COT 6405: Analysis of Algorithms

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www.cs.fiu.edu/~giri/teach/6405F19.html

Text

3rd Edition

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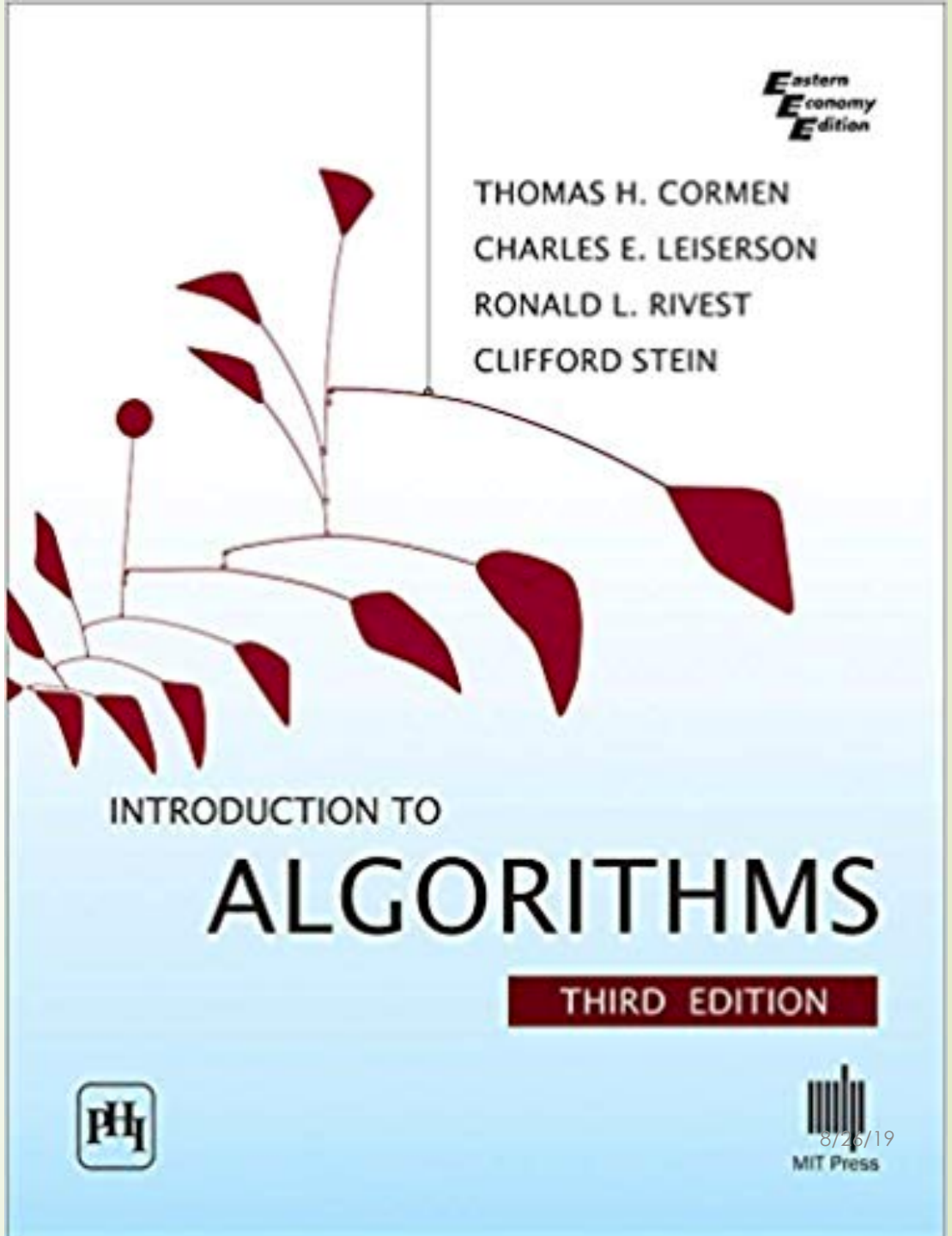

Course Preliminaries

- Course Webpage:
  http: //www.cs.fiu.edu/~giri/teach/6405F19.html
  - Lecture Slides; Reading Material; Announcements; HWs
  - VISIT OFTEN!
- Class meets MW 2:00 – 3:15 PM, CASE/ECS 235
- Office ECS 254B; Office Hours: By Appointment Only
- Phone: x-3748; Email: giri@cis.fiu.edu
- Final: Monday, 12/11/2019, 12:00 – 2:00 PM, CASE 235

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Momentos

- Slides and Audio online
- Need to register
  - Go to https://fiu.momentos.life
  - If you don't already have an account
    - Click on "Sign up"
    - Follow instructions & use referral code: **5T6LSV**
  - If you have an account, "Add Course" with code **5T6LSV**
  - Verify account using link sent to email

Why I am here?

I am here because …

- **It's required**

Hate being here because …

- **It's required**

- What do I expect to learn in this class?
- Who should know about Algorithms?
- Is there a future in this field?
- Would I ever need it if I want to be a software engineer or work with databases?

Questions you should ask …

- What do I expect to learn in this class?
- Who should know about **Algorithms**?
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Person of the Year …

Time's Person of the Year

2018

2017

The first hundred votes …

Who won a majority?

48	12	9	12	23	12	22	12	12	12
48	93	93	93	12	12	93	12	93	12
12	93	48	48	12	12	12	33	79	12
12	12	93	12	12	9	12	23	12	12
12	12	12	33	93	93	93	12	12	12
12	9	12	23	93	48	48	12	12	44
93	93	93	12	12	9	12	23	12	55
12	12	48	12	48	48	12	48	88	12
12	12	93	12	12	9	12	23	12	12
12	12	12	33	93	93	93	12	12	12

Every number in the table corresponds to a vote for a person with that ID

Majority: More than 50% of the votes

Standard Approaches

- Keep a list of candidates and their counts
  - Every vote needs to be compared against every candidate in the worst case
- Sort the list and count
  - Sorting is the bottleneck
  - Can we avoid sorting?

48	93	93	93	12	12	93	12	93	12	93	12	12	9	12	23	12	93	93	93	12	9	12	23
12	93	48	48	12	12	12	33	79	12	12	33	93	93	93	12	12	93	48	48	93	93	93	12
12	12	93	12	12	9	12	23	12	12	12	23	93	48	48	12	12	12	93	12	93	48	48	12
12	12	12	33	93	93	93	12	12	12	93	12	12	9	12	23	12	12	12	33	12	9	12	23
12	9	12	23	93	48	48	12	12	44	48	48	12	48	88	12	12	9	12	23	48	48	12	48
93	93	93	12	12	9	12	23	12	55	12	9	12	23	12	12	93	93	93	12	12	9	12	23
12	12	48	12	48	48	12	48	88	12	93	93	93	12	12	12	93	12	48	12	93	93	93	12
12	12	93	12	12	9	12	23	12	12	12	9	12	23	12	55	12	12	93	12	12	33	79	12
12	12	12	33	93	93	93	12	12	12	12	12	12	33	93	93	93	12	12	12	12	23	12	12
48	48	12	12	12	33	79	12	12	33	93	93	93	12	12	93	48	12	33	79	93	12	12	12
93	12	12	9	12	23	12	12	12	23	93	48	48	12	12	12	93	12	23	12	48	12	12	44
12	33	93	93	93	12	12	12	93	12	12	9	12	23	12	12	12	93	12	12	12	23	12	55
12	23	93	48	48	12	12	44	48	48	12	48	88	12	12	9	12	48	12	12	12	48	88	12
93	12	12	9	12	23	12	55	12	9	12	23	12	12	93	93	93	12	23	12	12	23	12	12
48	12	48	48	12	48	88	12	93	93	93	12	12	12	93	12	48	12	48	88	12	23	12	12
93	12	12	9	12	23	12	12	12	9	12	23	12	55	12	12	93	12	23	12	93	12	12	12
93	12	12	9	12	23	12	12	12	23	93	48	48	12	12	12	93	12	23	12	48	12	12	44
12	33	93	93	93	12	12	12	93	12	12	9	12	23	12	12	12	93	12	12	12	23	12	55
12	23	93	48	48	12	12	44	48	48	12	48	88	12	12	9	12	48	12	12	12	48	88	12
93	12	12	9	12	23	12	55	12	9	12	23	12	12	93	93	93	12	23	12	12	23	12	12
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48	48	12	12	12	33	79	12	12	33	93	93	93	12	12	93	48	12	33	79	93	12	12	12
93	12	12	9	12	23	12	12	12	23	93	48	48	12	12	12	93	12	23	12	48	12	12	44
12	33	93	93	93	12	12	12	93	12	12	9	12	23	12	12	12	93	12	12	12	23	12	55
12	23	93	48	48	12	12	44	48	48	12	48	88	12	12	9	12	48	12	12	12	48	88	12
93	12	12	9	12	23	12	55	12	9	12	23	12	12	93	93	93	12	23	12	12	23	12	12
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48	48	12	12	12	33	79	12	12	33	93	93	93	12	12	93	48	12	33	79	93	12	12	12
93	12	12	9	12	23	12	12	12	23	93	48	48	12	12	12	93	12	23	12	48	12	12	44
12	33	93	93	93	12	12	12	93	12	12	9	12	23	12	12	12	93	12	12	12	23	12	55
12	23	93	48	48	12	12	44	48	48	12	48	88	12	12	9	12	48	12	12	12	48	88	12
93	12	12	9	12	23	12	55	12	9	12	23	12	12	93	93	93	12	23	12	12	23	12	12
48	12	48	48	12	48	88	12	93	93	93	12	12	12	93	12	48	12	48	88	93	93	12	12
93	12	12	9	12	23	12	12	12	9	12	23	12	55	12	12	93	12	23	12	9	12	23	12
12	23	93	48	48	12	12	44	48	48	12	48	88	12	12	9	12	48	12	12	12	48	88	12
93	12	12	9	12	23	12	55	12	9	12	23	12	12	93	93	93	12	23	12	12	23	12	12
48	12	48	48	12	48	88	12	93	93	93	12	12	12	93	12	48	12	48	88	12	23	12	12
93	12	12	9	12	23	12	12	12	9	12	23	12	55	12	12	93	12	23	12	93	12	12	12

Wacky Ideas, anyone?

- What if I pick two random votes and they turn out to be different?
  - Discard and reduce the problem size
- What if I pick two random votes and they are the same?
  - Well, this needs work and you will need to think about it!

48	12	9	12	23	12	22	12	12	12
48	93	93	93	12	12	93	12	93	12
12	93	48	48	12	12	12	33	79	12
12	12	93	12	12	9	12	23	12	12
12	12	12	33	93	93	93	12	12	12
12	9	12	23	93	48	48	12	12	44
93	93	93	12	12	9	12	23	12	55
12	12	48	12	48	48	12	48	88	12
12	12	93	12	12	9	12	23	12	12
12	12	12	33	93	93	93	12	12	12

Difference between Intro and Analysis of Algorithms?

- More on how to analyze … more on complexity
- More on correctness …
- More algorithms …
- More data structures … bigger bag of tricks
- More on different algorithmic models …
  - Randomized, online, amortized, adaptive, approximation, heuristic, quantum,

Evaluation

- Exams (2) 45%
- Quizzes 10%
- HW Assignments 35%
- Class Participation 10%

What you should already know …

- Array Lists
- Linked Lists
- Sorted Lists
- Stacks and Queues
- Basic Sorting Algorithms
- Trees
- Binary Search Trees
- Heaps and Priority Queues
- Graphs
  - Adjacency Lists
  - Adjacency Matrices

The Algorithmic Process

- Formulate the question
- Write down a basic idea, an approach
- Write down pseudocode
- Prove correctness
- Analyze pseudocode and think about upper and lower bounds
- Iterate

History of Algorithms

- Euclid, 300 BC
- Bhaskara, 6th c
- Al Khwarizmi, 9th c
- Fibonacci, 13th c
- Gauss, 18-19th c
- Babbage, 19th c
- Turing, 20th c
- von Neumann, 20th c
- Knuth, Karp, Tarjan, Rabin, …, 20-21st c

Reading for next class

- Big-Oh notation
  - Chapter 2, 3
- All sorting algorithms and their analysis
  - Chapters 2, 6, 7, 8