SENIOR RESEARCH
CSC 450

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Course website: https://gdancik.github.io

Example #1: factorial method

```
// precondition: a non-negative integer (n) is ready to be specified
// postcondition: returns n! = n*(n-1)*(n-2)*...*1, with 0! = 1.
public static int factorial(int n) {
        int prod = 1;
        for (int i = n; i>1; i--) {
                prod *= i;
        }
        return prod;
}
```

- Can we *prove* that this method is *correct*?
- What if the method is called with a negative number?
- What if the method is called with a very large number? How *reliable* is the method?

Example #2: factorial method (recursive)

```
// precondition: a non-negative integer (n) is ready to be specified
// postcondition: returns n! = n*(n-1)*(n-2)*...*1, with 0! = 1.
public static int factorial(int n) {
        if (n == 0) return 1;
        int prod = n * factorial(n-1);
        return prod;
}
```

- Is this method *better* or *worse* than the *factorial* function on the previous page?
- How could we compare the two methods?

Paradigms in Computer Science

- Rationalist paradigm – programs are mathematical objects
  - Ex: we can theoretically *prove* a program is correct, will not crash, etc.
- Technocratic paradigm - we can empirically determine reliability through testing
  - Ex: program crashes 0.00001% of the time
- Scientific paradigm – programs are like natural processes and are amenable to experiment and study
  - Ex: Evaluate which sorting method is better, among 2 or more
  - Ex: Evaluate different ways of slowing a flu epidemic in a computer model of influenza infection
  - Ex: Evaluate which is ”better” -- Alexa, Google Assistant, or Siri (https://www.ibtimes.com/alexa-vs-google-assistant-vs-siri-googles-voice-assistant-has-higher-iq-2815141)

What is scientific research?

- Scientific research means a systematic investigation, including research development, testing, data collection and evaluation, designed to develop or contribute to generalizable knowledge (modified from National Science Foundation)

- Let's look at an example:
  - https://dl-acm-org.ecsu.idm.oclc.org/citation.cfm?id=3233186

  - What is the problem the authors are addressing?
  - What is the claim that the authors make?
  - What evidence do the authors have that supports their claim?

Entity-Based Query Recommendation for Long-Tail Queries

Query recommendation, which suggests related queries to search engine users, has attracted a lot of attention in recent years. Most of the existing solutions, which perform analysis of users' search history (or *query logs*), are often insufficient for *long-tail queries* that rarely appear in query logs. To handle such queries, we study the use of *entities* found in queries to provide recommendations. Specifically, we extract entities from a query, and use these entities to explore new ones by consulting an information source. The discovered entities are then used to suggest new queries to the user. In this article, we examine two information sources: (1) a knowledge base (or KB), such as YAGO and Freebase; and (2) a click log, which contains the URLs accessed by a query user. We study how to use these sources to find new entities useful for query recommendation. We further study a hybrid framework that integrates different query recommendation methods effectively. As shown in the experiments, our proposed approaches provide better recommendations than existing solutions for long-tail queries. In addition, our query recommendation process takes less than 100ms to complete. Thus, our solution is suitable for providing online query recommendation services for search engines.

Background
Problem
(significance)
Methods
Results
Conclusion
(significance)

Zhipeng Huang, et al. 2018. Entity-Based Query Recommendation for Long-Tail Queries. *ACM Trans. Knowl. Discov. Data* 12, 6, Article 64 (August 2018), 24 pages.
https://dl-acm-org.ecsu.idm.oclc.org/citation.cfm?id=3233186

Course Objectives

1. Demonstrate the ability to engage in independent inquiry
2. Apply current and critical thinking in a focused area of study
3. Reflect on the context of the independent inquiry or artistic creation
4. Reflect on this work as an outcome of a liberal arts education
5. Learn to write, communicate, and present research ideas and results in computer science.