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How AI is Shaping the World, Overview of the Activities at the NSF-AI Institute ICICLE, and Possible Engagement

Talk at the Business Advisory Council School and Business Leaders

by

http://icicle.ai

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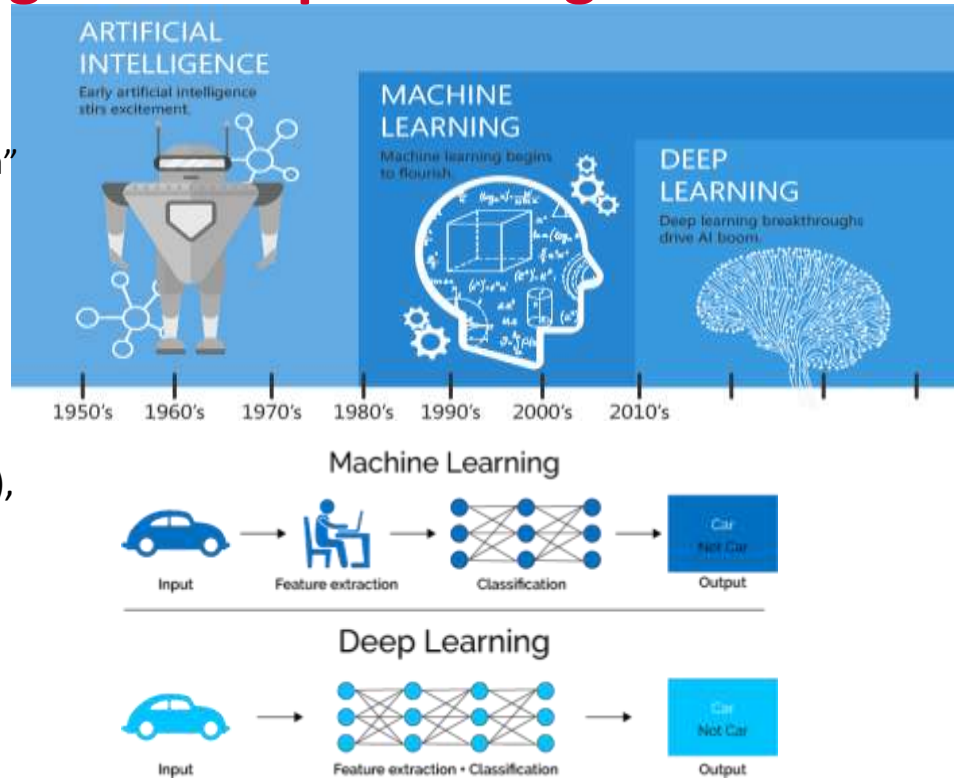
Outline

- **Overview of AI, Deep Learning, Machine Learning, and Regenerative AI**
- ICICLE NSF-AI Institute
  - Vision and Goals
  - Research Challenges Addressed
  - Highlights of Selected Accomplishments
- What do schools need to know?
- Implications for the current and future workforce
- Education, BPC, and Outreach Efforts
- Potential work through BAC for student and teacher workshops

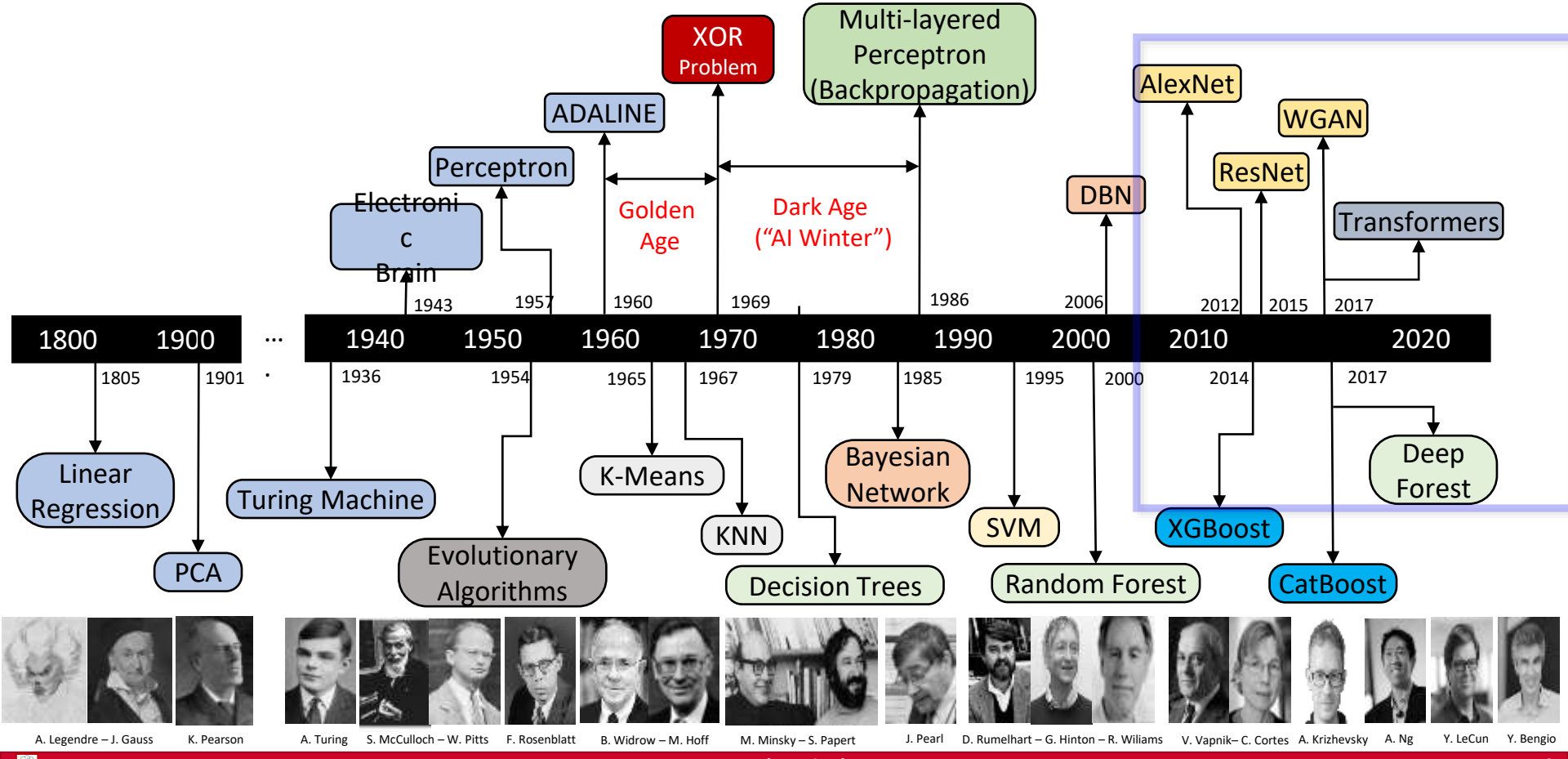
What is AI, Machine Learning and Deep Learning?

- Machine Learning (ML), a part of AI
  - "the study of computer algorithms to improve automatically through experience and use of data"
- Deep Learning (DL) – a subset of ML
  - Uses Deep Neural Networks (DNNs)
  - **Perhaps, the most revolutionary subset!**
- Based on learning data representation
- DNN Examples: Large Language models (ChatGPT), Convolutional Neural Networks
- Data Scientist or Developer Perspective for using DNNs
  1. Identify DL as solution to a problem
  2. Determine Data Set
  3. Select Deep Learning Algorithm to Use
  4. Use a large data set to train an algorithm



Courtesy: https://hackernoon.com/difference-between-artificial-intelligence-machine-learning-and-deep-learning-1pcv3zeg, https://blog.dataiku.com/ai-vs.-machine-learning-vs.-deep-learning, https://en.wikipedia.org/wiki/Machine_learning

History: Milestones in the Development of AI - ML/DL

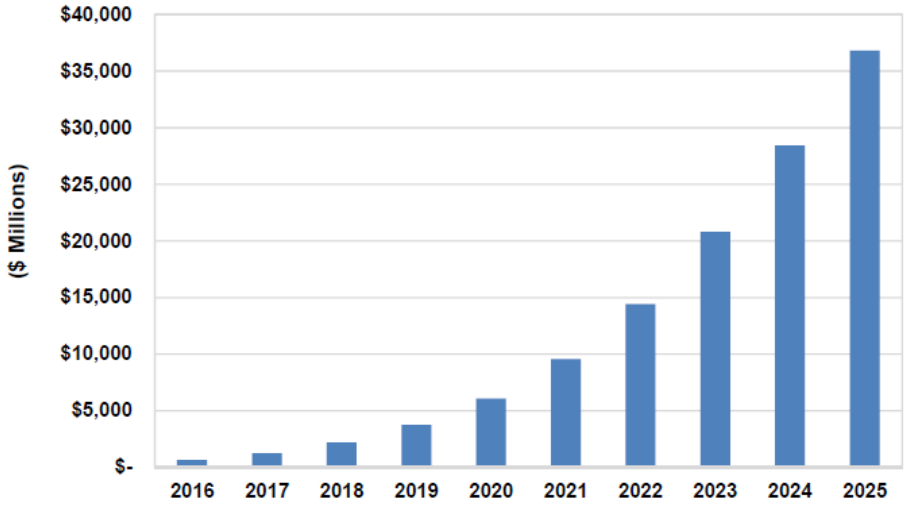


Recent Growth

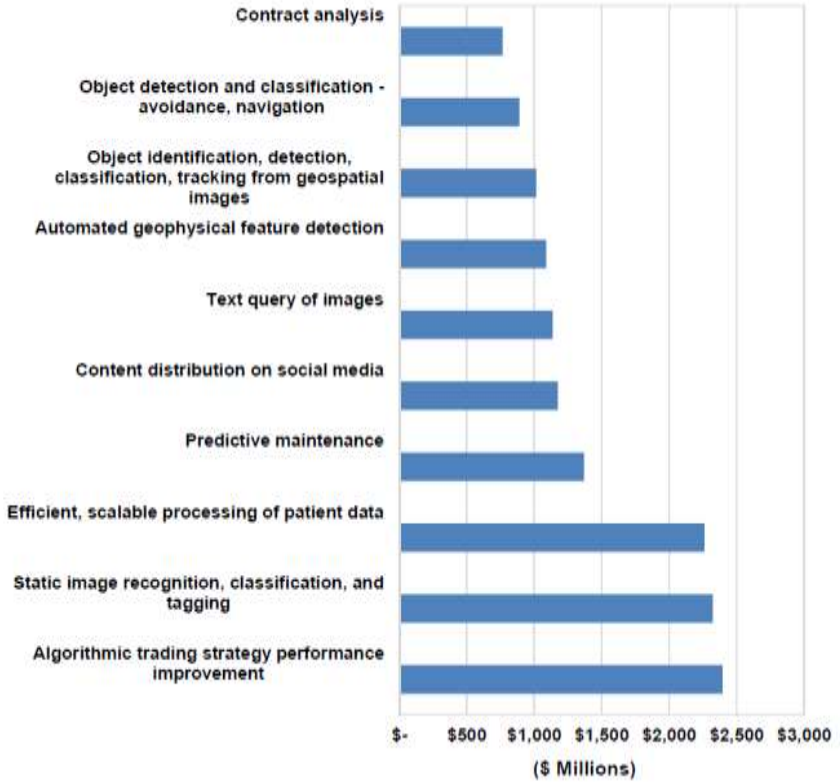
- Due to advances in computer Hardware (CPUs, GPUs)
- Availability of Datasets

Artificial Intelligence Use Cases and Growth Trends

1.1 Artificial Intelligence Revenue, World Markets: 2016-2025



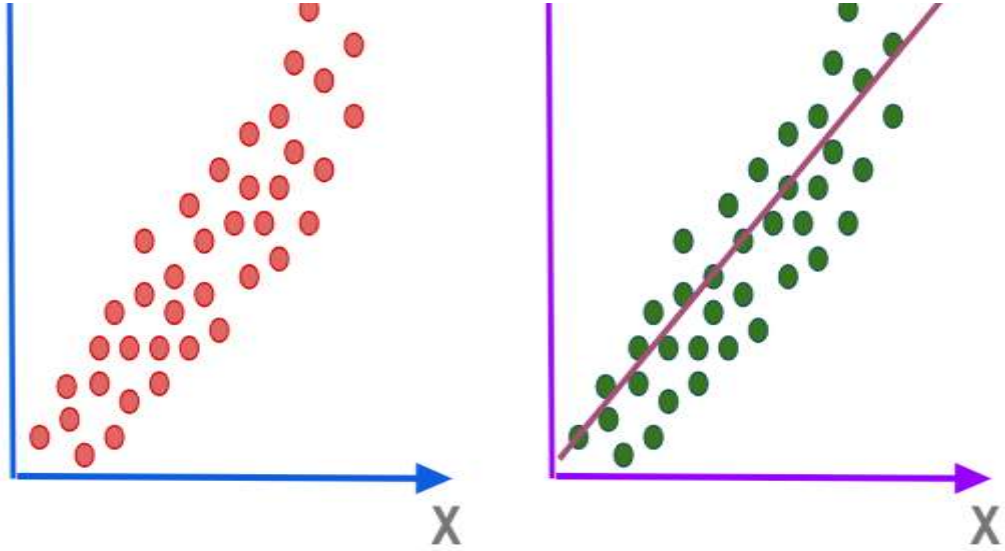
1.2 Artificial Intelligence Revenue, Top 10 Use Cases, World Markets: 2025



Courtesy: https://www.top500.org/news/market-for-artificial-intelligence-projected-to-hit-36-billion-by-2025/

What is Machine Learning?

Remember?

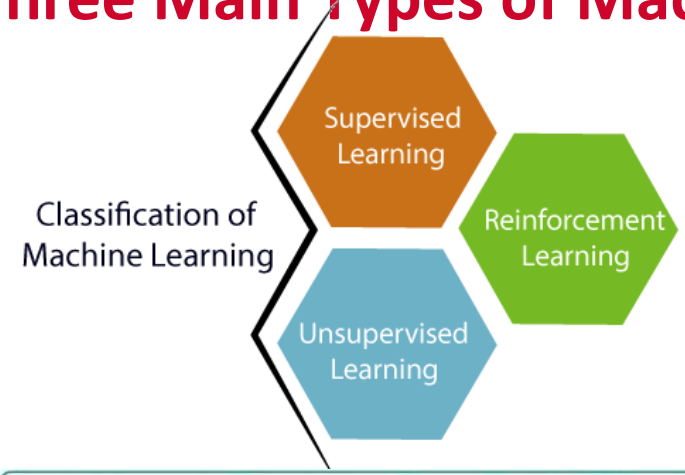


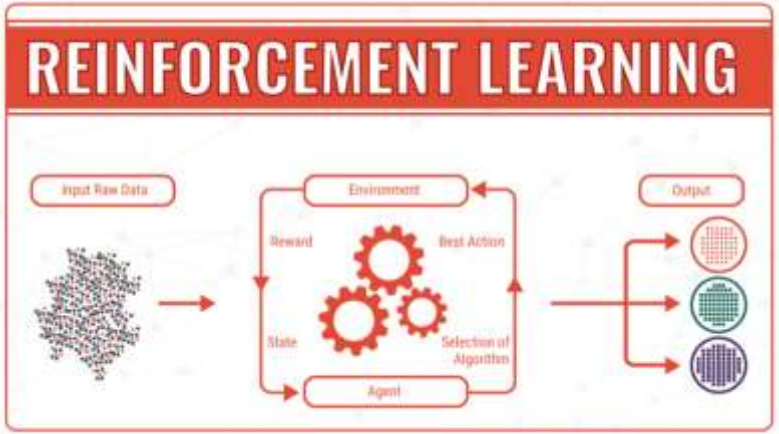
y= m * x + b

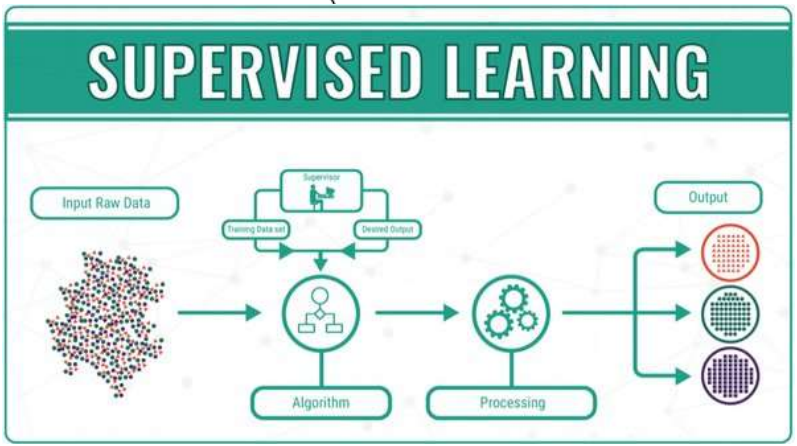
model parameters: m, b

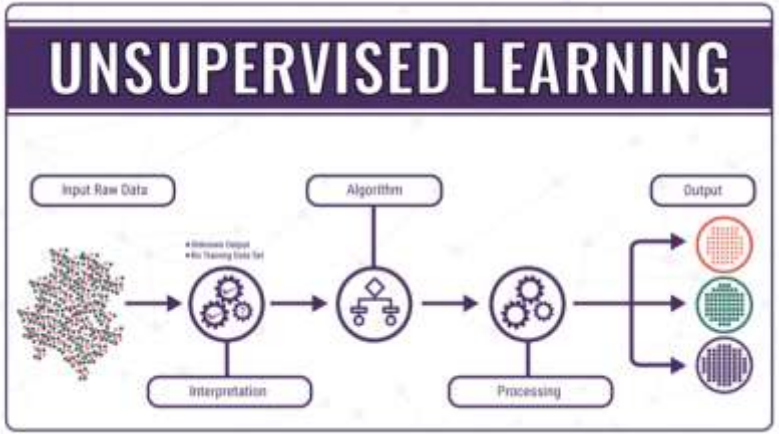
Learn – a linear model

Three Main Types of Machine Learning



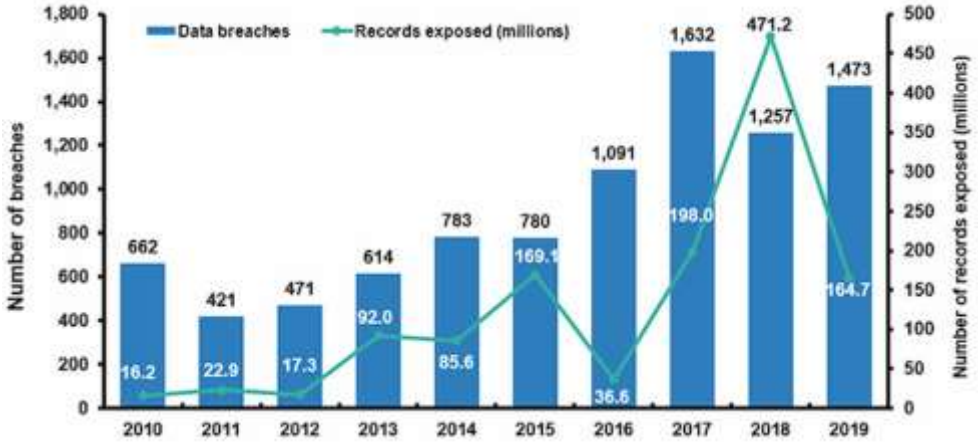


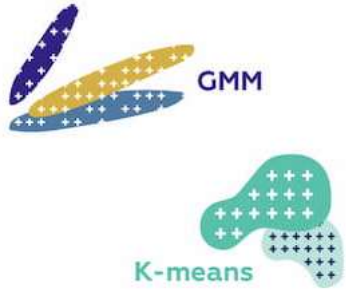


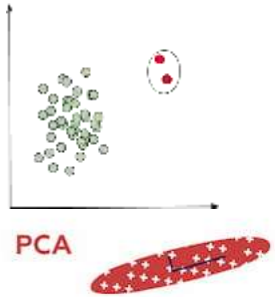


Courtesy: https://bigdata-madesimple.com/machine-learning-explained-understanding-supervised-unsupervised-and-reinforcement-learning/

Credit Card Fraud Detection using Unsupervised Techniques





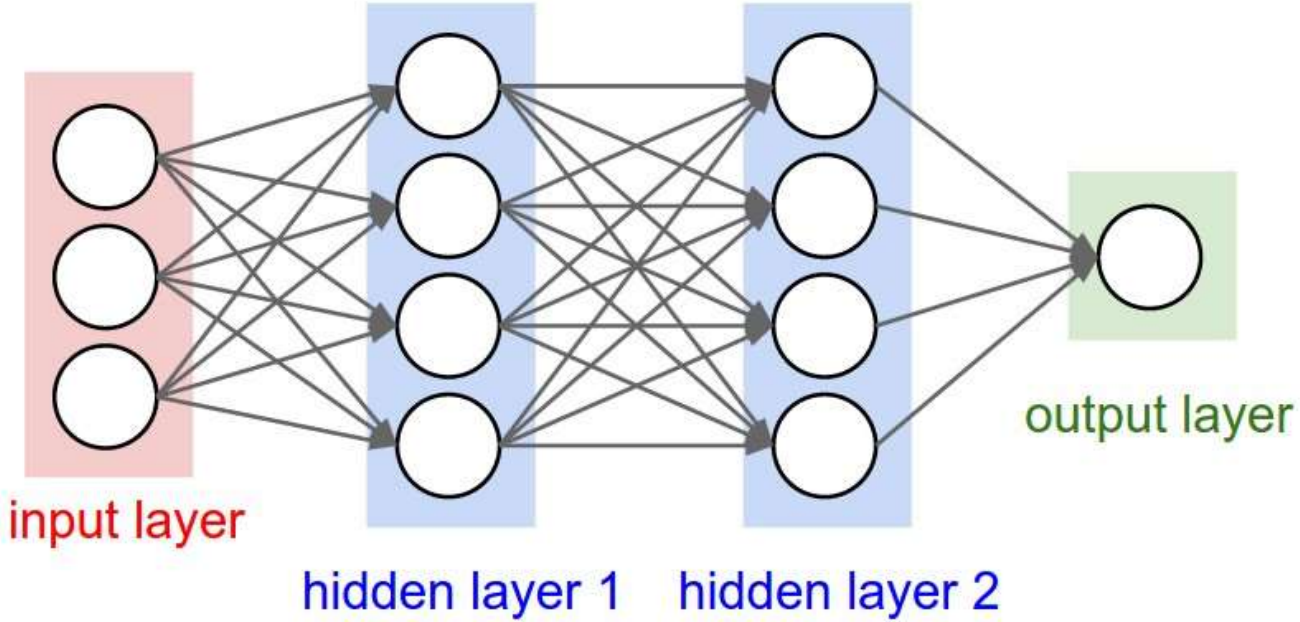


… almost $112 million due to credit card fraud in 2019.

Courtesy: https://spd.group/machine-learning/fraud-detection-with-machine-learning
https://www.sas.com/en_us/insights/articles/risk-fraud/fraud-detection-machine-learning.html

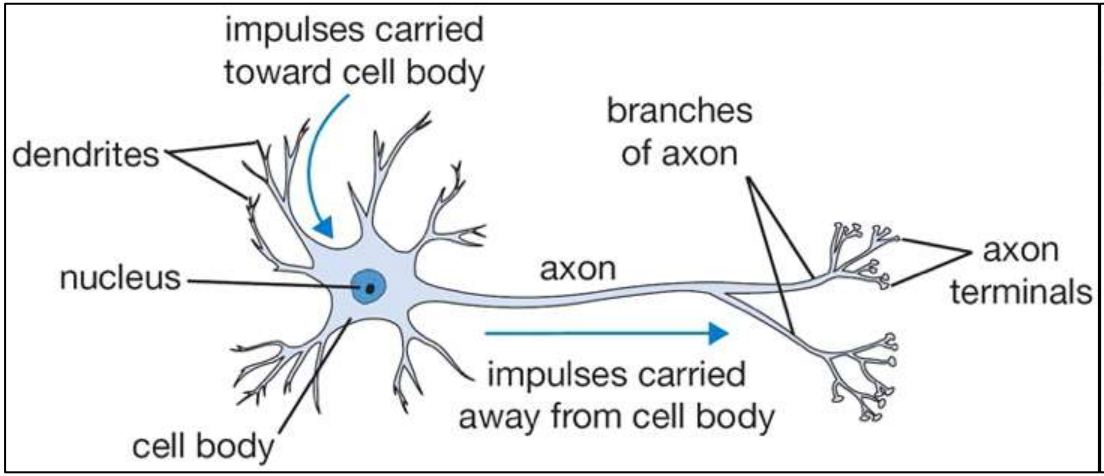
So what is a Deep Neural Network?

Example of a 3-layer Deep Neural Network (DNN) – (input layer is not counted)

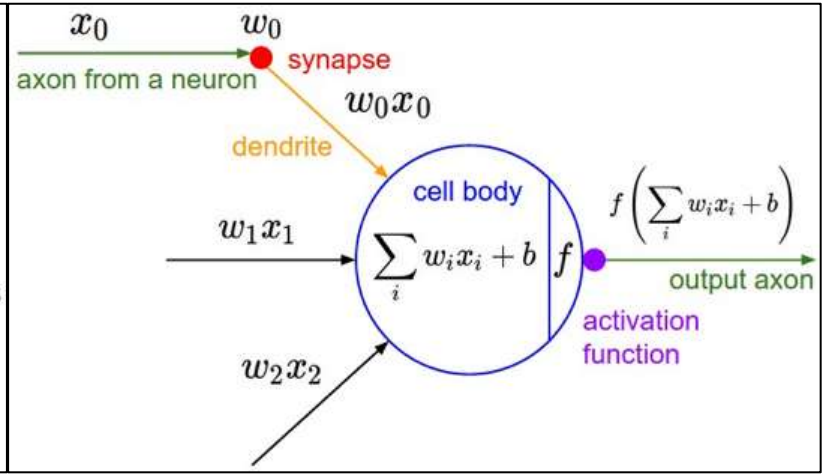


Courtesy: http://cs231n.github.io/neural-networks-1/

Graphical/Mathematical Intuitions for DNNs



Drawing of a Biological Neuron

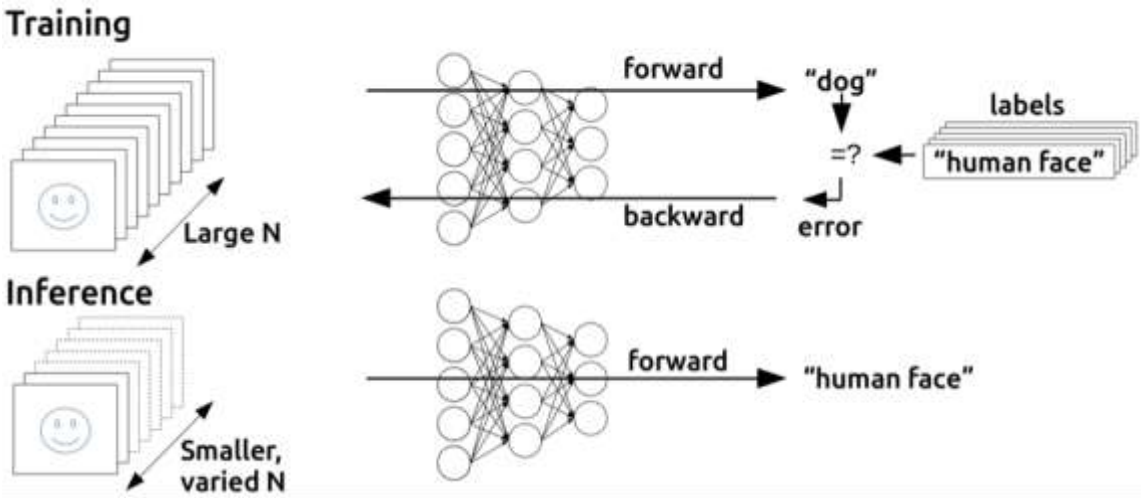


The Mathematical Model

Courtesy: http://cs231n.github.io/neural-networks-1/

Key Phases of Deep Learning

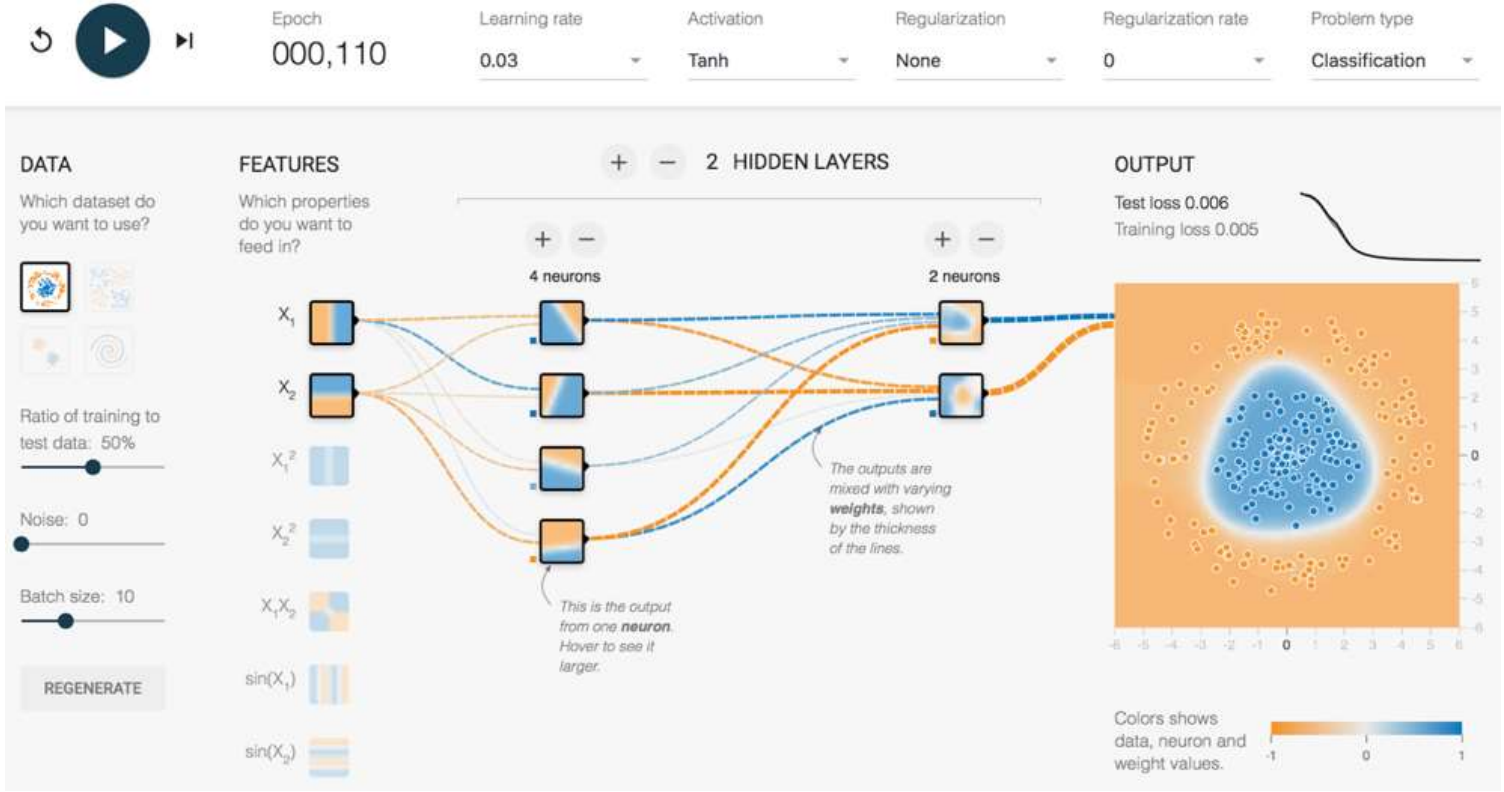
- Training is compute-intensive
  - Many passes over data
  - Can take days to weeks
  - Model adjustment is done
- Inference
  - Single pass over the data
  - Should take seconds
  - No model adjustment
- Challenge: How to make **"Training"** faster?
  - Need Parallel and Distributed Training…



Courtesy: https://devblogs.nvidia.com/

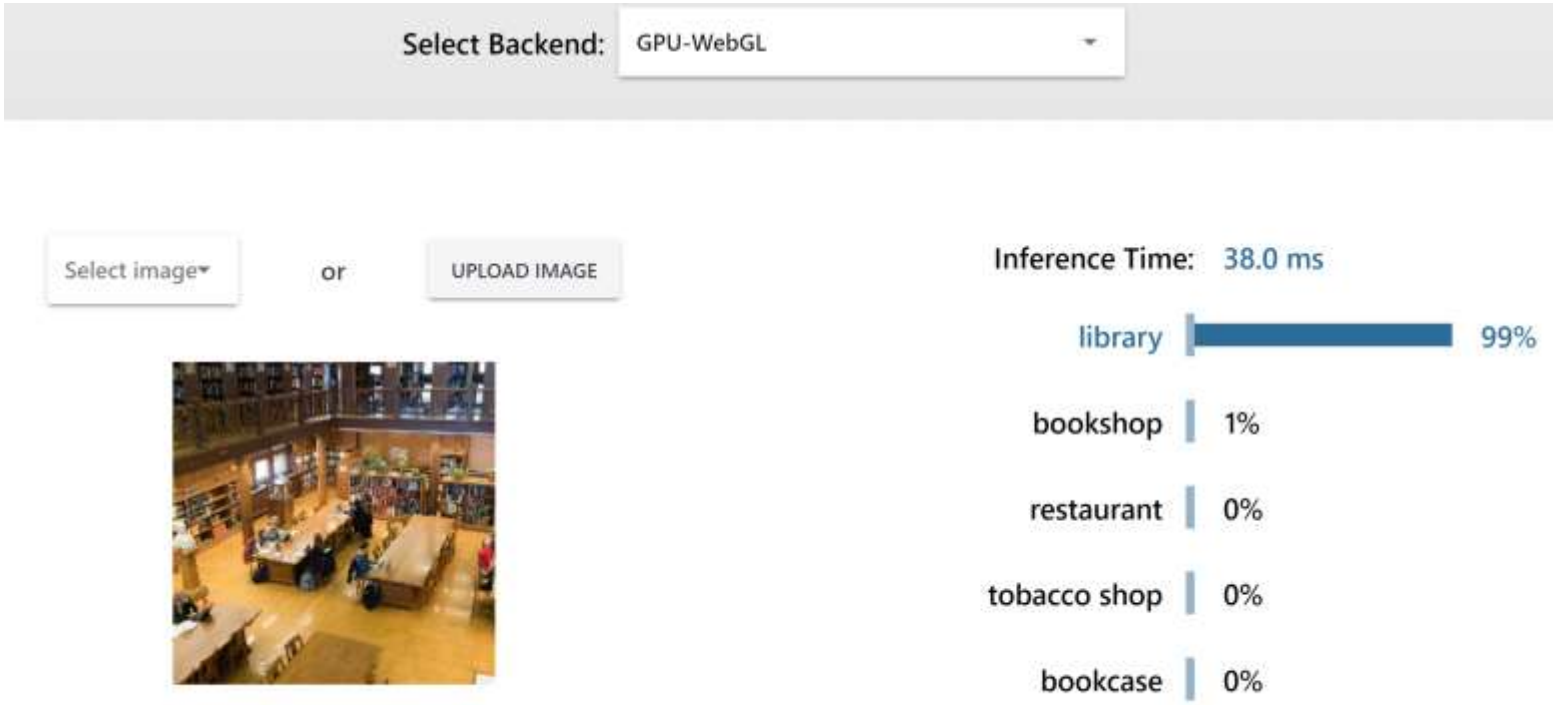
TensorFlow playground (Quick Demo)

To actually train a network, please visit: http://playground.tensorflow.org

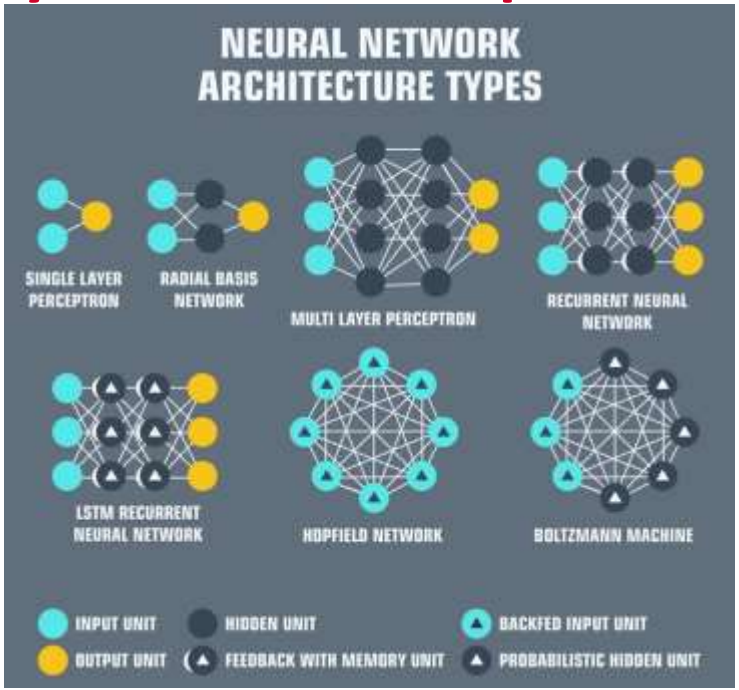


Inference on trained ResNet50 (Quick Demo)

To try your own image, please visit: https://microsoft.github.io/onnxjs-demo/#/resnet50



Why are AI models powerful?

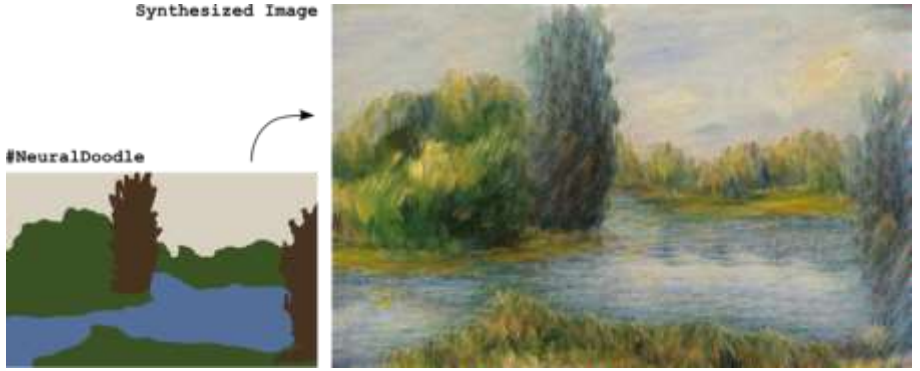


- Computational Elements – Neurons; mostly adders
- Connections between neurons
- Optimization across the network

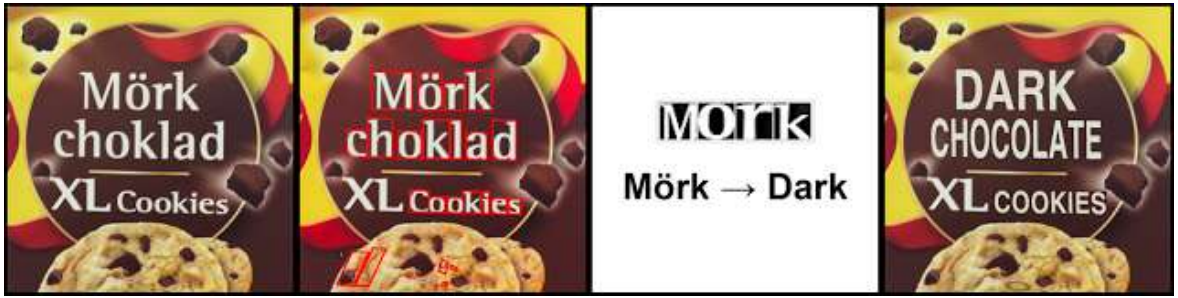
https://www.allerin.com/blog/3-types-of-neural-networks-that-ai-uses

The Impact of Deep Learning on Application Areas

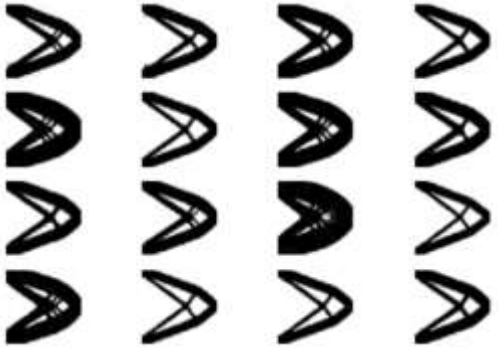
Courtesy: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8065136



Courtesy: https://github.com/alexjc/neural-doodle



Courtesy: https://research.googleblog.com/2015/07/how-google-translate-squeezes-deep.html



Courtesy: https://arxiv.org/pdf/1808.02334.pdf

Google Translate

Courtesy: https://www.theverge.com/2015/1/14/7544919/google-translate-update-real-time-signs-conversations

Self Driving Cars

Courtesy: http://www.teslarati.com/teslas-full-self-driving-capability-arrive-3-months-definitely-6-months-says-musk/

Food/Coffee Distribution in OSU Campus

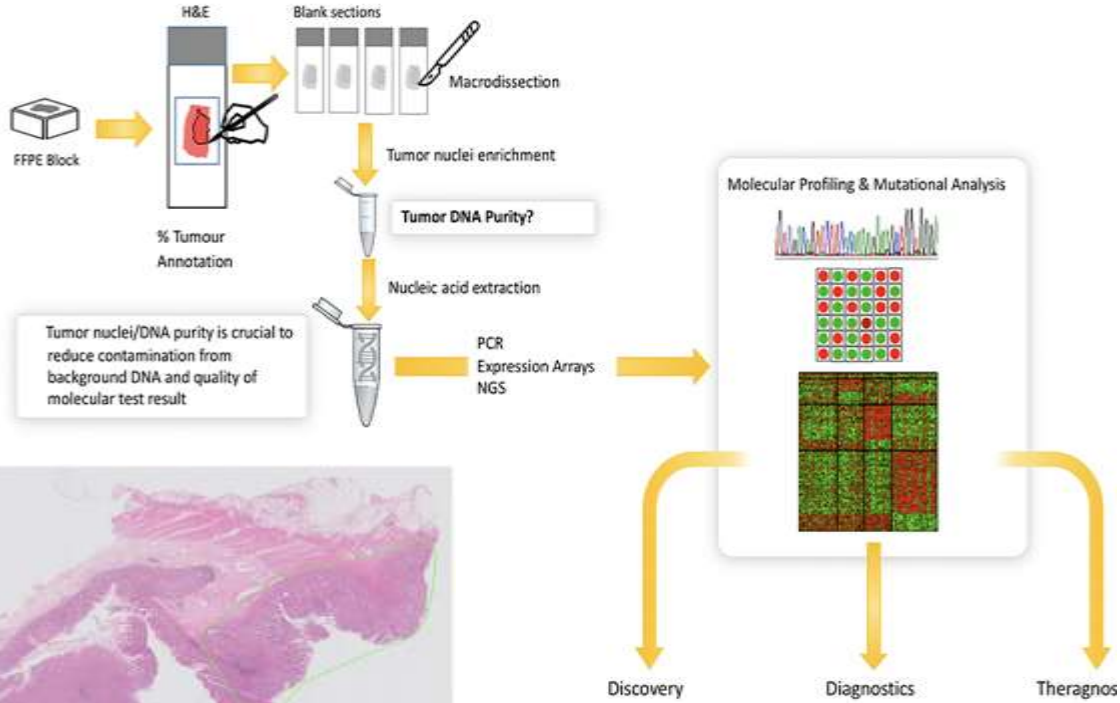


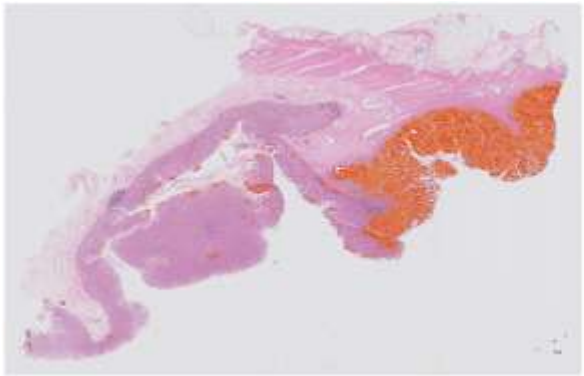

Will have significant impact in distribution of groceries, food, packages, mails, etc.

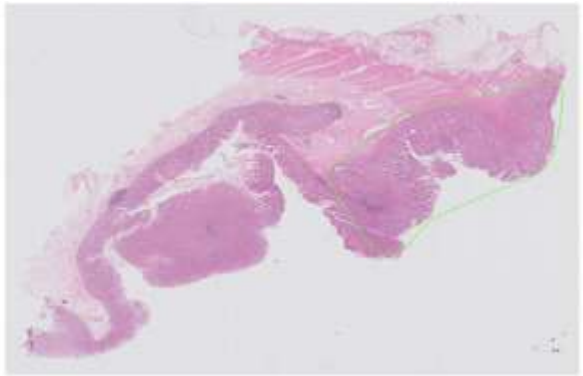
AI-Driven Digital Pathology

Applications

- Prostate Cancer Detection
- Metastasis Detection in Breast Cancer
- Genetic Mutation Prediction
- Tumor Detection for Molecular Analyses







Courtesy: https://www.frontiersin.org/articles/10.3389/fmed.2019.00185/full

Generative AI

- Generative AI (GenAI) is a broad label describing any type of artificial intelligence (AI) that can produce new text, images, video, or audio clips.
- Examples: ChatGPT, Dall-E, Gemini, Co-Pilot, etc.
- Simple example (cooking):
  - Learn the basic principles of cooking
  - Create new dish using a set of ingredients (fusion dishes)
- **Great focus recently in all disciplines/fields**

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Creating Intelligent Cyberinfrastructure for Democratizing AI: Overview of the Activities at the NSF-AI Institute ICICLE

Keynote Talk at Workshop on Indo-USA Initiatives (@HiPC '23)

by

http://icicle.ai

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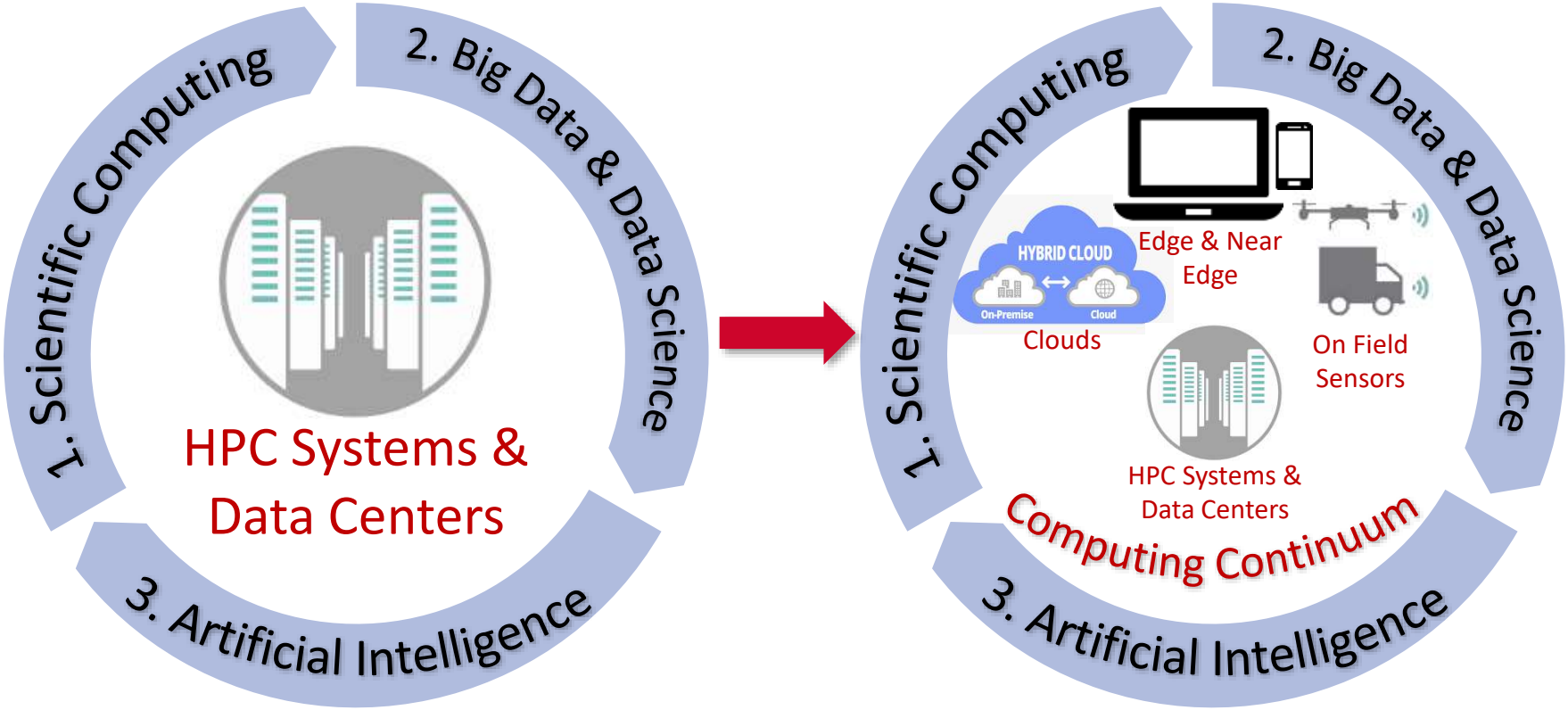
Credits to all ICICLE Team Members!!

ICICLE Members Attending All-Hands-Meeting In-Person (Nov ‘23)

Computing has been evolving over the last three decades with multiple **phases:**

- Phase 1 (1975-): Scientific Computing/HPC
- Phase 2 (2000-): HPC + Big Data Analytics
- Phase 3: (2010-): HPC + AI (Machine Learning/Deep Learning)

Emergence of the Computing Continuum



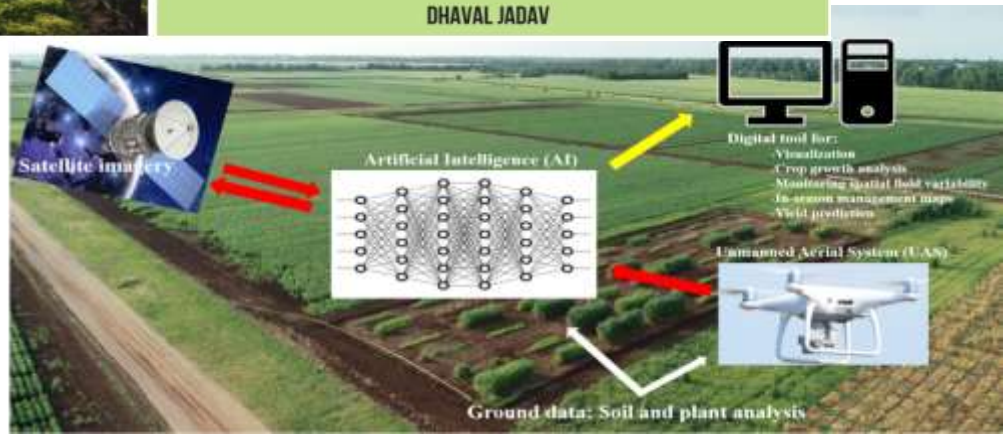
Societal Challenge (Example #1): Agriculture

- **Food security/sustainability in 2050**
  - 9.8B people, climate; 0.5x arable land per cap vs 1985
  - Wide gains in crop management needed (typical yields fall 3X below best practice)

- **Sustainable agricultural workforce**
  - The next generation of agriculture professionals will include engineers, computer scientists, data scientists

- **Democratization of digital agriculture capabilities**
  - Autonomous unmanned aerial vehicles, self-driving tractors and sprayers, fertilizer and seed recommendations
  - Big and small farms, staple and specialty crops, underrepresented communities
  - Privacy and ethical considerations

AI-Driven Digital Agriculture



https://ccag.tamu.edu/research-project/digital-agriculture/

https://medium.datadriveninvestor.com/artificial-intelligence-in-agriculture-62f71f8f6ae6

Societal Challenge (Example #2): Animal Ecology

- **Basic science:** The focus of Animal Ecology is understanding the functioning and behavior of animals individually and in groups *in the context of environment* and evolution.

- **Science + translational:**
  - Monitoring, understanding, and protecting biodiversity of the planet
  - Monitoring and understanding the impact of changing habitats on animals that live in them

- **Translational:** biodiversity conservation and mitigating the impact of climate change

Societal Challenge (Example #3): Smart Foodsheds

- **Food Supply Chain Vulnerabilities**
  - Concentration contributes to bottlenecks, lack of resilience to disruptions
- **High Food Insecurity**
  - Supply chain decisions fail to account for impacts on food access, cost, availability
- **Food Waste**
  - Inefficiencies in food supply chains and food systems lead to 30-40% waste
- **Negative Environmental Footprint**
  - Farming and food system has major impacts on environment
- **Holistic Food Systems Planning is Difficult**
  - Data is difficult to access, not coordinated across sectors or food supply chain actors

Many more examples

- Smart Cities
- Smart Manufacturing
- Smart Transportation
- Real-time Surveillance
- Computational Medicine (Pathology, Radiology, ..)

Broad Challenge

Designing the next-generation intelligent cyberinfrastructure for a computing continuum with heterogenous resources that is usable in a plug-and-play manner by stakeholders to solve societal challenges?

The ICICLE Overview Video

The Video is available from

https://youtu.be/gNFk5tDTtoU

Objectives: Intelligent CyberInfrastructure for Computing Continuum

Use Inspired Science Domains

Digital Agriculture

Smart Foodsheds

Animal Ecology

ICICLE: Intelligent CyberInfrastructure with Computational Learning in the Environment

Systems AI Foundational Research for CI

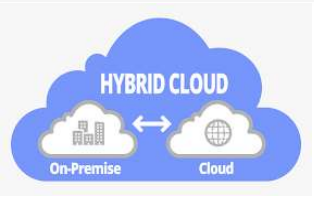
Intelligent Cyber Infrastructure

CI for AI

AI for "CI for AI"

On Field Sensors

Edge & Near Edge

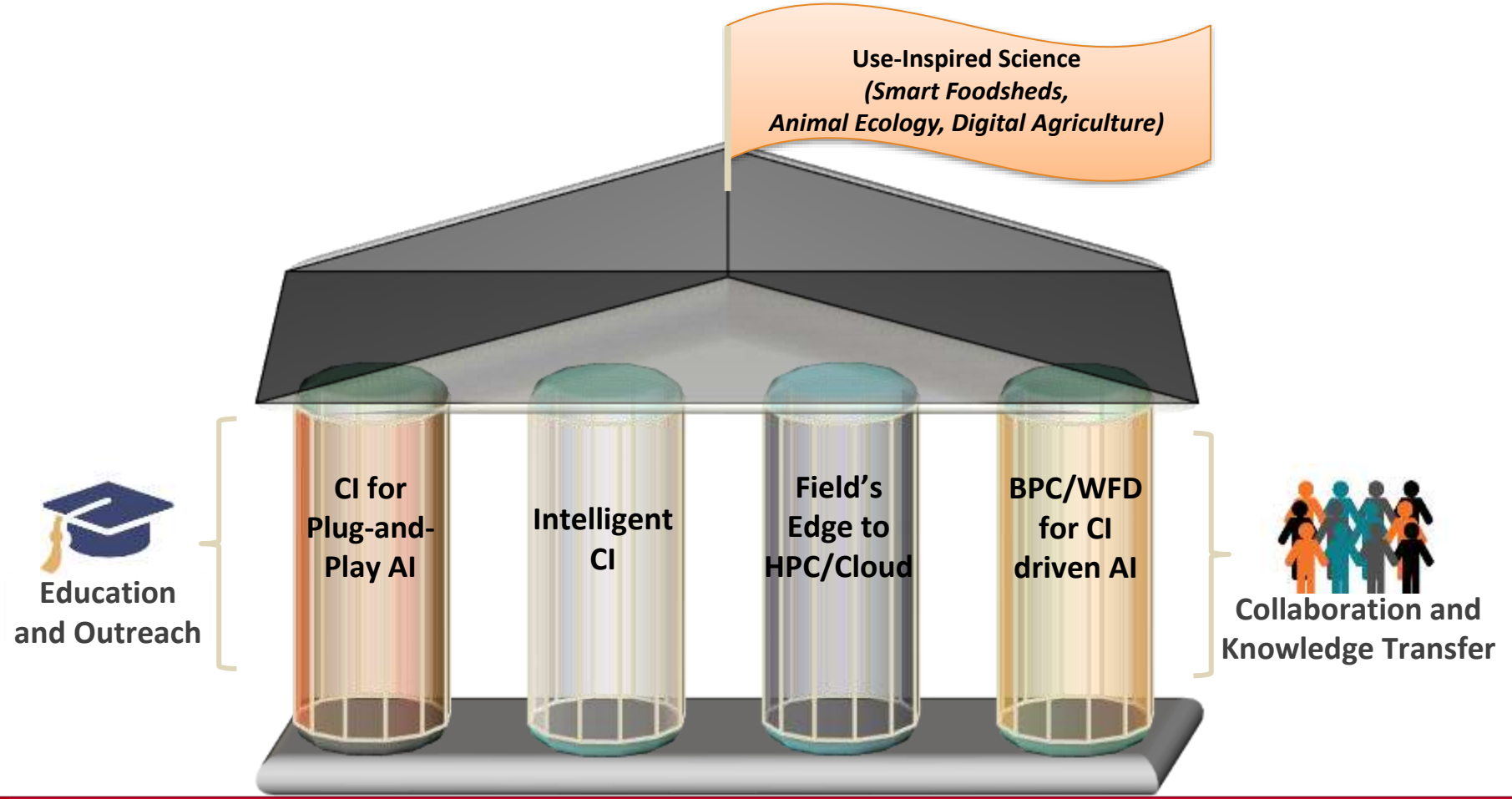


Clouds

HPC Systems & Data Centers

Emerging Computing Continuum

ICICLE As A Whole



Participation:
14 Organizations, 33 faculty, 41 staff, (58 PhD, 16 MS, 16 undergrad, 6 K-12) students & many Collaborators

Govt. Agencies & National Labs

Lawrence Livermore National Laboratory
BROOKHAVEN NATIONAL LABORATORY
Fermilab

International

University of Stuttgart Germany

Research Institutes

MOLSSI
SGCI Science Gateways Community Institute
TRUSTED CI
ECEP
CAHSI Computing Alliance of Hispanic-Serving Institutions
SCiEC AN NSF-I3OSE CENTER
neon Operated by Battelle
Jetstream

Industry

CNH INDUSTRIAL
ADC
WILDMT
Microsoft
FARM 2 FACTS
THE FINDINGS GROUP LLC RESEARCH & EVALUATION

NSF AI Institutes

AIFS AI Institute for Future Scientific Discovery

Hospitals & Universities

NATIONWIDE CHILDREN'S

Collaboration: ICICLE and the Technology Innovation Hub (TIH) at the Indian Institute of Technology Bombay (IIT-B), India

Digital Agriculture



This research collaboration will contribute novel design paradigms for context-adaptive CI and aims to develop next-generation CI for *Digital Agriculture* including AI and machine learning methods targeting 3 core areas.

Crop Health Modeling

- Sense crop health and level context to predict crop yield
- Detect stressors and diseases for geographically diverse crops
- Apply remedies with little human intervention via Internet of Things (IoT) and sensor systems

Aerial Crop Scouting

- CI for fully autonomous aerial systems
- Simplify deployment of UAV in real fields to capture common crop health conditions
- Provide accurate maps that yield valuable insights for crop management

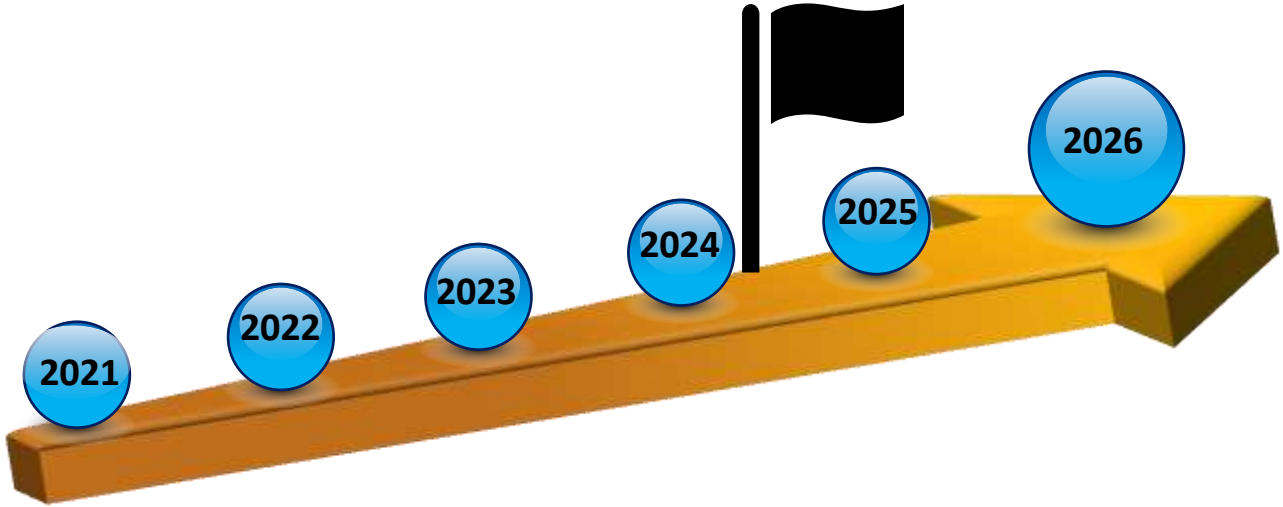
Privacy-Preserving Data Exchange

Create secure, trustworthy, and privacy-preserving platforms that connect farmers and allow them to share information and resources safely.

Building upon the existing ICICLE infrastructure, CI and AI capabilities, researchers will leverage contextual conditions in India for *Digital Agriculture* that differ from the United States to (1) expose brittle CI components, (2) make AI4CI more robust and expansive in the long-term, (3) devise principles that yield context-aware CI

Timeline

- Started on Nov 1, 2021
- Finishing 27 months of the project



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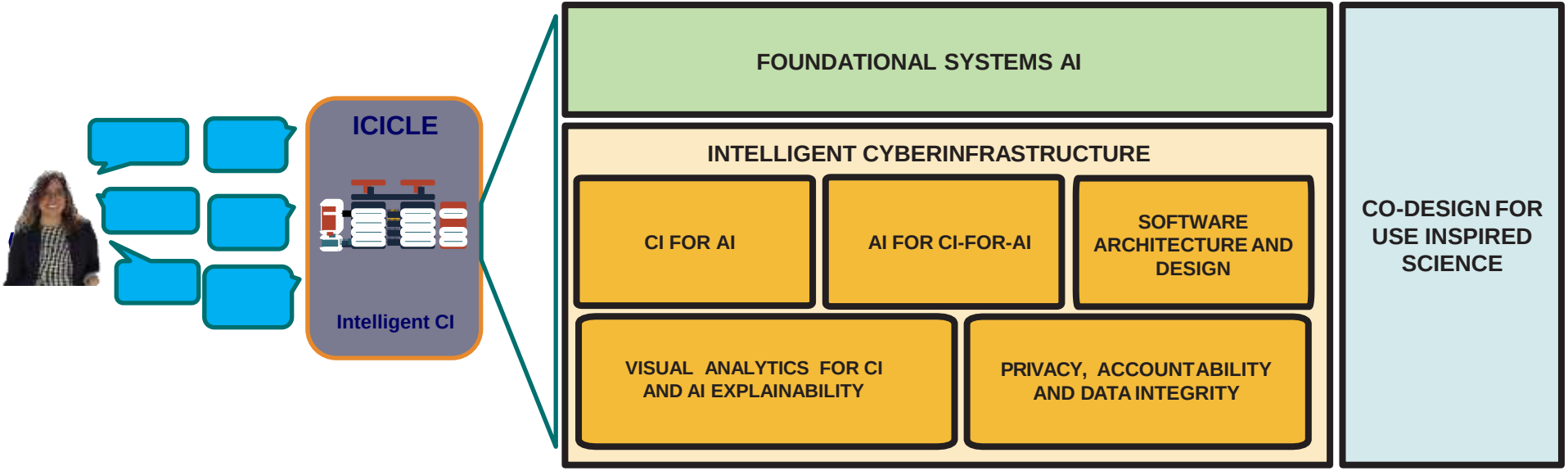
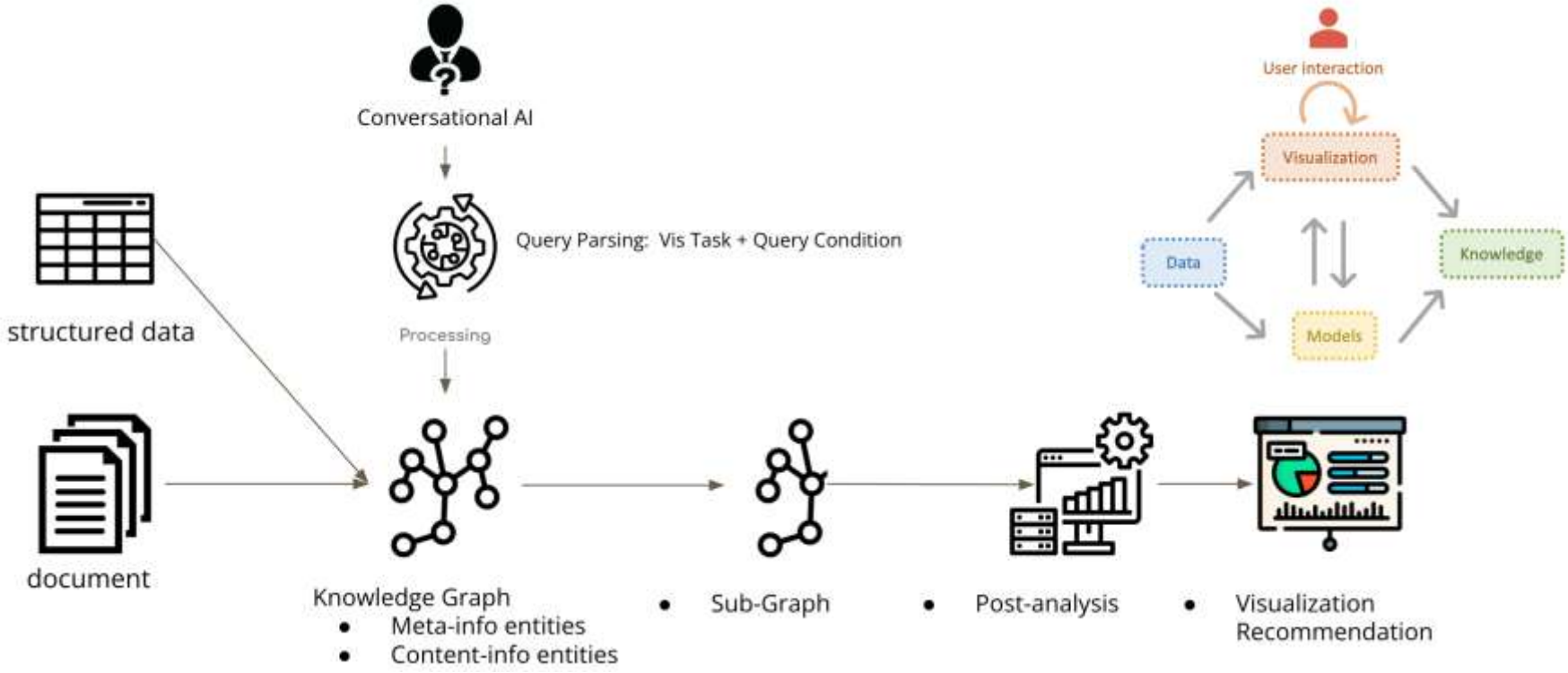
Research Plan: Overall Vision



Thrust: Privacy, Accountability and Data Integrity (PADI)

- PADI contributes to
  - ICICLE vision as *transparent and trustworthy* infrastructure for AI-enabled future
  - An ethically aligned infrastructure and workforce through an *AI ethics framework*
- PADI advances both technical and non-technical innovations and best practices that collectively contribute to a trusted environment
  - e.g., where stakeholders (farmers, industry partners, etc.) are comfortable contributing data and AI models for ICICLE AI research (and more broadly for AI research).
- PADI addresses both research questions and issues of practice (project norms and practice)

Thrust: Visual Analytics

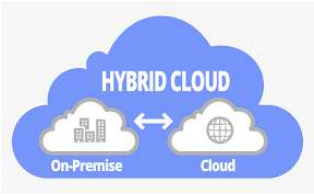


Co-Designing with use-inspired domains

Conv. AI

Data: On Field Sensors

Models: Edge & Near Edge



Data/Models: Cloud

Data/Models: HECs

ICICLE-enabled Computing Continuum

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CI/Software Components Released (so far)

2023.04 Release (04/30/23)

- **AI4CI**
  - HPC Application Runtime Predictor (HARP) v1.0
  - Intelligent Sparse Library (iSpLib) v1.0
- **Software and Reference Architecture**
  - Base ICICLE Tapis Software v1.3.0
  - Event Engine v0.2.0
  - Hello ICICLE Authentication Clients v0.0.1
  - Tapis Pods Service v1.3.0
  - CI Components Catalog v0.1.0
- **Animal Ecology**
  - Camera-Traps Edge Simulator v0.3.0
- **Digital Agriculture**
  - SoftwarePilot v1.2.5
- **Smart Foodsheds**
  - Persons-Projects-Organizations-Datasets (PPOD) Schema v0.9.1
  - Smart Foodsheds Visual Analytics (VA) Dashboard v0.1

2023.06 Release (06/30/23)

- **AI Foundations**
  - ICICLE Foodshed Parser v0.1
  - Species Classification using Multimodal Heterogeneous Context v0.1.0
  - Region2vec v1.0
- **Software and Reference Architecture**
  - Tapis Federated Authentication Service v1.3.4
  - ICICONSOLE v0.0.10
  - TapisCL-ICICLE v0.1.4
  - Tapis Pods Service v1.3.2
- **Animal Ecology**
  - Camera-Traps Edge Simulator v0.3.1
- **Digital Agriculture**
  - ICICLE Digital Agriculture Hub v1.0
  - Far-Edge Edge Simulator v1.0
  - In-Field Helper for Crop Scouts v1.0
- **Smart Foodsheds**
  - Persons-Projects-Organizations-Datasets_California (PPOD_CA) Knowledge Graph v23.06
  - Kroger Store Closure v0.1
  - Smart Foodsheds Visual Analytics (VA) Dashboard v0.2

https://icicle.osu.edu/cyberinfrastructure/software

CI/Software Components Released (so far)

2023.10 Release (10/06/23)

- AI for CI-for-AI
  - High Performance Computing Applications Dataset v1.0
  - HPC Application Runtime Predictor (HARP) v2.0
- Software and Reference Architecture
  - iciflaskn v1.0
  - TapisCL-ICICLE v1.0.11
  - ICICONSOLE v0.8.0
- Animal Ecology
  - Camera-Traps Edge Simulator v0.3.2
- Smart Foodsheds
  - Smart Foodsheds Visual Analytics (VA) Dashboard v0.3

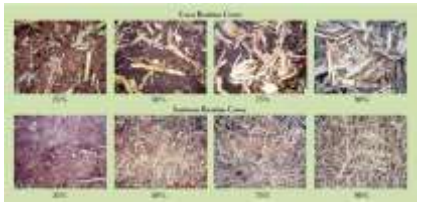
2024.01 Release (01/26/24)

- AI Foundations
  - Iluvatar Functions as a Service (FaaS) Control Plane v1.0.0
- Software Architecture and Design
  - Tapis Federated Authentication Service v1.5.0
  - Tapis Pods Service v1.5.3

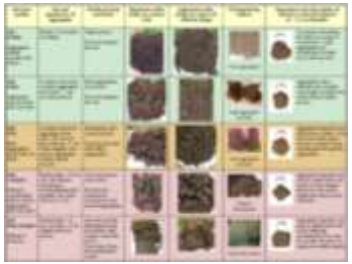
https://icicle.osu.edu/cyberinfrastructure/software

The Application Domain Challenge (Digital Agriculture)

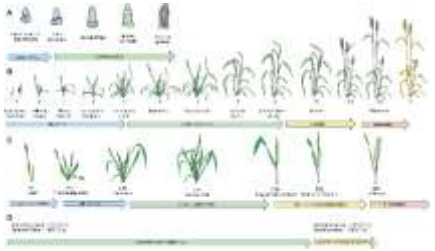
Computer Vision (CV) based classification scenarios are ubiquitous in use-inspired science domains such as Digital Agriculture



Residue Cover on Soil Surface



Soil Aggregate Size



Wheat Development

Non-Uniform Emergence

Nitrogen Deficiency

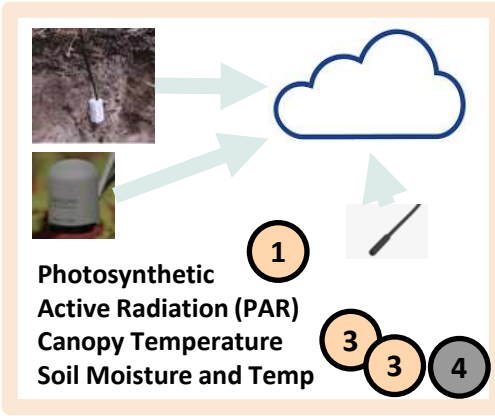
European corn borer

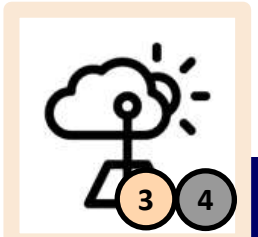
Corn leaf aphid

Mexican bean beetle defoliation

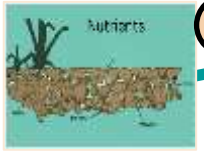
Models/Data in Digital Agriculture

Factors
1. Sunlight
2. Air
3. Temperature
4. Water
5. Genetics
6. Room to Grow
7. Nutrients
8. Disease and Pests
9. Weeds
10. Time and Space





Domain Expert Image and Automatic Data Labeling



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AI Classifiers (Use Cases)

Phenotypes

Timing of in-season treatments

Yield Estimation

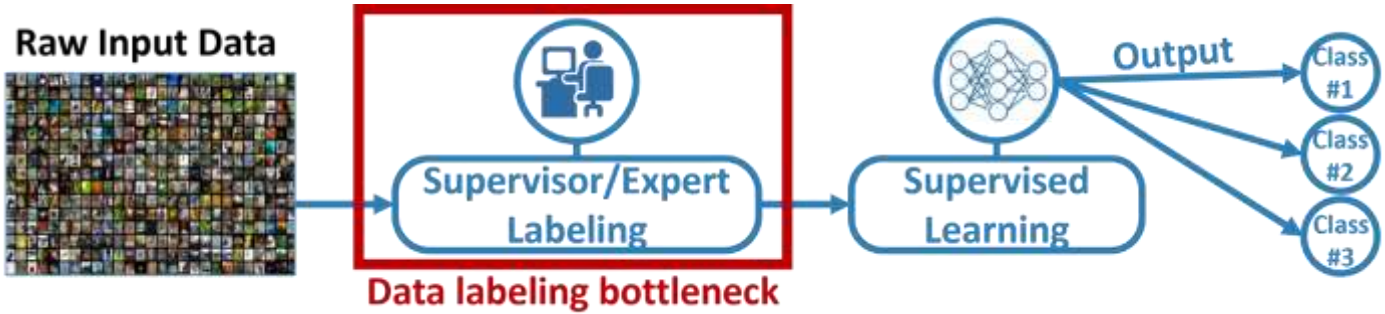
Locking in grain pricing

Soil Moisture

Quantifying soil resilience to drought stress

The Data Labeling Challenge

Challenge:



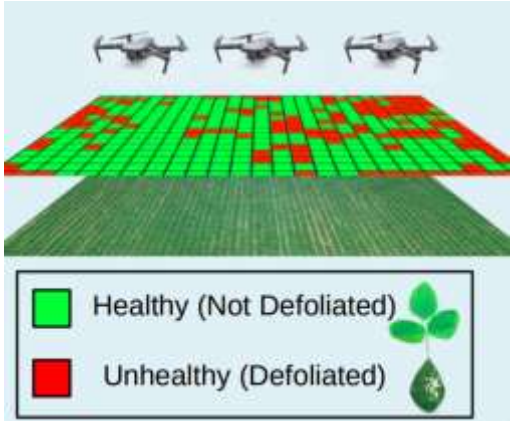
- Data samples need to be fully labeled by an expert for training and evaluation.
- Datasets may be collected frequently and in large volumes (millions of unlabeled images).
- Labeling data by experts is a significant bottleneck.
- Supervised learning can be time-consuming, costly, and infeasible for certain applications

Semi-Supervised Learning (SSL) for Digital Agriculture

- Only requires a subset of the training dataset to be labeled (less than 1% or few hundreds).
- Achieves high accuracies by training on the rest of the unlabeled data (up to 97% accuracy)

Digital Agriculture: Aerial Crop Scouting

- **Aerial Crop Scouting:** In this workload, we seek to create *heat maps* that describe crop health for a field
  - *Inform* self-driving tractors and sprayers to reduce the application of pesticide and fertilizer
  - *Predict* crop yields for harvest and market timing
  - *Identify* trends across farms, such as the introduction of resistant weeds
- **Technology:** Unmanned aerial vehicles (UAV) capture high resolution images
  - Flying low (15 ft above ground): 1 pixel -> mm
- **Transformative:** At mm-granularity, stakeholders can detect biological phenomena invisible to satellites
  - Soybean leaf defoliation caused by Japanese beetle
- **Software Pilot** (https://pypi.org/project/SoftwarePilot/)
- **OpenPass** (http://149.165.155.188:2298/)



Courtesy of LaRue Farms Inc.

Demo: Cloud-to-Edge Middleware

The Video is available from

https://www.youtube.com/watch?v=M6o0NVQXny0

GROCERY STORE CLOSURE & COMMUNITY HEALTH

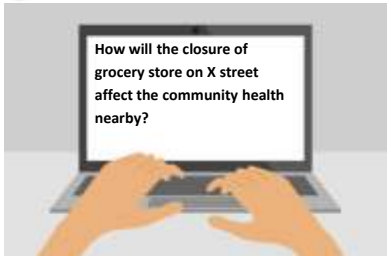
Pain points

- In public health and food systems, computer models are not used or have limited impact because decision-makers are not able to access them in a practical and timely manner.

SCENARIO

A food retail company announces plans to **close a grocery store** in a Columbus, Ohio neighborhood with **very high % of food-insecure households**.

Now the health commissioner wants to know how the grocery store closure will affect community health so they can lobby the food retail company to not close the grocery store or set up emergency food supply to reduce the impact on community health.



Our Solution (and use case in ICICLE)

A conversational AI-enabled web interface that allows decision-makers to run "What if?" scenarios based on an agent-based model for food insecurity.

Use Case

Objective: Help food system leaders quickly evaluate the impact of a food store closure on household food insecurity

Significance: Improving access to community-informed computational models empowers communities to use models to make better decision involving complex systems, such as the local foodshed.

Demo: GROCERY STORE CLOSURE & COMMUNITY HEALTH

The Video is available from

https://www.youtube.com/watch?v=GYjMeaE74sk

Outline

- Overview of AI, Deep Learning, Machine Learning, and Regenerative AI
- ICICLE NSF-AI Institute
  - Vision and Goals
  - Research Challenges Addressed
  - Highlights of Selected Accomplishments
- **What do schools need to know?**
- Implications for the current and future workforce
- Education, BPC, and Outreach Efforts
- Potential work through BAC for student and teacher workshops

What do Schools need to know?

- Like any new technology being introduced (remember issues about calculator, web access, smart phones, social media, …)
- Understanding AI trends
- Overview of AI concepts and technologies
- Implications of using AI technologies (good vs. bad)
  - Usefulness
  - Correctness
  - Privacy
  - Ethics

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Implications for the Current and Future Workforce

- Enormous!!
- Next-generation students and teachers need to be AI-Literate
  - Should be able to understand the implications of using AI technologies (good vs. bad) and make good judgment about use cases
- Students need to be motivated to work in this field with excitement and without reservations
  - Lead to stronger and matured next-generation workforce in AI
  - Should we able to use AI technologies to solve world problems

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Broader Impacts Backbone Network (BIBN)

BIBN is a consortium with the goal of democratizing AI!

Oversees activities towards broader impacts and engagement:

- Diversity Equity and Inclusion (DEI)
- Broaden Participation in Computing (BPC)
- Workforce Development (WFD)
- Collaboration and Knowledge Transfer (CKT)

Selected Accomplishments from BIBN

- BPC
  - Inclusive environments initiative: **ICICLE NextGens** group, **ICICLE Code of Conduct**
  - Building awareness: bi-weekly **Ally tips (bias);** AI Ethics tips purposed for Indiana Univ **K-12 summer camp**
- WFD
  - **Hello ICICLE:** clients (Notebooks, command line, python, Web client) for testing software
  - Summer 2023 launch of **ICICLE AI Ethics tips** series of 6 videos
  - Consolidation and organization of **ICICLE Publication and Training Resources** (with WFD and HelloICICLE)
- KT
  - ICICLE Seminar Series
  - **Partnership Agreements** for stakeholders to engage with ICICLE. (Students, Academic Scholars, Organizations, Industry Sponsored, and Stakeholder Roundtable)
  - Engaging stakeholders, including through 2023 class of 5 **ICICLE Educational Fellows**

https://icicle.osu.edu/knowledge-transfer/youtube-channel

Specific K-12 Activities

- Short Workshop with demo (1-2 hours) in various school events
  - Hudson Valley Middle School, Cuyahoga county, Science Fair Day
  - Columbus school for Girls' AI Workshop
  - Central Ohio's One-day Hackathon for High-Schoolers
- Typically involves
  - Short presentation on ICICLE
  - Demo of Flying Drone
- Can be customized based on the scope of the event and students interest

Multiple Levels of Collaboration and Engagement

- Using the Released Software/CI components
  - Available at https://icicle.osu.edu/cyberinfrastructure/software
  - Get engaged as a member in the Stakeholder Roundtable (more details below)
- Become a part of ICICLE (multiple options)
  - Student Associate
  - Visiting Research Fellow
  - Academic Collaborator
  - Industry Partner
  - Stakeholder Roundtable Member
  - More details at: https://icicle.osu.edu/engagement/join-us
- Join the ICICLE mailing lists (https://icicle.osu.edu/engagement/mailing-lists)
  - icicle-announce
  - icicle-discuss

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Work force Development Programs – CSE@Ohio State

The **Masters in Translational Data Analytics** combines design thinking, computer science, and statistics into a truly interdisciplinary program

Applications for Autumn 2024 are open.

Deadline: 6/1/2024

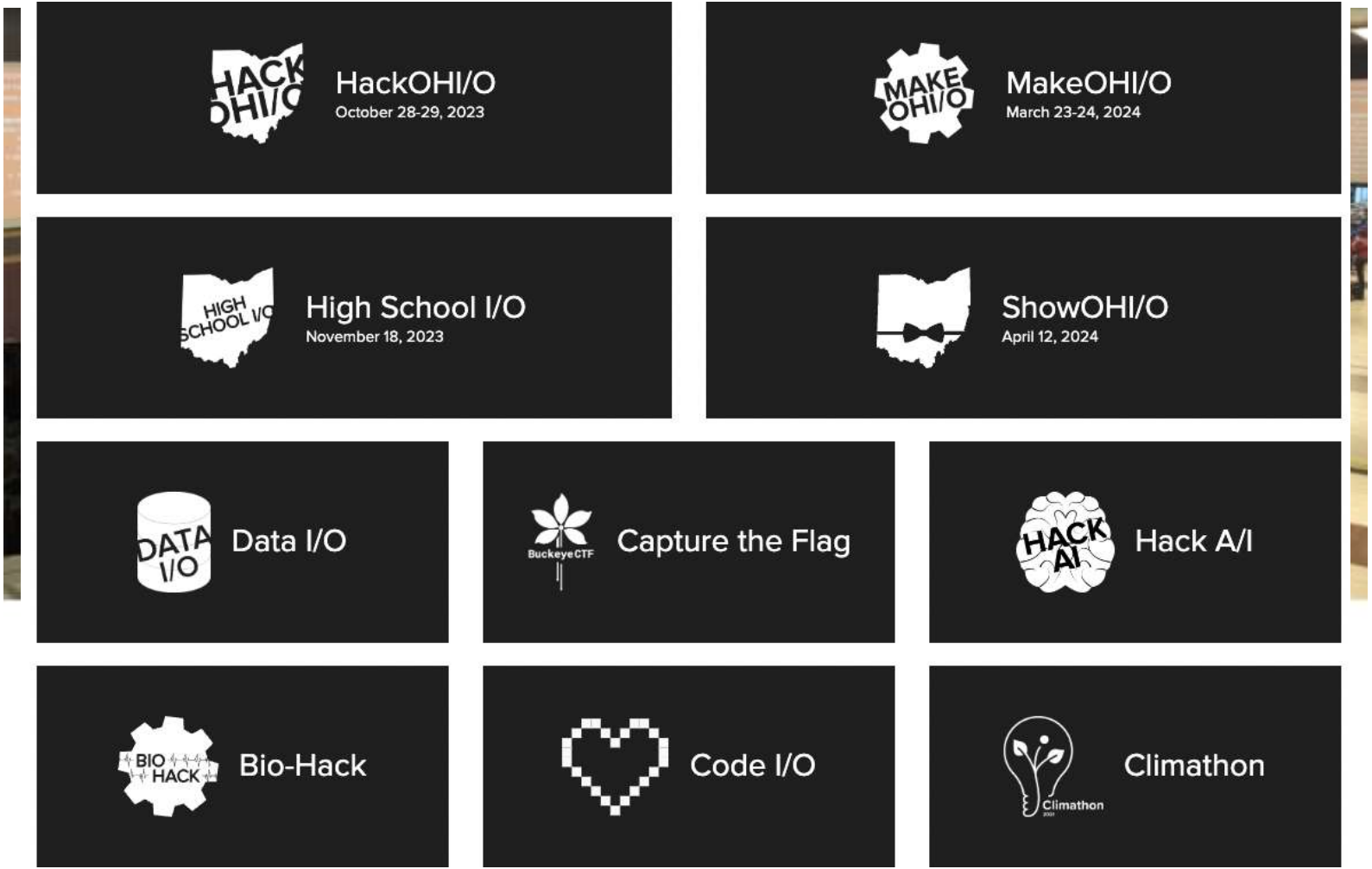
Ohio's 5G and Broadband Workforce Development

- https://5g-oh.osu.edu/

Programs supporting Broadband and 5G Workforce Strategy

5G-OH Connectivity Center for 5G and Broadband

- State support for curriculum (and broad) program development
- Undergrad certificate under development


HackOHI/O
October 28-29, 2023
MakeOHI/O
March 23-24, 2024
High School I/O
November 18, 2023
ShowOHI/O
April 12, 2024
Data I/O
Capture the Flag
Hack A/I
Bio-Hack
Code I/O
Climathon

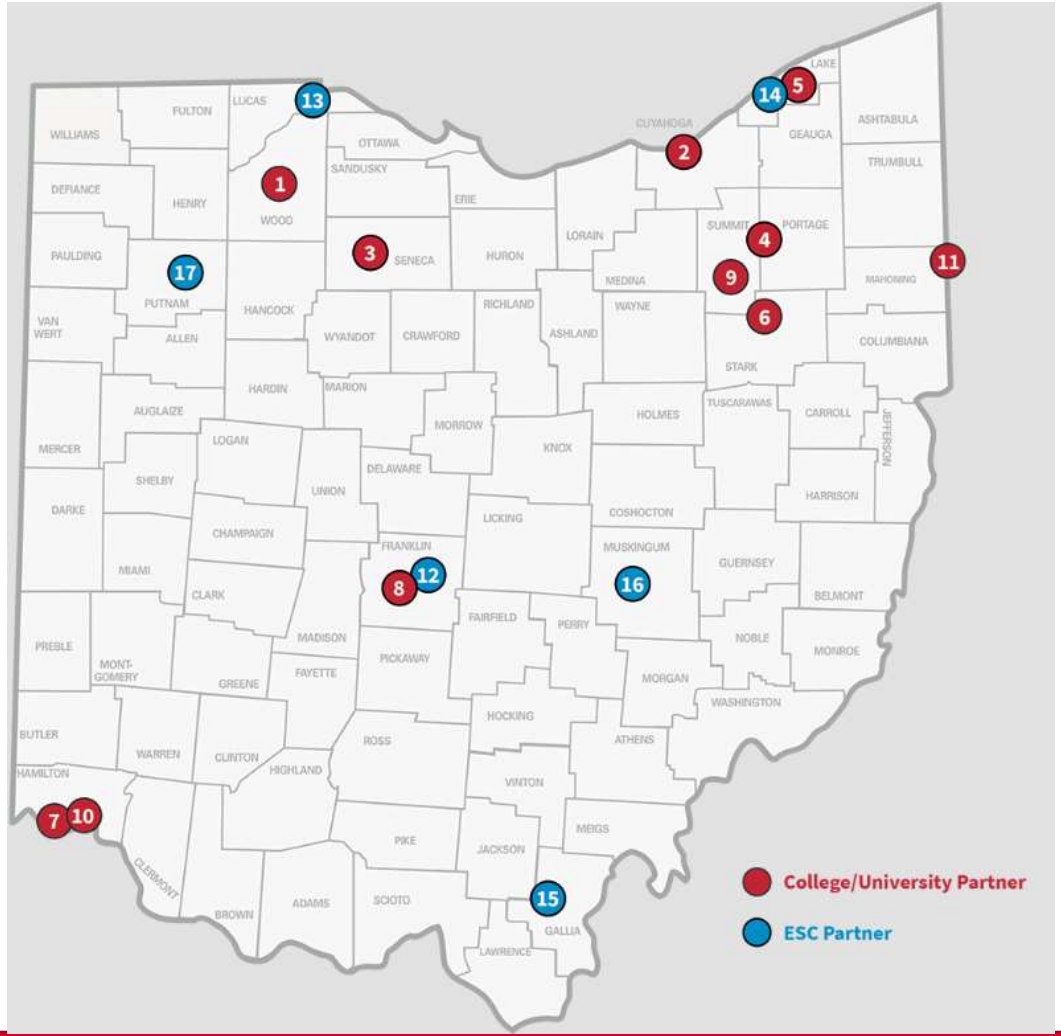
Teach CS Grant Program

Overview

House Bill 33 of the 135th General Assembly allocated $8 million over two fiscal years to support K-12 computer science instruction through the Teach CS Grant Program, established by Section 3333.129 of the Ohio Revised Code. The goal of the Teach CS grant program is "increasing the number of existing teachers who qualify to teach computer science" through supplemental licensure, university endorsement programs, and alternative resident educator licenses. For educators seeking to complete these pathways, the grant funds can be used to cover their coursework, materials, and exams.

Additionally, grant funds can be used for continuing education programs that offer professional development to existing teachers.

The Ohio Department of Higher Education (ODHE) released a Request for Applications on November 1, 2023, for institutions of higher education and educational service centers that sought to partner with ODHE on this important initiative. Six ESCs and 11 colleges and universities were selected to participate.


College/University Partner
ESC Partner
WILLIAMS
FULTON
LUCAS
DEFIANCE
HENRY
WOOD
OTTAWA
SANDUSKY
ERIE
PAULDING
PUTNAM
HANCOCK
SENECA
HURON
LORAIN
CUYAHOGA
LAKE
GEAUGA
ASHTABULA
TRUMBULL
SUMMIT
PORTAGE
MEDINA
MAHONING
VAN WERT
ALLEN
WYANDOT
CRAWFORD
RICHLAND
ASHLAND
WAYNE
STARK
COLUMBIANA
AUGLAIZE
HARDIN
MARION
MORROW
KNOX
HOLMES
TUSCARAWAS
CARROLL
JEFFERSON
MERCER
SHELBY
LOGAN
UNION
DELAWARE
DARKE
CHAMPAIGN
LICKING
COSHOCTON
HARRISON
MIAMI
CLARK
FRANKLIN
MUSKINGUM
GUERNSEY
BELMONT
PREBLE
MONT-GOMERY
GREENE
MADISON
FAYETTE
PICKAWAY
FAIRFIELD
PERRY
NOBLE
MONROE
MORGAN
WASHINGTON
BUTLER
WARREN
CLINTON
HIGHLAND
ROSS
HOCKING
ATHENS
HAMILTON
VINTON
MEIGS
PIKE
JACKSON
CLERMONT
BROWN
ADAMS
SCIOTO
GALLIA
LAWRENCE

Blended Programs – X+{CS,AI,*}

3 Questions: Blending computing with other disciplines at MIT

The Common Ground for Computing Education is facilitating collaborations to develop new classes for students to pursue computational knowledge within the context of their fields of interest.

- University is welcoming to blended programs
- X is a discipline that requires infusion of computing
- Interest at both graduate and undergraduate levels!
- Online is of great interest!

Blended Programs: Undergraduate, incl. X+CS

Biomedical Informatics

- X + CS: Planning for undergraduate programs

Design

- X + CS: Blueprint for a novel blended degree

Linguistics

X + CS: Blueprint for a novel blended degree

Electrical and Computer Engineering

- X + CS: Pathways leading to integrated hardware and software design

Blended Programs: Graduate incl. X+AI

- Certificates in Cybersecurity (Offense and Defense) on books
  - Master's program approval underway
- Applied AI certificate on books
- Certificates in AI + Digital Health on books
  - Master's program approval underway
- Masters' program in Computational approval underway

Potential for the ICICLE Solutions to be applied to more Verticals

Smart Foodsheds

Digital Agriculture

Animal Ecology

Health & Medicine

Environment

Communications & Collaboration

Mobility, Machines, & Manufacturing

AI for Social Good

ICICLE: Intelligent CyberInfrastructure with Computational Learning in the Environment

Systems AI Foundational Research for CI

Intelligent Cyber Infrastructure

CI for AI

AI for "CI for AI"

On Field Sensors

Edge & Near Edge

Clouds

HPC Systems & Data Centers

Emerging Computing Continuum

Acknowledgments to all ICICLE Participants (Faculty, Students and Staffs)

Current Faculty

- E. Ayday, CWRU
- V. Chaudhary, CWRU
- A. Azad, IU
- P. Sharma, IU
- H. Zhang, ISU
- T. Berger-Wolf, OSU
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- Y. Cai, OSU
- W. Chao, OSU
- E. Fosler-Lussier, OSU
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- R. Ramnath, OSU
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- H. Subramoni, OSU
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- A. Ahmad, Uni Stuttgart
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- P. Sadayappan, UU
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- S. Gao, UW-Madison
- A. Morales, UW-Madison

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- K. Pierce, TACC

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- S. Raje, UU
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- M. Tatineni, SDSC
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- J. Stubbs, TACC
- Z. Zhang, TACC
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- P. Huber, UC Davis
- C. Riggle, IC-Foods
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- M. Thomas, UCSD
- M. Miller, UW Madison

Current International Students TIH - IITB

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- RM. Chitre, TIH IITB
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- A. Thaduri, TIH IITB
- S. Zac, TIH IITB

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- Chalapathi G, IITB
- A. Sinha, IITB
- R. Velmurugan, IITB
- S. Paramane, TIH IITB

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- D. Lee, SDSC
- M. Ray, SDSC
- S. Samar, SDSC

Past K-12 Students

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- A. Sarin, SDSC

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- H. Panday, OSU
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- D. Sykes, UW Madison

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- V. Pahuja, OSU
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- E. Romero, OSU
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- Y. Tu, OSU
- S. Vallabhajosyula, OSU
- L. Waltz, OSU
- B. Wang, OSU
- X. Wang, OSU
- J. Yao, OSU
- X. Yue, OSU
- T. Zhang, OSU
- K. Zhang, OSU
- Z. Zhang, OSU
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- T. Jiang, UU
- Y. Xu, UU
- J. Yan, UU
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- J. Kline, OSU
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- C. Wise, TFG

Current Masters Students

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- M. Han, OSU
- A. O'Quinn, OSU
- C. Wang, OSU
- J. Yang, OSU
- Q. Ding, TACC
- V. deBella, UW Madison
- M. Krempely, UW Madison
- S. Suresh, UW Madison
- G. Wilkins, UW Madison

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- KA. Irizarry, OSU
- M. Lieber, OSU
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- D. Venkataraman, OSU
- S. Shah, UT Austin
- A. Karunakaran, UW Madison
- M. Kuhn, UW Madison
- Y. Qu, UW Madison
- K. Sung, UW Madison

Educational Fellows (2023)

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- TE. Feiten, UC
- A. Hingle, GMU
- C. Lucken, UC
- C. Okolo, CU

Past UG Students

- S. Ockerman, OSU
- KP. Sailaja, OSU
- C. Washington, OSU
- J.Kim, TACC
- C. Skevofilax, TACC
- S. Wegner, UW Madison

Thank You!