CS423 Finite Automata & Theory of Computation

TTh 12:30 - 13:50 in Smal Physics Lab 111 (section 1)

TTh 9:30 - 10:50 in Blow 331 (section 2)

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General Information

- Office Hours: TTh 11:00 - 12:00 in 114 McGl and W 2:30 - 3:00 on zoom or by email
- Grader: TBD for section 1 (office hour TBD on BB)
- Grader: TBD for section 2 (office hour TBD on BB)
- Textbook: Intro to the theory of computation (any edition), Michael Sipser. An e-book in PDF maybe available online.
- Prerequisites/background: Linear algebra, Data structures and algorithms, and Discrete math

Use of Blackboard

- Announcements
- Problem set (PSet)
- Solution sets
- Lecture notes
- Some recorded lectures (30-day limit)
- Grade calculation based on PSets, Midterm, and Final
- Check BB at least weekly

Lecture Notes (in various forms and places)

- Lecture slides: http://www.cs.wm.edu/∼ wm/
- Lecture notes posted on BB (A high-level summary)
- Your own class notes since not all taught in class are in the lecture notes or slides

Course Organization

- Automata theory: 50%
- Computability theory: 25%
- Complexity theory: 25%

Grading

- 10 PSets: 35%
- Midterm: 25% (on BB with a cheat sheet)
- Final: 40% (in-class with a cheat sheet)

Grading Scales

- $[90, 100]$: A or A-
- $[80, 90)$: B+, B, or B-
- $[70, 80)$: C+, C, or C-
- $[60, 70)$: D+, D, or D-
- $[0, 60)$: F

PSet Submission Policy and Accommodation

- Your PSets need to be typeset in LaTex with all figures drawn nicely and inserted. The pdf file is expected to be submitted to BB before or on the due date
- Extensions may be permitted for illness, family emergency, and travel to interviews and conferences. Requests must be made prior to the due date

PSet Completion Policy

- PSet must be typeset in LaTex. Nothing should be handwritten, including diagrams and tables
- Empty-hand policy when you discuss problems in a PSet with your classmates
- List your collaborators for each problem you discussed with the collaborators
- Cite all references you used to solve a problem
- In no case you should copy verbatim from other people's work without proper attribution, as this is considered plagiarism, thus a violation of the Honor Code

Exams

- Midterm: On BB, around Mar. 4-7, before Spring Break
- Final Exam: 9:00 -12:00, Wednesday, May 8 for section 1
- Final Exam: 9:00 - 12:00, Tuesday, May 7 for section 2
- For all exams, a cheat sheet (A4 size, both sides) is allowed

Other Important Dates (Please double check the dates)

- Jan. 24: Add/Drop starts until Feb. 3
- Jan. 25: First day of semester
- Mar. 4-7: Midterm on BB
- Mar 9 - 17: Spring Break
- Mar. 25: Last day to withdraw
- May 3: Last day of class and due date of your paper
- May 7: Final exam 9:00 - 12:00 (for section 2)
- May 8: Final exam 9:00 - 12:00 (for section 1)
- May 16 - 18: Commencement

Writing Assignments for CSci423W

- A paper of 2 to 3 pages about someone pioneering the field of ToC and one of his/her major research contributions, written in the IEEE standard format for CS conferences.
- The title of the paper should be in the format of “name and result”, e.g., “Alan Turing and the Enigma”, or “Stephen Cook and the Satisfiability Problem”, or “Rivest, Shamir, and Adleman and their RSA Cryptosystem”.
- More details after Spring break.

Creating solution sets in groups

- The class will be divided into ten groups, each being responsible for the production of one PSet solution. More details later.

Honor Code

- ”As a member of the William and Mary community, I pledge on my honor not to lie, or steal, either in my academic or personal life. I understand that such acts violates the Honor Code and undermine the community of trust, of which we are all stewards.”
- Academic honesty, the cornerstone of teaching and learning, lays the foundation for lifelong integrity. The Honor Code is, as always, in effect in this course. Please go to the ”Honor System” page in the wm.edu site to read the complete honor code document.

Student Accessibility Services
William & Mary accommodates students with disabilities in accordance with federal laws and university policy. Any student who feels they may need an accommodation based on the impact of a learning, psychiatric, physical, or chronic health diagnosis should contact Student Accessibility Services staff at 757-221-2512 or at sas@wm.edu to determine if accommodations are warranted and to obtain an official letter of accommodation. For more information, please go to www.wm.edu/sas
Please inform me privately of any accommodations you have arranged with the Office of SAS.

Mental and Physical Well-Being:
William&Mary recognizes that students juggle different responsibilities and can face challenges that make learning difficult. There are many resources available at W&M to help students navigate emotional/psychological, physical/medical, material/accessibility concerns, including:

- The W&M Counseling Center at (757) 221-3620. Services are free and confidential.
- The W&M Health Center at (757) 221-4386.
- For additional support or resources and questions, contact the Dean of Students at 757-221-2510.
- For other resources available to students, see https://tinyurl.com/wmmentalhealth

My goal: I will try my best to be understanding, fair, helpful, while creating a healthy learning experience for all.

- Here is how I will address student absences: a student's absence itself will not be part of the student's grade; I will also record some lectures and upload them to Blackboard so that the student can access the missing ones; the student should also communicate with me on how to handle possible late PSets.
- Here is how I will address instructor absence: If only a couple of lectures are missed, I will make up some of the missing ones through recorded lectures; if too many are missed, the department will get another instructor involved.
- Although recorded lectures can be of great help in some situations, please don't forget that each recording is only kept for 30 days and in-person attendance is often better.

1.1 Three areas of ToC (*Sipser 0.1*)

- Theory of Computation is to study the fundamental capabilities and limitations of computers. It contains three areas.
- Why Finite Automata? Finite automata are devices to recognize languages (set of strings).
- In the context of theoretical computer science, a finite automaton is a mathematical model of computation that operates on an input string of symbols and transitions between states according to a set of rules.

- Automata theory: Models of computation. Seeking a precise and concise definition of a computer.
- Computability theory: What can and cannot a computer do? Study of computationally unsolvable versus computationally solvable problems. Determining whether a problem is unsolvable by computer algorithms.
- Complexity theory: What can a computer do efficiently? Computationally hard versus computationally easy problems. For example, factorization versus sorting. Cryptography needs hard problems such as factorization to ensure security.
- Consider an example below.

- A farmer (F) with a cabbage (C), a dog (D), and a goat (G) wants to cross a river.
- There is a boat which can only carry the farmer plus one more.
- At any time, the cabbage and the goat cannot be left alone neither can the dog and the goat.
- How can the farmer cross the river?
- A finite automaton with start state $FCDG = \emptyset$ and accept state $\emptyset = FCDG$ can solve the puzzle.

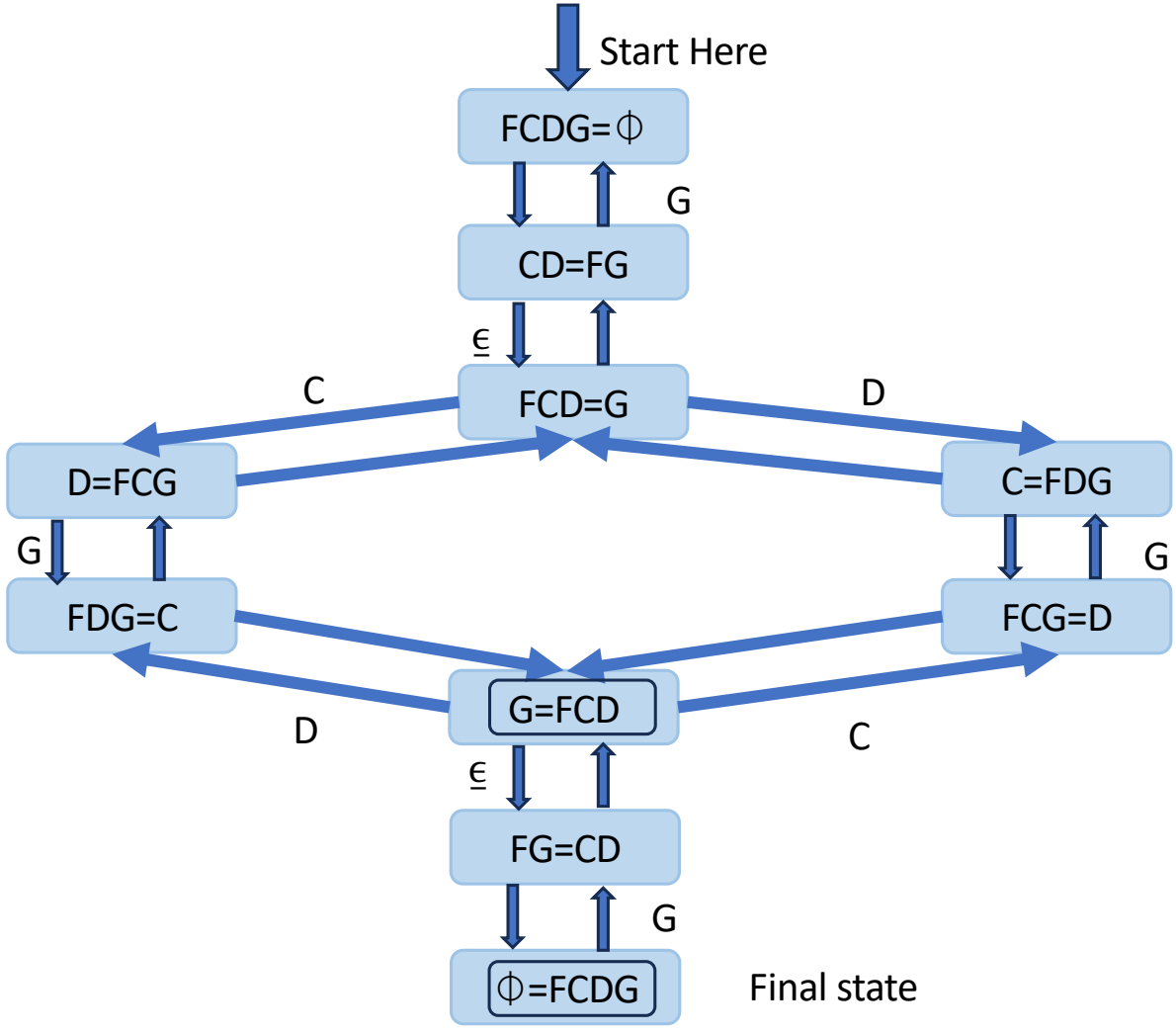

Figure 1: A DFA that solves the river crossing problem