

GSFC Activities in AI and Data Science

NASA AI

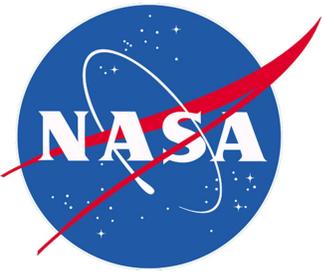
Nargess Memarsadeghi

Mark Carroll, Dan Duffy, Brian Thomas, Barbara Thompson, and Joe Foster

NASA GSFC

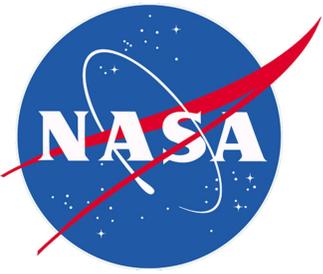
February 9, 2021

AI CENTER OF EXCELLENCE



AI Center of Excellence Introduction

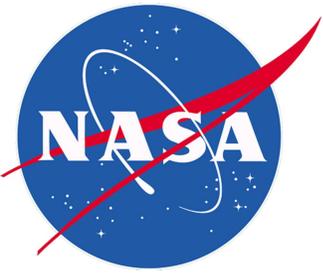
- Initial idea proposed to NASA Digital Transformation (DT) committee as a way to integrate AI/ML work across the agency
- Started in 2019 with seed funding from the Chief Technologist Office at GSFC
- Continued with funds from Computational Information Science and Technology Office (Code 606) funds
- Supplemented with funds from a Science Task Groups supported by code 600
- *Inaugurated in Spring 2020*



AI Center of Excellence (AICOE)



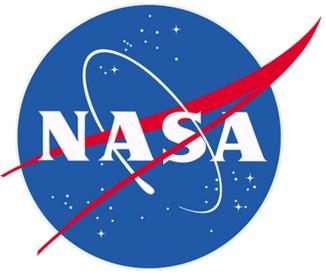
- Website: <https://ai.gsfc.nasa.gov>
- MS Teams: GSFC AI Center of Excellence , 145 members
- Focal point for information
 - GSFC AI/ML Communities of Practice
 - Goddard ML Academy
 - AI/ML Projects
 - Events (seminars, hackathons,..), conferences and workshops
 - Computational Resources (NCCS Scientific Computing, GSFC Cloud Computing program)
 - Funding opportunities
 - Publications



GSFC AI/ML Communities of Practice



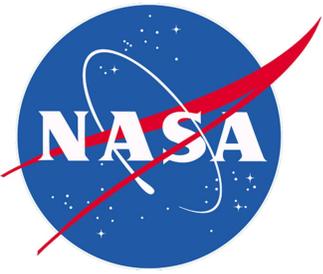
- Computational and Information Science and Technology Office's (CISTO) Data Science Group
- The Intelligent Systems and Data Analysis Technologies (ISDAT)
- The [Center for Helioanalytics](#)
- The Goddard Cloud Computing Program ([GCC](#))
- The Goddard Machine Learning Academy
- ML Science Task Group (STG)



AI Center of Excellence (AICOE)



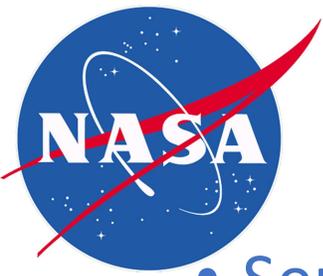
- Forming *partnerships*
- Developing the next generation workforce
- *Accelerating scientific discovery*



AICOE Partnerships



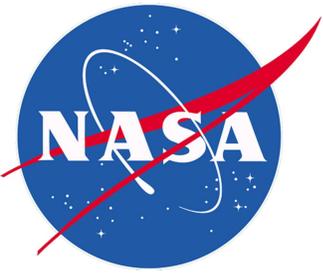
- Across organizations
 - GSFC scientists and engineers (IRADs, GCIF, STGs, ROSES,....)
- Academia
 - EPSCoR and Space Grant (POC: James Harrington)
 - Seed money grants to University to work with a NASA partner
 - Opportunity to collaborate with Academia
- Industry
 - Small businesses: SBIRS
 - Computational hardware and software
 - AWS, Google, NVIDIA, IBM



AICOE Events and Activities



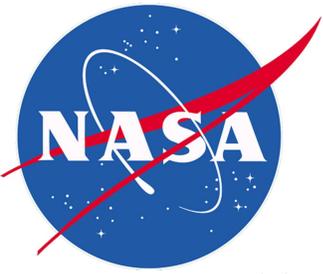
- Seminars since April 2020:
 - Hosted or co-hosted 24 seminars
 - Featuring various NASA programs: IRADS, ECF, NSTGRO, STGs, EPSCoR, SBIR,...
- *Workshop on AI/ML use in Strategic Planning and Science Prioritization (May 2020)*
- *AWS Immersion Day (June 17, 2020)*
- [Helio Hackweek 2020](#) (August 20-28, 2020).
 - Enhance skills in applying AI/ML for scientific discovery
 - Raise awareness of HEC, GPU, Commercial Cloud,



Workshop on AI/ML use in Strategic Planning and Science Prioritization



- 3 Days, ~40 participants: scientists and AI/ML practitioners.
- Forecasting 2010, 2020 Astronomy Decadal Survey priorities {We have a poster paper at AAS, research paper in draft}
- Developed a tool, “TEV” (Topic Emergence Visualizer). Identified several Test Cases.
- Workshop report, *coming soon*.
- Point of Contact: Dr. Brian Thomas.

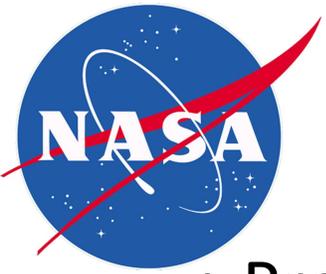


AWS Immersion Day and Projects

(in progress)



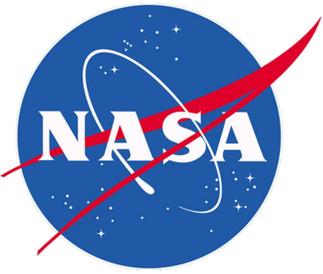
- How to Use Amazon Web Services (AWS) for AI/ML Projects
- Information on AWS AI/ML Services
- Solicited Projects:
 - AI/ML problem that requires significant compute
 - Finite duration (completion within 3 – 6 months)
 - Potential to result in publication
 - Topics from Earth, Helio, Solar System and Astro science areas as well as engineering
- Selected Projects *(in progress)*
 - Automated Detection of CME in SOHO/LASCO
 - Spatiotemporal Drought Estimation Quantification
 - Solar Irradiance Evaluation SDO/HMI – SORCE/TISIS-1
 - Remote Sensing Water Quality Parameters
 - Hurricane Prediction Deep Learning Mode



Helio Hackweek 2020



- Projects were “pitched” to the participants in early August to determine which project each participant was interested in
- Event held virtually August 20 – 27, 2020
- Tutorials presented by ASTG and NVIDIA August 20 and 21
- Five teams worked on individual projects August 25 – 27
- Report back on August 28
- Over 40 participants from 16 institutions, domestic and international
- Feedback from organizers and participants
 - Good balance between Helio science disciplines
 - Participants fully engaged the process
 - Skill sets of participants was well balanced on each team
 - Great support from industry partner

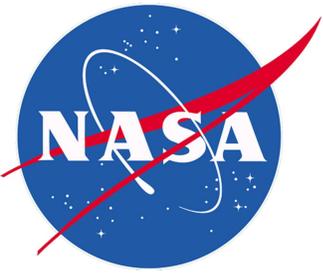


GSFC AI/ML Projects

(A few examples)



- Identification of AI/ML expertise at GSFC and the Agency via published papers
- From Data to Discovery in Astronomical Datasets
- Application of Random Forest to Quantify Lake Depth in Arctic Lakes
- Object Identification in Sub Meter Commercial Very High-Resolution Data Using Convolutional Neural Networks
- MERRA/Max: Harnessing the Potential of Climate Model Outputs in Studies of Ecosystem Change
- Machine Learning for 3D Lunar Data Analysis
- STEREO Space Weather Beacon Imagery Quality Enhancement
- Community Concept Mapping for Data-to-Decisions

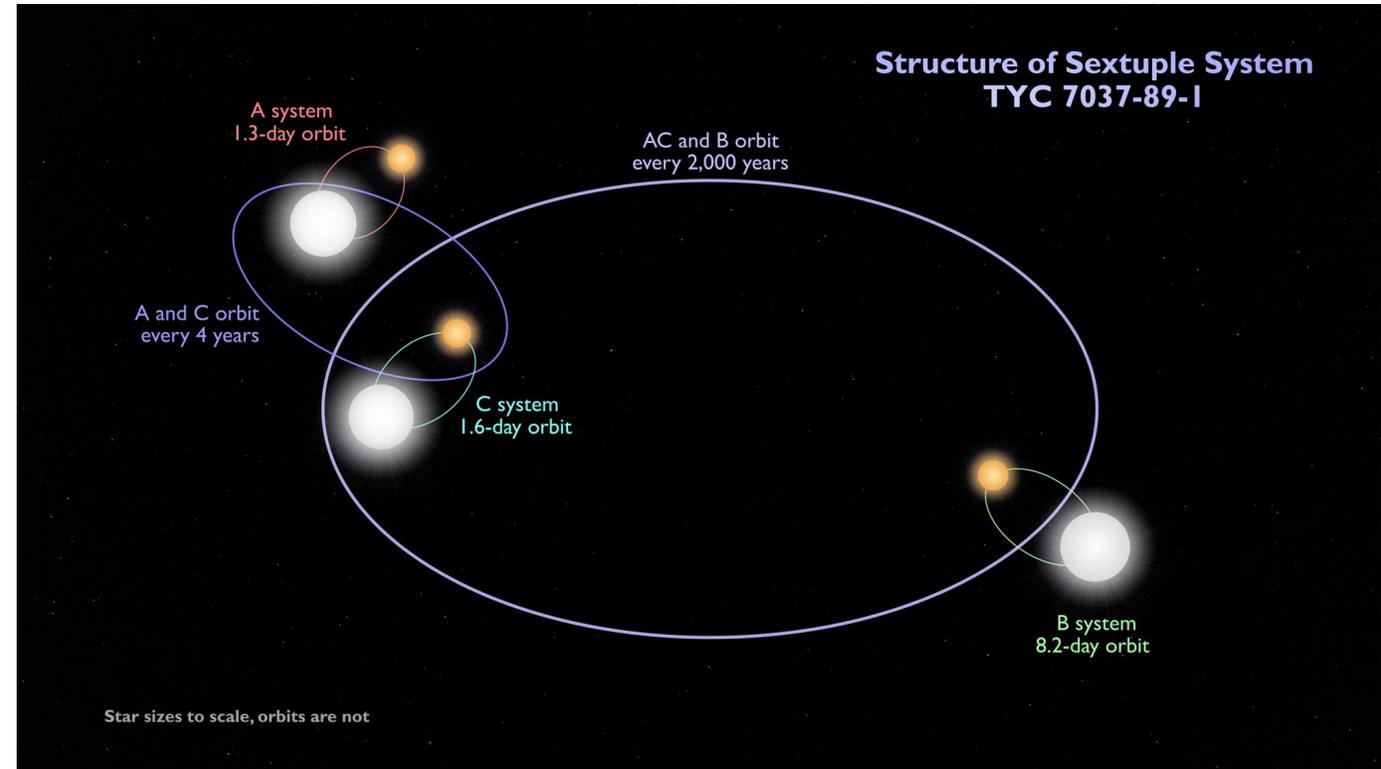


GSFC Data Science News!

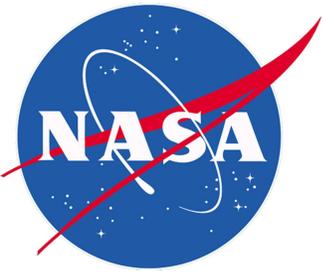


“**The discovery:** TYC 7037-89-1 is the first six-star system ever found where all of the stars participate in eclipses, a discovery made by [NASA’s Transiting Exoplanet Survey Satellite \(TESS\)](#). The system is located about 1,900 light-years away in the constellation Eridanus.”

“**The discoverers:** An international team, led by data scientist Brian P. Powell and astrophysicist Veselin Kostov at Goddard, made the discovery using TESS data.”

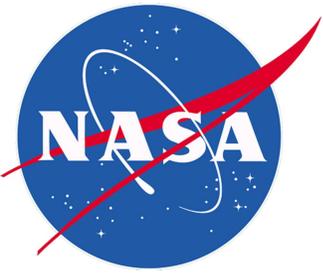


Reference and Image Credit: <https://exoplanets.nasa.gov/news/1672/discovery-alert-first-six-star-system-where-all-six-stars-undergo-eclipses/>



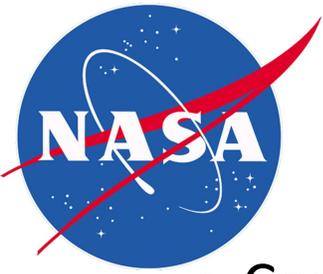
AICOE Partnerships: Academia

- Established the Academic Research Collaborative (ARC) led by *James Harrington*
- Identified research areas of interest to GSFC scientists and engineers, drafted an Appendix for the EPSCoR 2020 Solicitations for CISTO, Code 606
 - **Artificial Intelligence and Machine Learning (AI/ML)**
 - **Augmented Reality/Virtual Reality/Mixed Reality (AR/VR/MR)**
 - **High Performance Computing; Applications to Exascale**
 - **Citizen Science**
- Proposal reviews
- Providing Technical Monitors
- Providing Computational Resources



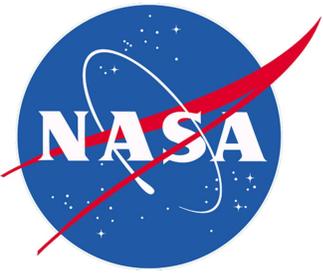
AICOE Partnerships: Academia

- 2020 EPSCoR Awardees, paired with a GSFC Collaborator/Technical Monitor
 - *Machine Learning for Environmental Feature Recognition (Wyoming)*
 - *A Generic Data-Driven Framework via Physics-Informed Deep Learning (South Carolina)*
 - *Ray Events Detected by Radio Probes (Delaware)*
 - *Framework for Increasing Generalizability of Machine Learning Models (Kansas)*
 - *AI-based framework for real time RFI detection in radio astronomy data (West Virginia)*
 - *Other: A Citizen Science Game EPSCoR R2 proposal (University of Vermont)*



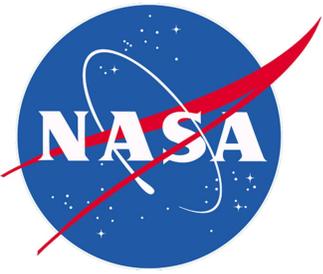
2021 EPSCoR Solicitation

- Computational and Information Sciences and Technology Office (CISTO) Computational and Technological *Advances for Scientific Discovery via AI/ML Modeling and Development Hackathons*.
 - Design a year of AI/ML education, training, networking and building of machine learning models in close collaboration with NASA project senior science and engineering mentors
 - “Hack Weeks as a Model” (<https://www.pnas.org/content/115/36/8872>)
 - SMD FDL Model
- Assessing and qualifying Citizen Science Labeling for Training Data for GLOBE Observer Mosquito and Land Cover protocols improving data quality within the GLOBE Observer community.
- Onboard Satellite Fault Diagnosis using Machine Learning
- Application of Machine Learning to High-Resolution Earth System Model Data
- *Under Review*, were due Feb. 5, 2021.



Looking Ahead

- Goddard has internally supported many cross-cutting data science activities through IRADs and Science Task Groups.
- Machine Learning for Everyone: A Model-Based Approach
 - Led by Dr. Barbara Thompson
 - FY21 with GSFC's Science Task Group Funding
 - Capture the full "Life Cycle" of a data science/machine learning project. The factors behind each decision point will be used to produce a MBx deployable methodology and toolkit



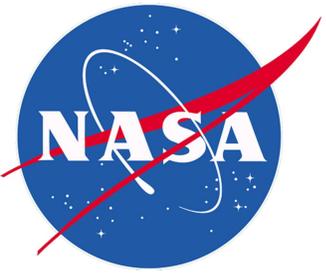
Summary and Next Steps

Seeking:

- Proposals
- Reviewers
- Speakers

Offering Opportunities to:

- Receive consultation services
- Access High-end computing environments
- Form partnerships
- Learn about various computational resources
- Learn about various funding opportunities



Questions?



Thank you!
Please do not hesitate to contact us