Foundation Models
Digital Twins
## More than just cheating on Homework

Michael Little

LS Technologies LLC

October 30, 2023

Advanced AI Topics at NASA

Foundation Models

An AI construct of self-supervised learning enabling re-use

- Large volumes of training data
- Expensive to Pre-train
- Cheap to Infer & re-use widely

- ❖ Land Surface (prithvi100M) NASA/IBM/ClarkU
- ❖ Climate/Weather: NASA/IBM/ORNL/NVIDIA
- ❖ Solar Dynamics: NASA Heliophysics SDO-GPT

Concept of Operations for NASA Foundation Models
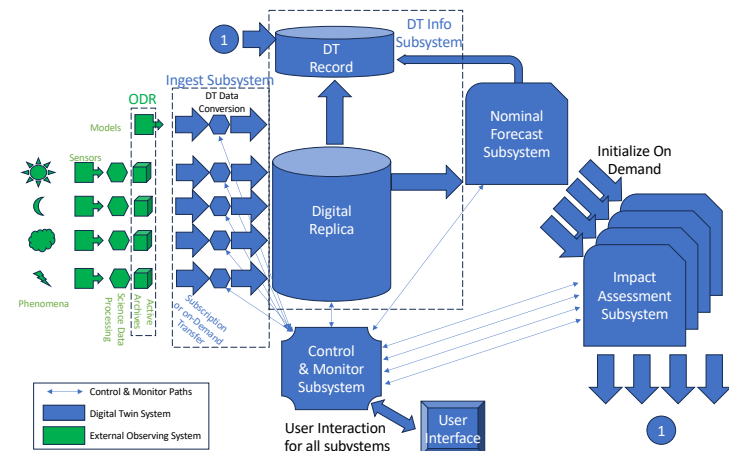
Earth Science Digital Twin

A dynamic, interactive Information System

- Near real time digital replica of system
- Nominal Forecast Model
- Impact Assessment

- ❖ JPL IDEAS (AIST, CNES, SCO): coastal flooding, AQ
- ❖ EC Initiative: Destination Earth (DestinE)
- ❖ Streamflow Hydrology: USACE, NASA, USGS, NOAA
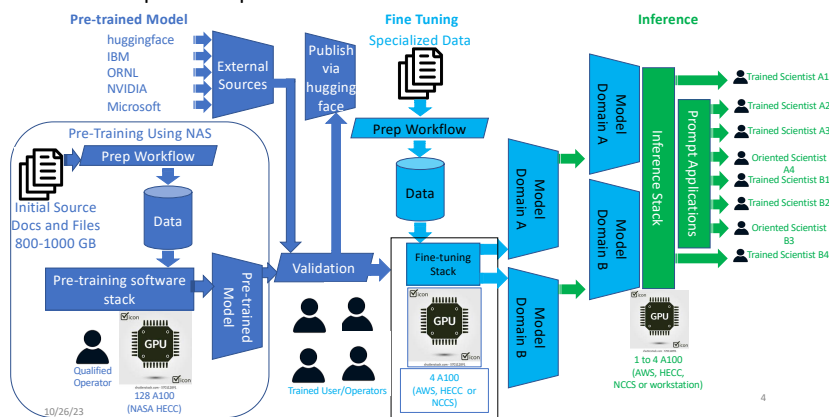
Thesis

- Foundation Models and Digital Twins can democratize science
  - Domain science is limited by resources for data and computing
    - Practiced by those with funding, data, computing and tool-maker knowledge
  - Investigations involving sophisticated tools require considerable effort by each user
    - Learn the tool and its origin and how to use it effectively
  - Allow non-traditional scientists to use sophisticated tools within guardrails
  - Shortcomings
    - Lack transparency
    - Model and data bias needs to be considered by users
    - Hype

- The ROI on FM/DT requires them to be re-usable across a wide range of related physical phenomena and natural processes by many users

- Must start with the Science community

- Re-usability requires credibility and ease of use

- Credibility comes from from validation, provenance and public discussion

- Ease of use comes from a forward looking, user-centered User Interface