

## Ashir Borah

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Computational Associate II  
 Target Validation and Advancement team  
 Cancer Dependency Map  
 Cancer Program, Broad Institute of MIT and Harvard  
 Merkin Building, 415 Main St, Cambridge, MA 02142

## EDUCATION

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**Dickinson College**, Carlisle, PA  
 Bachelor of Science, Mathematics and Computer Science, *Magna Cum Laude*, Phi Beta Kappa  
**GPA:** 3.89/4.00, Major GPA: 3.90/4.00  
**Senior Research:** *Computational Analysis of Phorbol 12-myristate 13-acetate (PMA) perturbation on Human Leukemia cell lines*

## RESEARCH EXPERIENCE

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**Graduate Researcher, University of California San Francisco** 2022-Present  
**Biological and Medical Informatics**

- Conduct computational analysis on CRISPR data
- Find interesting biological targets to do further experiments
- Cell/Tissue culture and molecular cloning experiments to validate hypothesis

**Computational Associate II, Broad Institute of MIT and Harvard** 2021 - 2022  
**Computational Associate I, Broad Institute of MIT and Harvard** 2019 - 2021

*Cancer Data Science, Dependency Map Project, Cancer Program*

Advisor: James McFarland

- Lead the computational effort to validate therapeutic genetic targets and find their biomarkers
- Develop innovative strategies for discovering new targets from genome-scale screens
- Contributed to an open-source machine learning platform that models genetic knockout dependency profiles from more than 100,000 genomic features
- Modeled the latent variables from genome-scale CRISPR-Cas9 screens to discover a new Integrator interaction
- Assisted in analyzing the use of RNAi and CRISPR screens as complementary data modalities
- Run various pipelines to analyze RNAseq, whole-exome and whole-genome, bisulfate sequencing screens

This work has resulted in two publications: one in *Nature* and one in *Cell*, and two manuscripts are in revision: *Cell Systems* and *Cancer Discovery*.

**Computational Research Assistant, Dickinson College** 2018 - 2019

Biochemistry and Molecular Biology

Advisor: Michael Roberts

Topic: *Computational Analysis of Phorbol 12-myristate 13-acetate (PMA) perturbation on Human Leukemia cell lines*

- Processed genomic data CRISPR knockout and overexpression experiments on HL-60 Leukemia cancer cell lines
- Found differentially expressed genes from a compound perturbation that induced differentiation
- Awarded The Best Poster award in All College Science Symposium

Presented our findings at the 2020 American Association for Cancer Research conference (AACR), and several students have followed up on the other targets in the subsequent years.

### Summer Research Assistant, Dickinson College

May 2018 - July 2018

Advisor: Grant Braught

Topic: *Self-Adaptive Chaotic Mutation Operators in Evolutionary Computation*

- Studied the use of chaotic generators as the source of pseudo-random numbers in chaotic algorithms
- Analyzed the performance differences that arise from this substitution

### Dana Research Assistantship, Dickinson College

January 2018 - May 2018

Advisor: Farhan Siddiqui

Topic: *Implementation of End-to-End Security on IoT Constrained Devices*

- Explored the current CoAP-DTLS stack and sought to implement end-to-end security without compromising the performance of the devices

### Student-Faculty Research/Independent Study Courses

2016 - 2019

Dickinson College

- Took several independent study/student-faculty research courses:
  - Computational Analysis of Human Leukemia (Fall 2018, Spring 2019)
  - Analysis of Genetic Networks (Spring 2018)
  - Applied Databased Development (Fall 2018)
  - Advanced Algorithms (Spring 2017)
  - Constraint Programming (Spring 2016)

## HONORS & AWARDS

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|---|------------|
| ● Spot Award (2), Broad Institute: Awarded for going above and beyond                                 | 2020, 2021 |
| ● Phi Beta Kappa Honor Society  | 2019       |
| ● <i>Best Poster Award</i> , All College Science Symposium  | 2019       |
| ● Biology Department Summer Research Grant; Dickinson College   | 2018       |
| ● Dana Research Assistantship   | 2018       |
| ● Pi Mu Epsilon: Mathematics National Honor Society   | 2018       |
| ● Upsilon Pi Epsilon: Computer Science National Honor Society   | 2018       |
| ● The Richard Howland Memorial Scholarship: Awarded to one student for excellence in Computer Science | 2018       |
| ● Jane Hill Prize in Computer Science: Awarded to one first-year who excels in computer science       | 2016       |
| ● Alpha Lambda Delta: First-year academic excellence honor society                                    | 2016       |

## PUBLICATIONS

### *Accepted*

Raghavan, S., Winter, P.S., Navia, A.W., Williams, H.L., DenAdel, A., Kalekar, R.L., Galvez-Reyes, J., Lowder, K.E., Mulugeta, N., Raghavan, M.S., **Borah, A.A.**, Kapner, K.S., ..., Wolpin, B.M., Hahn, W.C., Aguirre A.J., Shalek, A.K. **The tumor microenvironment drives transcriptional phenotypes and their plasticity in metastatic pancreatic cancer.** Accepted in principle at *Cell* (2021).

van Wietmarschen, N., Sridharan, S., Nathan, W.J., Tubbs, A., Chan, E.M., Callen, E., Wu, W., Belinky, F., Tripathi, V., Wong, N., Foster, K., ..., **Borah, A.A.**, ..., Bass, A.J., Nussenzweig, A. **Repeat expansions confer WRN dependence in microsatellite-unstable cancers.** *Nature* 586, 292–298 (2020).

### *Under Revision*

Pan, J., Kwon, J.J., Talamas, J.A., **Borah, A.A.**, Vazquez, F., Boehm, J.S., Tsherniak, A., Zitnik, M., McFarland, J.M., Hahn, W.C. **Sparse dictionary learning recovers pleiotropy from human cell fitness screens.** *Cell Systems*, under revision.

Cervia, L.D., Shibue, T., Gaeta, B., **Borah, A.A.**, Leung, L., Li, N., Dumont, N., Gonzalez, A., Bick, N., Kazachkoava, M., Dempster, J., ..., McFarland, J.M., Vazquez, F., Hahn, W.C. **A ubiquitination cascade regulates the integrated stress response and epithelial cancer survival.** *Cancer Discovery*, under revision.

### *Under Preparation*

Krill-Burger, J.M., Dempster, J.M., **Borah, A.A.**, Paoletta, B.R., Root, D.E., Golub, T.R., Boehm, J.S., Hahn, W.C., McFarland, J.M., Vazquez, F., Tsherniak, A. **Partial gene suppression improves identification of cancer vulnerabilities when CRISPR-Cas9 knockout is pan-lethal.** Under preparation.

## PRESENTATION

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Pan, J.; Kwon, J.J., Talamas, J.A., **Borah, A.A.**, Vazquez, F., Boehm, J.S., Tsherniak, A., Zitnik, M., McFarland, J.M., Hahn, W.C. **Sparse dictionary learning recovers pleiotropy from human cell fitness screens.** LMRL - Learning Meaningful Representations of Life, *NeurIPS*; 2021 Dec 13.

Pan, J.; Kwon, J.J., Talamas, J.A., **Borah, A.A.**, Vazquez, F., Boehm, J.S., Tsherniak, A., Zitnik, M., McFarland, J.M., Hahn, W.C. **Sparse dictionary learning recovers pleiotropy from human cell fitness screens.** *MICB*; 2021 Nov 22-23.

## POSTERS

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Cervia, L.D., Shibue, T., Gaeta, B., **Borah, A.A.**, Leung, L., Li, N., Dumont, N., Gonzalez, A., Bick, N., Kazachkoava, M., Dempster, J., ..., McFarland, J.M., Vazquez, F., Hahn, W.C. **A ubiquitination cascade regulates the integrated stress response and epithelial cancer survival** [abstract]. In: Proceedings of the American Association for Cancer Research Annual Meeting 2021; 2021 Apr 10-15 and May 17-21. Philadelphia (PA): AACR; *Cancer Res* 2021;81(13\_Suppl): Abstract nr 1950.

Roberts, M., Kageler, L., Bendinelli, K., Bonner, S., **Borah, A.**, Forrester, J. **The role of EGR1 and AP1 in acute myeloid leukemia cell reprogramming toward cell cycle arrest and apoptosis** [abstract]. In: Proceedings of the Annual Meeting of the American Association for Cancer Research 2020; 2020 Apr 27-28 and Jun 22-24. Philadelphia (PA): AACR; *Cancer Res* 2020;80(16\_Suppl): Abstract nr 4678.

Winter, P.S., Raghavan, S., Navia, A.W., Williams, H., Galvez-Reyes, J., Kalekar, R., **Borah, A.**, DenAdel, A., Raghavan, M., Lowder, K., Mulugeta, N., ..., Wolpin, B.M., Aguirre, A.J., Hahn, W.C., Shalek, A.K. **Matched metastatic pancreatic ductal**

**adenocarcinoma biopsies and organoid models reveal tumor cell transcriptional plasticity and subtype-specific microenvironmental crosstalk** [abstract]. In: *Proceedings of the AACR Special Conference on the Evolving Landscape of Cancer Modeling*; 2020 Mar 2-5; San Diego, CA. Philadelphia (PA): AACR; Cancer Res 2020;80(11 Suppl): Abstract nr PR02.

## TEACHING EXPERIENCE

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**Course Creator and Teaching Assistant, Cancer Program R BootCamp** 2019, 2021  
Broad Institute of MIT and Harvard

- Designed and implemented a curriculum to teach postdocs and graduate students the basics of R
- Deployed the curriculum in Shiny to enable browser-based learning including browser code execution
- More than 100 participants have completed the program
- Received an award (Spot Award) for going beyond duties and expectations and voluntarily developing this course

**Teaching Assistant, Mathematics and Computer Science** 2016 - 2019  
Dickinson College

- Facilitated lab classes helping students debug, grade homework, and answer questions
- Courses:
  - Introduction to Programming I: Fall 2016, Fall 2017, Fall 2018
  - Introduction to Programming II: Spring 2017, Spring 2019
  - Data Structures: Spring 2018
- Conducted after-hours college help room to help with questions

**Peer Tutor, Mathematics and Computer Science** 2018  
Dickinson College

- Tutored three students individually who were projected to fail in mathematics and computer science
- Each of the students passed their courses.

## WORK EXPERIENCE

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**Machine Learning Developer** August 2017 - December 2017  
Uliza, Cape Town, South Africa (Remote)

- Created smart systems to help with crowdsourcing of tasks and automated the process with machine learning
- Set up the complete technological backbone of the company, including server management, database optimization, and disaster recovery

**Resident Advisor** 2016 - 2019  
Dickinson College

- Acted as a liaison between the Residence Life & Housing and 40 residents by fostering a healthy community
- Organized and managed four events each semester to foster growth within the community

## SERVICE & OUTREACH

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**Computational Mentor, Roberts Lab** 2019 - Present  
Dickinson College

- Mentoring computational students from Dr. Michael Roberts' Cancer biology lab

- Aiding students in refining their computational biology projects
- Holding workshops to teach new computational biology techniques

**Co-chair, CodeRATS**

2020 - 2021

Broad Institute of MIT and Harvard

- Co-led a group aimed to foster a sense of community among the early computational researchers
- Held weekly office hours to help with code questions and help others to start with coding
- Facilitated periodic workshops to teach new skills and techniques

**Broad Scientists in the Classroom**

2020

Broad Institute of MIT and Harvard

- Visited an 8th-grade classroom of 30 students in Cambridge during their genetics and evolution unit to help explain concepts
- Designed and taught a module to explain mendelian genetics and basics of probability

**Afterschool Mentor**

2019

Enroot

- Mentored a high school student who had recently immigrated from Haiti and helped him acclimate to the US school system
- Helped him with 8th grade English, Mathematics and Science

**BioCoding club**

2019

Broad Institute of MIT and Harvard

- Visited the local Cambridge high school to help with an after-school program
- Taught 20 6-8th graders the Scratch programming language

**Mathematics and Computer Science Majors Committee**

2016 - 2019

Dickinson College

- Participated in various departmental duties, including planning new programs and faculty reviews
- Collaborated with four student members to organize quarterly departmental socials

**Volunteering Coordinator (North India)**

June 2014 - July 2015

Bhumi, New Delhi, India

- Designed and implemented the after-school mathematics and science curriculum
- Served as the youngest ever coordinator in one of India's largest volunteer organizations
- Managed more than 100 volunteers and their engagement projects
- Contributed 2700 hours to various projects during a single year
- Became one of 6 recipients of the 'Torchbearer Award' from a field of 8000 volunteers for starting the North India Science chapter