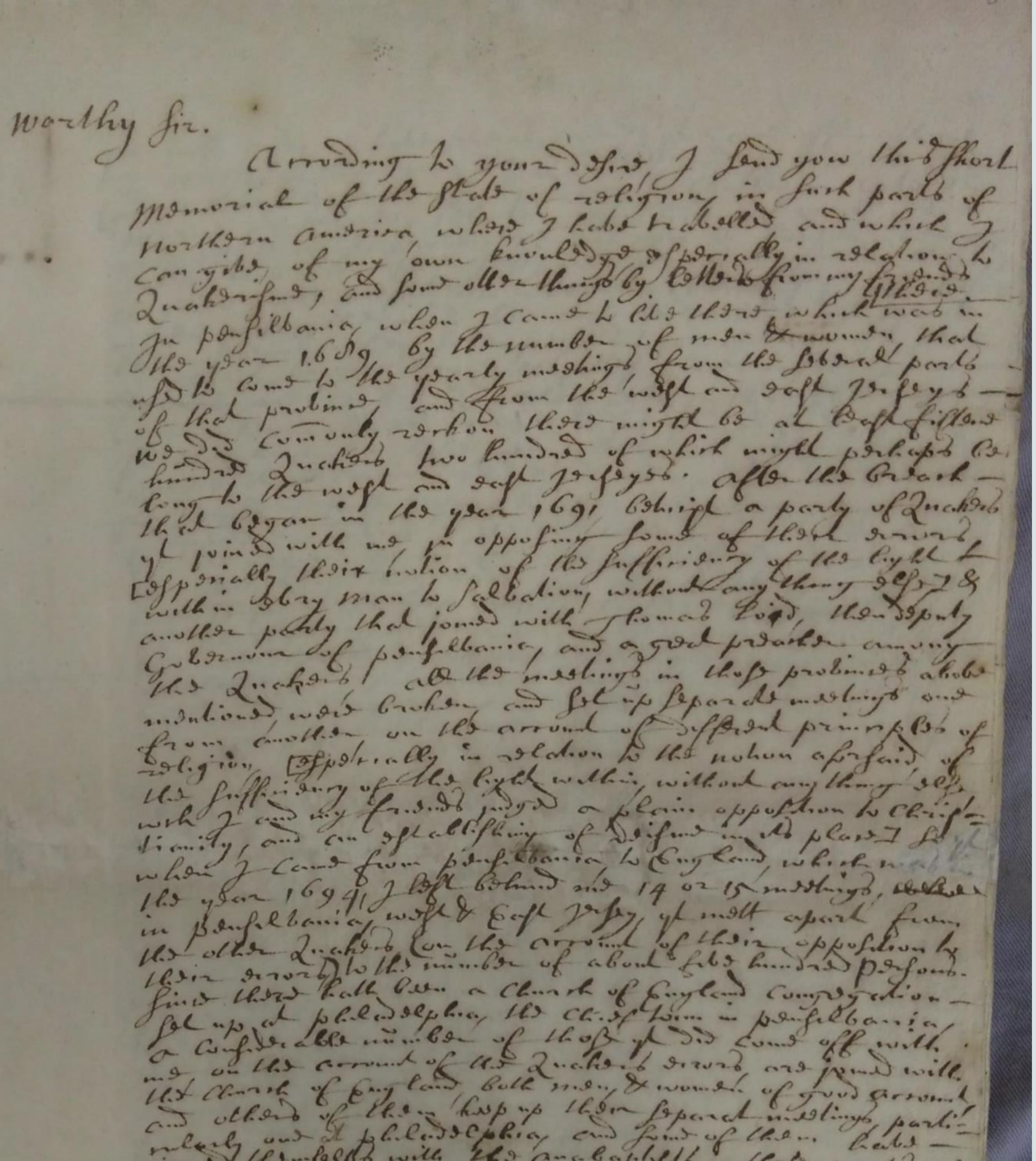
Handwritten Text Recognition: Using AI to make 18th-Century Missionary Records Publicly Accessible

Peter Walker (History)
Melissa Morris (History)

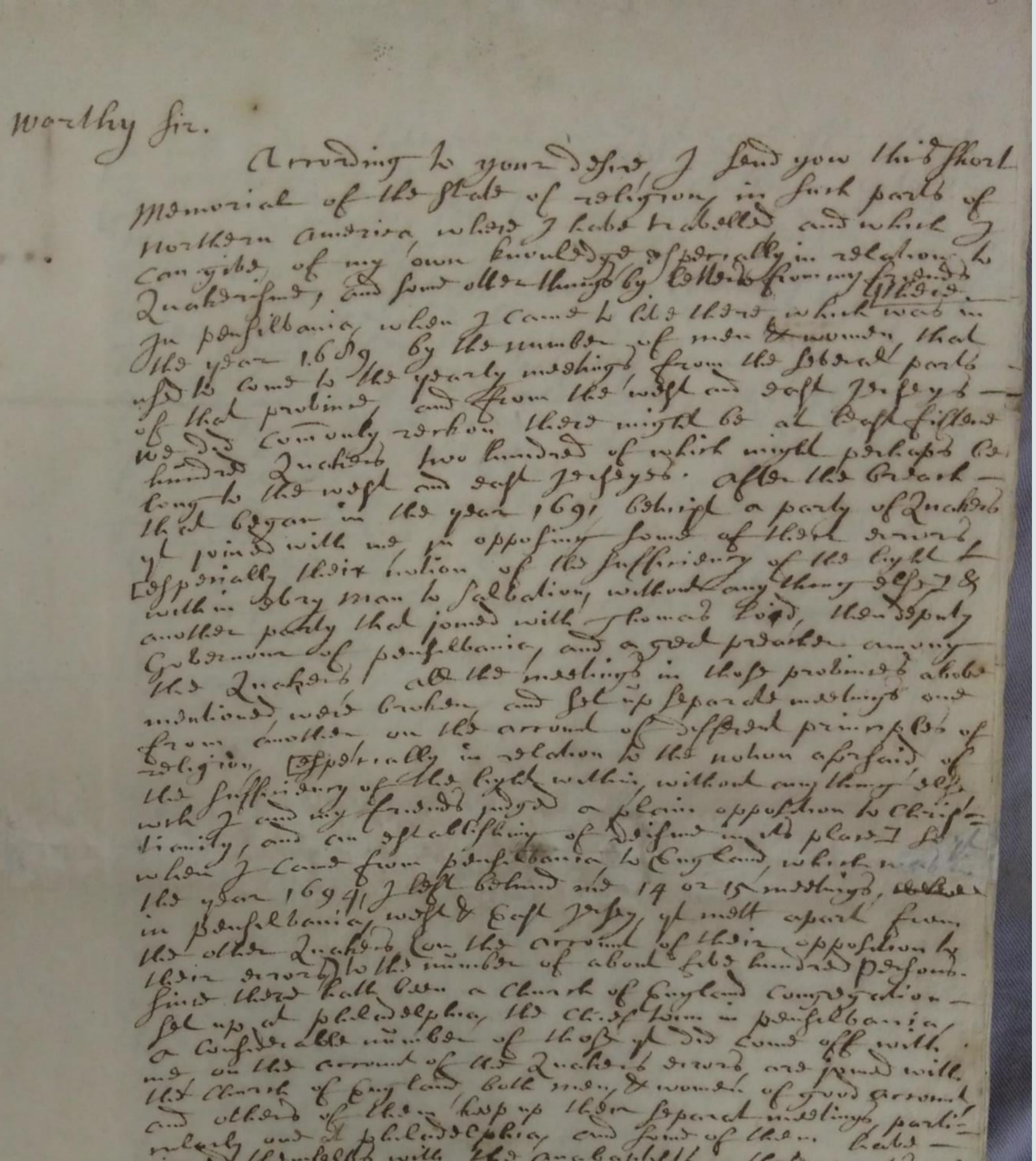
Handwritten text without transcription



Worthy Sir.

According to your desire, I send you this short Memorial of the State of religion in such parts of Northern America where I have travelled and which I can give of my own knowledge, especially in relation to Quakerism, and some other things by Letters from my friends there.

In Pensilbania when I came to live there which was in the year 1689, by the number of men & women that used to come to the yearly meetings from the several parts of that province, and from the west and east Jerseys as was commonly reckon[ed] there might be at least fifteen hundred Quakers (two hundred of which might perhaps belong to the west and east Jerseys). After the breach that began in the year 1691 betwixt a party of Quakers yt joined with me in opposing some of their errors [especially their notion of the sufficiency of the light within every man to salvation, without anything else] & another party that joined with Thomas Lloyd, then deputy Governour of Pensilbania, and a great preacher among the Quakers, all the meetings in those provinces above mentioned were broken and set up separate meetings one from another on the account of different principles of religion, [especially in relation to the notion aforesaid of the sufficiency of the light within, without anything else, wch I and my friends judged a plain opposition to Christianity, and an establishing of Deism in its place] So when I came from Pensilbania to England, which was in the year 1694, I left behind me 14 or 15 meetings, ~~[illegible]~~ in Pensilbania, west & East Jersey, yt met apart from the other Quakers (on the account of their opposition to their errors) to the number of about five hundred persons. Since there hath been a Church of England Congregation set up at Philadelphia, the chief town in Pensilbania, a considerable number of those yt did come off with me on the account of the Quakers errors are joined with the Church of England both men & women of good account and others of them keep up their separate meetings particularly out of Philadelphia, and some of them have [illegible]



Handwritten text with transcription

- Worthy Sir, / According to your desire I send you this short Memorial of the State of religion in such parts of northern America, where I have travelled and which I can give of my own knowledge of especially in relation to Quakerisme & some other things by Letters from my friends there. In Pensylvania when I came to live there, which was in the year 1689 by the number of men & women that used to Come to the Yearly meetings from the several parts of that province, & from the West & East Jerseys, We did commonly reckon there might be at least Fifteen Hundred Quakers, Two Hundred of which might Perhaps belong to the West and East Jerseys. After the Breach that Began in the Year 1691 betwixt a Part of Quakers that joined with me in opposing some of their errors (Especially their Notion of the Sufficiency of the light within every man to salvation, without any thing else) & another Party that joined with Thomas Loyd then Deputy Gouvernor of Pensylvania & a great preacher among the Quakers all the Meetings in those Provinces above mentioned, were broken & set up separate meetings one from another in the account of Different Principles of Religion (Especially in relation to the Notion aforesaid, of the Sufficiency of the light within, without any thing else which I & my Friends judged a plain Opposition to Christianity, & an establishing of Deisme in it's place) so that when I came from Pensylvania to England which was in the year 1694, I left behind me 14 or 15 meetings, in Pennsylvania, West & East Jersey, that mett apart from the other Quakers (on the account of their Opposition to their Errors) to the number of about five Hundred Persons. Since there hath been a Church of England Congregation sett up at Philadelphia, the Chief town of Pensylvania, A Considerable number of those that did come off with me on the account of the Quakers Efforts, are joined with the Church of England both Men & Women of good account, & others of them keep up their Separate meetings, particularly one at Philadelphia, & some of them have joined themselves with the Anabaptists in those Parts, as I have had Particular Information by Letters from my Friends there, year after year.

OCR vs HTR

Optical Character Recognition

Widely used since 1990s

Works well with printed texts but not with handwritten texts

Targets one character at a time

Handwritten Text Recognition

First developed in mid-2010s

Based on machine learning and probability

Targets strings of characters to produce character probabilities

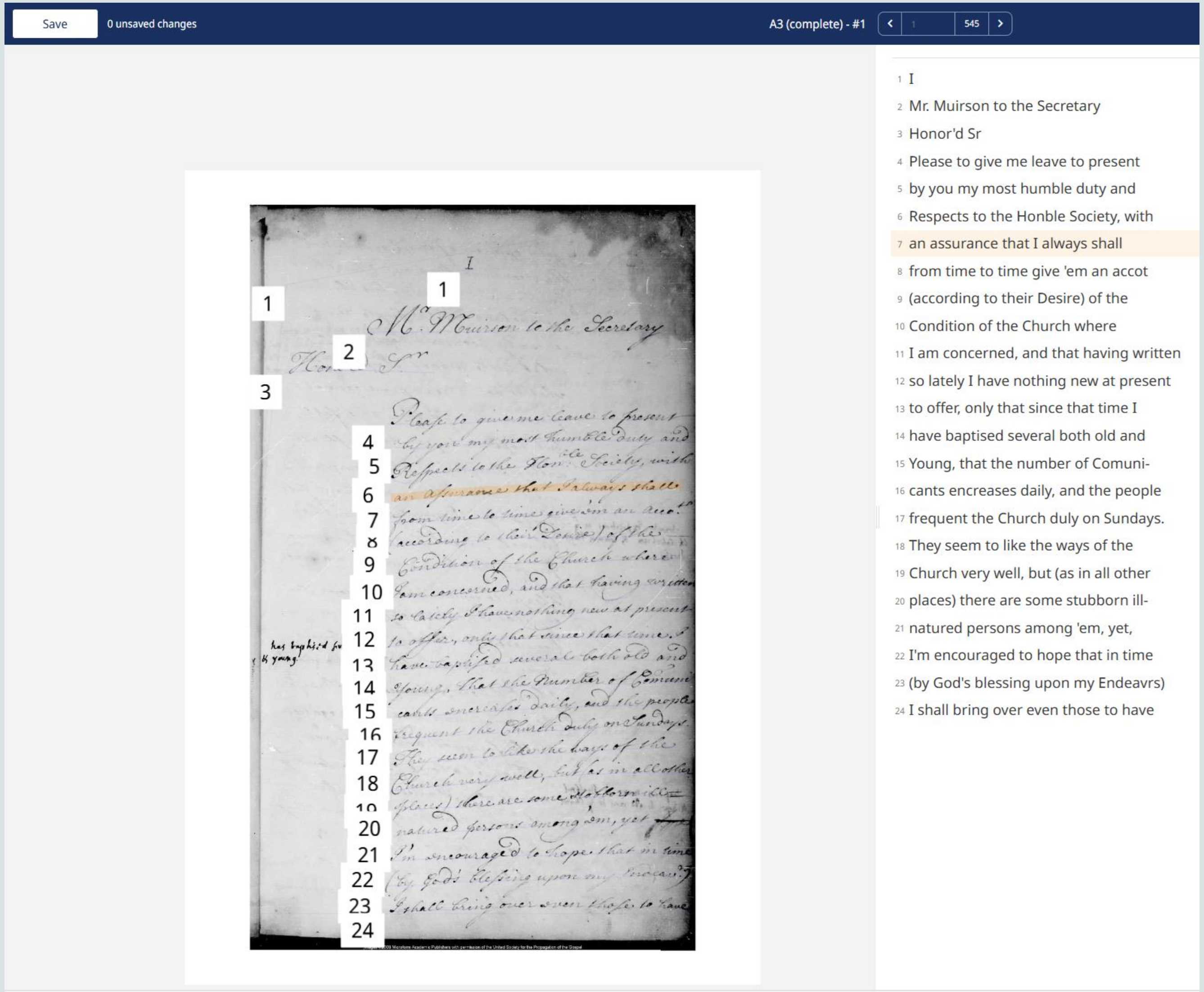
e.g. “I like to eat cheese s?ndwiches”

Transkribus produces transcriptions

Transcriptions are manually corrected

Corrected transcriptions become training data

AI model improves



Applying HTR to the SPG archive

Society for the Propagation of the Gospel (SPG), established in 1701

Sent clergy to British colonies, including the Thirteen Colonies

Archives (now at the University of Oxford) comprise 1063 feet of shelf space

Dr Alison Searle (University of Leeds) is working with the USPG (the SPG's successor) to digitize this archive

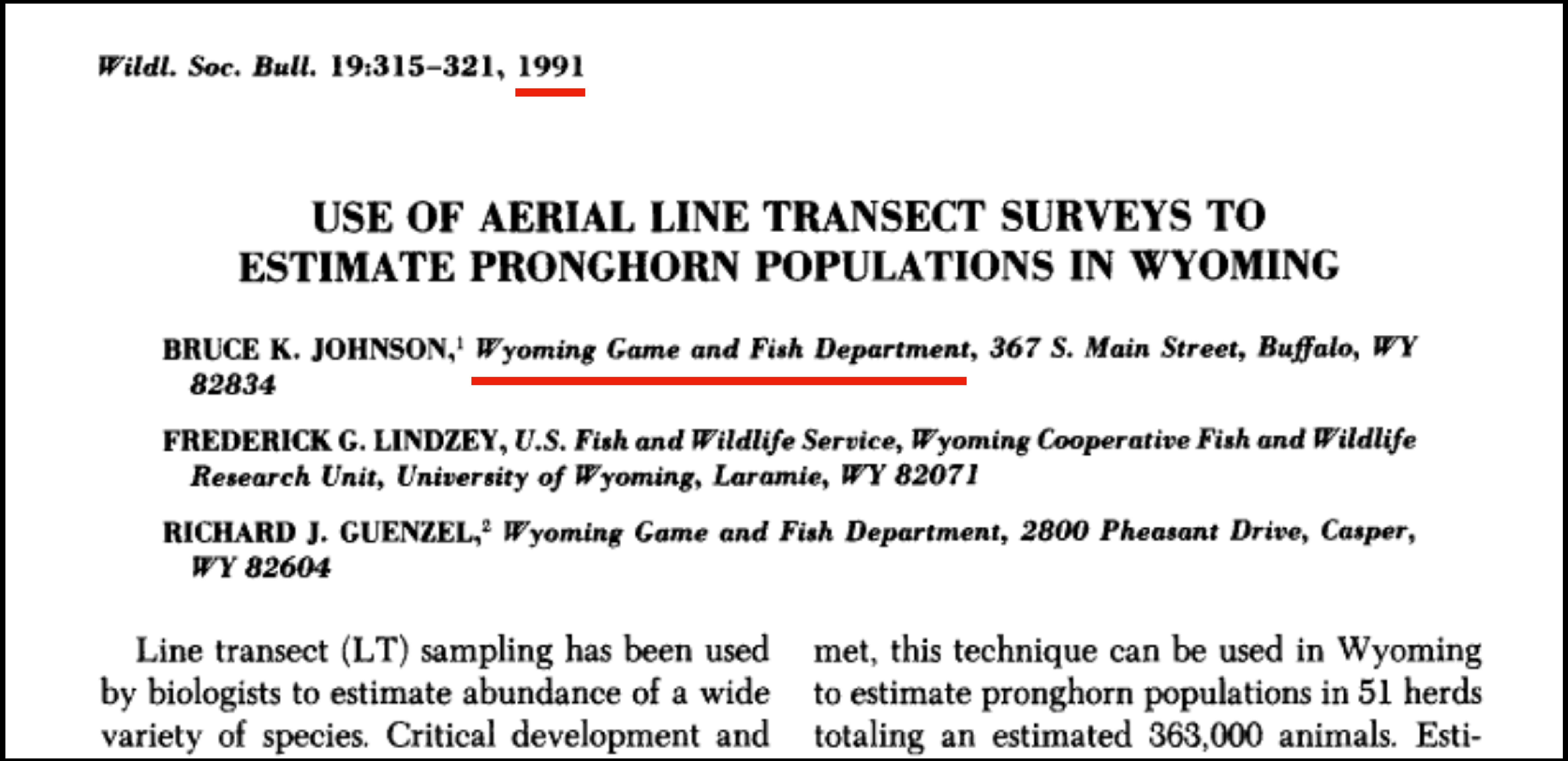
UW team will provide transcriptions and lead applications to US funding sources (NEH Digital Humanities Advancement Grant)

Statewide AI driven pronghorn monitoring

Ben Koger
Assistant Professor
School of Computing & Department of Zoology and Physiology
University of Wyoming

Pronghorn are an icon of Wyoming

Wyoming is the leader in pronghorn monitoring



Wildl. Soc. Bull. 19:315–321, 1991

USE OF AERIAL LINE TRANSECT SURVEYS TO ESTIMATE PRONGHORN POPULATIONS IN WYOMING

BRUCE K. JOHNSON,[1] *Wyoming Game and Fish Department, 367 S. Main Street, Buffalo, WY 82834*

FREDERICK G. LINDZEY, *U.S. Fish and Wildlife Service, Wyoming Cooperative Fish and Wildlife Research Unit, University of Wyoming, Laramie, WY 82071*

RICHARD J. GUENZEL,[2] *Wyoming Game and Fish Department, 2800 Pheasant Drive, Casper, WY 82604*

Line transect (LT) sampling has been used by biologists to estimate abundance of a wide variety of species. Critical development and met, this technique can be used in Wyoming to estimate pronghorn populations in 51 herds totaling an estimated 363,000 animals. Esti-

Method used across western states

Wyoming is the leader in pronghorn monitoring

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Line transect (LT) sampling has been used by biologists to estimate abundance of a wide variety of species. Critical development and met, this technique can be used in Wyoming to estimate pronghorn populations in 51 herds totaling an estimated 363,000 animals. Esti-

- Dangerous
- Hard to verify
- Varies with observer

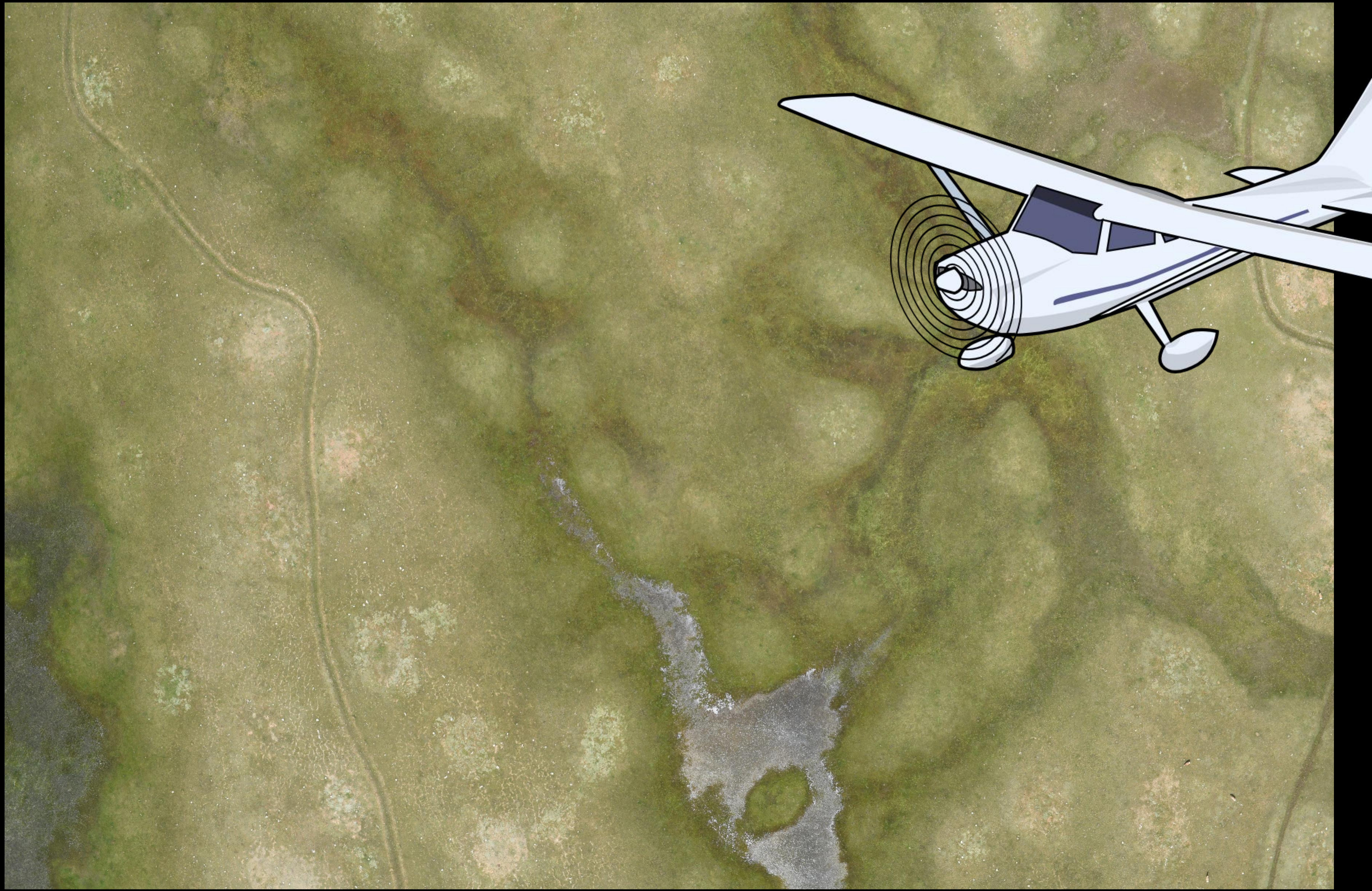
21st century AI pronghorn monitoring

Jason Carlisle

Eric Newkirk

Lee Knox

WYOMING GAME & FISH DEPARTMENT



21st century AI pronghorn monitoring

Each image spans the distance a human observes in the traditional method

21st century AI pronghorn monitoring

- Training machine learning models require lots of annotated images
- Pronghorn are hard to find in raw imagery
- Need to build software and train models just to annotate images

21st century AI pronghorn monitoring

- Seed grant funds Michael Lance’s work on this project
- Undergraduate in the School of Computing’s Applied Software Development program
- Graduate of Central Wyoming College

21st century AI pronghorn monitoring

- Without software, can annotate about 35 pronghorn / week
- With current software, can annotate over 500 pronghorn / week
- Current model detects over 95% of annotated pronghorn

Next steps

Hundreds of thousands of hectares of landscape imagery

ASSOCIATION of FISH & WILDLIFE AGENCIES

Next steps

Hundreds of thousands of hectares of landscape imagery

Next steps

Hundreds of thousands of hectares of landscape imagery






Leading the next 30 years of pronghorn monitoring

UW
School of Computing

WYOMING GAME & FISH DEPARTMENT

Center for Wildlife, Technology & Computing
WYLD TECH
University of Wyoming

ASSOCIATION of FISH & WILDLIFE AGENCIES

Washington Department of
FISH & WILDLIFE

NATIONAL PARK SERVICE

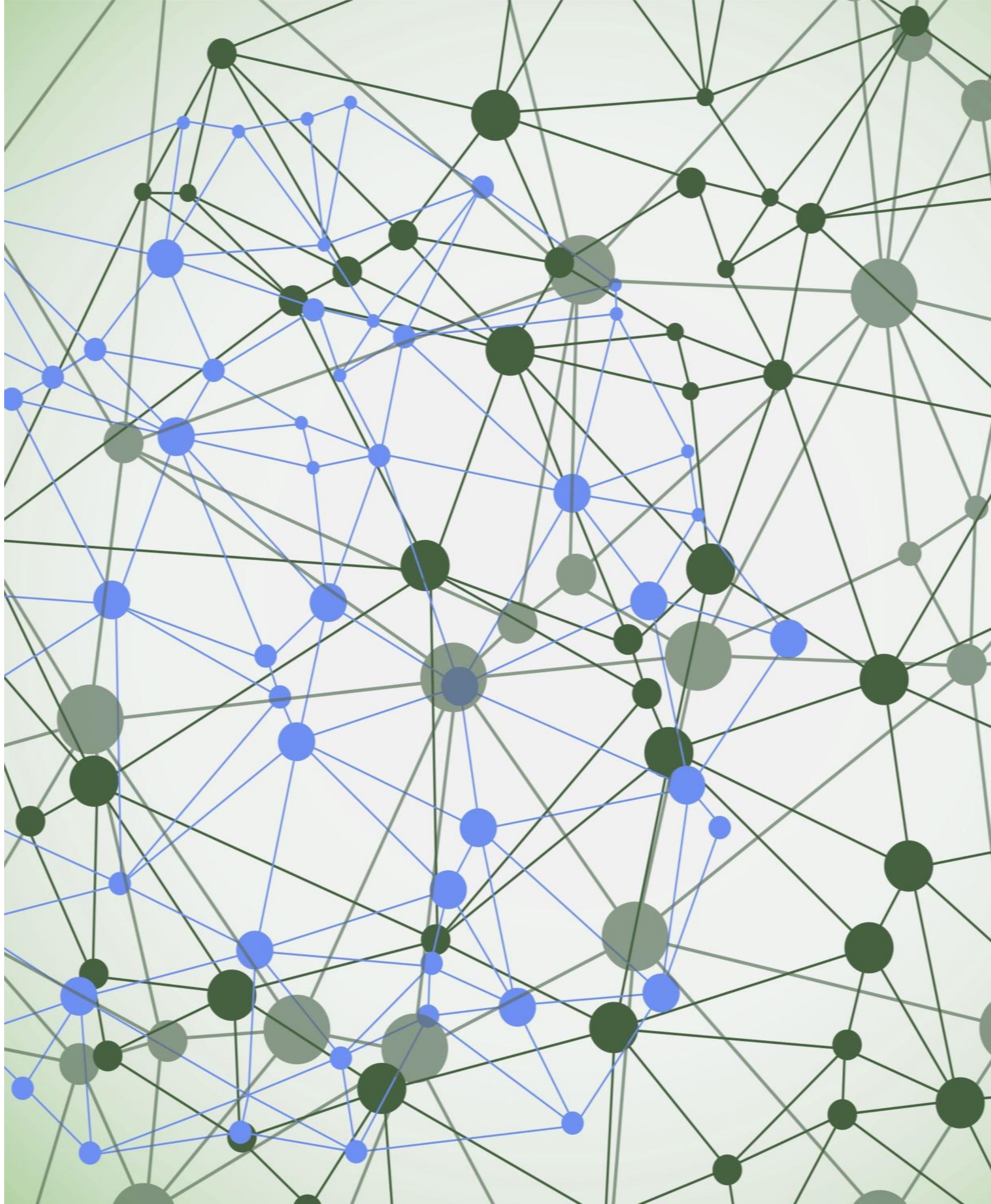
AMERICAN PRAIRIE

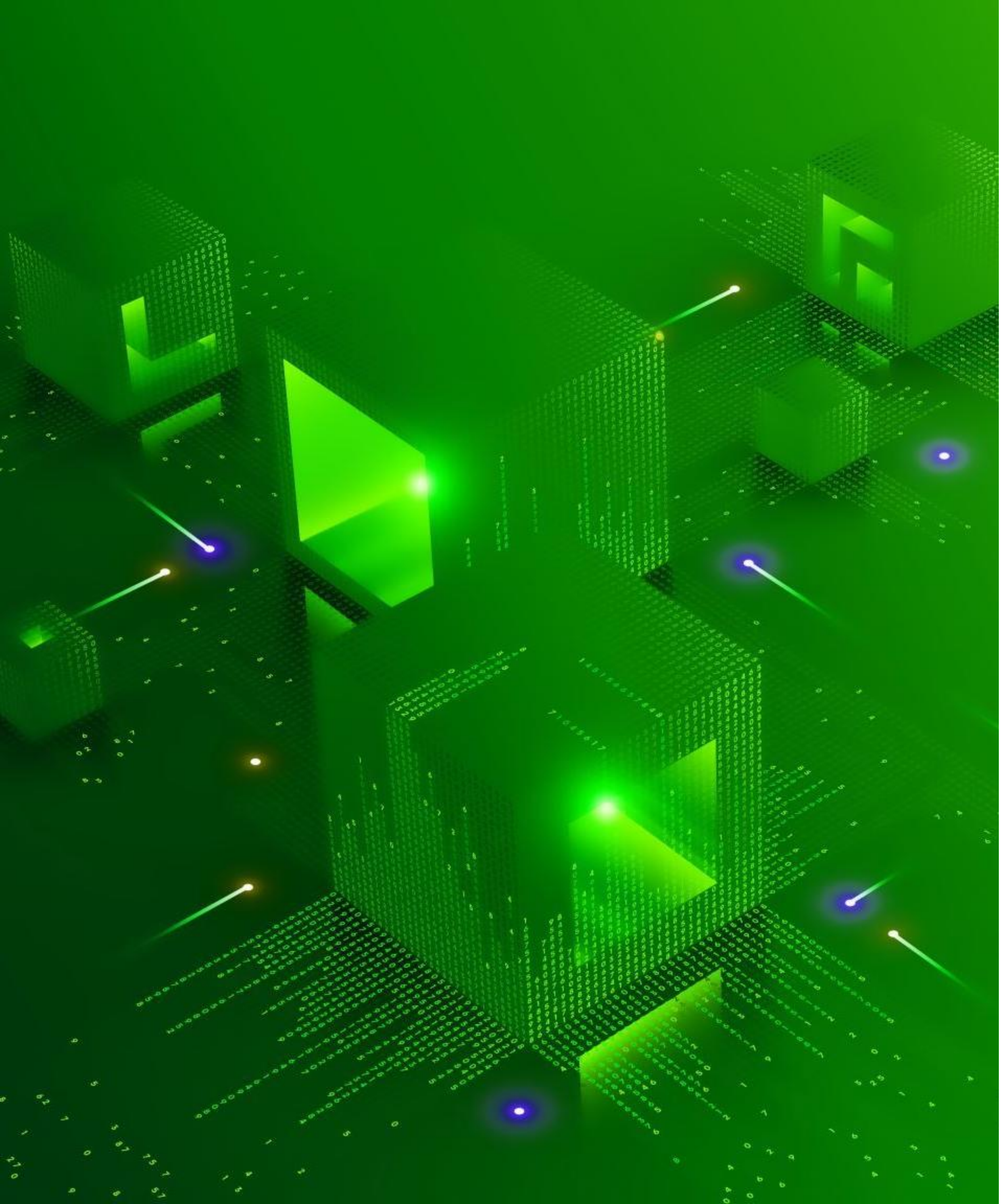
Smithsonian
National Zoological Park
Conservation Biology Institute

Enhancing Rural Resilience through Adaptive Learning Systems Powered by Neuro-Symbolic AI Models

Diksha Shukla, Ph.D.

Assistant Professor, Department of Electrical Engineering and Computer Science (EECS)





Introduction

- Artificial intelligence (AI) systems have made significant strides in perception tasks, but their ability to reason across multiple modalities— such as language, vision, and spatial contexts— remains limited, especially in dynamic, real-world environments.
- In rural communities, where complex challenges are often compounded by limited resources and access to technology.
- There is a pressing need for AI systems that can adapt to specific local contexts and provide trustworthy, interpretable solutions for sustainable development.

Research Objectives

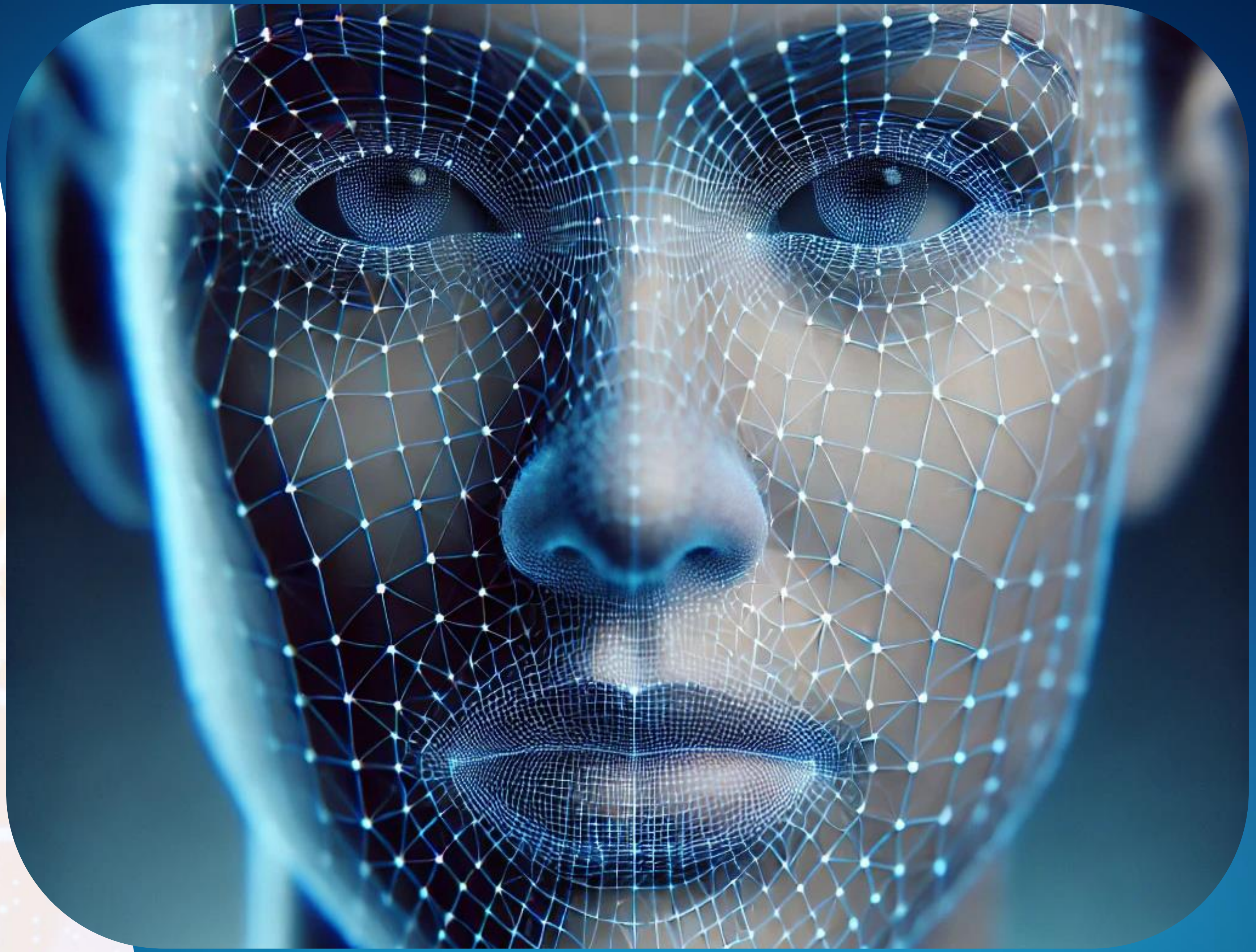
RO1: Spatial Reasoning – Develop novel algorithms that integrate symbolic reasoning with the neural engine to perform resilient spatial reasoning in real-world scenarios. This involves real-world scenes (e.g., variations in colors, background, shapes, material, and sizes) and complex questions.

RO2: Chain of Operations Reasoning – Develop novel algorithms that integrate symbolic reasoning with the neural engine to perform a resilient chain of operations/thought reasoning. This includes standard operations such as zero-hop, one-hop, multi-hop, comparisons, and, or, add, subtract, part, and replace.

RO3: Reasoning Inference Explanations – Refine the developed models for spatial, and chain of operations reasoning to generate interpretable explanations for reasoning inferences.

Thank You!

TRACKING FACIAL MOVEMENTS : USING AI FOR RURAL TELEHEALTH SPEECH THERAPY



Zoe Kriegel, Ph.D. CCC-SLP

Assistant Professor, Division of Communication Disorders

Diksha Shukla, Ph.D.

Assistant Professor, Department of Electrical Engineering and Computer Science

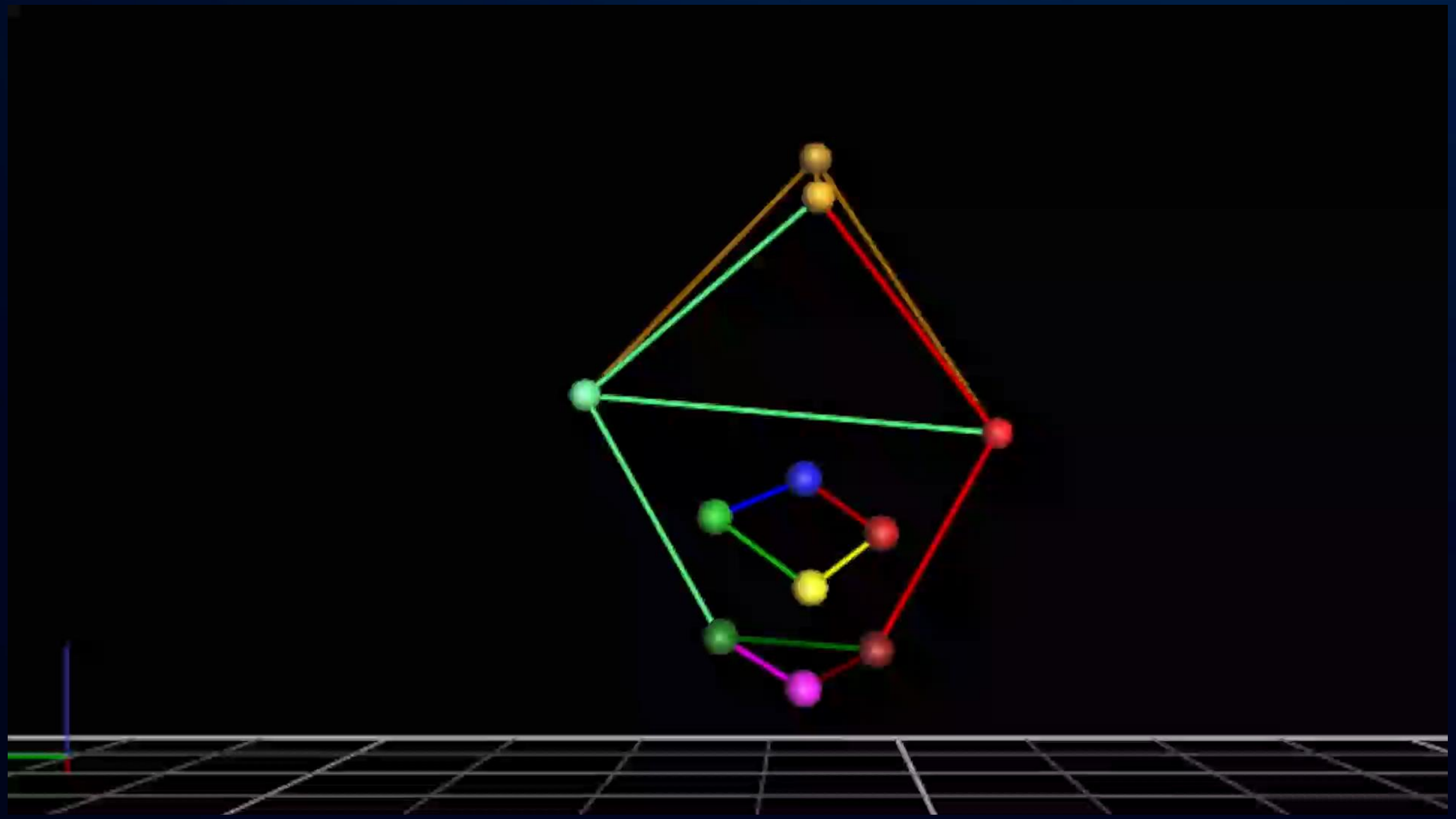
INTRODUCTION

- Between 70-90% of individuals living with Parkinson disease will experience a **degeneration in their ability to speak**[1]
  - **Speech language pathologists** diagnose and treat progressive communication disorders
- Access to specialized therapies for Parkinson’s is a **marked barrier** in Wyoming[2] and other rural communities
- Telehealth speech measurement tools would **expand access** to individualized speech therapy

GOALS

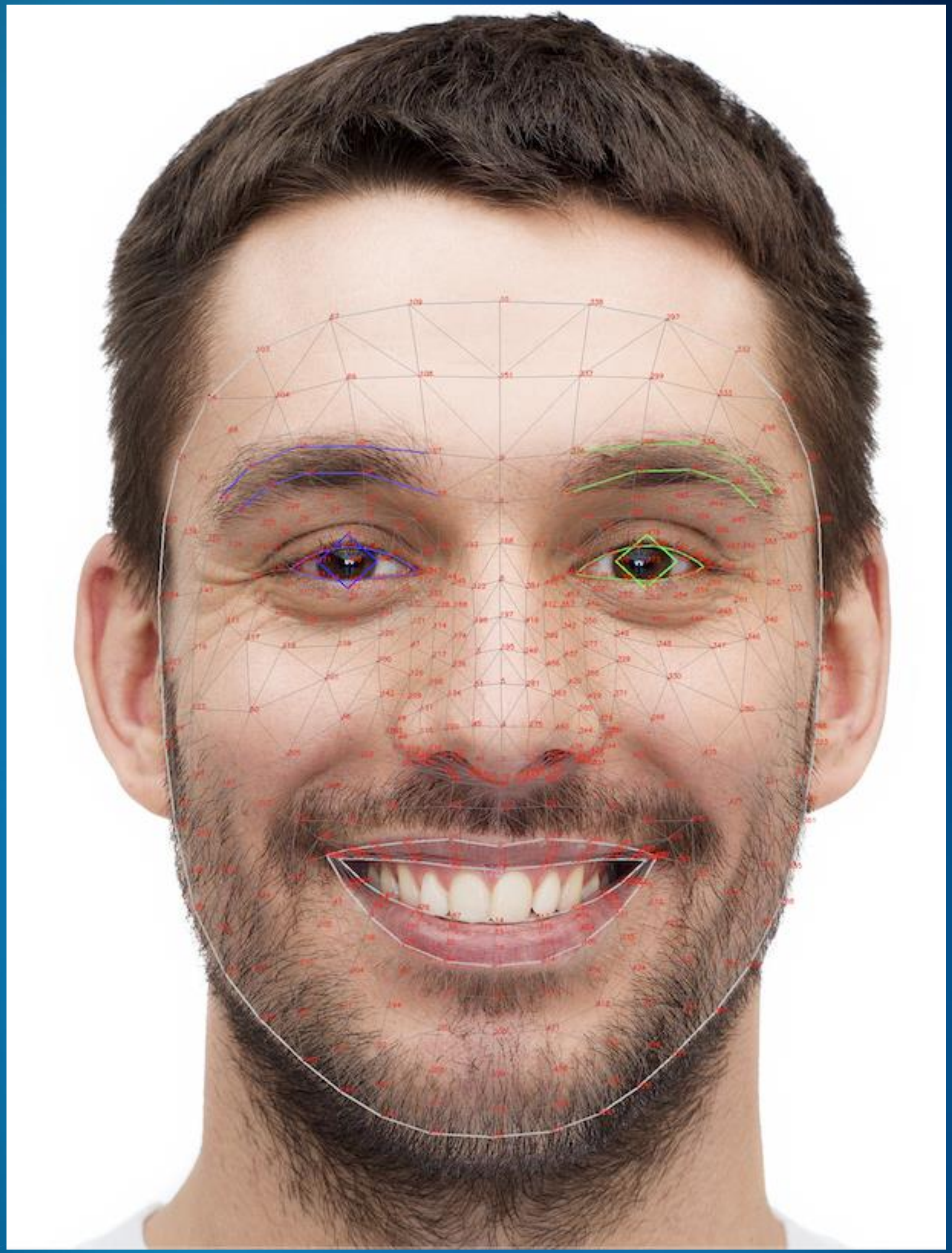
Leverage artificial intelligence techniques [3] with widely available consumer device cameras to:

1) Support speech language pathologists in diagnosing speech problems earlier and more accurately
2) Enhance speech therapy treatment tools and measure treatment progress



EXPECTATIONS

- Develop a tool to support **speech language pathologists** in early diagnosis and precision treatment monitoring for progressive speech disorders
- Support **Wyomingites living with Parkinson's** to access speech disorder diagnosis and treatment



(3) Google MediaPipe Solutions

THANK YOU

REFERENCES

[1] Ramig LO, Countryman S, Thompson LL, Horii Y. Comparison of two forms of intensive speech treatment for Parkinson disease. *J Speech Lang Hear Res.* 1995;38(6):1232-1251.

[2] Singh RL, Bush EJ, Hidecker MJC, Carrico CP, Sundin S. Considering health care needs in a rural Parkinson disease community. Progress in Community Health Partnerships: Research, Education, and Action. April 11, 2020. Accessed March 10, 2025. https://muse.jhu.edu/article/753433.

[3] Google, "Face Landmarker | MediaPipe Solutions," Google AI. [Online]. Available:https://ai.google.dev/edge/mediapipe/solutions/vision/face_landmarker. Accessed: Mar. 10, 2025.

School of Computing

Zoology and Physiology

Haub School of Environment and Natural Resources

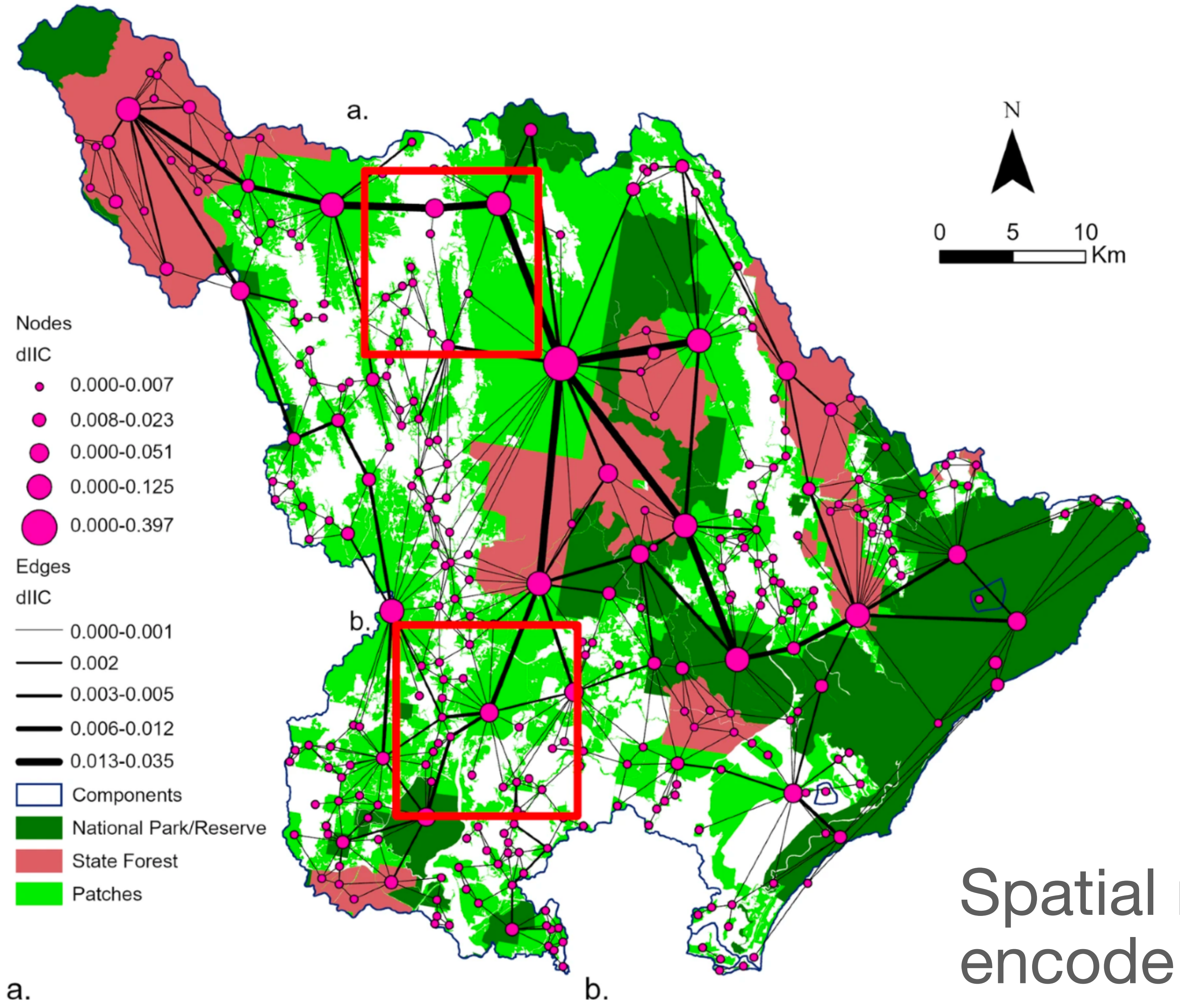
AI Seed Grant Project Overview:

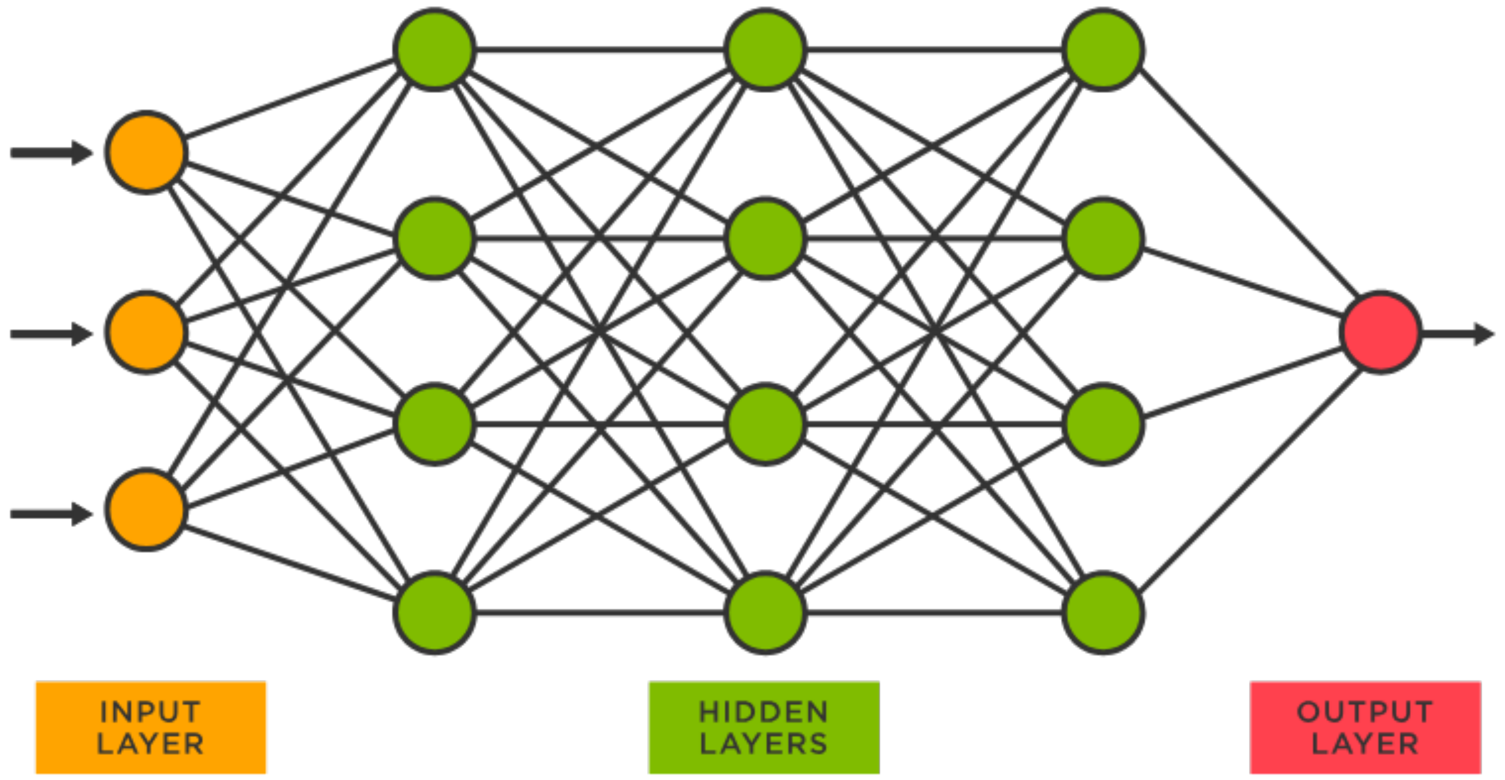
Migration connectivity analysis and design with topology and AI

- **Dane Tayor** (PI), Assistant Professor, School of Computing and Department of Mathematics & Statistics
- **Guram Mikaberidze** (coPI), Postdoc, School of Computing
- **Jerod Merkle** (coPI), Knobloch Professor in Migration Ecology and Conservation, Department of Zoology and Physiology
- **Drew Bennet** (coPI), Whitney MacMillan Professor of Practice, Private Lands Stewardship Program, Haub School of Environment and Natural Resources

Network Modeling is Ubiquitous

- **Networks map the intricate connections between things**
  - Connections between people
  - Connections between computers
  - Connections between *neurons* in brains and AI algorithms
  - Connections between <u>regions of land</u>



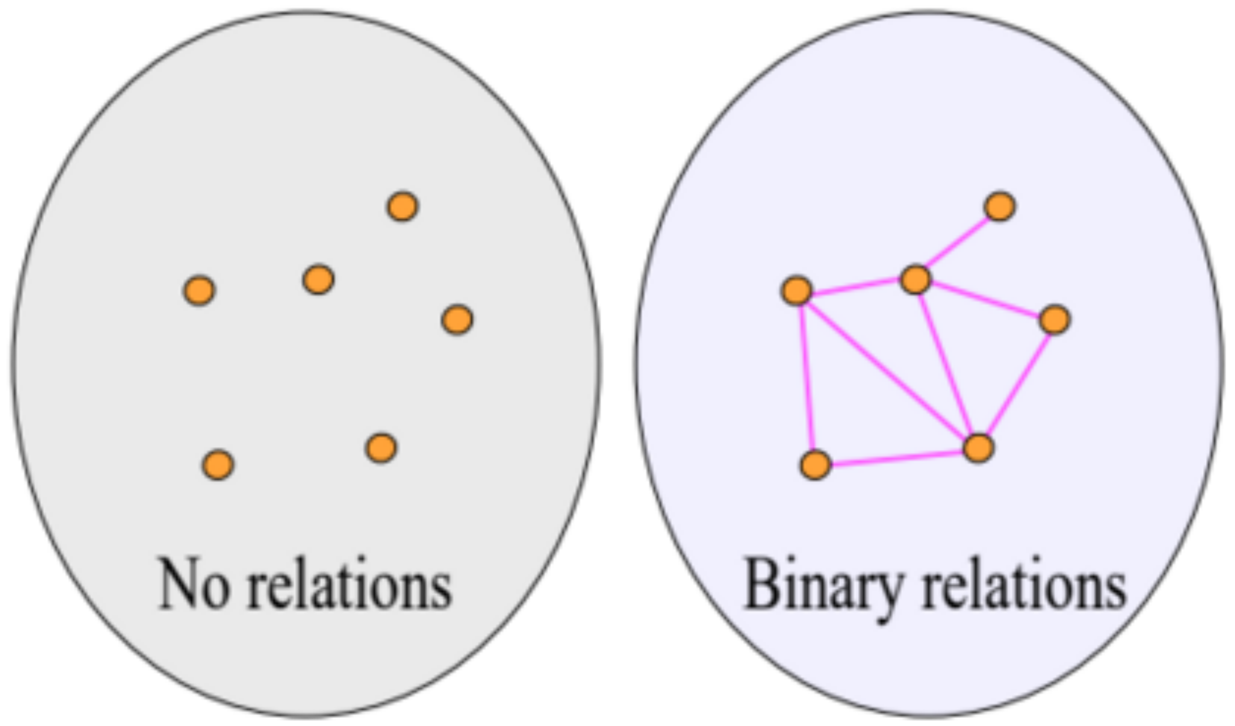


Spatial regions are represented by “nodes” and connections encode animal movements between regions

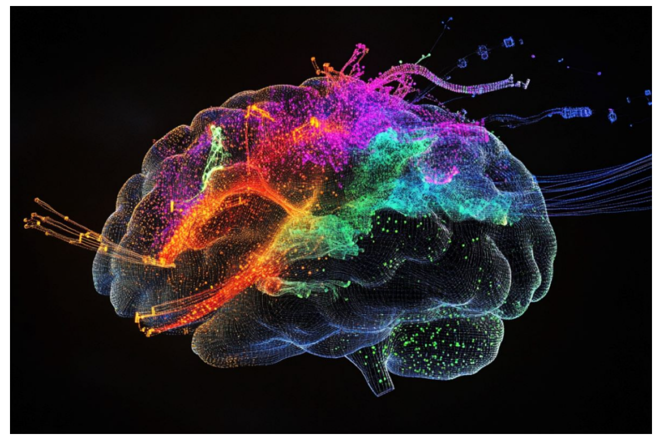
Topological Data Analysis (TDA)

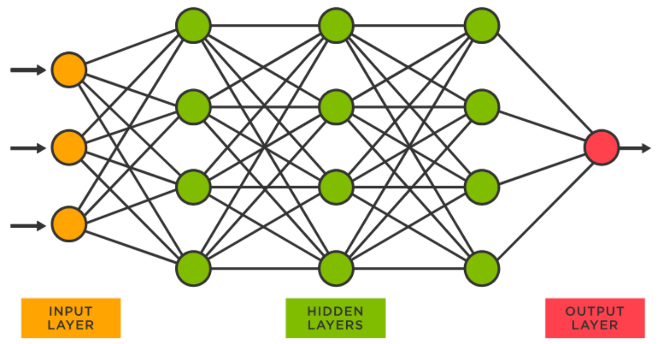
- **<u>Definition:</u> Topology is the branch of mathematics that studies shape.**
- Topology is starting to change how experts build models in neuroscience, AI and beyond.

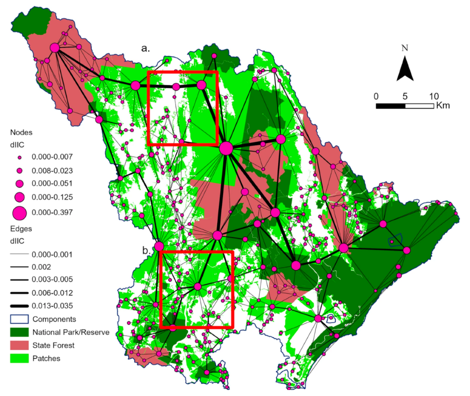
<u>Classical modeling with “graphs”</u>



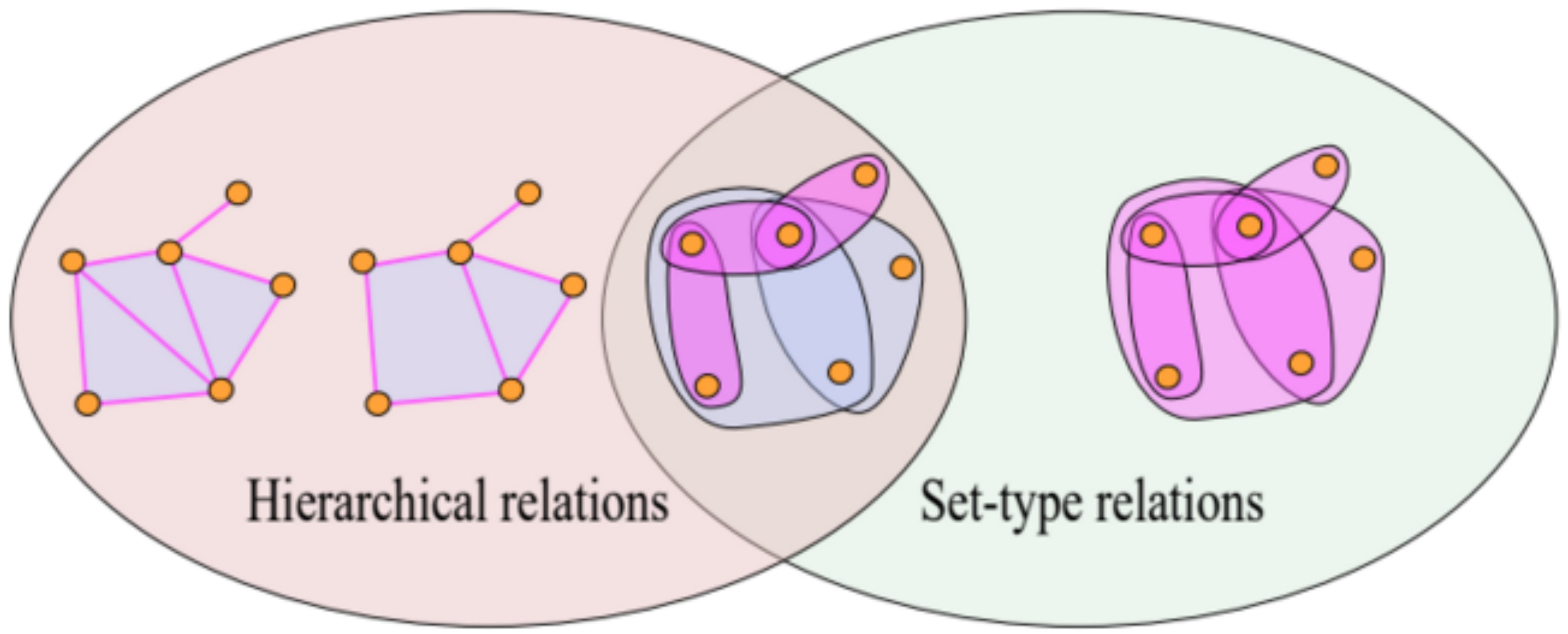
<u>previous examples from neuroscience, AI and ecology</u>







<u>More advanced models from topology</u>



<u>Evidence of novelty</u>

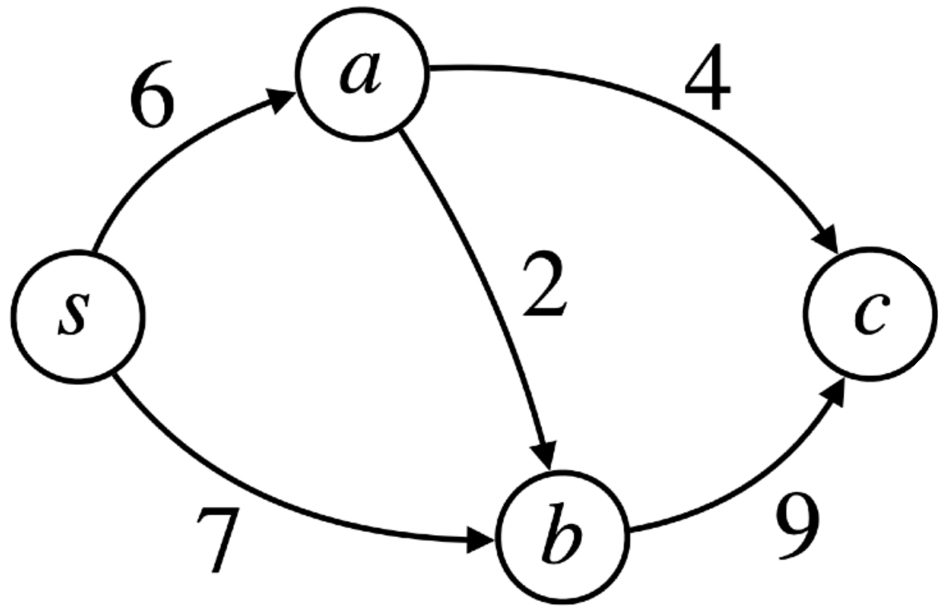
- Semester-long workshop at Brown University (Fall ’23) *Math + Neuroscience: Strengthening the Interplay Between Theory and Mathematics*
- Book: *Topological Deep Learning: Going Beyond Graph Data, Nina Miolane et al, 2024.*

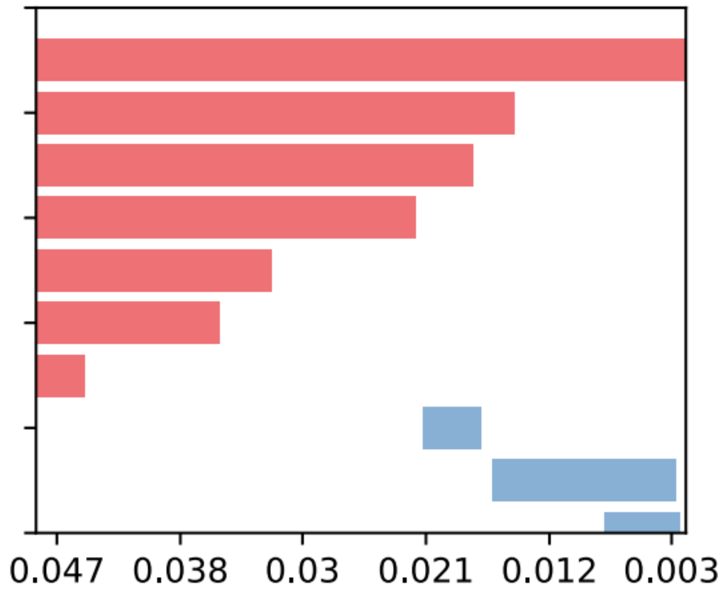
Apply TDA to Migration Networks

- **GOAL 1: Use TDA to build state-of-the-art methods to quantify the robustness of migration pathways.**

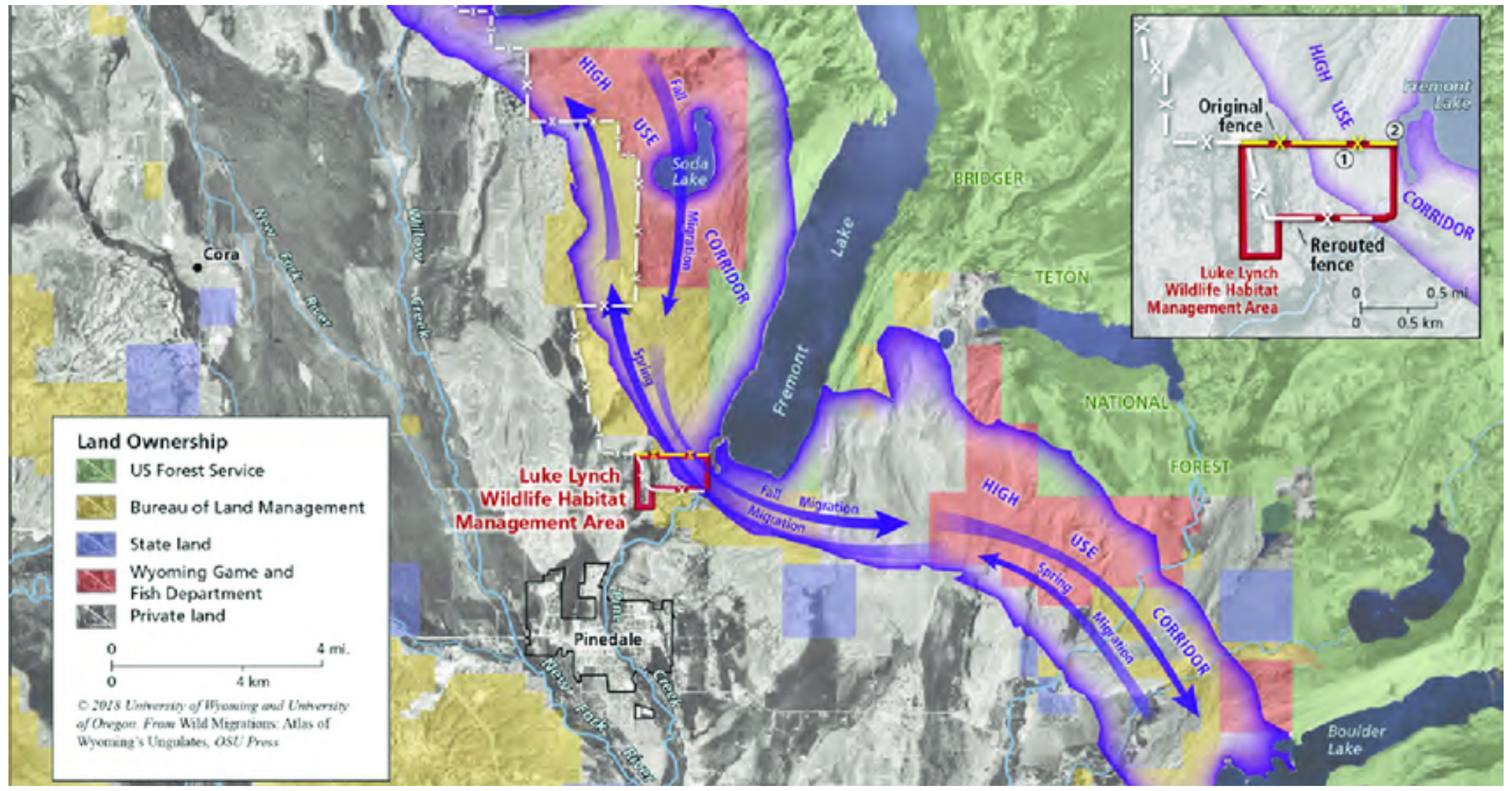
<u>Approach</u>: Builds on previous work using TDA to summarize patterns of “loops” and “pathways”

MQ Le and D Taylor (2022) Persistent homology of convection cycles in network flows. Physical Review E 105, 044311.





TDA converts loops into a “barcode representation” that can be input into ML/AI algorithms



<u>Ecological context</u>: A lack of pathway “options” causes a “bottleneck” to migrations (e.g., Freemont Lake bottleneck near Pinedale, WY)

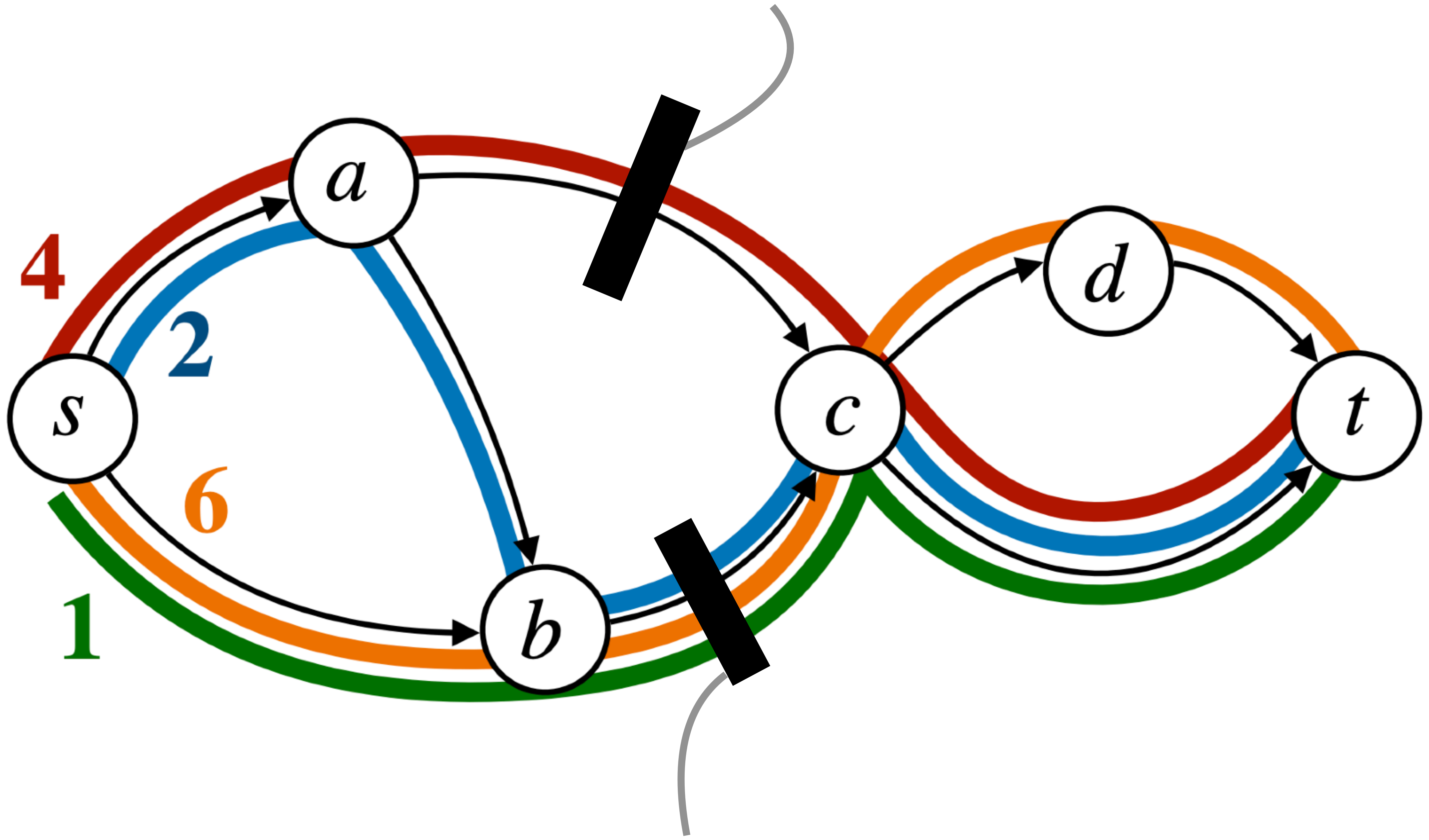
Study Fencing Impact with TDA

- **GOAL 2: Study how fence removal effects migration pathways at Wyoming study sites.**

Step 1: Construct network models that integrate several data types from the Merkle Lab (fence data, geospatial images and GPS animal tracking)

Step 2: Simulate fence removals and study their impact on pathway options (which are revealed and measured using TDA)

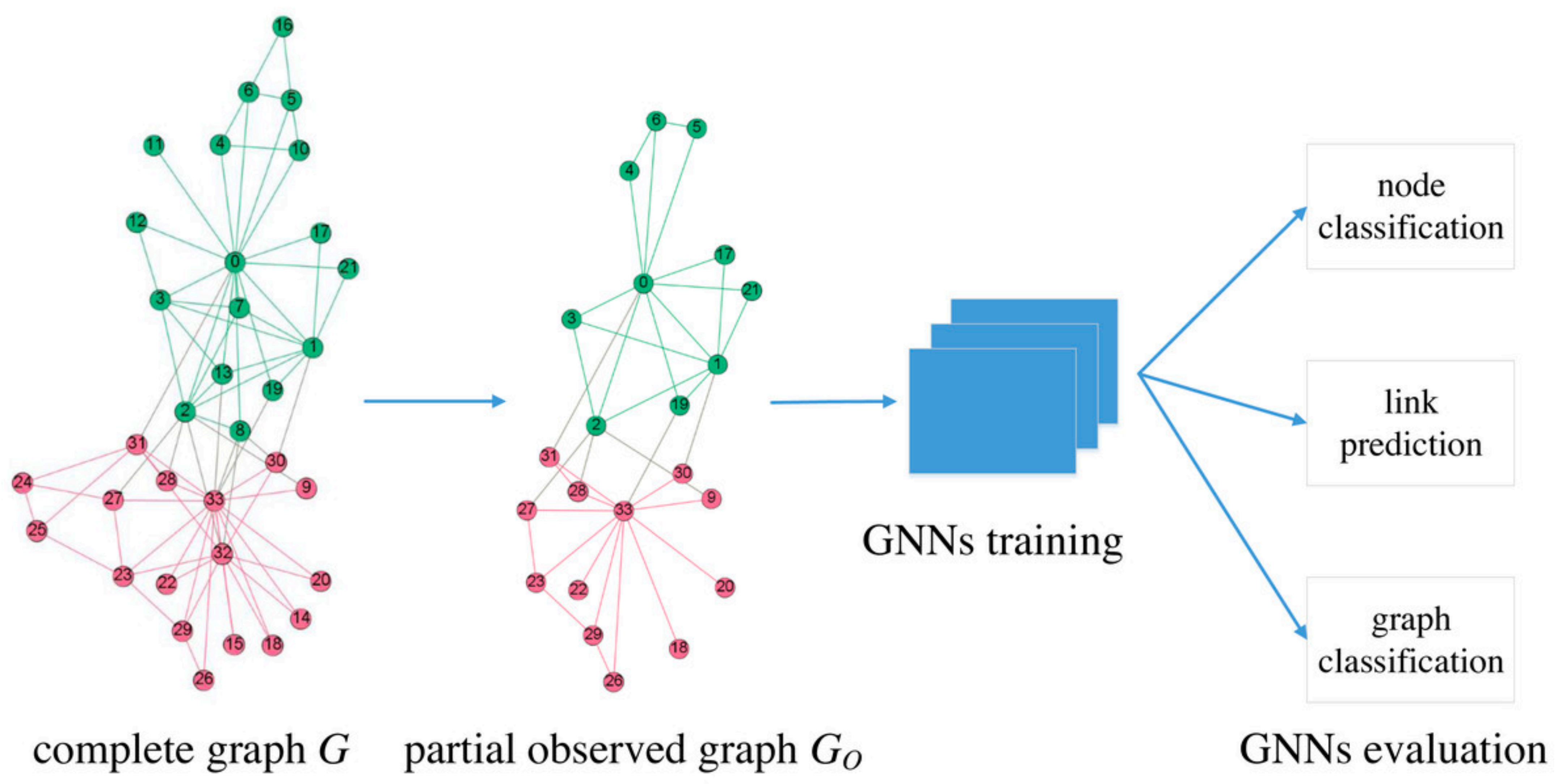
Removing this fence opens up 1 pathway option



Removing this fence opens more pathways options

Optimize Fence Removals with Topological AI

- **GOAL 3: Integrate TDA into an AI framework that optimally replaces fences with virtual fences.**



<u>Approach</u>: Leverage AI methods for network optimization that are under development by Dr. Mikaberidze. This project is partially supported by the AI matching program for an award from Alumbra LLC.

<u>Realistic Modeling</u>: Leverage Dr. Bennett's expertise to consider realistic virtual-fence replacement opportunities, given that it requires cooperation among land managers.

Timeline and Outcomes

- **Spring 2025** - PhD student Chamod Haputhanthiri begins applying TDA to spatial movement models
- **Summer 2025** - Complete Goals 1-2 and draft paper.
- **Fall 2025** - Submit paper for a publication and obtain preliminary results for Goal 3.
- **Spring 2026** - Submit NSF proposal
  "Topological AI for migration resilience"

UW Alignment: We plan to interface this project with an AI prediction model for individual mule deer that is under development in Taylor Lab. Math major Carter McBurnett and zoo/phys PhD student Luke Wilde are leading that project with funding by the *UW Center for Wildlife, Technology & Computing (WyldTech)* and the *SoC Undergraduate Research Experience (SURE)* program.