Academic CV

Anup Das

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Contents

1 Curriculum Vitae

1.1 Current position

Rank:	Associate Professor
Department:	Department of Electrical and Computer Engineering

1.2 Contact Information

Office Address:	Department of Electrical and Computer Engineering Drexel University 3101 Market Street, Suite 236 Philadelphia, PA 19104-2875, USA
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Personal URL:	`http://www.pages.drexel.edu/~ad3639/`

1.3 Education

2014	**Ph.D.** in Computer Engineering National University of Singapore, Singapore Advisor: Akash Kumar & Bharadwaj Veeravalli
2004	**B.E.** in Electronics and Telecommunication Engineering Jadavpur University, Kolkata (Calcutta), India

1.4 Employment

2022 – Present:	**Associate Professor** Department of Electrical and Computer Engineering Drexel University, Philadelphia, Pennsylvania
2018 – 2022:	**Assistant Professor** Department of Electrical and Computer Engineering Drexel University, Philadelphia, Pennsylvania
2015 – 2017:	**Research Scientist** IMEC Eindhoven, Netherlands
2014 – 2015:	**Post Doctoral Fellow** ARM-ECS Research Centre University of Southampton, Southampton, United Kingdom

2013 – 2014: **Singapore President Fellow**
National University of Singapore, Singapore

2011 – 2013: **Research Fellow**
National University of Singapore, Singapore

2008 – 2011: **Senior Design Engineer**
LSI Corporation
Bangalore, India

2007 – 2008: **Member of Technical Staff**
Transwitch Corporation
New Delhi, India

2004 – 2007: **Design Engineer**
STMicroelectronics
Noida, India

1.5 Research Activities

This section details my research activities, including awards, publications, and funding-related activity.

1.5.1 Google Scholar Citations

Total Citations:	**3163**
h-index:	**32**
i10-index:	**86**

1.5.2 US Patents

Total:	**1**
At Drexel:	**1**
Last Academic Year:	**0**

1. 2018 F. Catthoor et al., "Memory Structure Comprising Scratchpad Memory," US Patent 10,592,430, 2018.

1.5.3 Published Books

Total:	**1**
At Drexel:	**1**
Last Academic Year:	**0**

1. 2018 **A. Das**, A. Kumar, B. Veeravalli, and F. Catthoor, "Reliable and Energy Efficient Streaming Multiprocessor Systems," *Embedded Systems Series*, N. Dutt, G. Martin, and P. Marwedel (Editors), Springer, 2018.

1.5.4 Book Chapters (Published/In-Production)

Total: **7**
At Drexel: **5**
Last Academic Year: **2**

1. 2022 M. L. Varshika and **A. Das**, "Platform-based Design of Embedded Neuromorphic Systems," *Embedded Machine Learning for Cyber-Physical, IoT, and Edge Computing*, Springer, 2022.

2. 2022 S. Sahoo, **A. Das** and A. Kumar, "Fault Tolerant Architectures," *Handbook of Computer Architecture*, Springer, 2022.

3. 2021 E. Moyer and **A. Das**, "Machine Learning Applications to DNA Subsequence and Restriction Site Analysis," Springer, 2021.

4. 2020 W. Tan and **A. Das**, "Estimating the Respiratory Rate from ECG and PPG Using Machine Learning Techniques," *Machine Learning, Big Data and IoT for Medical Informatics,*, P. Kumar, Y. Kumar, and M. Tawhid (Editors), Elsevier, 2020.

5. 2019 **A. Das** and A. Kumar, "Runtime thermal management of many-core systems," *Many-Core Computing: Hardware and Software*, B. M. Al-Hashimi and G. V. Merrett (Editors), IET, 2019.

1.5.5 Refereed Journal Publications

Total: **29**
At Drexel: **18**
Last Academic Year: **7**

1. 2022 A. Balaji, K. Huynh, F. Catthoor, N. Dutt, J. Krichmar, and **A. Das**, "NeuSB: A Scalable Interconnect Architecture for Spiking Neuromorphic Hardware", *IEEE Transactions on Emerging Topics in Computing*, 2022. (Under Review)

2. 2022 L. M. Varshika, F. Corradi, and **A. Das**, "Nonvolatile Memories in Spiking Neural Network Architectures: Current and Emerging Trends", *Electronics, 11(10), 1610*, 2022.

3. 2022 A. Mishra, **A. Das**, and N. Kandasamy, "Built-In Functional Testing of Analog In-Memory Accelerators for Deep Neural Networks", *Electronics, 11(16), 2592*, 2022.

4. 2022 A. Paul, M. Tajin, **A. Das**, W. Mongan, and K. Dandekar, "Energy-Efficient Respiratory Anomaly Detection in Premature Newborn Infants", *Electronics, 11(5), 682*, 2022.

5. 2022 S. Song, A. Balaji, **A. Das** and N. Kandasamy, "Design-Technology Co-Optimization for NVM-based Neuromorphic Processing Elements", *ACM Transactions on Embedded Computing (TECS)*, 2022.

6. 2022 A. Paul, S. Song, T. Titirsha and **A. Das**, "On the Mitigation of Read Disturbances In Neuromorphic Inference Hardware", *IEEE Design and Test*, 2022.

7. 2021 S. Song, H. Chong, J. Baron, A. Balaji, **A. Das**, J. Shackleford, and N. Kandasamy, "DFSynthesizer: Dataflow-based Synthesis of Spiking Neural Networks to Neuromorphic Hardware", *ACM Transactions on Embedded Computing (TECS), 21(3), 1-35*, 2022.

8. 2021 S. Song, J. Hanamshet, A. Balaji, **A. Das**, J. Krichmar, N. Dutt, N. Kandasamy, and F. Catthoor, "Dynamic Reliability Management in Neuromorphic Computing", *ACM Journal on Emerging Technologies in Computing Systems (JETC), 17(4), 1-27*, 2021.

9. 2021 T. Titirsha, S. Song, **A. Das**, J. Krichmar, N. Dutt, N. Kandasamy, and F. Catthoor, "Endurance-Aware Mapping of Spiking Neural Networks to Neuromorphic Hardware", *IEEE Transactions on Parallel and Distributed Systems (TPDS), 33(2), 288-301*, 2021.

10. 2020 A. Balaji, S. Song, **A. Das**, J. Krichmar, N. Dutt, J. Shackleford, N. Kandasamy, and F. Catthoor, "Resource-Aware Mapping of Spiking Neural Networks via Spatial Decomposition", *IEEE Embedded Systems Letters (ESL), 13(3), 142-145*, 2020.

11. 2020 A. Balaji, T. Marty, **A. Das**, and F. Catthoor, "Run-time Mapping of Spiking Neural Networks to Neuromorphic Hardware", *Springer Journal of Signal Processing Systems (JSPS), 92(11), 1293-1302*, 2020.

12. 2020 A. Balaji, **A. Das**, Y. Wu, K. Huynh, F. Dell'Anna, G. Indiveri, J. Krichmar, N. Dutt, S. Schaafsma, and F. Catthoor, "Mapping spiking neural networks to neuromorphic hardware", *IEEE Transaction On Very Large Scale Integration (VLSI) Systems, 28 (1), 76-86*, 2020.

13. 2019 A. Balaji, S. Song, **A. Das**, J. Krichmar, N. Dutt, N. Kandasamy, and F. Catthoor, "A Framework to Explore Workload-Specific Performance and Lifetime Trade-offs in Neuromorphic Computing", *IEEE Computer Architecture Letters, 18 (2), 149-152*, 2019.

14. 2019 S. Song, **A. Das**, N. Kandasamy, and O. Mutlu, "Enabling and Exploiting Partition-Level Parallelism (PALP) in Phase Change Memories", *ACM Transactions on Embedded Computing Systems (TECS), 18 (5s), 1-25*, 2019.

15. 2018 A. Balaji, F. Corradi, **A. Das**, S. Pande, S. Schaafsma, and F. Catthoor, "Power-Accuracy Trade-offs for Heartbeat Classification on Neural Networks Hardware", *Journal of Low Power Electronics (JOLPE), 14 (4), 508-519*, 2018.

16. 2018 **A. Das**, P. Pradhapan, W. Groenendaal, P. Adiraju, R. Rajan, F. Catthoor, S. Schaafsma, J. Krichmar, N. Dutt and C. Van Hoof, "Unsupervised Heart-rate Estimation in Wearables With Liquid States and A Probabilistic Readout", *Elsevier Neural Networks, 99, 134-147*, 2018.

17. 2018 **A. Das**, F. Catthoor, A. Bourdoux and B. Gyselinckx, "Energy Efficient Mapping of LTE-A PHY Signal Processing Tasks on Microservers", *IEEE Transactions on Green Communication and Networking, 2 (2), 397-407*, 2018.

18. 2018 R. Rajan, R. Schaijk, **A. Das**, J. Romme, and F. Pasveer, "Reference-free Calibration in Sensor Networks", *IEEE Sensors Letters, 2 (3), 1-4*, 2018.

1.5.6 Refereed Conference Publications

Total: 60
At Drexel: 34
Last Academic Year: 8

1. 2022 A. Paul, S. Wagner, and **A. Das**, "Learning in Feedback-driven Recurrent Spiking Neural Networks using full-FORCE Training", *IEEE International Joint Conference on Neural Networks (IJCNN)*, 2022.

2. 2022 M. Halac, M. Isik, H. Ayaz, and **A. Das**, "Multiscale Voxel Based Decoding For Enhanced Natural Image Reconstruction From Brain Activity", *IEEE International Joint Conference on Neural Networks (IJCNN)*, 2022.

3. 2022 L. Niedermeier, K. Chen, J. Xing, **A. Das**, J. Kopsick, E. Scott, N. Sutton, K. Weber, N. Dutt, and J. L. Krichmar, "CARLsim 6: An Open Source Library for Large-Scale, Biologically Detailed Spiking Neural Network Simulation", *IEEE International Joint Conference on Neural Networks (IJCNN)*, 2022.

4. 2022 M. Isik, A. Paul, M. L. Varshika, and **A. Das**, "A design methodology for fault-tolerant computing using astrocyte neural networks", *19th ACM International Conference on Computing Frontiers (CF), pp. 169-172*, 2022.

5. 2022 M. Lakshmi Varshika, A. Balaji, F. Corradi, **A. Das**, J. Stuijt and F. Catthoor, "Design of Many-Core Big Little μBrains for Energy-Efficient Embedded Neuromorphic Computing", *Proceedings of the IEEE Design, Automation and Test in Europe Conference (DATE)*, 2022.

6. 2021 A. Paul, S. Song and **A. Das**, "Design Technology Co-Optimization for Neuromorphic Computing", *Proceedings of the* 12^{th} *IEEE International Green and Sustainable Computing Workshops (IGSC Workshops)*, 2021.

7. 2021 S. Song, M. Lakshmi Varshika, **A. Das** and N. Kandasamy, "A Design Flow for Mapping Spiking NeuralNetworks to Many-Core Neuromorphic Hardware", *Proceedings of the* 40^{th} *IEEE/ACM International Conference on Computer Aided Design (ICCAD)*, 2021.

8. 2021 S. Curzel, N. Agostini, S. Song, I. Dagli, A. Limaye, C. Tan, M. Minutoli, V. Castellana, V. Amatya, J. Manzano, **A. Das**, F. Ferrandi, and A. Tumeo, "Automated Generation of Integrated Digital and Spiking Neuromorphic Machine Learning Accelerators", *Proceedings of the* 40^{th} *IEEE/ACM International Conference on Computer Aided Design (ICCAD)*, 2021.

9. 2021 A. Balaji, S. Song, T.Titirsha, **A. Das**, J. Krichmar, N. Dutt, J. Shackleford, N. Kandasamy, and F. Catthoor, "NeuroXplorer 1.0: An Extensible Framework for Architectural Exploration with Spiking Neural Networks", *Proceedings of the* 2^{nd} *ACM International Conference on Neuromorphic Systems (ICONS)*, 2021.

10. 2021 S. Song, T. Titirsha, and **A. Das**, "Improving Inference Lifetime of Neuromorphic Systems via Intelligent Synapse Mapping", *Proceedings of the* 32^{nd} *IEEE International Conference on Application-Specific Systems, Architectures and Processors (ASAP)*, 2021. (Best Paper Honorable Mention Award)

11. 2021 T. Titirsha, S. Song, A. Balaji, and **A. Das**, "On the Role of System Software in Energy Management of Neuromorphic Computing", *Proceedings of the* 18^{th} *ACM Computing Frontiers (CF)*, 2021.

12. 2021 A. Paul, K. Wong, **A. Das**, D. Lim, and M. Tan, "Machine Learning Validated Screening Tool to Predict Obstructive Sleep Apnea in Cancer Patients", *American Thoracic Society (ATS)*, 2021.

13. 2021 A. Paul, K. Wong, **A. Das**, D. Lim, and M. Tan, "STOP-Bang Score and History of Radiation Predicts Risk of Obstructive Sleep Apnea in Cancer Patients: A Machine Learning Study", *Sleep 2021: The* 35^{th} *Annual Meeting of the Associated Professional Sleep Societies, LLC (APSS)*, 2021.

14. 2021 T. Titirsha, S. Song, and **A. Das**, "Reliability Analysis for ML/AI Hardware", *Proceedings of the* 31^{st} *IEEE VLSI Test Symposium (VTS)*, 2021.

15. 2021 S. Song, **A. Das**, O. Mutlu, and N. Kandasamy, "Aging Aware Request Scheduling for Non-Volatile Main Memory", *Proceedings of the* 26^{th} *ACM Asia and South Pacific Design Automation Conference (ASP-DAC)*, 2021.

16. 2020 T. Titirsha and **A. Das**, "Thermal-Aware Compilation of Spiking Neural Networks to Neuromorphic Hardware", *Proceedings of the* 33^{rd} *Springer Workshop on Languages and Compilers for Parallel Computing (LCPC)*, 2020.

17. 2020 E. Moyer and **A. Das**, "Neuromorphic Approaches to DNA Subsequence and Restriction Site Analysis", *Proceedings of the* 10^{th} *IEEE Signal Processing in Medicine and Biology Symposium (SPMB)*, 2020.

18. 2020 T. Titirsha and **A. Das**, "Reliability-Performance Trade-offs in Neuromorphic Computing", *Proceedings of the* 11^{th} *IEEE International Green and Sustainable Computing Workshops (IGSC Workshops)*, 2020.

19. 2020 S. Song and **A. Das**, "Design Methodologies for Reliable and Energy-efficient PCM Systems", *Proceedings of the* 11^{th} *IEEE International Green and Sustainable Computing Workshops (IGSC Workshops)*, 2020.

20. 2020 A. Balaji and **A. Das**, "Compiling Spiking Neural Networks to Mitigate Neuromorphic Hardware Constraints", *Proceedings of the* 11^{th} *IEEE International Green and Sustainable Computing Workshops (IGSC Workshops)*, 2020.

21. 2020 S. Song and **A. Das**, "A Case for Lifetime Reliability-Aware Neuromorphic Computing", *Proceedings of the* 63^{rd} *IEEE International Midwest Symposium on Circuits and Systems (MWSCAS)*, 2020.

22. 2020 S. Song, **A. Das**, and N. Kandasamy, "Improving Dependability of Neuromorphic Computing With Non-Volatile Memory", *Proceedings of the* 16^{th} *IEEE European Dependable Computing Conference (EDCC)*, 2020. (Distinguished Paper)

23. 2020 S. Song, **A. Das**, O. Mutlu, and N. Kandasamy, "Improving Phase Change Memory Performance with Data Content Aware Access", *Proceedings of the* 6^{th} *ACM International Symposium on Memory Management (ISMM)*, 2020.

24. 2020 S. Song, **A. Das**, and N. Kandasamy, "Exploiting Inter- and Intra-Memory Asymmetries for Data Mapping in Hybrid Tiered-Memories", *Proceedings of the* 6^{th} *ACM International Symposium on Memory Management (ISMM)*, 2020.

25. 2020 S. Song, A. Balaji, **A. Das**, N. Kandasamy, and J. Shackleford, "Compiling Spiking Neural Networks to Neuromorphic Hardware", *Proceedings of the* 5^{th} *ACM International Conference on Languages, Compilers, and Tools for Embedded Systems (LCTES)*, 2020.

26. 2020 A. Balaji, P. Adiraju, H. Kashyap, **A. Das**, N. Dutt, J. Krichmar, and F. Catthoor, "PyCARL: A PyNN Interface for Hardware-Software Co-Simulation of Spiking Neural Network", *Proceedings of the* 34^{th} *IEEE Joint Conference on Neural Networks (IJCNN)*, 2020.

27. 2019 A. Balaji, and **A. Das**, "A Framework for the Analysis of Throughput-Constraints of SNNs on Neuromorphic Hardware", *Proceedings of the* 18^{th} *IEEE Computer Society Annual Symposium on VLSI (ISVLSI)*, 2019.

28. 2019 A. Balaji, S. Ullah, **A. Das**, and A. Kumar, "Design methodology for embedded approximate artificial neural networks", *Proceedings of the* 29^{th} *ACM Great Lakes Symposium on VLSI (GLSVLSI)*, 2019.

29. 2019 A. Balaji, Y. Wu, **A. Das**, F. Catthoor, and S. Schaafsma, "Exploration of segmented bus as scalable global interconnect for neuromorphic computing", *Proceedings of the* 29^{th} *ACM Great Lakes Symposium on VLSI (GLSVLSI)*, 2019.

30. 2018 **A. Das**, F. Catthoor, and S. Schaafsma,"Heartbeat classification in wearables using multilayer perceptron and time-frequency joint distribution of ECG", *Proceedings of the* 4^{th} *IEEE/ACM International Conference on Connected Health: Applications, Systems and Engineering Technologies (CHASE)*, 2018.

31. 2018 **A. Das**, D. Balsamo, G. Merrett, B. M. Al-Hashimi, and F. Catthoor, "Graceful Performance Adaption through Hardware-Software Interaction for Autonomous Battery Management of Multicore Smartphones", *Proceedings of the* 9^{th} *IEEE International Green and Sustainable Computing Conference (IGSC)*, 2018.

32. 2018 **A. Das**, Y. Wu, K. Huynh, F. Dell'Anna, F. Catthoor and S. Schaafsma,"Mapping of Local and Global Synapses on Spiking Neuromorphic Hardware", *Proceedings of the* 21^{st} *IEEE Conference on Conference on Design, Automation, Test & Exhibition (DATE)*, 2018.

33. 2018 **A. Das** and A. Kumar,"Dataflow-Based Mapping of Spiking Neural Networks on Neuromorphic Hardware", *Proceedings of the* 28^{th} *ACM Great Lakes Symposium on VLSI (GLSVLSI)*, 2018.

34. 2018 **A. Das**, H. Hassan, and O. Mutlu, "VRL-DRAM: Improving DRAM Performance via Variable Refresh Latency", *Proceedings of the* 55^{th} *IEEE/ACM Design Automation Conference (DAC)*, 2018.

1.5.7 Supervised Thesis

Total: **11**
At Drexel: **7**
Last Academic Year: **4**

1. 2022 **Adarsha Balaji**, *Hardware-Software Co-design for Neuromorphic Computing*, Ph.D. Dissertation, Drexel University, June 2022.

2. 2022 **Shihao Song**, *Design methodologies for reliable and high performance non volatile memories (NVMs) systems*, Ph.D. Dissertation, Drexel University, December 2021.

3. 2022 **Quang Anh Huang**, *Simulating Dataflow accelerators for Deep Learning applications in Heterogeneous System*, MS Thesis, Drexel University, August 2022.

4. 2022 **Hanh Dieu Do-Phung**, *Mapping DNNs onto a NoC-based MPSoC using Synchronous Dataflow Graphs*, MS Thesis, Drexel University, June 2022.

5. 2021 **Jeechieu Ta**, *Learning to Continously Learn Atari Games with Meta-loss*, MS Thesis, Drexel University, June 2021.

6. 2021 **Hieu Quang Mai**, *Exploiting Power-Performance Tradeoffs for GPU-NVM Systems*, MS Thesis, Drexel University, June 2021.

7. 2021 **Wenhan Tan**, *Detection of Prostate Cancer in Patch-Level Gleason Grading using Deep Learning*, MS Thesis, Drexel University, June 2021.

1.5.8 Invited Tutorials, Talks, and Posters

Total: **20**
At Drexel: **17**
Last Academic Year: **4**

1. 2022 *Compiler for Neuromorphic Computing*, Invited Talk at TU Eindhoven, Eindhoven, Netherlands, 2022.

2. 2021 *Intelligent Software for Intelligent Machines*, Invited Talk at University of Delaware, Virtual, 2021.

3. 2021 *Intelligent Software for Intelligent Machines*, Invited Talk at Villanova University, Virtual, 2021.

4. 2021 *Intelligent Software for Intelligent Machines*, Invited Talk at Invited Talk at International Workshop on Machine Learning for Software Hardware Co-Design, Virtual, 2021.

5. 2021 *Software Based Dependability Management of Neuromorphic Computing*, Invited Talk at AI-Treats, European Test Symposium (ETS), Virtual, 2021.

6. 2021 *Reliability Analysis for ML/AI Hardware*, Special Session at VLSI Test Symposium (VTS), Virtual, 2021.

7. 2021 *Neuromorphic Computing – The Future of AI-Driven Technologies*, Drexel Women in Computing Society (WiCs), 2021.

8. 2021 *Design Methodologies for Energy-Efficient Neuromorphic Computing*, Keynote at SASIMI, Higashi-Osaka, Japan, 2021.

9. 2021 *In-Memory Neuromorphic Computing*, NSF Workshop on Processing-in-Memory Technology, Virtual, USA, 2021.

10. 2020 *Facilitating Dependable Neuromorphic Computing: Vision, Architecture, and Impact on Programmability*, NSF Workshop on Electronic Design and Automation: Challenges and Opportunities, Virtual, USA, 2020.

11. 2020 *Improving Dependability of Neuromorphic Computing with Non-volatile Memory*, IBM Watson Lab, Yorktown Heights, New York, 2020.

12. 2020 *Enabling Resource-Aware Compilation of Spiking Neural Networks to Neuromorphic Hardware*, IBM Watson Lab, Yorktown Heights, New York, 2020.

13. 2020 *Efficient Compilers for Spiking Neural Networks*, CEA-Leti, Grenoble, France, 2020.

14. 2020 *Compiler for Neuromorphic Computing*, Keynote at ValleyML AI Expo, San Francisco, USA, 2020.

15. 2020 *Design Methodologies for Reliable and Energy Efficient Neuromorphic Computing*, Western Digital, Bangalore, India, 2020.

16. 2019 *Neuromorphic Computing: A Step Towards Energy-Efficient Machine Learning*, Accelerating AI for Embedded Autonomy Workshop, New York, 2019.

17. 2019 *Neuromorphic Computing with Non-Volatile Memories*, IBM Watson Lab, Yorktown Heights, New York, 2019.

1.5.9 Research Proposals Funded

Total:	**15**
At Drexel:	**11**
Last Academic Year:	**4**

Research Funds Awarded at Drexel (as PI or Co-PI) :

Total:	**$ 4,560,183**
Internal (Co-PI):	**$ 250,000**
External (PI):	**$ 2,046,899**
External (Co-PI):	**$ 2,263,284**

1. 2022
   - *Sponsor:* Accenture
   - *Program:* Gift
   - *Title:* Research on Software Framework for SNN on FPGA
   - *PI:* **A. Das**
   - *Co-Is:* N. Kandasamy and J. Shackleford
   - *Amount:* $200,000
   - *Duration:* 2022-2024

2. 2022
   - *Sponsor:* National Science Foundation
   - *Program:* Cyberinfrastructure for Sustained Scientific Innovation (CSSI)
   - *Title:* Elements: Software Infrastructure for Programming and Architectural Exploration of Neuromorphic Computing Systems
   - *PI:* N. Kandasamy
   - *Co-Is:* **A. Das**
   - *Amount:* $571,654
   - *Duration:* 2022-2025

3. 2022
   - *Sponsor:* National Science Foundation
   - *Program:* Faculty Early Career Development Program (CAREER)
   - *Title:* Supplement to CAREER: Facilitating Dependable Neuromorphic Computing: Vision, Architecture, and Impact on Programmability
   - *PI:* **A. Das**
   - *Co-Is:*
   - *Amount:* $21,000
   - *Duration:* 2022-2023

4.	2022	*Sponsor:*	Miami VA
		Program:	IPA
		Title:	Effect of Cyclical Intermittent Hypoxia on Lung Cancer Progression
		PI:	**A. Das**
		Co-Is:	
		Amount:	$34,800
		Duration:	2022-2023
5.	2021	*Sponsor:*	Department of Energy (DOE)
		Program:	Early Career Research Program (CAREER)
		Title:	Architecting the Hardware-Software Interface for Neuromorphic Computers
		PI:	**A. Das**
		Co-Is:	None
		Amount:	$750,004
		Duration:	2021-2026
6.	2020	*Sponsor:*	National Science Foundation (NSF)
		Program:	Faculty Early Career Development Program (CAREER)
		Title:	Facilitating Dependable Neuromorphic Computing: Vision, Architecture, and Impact on Programmability
		PI:	**A. Das**
		Co-Is:	none
		Amount:	$540,240
		Duration:	2020-2025
7.	2020	*Sponsor:*	National Science Foundation (NSF)
		Program:	Research Experiences for Undergraduates (REU)
		Title:	Design of System Software to Facilitate Real-Time Neuromorphic Computing
		PI:	**A. Das**
		Co-Is:	N. Kandasamy and J. Shackleford
		Amount:	$16,000
		Duration:	2020-2020
8.	2020	*Sponsor:*	National Science Foundation (NSF)
		Program:	Computer and Network Systems (CNS): Core Programs
		Title:	Online Performance Monitoring of Neuromorphic Services
		PI:	N. Kandasamy
		Co-Is:	**A. Das**
		Amount:	$494,073
		Duration:	2020-2023
9.	2019	*Sponsor:*	National Science Foundation (NSF) / Defense Advanced Research Projects Agency (DARPA)

		Program:	Real-Time Machine Learning (RTML)
		Title:	Design of System Software to Facilitate Real-Time Neuromorphic Computing
		PI:	**A. Das**
		Co-Is:	N. Kandasamy and J. Shackleford
		Amount:	$484,855
		Duration:	2019-2022
10.	2019	*Sponsor:*	National Science Foundation (NSF) / National Institute of Health (NIH)
		Program:	Smart and Connected Health (SCH)
		Title:	Smart and Connected Health for Newborn Ventilation
		PI:	K. Dandekar
		Co-Is:	V Bhandari, **A. Das**, G. Dion, and W. Mongan
		Amount:	$1,197,557
		Duration:	2019-2023
11.	2019	*Sponsor:*	Drexel University
		Program:	Drexel Areas of Research Excellence (DARE)
		Title:	Internet of Things for Future Smart Campus and City
		PI:	K. Dandekar
		Co-Is:	E. Anday, V. Bhandari, **A. Das** et al.
		Amount:	$250,000
		Duration:	2019-2020

1.5.10 Graduated Ph.D. Students

Total:	**2**
At Drexel:	**2**
Last Academic Year:	**2**

1. 2022 — Adarsha Balaji, Ph.D., Thesis: Hardware-Software Co-design for Neuromorphic Computing. **First Employment:** Argonne National Laboratory, Illinois, USA

2. 2021 — Shihao Song, Ph.D., Thesis: Design Methodologies for Reliable and High-Performance NVM Systems. **First Employment:** Nvidia, California, USA

1.5.11 Current Ph.D. Students

Total:	**10**
At Drexel:	**10**
Last Academic Year:	**10**

1. 2020-pres. — Abhishek Kumar Mishra, Ph.D. student, Expected to graduate in Sep. 2024.

2. 2020-pres. — Ankita Paul, Ph.D. student, Expected to graduate in Sep. 2024.

3. 2021-pres. — Lakshmi Varshika Mirtinti, Ph.D. student, Expected to graduate in Sep. 2024.

4.	2021-pres.	Arghavan Mohammadhassani, Ph.D. student, Expected to graduate in Sep. 2024.
5.	2021-pres.	Murat Can Isik, Ph.D. student, Expected to graduate in Sep. 2025.
6.	2022-pres.	Phu Khanh Huynh, Ph.D. student, Expected to graduate in Mar. 2025.
7.	2022-pres.	Suman Kumar, Ph.D. student, Expected to graduate in Sep. 2025.
8.	2022-pres.	Sarah Johari, Ph.D. student, Expected to graduate in Sep. 2025.
9.	2022-pres.	Ilknur Mustafazade, Ph.D. student, Expected to graduate in Sep. 2025.
10.	2022-pres.	Tarun Pulluri, Ph.D. student, Expected to graduate in Sep. 2025.

1.5.12 Industrial Collaboration

Total: **3**
At Drexel: **3**
Last Academic Year: **3**

	Date	Collaboration
1.	2020-Pres.	PNNL, USA
2.	2018-Pres.	Imec, Netherlands and Belgium
3.	2021-Pres.	Intel Architecture Group, India

1.6 Teaching Activities

1.6.1 Summary of Courses Taught and Student Evaluations

Total: **24**
At Drexel: **24**
Last Academic Year: **5**

The following table lists the courses taught in Fall (FA), Winter (WI), Spring (SP), and Summer (SU) at the graduate (G) and undergraduate (UG) levels. Course evaluation data is provided using "average instructor rating" for the respective course obtained from AEFIS.

Term	Level	Course Number	Course Title	Total Students	Course Participation	Avg. Rating
			Academic Year 2021-22			
FA	UG	ECEC 412	Modern Processor Design	28	100%	4.46/5.0
FA	G	ECEC 621	High Performance Computer Architecture	21	100%	4.59/5.0
WI	UG	ECEC 355	Computer Organization & Architecture	31	91%	3.76/5.0
SP	G	ECEC 623	Advanced Topics in Computer Arch.	8	25%	–

SU	UG	ECEC 355	Computer Organization & Architecture	31	100%	4.03/5.0
			Academic Year 2020-21			
FA	UG	ECEC 412	Modern Processor Design	36	100%	4.75/5.0
FA	G	ECEC 621	High Performance Computer Architecture	24	100%	4.88/5.0
WI	UG	ECEC 355	Computer Organization & Architecture	56	100%	3.75/5.0
SP	G	ECEC 623	Advanced Topics in Computer Arch.	12	50%	4.00/5.0
SU	UG	ECEC 355	Computer Organization & Architecture	46	98%	4.05/5.0
			Academic Year 2019-20			
FA	UG	ECEC 412	Modern Processor Design	52	100%	4.92/5.0
FA	G	ECEC 621	High Performance Computer Architecture	24	100%	4.75/5.0
WI	UG	ECEC 355	Computer Organization & Architecture	52	94%	4.29/5.0
WI	UG	ECE T480	ST: Special Topics in Computer Arch.	39	87%	4.59/5.0
WI	G	ECEC 623	Advanced Topics in Computer Arch.	25	84%	4.81/5.0
SU	UG	ECEC 355	Computer Organization & Architecture	25	100%	4.48/5.0
			Academic Year 2018-19			
FA	UG	ECEC 412	Modern Processor Design	31	77%	4.08/5.0
FA	G	ECEC 621	High Performance Computer Architecture	9	89%	4.38/5.0
WI	UG	ECEC 355	Computer Organization & Architecture	54	94%	4.76/5.0
SP	UG	ECE T480	ST: Special Topics in Computer Arch.	15	47%	4.86/5.0
SP	G	ECEC 623	Advanced Topics in Computer Architecture	3	67%	-
SU	UG	ECEC 355	Computer Organization & Architecture	35	97%	4.32/5.0
			Academic Year 2017-18			
WI	G	ECE-C621	High Performance Computer Architecture	30	27%	3.88/5.0
SP	G	ECE-C623	Advanced Topics in Computer Architecture	8	50%	-

1.6.2 Undergraduate/Graduate Courses Taught

Total:	**3**
At Drexel:	**3**
Last Academic Year:	**3**

1. **Computer Organization & Architecture (ECE-C355)**
   This course covers the principles of designing microprocessors using solid engineering fundamentals and quantitative cost/performance trade-offs. Topics include computer performance from hardware and software perspective, instruction set architectures focusing on RISC-V, arithmetic for computers, processor datapath and control, single cycle microarchitectures and pipeline architectures. The course also introduced issues in pipeline design and techniques to solve these issues.

2. **Modern Processor Design(ECE-C412) / High Performance Computer Arch. (ECE-C621)**
   This course introduced modern processor design in a systematic manner. It discussed dynamically scheduled superscalar techniques including advanced branch prediction, performance analysis of static and dynamic branch prediction techniques, cache design principles, cache replacement policies, techniques to exploit instruction-level parallelism via out-of-order execution, and techniques to tolerate long memory latencies via speculative and run-ahead executions. The course provided a comprehensive coverage of modern practices in processor design.

3. **Special Topics in Computer Arch. (ECE-T480)/ Advanced Topics in Computer Arch. (ECE-C623)**
This course covered advanced topics in computer architecture, starting from approaches to parallelism, cache designs, caches for multi-core systems, cache coherency and cache consistency. The course then looked at the memory controller design for DRAMs and other non-volatile memories. Next, the course introduced students to internal architecture of main memory, including techniques to perform in-memory computing. Finally, the course taught students the fundamentals of emerging computing architectures, including neuromorphic and data-flow based computing.

1.6.3 Major Revisions of Existing Courses

Total:	**5**
At Drexel:	**5**
Last Academic Year:	**0**

1. 2021 **Advanced Topics in Computer Architecture (ECE-C623)**
Revision of course material and coverage, including neuromorphic computing, dataflow-based computing, and in-memory computing.
2. 2020 **Advanced Topics in Computer Architecture (ECE-C623)**
Major revision of course material and coverage, including Very Long Instruction Word (VLIW) architecture, Systolic architecture, Non-Volatile Memory (NVM), and Memory Controller Design.
3. 2020 **High Performance Computer Architecture (ECE-C621)**
Major revision of course material and coverage, including tolerating long latency of memory accesses via speculative execution, runahead execution, and software pipelining.
4. 2019 **Computer Organization & Architecture (ECE-C355)**
Major revision of course material and coverage, including C- programming assignments for RISC-V architectures.
5. 2018 **High Performance Computer Architecture (ECE-C621)**
Major revision of course material and coverage, including substantive assignments dealing with cache and dynamic branch prediction.

1.6.4 Capstone Senior Design Projects Supervised

Total:	**8**
At Drexel:	**8**
Last Academic Year:	**0**

1. 2020-2021 Real-Time Image Segmentation for Robotic Platforms
2. 2020-2021 Sleep Apnea Detection Using a Spiking Neural Network on an FPGA
3. 2020-2021 AiWitness App
4. 2019-2020 Floating Smart Camera
5. 2019-2020 Autonomous Vehicle
6. 2019-2020 Real-Time 3-D Sound Localization on FPGAs
7. 2018-2019 Indoor Environmental Detection with Heterogeneous Sensor Fusion
8. 2018-2019 Autonomous Vehicles with Machine Learning

1.6.5 Internal and External Awards

Total:	**7**
At Drexel:	**5**
Last Academic Year:	**3**

	Date	Award
1.	2022	PECASE Award (nominated)
2.	2021	Best Poster Award, IBM Compute Symposium
3.	2021	IEEE CEDA Ernest S. Kuh Early Career Award (nominated)
4.	2020	Drexel College of Engineering Early Faculty Research Award (nominated)
5.	2019	Drexel College of Engineering Outstanding Teaching Award (nominated)

1.7 Professional Service Activities

1.7.1 Society Membership

Total: **6**
At Drexel: **6**
Last Academic Year: **6**

	Date	Activity
1.	2011-pres.	Senior Member, Institute of Electrical and Electronics Engineers (IEEE)
2.	2018-pres.	Member, IEEE Computer Society
3.	2018-pres.	Member, IEEE Computational Intelligence Society
4.	2018-pres.	Member, Association for Computing Machinery (ACM)
5.	2018-pres.	Member, ACM Special Interest Group in Computer Architecture (SIGARCH)
6.	2020-pres.	Member, ACM Special Interest Group in Design Automation (SIGDA)

1.7.2 Journal Editorials

Total: **3**
At Drexel: **3**
Last Academic Year: **1**

	Year	Journals
1.	2021	Associate Editor, Frontiers in Neuroscience
2.	2021	Guest Editor, "Computing Inovations for Scale-up AI", Frontiers in Neuroscience
3.	2021	Guest Editor, "Neuromorphic Sensing and Computing Systems", Electronics

1.7.3 Conference Program Committee Memberships

Total: **17**
At Drexel: **13**
Last Academic Year: **6**

1. Design Automation Conference (DAC)
2. Design, Automation, Test & Exhibition (DATE)
3. Compiler, Architecture, Synthesis of Embedded Systems (CASES)
4. Computing Frontiers (CF)
5. Machine Learning for CAD (MLCAD)
6. VLSI Design (VLSID)
7. Real-Time Systems Symposium (RTSS)

8. International Conference on Computer-Aided Design (ICCAD)
9. Great Lakes Symposium on VLSI (GLSVLSI)
10. International Conference on Computer Design (ICCD)
11. International Green and Sustainable Computing Conference (IGSC)
12. International Conference on Field-Programmable Logic and Applications (FPL)
13. International Conference on Omni-Layer Intelligent Systems (COINS)

1.7.4 Conference and Workshop Organization and Leadership

Total: **9**
At Drexel: **9**
Last Academic Year: **3**

	Date	Conference
1.	2022	Session Chair, IJCNN, Padova, Italy
2.	2021	Organizer, Special Session on Hardware/software Co-design for Neuromorphic Computing in International Conference on Computer-Aided Design (ICCAD), Virtual
3.	2021	Organizer, Special Session on Reliability Analysis for ML/AI Accelerators in VLSI Test Symposium, Virtual
4.	2021	General Chair, ACM SIGDA University Demo, DAC, San Francisco
5.	2021	Session Chair, DATE, Virtual, Europe
6.	2020	General Chair, ACM SIGDA University Demo, DAC, San Francisco
7.	2019	Session Chair, CASES, New York
8.	2019	Neuromorphic Computing Workshop Oragnization, GLSVLSI, Washington DC
9.	2019	TPC Track Chair, DAC, Las Vegas

1.7.5 Proposal Review Panels

Total: **4**
At Drexel: **4**
Last Academic Year: **1**

	Date	Workshop/Panel
1.	2021	NSF proposal review panel
2.	2020	NSF proposal review panel (2x)
3.	2020	DOE proposal review panel

1.8 University Service Activities

1.8.1 Member of Department Committees

Total: **4**
At Drexel: **4**
Last Academic Year: **1**

	Date	Position
1.	2022	Undergraduate Affairs Committee (UAC)
2.	2021	Undergraduate Affairs Committee (UAC)
3.	2020	Undergraduate Affairs Committee (UAC)
4.	2019	Undergraduate Curriculum Restructure Committee

1.8.2 Other Activities

Total: **5**
At Drexel: **5**
Last Academic Year: **3**

	Date	Position
1.	2021	Member of Search Committee for tenure-track hire in CAEE in "Energy and Sustainability"
2.	2021	Contributing Member of IEEE Standards Study Group on Additional Floating-Point Formats to Support Machine Learning
3.	2021	Member of Drexel Neuroengineering Initiative
4.	2020	Internal Reviewer of NSF CAREER Award
5.	2019	Ambassador for IEEE Sponsored Drexel AI