of attack trees. Therefore, designing and manipulating complex attack trees in Lina provides a higher confidence that the resulting analysis is correct.**

STUDENT TASKS AND QUALIFICATIONS NEEDED:   
List necessary student skills or qualifications, if any.**\***

**The student should have the following qualifications:**

* **Enrolled as a computer science major**
* Have taken the following courses:
  + CSCI:3400 Data Structures
  + CSCI:3030 Mathematical Structures in CS
  + CSCI:3300 Programming Language Concepts
* Optional Qualifications:
  + Interested in web development
  + Interested in applications of logic in computer science