

# Mustafa A. Abdallah

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## Research Interests

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Game Theory, Deep Learning, Behavioral Decision-Making, Data Science, Network Security, and Speech Recognition.

## Education

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**Purdue University, West Lafayette, IN, USA.**

**Aug. 2017 – May 2022**

- PhD in Computer Engineering under supervision of Professors Saurabh Bagchi and Shreyas Sundaram, Current GPA: 4.0/4.0
- Courses: Data Analytics for Scientists and Engineers, Advanced Game Theory, Graph Theory, Fault Tolerant Computer Systems, Lumped System Theory, Optimization Methods For Systems And Control, Structure & Dynamics of Large-Scale Networks.

**Cairo University, Egypt.**

**Sep. 2012 – Jul. 2016, Sep. 2007 – Jul. 2012**

- M.Sc. in Engineering Mathematics, GPA: 3.9/4.0 Sep. 2012 – Jul. 2016
- B.Sc. in Electrical Engineering, GPA: 87.60/100, Distinction with honors, rank: 12/320 Sep. 2007 – Jul. 2012

## Relevant Experience

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- **Research Assistant**; School of Electrical and Computer Engineering, Purdue University. Aug. 2017 – Present
  - Developed a behavioral security game model for studying security of Cyber Physical Systems.
  - Illustrated the effects of behavioral decision-making on security resource allocations via five real-world interdependent Cyber Physical Systems with different attack scenarios.
  - Developed an algorithm for automatic tuning of genomic error correction tools using Recurrent Neural Network.
  - Developed a machine learning algorithm to predict failure of sensor nodes in smart agriculture system.
- **Data Science Research Intern**; Adobe Research, San Jose, CA. May 2021 – Aug. 2021
  - Proposed meta-learning approach for automatic time-series forecasting model selection to reduce cloud costs.
  - Developed meta-features and performance benchmarks on large-scale time-series testbeds with 600 datasets.
- **Data and Operations Research Scientist Intern**; Principal Financial Group, Iowa. May 2020 – Aug. 2020
  - Developed Kalman filter model to predict financial health of companies and enhance asset allocation.
  - Performed exploratory data analysis and system identification on large-scale data with 2500 companies.
- **Part-time Engineer**; Engineering Company for the Development of Digital Systems (RDI), Egypt. 2012 – 2017
  - Applied deep learning techniques to enhance performance of Arabic-based Speech Recognition applications.
  - Developed Speaker-Clustering algorithm in Multi-Genre Broadcast (MGB) challenge.
- **Research and Teaching Assistant**; Engineering Mathematics and Physics Dept., Cairo University. 2012 – 2017
  - Proposed automatic transcribing of unlabeled speech data using confidence measures.
  - Taught several undergraduate engineering mathematics courses.
- **Summer Intern**; National Telecommunications Regulatory Authority (NTRA), Egypt. Jun. 2011 – Sep. 2011
  - Performed site measurements (i.e., power and connectivity) and helped evaluate mobile operators.

## Technical Skills

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- **Programming languages:** Python, Java, Matlab, C++, and Java Script.
- **Systems and Database Management:** Linux, Windows, MongoDB, and SQL.
- **Developments tools:** MS Visual Studio, Git Source Control, and LaTeX.
- **Libraries and SDKs:** TensorFlow, Kaldi, Pandas, Cudamat, Numpy and Keras.
- **Virtual Environment and Package Management:** Conda, and Pip.

## Leadership and Mentoring Experience

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- Mentor of an undergraduate student on NSF SaTC Project, Purdue University. Dec. 2018 – Dec. 2019
- President; Egyptian Student Association at Purdue. May 2018 – May 2019
- Student academic member in IEEE Cairo University Student Branch (IEEE-CUSB). Fall 2011 – Spring 2012

## Honors and Awards

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- Purdue Bilsland Dissertation Fellowship, Purdue University. 2021
- ECE COVID-19 Impact Scholarship, Purdue University. 2021
- Travel Support Award for attending virtual Conference on Decision and Control (CDC). 2021
- Dependable Computing Systems Lab (DCSL) Group Champ Award, Purdue University. 2020
- Travel Support Award for attending virtual Conference on Decision and Control (CDC). 2020
- Travel Award for attending American Control Conference (ACC). 2019
- Best Fresher in DCSL Research Group, Purdue University. 2017
- Graduate Research Assistantship, Purdue University. 2017
- M.Sc. fellowship, Faculty of Engineering, Cairo University. 2012 – 2016
- Best Computer Engineering Graduation Project of the year 2012, Smart Village, Egypt. 2012
- 3rd place in Orange Competition for Graduation Projects of the year 2012, Smart Village, Egypt. Aug. 2012.
- B.Sc. with Honors from Faculty of Engineering, Cairo University. 2012
- Undergraduate Academic Outstanding Award from the Egyptian Government. 2007 – 2012

## Publications

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### Journal Papers

- **M. Abdallah**, P. Naghizadeh, A. Hota, T. Cason, S. Bagchi, and S. Sundaram, “Behavioral and Game-Theoretic Security Investments in Interdependent Systems Modeled by Attack Graphs,” *IEEE Transactions on Control of Network Systems (TCNS)* (Impact Factor: 4.802), vol. 7, no. 4, pp. 1585-1596, December 2020.[Link]
- B. Chatterjee, D. Seo, S. Chakraborty, S. Avlani, X. Jiang, H. Zhang, **M. Abdallah**, N. Raghunathan, C. Mousoulis, A. Shakouri, S. Bagchi, D. Peroulis, and S. Sen, “Context-Aware Collaborative-Intelligence with Spatio-Temporal In-Sensor-Analytics for Efficient Communication in a Large-Area IoT Testbed,” *IEEE Internet of Things Journal (IoT-J)* (Impact Factor: 9.936), vol. 8, no. 8, pp. 6800-6814, April 2021.[Link]
- D. Woods, **M. Abdallah**, S. Bagchi, S. Sundaram, and T. Cason, “Network Defense and Behavioral Biases: An Experimental Study,” *Experimental Economics Journal* (Impact Factor: 2.367), February 2021.[Link]
- **M. Abdallah**, A. Mahgoub, S. Bagchi, and S. Chaterji, “Athena: Automated Tuning of Genomic Error Correction Algorithms using Language Models,” *Nature Scientific Reports* (Impact Factor: 4.525), vol. 9, no. 1, 2019.[Link]
- **M. Abdallah**, A. Moussa, S. Abdou, M. Rashwan, and H. Al-Barhamtoshy, “Automatic Selection of Speech Data based on Confidence Measure,” *International Journal of Engineering and Technology*, vol. 8, pp. 158-160, 2019.[Link]
- M. Al-Marri, H. Raafat, **M. Abdallah**, S. Abdou, and M. Rashwan, “Computer Aided Quran Pronunciation using DNN,” *Journal of Intelligent & Fuzzy Systems* (Impact Factor: 1.851), vol. 34, pp. 3257-3271, 2018.[Link]

### Conference Papers

- S. Suryavansh, T. Gupta, **M. Abdallah**, C. Bothra, M. Chiang, C. Peng, K. Kim, S. Bagchi, “I-BOT: Interference-Based Orchestration of Tasks for Dynamic Edge Computing,” Submitted to 22nd ACM Middleware Conference, 2021.
- **M. Abdallah**, D. Woods, P. Naghizadeh, I. Khalil, T. Cason, S. Sundaram, and S. Bagchi, “TASHAROK: Using Mechanism Design for Enhancing Security Resource Allocation on Interdependent Systems Modeled by Attack Graphs,” Submitted to ACM SIGMETRICS International Conference on Measurement and Modeling of Computer Systems (SIGMETRICS), 2021.
- **M. Abdallah**, D. Woods, P. Naghizadeh, I. Khalil, T. Cason, S. Sundaram, and S. Bagchi, “Morshed: Guiding Behavioral Decision-Makers towards Better Security Investment in Interdependent Systems,” *Proceedings of the 2021 ACM Asia Conference on Computer and Communications Security (ASIACCS)*, pp. 378-392 (Acceptance rate: 28/157 = 17.8%), May 2021.[Link]

- **M. Abdallah**, S. Mitra, S. Sundaram, and S. Bagchi, “HIOA-CPS: Combining Hybrid Input-Output Automaton and Game Theory for Security Modeling of Cyber-Physical Systems,” IEEE Security and Privacy Workshops (SPW), pp. 253-259, 2021.[Link]
- **M. Abdallah**, T. Cason, S. Bagchi, and S. Sundaram, “The Effect of Behavioral Probability Weighting in a Simultaneous Multi-Target Attacker-Defender Game,” IEEE European Control Conference (ECC), July 2021.[Link]
- **M. Abdallah**, T. Cason, S. Bagchi, and S. Sundaram, “The Effect of Behavioral Probability Weighting in a Sequential Defender-Attacker Game,” IEEE Conference on Decision and Control (CDC), pp. 3255-3260, December 2020.[Link]
- **M. Abdallah**, W. Lee, N. Raghunathan, C. Mousoulis, J. W. Sutherland, and S. Bagchi, “Anomaly Detection through Transfer Learning in Agriculture and Manufacturing IoT Systems,” Submitted to 26th ACM Conference on Knowledge Discovery and Data Mining (KDD), February 2020.[Link]
- **M. Abdallah**, P. Naghizadeh, T. Cason, S. Bagchi, and S. Sundaram, “Protecting Assets with Heterogeneous Valuations under Behavioral Probability Weighting,” IEEE Conference on Decision and Control (CDC), pp. 5374-5379, 2019.[Link]
- **M. Abdallah**, P. Naghizadeh, A. R. Hota, T. Cason, S. Bagchi, and S. Sundaram, “The Impacts of Behavioral Probability Weighting on Security Investments in Interdependent Systems,” American Control Conference (ACC), pp. 5260-5265, 2019.[Link]
- H. Ahmed, M. Elaraby, A. Moussa, **M. Abdallah**, and M. Rashwan “Unsupervised Speaker Clustering based on SOM and I-vectors for Speech Recognition Systems,” Third Arabic NLP Workshop, European Chapter of the Association for Computational Linguistics (EACL), pp. 79-83, April 2017.[Link]
- M. Elaraby, **M. Abdallah**, S. Abdou, and M. Rashwan, “A Deep Neural Networks (DNN) Based models for a Computer Aided Pronunciation Learning System,” International Conference on Speech and Computer (SPECOM), Springer Proceedings, pp. 51-58, 2016.[Link]
- **M. Abdallah**, M. Al-Marri, S. Abdou, M. Rashwan, and M. A. El-Gamal, “Improving Holy Qur’an recitation system using Hybrid DNN-HMM approach,” Third International Conference on Islamic Applications in Computer Science, Turkey, 2015.[Link]
- **M. Abdallah**, M. Saad, M. Montaser, M. Lasheen, M. Mostafa, S. Abdou, and M. Rashwan, “Implementing Arabic-based Speech Recognition System on an Android Platform,” The Twelfth Conference on Language Engineering (ES-OLEC), Ain Shams University, Egypt, November 2012.

### Working Papers

- **M. Abdallah**, R. Rossi, K. Mahadik, H. Zhao, S. Kim, H. Wang, and S. Bagchi, “AutoForecast: Meta-Learning for Fast Automatic Forecasting Model Selection,” Under submission as a conference paper at ICLR, 2022.
- **M. Abdallah**, D. Woods, T. Cason, S. Bagchi, and S. Sundaram, “A Game-Theoretic Analysis to Protect Heterogeneous Common Pool Resources under Behavioral Probability Weighting,” Under submission as a journal paper at Games and Economic Behavior (GEB), October 2021.
- **M. Abdallah**, P. Naghizadeh, D. Woods, T. Cason, S. Bagchi, and S. Sundaram, “On the Participation of Defenders and Behavioral Bias in Tax-based Mechanisms in Systems Modeled by Directed Attack Graphs,” 2021.

### Patents

- **M. Abdallah**, R. Rossi, K. Mahadik, H. Zhao, S. Kim, H. Wang, and S. Bagchi, “AutoForecast: Meta-Learning for Fast Automatic Forecasting Model Selection,” Pending submission, 2021.

### Poster Presentations

- **M. Abdallah**, P. Naghizadeh, A. Hota, T. Cason, S. Bagchi, and S. Sundaram, “Impacts of Behavioral Probability Weighting on Security Investments in Interdependent Systems,” The Annual CERIAS Information Security Symposium, Purdue University (virtual), September 21, 2020.
- **M. Abdallah**, “Kalman Filter Application for Financial Distress Prediction,” Intern Poster Session, Principal Financial Group, August 13, 2020.
- **M. Abdallah**, W. Lee, N. Raghunathan, C. Mousoulis, J. W. Sutherland, and S. Bagchi, “Anomaly Detection and Transferring Learning across sensors in IoT system,” SMART Industry Day, Birck Atrium, Purdue University, December 5, 2019.
- H. Zhang, **M. Abdallah**, X. Jiang, N. Raghunathan, and S. Bagchi, “Reliable and Energy Efficient Wireless Mesh Network and Data Visualization,” SMART Industry Day, Birck Atrium, Purdue University, November 18, 2018.
- **M. Abdallah**, A. Hota, T. Cason, S. Bagchi, and S. Sundaram, “The Impact of Behavioral Probability Weighting on Security Investments in Interdependent Systems,” 7th Midwest Workshop on Control and Game Theory, Michigan State University (MSU), Michigan, April 28-29, 2018.

## Oral Presentations and Talks

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- **M. Abdallah**, “The Effect of Behavioral Probability Weighting in a Simultaneous Multi-Target Attacker-Defender Game,” IEEE ECC, virtual, July 2021.
- **M. Abdallah**, “Morshed: Guiding Behavioral Decision-Makers towards Better Security Investment in Interdependent Systems,” ACM ASIACCS 2021, virtual, June 2021.
- **M. Abdallah**, “HIOA-CPS: Combining Hybrid Input-Output Automaton and Game Theory for Security Modeling of Cyber-Physical Systems,” IEEE Security and Privacy Workshops 2021, virtual, May 2021.
- **M. Abdallah**, “Protecting Assets with Heterogeneous Valuations under Behavioral Probability Weighting,” IEEE CDC 2019, Nice, France, December 2019.
- **M. Abdallah**, “The Impacts of Behavioral Probability Weighting on Security Investments in Interdependent Systems,” IEEE ACC 2019, Philadelphia, Pennsylvania, USA, July 2019.
- **M. Abdallah**, “A Deep Neural Networks (DNN) Based models for a Computer Aided Pronunciation Learning System,” SPECOM 2016, Budapest, Hungary, August 2016.

## Teaching Experience

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- Teaching Assistant; Engineering Math and Physics Dept., Cairo University. Fall 2012 – Spring 2017
- Tasks: Solving exercises in tutorials, discussing assignments, and marking exams.
- Courses:
  - Probability and Statistics: Spring 2014, Spring 2015, Summer 2016.
  - Linear Algebra and Numerical Analysis: Fall 2012, Spring 2016, Spring 2017.
  - Differential Equations: Fall 2013, Fall 2015, Fall 2016.
  - Calculus: Fall 2014, Summer 2015, Spring 2017.

## Peer-Reviewing Experience

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### Conference Reviewer

- IEEE Conference on Decision and Control (CDC). 2019 – present
- European Control Conference (ECC). 2020 – present
- International Conference on Communication Systems & Networks (COMSNETS). 2020 – present

### Journal Reviewer

- The IEEE Transactions on Robotics (T-RO). 2020 – present
- The IEEE Transactions on Automatic Control (TAC). 2021 – present
- The IEEE Transactions on Networking (TNET). 2021 – present

## Professional References

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- **Shreyas Sundaram** - Marie Gordon Associate Professor at the school of Electrical and Computer Engineering, Purdue University.
  - Contact: sundara2@purdue.edu
- **Saurabh Bagchi** - Professor at the school of Electrical and Computer Engineering and the Department of Computer Science, Purdue University.
  - Contact: sbagchi@purdue.edu
- **Timothy Cason** - Distinguished Professor and Robert and Susan Gadowski Chair in Economics, Purdue University.
  - Contact: cason@purdue.edu
- **Parinaz Naghizadeh** - Assistant Professor at the Integrated Systems Engineering Department and the Electrical and Computer Engineering Department, Ohio State University.
  - Contact: naghizadeh.1@osu.edu
- **Ryan Rossi** - Senior Research Scientist, Adobe Research.
  - Contact: ryrossi@adobe.com