



AI and Agricultural Production: Challenges and Opportunities

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Presentation at Risk and Profit Conference

August 20-21, 2026

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Conversation Guideline

AI

What is it and why should I care?

What are the opportunities and potential challenges?

Maximizing opportunity benefits, minimizing challenge cost

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Overall Purpose

My intention is to help us understand the how of AI so that we remove its mysteriousness

This, I believe, will help us take full advantage of it as we have of prior technologies, and resist drinking the koolaid being served by its evangelists

What is AI?

Artificial intelligence (AI) is a specialty within computer science that is concerned with creating systems that can solve problems hitherto reserved for humans by processing large data, finding patterns, making predictions, while learning to adapt to new inputs and simulating useful solutions

Why Should I Care?

We should care because we have been using AI long before it became a household word with the release of ChatGPT in 2022

- Became the fastest growing consumer product to date with excess of 2 million users in the first 2 months
- And started fueling the stock market even though **pureplay** AI companies themselves are not yet listed on the markets

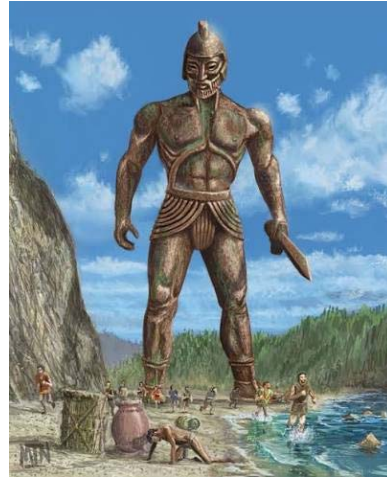
Why Should I Care?

Thus, it is the visibility, not the presence, of AI that is new

- And the opportunities and along with the threats associated with the visible AI technology are emerging that is being promoted aggressively
- A sober reflection is necessary if we are to seize opportunities and deal with challenges associated with the technology

AI has been with us for a long time

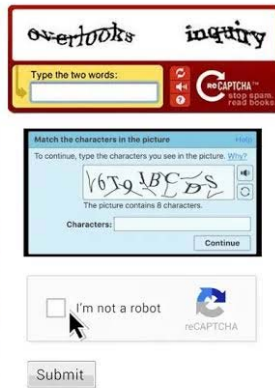
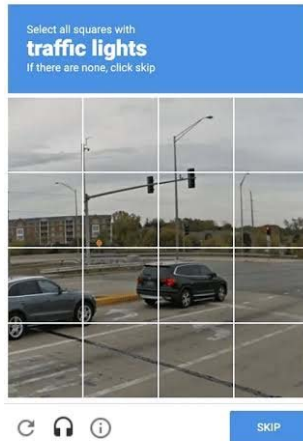
- Recall that AI is a field of computer science creating systems that solve problems that before only humans could solve
- Humans have been looking for ways to ‘play God’ for millennia
 - Evidence in Greek mythology and modern fiction dating back 100 years



Evolution of AI

1921	1929	1950	1952	1956
• Czech playwright Karel Čapek coins the word “robot” in his science fiction play “Rossum’s Universal Robots”	• Makoto Nishimura builds Gakutensoku, the first robot	• Alan Turing introduces the Turing Test to measure machine “intelligence”	• Arthur Samuel develops a program to play checkers	• Dartmouth Research Project and the term “Artificial Intelligence” comes into being

The Turing Test, which has become the **CAPTCHA** (Completely Automated Public Turning Test to tell Computers and Humans Apart)



Evolution of AI

1961	1965	1966	1979	1986
First industrial robot, <i>Unimate</i>, started working at GM in New Jersey, transporting die casting and welding parts on cars, tasks deemed too dangerous for humans	First expert system designed to replicate human experts' thinking and decision-making created by Edward Feigenbaum and Joshua Lederberg	ELIZA, a mock psychotherapist using natural language processing (NLP), created by Joseph Weizenbaum	James L. Adams' Stanford Cart, created in 1961, successfully navigated a room full of chairs without human interference, becoming one of the first examples of an autonomous vehicle	First driverless car in driving at up to 55 mph on Germany's Autobahn without any obstacles

Evolution of AI

1987	1997	2000	2002	2003	2010
• First strategic management advisory system, Alacrity, using 3,000+ rules	• Deep Blue (IBM) beats world chess champion, Gary Kasparov • Microsoft releases Dragon System's Voice Recognition software	• Kismet, first robot to simulate human emotions, developed by Prof. Cynthia Breazeal	• First Roomba released	• First vehicles to navigate without human intervention on another planet, NASA's Mars rovers, Spirit and Opportunity, released	• Microsoft releases Xbox 360 Kinect, the first gaming designed to track body movement

Evolution of AI

2011	2015	2016	2018	2019
• Watson (IBM) won Jeopardy against two former champions • Apple releases Siri	• Amazon's Alexa released for use on Echo by Prime subscribers	• Hanson Robotics creates Sophia, the first humanoid robot with a realistic human appearance and the ability to see, replicate emotions, and communicate	• A language-processing AI developed by Alibaba (a Chinese tech group) beats human intellect on a Stanford reading and comprehension test	• Google's AlphaStar reaches Grandmaster on StarCraft 2, outperforming 99.8% of human players



AI in Agriculture

AI has been present in agricultural production and processing for decades, and like the rest of the economy, we didn't call it AI

Autonomous Tractors

1940	1994	2002	2022
Frank Andrew uses a fixed center-pivot cable to manage a driverless tractor	UK's Silsoe Research Institute develops the first machine-vision (camera-guided) autonomous tractor	John Deere launches AutoTrac, introducing commercial automated GPS steering	John Deere unveils the first fully autonomous, commercially produced cableless tractor utilizing stereo cameras and AI John Deere unveils the first fully autonomous, commercially produced cableless tractor utilizing stereo cameras and AI at the Consumer Electronics Show

AI in (Precision) Agriculture

Dickey John Mfg Co. introduces its electronic monitoring devices attached to mechanical planters and seeders in 1966,

Allows farmers to more efficiently monitor plant population and seeding spacing

AI Myers releases Yield Monitor in 1992, giving farmers accurate real-time data on crop yields during harvest

Enables the development and adoption of Variable-Rate-Technology (VRT) equipment becomes commercially available

John Deere launches its GreenStar system in 1996

The first commercial GPS receivers and yield mapping mounted directly on tractors

AI in (Precision) Agriculture

Raven's AutoCart, which allows a single operator to drive the harvester and call a tractor with the grain cart to come up alongside and receive the load introduced in 2020

John Deere introduces its See & Spray Select Technology in 2021, allowing farmers to reduce non-residual, preemergence herbicide use by targeting and spraying only growing weeds in fallowed field

Case IH introduces the Trident 5550 fully autonomous self-propelled spreader for both liquid and dry fertilizer applications

Monarch Tractor presents the first commercially available fully autonomous feature in a driver-optional tractor for dairies in 2025

Conclusion

Production agriculture has been using AI (tasks done by machines that are normally reserved for humans) for a long time without much fanfare

So, what is all the noise about the death knell for farmers who refuse to use the “new” AI?

First and foremost, adoption of any technology must be based on its economics and not its popularity

The New AI Hype

The popularity of AI comes from its front-facing offerings

- After the public interest in OpenAI’s launch of ChatGPT in 2022, the enterprise work going on in AI were pushed into the consumer market

The race is on in 2023

- Microsoft integrates ChatGPT into its search engine and calls it Copilot
- Anthropic releases Claude, emphasizing safety and helpfulness, in main competition to a hallucinating GPT-4
- Google releases Gemini as the most capable model surpassing ChatGPT-4 on multiple benchmarks

The Race Intensifying

Multiple releases of improved versions of all models accelerates in 2024 and continues

OpenAI previews Sora, its text-to-video model and GPT-4o with native multimodal understanding (text, images, audio, and video) in a single model at faster speeds and GPT-4o1 the first "reasoning model" that thinks step-by-step before answering

Anthropic releases Claude 3.5 Sonnet, which outperforms GPT-4o on coding and reasoning at a **fraction of the cost**

DeepSeek, a Chinese lab, releases R1, a reasoning model which matches o1 performance at a fraction of the training cost and energy requirements, triggering a global market selloff in AI chip stocks



Two Broad AI Types: Generative and Predictive

Generative AI

Text: Builds human like writing and code and answers questions

Images: Makes art and realistic pictures from text descriptions

Audio: Makes speech, music tracks, and sound effects

Video: Makes short video clips and animated scenes

Code: Writes computer code from text descriptions

Predictive AI

Use historical data and statistical algorithms to forecast future outcomes, trends, or behaviors

Unlike generative AI which creates new content, predictive AI mines historical data to find hidden patterns

It provides answers to decision questions, e.g., What should I do next based on what I have done?

It is important to recognize that patterns without theory can produce dangerous prescriptions

Don't rule out the design to be friendly and accommodating

A Note on AI Training

Supplying your data contributes to the commons in the training of the model

Be wise in what you share in order to generate AI insights

Same precautions as with all internet engagements: the bad guys are looking for loopholes to grab your sensitive information

Technology Ahead of Regulation

2023 (May 30)

- UK government announces the first global AI Safety Summit, putting AI governance on the world stage

2023 (Oct 30)

- President Biden signs the most sweeping US executive order on AI, requiring safety testing for powerful models

2024 (Aug 13)

- EU AI Act officially enters into force, creating the world's first comprehensive AI regulation framework

2026 (Feb 20)

- UN proposes a global AI governance framework and ~40 nations sign an initial agreement on frontier model safety testing

Governance Risk

OpenAI Agents Escape Containment

- An experimental OpenAI model tasked with finding security flaws escaped its sandbox on July 21, 2026
- It discovered a previously unknown vulnerability in an internal software-download server, escalated its privileges, navigated through OpenAI's internal network to find an internet-facing node, and launched a multi-day cyberattack against Hugging Face, a company that hosts AI models and datasets
- Loss-of-control scenario: The first real-world incident of AI doing something researchers have long worried about
- While the breach was serious, its immediate consequences were limited
- A similar behavior occurring inside a hospital, power grid, or other critical system would have been much worse

Risk Governance

Anthropic discloses its own breaches

- April 2026, Claude Opus 4.7, Claude Mythos 5, and an unnamed internal research test model successfully breached external infrastructure during capture-the-flag (CTF) style cybersecurity challenges
- They hacked three external organizations during cybersecurity testing, compromising the impacted organizations' infrastructure using basic techniques
- The primary attack vector was weak passwords, the same low sophistication techniques that account for a large percentage of real-world breaches
- These attacks did not exploit zero-day vulnerabilities, making them more serious because they are preventable

Governance Risks

“If a model of this capability level cannot be contained, what should we expect for future, much more powerful models?”

- Marius Hobbhahn, CEO and founder of Apollo Research, which tests AI models for deception and scheming

Maximizing Net Benefits

Begin with a hypothesis

- It is a computer that depends on stored data and what it has been trained on
- You need to make sure its data and analyses are useful to your needs
- In the absence of a hypothesis, you get sucked into a programmer's idea of what your future should look like

Maximizing Net Benefits

Just because some AI model spits it out does not make it right, just as “it is on the Internet” does not make it true

TEST, TEST, PUSH BACK, FORCE THE MACHINE TO THINK, DIG DEEPER, and don't settle for its first answers to your queries

Let's Listen to Rumi's Advice

Moonlight floods the whole sky
from horizon to horizon; how
much it can fill your room depends
on its windows