



### ***Twin Cities Campus***

## **Data Science in Astrophysics Minor**

*Astrophysics, Minnesota Institute for*

**College of Science and Engineering**

Link to a [list of faculty](#) for this program.

### **Contact Information:**

Minnesota Institute for Astrophysics, John T. Tate Hall, 116 Church Street S.E., Minneapolis, MN 55455 (612-624-4811; fax: 612-626-2029)

Email: [MIfA@umn.edu](mailto:MIfA@umn.edu)

Website: <https://cse.umn.edu/mifa/grad/program/minor-big-data>

- Program Type: Graduate minor related to major
- Requirements for this program are current for Spring 2022
- Length of program in credits (Masters): 8
- Length of program in credits (Doctorate): 12
- This program does not require summer semesters for timely completion.

Along with the program-specific requirements listed below, please read the [General Information](#) section of the catalog website for requirements that apply to all major fields.

The minor in Data Science in Astrophysics is designed to be interdisciplinary and integrates data science (statistics, data processing, artificial intelligence) with the field of astrophysics. Students pursuing the minor will receive the training needed to advance the field of astrophysics, while simultaneously preparing to be successful professionals and leaders in the modern data-driven workforce.

The curriculum covers the fundamental concepts in statistics, data processing and data management, as well as the modern machine learning and deep learning techniques needed for analyzing the ever-increasing astrophysics data-sets. Students will have opportunities to conduct frontier research projects using modern astrophysics data-sets, and will work in interdisciplinary teams mentored by interdisciplinary faculty. They will also have opportunities to develop their professional skills, such as communications and leadership.

## **Program Delivery**

This program is available:

- via classroom (the majority of instruction is face-to-face)

## **Prerequisites for Admission**

The preferred undergraduate GPA for admittance to the program is 3.00.

### **Special Application Requirements:**

Students interested in the minor are strongly encouraged to confer with their major field advisor and director of graduate studies, and the Data Science in Astrophysics director of graduate studies regarding feasibility and requirements. A background in science, engineering, or statistics is preferred.

For an online application or for more information about graduate education admissions, see the [General Information](#) section of the catalog website.

## **Program Requirements**

Use of 4xxx courses towards program requirements is not permitted.

Courses offered on both the A-F and S/N grading basis must be taken A-F, with a minimum grade of C earned for each course.

The minimum cumulative GPA for the minor is 3.00.

### **Required courses (8 credits)**

#### **Astrostatistics (4 credits)**

All students select 1 of the following in consultation with the Data Science in Astrophysics director of graduate studies.

[AST 5731](#) - Bayesian Astrostatistics (4.0 cr)

or [STAT 5731](#) - Bayesian Astrostatistics (4.0 cr)



### Big Data (4 credits)

All students select 1 of the following in consultation with the Data Science in Astrophysics director of graduate studies.

[AST 8581](#) - Big Data in Astrophysics (4.0 cr)

or [CSCI 8581](#) - Big Data in Astrophysics (4.0 cr)

or [PHYS 8581](#) - Big Data in Astrophysics (4.0 cr)

## Program Sub-plans

Students are required to complete one of the following sub-plans.

Students may not complete the program with more than one sub-plan.

### Masters

### Doctoral

#### Electives (4 credits)

Doctoral students select 4 additional credits in consultation with the Data Science in Astrophysics director of graduate studies to meet the 12-credit minimum.

[AST 5022](#) - Relativity, Cosmology, and the Universe (4.0 cr)

[AST 8001](#) - Radiative Processes in Astrophysics (4.0 cr)

[AST 8011](#) - High Energy Astrophysics (4.0 cr)

[AST 8990](#) - Research in Astronomy and Astrophysics (1.0 - 4.0 cr)

[CSCI 5521](#) - Machine Learning Fundamentals (3.0 cr)

[CSCI 5523](#) - Introduction to Data Mining (3.0 cr)

[CSCI 5525](#) - Machine Learning: Analysis and Methods (3.0 cr)

[CSCI 5609](#) - Visualization (3.0 cr)

[CSCI 5707](#) - Principles of Database Systems (3.0 cr)

[EE 5239](#) - Introduction to Nonlinear Optimization (3.0 cr)

[EE 5251](#) - Optimal Filtering and Estimation (3.0 cr)

[EE 5531](#) - Probability and Stochastic Processes (3.0 cr)

[EE 5542](#) - Adaptive Digital Signal Processing (3.0 cr)

[EE 5561](#) - Image Processing and Applications: From linear filters to artificial intelligence (3.0 cr)

[EE 5571](#) - Statistical Learning and Inference (3.0 cr)

[EE 8591](#) - Predictive Learning from Data (3.0 cr)

[PHYS 8611](#) - Cosmic Rays and Plasma Astrophysics (3.0 cr)

[PUBH 7460](#) - Advanced Statistical Computing (3.0 cr)

[PUBH 8442](#) - Bayesian Decision Theory and Data Analysis (3.0 cr)

[STAT 5302](#) - Applied Regression Analysis (4.0 cr)

[STAT 5401](#) - Applied Multivariate Methods (3.0 cr)

[STAT 5421](#) - Analysis of Categorical Data (3.0 cr)

[STAT 5511](#) - Time Series Analysis (3.0 cr)

[STAT 5601](#) - Nonparametric Methods (3.0 cr)

[STAT 8051](#) - Advanced Regression Techniques: linear, nonlinear and nonparametric methods (3.0 cr)