

**Dr. Lika Guhathakurta on behalf of the FDL Team**  
Lead Developer, NASA Innovation, Initiatives, Impact Program  
NASA Ames Research Center (on detail from NASA HQ, Heliophysics Division)







CREDIT: FDL





CREDIT: A GENIUS

**What is NASA Doing with Big Data?**

**2 Gigabytes**

**Every 15 seconds**

# What If...? AI Meets Space Science



Planetary Defense



Space Resources



Space Weather



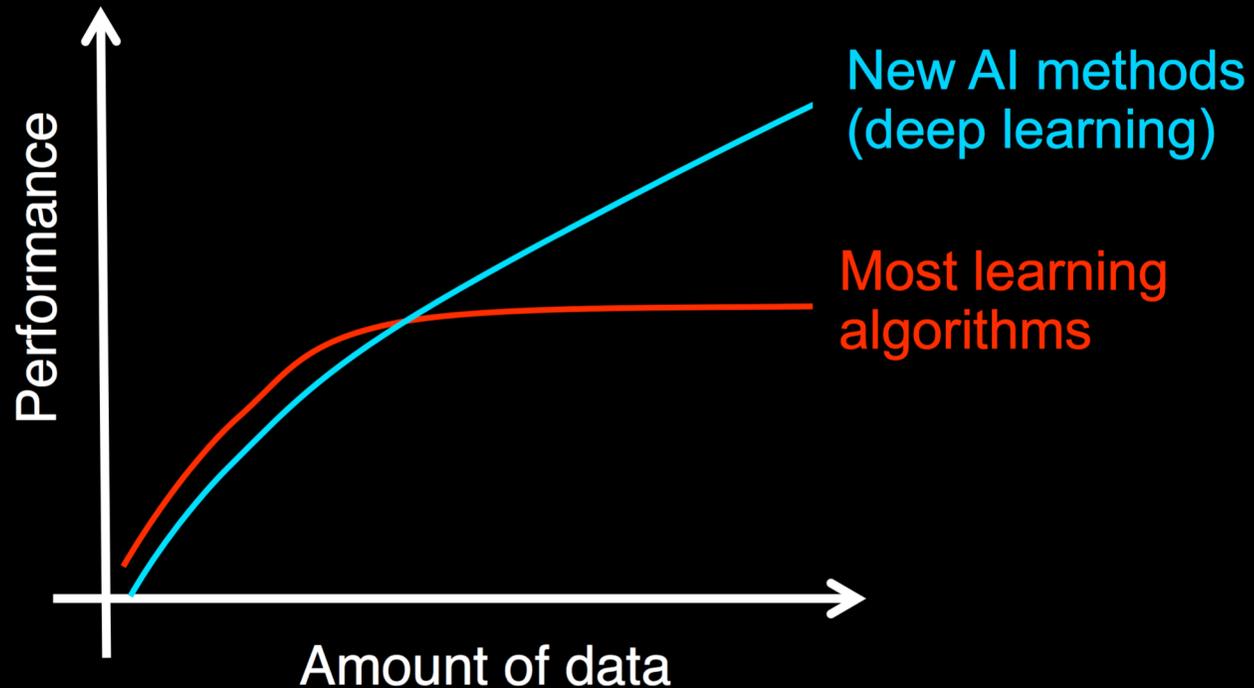
Exoplanets



Astrobiology

# Space Science and Deep Learning

## Space Science is **Data** Heavy

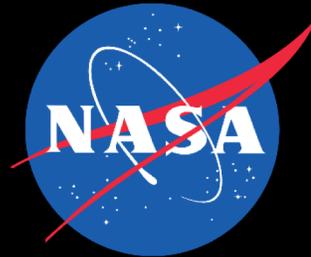


Credits: Andrew Ng

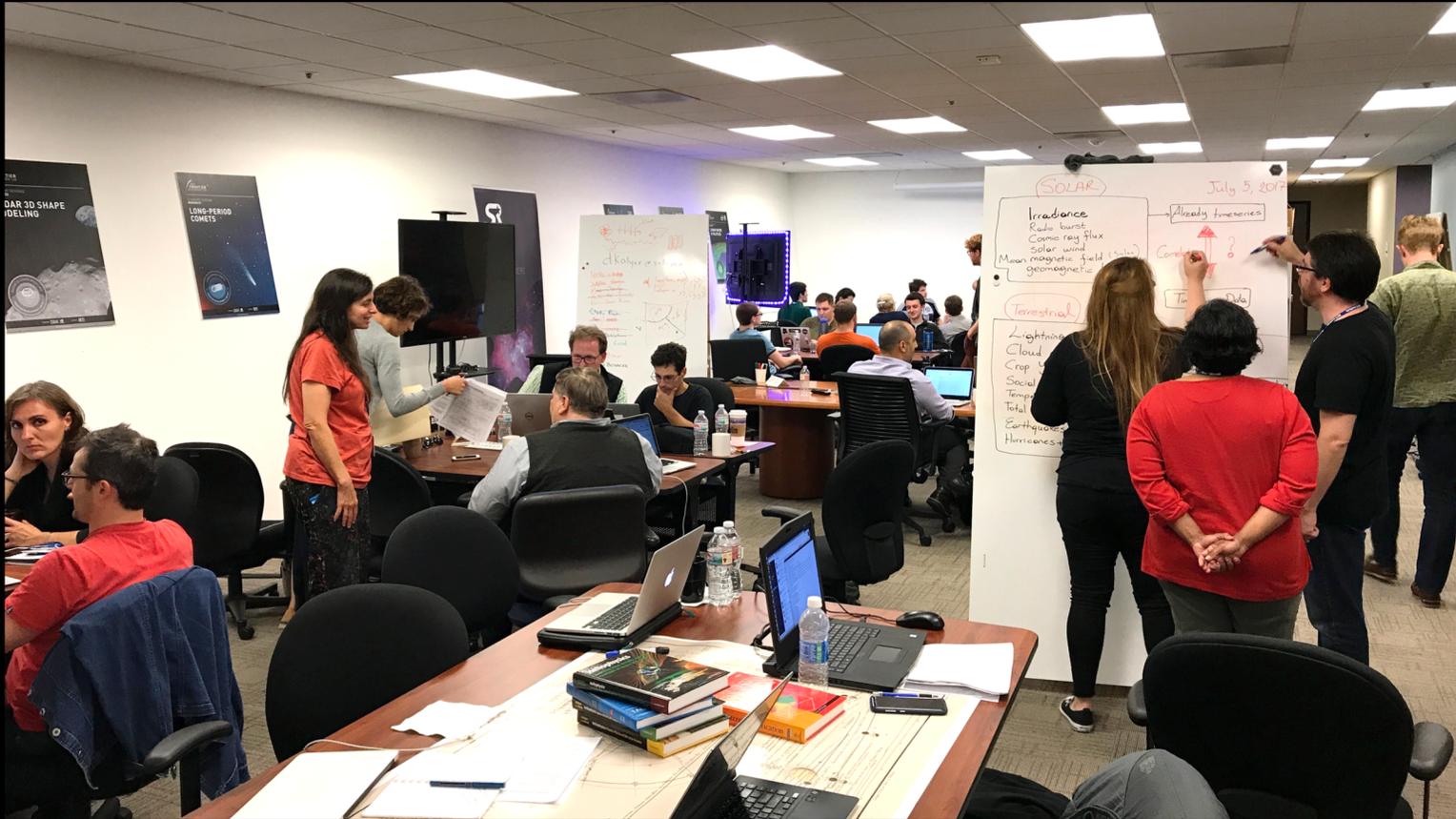
**Data Scale** When properly architected, the efficacy of DL systems continue to improve with more data, long after statistical models have plateaued.

# Who: The Players...

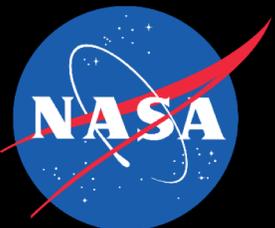
- Early-career PhD's in AI/ML
- Early-career PhD's in Space Research
- AI & Deep Science SME's & Mentors
- NASA Stakeholders
- Industry Partners
- Academia



# What: 8-Week Summer Research Accelerator



Interdisciplinary teams leverage the latest GPU & CPU technology and advanced machine learning tools for an intensive summer workshop – supported by subject matter experts from Industry, NASA and the research community



# Why? To Accelerate Discovery & Understanding

## Process Improvement:

3D asteroid shape modeling

## Discovery:

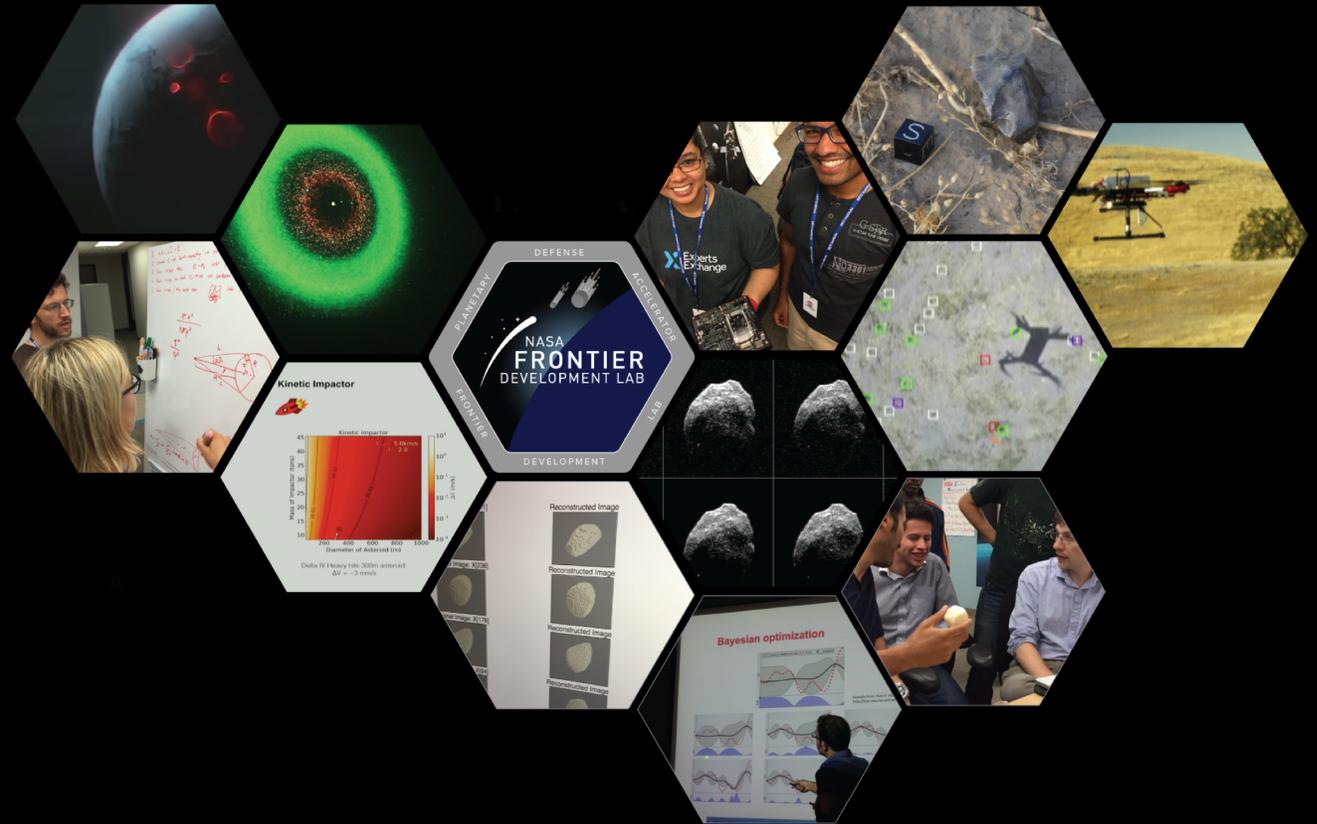
Finding long-period comets

## Understanding:

Forecasting solar behavior

## Exploration:

Enabling autonomous navigation



*Pace of Data Generation Far Exceeds Pace of Data Analysis*



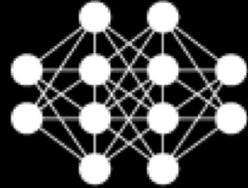
# NASA Frontier Development Lab

## AI Accelerator for Space Science and Exploration

- Unique initiative that combines the strengths of NASA, private corporations and academic partners.
- Annual program with an intensive 2-month implementation phase that tackles problems that are important to NASA missions and space science.
- Track record of success in using advanced AI methodologies to complement physics-based analytics.

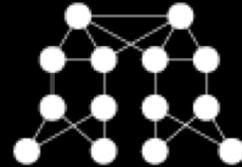


# AI/ML Tools Applied to FDL Challenges



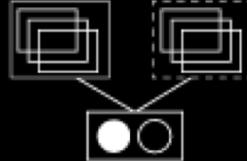
**Convolutional  
Neural Nets  
(CNNs)**

**Machine Vision**



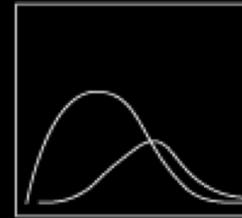
**Deconvolutional  
Neural Nets  
(DNNs)**

**Machine Learning**



**Generative  
Adversarial  
Networks  
(GANs)**

**"Alpha-Go"**



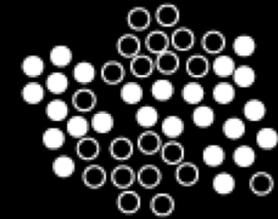
**Bayesian  
Optimisation**

**Optimising  
expensive functions**



**Variational  
Auto-Encoders  
(VAEs)**

**Generated  
Sample Data**



**T-SNEs**

**Multi-dimensional  
Visualization**

**DEEP LEARNING**

**MACHINE INTELLIGENCE**

# PROJECT IMPACT OVERVIEW

DISCOVERY WORKFLOWS

SPACE SITUATIONAL AWARENESS

DECISION INTELLIGENCE



## ARE WE ALONE?

INARA

(Atmospheric Retrieval)

ATMOS 2.0

(BioHints)

ExoNET



## PLANETARY DEFENSE

CAMS (long period comets)

NEO SHAPE MODELING

DEFLECTOR SELECTOR

METEORITE DRONE



## LIVING WITH A STAR

FLARENET

STING (Kp Index)

DeepEM: UV Prediction

GPS Scintillation



## THE MOON FOR GOOD

LUNARUSH

(Lunar Mapping)

MARMOT

(Co-operative Robots)

LOCALIZATION



## MISSION CONTROL EARTH

Multi<sup>3</sup>Net

(Disaster Response)

Informal Settlements

KEY:

- DEPLOYED AI ON NASA FUNDED PROGRAM
- PEER REVIEWED JOURNAL PAPERS
- UNDER DEVELOPMENT WITH PARTNER / SPINOUT
- CONFERENCE PAPER (E.G. NEURIPS / AAAI)
- ONGOING DEVELOPMENT WITH FDL OR NASA (TECH DEMO)
- TOOLS USEFUL FOR SCIENCE COMMUNITY
- SYNTHETIC / TRAINED DATA
- STORYTELLING / CITIZEN SCIENCE

# NASA FRONTIER DEVELOPMENT LAB - FORMULA

