Curriculum Vitae

Tanbir Ahmed

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Education

2009 – 2013 **Ph.D. in Computer Science**, Concordia University, Montréal, Canada.
Thesis: *Some results in extremal combinatorics*. Advisor: Prof. Clement Lam.

2005 – 2009 **M.Sc. in Computer Science**, Concordia University, Montréal, Canada.
Thesis: *An implementation of the DPLL algorithm*. Advisor: Prof. Vašek Chvátal.

1996 – 2001 **B.Sc. in Computer Science and Engineering**, BUET, Dhaka, Bangladesh.

Experience

2024 – present **Research Associate**, University of Windsor, Windsor, Ontario, Canada.

2010 – present **Casual Researcher**, worked/published with the following mathematicians and computer scientists:

Laurent Bartholdi, Arie Bialostocki, Luis Boza, Curtis Bright, Srecko Brlek, José M. R. Caballero, Janusz Dybizbański, Michael G. Eldredge, André Kézdy, Oliver Kullmann, Clement Lam, Jonathan J. Marler, Thang Pham, Maria P. Revuelta, Maria I. Sanz, Daniel Schaal, Hunter Snevily, Le Anh Vinh, Douglas B. West, David Wildstrom

2021 – 2024 **AI Developer**, ICM MeTRO project, Montréal, Canada.

2010 – 2021 **Clinical Research Software Designer**, Montréal Heart Institute, Canada.

2015 – 2018 **Post Doctoral Fellow**, LaCIM, UQAM, Montréal, Canada.

2013 – 2015 **Research Associate**, Concordia University, Montréal, Canada.

2005 – 2013 **Research Assistant**, Concordia University, Montréal, Canada.

2005 – 2010 **Teaching Assistant**, Concordia University, Montréal, Canada.

2002 – 2005 **Lecturer**, Southeast University, Bangladesh.

Research Interests

Computer-assisted proofs, SAT-solving, Mathematical Programming, Artificial Intelligence, Ramsey Theory on the Integers, Discrete Mathematics, Experimental Mathematics.

Teaching Interests

- **Computer Science (Undergraduate):** Discrete Mathematics, Algorithms and Data Structures, Artificial Intelligence Fundamentals, Web Application Development, Introduction to Machine Learning.
- **Mathematics (Undergraduate)**: Introduction to Combinatorics, Graph Theory and Applications, Mathematical Foundations for Computer Science.
- **Computer Science (Graduate)**: Advanced Algorithms and Optimization, Natural Language Processing, Experimental Methods in Computer Science, Cloud Computing and AI Integration.
- **Mathematics (Graduate)**: Advanced Topics in Discrete Mathematics, Combinatorial Optimization, Mathematics of AI and Machine Learning.
- **Interdisciplinary courses**: AI and Mathematical Modeling, Computational Discrete Mathematics.

Research

Journal articles (Published)

2023 18. T. Ahmed, L. Boza, M. P. Revuelta, M. I. Sanz, Exact values and lower bounds on the n-color weak Schur numbers for $n = 2, 3$., The Ramanujan Journal, 62 (2) (2023), 347–363. Open access, (2023).

2022 17. L. Bartholdi, J. M. R. Caballero and T. Ahmed, Thue–Morse substitution and self similar groups and algebras, Algebra and Discrete Mathematics, 34 (1) (2022), 1–14.

2019 16. T. Ahmed, A. Bialostocki, T. Pham and L. A. Vinh, Power Sum Polynomials as Relaxed EGZ Polynomials, Integers, 19, A49.

15. T. Ahmed and J. M. R. Caballero, A Family of doubly stochastic matrices involving Chebyshev polynomials, Algebra and Discrete Mathematics, 27 (2), 155–164.

2016 14. T. Ahmed and D. Schaal, On Generalized Schur numbers, Experimental Mathematics, **25 (2)**, 213–218.

13. T. Ahmed, On colouring integers avoiding t-AP distance sets, Algebra and Discrete Math., **22 (1)**, 1–10.

2015 12. T. Ahmed and D. Wildstrom, On distance sets in the triangular lattice, Bull. ICA **75**, 118–127.

11. T. Ahmed, A. Kézdy and Douglas B. West, Remembering Hunter Snevily , Bull. ICA **73**, 7–17.

2014 10. T. Ahmed, O. Kullmann and H. Snevily, On the van der Waerden numbers $w(2; 3, t)$. Disc. Appl. Math., **174**, 27–51. This paper garnered significant attention from diverse sections of the CS and Math communities:

- Cited in D. E. Knuth's legendary book *The Art of Computer Programming*.

- Motivated the SAT community to introduce Van der Waerden problems in SAT 2011 competition (an early draft was available at that time).

- Motivated Cube and Conquer to use DPLL as a partitioning tool based on the experimental evidence that DPLL performs better on certain problems such as the van der Waerden numbers.

- Motivated mathematicians to settle the elusive quadratic bound conjecture of $w(2; 3, t)$.

9. T. Ahmed and H. Snevily, The α-labeling number of comets is 2, Bull. ICA **72**, 25–40.

2013 8. T. Ahmed and H. Snevily, Sparse Distance sets in the Triangular Lattice, The Electronic J. of Combinatorics **20(4)**, #P33.

7. T. Ahmed, J. Dybizbański and H. Snevily, Unique Sequences Containing No k-Term Arithmetic Progressions, The Electronic J. of Combinatorics **20(4)**, #P29.

6. T. Ahmed and H. Snevily, Some properties of Roller Coaster permutations, Bull. ICA **68**, 55–69.

5. T. Ahmed, M. G. Eldredge, J. J. Marler and H. Snevily, Strict Schur numbers, Integers **13**, A22.

4. T. Ahmed, Some more van der Waerden numbers, Journal of Integer Sequences **16(4)**, A13.4.4.

2012 3. T. Ahmed, On computation of exact van der Waerden numbers, Integers **12(3)**, 417–425; **11**, A71.

2010 2. T. Ahmed, Two new van der Waerden numbers: $w(2; 3, 17)$ and $w(2; 3, 18)$, Integers **10(4)**, 369–377. A32.

- Introduced basic application of a technique which soon evolved as Cube and Conquer.

- First use of distributed SAT-solving to compute Ramsey-type numbers.

2009 1. T. Ahmed, Some new van der Waerden numbers and some van der Waerden type numbers, Integers **9(1)**, 65–76, A6.

Journal articles (Submitted)

2024 3. T. Ahmed, R. Malo, and D. Schaal, A Note on the Rado numbers $R_k(3, c)$, Submitted to a journal.

2. T. Ahmed, L. Boza, M. P. Revuelta, and M. I. Sanz, On the 3-color off-diagonal generalized Schur numbers $S(3; 2, k_1, k_2)$, Submitted to a journal.

1. T. Ahmed, L. Boza, M. P. Revuelta, and M. I. Sanz, On the 3-color off-diagonal generalized Schur numbers $S(3; 2, 2, k)$, Submitted to a journal.

Conference papers (published)

2023 2. T. Ahmed, L. Boza, M. P. Revuelta, and M. I. Sanz, Lower bounds and exact values of the 2-color off-diagonal generalized weak Schur numbers $WS(2; k_1, k_2)$, Procedia Computer Science, 223 (2023), 403-405. XII Latin American Algorithms, Graphs, and Optimization Symp. (LAGOS 2023).

1. 2006 T. Ahmed, G. Garhne, Parallel Composition of Finite State Activity Automata, 8th International Workshop on Descriptional Complexity of Formal Systems - DCFS 2006, Las Cruces, New Mexico, USA, June 21–23, 2006

Invited Talks

2023 2. Computer Assisted discovery of patterns and properties in Ramsey Theory on the Integers, University of Windsor CS Colloquium (Video link), Windsor, ON, Canada.

2015 1. Ramsey Theory on the Integers - Some Results and Conjectures on the Schur Numbers, Seminar at LACIM of Centre de Recherche Mathematique (CRM), 201, av. du Président-Kennedy, local PK-4323, Montréal, QC, Canada.

Discovery of Combinatorial Objects

- ◇ Discovered **65** previously unknown van der Waerden numbers (see Wikipedia entry).
- ◇ Contributions in the Online Encyclopaedia of Integer Sequences (OEIS):
  A232996, A003002, A065825, A217005, A217007, A217008, A217058, A217059,
  A217060, A217236, A217237, A171081, A171082, A217235, A217037, A225231.

Review / Referee services

- ◇ AMS - Mathematics of Computation
- ◇ Discrete Applied Mathematics
- ◇ Rocky Mountain Journal of Mathematics
- ◇ Journal of Inequalities and Applications
- ◇ Bulletin of the Korean Mathematical Society
- ◇ Integers - Electronic Journal of Combinatorial Number Theory
- ◇ The Ramanujan Journal
- ◇ AMS - Mathematics Reviews:
  MR3061011, MR3062784, MR3063975, MR3134264, MR3190574, MR3194752, MR3231981, MR3274878.
- ◇ ACM - Computing Reviews:
  CR141762, CR141855, CR142155, CR142308, CR142738, CR142894.

Unpublished Surveys / Other publications

2008 3. T. Ahmed, Erdős problem on point sets - a survey (report)

2007 2. T. Ahmed, A survey on the Chvátal-Erdős theorem (Cited by Graphs Combin. and Chinese Annals of Math.; Used as study material at UC Davis Graph Theory course) (report)

2004 1. T. Ahmed, M. S. Ali, M. Kaykobad, Brain Twisters - Delightful Mathematics, Voyager Publishers, Bangladesh.

Research Mentoring experience

2024 – **Lamina Zaman (C.S., Undergraduate, U. Windsor)**. Mentoring a project in extremal combinatorics and SAT solving. Several new numerical and theoretical results are obtained and a paper is under preparation for a journal submission.

2024 – **Amadou Keita (MathStat, Ph.D., U. Windsor)**. Mentoring a project in combinatorial design theory.

Teaching

As Instructor (2002 – 2005), Southeast University, Dhaka, Bangladesh
I have participated in the development of courses such as Data Structures, Discrete Mathematics, and Mathematical Analysis for Computer Science. I have also worked as an instructor for these courses:

2005	Spring	Discrete Mathematics (CSE 121)
2004	Fall	Mathematical Analysis for Computer Science (CSE 231)
2004	Spring	Discrete Mathematics (CSE 121)
2003	Fall	Mathematical Analysis for Computer Science (CSE 231)
2003	Spring	Discrete Mathematics (CSE 121)
2002	Fall	Mathematical Analysis for Computer Science (CSE 231)

The number of students in the CSE 121 classes were between 20–30 and in the CSE 231 classes were between 10–15.

Industry Experience / skills

In Canada, I have worked in the software development industry (cloud solutions, web applications, DevOps) in the field of clinical research for more than a decade. Recently, I switched to AI development (LLM-related applications in particular) through several diplomas and nano-degrees such as:

- ◇ **NLP Specialization**, DeepLearning.ai, 2021.
- ◇ **AI for Medicine**, DeepLearning.ai, 2020.
- ◇ **Self-Driving Car Engineering Nanodegree**, Udacity, 2019.
- ◇ **Machine Learning Nanodegree**, Udacity, 2018.

At various times, I have used the following languages, tools, and libraries for research and development:

- ◇ **Languages:** Python, JavaScript, PHP, C, C++
- ◇ **Python AI/ML frameworks:** PyTorch, TensorFlow, Scikit-Learn, Keras, FastAI.
- ◇ **NLP Tools:** BERT, Transformers, spaCy, LangChain, NLTK, FastText, Gensim, OpenAI API.
- ◇ **Cloud Platforms:** GCP, AWS, MS Azure.
- ◇ **Cloud Dev. Python tools:** google-cloud-*, boto3, azure-sdk, GitPython, Docker-py, Python-Kubernetes, CDKTF, Python-Terraform, PyMongo.
- ◇ **Python web frameworks:** Django, FastAPI, Flask, SQLAlchemy, sqlite3, pymongo, redis-py.
- ◇ **JS tools:** React, Express, Mongoose, Sequelize, Firebase, Node.js, Axios, serverless.
- ◇ **CI/CD:** GKE, AKS, ECS, CircleCI, TravisCI, Google Cloud Build, Azure DevOps.
- ◇ **Data Engg. Tools:** pandas, NumPy, PySpark, PostgreSQL, MySQL, SQLite, Apache Kafka, ETL.
- ◇ **Visualization Tools:** Matplotlib, Seaborn, Plotly, Dash, Tableau.
- ◇ **Project Management Tools:** Agile methodologies, Jira, Confluence
- ◇ **Version Control:** Git, GitHub, GitLab, Bitbucket.
- ◇ **Testing Frameworks:** Pytest, Unittest, Selenium, JUnit.
- ◇ **Monitoring and Logging:** ELK Stack (Elasticsearch, Logstash, Kibana)

Voluntary Activities

In Bangladesh, during my time at Southeast University, I was heavily involved in encouraging Computer Science and Mathematics students to participate in competitive programming. Some of my notable responsibilities were:

- ◇ **Contest Director**, *National Computer Programming Contest (NCPC)*, 2003, organized jointly by Bangladesh Computer Council, Southeast University, and Ministry of Science and ICT.
- ◇ **Judge**, ACM - ICPC, Asia Region, Dhaka Site, 2002.
- ◇ **Contest Director**, *Regional Warm-up contest*, 2002.