UGA Computer Science

Research Day

Demo Competition

April 9, 2010

12:00 to 3:00 pm

Tate Reception Hall

Welcome to Computer Science Research Day at UGA.

This event is designed to showcase the accomplishments and abilities of our thriving graduate program and takes the form of a poster/demo competition among the graduate students. We invite the university community, potential graduate students, alumni, and current and potential industrial affiliates to:

- Meet our graduate students and view their research posters/demos.
- **Cast your vote** for your **top 3** favorite posters.
- **Cast your vote** for your **top 3** favorite demos.
- Drop your vote in the blue ballot box.

Please circulate around to meet our faculty members, discuss ideas for collaboration, identify potential assistants for your research or other funded work, or learn about our graduate program. Thanks so much for joining us today!

The Computer Science Research Day Committee

-- Professors Eileen Kraemer, Budak Arpinar, and Khaled Rasheed

#1 Approximate Structure Search in RNA via Graph Homomorphism

Zhibin Huang

Non-coding RNA (ncRNA) secondary structural homologs can be detected effectively in genomes with profile-based search methods. However, due to the lack of appropriate ncRNA structural evolution models, it is difficult to accurately detect distant structural homologs. This paper presents results of an investigation toward developing a new framework for distant ncRNA structural homolog search. In this work, secondary structure conformations are modeled with graphs of small tree width and sequence-structure alignment for homolog detection is formulated as graph homomorphism. The technique of NULL stem is used to resolve the issue of optional stems that may be deleted from the structure profile or may be a misalignment. Test results on Infernal's benchmark data sets show that a program based on these ideas, RNAv, and with the capability of detecting pseudoknots, has a comparable performance to the latest version of Infernal, and is better in detection of some distant homologs.

The inputs are the training data, a multiple structure alignment file with conformational graph information, and the testing genome file. The output is the structures found in the genome with similar structure (graph homomorphism).

#2 Semantics and Services Enabled Problem-Solving Environment for *T. cruzi*

Amir H. Asiaee

Semantics-driven Query Interface for Biological Data is a project which aims to utilize state-of-the-art semantic technologies for effective querying of multiple semantic data sources through creation of a suite of ontologies modeling multiple aspects of the *T. cruzi* research domain. A part of this project is a web-based tool called Cuebee (Knowledge-Driven Query Formulation) which is targeted at non-computer expert users for SPARQL generation. It uses ontology schemas to guide users step-by-step in formulating queries in an intuitive way. Cuebee takes advantage of an OWL-DL reasoner called Pellet which is equipped with SPARQL-DL (an extension of SPARQL suitable for OWL-DL ontologies). Cuebee uses two query engines: Suggestion List Query Engine works with ontology schema and formulates a SPARQL-DL query for each step. These queries support a great deal of OWL-DL restrictions, and Final Query engine dynamically generates a SPARQL-DL query based on user's term selections. The latter is able to generate directed and undirected path queries as well as SPARQL ASK queries.

#3 Visual Feature Fingerprints for Location Recognition and Mapping

B. J. Wimpey

We present our framework to enable an autonomous mobile robot to map its environment and recognize places it has visited. To accomplish this goal, we map places visited by the robot by encapsulating various visual feature "ridges" into location "fingerprints". To help accomplish this, we use SIFT, the Scale Invariant Feature Transform. SIFT, however, performs poorly on locations or objects with uniform color. We therefore fortify the fingerprints with other ridges such as object recognition, line extraction, color histograms, and text recognition. The goal is to allow the robot multiple sources of evidence from which to make an informed decision about its location.

In the demo we present the various fingerprint ridges for our system which will enable an autonomous mobile robot to map its environment and recognize places it has visited. We present object recognition, line extraction, color histograms, and text recognition. When combined together, these ridges will form our fingerprint for a specific location in the environment.

#4 Localization in Dynamic Multi-Agent Systems

Anousha Mesbah

Just like humans with different levels of uncertainty about the surrounding world, robots are uncertain about their environments. A robot with a low battery or inaccurate sensors will certainly get noisy observations about the environment and therefore will make an imperfect decision. In robotics, SLAM is a probabilistic technique that is used by a robot to localize itself in an unknown environment. Researchers take different approaches in implementing SLAM, many of whom use Bayes Theorem as their fundamental step to calculate the state of a robot at a certain point in time. One of these approaches is particle filtering. Particle filtering is a model estimation technique based on simulation. It estimates a set of state hypotheses based on noisy observations. The purpose of this project is to use and enhance the particle filtering algorithm such that the robots can localize themselves in a dynamic environment. The environment is a simulated maze, in which a set of landmarks can be misplaced. A single robot tries to localize itself in the map, while the other robot changes the location of one or multiple landmarks.

#5 On the Utility of WordNet for Ontology Alignment

Uthayasanker Thayasivam

The popularity of semantic web resulted in the development and publication of an increasing number of ontologies. Naturally, these ontologies vary in structure and syntax. Matching similar ontologies is a challenging research problem. It is pretty common to employ lexical databases to improve the matching task. WordNet is the most popular lexical database exploited to align ontologies. This poster presents an empirical study of the use of WordNet for ontology alignment. Aligning an ontology means matching its elements (Concepts, properties and instances). Each element carries its own set of attributes. The key attribute used to match an element is the label (name) of that element. A measure of similarity between two labels is compulsory in matching elements. WordNet is a well known lexical database used in most of the semantic similarity measures. It is widely believed to yield improved results with a little performance tradeoff.

#6 GaTAC: A Scalable and Realistic Testbed for Multiagent Decision Making

Ekhlas Sonu

Recent algorithmic advances in multiagent sequential decision making have opened up a need to move beyond the traditional toy problems such as the multiagent tiger problem. Further evolution of the algorithms will only make the gap more significant. The aim of the project is to introduce the Georgia Testbed for Autonomous Con trol of vehicles (GaTAC), which facilitates scalable and realistic problem domains pertaining to autonomous control of unmanned agents such as uninhabited aerial vehicles (UAVs). GaTAC provides a low-cost, open-source and flexible environment for realistically simulating the problem domains and evaluating solutions produced by multiagent decision making algorithms. We describe GaTAC in detail and demonstrate example problem settings that we are using in GaTAC. We expect GaTAC to facilitate the development and evaluation of scalable decision making algorithms with results that have immediate practical implications.