



# Big O Theory Club

8/27: FIRST MEETING

# What We Do

## Two Types of Meetings

- **Faculty/Student Talks :**
  - No prerequisite knowledge for most talks
  - We welcome talks from students!
- **Problem Sessions**
  - Small group work
  - 3 - 5 themed CS theory problems





THEORY CLUB

# ELLIPTIC CURVE CRYPTOGRAPHY



ES&T L1175: 04/03 @6PM  
with  
PROFESSOR MATTHEW BAKER



THEORY CLUB  
SYNCHRONOUS  
CHAOS  
AKA THEORY CLUB  
ELECTIONS

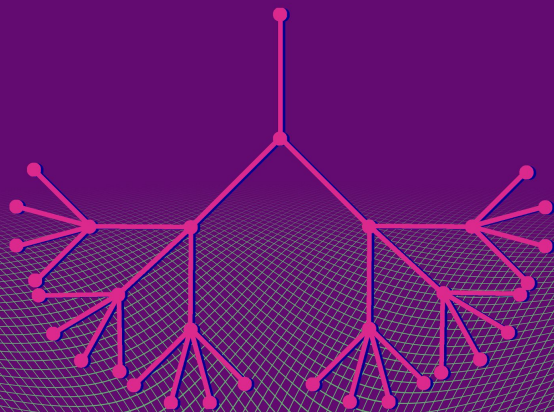
CCB 102: 04/23 @6PM  
with  
DIPTODIP DEB





THEORY CLUB

# PROBLEM SESSION



CCB 102: 02/26 @6PM  
with  
SHERRY SARKAR





11.03.2017 7PM  
11.04.2017 1PM  
KLAUS 1116

# DEEP LEARNING COMPETITION

## prizes

- 1st: GTX 1080 GPU(s)
- 2nd: Google Home(s)
- 3rd: Arduino Starter Kit(s)

**food will be provided**

**teams of up to 3**

**register at <https://goo.gl/PaqCzz>**

( prizes are 1 per  
person on team )

contact [jared\\_moore@homedepot.com](mailto:jared_moore@homedepot.com)

Georgia Tech Learning  
THEORY CLUB



# What We Do

Get you involved in research

- How to approach professors
- What classes should you take
- How to apply to REUs





# Variant of Nim

## RULES:

- Two players
- $N$  paper clips in a pile
- Player 1 on his/her first move can take up to  $N - 1$  paper clips
- A player can take up to twice the number of paper clips the last player took

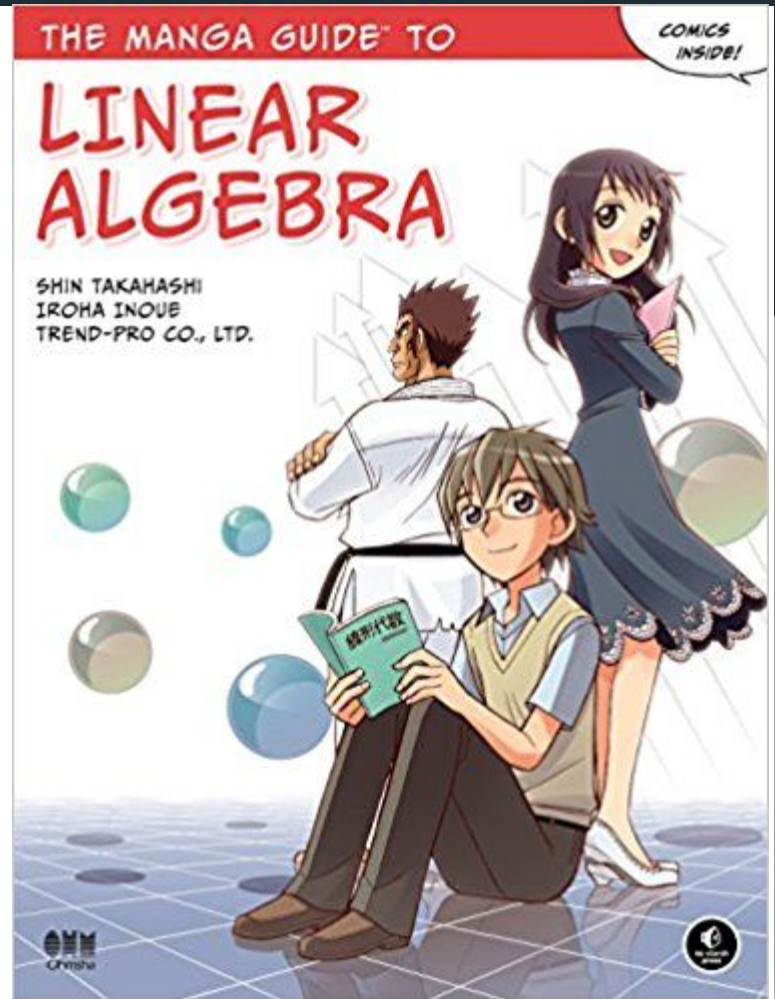
**GOAL:** Take the last paper clip!





# Fibonacci Nim

- Many of you noticed that 3 paper clips was a bad game to start.
  - And 5 paper clips
- A **losing position** is a position in which the player who makes a move in that position will surely lose (assuming the other player plays correctly).
  - 3, 5 paper clips are losing positions.
- Consider the 8 paper clip game. Notice that removing 3 clips is not



# Fibonacci Nim

- The losing positions we know so far:
  - 2, 3, 5, 8....
- Perhaps we can “add” two losing positions together to create a larger losing position!
  - Can’t just add two arbitrary losing positions : for example  $8 + 2 = 10$  is not a losing position.
  - Left as an exercise to the reader
- **Theorem** : The Fibonacci numbers are losing positions - there is no way to win a Fibonacci number of clips unless you can remove all clips.

# Winning Strategy

- **Zeckendorf's Theorem** : Any positive integer can be expressed as the sum of non consecutive Fibonacci terms.
  - $20 = 13 + 5 + 2$
  - Left as a trivial exercise to the reader
- **Lemma** :  $F_{n+1} < 2 * F_n < F_{n+2}$ 
  - **O B V I O U S**
- So, if we remove the smallest losing position, then we force our opponent to play losing positions (since he/she can't remove the entire position).



# Problem 1

A two-player game involves placing pennies on a circular table such that in each turn, the coin that is placed neither overlaps with the other coins nor hangs off the table. Whoever cannot place a coin on a turn loses. Who has a winning strategy?



## Problem 2

In a set of  $n$  persons, any subset of four contains a person who knows the other three persons. Prove that there exists a person who knows all the others. (If  $A$  knows  $B$  then  $B$  knows  $A$ ).



## Problem 3

Peter has 3 accounts in a bank, each with an integral number of dollars. He is only allowed to transfer money from one account to another so that the amount of money in the latter is doubled.

- Prove that Peter can always transfer all his money into two accounts.
- Can he always transfer all his money into one account?

