

# ANNA GRIM

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## Education

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### Brown University

Sep. 2016 – Expected 2022

*Doctor of Philosophy in Applied Mathematics*

*Providence, RI*

### University of St. Thomas

Sep. 2012 – May 2016

*Bachelors of Science in Mathematics, Minor in Computer Science*

*St. Paul, MN*

## Relevant Coursework

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|--------------------|----------------------------|----------------------------|-------------------|
| • Machine Learning | • Numerical Analysis I, II | • Probability              | • Data Structures |
| • Deep Learning    | • Probability I, II        | • Recent Applications of   | • Object Oriented |
| • Image Processing | • Computational            | Probability and Statistics | Programming       |
| • Computer Vision  |                            |                            |                   |

## Professional Experience

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### Brown University

Sep. 2016 – Current

*Research Assistant*

*Providence, RI*

- Advised by Pedro Felzenszwalb.
- Areas of interest include graphical models, computational probability, algorithm development, machine learning, image processing.
- Conducted research on a graph algorithm called belief propagation that is used to perform approximate inference in a probabilistic graphical model.

### Soroco

May 2021 – Aug. 2021

*Technical Lead Intern - Machine Learning*

*Boston, MA*

- Designed and implemented semi-supervised learning algorithms that is used in a natural language processing pipeline.
- Researched semi-supervised learning approaches in the literature, then implemented and tested them on our data.
- Developed SQL queries to extract data from a large database.

### Lawrence Livermore National Laboratory

May 2016 – Aug. 2016

*Image Processing Intern*

*Livermore, CA*

- Developed image processing software that automates inspection of micrographs of optics used in lasers at the National Ignition Facility (NIF).

### Institute for Computational and Experimental Research in Math (ICERM)

June 2015 – Aug. 2015

*Research Intern*

*Providence, RI*

- Wrote code that analyzes the behavior of a discrete dynamical system known as the four bug problem.
- Proved theoretical results that describe the limiting behavior of these systems.

### University of Minnesota, Department of Mathematics

May 2014 – May 2015

*Research Assistant*

*Minneapolis, MN*

- Wrote code that generates and solves 3-dimensional jigsaw puzzles.
- Extended methodology to digitally reassemble broken objects such as an ostrich egg.

## Technical Skills

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**Languages:** Python, Matlab, SQL, Java, Mathematica, SolidWorks, R

**Python Packages:** Numpy, Scikit-learn, Pandas, Matplotlib, Tensorflow, NLTK

## Awards

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### **Presidential Fellowship**, Brown University

- Awarded to the most outstanding applicants to doctoral programs across all disciplines. It is given on a competitive basis, the primary selection criterion is letters of recommendations, publications, and undergraduate GPA.

### **Goldwater Scholar, Honorable Mention**, Barry Goldwater Foundation

- Annually awarded to 300 undergraduate students nationwide and 150 applicants are recognized with official Honorable Mentions. Each university is allowed to nominate only four undergraduate students per year and the awards are granted on based on the academic merit.

### **Minnesota High Tech Association Foundation STEM Scholar**, Minnesota High Tech Association Foundation

- Awarded by the Minnesota High Tech Association to 15 applicants who are studying a STEM related field at a university in Minnesota.

### **Life Saving Award**, Village of Rothschild

- Awarded for rescuing a 4 year boy from a swimming pool and performing several rounds of CPR as a lifeguard at a community pool.

## Publications

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1. Grim, A., and Felzenszwalb, P., Sum-Product Belief Propagation on Factor Graphs with Numerical Homotopy Continuation, (In preparation).
2. Grim, A., and Felzenszwalb, P., Convex Combination Belief Propagation Algorithms, (submitted, 2021).
3. Grim, A., Iskra, B., Ju, N., Kryshchenko, A., Medina, P., Ness, L., Ngamini, Owen, M., Paffenroth, R., and Tang, S., Analysis of Simulated Crowd Flow Exit Data: Visualization, Panic Detection, and Exit Time Convergence, *Attribution, and Estimation, Research in Data Science* (2018), 239-281.
4. Arnold, M., Golich, M., Grim, A., Vargas, L., Zharnitsky, V., Square and bow-tie configurations in the cyclic evasion problem, *Nonlinearity* **30.5**, 1773-1787 (2017).
5. Grim, A., O'Connor, T., Olver, P., Shakiban, C., Slechta, R., and Thompson, R., Automated Reassembly of Three Dimensional Jigsaw Puzzles, *International Journal of Image and Graphics* **16** (2016).
6. Grim, A., Applications of Signatures in Diagnosing Breast Cancer, *Minnesota Journal of Undergraduate Mathematics* **1** (2015).

## Projects

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### **Co-Salient Object Detection Across Multiple Images**

- Co-salient object detection is a computational problem that aims at detecting similar salient objects from a collection of images.
- RCNN (region-based CNN) was used to extract CNN features from images patches. We built a hierarchy of features by extracting the features generated from the later layers of the network.
- Similar objects were detected by solving a graph based optimization problem. Obtaining a solution involved using locality sensitive hashing to find approximate nearest neighbors.

### **Breast Cancer Diagnostic Program**

- Wrote a program that diagnoses breast tumors detected in mammograms by measuring global and local symmetry present in the contour.
- Used active contour segmentation to extract contours from a mammogram image.
- Computed signature curves (parametric curve of curvature) of each contour and analyzed the signature to detect global and local symmetries.

### **Automated Recipe Program**

- Created a small database of recipes, where each recipe consists of the ingredients stored as (item, quantity, unit) triples and instructions.
- Wrote a program that automates writing a grocery list. Given a list of recipe names, the program queries the database for ingredients along with their quantity and units. This information is compiled into a list, then sent as an email to the user.
- Code database includes subroutines that perform unit conversion along with using cooking versus shopping units.