

# Steps Towards Building Library AI Infrastructures and Programs

(Research Data Repositories, Scholarly Research Ecosystems and AI Scaffolding)

**Presented for New Horizons in AI for Libraries**  
IFLA Satellite Conference, Galway, Ireland  
National University of Ireland, July 21, 2022

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Texas State University Libraries, USA  
July 2022, [ruzwyshyn@txstate.edu](mailto:ruzwyshyn@txstate.edu)



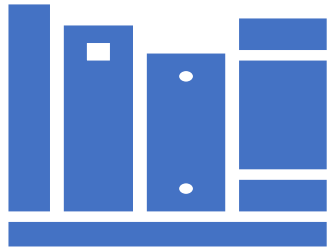
# Laddered Processes Towards Building Library AI Awareness & Competencies

Awareness, Building Skills, Knowledge, Mastery



Multi-Year Process 2014-2022

# Texas State University Libraries



Large Academic Library system,  
ARL Library  
Main campus Library and other  
offsite libraries (Health  
Professions, Austin/Roundrock)



Texas State University,  
Undergraduate, Graduate  
and Doctoral Institution  
40,000 Students



Texas State Libraries,  
Academic Research Library  
ARL Library

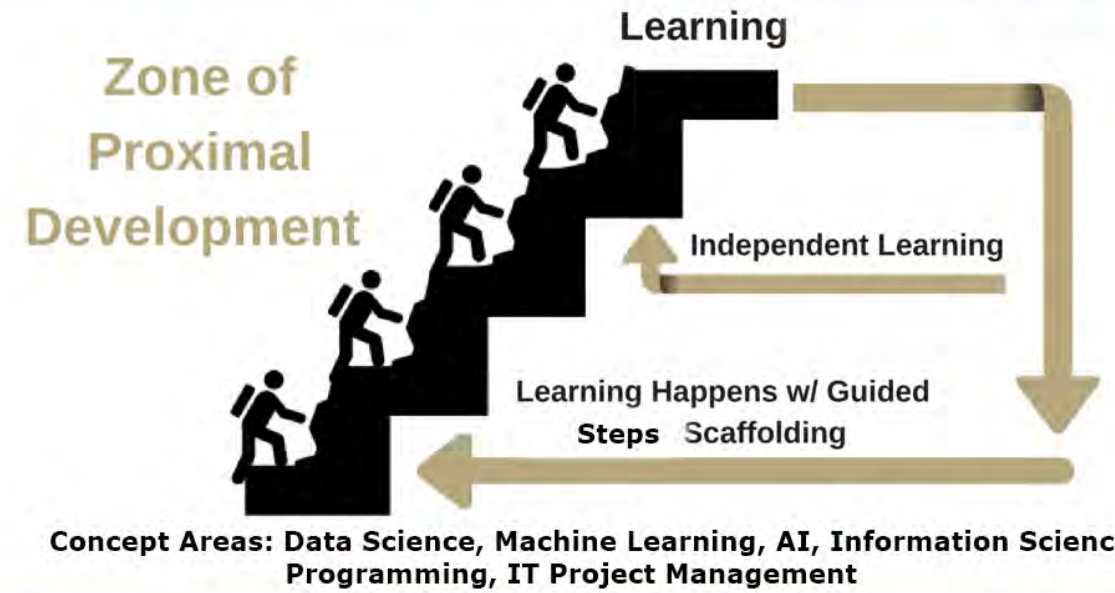


# Steps and Scaffolding Towards Building Library AI Infrastructures

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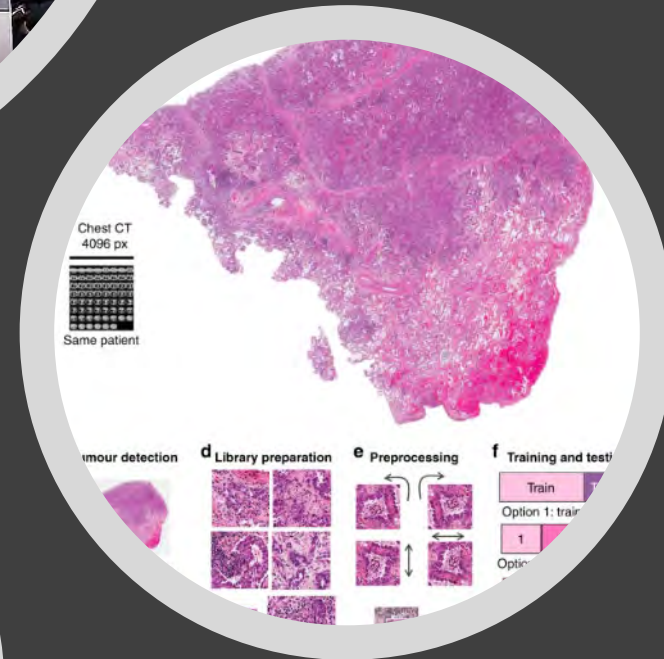
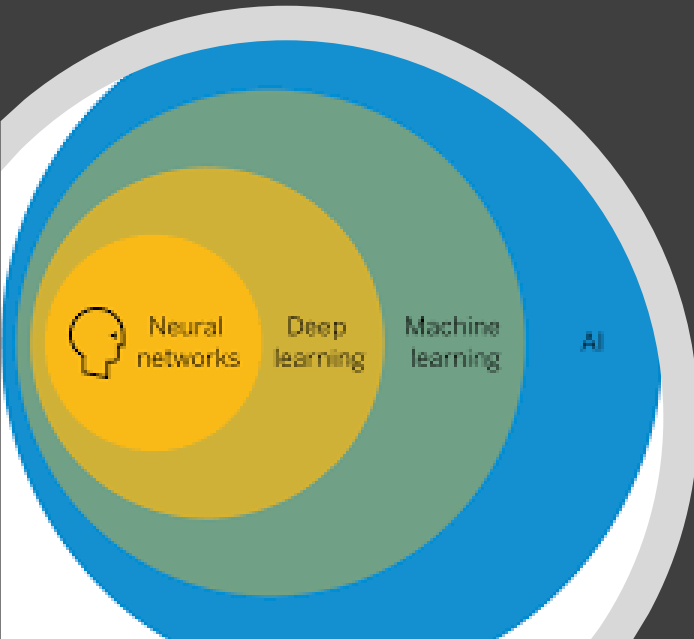
## Learning is Too Hard: Anxiety



## Learning is Too Easy: Boredom

# Last Ten Years Has Shown Incredible Progress of AI

AI (Machine Learning (Deep Learning)) =  
Better Algorithms + Greater Computing Power + Large Data Sets

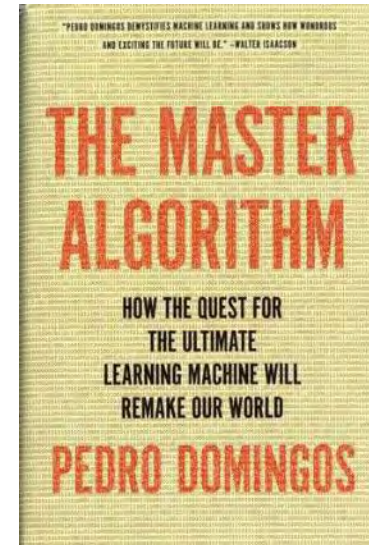


- Natural Language Processing (Speech to Text, Translation)
- Fraud Detection & Cybersecurity
- Conversational Chatbots & Robotic Agents
- Strategic Reasoning (AlphaGo)
- Computer Vision (Facial + Object Recognition Cancer Cell Detection) )

# AI Has Many Paradigms and Origins

Algorithms, Suitable Problem and Solution Methods,  
Dr. Pedro Domingos, University of Washington

AI Paradigm	Origin	Algorithm	Problem	Solution
<b>Deep Learning Machine Learning</b>	<b>Neuroscience (Neural Nets)</b>	<b>Back Propagation Neural Nets</b>	Complex Tasks, Hidden Patterns	Back propagation
<b>Symbolic AI</b>	Logic, Philosophy	Inverse Deduction	Knowledge Composition	Inverse Deduction
<b>Bayesian Inference</b>	Statistics, Probability Theory	Probabilistic Inference	Uncertainty	Probabilistic Inference
<b>Evolutionary Computation</b>	Evolutionary Biology (Complexity Theory)	Genetic Algorithms	Structure Discovery	Genetic Programming
<b>Reasoning by Analogy</b>	Psychology	Kernel Machines (Support Vector Machines)	Similarity	Kernel Machines





# Recommendation #1: Begin with an Academic Data Research Repository



[About](#) [Documentation](#) [FAQs](#) [Log In](#) [Help](#)

Search the Texas Data Repository

FIND



Add a Dataset



Create a Dataverse



Explore Data  
Repository



Learn More



Get Help

Publish and Track Your Data, Discover and Reuse Others' Data!

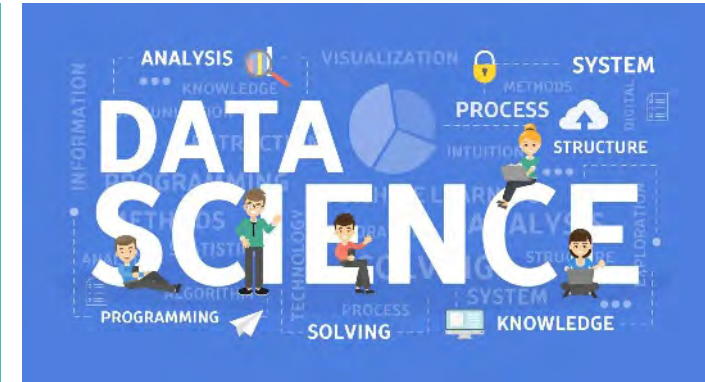
POWERED BY

**Dataverse**



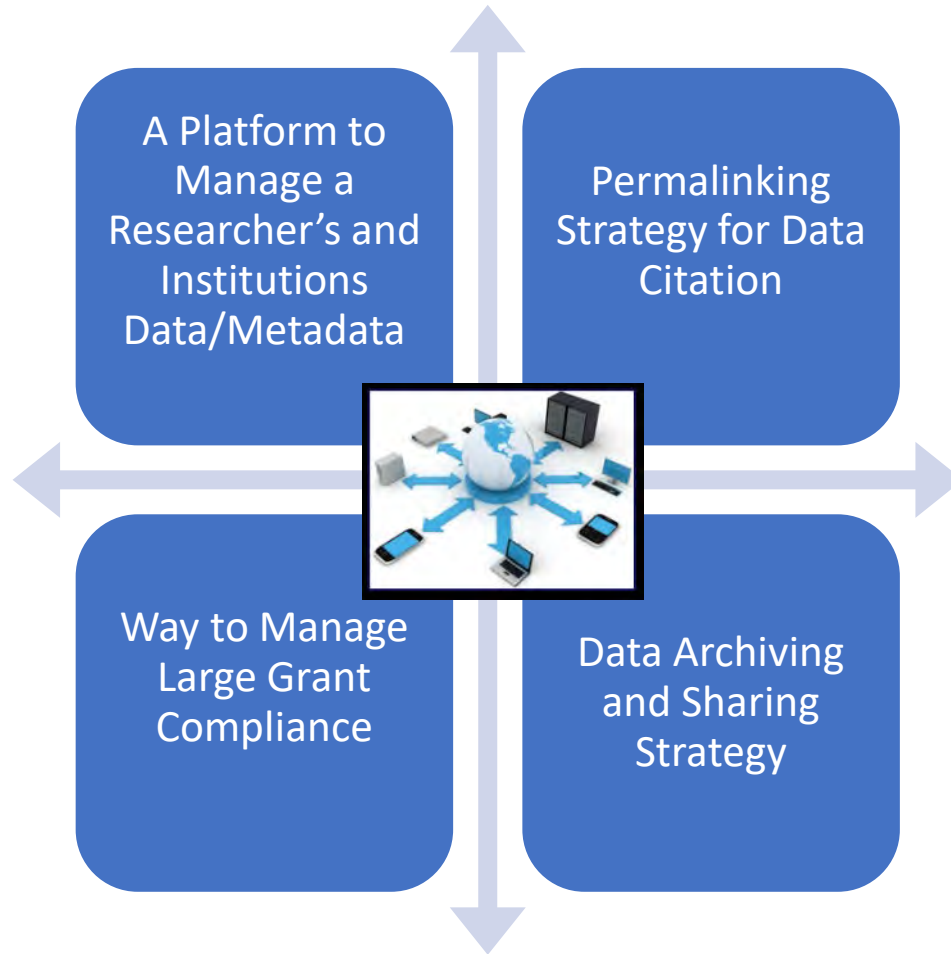
<http://data.tdl.org>

Clear Trajectory  
in Libraries from  
**Data** Collection  
To Data Science ->  
Data Repositories ->  
Data Analytics ->  
Data Visualization >  
**AI**






# What is an Online Data Research Repository?



# TEXAS RESEARCH DATA REPOSITORY

 **Texas Digital Library Test Dataverse** A statewide collaboration of higher education institutions in Texas


Metrics 26 Downloads


Share, publish, and archive your data. Find and cite data across all research fields.


Welcome to the Texas Digital Library Test Dataverse!


IMPORTANT: This Dataverse server does NOT include the [TwoRavens add-on](#).

Because of this, you may receive errors when ingesting certain datasets and the "explore" button will not work.

 **TRINITY UNIVERSITY**  
Trinity University Dataverse

 **utmb Health**  
Working together to save lives™  
UT Medical Branch Dataverse

 **TEXAS**  
University of Texas Dataverse

 **TEXAS STATE UNIVERSITY**  
Texas State University Dataverse

[Advanced Search](#)



Texas Digital Library Consortium of 22 universities across Texas  
leveraging technological cooperation among academic libraries

# Data Repositories Allow Building Skills For AI

Data Organization, Data Cleaning, Structured Data Citation, Sensitive Data and Metadata Schemas



OpenRefine is a powerful tool for working with data: (cleaning it)

## Harvard Dataverse Network

Search, Info, Chat, Create Acc

### REPLICATION DATA FOR: A MULTIVARIATE MODEL OF STRATEGIC ASSET ALLOCATION

hdl:1902.1/QBXRSFLBQJUNF:3:ZnYhHkZe2veTJAWaBDpPKA==

Version: 2 – Released: Thu Oct 03 16:46:32 EDT 2013

#### CATALOGING INFORMATION

Data & Analysis

Comments (0)

Versions

If you use these data, please add the following citation to your scholarly references. [Why cite?](#)

John Y. Campbell; Yeung L. Chan; and Luis Viceira, 2007, "Replication data for: A Multivariate Model of Strategic Asset Allocation", <http://hdl.handle.net/1902.1/QBXRSFLBQJUNF:3:ZnYhHkZe2veTJAWaBDpPKA==> The Harvard Dataverse Network [Distributor] V2 [Version]

Citation Format

Results found in this publication can be replicated using these data.

#### Original Publication


Campbell, John Y.; Chan, Yeung Lewis; and Viceira, Luis M., 2003, "A multivariate model of strategic asset allocation," *Journal of Financial Economics*, Elsevier, vol. 67(1), pages 41-80: [article available here](#)

#### Publications

John Y. Campbell & Yeung Lewis Chan & Luis M. Viceira, 2001. "A Multivariate Model of Strategic Asset Allocation," NBER Working Paper, National Bureau of Economic Research, Inc. [article available here](#)

Campbell, John Y & Chan, Yeung Lewis & Viceira, Luis M, 2001. "A Multivariate Model of Strategic Asset Allocation," CEPR Discussion Paper 3070, C.E.P.R. Discussion Papers. [article available here](#)

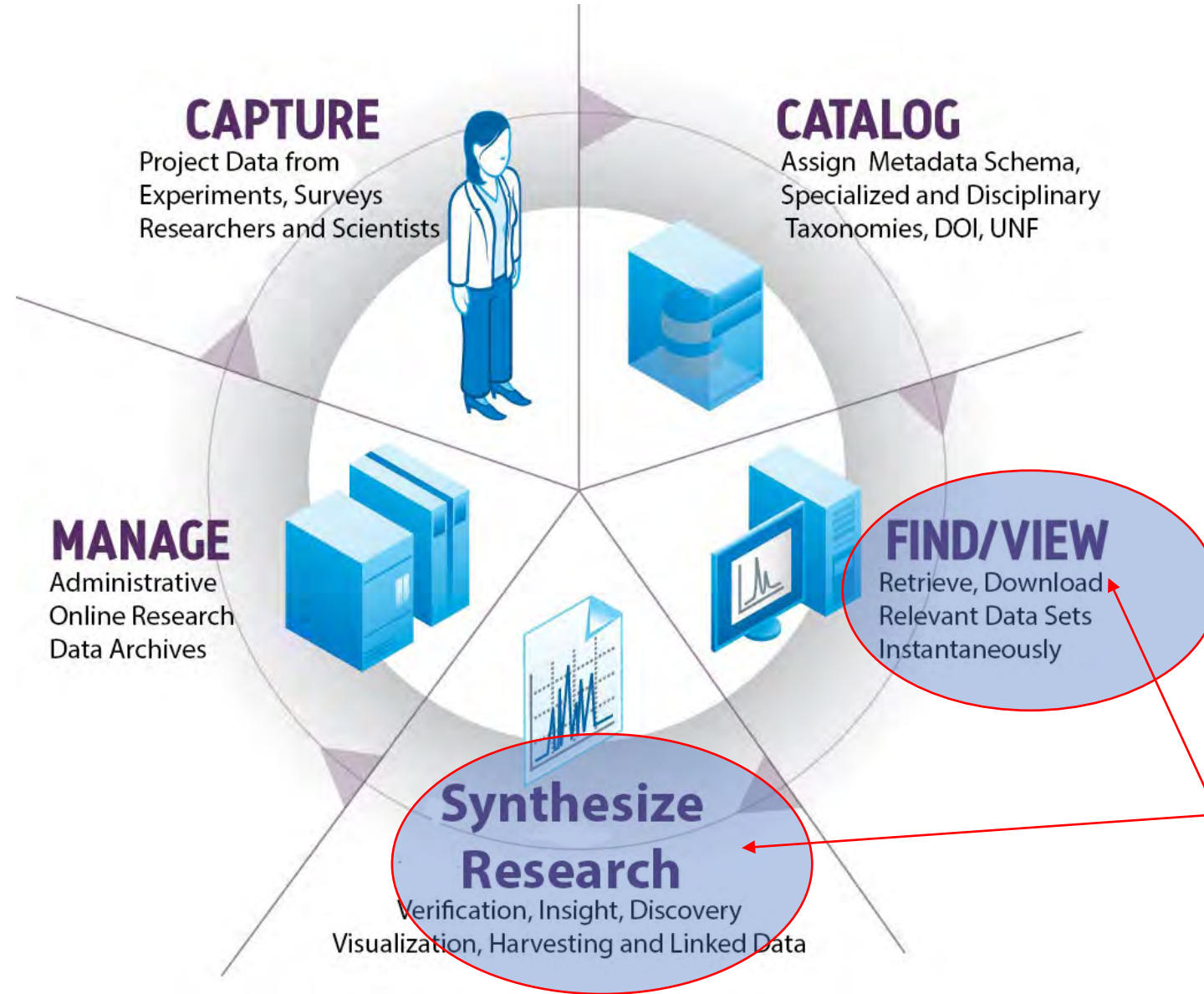
#### Data Citation Details

Title	Replication data for: A Multivariate Model of Strategic Asset Allocation
Study Global ID	hdl:1902.1/QBXRSFLBQJ
Authors	John Y. Campbell (Harvard University); Yeung L. Chan; and Luis Viceira
Producer	John Y. Campbell  HARVARD Faculty of Arts and Sciences DEPARTMENT OF ECONOMICS
Production Date	2003
Funding Agency	National Science Foundation; Hong Kong RGC Competitive Earmarked Research Grant (HKUST 6965/01H); Division of Research of the Business School



# The Research Data Repository Lifecycle

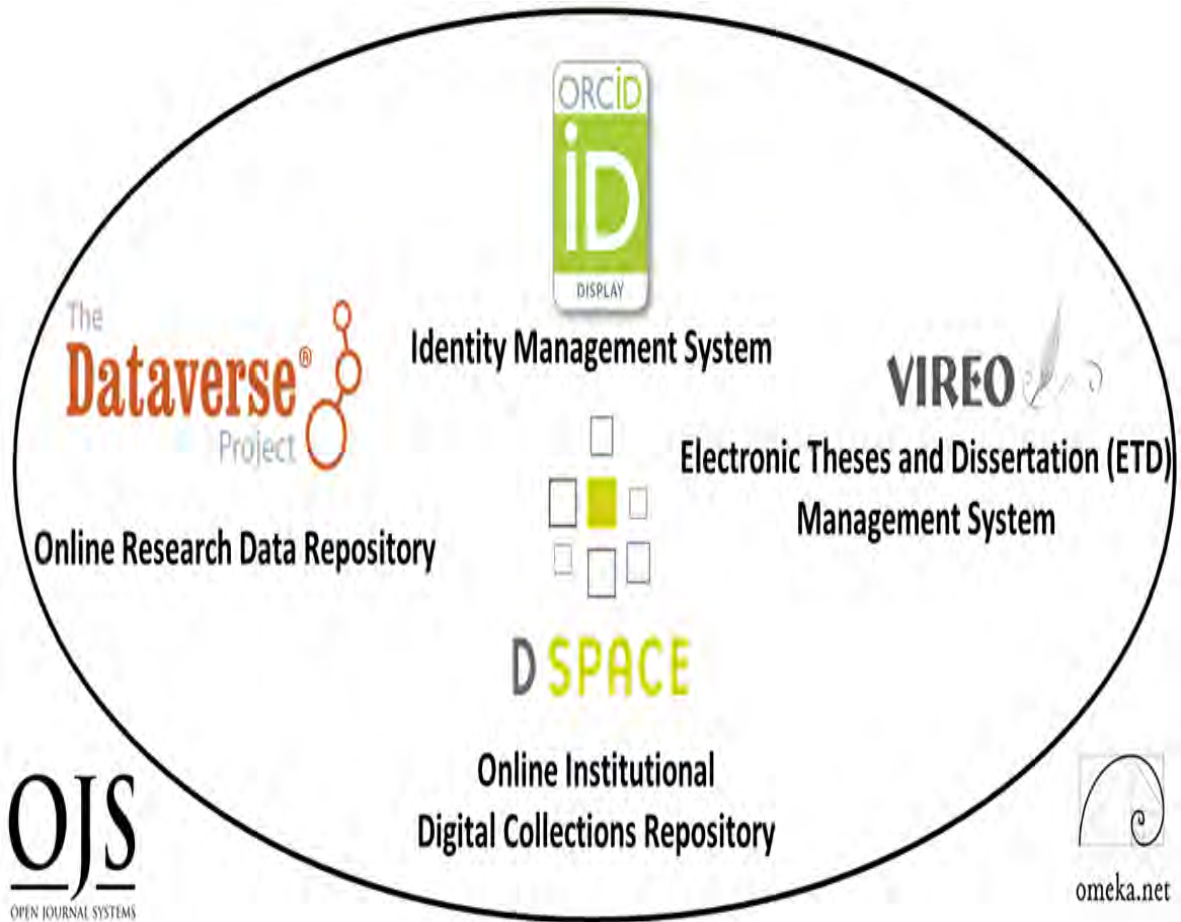
Setting Better Foundations & Organization for AI Infrastructures



Data Repository provides Basic AI, Machine Learning, Open Science and Research Needs.

# Recommendation #2: Digital Scholarship Ecosystems, Foundations for AI

## Six Open Source Software Components



### TWO PRIMARY COMPONENTS (Content)

- RESEARCH DATA REPOSITORY
- DIGITAL COLLECTIONS REPOSITORY

### FOUR TERTIARY COMPONENTS (Communication)

- Electronic Thesis and Dissertation Management System
- Identity Management System
- Open Academic Journal Software
- User Interface/Content Management Software

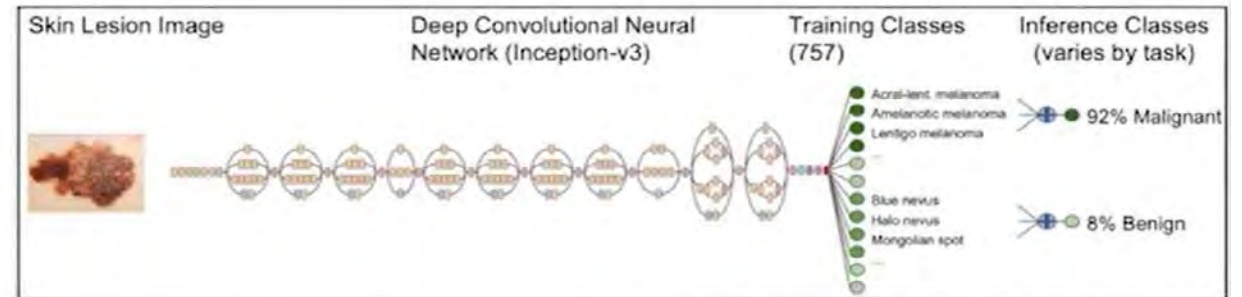
# Dermatologist-level Classification of Skin Cancer with Deep Neural Networks,

**Nature 2017**, Andre Esteva, Brett Kupress, Sebastian Thrun et al.

AI Models, Deep Learning, Convolutional Neural Nets, Labeled Medical Data from Image Data Archives

## Skin Cancer Diagnosis:

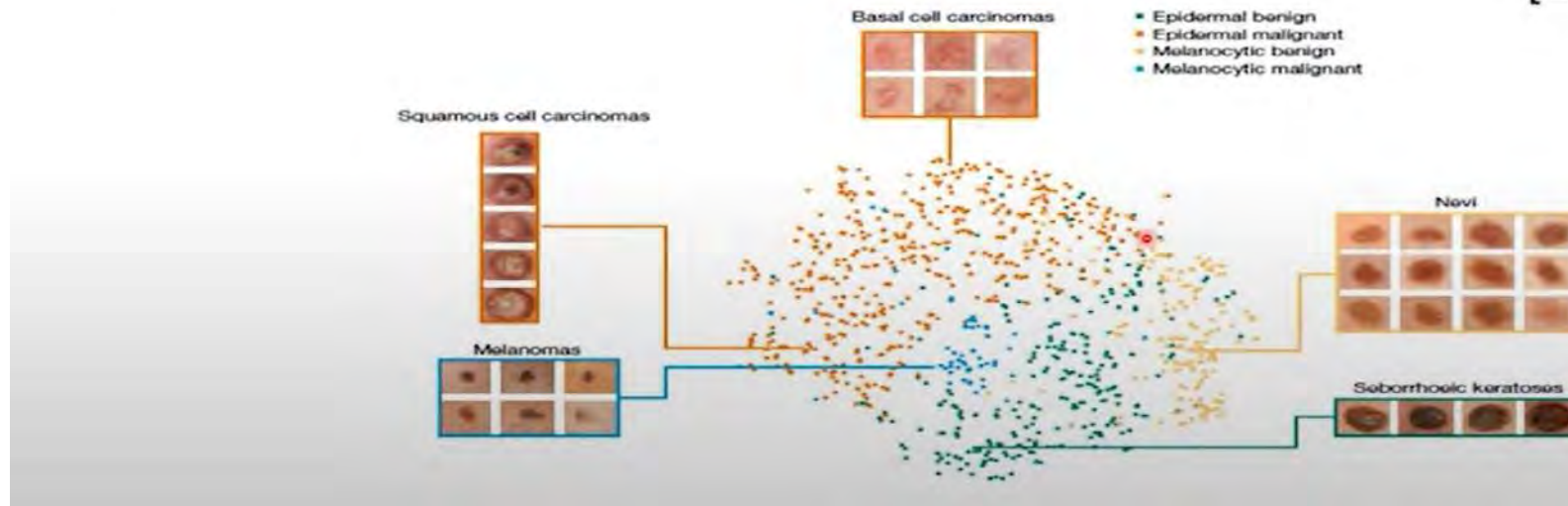
Trained on 1.4 M standard photographs  
Retrained on 129,450 skin images  
Deep net Inception v3 architecture  
Outperforms doctors



[Esteva et al., *Nature* 2017]

[Video](#)

[Stanford  
Overview](#)




Open Science, Data Research Repositories, Discovery and AI



# Dataverse Data Research Repository

Dermatology Image Dataset,  
Dr. Philip Tschandl, Vienneesse  
Dermatologist

- Great Example of Open Science
- <https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/DBW86T>




Add Data ▾ Search ▾ About User Guide Support Sign Up Log In

ViDIR Dataverse  
(Medical University of Vienna)

Harvard Dataverse > ViDIR Dataverse >

## The HAM10000 dataset, a large collection of multi-source dermatoscopic images of common pigmented skin lesions

Version 3.0



Tschandl, Philipp, 2018, "The HAM10000 dataset, a large collection of multi-source dermatoscopic images of common pigmented skin lesions", <https://doi.org/10.7910/DVN/DBW86T>, Harvard Dataverse, V3, UNF:6/APKSsDGVDhwPBWzsStU5A== [fileUNF]

Cite Dataset ▾ Learn about Data Citation Standards.

Access Dataset ▾

Contact Owner Share

Dataset Metrics ⓘ  
58,334 Downloads ⓘ

Description ⓘ

Training of neural networks for automated diagnosis of pigmented skin lesions is hampered by the small size and lack of diversity of available dataset of dermatoscopic images. We tackle this problem by releasing the HAM10000 ("Human Against Machine with 10000 training images") dataset. We collected dermatoscopic images from different populations, acquired and stored by different modalities. The final dataset consists of 10015 dermatoscopic images which can serve as a training set for academic machine learning purposes. Cases include a representative collection of all important diagnostic categories in the realm of pigmented lesions: Actinic keratoses and intraepithelial carcinoma / Bowen's disease ( **akiec** ), basal cell carcinoma ( **bcc** ), benign keratosis-like lesions (solar lentigines / seborrheic keratoses and lichen-planus like keratoses, **bkl** ), dermatofibroma ( **df** ), melanoma ( **mel** ), melanocytic nevi ( **nv** ) and vascular lesions (angiomas, angiokeratomas, pyogenic granulomas and hemorrhage, **vasc** ).

Files Metadata Terms Versions

Search this dataset...



Filter by

File Type: All ▼

Access: All ▼

1 to 6 of 6 Files

		<a href="#">HAM10000_images_part_1.zip</a> ZIP Archive - 1.3 GB Published Jun 4, 2018 15,433 Downloads MD5: 463..e46
		<a href="#">HAM10000_images_part_2.zip</a> ZIP Archive - 1.3 GB Published Jun 4, 2018 11,809 Downloads MD5: da4..84b
		<a href="#">HAM10000_metadata.tab</a> Tabular Data - 810.9 KB Published Jan 29, 2021 5,938 Downloads 8 Variables, 10015 Observations UNF:6:WcXi...myQ==

# Metadata and Image Data for Download From Data Repository

# BRAC University Dhaka, Bangladesh Institutional Repository

Digital Collections  
Repository

Dspace  
<http://dspace.bracu.ac.bd/>



Institutional Repository

BracU IR / School of Data and Sciences (SDS) / Department of Computer Science and Engineering (CSE) / Thesis & Report, BSc (Computer Science and Engineering) / View Item

## An efficient deep learning approach to detect skin Cancer



View/Open  
20341030, 19141024,  
16141014\_CSE.pdf (2.208Mb)

Date  
2021-09

Publisher  
Brac University

Author  
Islam, Ashfaqu  
Khan, Daiyan  
Chowdhury, Rakeen Ashraf

Metadata  
Show full item record

### URI

<http://hdl.handle.net/10361/15932>

### Abstract

Each year, millions of people around the world are affected by cancer. Research shows that the early and accurate diagnosis of cancerous growths can have a major effect on improving mortality rates from cancer. As human diagnosis is prone to error, a deep-learning based computerized diagnostic system should be considered. In our research, we tackled the issues caused by difficulties in diagnosing skin cancer and distinguishing between different types of skin growths, especially without the use of advanced medical equipment and a high level of medical expertise of the diagnosticians. To do so, we have implemented a system that will use a deep-learning approach to be able to detect skin cancer from digital images. This paper discusses the identification of cancer from 7 different types of skin lesions from images using CNN with Keras Sequential API. We have used the publicly available HAM10000 dataset, obtained from the Harvard Dataverse. This dataset contains 10,015 labeled images of skin growths. We applied multiple data pre-processing methods after reading the data and before training our model. For accuracy checks and as a means of comparison we have pre-trained data, using ResNet50, DenseNet121, and VGG11, some well-known transfer learning models. This helps identify better methods of machine-learning application in the field of skin growth classification for skin cancer detection. Our model achieved an accuracy of over 97% in the proper identification of the type of skin growth.

### Keywords

Cancer detection; Convolutional neural networks; Image classification; Deep learning

### LC Subject Headings

Machine learning; Cognitive learning theory (Deep learning)

### Description

This thesis is submitted in partial fulfillment of the requirements for the degree of Bachelor of Science in Computer Science and Engineering, 2021.

### POLICY GUIDELINES

- BracU Policy
- Publisher Policy

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☐ This Collection

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- Table of Contents
- List of Figures
- List of Tables
- Nomenclature
- Introduction
- Related Work
- Different Types of Skin Cancer
- Dataset Description
- Dataset Pre-processing
- Model Training
- Model Building and Evaluation by CNN Model using Keras Sequential API
- Model Building and Evaluation using RESNET50
- Model Building and Evaluation using DENSENET121
- Model Building and Evaluation using VGG11
- Conclusion
- Bibliography

# An Efficient Deep Learning Approach to Detect Skin Cancer

by

Ashfaquul Islam  
20341030

Daiyan Khan  
19141024

Rakeen Ashraf Chowdhury  
16141014

A thesis submitted to the Department of Computer Science and Engineering  
in partial fulfillment of the requirements for the degree of  
B.Sc. in Computer Science

Department of Computer Science and Engineering  
Brac University  
September 2021

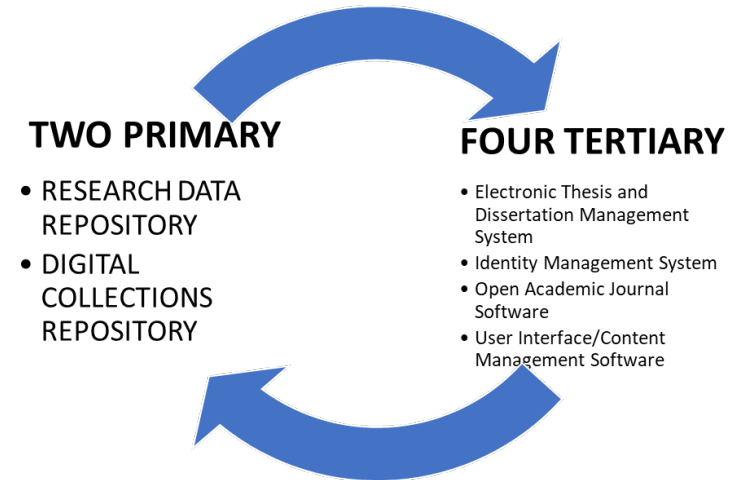
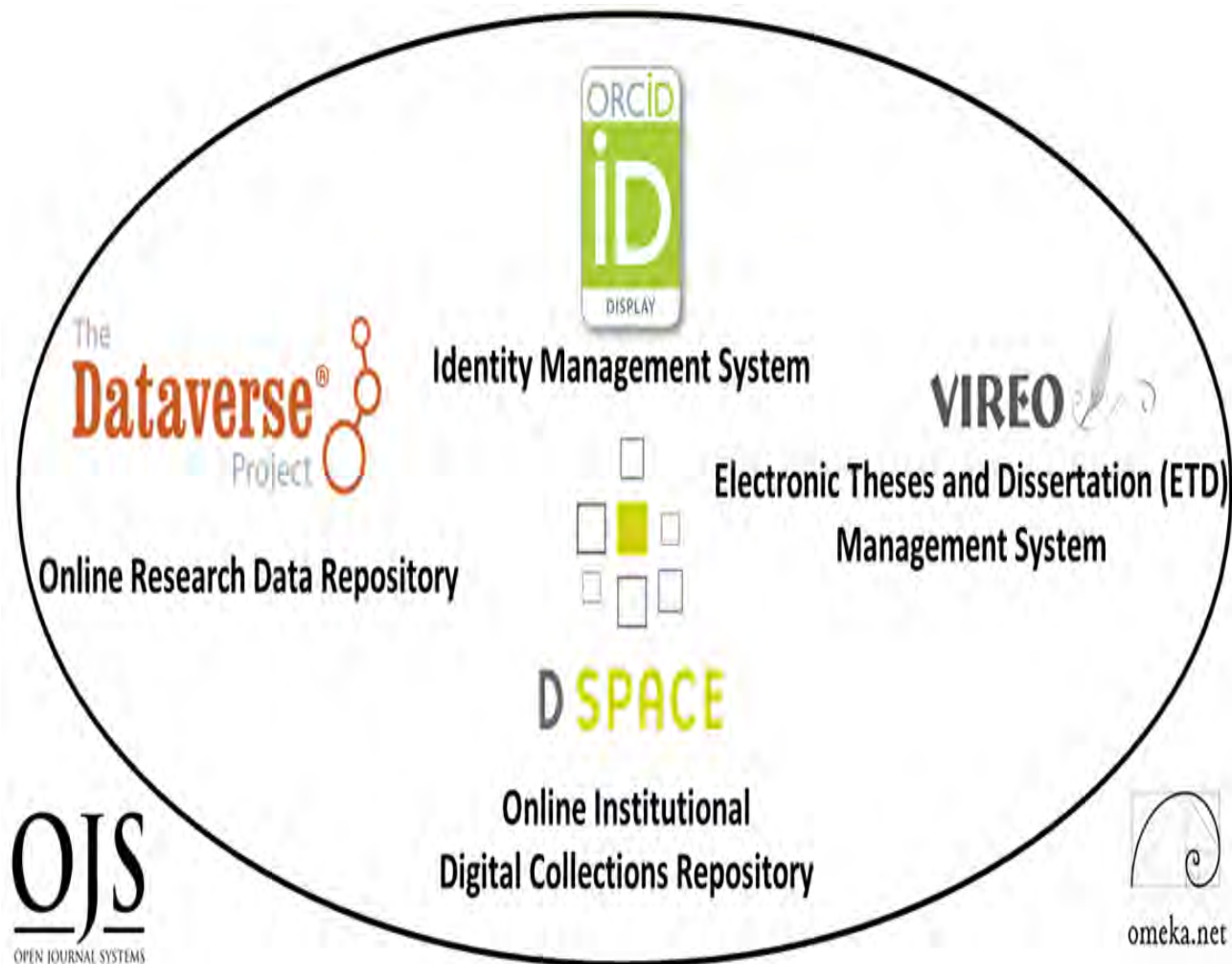
**The Progress of Knowledge**

**2017 Stanford Nature Deep Learning Cancer ID Article**

**2018 Harvard Dataverse Datarepository Upload**  
Open Source Vienneesse Dermatological Image Library

**November 2021**  
Dspace Repository  
Undergraduate Thesis  
BRAC University, Dhaka  
Bangladesh, Dept. of  
Computer Science and  
Engineering  
**Downloaded July 2022**

# Digital Scholarship Ecosystem Centered on Research Data Repository and Collections Repository



**Many Useful Data Science Skills for AI Will Be Useful Here**

Metadata Schemas

Data Organization

Data Cleaning

Data Classification

Creating Dataset Benchmarks

Standardization of Data

# Part II: Human Resource Infrastructures (Working Teams)



## Future Hires

Machine Learning/Deep Learning/AI Specialist/ Data Scientist and/or AI Librarian (working with the data)

Data Visualization and Analytics Specialist  
(Tableau, Bayesia, Power BI)

## Committee for Data Repository Workflows & Policies

## Onsite Staff Skills

Metadata Specialist/Cataloger  
Data Repository Faculty/Student Liaison  
Subject Liaisons (Outreach)

## Current Staff

### Digital Collections Librarian

(Texas State Data Repository Librarian

Dataverse/Publications Repository: D-Space)





# DATA VISUALIZATION & ANALYTICS SPECIALIST

Texas State University Libraries is seeking Data Visualization & Analytics Specialist to provide library-wide support for data visualization and data analytics projects to support data-driven decision making and finding insights. This position requires a higher level of technology expertise and specialized knowledge to gather, manage, and analyze data and report complex data in easy-to-understand information visualizations.

**RESPONSIBILITIES:** Develop and maintain a data visualization and analytics strategy. Develop strategies to clean and normalize data for use in further analysis. Utilize data visualization strategies to report and present analytics and answer questions related to data analytics and data visualization. Pursue professional development activities to improve knowledge, skills, and abilities and perform special projects and other duties as needed.

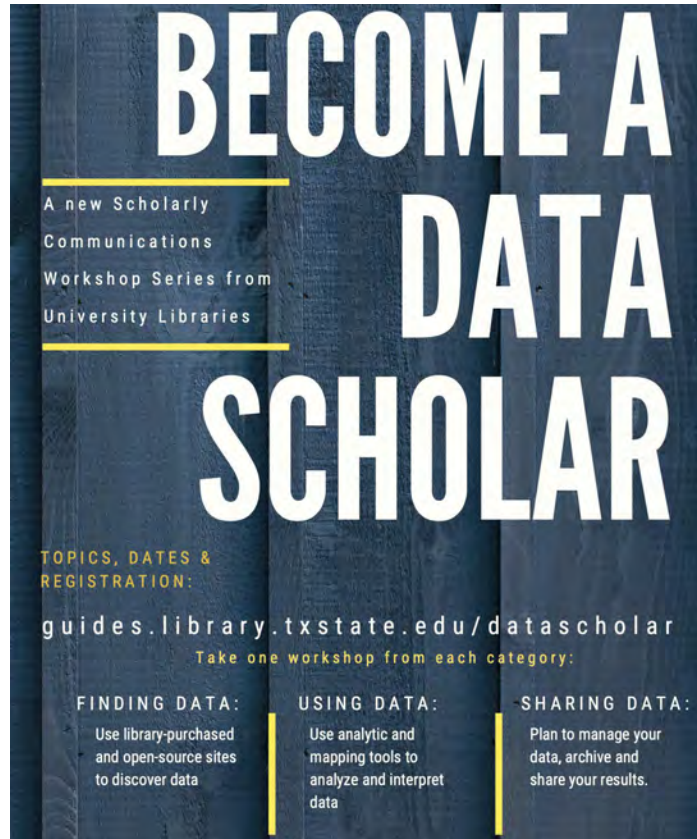
## QUALIFICATIONS:

- Required:** Ability to read, analyze, and understand data in a variety of formats; strong written, oral, and interpersonal skills, including ability to work effectively in a team; knowledge of data visualization applications such as PowerBI, Tableau or others; analytical skills; proficiency with Microsoft Excel; ability to utilize analytics/visualization tools in new, creative, and effective ways.
- Preferred:** Degree in information science, applied statistics, business analytics, computer science or another quantitative or data visualization field; experience with SQL or other query language; experience with R, Python, statistical analysis languages, predictive analytics, and/or AI software.

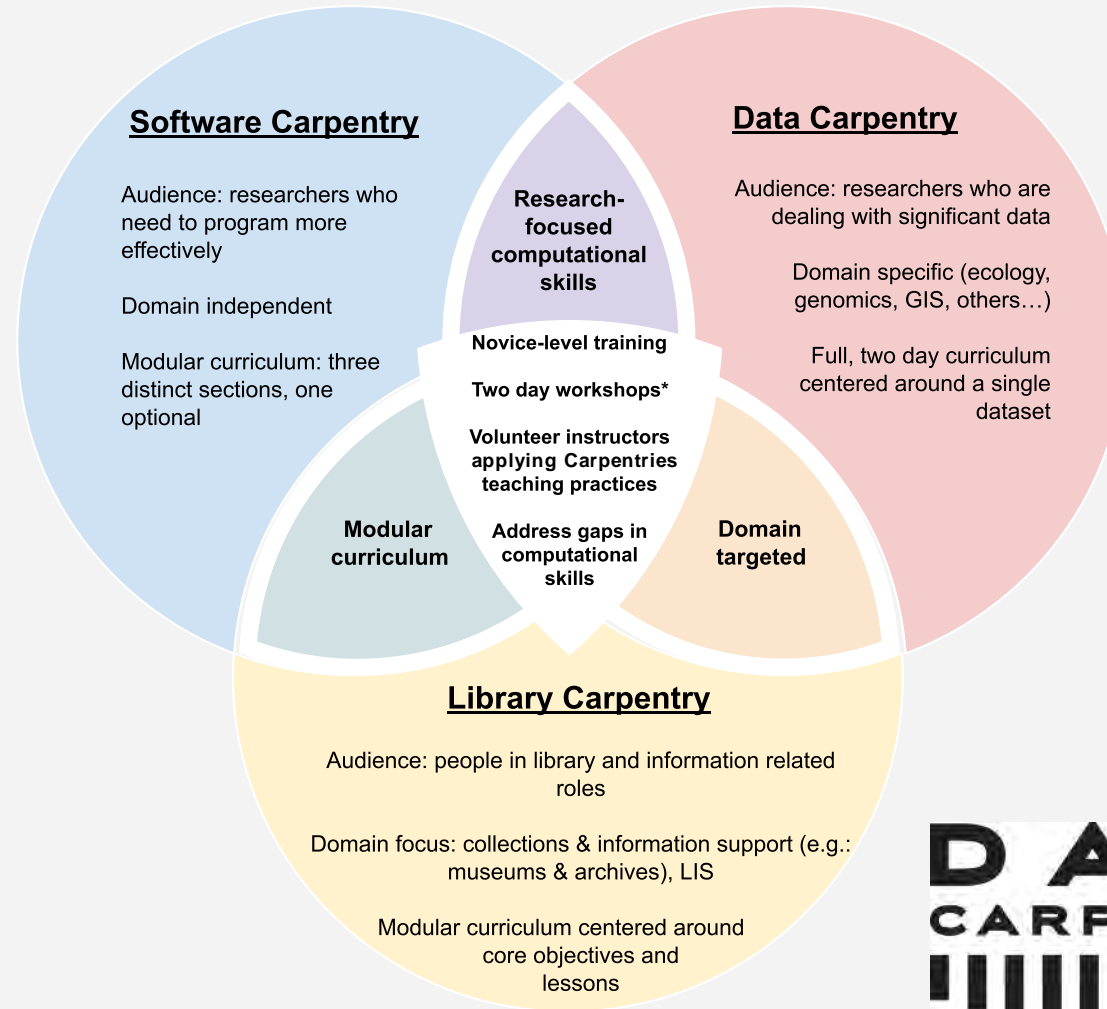


# Further Learning Paths: Data to Carpentries

## Foundational Coding and Data Science Skills for researchers Worldwide



Libraries Can  
Host Carpentry  
Workshops



<https://carpentries.org/>



# Conferences and Learning

Library IT and Digital Services May Be Getting Interested in AI



## Fantastic Futures

2<sup>nd</sup> International Conference on AI  
for Libraries, Archives and Museums  
Stanford Libraries (2019)

## Artificial Intelligence

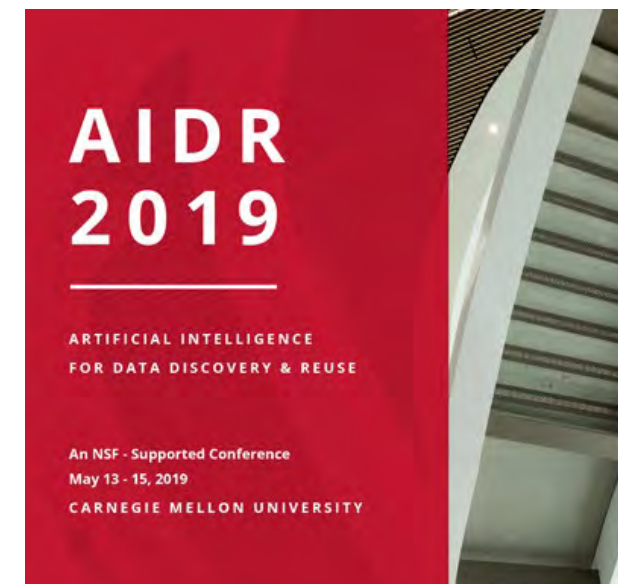
for Data Discovery  
& ReUse & Open Science  
Symposium (2020), Carnegie Mellon



## Texas Conference on Digital Libraries,

Patrice Andre Prud'homme (TCDL)  
Oklahoma State,

Computers in Libraries, Yale Art  
History, Pixplot (Image Categorization, CNI, C





# R&D & Learning, Area 1: Digital and Web Services

Deep Learning Models and Convolutional Neural Nets

- **University Archives**

San Marcos Public  
Newspaper Image Negatives  
90 years of digitization 800, 000 images

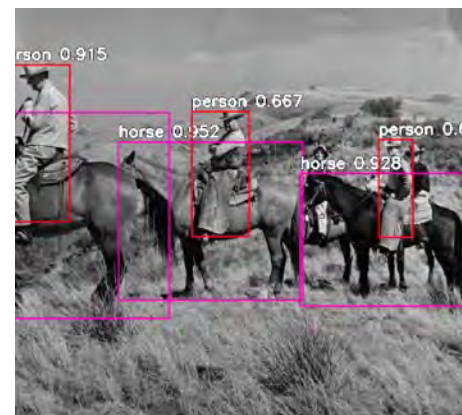
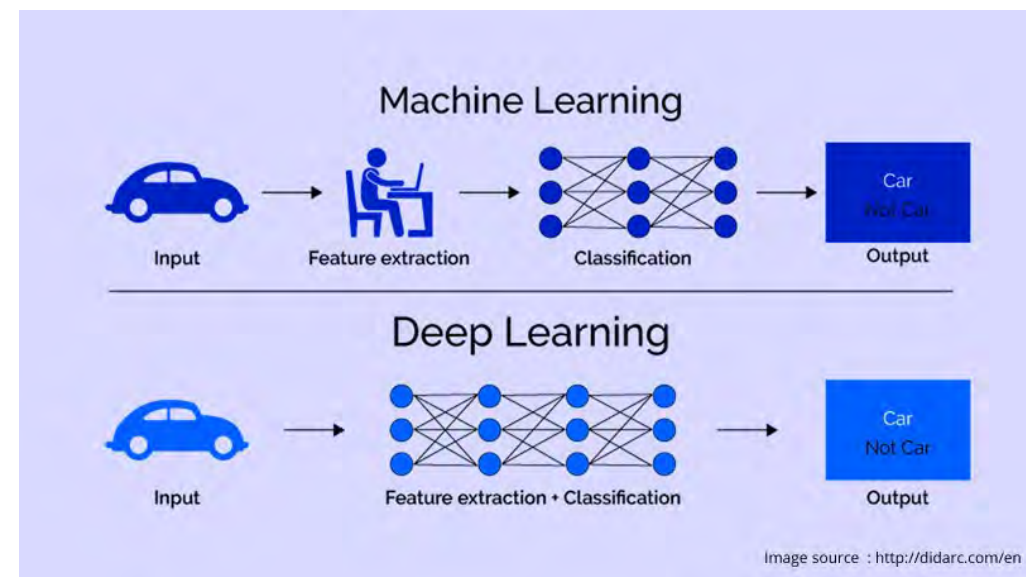
- **Processing Power**  
(Compute)

- **Python**

- **Video Cards**  
(NVIDIA GPU's)

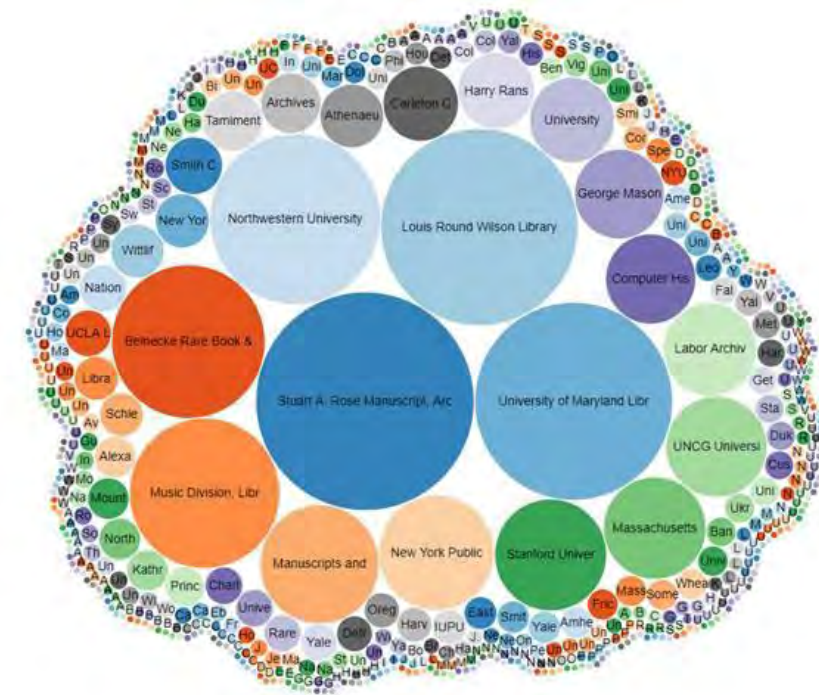
- **Pretrained Models**

- **ResNet, YOLO, COCO**  
(200k labeled images, 80 categories)



## Area II: Metadata, Wikidata, Semantic Web, AI

- Metadata Services Cataloger
- Crosswalking between Systems
- Successful Linked Data Project  
Wikidata Semantic Web Project: Faculty, Oral History Collections, Wittliff Archives, OJS Journals  
(Data that is Machine Readable, ie. Google etc)  
Moving from MARC Silos to Online (Wikidata)
- Learning Many Data Science Skills, Data Models, Data Batch & Cleaning Tools: OpenRefine, Quickstatements, Python (7 staff)





**WIKIDATA**

Project page | Discussion | Read | Edit | View history

# Wikidata:WikiProject PCC Wikidata Pilot/Texas State University Libraries

< Wikidata:WikiProject PCC Wikidata Pilot

A WikiProject for work performed by Texas State University Libraries Staff under the PCC Wikidata Pilot.

<b>Contents</b> [hide]	
1	Aim and Scope
2	Projects
3	Contributors
4	Models for Current Faculty
4.1	Basic statements
4.2	Extended statements
5	Models for Wittliff Archival Collections
5.1	Basic statements
5.2	Extended statements
6	Models for University Archives Oral History Collections
6.1	Basic statements
6.2	Extended statements
7	Models for Digital Collections Journal Project
7.1	Basic statements
7.2	Extended statements
8	Queries
9	Useful Resources

# Workshops and Training IDEA Institute on Artificial Intelligence

(Recommendation Letter, July, 2022)

- Week Long Fellows Program at University of Texas Austin (20 Fellows)
- Onboarding, Institute, Library Centered AI, Final Project
- Networking with National Library AI Experts and Other Fellows



- AI challenges and opportunities, Ethical considerations and guidelines
- UX-Human/AI Interaction Lifecycle
- Existing library, archive, and museum projects
- AI project planning
- Project Design
- Data collection, classification, and transformation
- Roles and implementation
- Python Basics, Python for Machine Learning
- APIs and bibliometrics
- AI in search and discovery
- Machine learning and coding
- Harvesting, evaluating, and training data sets for use in AI
- Conversational AI – Theoretical foundations
- Conversational AI – applications
- Linked open data Machine learning for text with topic modeling and clustering

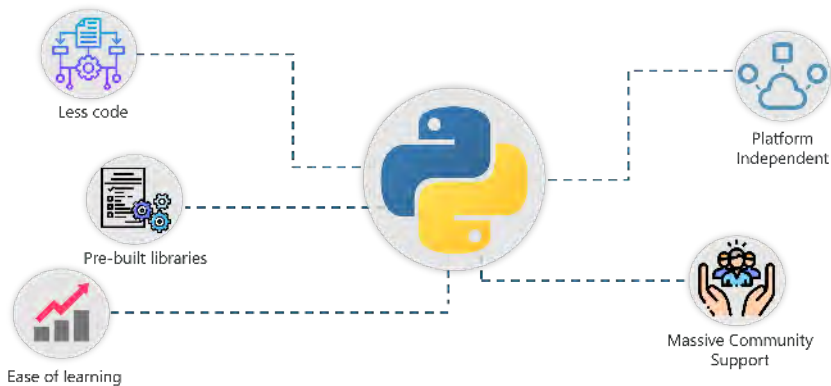




# Steps Towards AI: Learning Python, Spring 2022

Hi Ray,

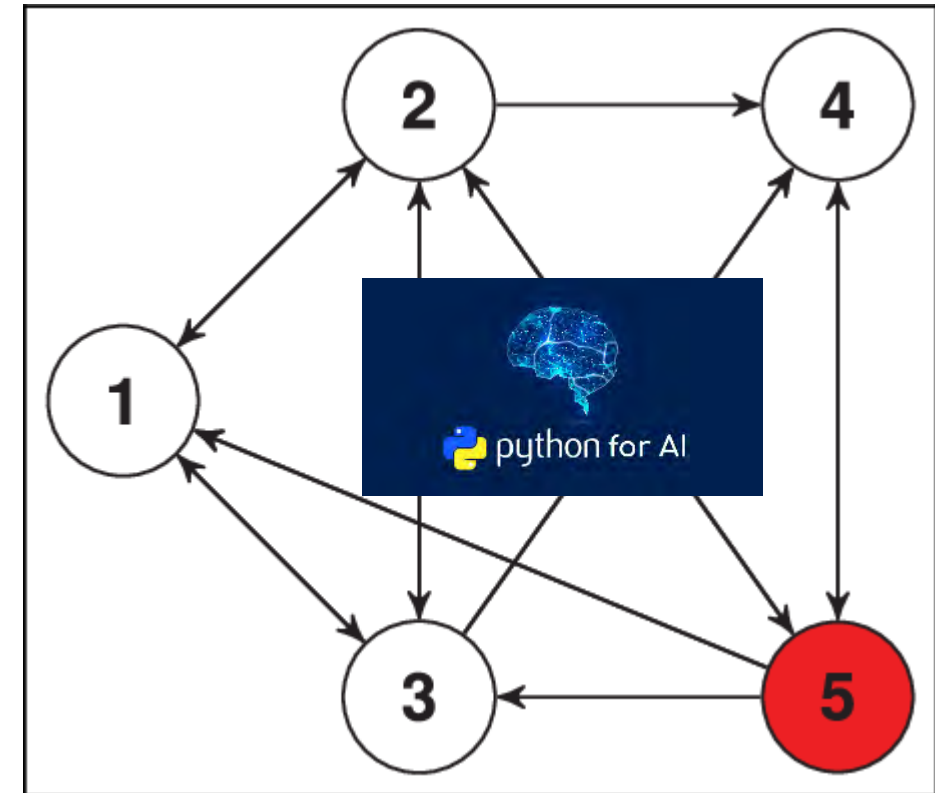
I wanted to let you know that we've started a Teams Group for myself, Carol, Alex and Amanda named "Python learners" so we could share tips and help each other on our various learning paths in an encouraging, safe space. 😊 ---Mary



Courses: Getting up to Speed with Python, Python and Machine Learning  
Why Python for AI? – Artificial Intelligence with Python

Carol, Library Management  
System (LMS) Usage Data Insights

Mary,  
Metadata  
AI Extraction



Alexandria  
Collections Analytics, Data  
Visualization

Amanda,  
Collections  
Budget,  
Insight and  
Analytics

Todd/Jason  
Image  
Recognition  
Neural Nets  
Part II?

# Area III: Ocelot Chatbot Administrator



Transformation of Research and  
Information Outreach Services  
(Reference & Subject Librarians)



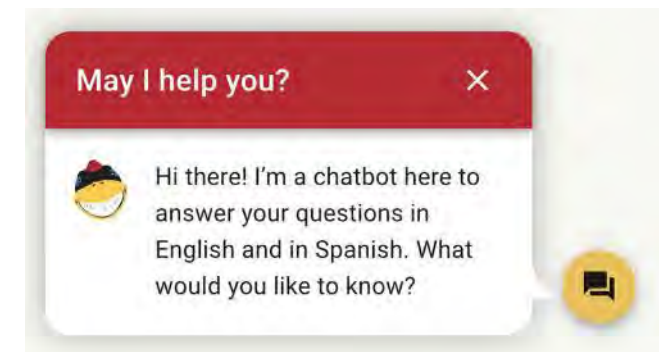
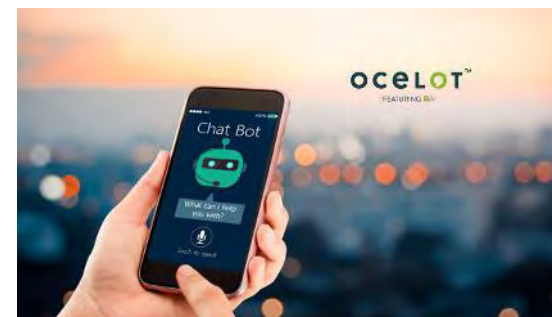
University IT Adopts New Ocelot  
Chatbot Infrastructure



Digital and Collection Services  
receives New Libraries  
Chatbot Administrator



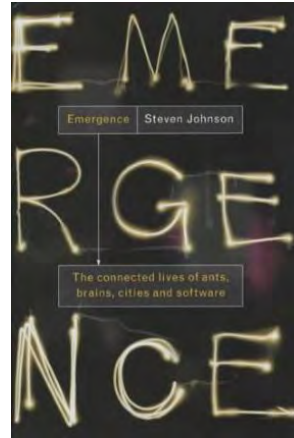
Future Natural Language  
Processing R&D  
(GPT3-4, DeepMind Gopher)



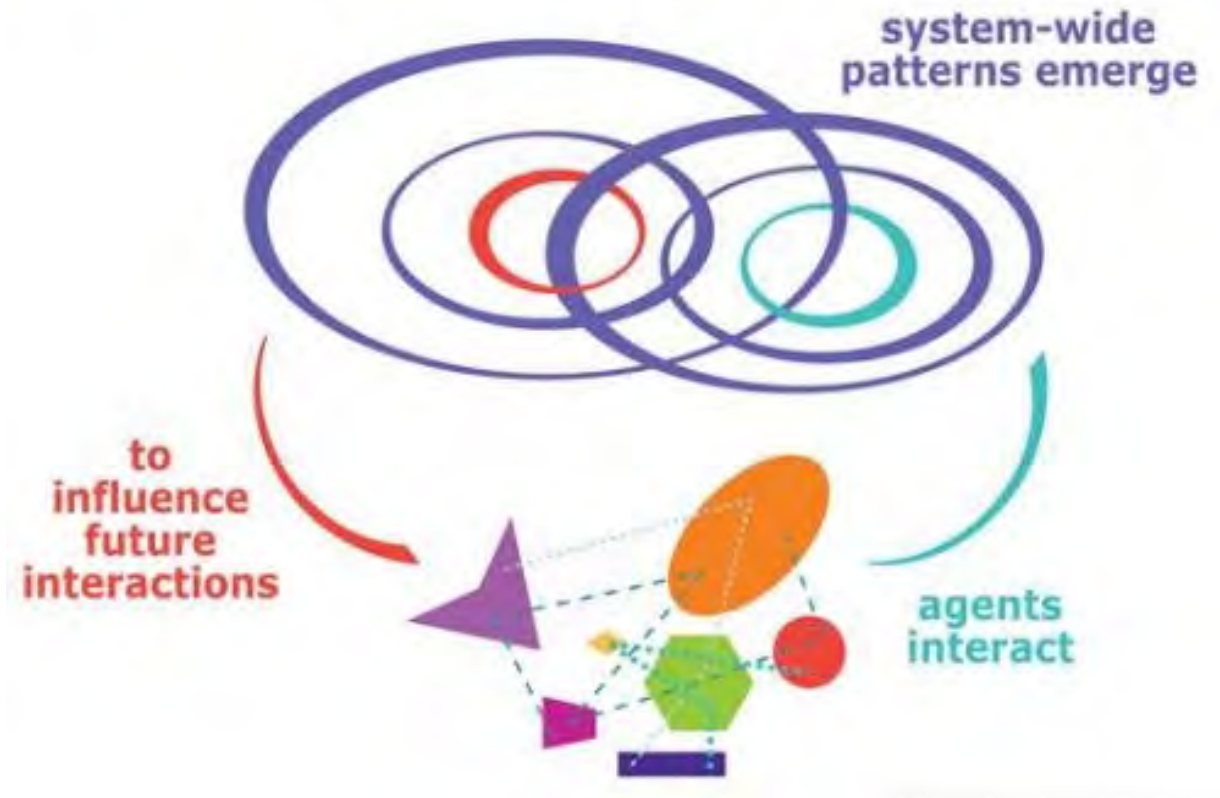


# Libraries are Complex Adaptive Non-Linear Dynamic Systems

Emergence, Chaos Theory Complexity, Genetic Algorithms



- Complex Adaptive System (CAS)





# TEXAS STATE AI WORKING GROUP

## (AIWG)



**Purpose:** An AI Working Group, information sharing, direction, responsibility and accountability for:  
1) Artificial Intelligence Projects, Policy  
Ethics related discussions



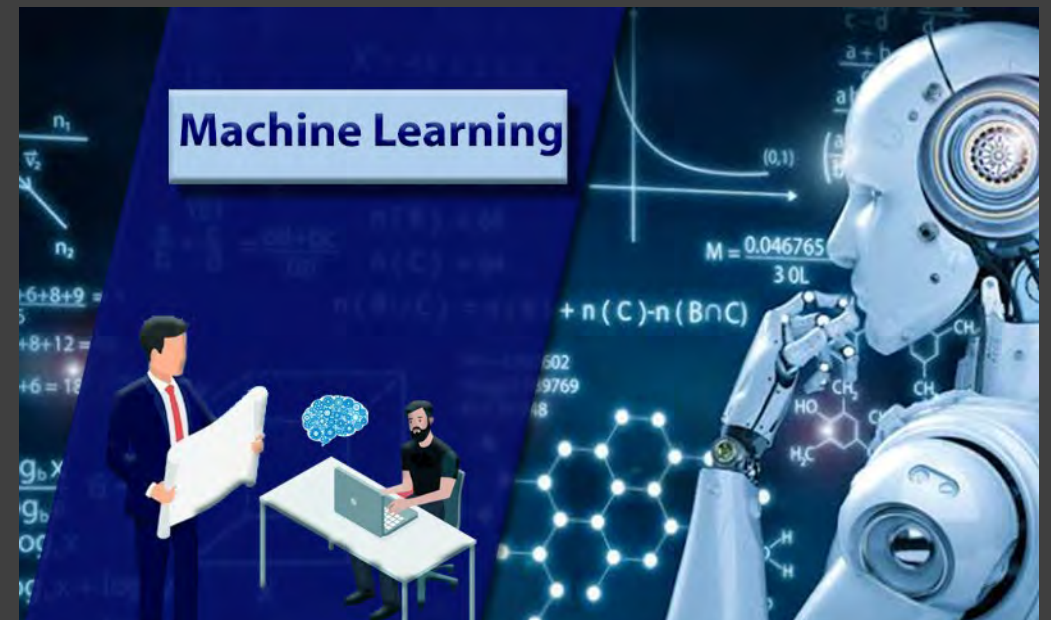
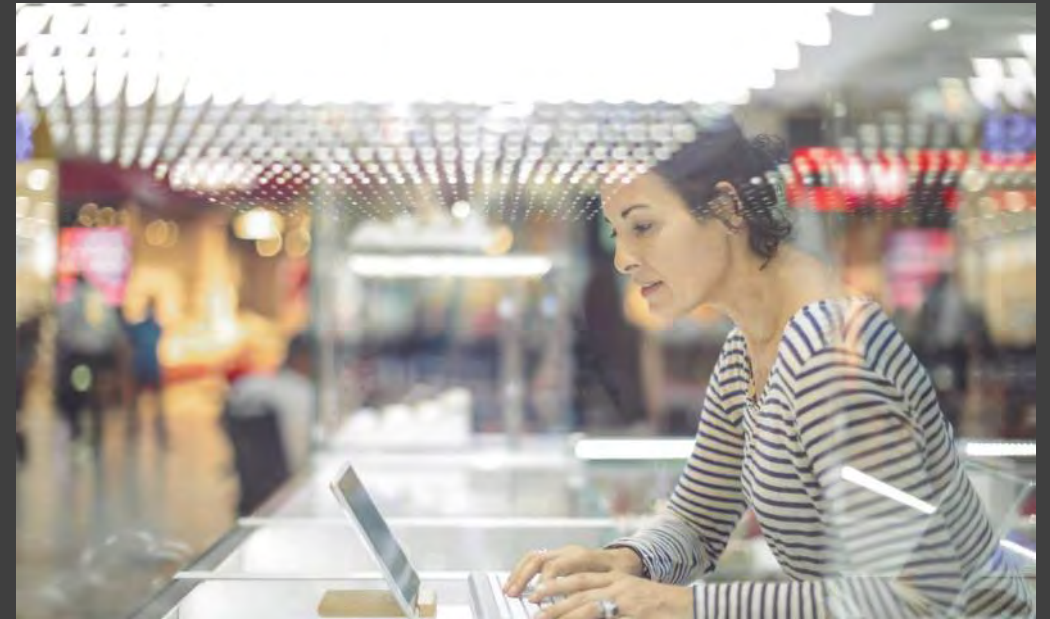
**Membership:** Metadata, Acquisitions, Digital Services, Special Collections, New Technologies, and Research Services. (9-10 Staff).



# Next Steps: A Graduate Student or Two

- Any University Engineering School or Computer Science Department Will Have Graduate Students and Courses Like This:
- E5331 – [Machine Learning for Engineering Applications](#) (2019-2021) [*Listed Fall – 2022*]
- EE4331 – [Intro to ML for Engineering Applications](#) (2020-2021) [*Listed Fall – 2022*]

Form a Relationship with the Electrical Engineering Professor and Hire His Graduate Student to Help with your team as part of their final project, graduate theses or part time Research Assistant to provide computational assistance and resources. These can be Masters Candidates or good advanced undergraduate students.



# Future Steps: AI Postdoctoral Fellows and Permanent Library AI Positions

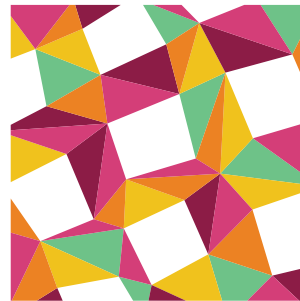
Postdoctoral Fellowship Program offers recent AI/Machine Learning related Ph.D. graduates the chance to develop research tools, resources, and services while exploring new career opportunities and opening Library possibilities.



<https://www.clir.org/>

<https://www.clir.org/global/>

Postdoctoral AI Fellows work with library staff, faculty and graduate students on library related projects that forge and strengthen connections among library collections, archives, special collections digital technologies, and their current AI research and skills.



**CLIR**  
POSTDOCTORAL  
FELLOWSHIP  
PROGRAM

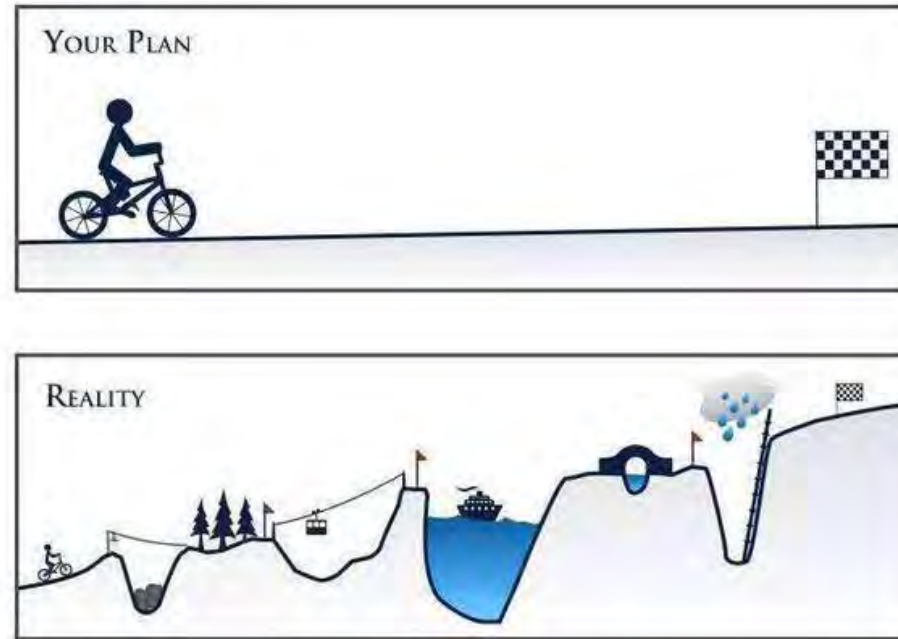
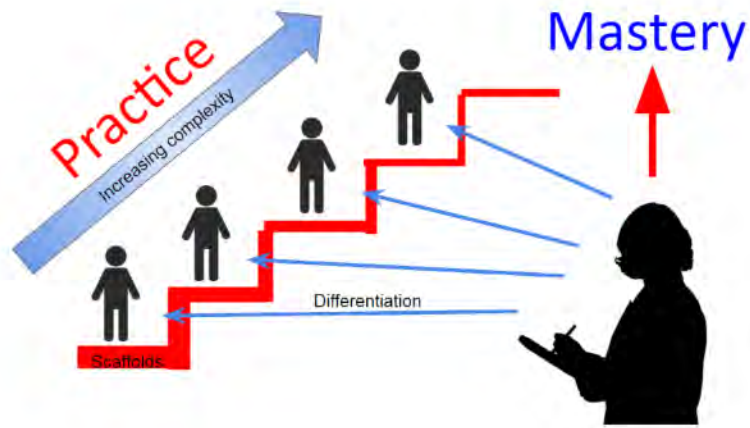
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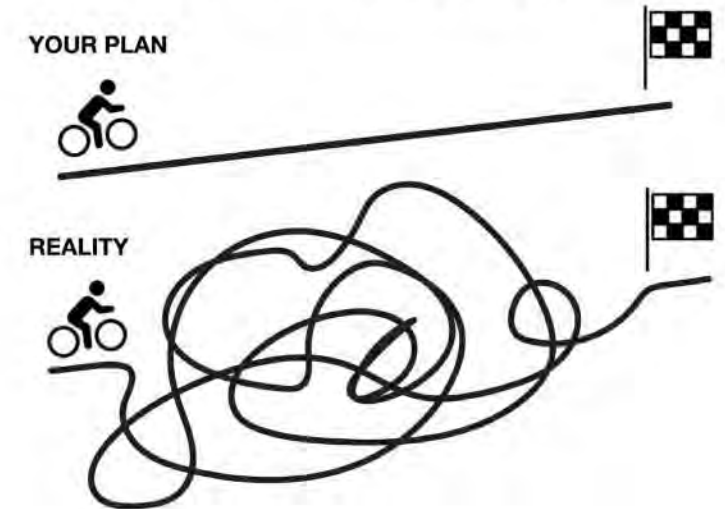
<https://haira.clir.org/blog/>



# Steps and Ideas For Scaffolding Towards Library AI Projects and Foundational Infrastructure Success



What reaching success looks like:



# Questions/Comments



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## General AI Video Overviews/Introductions

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