National Aeronautics and Space Administration

Big Data Applications/Program/Initiative Challenges at NASA

Office of the Chief Information Officer

2nd NIST Big Data Public Working Group

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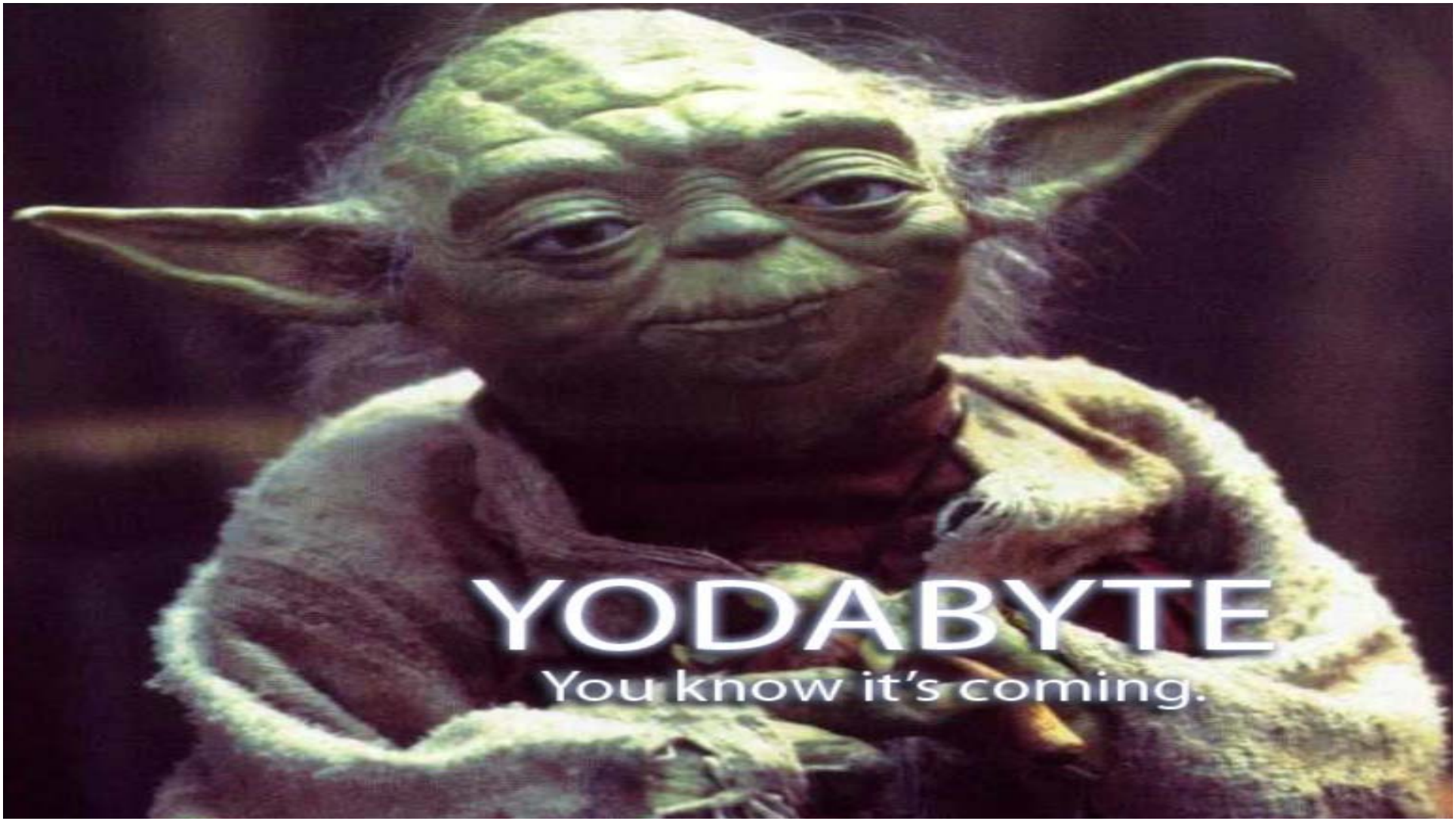
5/30/2017

www.nasa.gov

NASA CIO Office of the Chief Information Officer

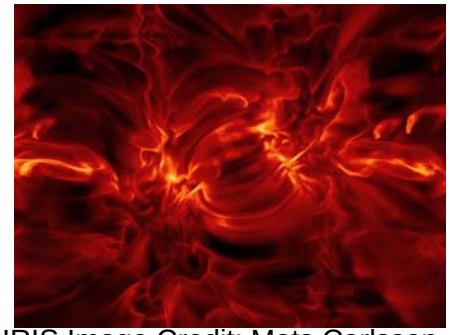
Agenda

- Big Data Use Cases
- Big Data Challenges
- Questions


YODABYTE
You know it's coming.

Big Data Use Cases:
NASA's Pleiades Supercomputer

- State-of-the-art tech for agency's supercomputing requirements.
- 5.95 Pflop/s LINPACK rating (#13 on Nov 2016 in the world).
- NASA’s Interface Region Imaging Spectrograph spacecraft flying above solar surface at 6,000 miles, showing only plasma at a temp of about 35,000 degrees Fahrenheit.



IRIS Image Credit: Mats Carlsson, University of Oslo

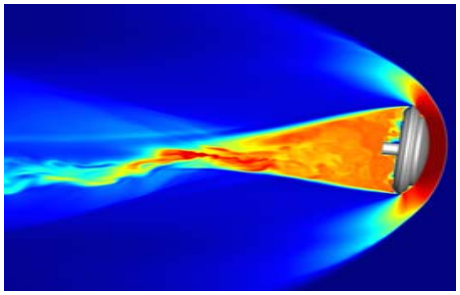
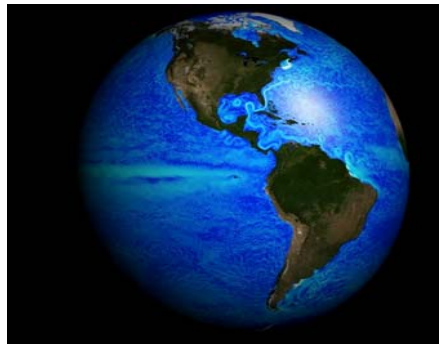


Image Credit: NASA Ames

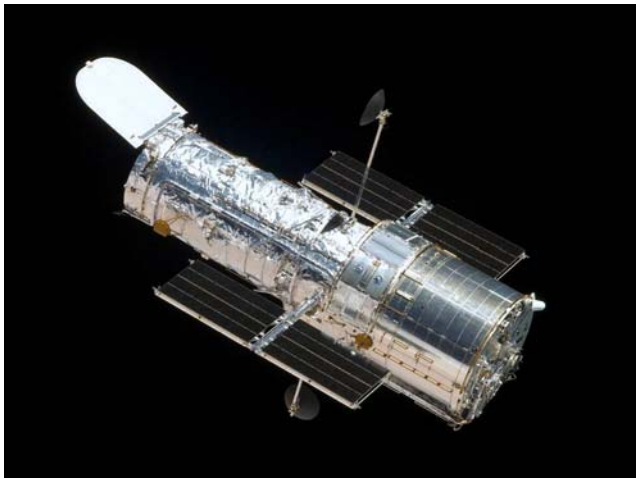
- Modeling for Entry, Descent, and Landing.
- Simulation of the global state of the ocean by ECCO Consortium, over 5 PBs for 14 months.



ECCO Image Credit: Chris Henze NASA Ames

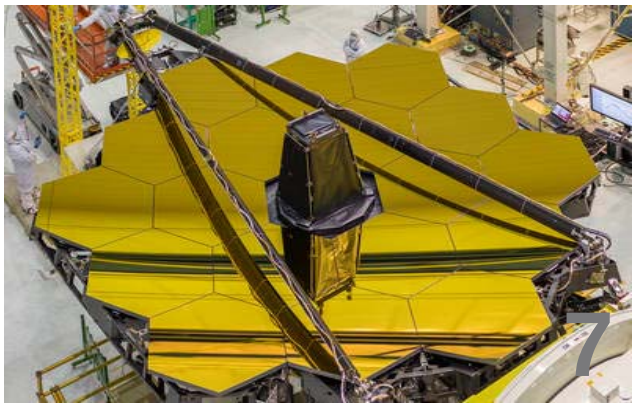
https://www.nas.nasa.gov/hecc/resources/pleiades.html

Big Data Use Cases: Unmanned Missions

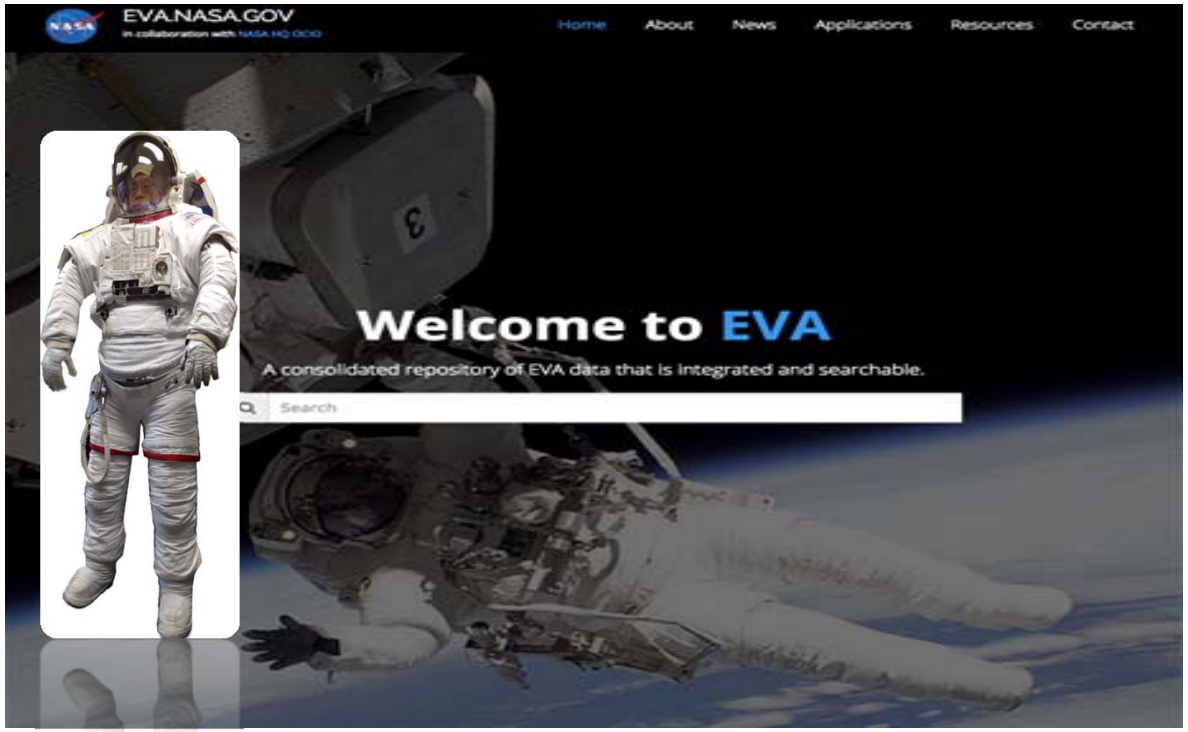


- Hubble Space Telescope, deployment in April 1990
- First major optical telescope to be placed in space
- More than 1.3 M observations, 14K scientific papers
- Hubble archive contains more than 120 Terabytes, and Hubble science data processing generates about 10 Terabytes of new archive data per year

- James Web Space Telescope (JWST)
  - » Space-based observatory, optimized for infrared wavelengths, which will complement and extend the discoveries of the Hubble. Launches in 2018
  - » 6 times larger in area than Hubble



Big Data Use Cases:
Extra Vehicular Activity (EVA) Data Integration



Access to all EVA data – Search, Browse, Navigate & Analyze

Just Completed Phase 2

State-of-the-art Platform using Tools:

- Core platform based on ELK Stack
- Prelert for Anomaly Detection
- Hosted in AWS Government Cloud
- Various databases including RethinkDB, Neo4J, Amazon RDS, & PostgresSQL
- APIs deployed as micro services using Docker container
- Amazon S3 for document storage
- Integrated with jBPM workflow engine
- UI framework: HTML5, Angular, Bootstrap, Materialize CSS
- 2D and 3D models for browsing

Big Data Use Cases:
Moon Laser
(Lunar Laser Communication Demonstration)

- Pulsed laser beam set record in data transmission
  - » Transmitted data over 239,000 miles between moon and Earth, record-breaking download rate of 622 Mbps
- Developed by MIT's Lincoln Laboratory, Hosted on LADEE
- Prep for Laser Communications Relay Demo (LCRD)
  - » Transmit data 10 to 100 times faster than the fastest radio-frequency systems, Uses significantly less mass/power
  - » Being built at NASA's Goddard Space Flight Center
  - » First time NASA has contracted to fly a payload on an American-manufactured commercial communications satellite, launching in mid-2019

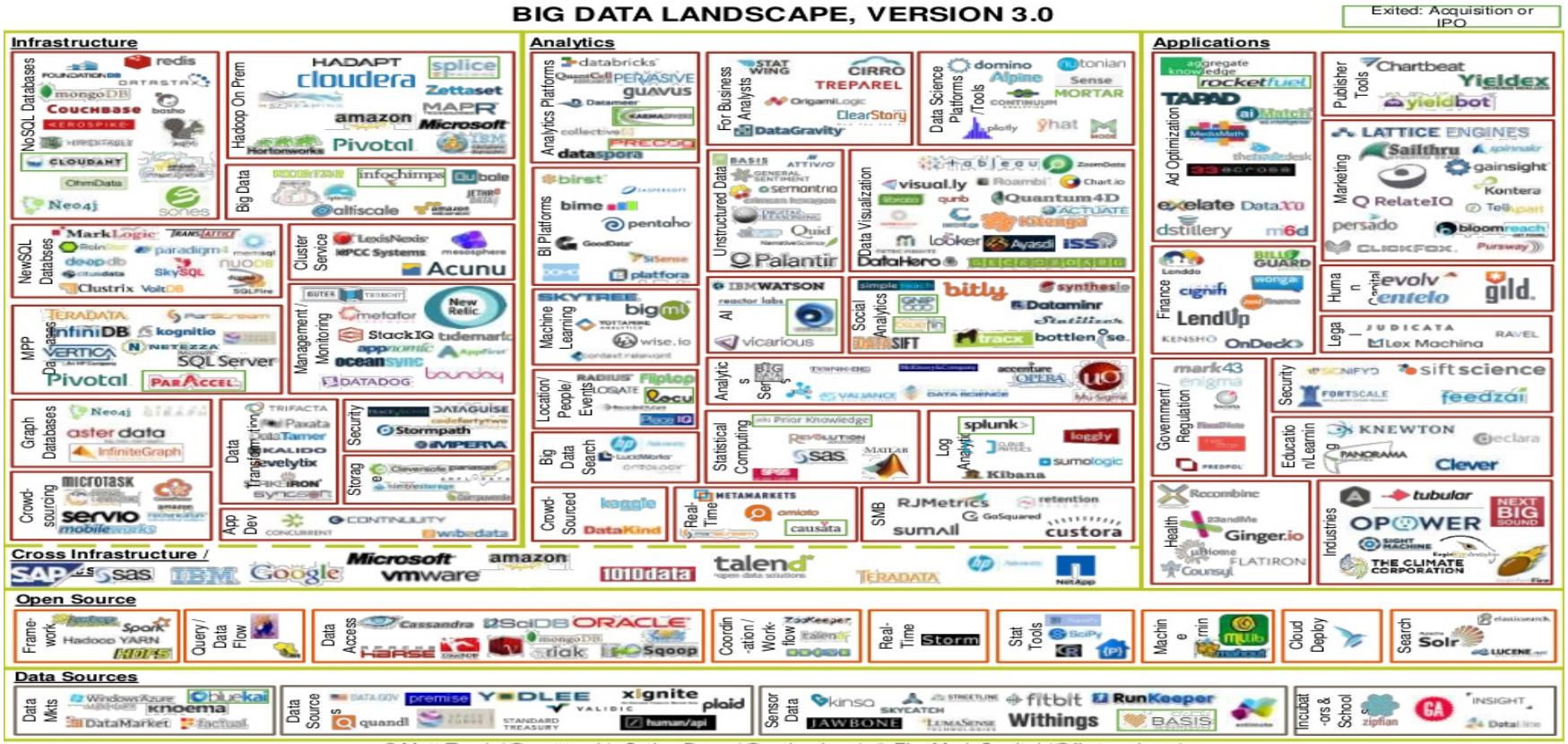
Big Data Use Cases
Quantum Artificial Intelligence Laboratory (QuAIL)

- QuAIL is the space agency's hub for an experiment to assess the potential of quantum computers to perform calculations that are difficult or impossible using conventional supercomputers.
- “The D-Wave took about a hundredth of a second; with a classical computer it'd take about 100 days”, Google’s Director of Engineering, Hartmut Neven
- Beginning with the D-Wave Two™ quantum computer, NASA’s QuAIL team is evaluating various quantum computing approaches to help address NASA challenges.

Photo by John Sprague taken 1 May 2014, with my friend Ed McLarney from Langley Research Center.

https://ti.arc.nasa.gov/tech/dash/physics/quail/

Big Data Challenges
Common Tools, New Tools



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Big Data Challenges

- Obviously--the Velocity, and Volume
- Tight Budgets
- Data Architectures
- Mission Silos
- Internet of Things
- Data Management/Visualization Skills

Questions?