Overview of the Institute for Experiential AI

Usama Fayyad
Executive Director, **IEAI &**
Professor of the Practice, **Khoury College of Computer Sciences**

Vision

Create the **leading research institute** focused on the fusion of human and machine intelligence into working AI solutions that naturally and effectively augment the best of machine algorithms with the intelligence that humans uniquely bring to bear

- Working with industry, public institutions, and academia on R&D problems that
  - Deliver **economic value** through applied intelligence addressing hard AI problems
  - Support education at graduate, undergrad, and professional levels through **experience with solving real-world problems and challenges on actual live projects**
  - Advance the state of research by focusing on the deep problems associated with making the technology work in practice
  - Collaborate across **multi-disciplinary research** on **high impact** business & societal problems
- Provide a unified umbrella for AI activities across Northeastern University

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Institute for *Experiential* AI

What do we mean by *Experiential* AI?

- AI with human-centric approach and goals
- AI applied to real-world problems yielding pragmatic working solutions

Why do we believe EAI is the right direction?

Much evidence that pragmatic working AI solutions have two characteristics:

1 ***Human-in-the-loop:*** ability to bring human decision-making, common sense reasoning into the solution operation in the right context

2 ***Strong dependence on Data:*** Machine Learning and Data Science to leverage more quality (big) data : ***"We don't have better algorithms… we just have more data"***

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What Has Been Missed by Academia?

1. ***Engineering working solutions leads to relevant research problems:*** some of the fundamental research lies at the heart of making the technology work in practice

2. ***Apprenticeship and Experiential Education are key:*** Most of the work is in understanding the limitations of algorithms and knowing when and how human intervention must happen

Covers a wide range of problems:

- Google search and relevance feedback
- Recognition of objects in images, “autonomous” vehicles

Few ever consider that most expensive part of Machine Learning is getting reliably labeled data (from humans)

Three Key Dimensions of Approach

Our current approach to starting IEAI has major dimensions, each with several challenges to be addressed.

Dimensions of Approach:

1. ***AI/Data Science:*** creating the environment to address real problems with real issues, real deliverables
2. ***Application Domains:*** choice of focus areas of specialty where we build differentiation and a competitive edge (academically and economically)
3. ***Research Differentiation:*** New emergent key areas of research not well covered by others

We cover the details for each dimension on next slides

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Dimension 1

Issues with Data Science

There is a **huge** demand in industry, world-wide, for Data Science but a **low** supply of **qualified talent**

Two big issues with talent:

1. ***Quantity:*** not enough qualified graduates from university programs

2. ***Quality:*** Graduates of university, at any level, need 1-2 years before they learn enough of the Art of DS to be effective

How do we address both issues?

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Dimension 1

Learning the Art

Data Science/AI Solutions Factory

Create a factory for AI/DS solution development over real-world problems and data sets: **The analogy:** residency programs in medicine

- **Staff Senior Data Scientists:** actual practitioners
  - augmented by faculty & AI/ML/DS researchers and subject matter experts from other disciplines
- Make the needed data manageable and easily usable
- Work with industry and government
  - Leverage the data platform/environments to enable IEAI experts to address/solve DS problems
  - Collaborate with staff/employees of organizations providing data and applications challenges

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Residency Program in Data Science

Within the AI Solutions factory:

- ***Audience:*** students (BS, MS, PhD) and postdocs willing to spend 6-9 months in residency
  - Open up to professionals seeking upskilling in their current roles
- ***Context:*** Leverage solution development factory to let "residents" learn the art of Data Science through ***apprenticeship***
- ***Economic Impact:***
  - graduates ready to tackle real-world problems – much more desirable as employees
  - significant problems solved as part of training delivery

Dimension 1

IEAI as Globally Visible Home for AI at NU

- Project a strong presence in AI and society in general - build a community at NU
  - Marketing, corporate outreach, focus on AI funding opportunities
  - Publicity, public outreach, strong on-line visibility, capture mind-share in EAI
- Increase activities in AI and accelerate AI project/research
- Increase the quality and relevance of research by making it easier to engage with applied projects and address research in the context of real applications
  - Source new projects for applied work – and use the work for education/courses as well as research on difficult embedded theoretical problems
- Infrastructure to support sourcing qualified interest, starting new projects, and helping produce proposals to industry and government

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Dimension 2

Domains Where to Focus Applications

AI solutions factory (our “Teaching Hospital”) needs to solve real problems from domains of applications that matter

Our approach to select areas of application

1. ***Existing Strengths of NU:*** areas where we have an advantage and critical mass of work
2. ***Market & Societal Demand:*** pick areas with major impact economically or socially
3. ***Research Differentiation:*** pick areas with interesting research problems

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Dimension 2

Choice of focus

Candidate Areas of Application

- **Life Sciences & Healthcare Informatics**
  - Collaborate with Health Information Exchanges and EHR/Claims data collections
  - Optimization of trials, of medical procedures/protocols, epidemiology methods
  - Bioinformatics: Genomics, Proteomics, Drug Discovery
  - AI/Predictive analytics in Computational Medicine
  - OHDSI/OMOP for evidence-based healthcare
- **Cybersecurity**
  - Identify, leverage, analyze and use information from a data lake via AI and deliver actionable insight to enhance intelligence, trends, patterns, controls and procedures
  - Example use case in SOC monitoring – example in overview slides
- **AI Algorithms for Network Sciences – social and physical**
  - Data Fusion for complex network understanding and optimization
  - Identification of behaviors and events in networks
  - Scale management of systems to larger networks (as in 5G and large enterprises)

Dimension 3

Taking the lead

New Area of Research - IR 3.0

- **Information Retrieval 3.0:** Modernize tools to retrieve from large digital collections of documents
  - IR 1.0: Led by academia – ended late 90's
  - IR 2.0: Led by tech/search giants – late 90's to now – little action in academia
  - IR 3.0: *hopefully to be led by academia* - We believe the limits of statistical search are reached and we need a new generation of methods that exploit structure and semantics, domain knowledge, etc.
- **Problems to address** with ***s***pecialized search engines, embedded semantics and domain knowledge:
  - E-Discovery in Legal Proceedings
  - Healthcare studies
  - Drug Discovery
  - Intelligence Analytics
  - Background checks and reputation online
  - Library Science & Systematic Review

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Dimension 3

Taking the lead

New Area of Focus: Responsible AI

- **Ethical, Trustworthy and Responsible AI**
  - Interpretable and/or explainable AI
  - Debunking AI misuse (e.g., phrenology based in facial biometrics)
- **Approach by offering a *consulting service* in Audit & Certification**
  - Algorithmic certifications/audits for discrimination and/or bias
  - Create a better understanding of issues
  - Create standards for practice and monitoring
- **Create courses and learning curriculum around this new area**
  - Graduate students who are functional in this space
  - Offer to professional education for organizations to have personnel trained

This area should feedback and influence all other areas

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Some of the Partnership Discussions…

Maine

The Jackson Laboratory

Sun Life

wex

MaineHealth

MAINE UNIVERSITY OF MAINE SCHOOL OF LAW

CLYNK

National/International

Adobe

StanleyBlack&Decker

MITRE

BANK OF AMERICA

GENERALI

Singtel

Prudential

logitech

Silicon Foundry

DECIBEL

KPMG

ntfy

PARTHENON THERAPEUTICS

accenture

NASA JPL Jet Propulsion Laboratory California Institute of Technology

DATA OBSERVATORY

verizon

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Final Words

- We want to create **hands-on experiential environments** and we embrace working through details of applications
- We believe **deep research issues** can be addressed in the context of real applications with real results of market and science value
- We believe great and unique **educational experiences and unique courses** can be created from such environments
- We need your help:
  - your input and ideas on areas of emphasis and applications
  - Generating demand for the AI Solutions factory and the Responsible AI practice
  - Engaging on strategic collaboration areas

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