Scientific Computing Enables Research, Education, and Extension

Community IT Event

Julie Swann (Research Computing and Data in OIT) [Overview]

Bonnie Hurwitz (Bioinformatics Research Center) [Research Example]
Collin Lynch (Computer Science) [Education Example]
Chris Reberg-Horton (Plant Sciences Institute) [Extension Example]

Thanks also to Eric Sills of OIT!

March 2, 2026

Research Computing and Data (RCD)

- RCD is a comprehensive ecosystem of infrastructure, services, and expertise that empowers research (and education and extension) through advanced computing and data capabilities.
  - High-performance computing
  - Data management and storage
  - Research facilitation and consulting
  - Software and tools
  - Cyberinfrastructure
  - Training and workforce development

Without scientific computing, most research stops.

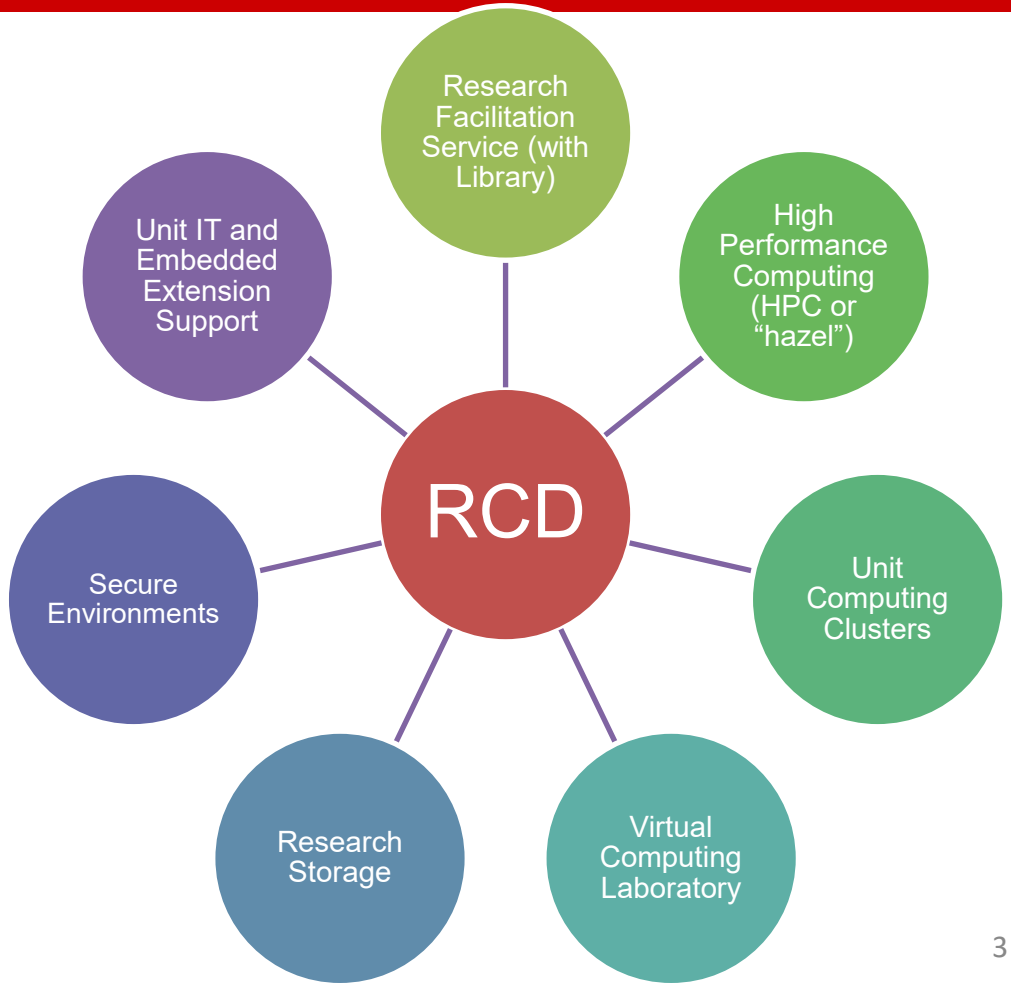
Education is limited.

Extension is impaired.

RCD Ecosystem at NC State

(with institutional support)

OIT	Libraries
Provost	Finance & Business Administration
Office of Research and Innovation	Colleges, Units, and Centers



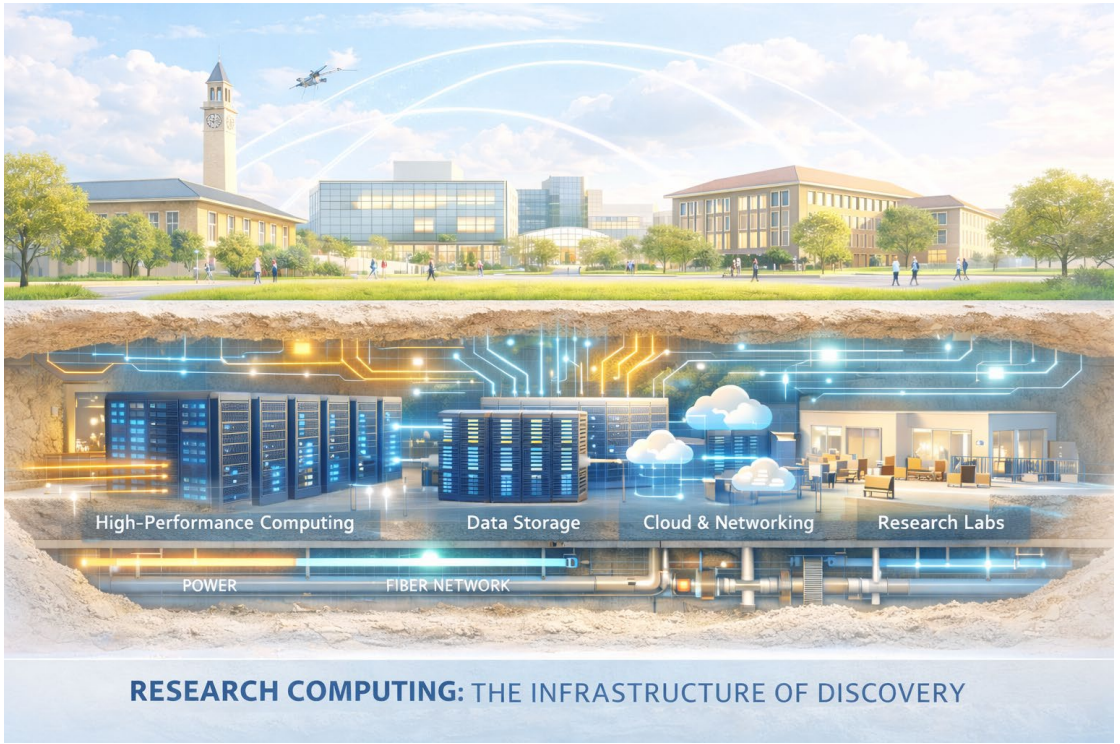
Some of my Goals as iAVC RCD

1. Grow the use of scientific computing on campus
2. Plan for the future of RCD at NC State
3. Improve services (and training)
4. Build foundation for financial sustainability

RCD should support needs from pre-proposal to computing to extension and dissemination while being good stewards of resources.

Primary focus is research while noting some overlap with education and extension.

Planning for the Future of RCD



Investing for the future of RCD

- Demand for research computing is growing
- The nature of research computing infrastructure is changing
  - Newer hardware requires liquid cooling and significantly higher power
  - Hosting this hardware in distributed, local campus spaces is not secure, cost-effective, or scalable
- Infrastructure investments today are realized in 2-5 years
- Bottom line
  - To remain a major participant in scientific computing for research, education, and extension, NC State must make substantial, forward-looking investments now

Planning and Investments (Overview)

- Long-term: On-Premises Research Computing Facility
  - Most cost-effective solution over the long term; not available for 5+ years
  - Status: Submitted through the Campus Needs process
- Medium-term: Colocation with partner
  - Build out dedicated space with power in advance (~ 2 years)
  - Delays in commitment increase short-term costs
  - Status: On hold in the University Strategic Budgeting Initiative process
- Short-term: Bridging the Gap
  - Early replacement of hardware (~$5M) to increase near-term capacity
  - Expand training and use of external resources to supplement capacity
- Personnel also needed to provide services and training

Other Recent RCD Initiatives

- Planned shift of scheduling system to Slurm (from user survey)
- Ensuring financial sustainability and broad access
- Co-developing training with RFS and ORI
- Partnerships across campus

RCD Activities across Campus

Research, Education, and Extension

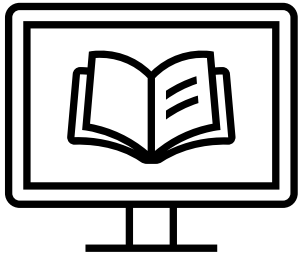
RESEARCH
Bioinformatics …

Dr. Bonnie Hurwitz
Director of the Bioinformatics Research Center
Associate Professor of Biological Sciences

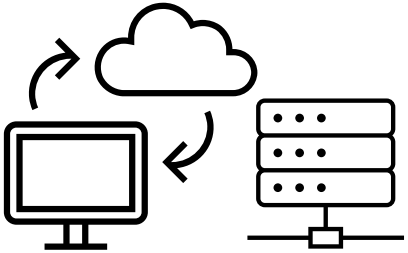
NC STATE UNIVERSITY

BIOINFORMATICS RESEARCH CENTER

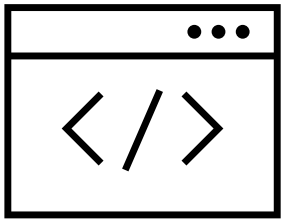
Machine Learning & NLP



Scalable Computing

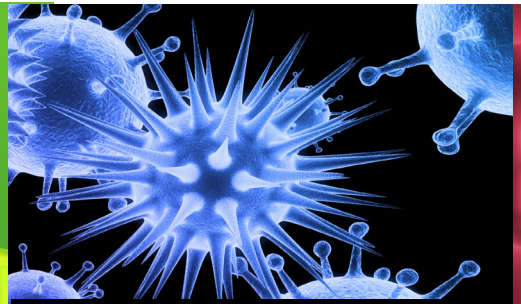


Algorithms



Cyberinfrastructure

The blue print in action: genotype to phenotype



Architecting life: population biology & microbiome

Vital Ecosystems: Human & environment

Intelligence Unleashed: Bioinformatics, AI & cyberinfrastructure

Creating a BRC Computing Ecosystem

Tailored Documentation

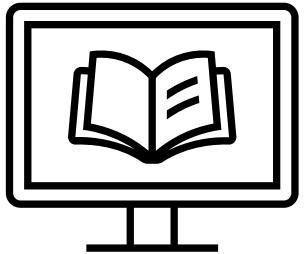
quarto®

Central Hub: GitHub Organization

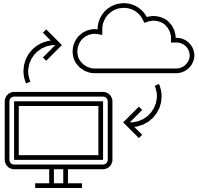
GitHub

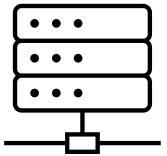
The Community Layer:

Hacky Hour



slack





EDUCATION
Engineers Building AI

Dr. Collin F. Lynch
Associate Professor of Computer Science

EDUCATION
Engineers Building AI
EVERYONE Using AI!

Dr. Collin F. Lynch
Associate Professor of Computer Science

The Only Constant is Change.

- Growth overall: *40,503 students at NCSU*

- Growth in Computing Majors:
  - CSC: 1,500 undergraduates & intended.
  - ECE: 1,100 undergraduates & intended
  - New Interdisciplinary Quantum Computing Program

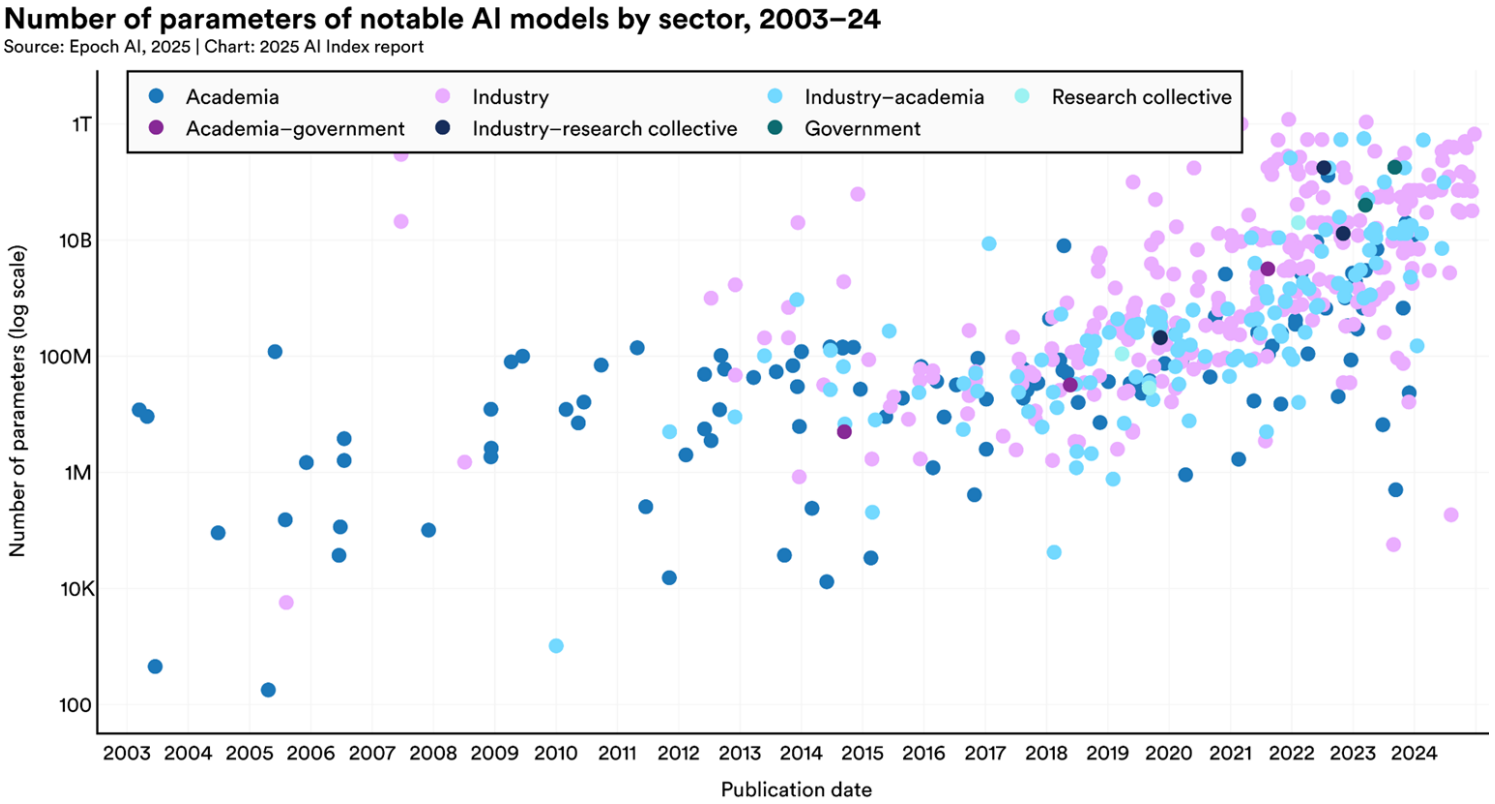
- New interdisciplinary courses:
  - Robotics in Civil Engineering
  - Social Network Analysis in Sociology
  - Responsible AI in English

Projects not (just) Courses.

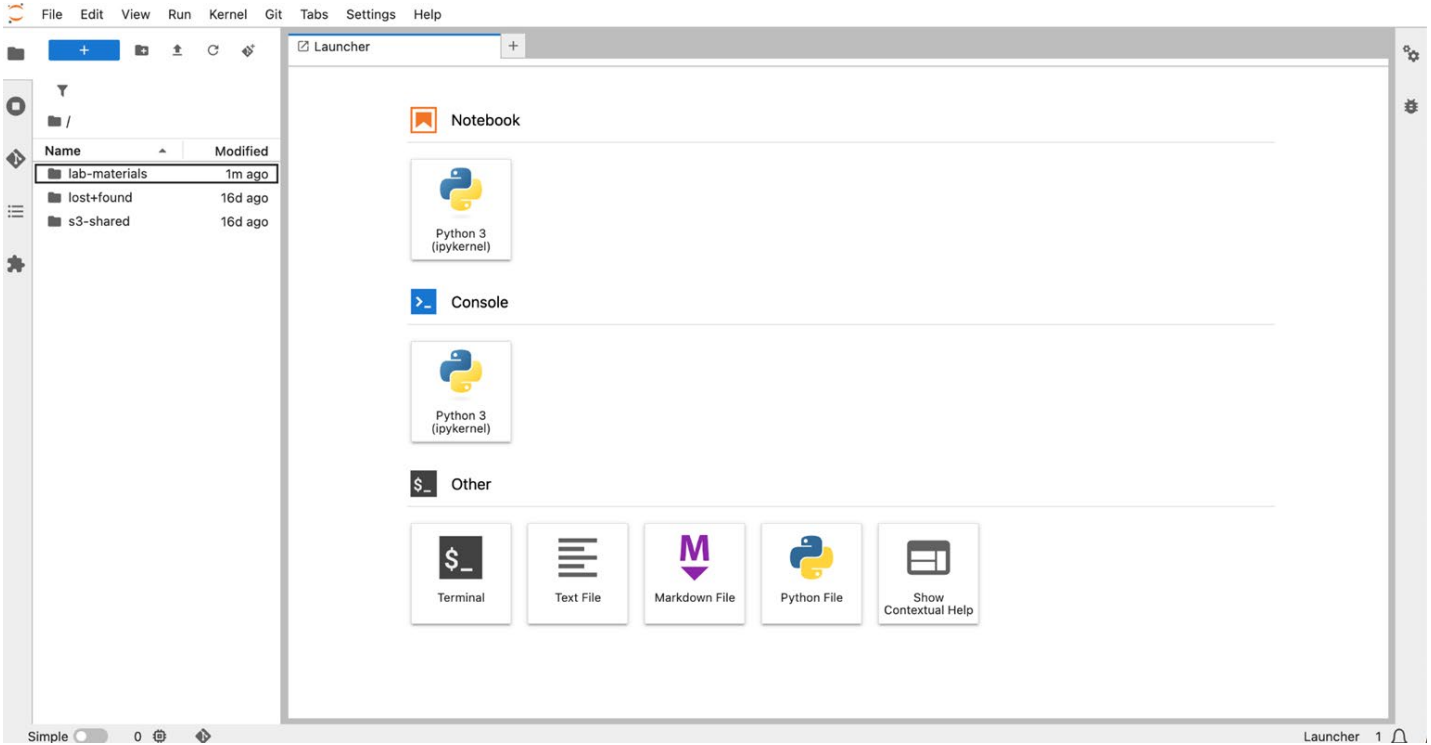
“AI” is not “Generative AI”

- Large-scale data analysis for crop science.
- UAVs for construction site monitoring.
- Visual recognition for animal health.
- Canine behavior models for system interaction.
- Adaptive sensors for new clothing design.
- Predictive models for public health.
- Network analysis of supply chains.

Expensive Tools



New Platforms: JupyterHub



New Course Sequences

Jointly developed with: David Roberts, Adam Gaweda, & Sarah Heckman

Fundamentals of Applied AI for Engineering

- *How do you formalize engineering problems as AI problems?*
- Identify and recall core AI concepts and methods.
- Explain core AI methods and algorithms
- Align them with problems in Engineering
- Apply core AI methods such as search and optimization to solve engineering problems.
- Analyze the behavior of AI algorithms and applications on real-world problems.
- Evaluate AI applications in engineering domains for: appropriateness; validity; outcomes; and ethics

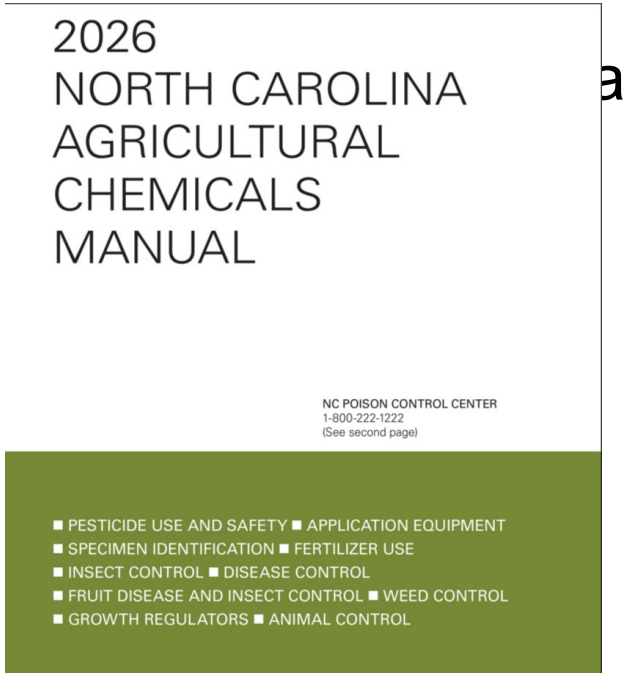
Problem-Solving with Applied AI for Engineering

- ***How do you leverage AI tools to solve Engineering Problems?***
- ***Utilize common AI tools and natural language processing methodologies***
- ***Utilize Generative AI tools to develop AI workflow solutions***
- Compare regression and classification model outputs for statistical analysis
- Justify appropriate AI workflows for solving different types of engineering problems
- Communicate AI results through data visualizations and result evaluations
- Build a development workflow from data collection to evaluation for an AI use case

EXTENSION
From the Ground to the Sky

Dr. Chris Reberg-Horton
Professor of Crop and Soil Sciences

EXTENSION: AI products for farmers



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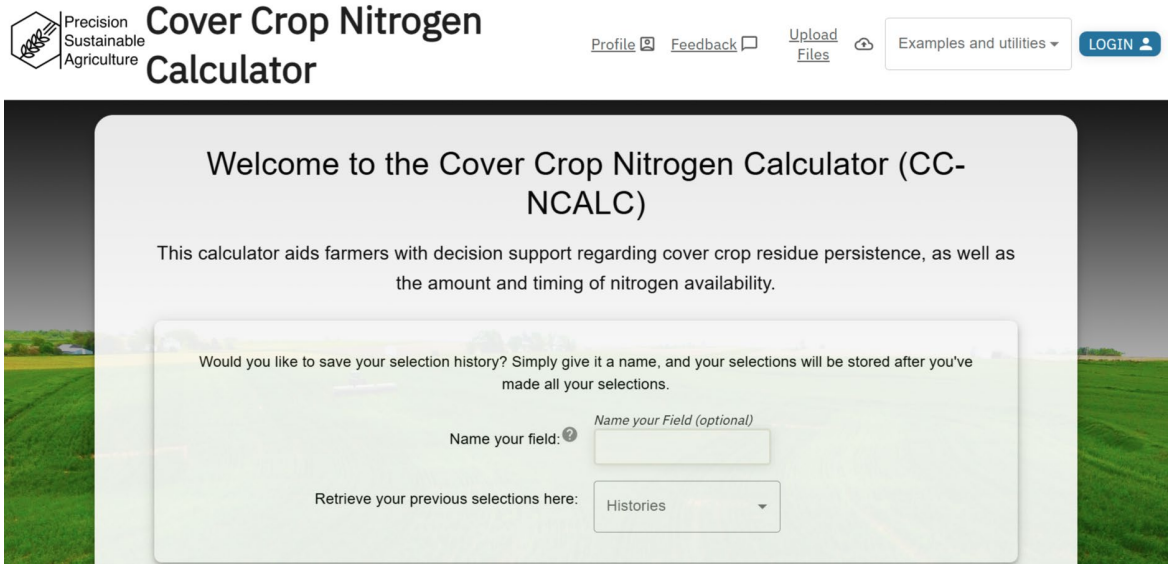
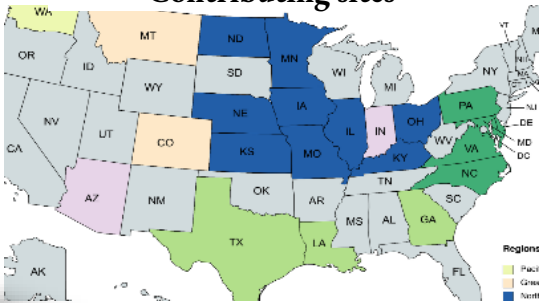


Computer vision requires 10,000s of images

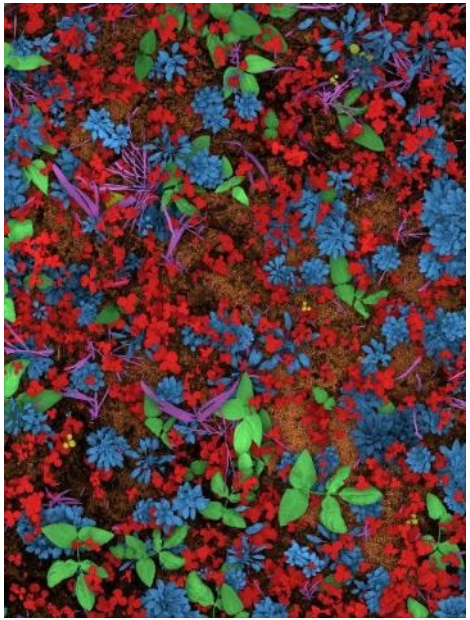
Contributing sites



Synthetic natural images

Known percent overlap and coverage

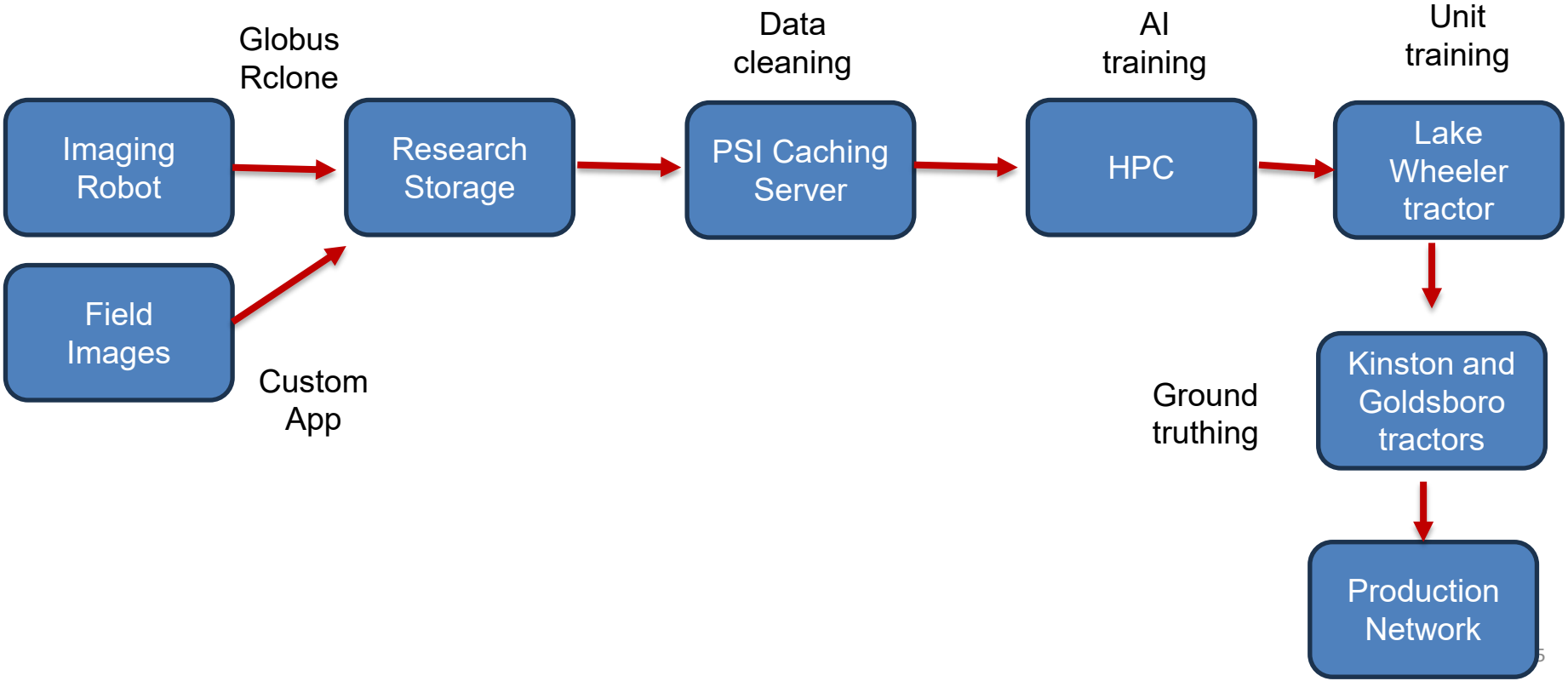
Synthetic training image



Synthetic training label

On Field Setup

Long data pipelines



GROUP DISCUSSION

RCD across Campus

- Research
  - Opportunities and needs
- Education
  - Status quo and future plans
- Extension
  - Opportunities and gaps

QUESTIONS/DISCUSSION

- Julie Swann
  - jlswann@ncsu.edu
- Eric Sills (Technical Architect of HPC)
  - edsills@ncsu.edu
- Research Facilitation Service
  - group-research_facilitation@ncsu.edu
- High Performance Computing
  - https://hpc.ncsu.edu/main.php
- Bonnie Hurwitz
  - blhurwit@ncsu.edu
- Collin Lynch
  - cflynch@ncsu.edu
- Chris Reberg-Horton
  - screberg@ncsu.edu

APPENDIX