

COMP 3270: Introduction to Algorithms



AUBURN UNIVERSITY

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What is an algorithm?

- An algorithm is a well-defined computation procedure (i.e., a finite number of computational steps specified at the required level of detail) that generally (but not always) takes some data as input and generally (but not always) produces some data as output in order to solve a problem.

Different views of algorithms

- They are magical, all powerful and taking over the world!
 - <http://www.youtube.com/watch?v=TDaFwnOiKVE>
- They are for socially inept nerds...
 - <https://www.youtube.com/watch?v=k0xgjUhEG3U>
- They are for everybody, and here is why in plain language...
 - <https://www.youtube.com/watch?v=vSi6YoTPWLw>
- But what we're concerned about is technical stuff, like this...
 - <https://www.youtube.com/watch?v=kPRA0W1kECg>

Why did I show these videos?

- To illustrate how pervasive algorithms have become...
- To emphasize that algorithms may be mysterious/magical, unreadable and uncontrollable to lay people, but you, as students of computing, must develop the skills of algorithmic thinking: being able to understand, design, implement and control them!

Why study algorithms?

- Algorithms affect ALL FACETS of your life!
 - your romantic life
 - your social life
 - your financial transactions
 - how you entertain yourself
 - your privacy (or lack of it)

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http://en.wikipedia.org/wiki/Stable_marriage_problem#Algorithm

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www.nytimes.com/2014/06/30/technology/facebook-tinkers-with-users-emotions-in-news-feed-experiment-stirring-outcry.html?_r=0

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Facebook Tinkers With Users' Emotions in News Feed Experiment, Stirring Outcry

By VINDU GOELJUNE 29, 2014

Facebook revealed that it had altered the news feeds of over half a million users in its study. Karen Bleier/Agence France-Presse — Getty Images

To [Facebook](#), we are all lab rats.

Facebook routinely adjusts its users' news feeds — testing out the number of ads they see or the size of photos that appear — often without their knowledge. It is all for the purpose, the company says, of creating a more alluring and useful product.

But last week, Facebook revealed that it had manipulated the news feeds of over half a million randomly selected users to change the number of positive and negative posts they saw. It was part of a psychological study to examine how emotions can be spread on social media.

The company says users consent to this kind of manipulation when they agree to its terms of service. But in the quick judgment of the Internet, that argument was not universally accepted.

“I wonder if Facebook KILLED anyone with their emotion manipulation stunt. At their scale and with depressed people out there, it's possible,” the

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IBM Research: Machine learning for financial fraud detection - Mozilla Firefox

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Using machine learning and stream computing to detect financial fraud

How IBM Research can help companies save billions annually

Fraud costs the financial industry approximately \$80 billion annually¹; U.S. credit and debit card issuers alone lost \$2.4 billion². For individual victims of fraud, the experience can be costly and even lead to identity theft, which can take years to resolve. But by using **machine learning** and **stream computing** to create virtual "data detectives," IBM researchers are working to reduce the risk.

Existing fraud detection systems operate on a set of rules, such as flagging ATM withdrawals over a certain amount or credit card purchases that take place outside a card holder's home country. While this method helps stop a large number of fraudulent cases, a team of researchers in the Machine Learning Technologies group at IBM Research - Haifa are taking

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Meet the researchers

 **Yaara Goldschmidt**
Manager, Machine Learning


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Amazon.com: The Hunger Games: Jennifer L...

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THE FIRST FILM IN THE HUNGER GAMES FRANCHISE. Based on the best-selling book, 16-year-old Katniss (Jennifer Lawrence) volunteers to take her younger sister's place in the Hunger Games.

Starring: Jennifer Lawrence, Josh Hutcherson
Directed by: Gary Ross
Runtime: 2 hours 23 minutes
Release year: 2012
Studio: Lionsgate

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<http://en.wikipedia.org/wiki/Cryptography>

Why study algorithms?

- Algorithms form the backbone of all computations.
- And, as students majoring in a computing-related discipline, you must develop skills to understand and analyze computation, and know how to design computations to solve problems!
- So really, this course is actually about **Computational Problem Solving** – Algorithms are the products of computational problem solving.

- **Computational Problem Solving** is the art of coming up with a correct AND efficient computational solution (i.e., one or more algorithms) to a given problem.

Problems and Problem Instances

- An instance of a problem consists of one set of valid inputs from which a solution to the problem can be computed.
- “How to sort a set of numbers in the ascending order” is a problem.
- “Sorting the set of numbers 4,5,7,1,2,0 in the ascending order” is a problem instance.

Steps of Computational Problem Solving

- Problem specification
- Designing solution strategies
- Developing corresponding algorithms
 - Understand existing algorithms and modify/reuse, or
 - Design new algorithms
- Understanding the algorithms by simulating their operation on inputs
- Ensuring/proving correctness of the algorithms
- Analyzing and comparing the performance/efficiency of algorithms
 - Theoretically: Using a variety of mathematical tools
 - Empirically: Code, run and collect performance data
- Choosing the best algorithm to code

More on why study algorithms?

- You could make a good living (or even become one of the richest persons on earth) if you know how to design algorithms!
- Or get hired by big tech companies like Google.
- Or convince some investors to fund your startup.

What have we covered so far?

- Different perspectives on algorithms
 - And what perspective we should take as serious students of computing.
- Discussion of why algorithms are important
- Problems and Problem Instances
- The process of Computational Problem Solving
- We will begin to delve into the technical material next
- Meanwhile, a warm-up reading/watching assignment
 - “How algorithms rule the world”: <https://www.theguardian.com/science/2013/jul/01/howalgorithms-rule-world-nsa>
 - “How Google’s algorithm rules the web”: https://www.wired.com/2010/02/ff_google_algorithm/
 - Another TED talk: https://www.youtube.com/watch?v=H_aLU-NOdHM



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