CS 525 - Computational Complexity (Spring 2003)

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1 Preview

This course is intended for a graduate audience in the CSEE and Mathematics Departments. It will serve as a thorough introduction to the fundamentals of Computational Complexity.

2 Pre-requisites

A course on Analysis of Algorithms and a course in Finite Automata Theory.

3 Logistics

1. Class Times Tu - Th $9:30\ am - 10:45\ am$
2. Location - 801 ESB
3. Office Hours - By appointment
4. Class URL: `http://www.csee.wvu.edu/~ksmani/sp03/cc/cc.html`

4 Syllabus sketch

1. Introduction to Computability - Turing Machine Concepts, Multi-tape and Non-deterministic Turing Machines, Church's Thesis, RAMs. (See Chapter 2 of [HS01].)
2. Undecidability - Decision problems, Undecidable problems, Pairing Functions, Computably enumerable sets, Halting Problem, Recursion Theorem, Rice's Theorem, Turing reductions and Oracle Turing Machines. (See Chapter 3 of [HS01].)
3. Introduction to Complexity Theory - Complexity Classes and Complexity Measures. (See Chapter 4 of [HS01].)
4. Basic results of Complexity Theory - Linear Compression and Speedup, Constructible Functions, Tape reduction, Separation results, Translation Techniques and Padding, Relations between the Standard classes. (See Chapter 5 of [HS01].)
5. Non-determinism and `NP-completeness` - Characterizing `NP`, the class `P`, Enumerations, `NP-completeness`, The Cook-Levin Theorem and `NP-complete` problems. (See Chapter 6 of [HS01].)
6. Relative Computability - `NP-Hardness`, Search Problems, The Structure of `NP`, The Polynomial Hierarchy, `PSPACE`, `EXPTIME`, Polynomial Time and Logarithmic Space. (See Chapter 7 of [HS01].)

5 Material

For the most part, this course will be based on selected Chapters of [HS01]. [GJ79] and [Pap94] are highly recommended for supplemental reading.

6 Assessment

1. Quizzes (2) - Two quizzes will be held; one on February 13 and the other on April 17. These quizzes will be in-class and closed book. Each quiz is worth 20% (for a total of 40%) of your grade.
2. Midterm - The midterm will be held on March 13. It is in-class, closed book and worth 30% of your grade.
3. Final - The final will be held on May 8, $11:00-13:00$. It is in-class, closed book and worth 30% of your grade.

A maximum of 10 points is reserved for class performance, which includes regular attendance, participating in class discussions and presenting a research paper.

7 Grade Boundaries

1. **A** - ≥ 90
2. **B** - $75-89$
3. **C** - $60-74$
4. **D** - $50-59$
5. **F** - $0-49$

8 Social Justice Statement

West Virginia University is committed to social justice. I concur with that commitment and expect to foster a nurturing learning environment, based upon open communication, mutual respect and non-discrimination. Our University does not discriminate on the basis of race, sex, age, disability, veteran status, religon, sexual orientation, color or national origin. Any suggestions to further such a positive and open environment in this class will be appreciated and given serious consideration. If you are a person with a disability and anticipate needing any type accommodation, in order to participate in this class, please advise me of the same and make appropriate arrangments with Disability Services $(293-6700)$.

If you feel that you are being treated inappropriately or unfairly in any way, please feel free to bring your concerns to my attention; rest assured that doing so will not prejudice the grading process. In return, I expect you to behave professionally and ethically.

References

[GJ79] M. R. Garey and D. S. Johnson. *Computers and Intractability: A Guide to the Theory of NP-Completeness.* W. H. Freeman Company, San Francisco, 1979.

[HS01] Steven Homer and Alan L. Selman. *Computability and Complexity Theory.* Springer-Verlag, 2001.

[Pap94] Christos H. Papadimitriou. *Computational Complexity.* Addison-Wesley, New York, 1994.