

ASSET Bioinformatics Workshop 2026 Series

Artificial Intelligence In Modern Agriculture

The Future of Smart Farming

Session 1 (Week 1)

Introduction to Ag & AI

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Join the Smart Farming Revolution

This 6-week online program is custom-built for high school, graduate, and master's students eager to build a career at the intersection of AI, engineering, and data science.

"Anyone passionate about AI, technology, and the future of agriculture is warmly welcome to join!"

Core Learning Objectives

- **IoT & Drones:** Real-time field telemetry and multi-spectral imaging.
- **AI Decision Making:** Turning sensory datasets into predictive insights.
- **Sustainable Design:** Formulate AI solutions for climate-resilient farming.
- **Career Pathways:** Explore high-impact roles in smart tech and STEM fields.

How Do We Sustainably Feed the World by 2050?

As populations surge, arable land is shrinking and resource degradation is worsening.

9.7 B

Projected Population

The global population is on track to reach 9.7 billion by 2050, putting extreme strain on our agricultural supply chains [FAO News](<https://www.fao.org/newsroom/detail/better-land--soil-and-water-management-key-to-feeding-10-billion-people--fao-warns/en>).

+50%

Food Production Demand

To feed this population, agriculture must produce 50% more food, feed, and fiber, alongside a massive 25% increase in freshwater [FAO News](<https://www.fao.org/newsroom/detail/better-land--soil-and-water-management-key-to-feeding-10-billion-people--fao-warns/en>).

60%

Arable Land Degradation

Over 60% of human-induced land degradation now occurs on agricultural soil. Expanding farming areas is no longer an option [FAO News](<https://www.fao.org/newsroom/detail/better-land--soil-and-water-management-key-to-feeding-10-billion-people--fao-warns/en>).

Producing More & Better with Smart Technologies

Smart farming leverages data and automated machinery to maximize crop vitality and minimize input waste.



IoT & Soil Sensors

Constantly measure underground moisture, salinity, and temperature, delivering real-time telemetry from the field.



Drones & Satellites

Utilize multi-spectral cameras to capture crop vigor from the air, highlighting stress long before it's visible to the naked eye.



Farming Robotics

Autonomous weeding, picking, and targeted tillage platforms operating round-the-clock without manual labor dependency.



AI Cloud Engines

Aggregates weather, soil, and machinery data feeds into centralized portals for precise irrigation, fertilization, and harvesting schedules.

How Computers Learn From Agronomic Data

AI translates complex, noisy sensory data into automated actions that farmers can act on immediately.

Core AI Concept

Artificial Intelligence (AI) is the broader concept of machines executing tasks that mimic human intelligence.

Machine Learning (ML) is the practical subset. Instead of writing hardcoded rules, we feed a program millions of examples (like healthy vs. diseased leaves) and let the computer mathematically "learn" to spot the difference on its own.

The AI Application Bridge

In Everyday Life

FaceID unlocking your smartphone, Netflix recommending your next series, and smart assistants interpreting your voice.

In Food Production

Targeted nozzle triggering on weed sprayers, predictive disease models on remote crops, and robotic mechanical pickers navigating fields autonomously.

John Deere's See & Spray: Slashing Herbicide Use by 50%

How real-time artificial intelligence saves millions of gallons of chemicals while maximizing crop protection.

How It Works

 **Real-time Object Detection:** Custom CNN algorithms (like YOLO variants) process incoming video streams from boom-mounted high-resolution cameras.

 **Millisecond Decisions:** Running at 15 mph, the machine uses edge GPUs to achieve an execution window of <50 milliseconds from detection to precise target spraying.

 **77+ Weed Species:** Large-scale training datasets compiled by Blue River Technology enable robust classification regardless of visual similarities to crops.

Quantitative Impact (2025)

31M gal
Herbicide Saved

5M acres
Treated Fields

~50%
Chemical Reduction

1 Season
Typical ROI Payback

Integrating robotics and computer vision slashes chemical footprint by up to 90% in clean fields while fully safeguarding yields [John Deere Case Study](<https://reruption.com/en/knowledge/industry-cases/john-deere-see-spray-ai-slashes-herbicide-use-by-50>).

CropX: Translating Real-Time Soil Telemetry into Water Savings

By aggregating data from "soil to sky," farmers make predictive irrigation decisions to mitigate drought and disease.

The Hardware & Software Stack

 **Continuous In-Situ Soil Monitoring:** Rugged, self-contained soil probes capture real-time moisture, electrical conductivity (EC), and temperature at multiple depths.

 **Satellite & Telemetry Fusion:** Soil measurements are aggregated in the cloud alongside dynamic meteorological and multi-spectral satellite imagery.

 **Agronomic Decisions:** Direct guidance on when to spray fungicide, how to optimize water schedules, and predicting dryland moisture trends.

How CropX Drives Efficiency

Yield Optimization

By giving plants precise nutrition and irrigation when sensor thresholds indicate stress, farmers consistently increase average output per acre.

Resource Conservation

Overwatering causes root rot and nutrient runoff. Precision watering schedules ensure water is applied strictly within root-zone boundaries.

Risk Reduction

Predictive disease models flag potential mildew or root fungal outbreaks ahead of physical crop manifestation, prompting early protection.

Monarch Tractor: Innovation, Litigation, and Market Realities

A textbook engineering case study on how hardware complexity and product reliability determine agtech success.

The Rise & Pivot

 **The Vision:** The MK-V tractor was designed as the world's first fully electric, driver-optional, AI-guided tractor targeting specialty vineyards.

 **Dealership Lawsuits:** In 2024 and 2025, dealers reported operational issues such as sudden power loss, stalling, and failure to perform autonomously as represented.

 **Caterpillar Acquisition:** After laying off employees, closing its headquarters, and ceasing hardware manufacturing, its core intellectual assets were acquired by Caterpillar in April 2026.

Engineering & Career Lessons

Harsh Field Environments

Farming machinery faces dust, vibrations, temperature swings, and chemical sprays. Hardware must be highly ruggedized, and software must support graceful fail-safes.

Real-World Liability

In agriculture, hardware failure means lost crops and immediate financial strain. Designing dependable safety layers in autonomous systems is a legal and economic prerequisite.

Software Licensing Pivot

Capital-intensive hardware is incredibly risky for startups. Monarch's attempt to license its "Monarch One" software autonomous platform showcases the business value of flexible AI systems.

Ensuring Food Security Without Environmental Exploitation

Smarter production paradigms close yield gaps and preserve biodiverse ecosystems.

Smart Intensification

 **Ecosystem Integrity:** Clearing native forests or converting wetlands to expand farming destroys key carbon sinks and global biodiversity [FAO SOLAW Report](<https://www.fao.org/newsroom/detail/better-land--soil-and-water-management-key-to-feeding-10-billion-people--fao-warns/en>).

 **Smarter Production:** Future agricultural yield improvements must rely on closing existing yield gaps, utilizing drought-tolerant cultivars, and utilizing precision monitoring.

 **Conservation Agriculture:** Broad scale adoption of organic composting, rotational grazing, and soil moisture conservation dramatically improves smallholder resilience [FAO SOLAW Report](<https://www.fao.org/newsroom/detail/better-land--soil-and-water-management-key-to-feeding-10-billion-people--fao-warns/en>).

Next-Gen STEM Opportunities

Remote Sensing Scientist

Leverage multi-spectral satellite imagery and machine learning to map soil erosion, carbon sequestration, and crop canopy coverage.

Agronomic AI Engineer

Build edge computer vision models, robotic controllers, and IoT cloud platforms to deliver tangible recommendations directly to farmers.

Bioinformatics Researcher

Analyze plant genomic datasets to breed hyper-resilient, climate-hardy seeds designed for regional weather stresses.

Activity Workshop: "AI Around Me"

Connecting everyday smartphone tools directly with robotic solutions in global farming.

Your Challenge

 **Time Allocated:** 10 Minutes Group Brainstorm

 **Step 1:** Identify five distinct artificial intelligence applications you use on your personal phone or computer every single day.

 **Step 2:** Bridge the technology gap. Translate how those exact underlying models could help farmers streamline fieldwork.

 **Step 3:** Appoint a team spokesperson to pitch your favorite agricultural concept to the wider group!

Example Bridges

 **Facial Recognition → Pest Identification**

FaceID maps micro-features to authenticate. Similarly, neural nets map structural bug anatomy to flag leaf infections instantly.

 **Google Maps Navigation → Autonomous Tractor Pathing**

Real-time GPS routing avoids urban congestion. In fields, centimeter-level RTK GPS maps perfect rows to prevent crop damage.

 **Autocomplete Text → Yield Predictions**

Predictive text calculates the most likely next word. Agricultural time-series models predict yield trajectories based on historical rainfall.

The Programming Paradigm Shift in Agriculture

Why manual engineering rules fail in dynamic natural environments and how Machine Learning solves it.

Traditional Rule-Based Coding

 **How it is built:** Human programmers write manual logical rules (If/Else conditions, static math thresholds) to solve specific problems.

```
Data + Rules → CPU → Answers

if leaf_color == "yellow" and humidity > 80:
    trigger_fungicide_spray()
```

 **Why it fails in farming:** Weather changes, variable lighting, dust, mud, and unique weed sizes break hardcoded software parameters instantly.

Machine Learning (Data-Driven)

 **How it is built:** Feed an algorithm labeled input datasets alongside historical targets, allowing the machine to learn optimal models.

```
Data + Answers → GPU Training → Rules (AI Model)

10M Images of Crops/Weeds + Labeled Classifications →
Neural Network → Accurate Weed Classifier
```

 **The Smart Advantage:** The resulting model automatically scales to varying lighting, soil textures, and organic shape transformations.

How Convolutional Layers Isolate Plant Anomalies

Understanding structural layers in computer vision networks mapping leaf disease and crop classifications.

01

Convolutional Filters

A mathematical sliding kernel moves across raw plant image pixels, detecting micro-geometric details like sharp leaf boundaries, soil background transitions, and disease lesion edges.

02

Max-Pooling Layers

Downsamples the spatial dimensionality of activation maps, extracting strictly dominant features while discarding redundant noise. This minimizes hardware processing load on edge field devices.

03

Softmax Output

Flattens spatial layers into integrated linear tensors. Calculates relative confidence probabilities (e.g., 98.4% Cotton, 1.2% Pigweed, 0.4% Soil) to trigger targeted mechanical or chemical actions in real time.

On-Device GPUs vs. Cloud Latency in Farming Fields

Why smart machinery requires ruggedized edge systems instead of remote internet networks.

The Cloud AI Bottleneck

 **Network Dependency:** Farmland areas consistently suffer from spotty 4G/5G cellular coverage. Relying on remote servers leads to critical system interruptions.

 **High Latency:** Uploading image coordinates, waiting for cloud classification, and receiving nozzle targets takes 1000–3000ms. At 15 mph, the machine will overshoot targets entirely.

 **Bandwidth Costs:** Streaming continuous gigabytes of real-time high-resolution video feeds across satellite links generates prohibitively high cellular data bills.

The Edge AI Advantage

 **Ruggedized Edge GPUs:** Direct installation of TensorRT optimized models on machine-mounted accelerators (like NVIDIA Jetson or customized on-board chips).

 **Ultra-Low Latency:** Eliminates data packages leaving the boom. Image acquisition to actuation completes in **<50ms**, keeping sprays perfectly centered [John Deere Case Study](<https://reruption.com/en/knowledge/industry-cases/john-deere-see-spray-ai-slashes-herbicide-use-by-50>).

 **Autonomous Continuity:** Machinery operates flawlessly inside deep valleys or mountain shadows, saving operations metrics regardless of global network availability.

John Deere See & Spray: Precision Machinery in Action

High-resolution cameras mounted along the boom detect crops vs. weeds dynamically, controlling specialized micro-nozzles.



System Architecture

 **Stereo Canopy Cameras:** Mounted every 10 inches along the 120-foot carbon fiber boom, continuously acquiring raw spatial RGB frames.

 **Dynamic Segmentation:** Neural network architecture classifies soil (brown), weeds (bright green), and soybean crops (muted green) independently.

 **Targeted Actuation:** Individual solenoids pulse the targeted nozzle body directly, delivering an exact micro-dose of chemistry exclusively on weed pixels [John Deere Case Study](<https://reruption.com/en/knowledge/industry-cases/john-deere-see-spray-ai-slashes-herbicide-use-by-50>).

Analyzing Arable Soil Physics and Resource Boundaries

Understanding human-induced degradation patterns to build targeted, ecological conservation models.

Physical Soil Stresses

 **Erosion & Topsoil Stripping:** Conventional blanket tillage disrupts organic soil horizons, accelerating microbial carbon oxidation and wind/water erosion by up to 100x compared to natural rates.

 **Salinization Stresses:** Poorly managed irrigation in arid climates drives mineral salt accumulation in root zones, disrupting osmotic water absorption and leading to physiological crop drought.

 **Structural Compaction:** Heavy wheel loads from traditional machinery collapse soil macropores, restricting essential oxygen flow and deep root penetration.

Macro Resource Demands

Land Allocation Efficiency

Agricultural production has tripled over the past 60 years while land footprint increased by only 8%, proving that technological efficiency holds the key to food security [FAO SOLAW Report](<https://www.fao.org/newsroom/detail/better-land--soil-and-water-management-key-to-feeding-10-billion-people--fao-warns/en>).

Rainfed Yield Gaps

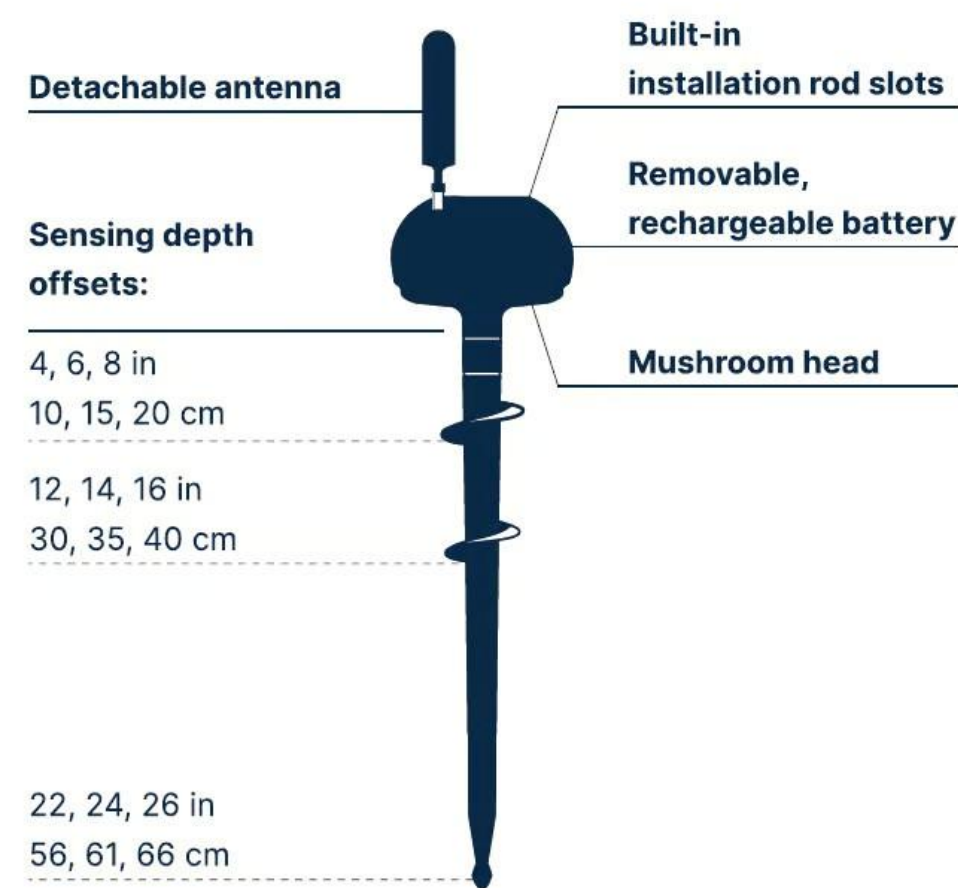
In Sub-Saharan Africa, rainfed crop yields are performing at only 24% of their attainable capacity. Closing this gap is the priority for sustainable international development [FAO SOLAW Report](<https://www.fao.org/newsroom/detail/better-land--soil-and-water-management-key-to-feeding-10-billion-people--fao-warns/en>).

Freshwater Consumption

Farming accounts for 70% of total global freshwater withdrawals. Deploying soil-moisture intelligence is crucial to prevent critical dryland water basin collapse.

[CropX](https://cropx.com/) Multi-Depth Soil Telemetry Hardware

How advanced capacitive soil sensors transmit subterranean physical metrics to predictive AI models.

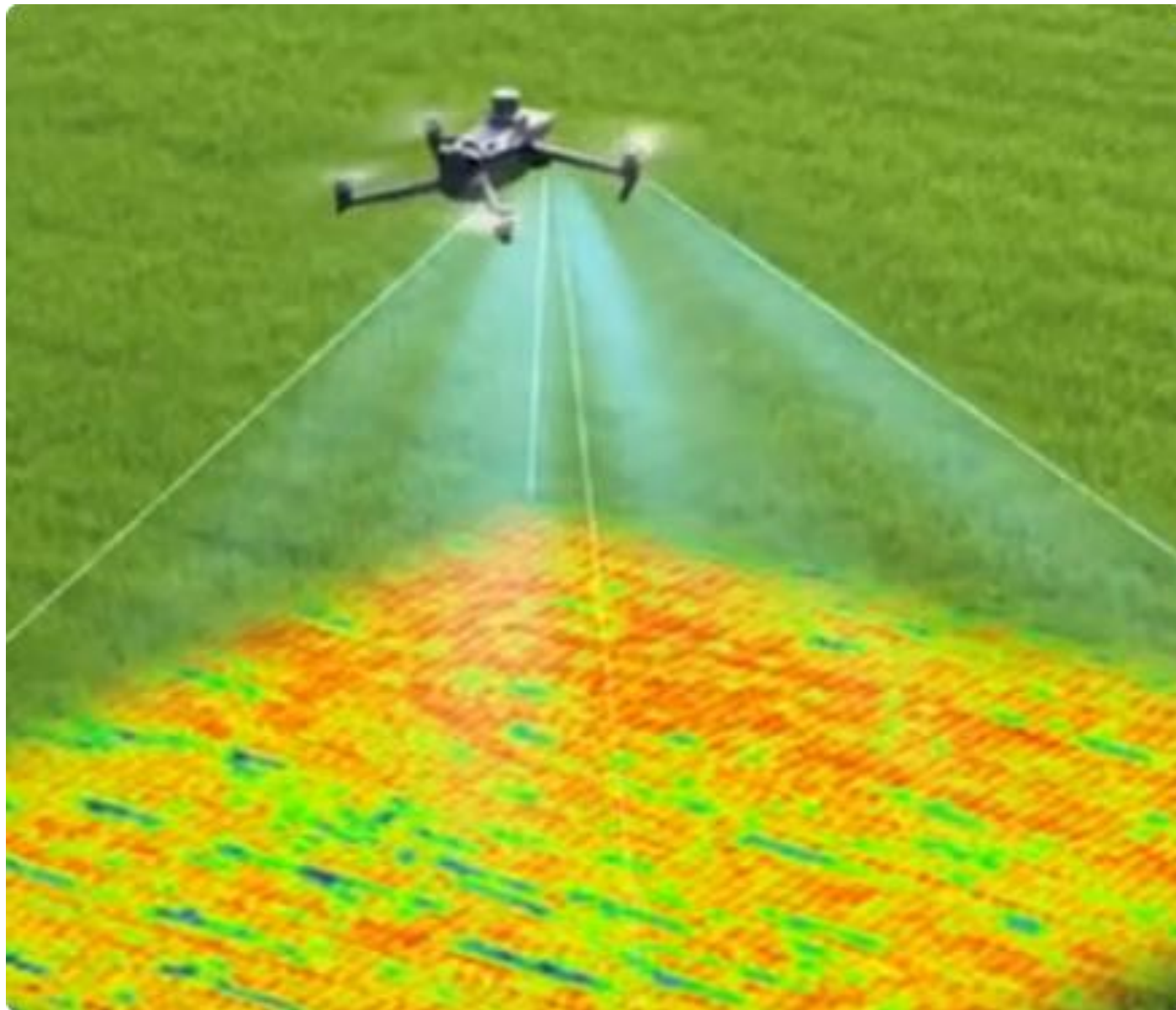


Soil-to-Cloud Integration Stack

-  **Capacitive Moisture Waveforms:** Sensor nodes utilize electromagnetic waves to measure dielectric permittivity at deep intervals (e.g., 20cm, 40cm, and 80cm depths) mapping root-zone activity.
-  **LoRaWAN Telemetry:** Low-power wide-area network links transmit soil moisture tension, salinity profiles, and temperature readings directly to local field gateways up to 10 miles away.
-  **Evapotranspiration Math:** Aggregated data integrates directly with regional wind velocity, temperature, and sun canopy models, projecting transpiration loss and recommending precise volumetric water targets [CropX Case Study](https://cropx.com/2025/08/26/soil-sensors-xtremefarm-dryland/).

Normalized Difference Vegetation Index (NDVI) and Band Math

How chlorophyll cellular structure reflects near-infrared light, enabling drone-based remote health modeling.



Spectral Reflection Physics

$$\text{NDVI} = (\text{NIR} - \text{Red}) / (\text{NIR} + \text{Red})$$

 **Near-Infrared (NIR):** Healthy mesophyll leaf cell structures strongly reflect NIR light back into space to protect the plant from overheating.

 **Visible Red Light:** Chlorophyll pigments in active photosynthesis strongly absorb visible red light, using the energy to fuel carbon fixation.

 **Value Scale [-1 to +1]:** High positive numbers (e.g., 0.7 to 0.9) represent dense, healthy forest canopy. Values near 0 represent barren sand or soil, while negative values indicate open water surfaces.

Water Budget Balance Modeling & Penman-Monteith Equations

Calculating physical soil moisture transpiration loss profiles mathematically to protect water resources.

Soil Depletion Calculations

 **Soil Water Balance Formula:**

$$D_{r,t} = D_{r,t-1} - P_t - I_t + ET_{c,t} + DP_t$$

 Where: **D_r** is root depletion, **P** is precipitation, **I** is irrigation, **ET_c** is crop evapotranspiration, and **DP** is deep percolation.

 **Managed Allowable Depletion (MAD):** The exact physiological moisture boundary before crops suffer stress damage, defining the optimal algorithmic point to trigger pivot systems automatically.

Penman-Monteith (FAO-56)

Aerodynamic + Solar Thermal Evaporation Physics:

$$ET_o = [0.408\Delta(R_n - G) + \gamma(900 / (T+273)) u_2 (e_s - e_a)] / [\Delta + \gamma(1 + 0.34 u_2)]$$

 **Thermal Input variables:** Net solar radiation (**R_n**), average temperature (**T**), wind velocity at 2m (**u₂**), and vapor pressure deficit (**e_s - e_a**).

 **Dynamic Crop Coefficients (K_c):** Multiplies raw standard ET_o by plant-specific values representing maturity levels, translating global forecasts into field recommendations.

SLAM Navigation and Kinematics in Row Crop Fields

How autonomous agricultural robots map uneven surfaces and navigate row channels without damaging crop roots.

Simultaneous Localization & Mapping

 **RTK-GPS Integration:** Real-Time Kinematic satellite pathing reduces typical cellular GPS positioning variance down from 2-3 meters to **<2 centimeters**.

 **LiDAR & Depth SLAM:** Continuous laser scanner arrays construct an instantaneous 3D point cloud of organic canopies and soil barriers.

 **Extended Kalman Filtering:** Merges wheel encoder odometry, IMU angular velocity, and sensor inputs to track robot localization inside highly muddy or sandy environments.

Steering Kinematic Systems

Ackerman Steering Mechanics

Slightly varies steering angles on inside vs. outside wheels during headland turns to prevent wheel scrubbing and extreme compaction of topsoil.

Crab & Skid Steering Control

Allows independent four-wheel articulation. This enables heavy agricultural robots to glide laterally on slopes, mitigating slipping errors.

Safe-Stop Obstacle Models

Ultrasonic range arrays instantly lock brakes whenever unknown objects, humans, or farm animals cross path trajectory models.

Autonomous Field Robotics for Herbicide-Free Farms

Deploying high-precision physical mechanisms to manually terminate invasive weeds.



Eradication Tech Stack

⚡ **Thermal Laser Burn:** Laser guidance directs short CO2 laser heat bursts targeting weed meristems, terminating growth without shifting soil layers.

🔪 **Inter-Row Hoe Shuttles:** Hydraulic shuttle arms instantly retract whenever proximity sensors detect crop trunks, cutting weeds directly between crop stems.

🌱 **Underground Root Pulling:** Rotational steel claws plunge deep into sub-soil layers beneath targeted weed pixels, pulling roots out completely [Modern Farmer](<https://modernfarmer.com/2020/02/futuristic-farming-has-arrived-with-weeding-robots/>).

Decarbonizing Agriculture with Machine Learning

Using AI data streams to reduce synthetic inputs, optimize carbon sequestration, and secure eco-credits.

Carbon Capture Physics

 **Cover Crop Canopy Indexing:** Drones map chlorophyll biomass densities of rotational ground crops like clover or rye, calculating carbon volumes captured.

 **No-Till Soil Optimization:** Soil-moisture telemetry maps organic microbial respiratory patterns, directing no-till strategies that store carbon inside deep clay structures.

 **Agroforestry Canopy Maps:** Neural network segmentation isolates individual shade trees inside coffee and cocoa farms, predicting carbon values for global offset credit markets.

Smarter Nitrogen Management

Nitrous Oxide Emissions

Nitrous Oxide (N₂O) is a potent greenhouse gas that is 300x more destructive than carbon dioxide. Overusing fertilizers triggers massive atmospheric runoff.

Variable Rate Nitrogen Application

Combines soil EC maps with vegetation indices to adjust nitrogen delivery down to sub-meter sectors. This prevents runoff into water basins.

Measurable Carbon Offsets

Authentic, sensor-verified compliance tracking allows farmers to certify their low-carbon operations on regional green marketplaces.

Analyzing the Agtech Startup and Venture Capital Landscape

How global investors fund AI agricultural solutions and the critical market scaling challenges startups face.

\$240M+

Venture Funding Scale

Venture capital funding allows ambitious startups to accelerate software models. For instance, Monarch Tractor raised over \$240 million to build its autonomous vehicle systems [Monarch Wiki](https://en.wikipedia.org/wiki/Monarch_Tractor).

\$518M

Peak Valuation Trajectory

Capital influxes can drive rapid agtech startup valuations, with leading autonomous driving developers climbing to over half a billion dollars in valuation [Monarch Wiki](https://en.wikipedia.org/wiki/Monarch_Tractor).

Caterpillar

Corporate IP Consolidation

Hardware challenges often lead to industrial asset consolidation. Caterpillar's acquisition of Monarch's patents in April 2026 demonstrates how enterprise players absorb startup tech [Monarch Wiki](https://en.wikipedia.org/wiki/Monarch_Tractor).

Designing a Closed-Loop Automated Smart Greenhouse

Students apply IoT sensor theory and closed-loop actuation code models to architect an indoor vertical farm.

The Architecture Blueprint

 **Duration:** 15 Minutes Collaborative Brainstorm

 **Step 1: Sensor Array Placement:** Map where to install soil tension probes, air humidity sensors, and leaf canopy cameras to track plant health.

 **Step 2: Actuator Logic:** Construct the dynamic code rules to automatically trigger ventilation fans, drip mist lines, and artificial grow lamps.

 **Step 3: Concept Pitch:** Present your system logic blocks on the whiteboard, explaining how your greenhouse mitigates water and energy waste.

System Hardware Blocks

 **Sensory Inputs (Inputs)**

Light intensity levels (lux), soil moisture levels (volumetric water content), ambient air temperature (°C), and leaf temperature profiles via thermal cameras.

 **Decision Controller (Rules)**

A central controller logic block (representing classical code rules or light-weight machine learning layers) reading inputs and generating actuation targets.

 **Actuators (Actions)**

Relay-switched water valves, heating elements, fan shutters, and adjustable full-spectrum horticultural LED overhead arrays.

Algorithmic Gene Mapping & Climate-Hardy Crop Breeding

Mapping Single Nucleotide Polymorphisms (SNPs) to breed crops with higher drought, thermal, and disease resilience.

Sequence Alignment & Genomes

 **Genome Sequencing Assembly:** Algorithmic parsing of gigabases of raw sequence reads from resilient wild cultivars using high-throughput sequencing pipelines.

 **Single Nucleotide Polymorphic Markers:** Using machine learning classification models to link specific SNP markers with observable physical properties like thermal defense or structural root depth.

 **CRISPR Guide RNA Selection:** Neural networks optimize CRISPR-Cas9 target alignments, predicting editing efficiency and avoiding unintended genetic cuts.

Resilience Vector Goals

Extreme Thermal Resilience

Developing heat-shock protein expression patterns in cereal crops to maintain starch synthesis rates under high temperature spikes.

Hyper-Drought Conservation

Modulating stomatal guard cell response signals via abscisic acid pathway algorithms, maximizing water use efficiency during dry cycles.

Natural Pathogen Defenses

Breeding localized receptor-like kinases that instantly identify viral and fungal proteins, triggering targeted defensive responses.

Interactive Discussion: Navigating the Future of AgTech

Students engage in open debates exploring technical trade-offs, ecological dilemmas, and career futures.

Technical Debates

 **Socio-Economic Barriers:** If advanced AI tools reduce input costs by 50%, how do smallholder farmers in developing nations access the initial capital required for edge GPU hardware?

 **Ecological Consequences:** Can herbicide-free mechanical weeding robots fully scale to eliminate chemical resistance issues, or do they create soil compaction trade-offs?

 **Autonomous Decisions:** Who carries the ultimate legal and moral liability when an autonomous sprayer misidentifies an organic heirloom crop as an invasive weed and terminates it?

Your Next-Gen AgTech Journey

Bioinformatics & Robotics Pathways

Our 6-week curriculum is built to bridge computation, engineering, and agronomy, preparing you for top graduate or industry research programs globally.

Authentic, Grounded Science

By utilizing real physical equations (Penman-Monteith, NDVI band calculations) and analyzing actual industry hardware collapses, we prepare you for real-world impact.

Open Floor Discussion

Ask anything! Clarify software, physical soil dynamics, satellite telemetry, or discuss direct career-building strategies with your instructors.

The Strategic Intersection of Biology, Robotics, and Data

Consolidating core insights from global resource constraints, real-world machine learning deployments, and market realities.



Resource-Driven Demand

Traditional farming cannot expand outward without destroying vital forest sinks and biodiverse ecological reserves. Future output gains must rely strictly on algorithmic crop intensification and closing yield gaps.



Selective Edge AI

Blanket operations (such as broad pesticide application) are economically and ecologically obsolete. Computer vision systems deployed on ruggedized edge GPUs enable micro-dose precision targeting at millisecond scale.



Dependable Engineering

Real-world farming demands bulletproof, ruggedized hardware. High capital complexity is a barrier for startup hardware plays, driving a trend toward flexible software platform licensing models.

References: FAO Flagship SOLAW 2025 Report; John Deere See & Spray Case Study (Reruption, 2025); Monarch Tractor Venture Metrics (Wikipedia, 2026).

Next Week: Entering the Realm of IoT Agronomic Sensors

Translating basic concepts into real physical hardware data next Sunday.

Session 1 Key Takeaways

- **The Food Paradox:** Squeezed resources and rising populations require 50% more productivity with smarter, not larger, cropland footprint.
- **Robotic Automation:** Computer vision technologies enable selective action (like See & Spray), reducing chemical waste by 50%.
- **IoT Connected Field:** Sensors monitor underground health continuously, taking the guesswork out of agronomic irrigation schedules.
- **Diverse STEM Pathways:** Careers in agtech are surging. Students can bridge biology and computation to make direct, highly sustainable global impacts.