AI for Search and Rescue

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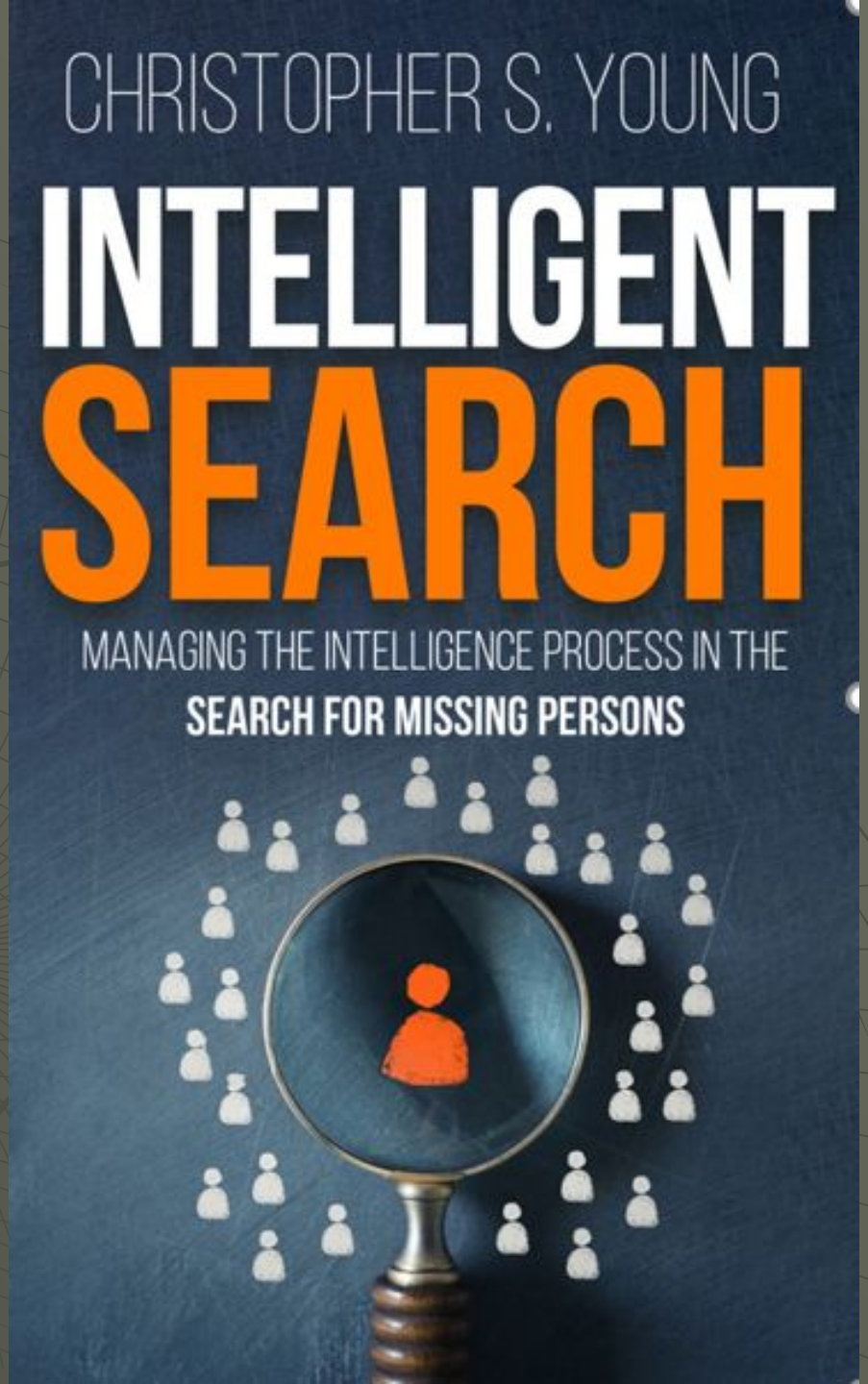
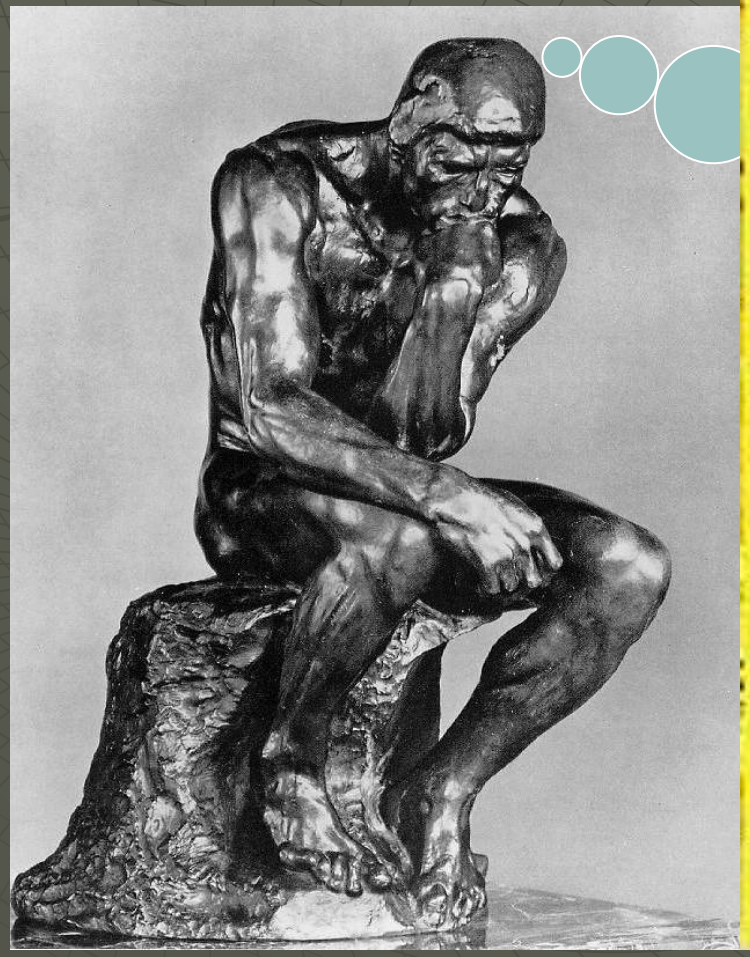
NMUPC

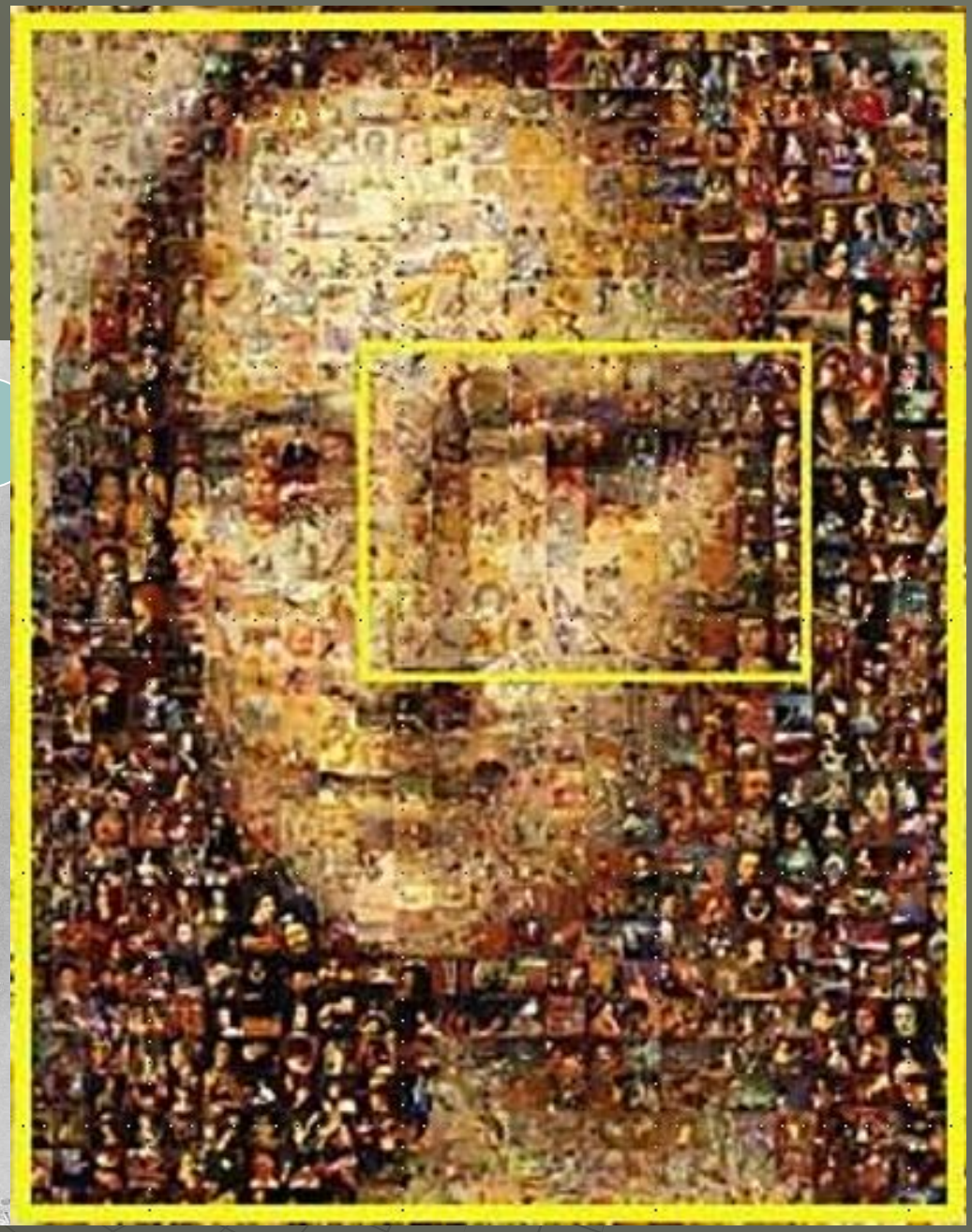
04-15-2025

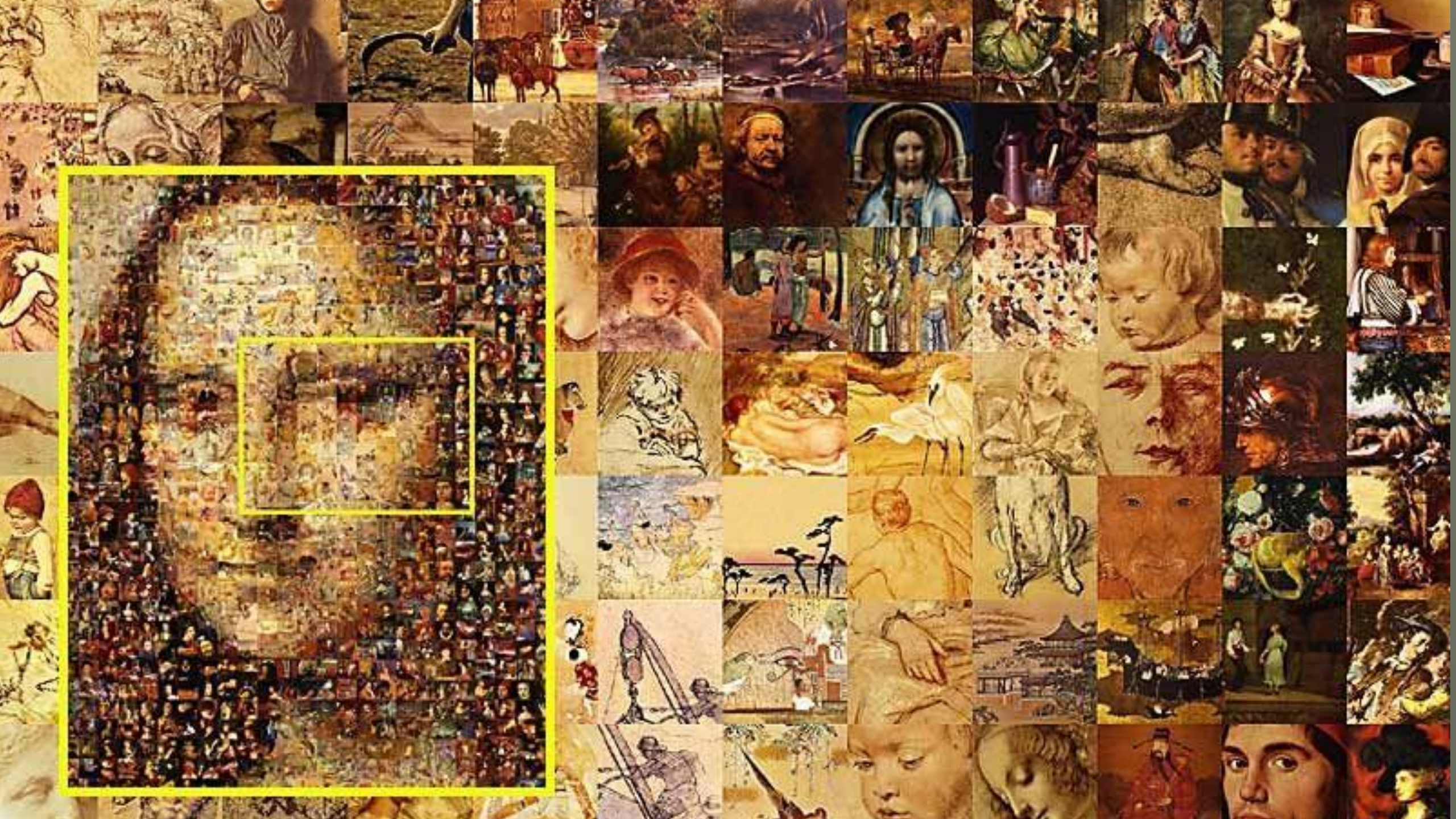
A Quick Primer on Intelligent Search Management

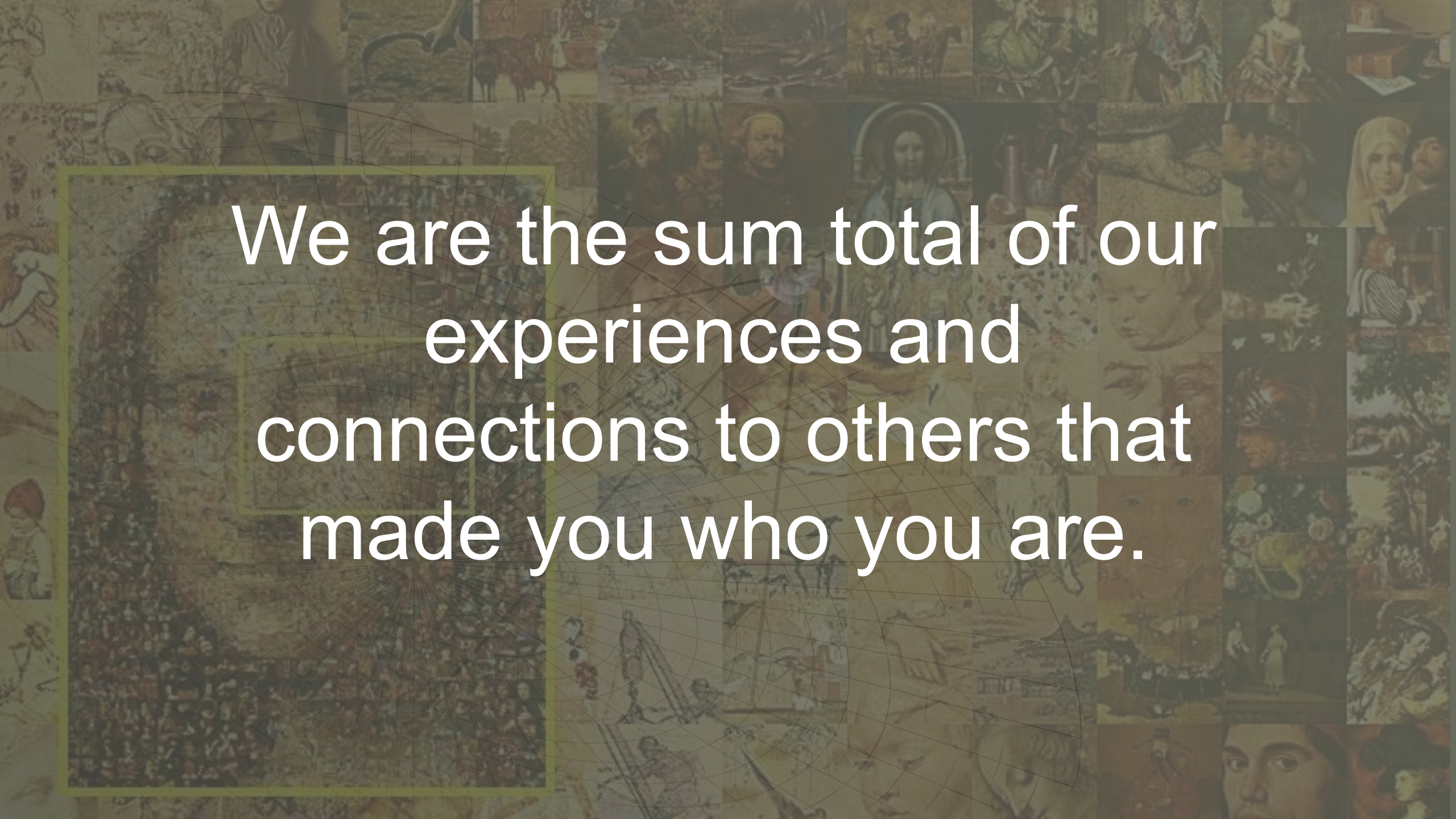

CHRISTOPHER S. YOUNG
INTELLIGENT
SEARCH
MANAGING THE INTELLIGENCE PROCESS IN THE
SEARCH FOR MISSING PERSONS

Painting a Picture



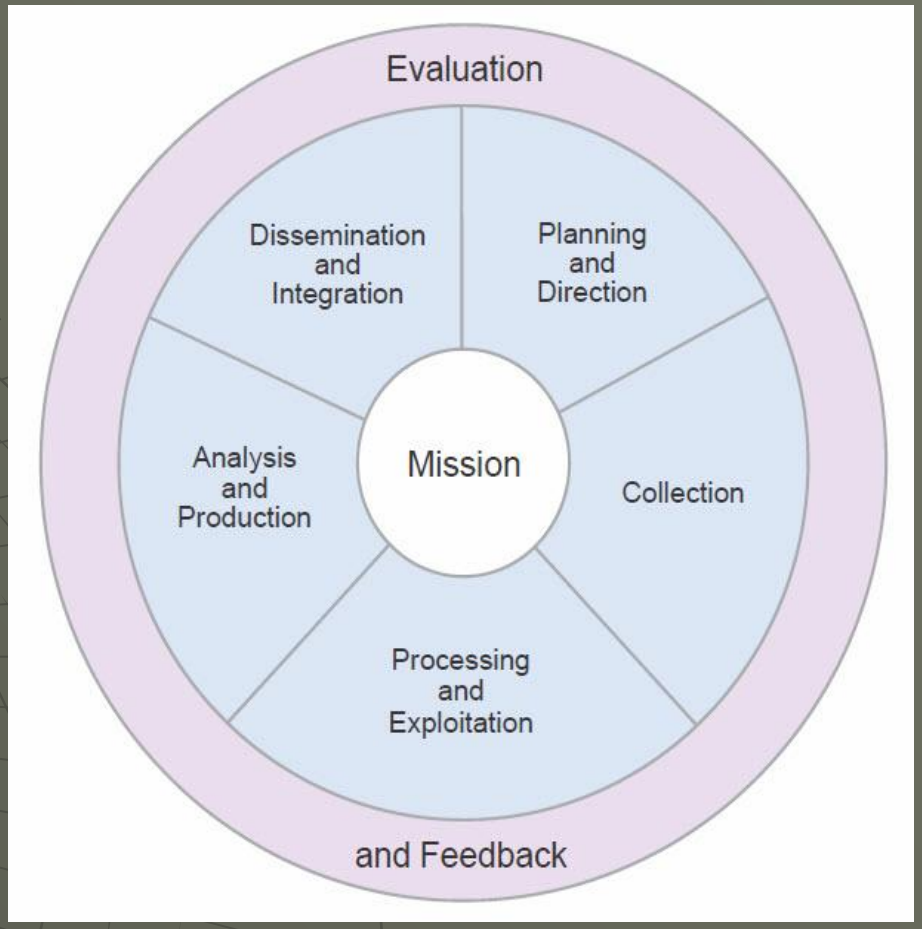





We are the sum total of our experiences and connections to others that made you who you are.

Intelligence as a Process

- Planning and direction
- Collection
- Processing and exploitation
- Analysis and production
- Dissemination and integration (take action)
- Evaluation and feedback



Intelligent Evaluation Requires Data

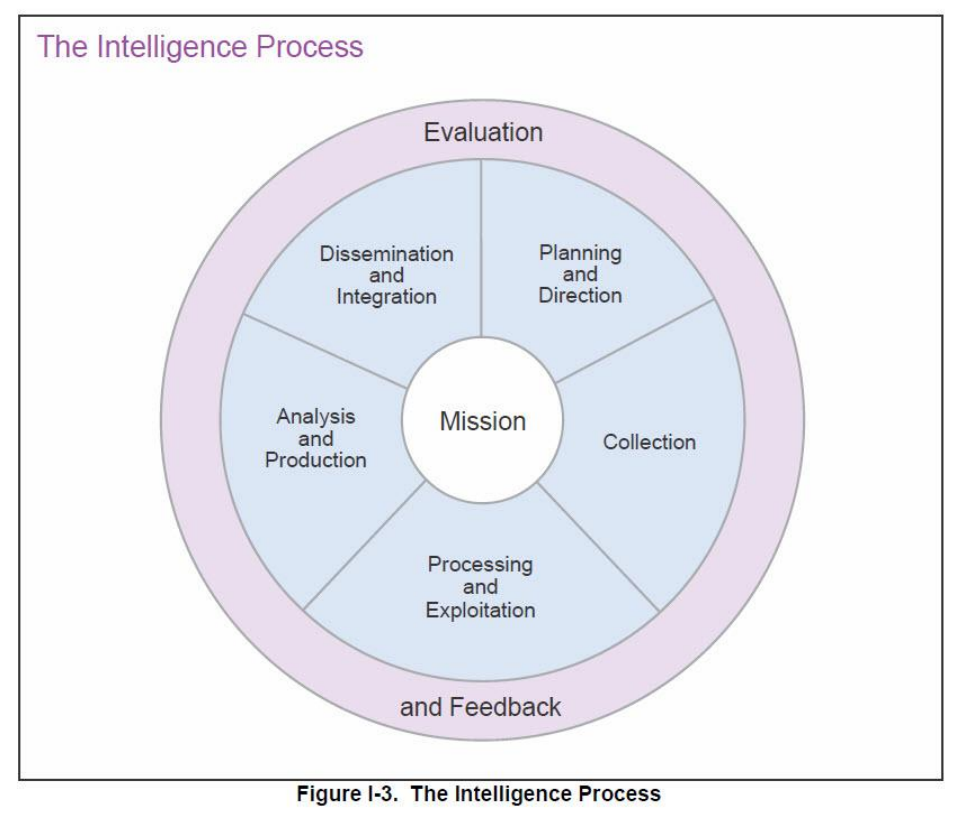


Figure I-3. The Intelligence Process

"Data! Data! Data!" he cried impatiently. "I can't make bricks without clay."

- Sherlock Holmes: The Adventure of the Copper Beeches

IntelliSAR Project Introduction

Gary Bloom

Project Overview

A collaborative effort with California Polytechnic State University (Cal Poly) Computer Science and Software Engineering Department and experienced SAR leaders

- Professor Dr. Franz Kurfess, undergraduate and graduate students
- Experienced SAR leaders and Cal Poly Alumnus Gary Bloom and Dr. Chris Young

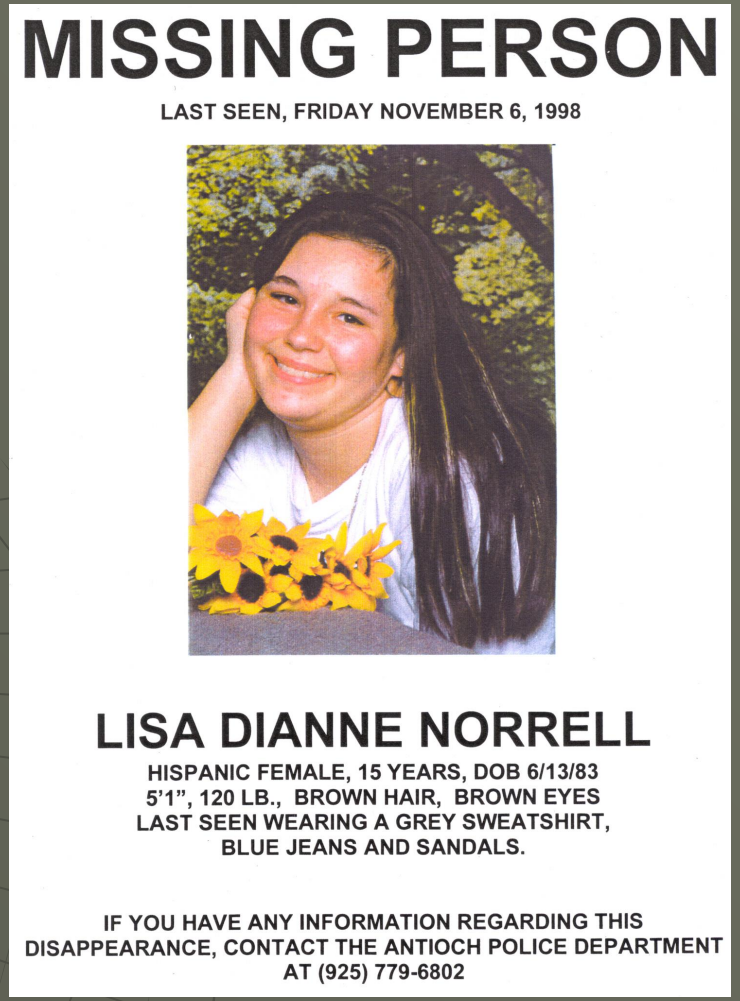
Started in the summer of 2021 through private funding, leading to student led research, senior projects and master's theses.

The “Art of What’s Possible”

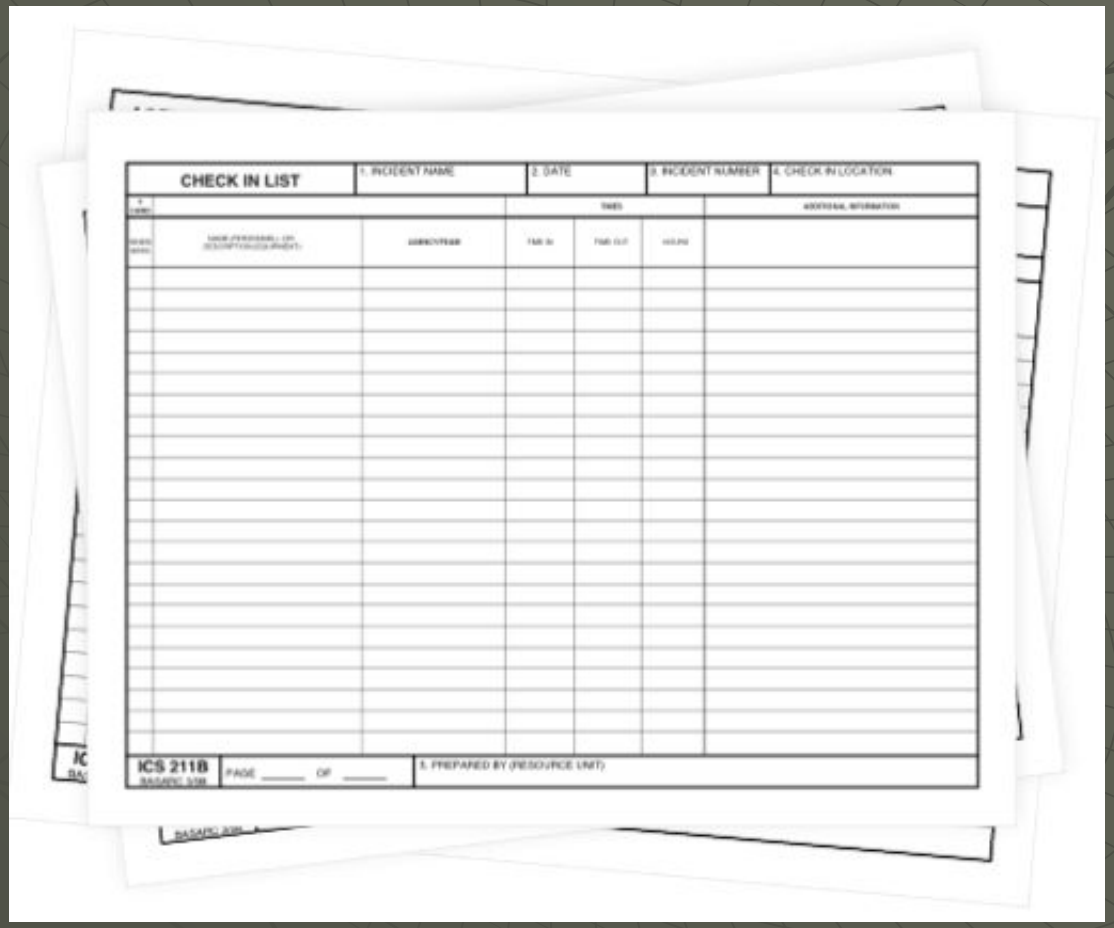
Collect search data in real-time and apply next generation AI technologies to a search operation in progress to predict where to look and to improve the time and probability of locating the missing subject.

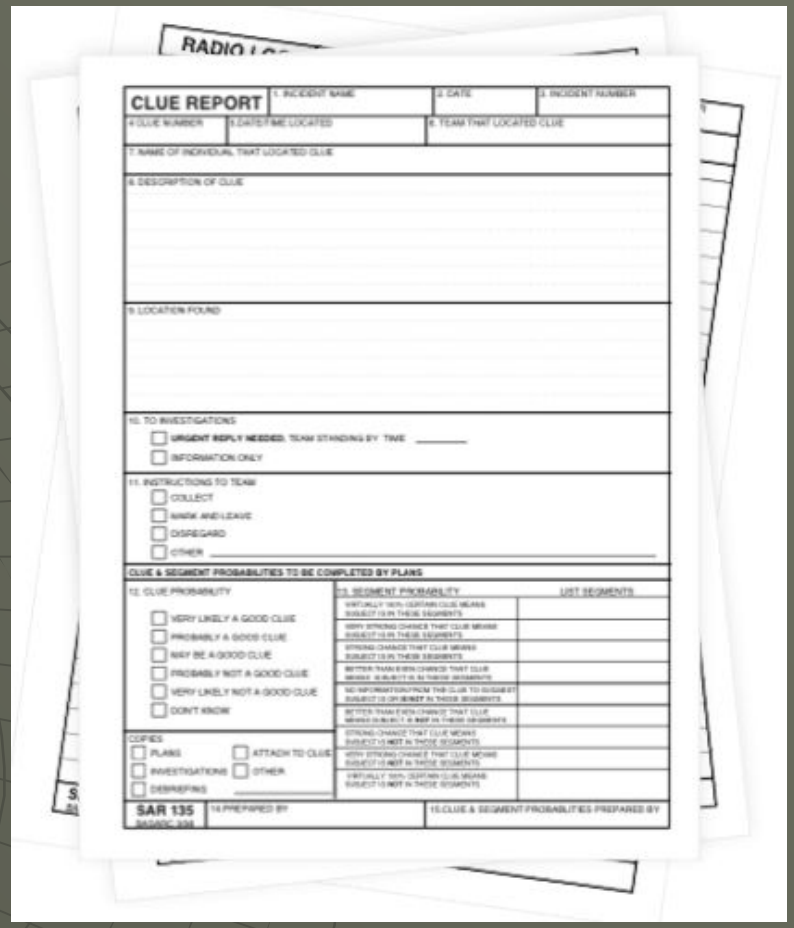
The “Art of What’s Possible”

Put more simply - - find the missing faster!!



Today's Reality: SAR is mostly a paper-based system





From Check-in to Investigations

CHECK IN LIST

1. INCIDENT NAME	2. DATE	3. INCIDENT NUMBER	4. CHECK IN LOCATION

		TIMES			

ICS 211B PAGE _____ OF _____ 5. PREPARED BY (RESOURCE UNIT)

Insert Logo Here

[Insert Name of Agency, SAR Team or Organization]

Missing Person (MP) Questionnaire/Interview Form/Guideline

(v6 rev. 01/06/2022)

For hard copy of this form go to: www.intelligentsearchmgt.com or see this QR code

NOTE: Use pencil/black ink, print clearly. Avoid confusing phrases/words and unfamiliar abbreviations. Record complete and detailed answers for future use. Answer ALL relevant questions, if possible.

INTERVIEWER: Introduce yourself, background, qualifications, and explain purpose and process of the interview.

***IMPORTANT**: Take breaks during the interview to report important search and planning information to CP.*
Complete & report highlighted sections & item #s to CP ASAP.
Check with Search Management for any additional high priority items.

A. INCIDENT INFORMATION

1. Incident Name:_____ 2. Today's date: _____ 3. Time: _____
4. Interviewer(s): _____ 5. Location: _____ 6. Incident number: ___

B. SOURCE(S) INFORMATION

1. Name: _____2. How Info received: ❑ In Person ❑ Phone ❑ Other _____
3. Home Address: _____
4. Phone 1: _____ 5. Phone 2: _____6. Relationship to MP: _____
7. Where/How to contact now: _____
8. Where/How to contact later: _____
9. What does interviewee believe happened: _____
9. Why is witness qualified to provide background information: _____

C. MISSING PERSON INFORMATION

1. Full Name: _____ 2. DOB: _____ 3. Sex: _____
4. Maiden Name: _____ 5. Nicknames: _____ 6. Other AKA's: _____
7. Name to call: _____ 8. Safe/Password: _____ 9. Who Knows Safe/Password: _____
10. Home Address: _____ 11. Zip: _____
12. Local Address/Campsite/Lodging: _____ 13. Zip: _____
14. Home Phone: _____ 15. Local Phone: _____ 16. E-mail Address(es): _____
17. 1st Cell Phone: _____ 18. 1st Cell Carrier: _____ 19. 1st Voice Mail PIN: _____
20. 2nd Cell Phone: _____ 21. 2nd Cell Carrier: _____ 22. 2nd Voice Mail PIN: _____

(Complete Section N with more Cell Phone data)

23. How long lived at this location/area? ____ 24. Previous addresses: _____
_____
25. Facebook/Other Sites: _____ 26. Screen Names/Alias: _____ *(See Section N for Details)*
27. Birthplace: _____ 28. Ethnicity: _____ 29. National Origin: _____ 30. Immigration Status: _____
31. Language(s)/Preferred: _____ 32. Spoken under stress (curse): _____ 33. Impediments/accent: _____
34. Work/Student: _____ 35. Contact Person: _____ 36. Phone: _____
37. Work/School Address: _____
38. Driver's License Number: _____ 39. State: _____ 40. Status (Current/Suspended): _____

This Reality Makes Analysis of the Data Very Difficult and Real-Time Analysis Impossible

The Solution – IntelliSAR (Step One)

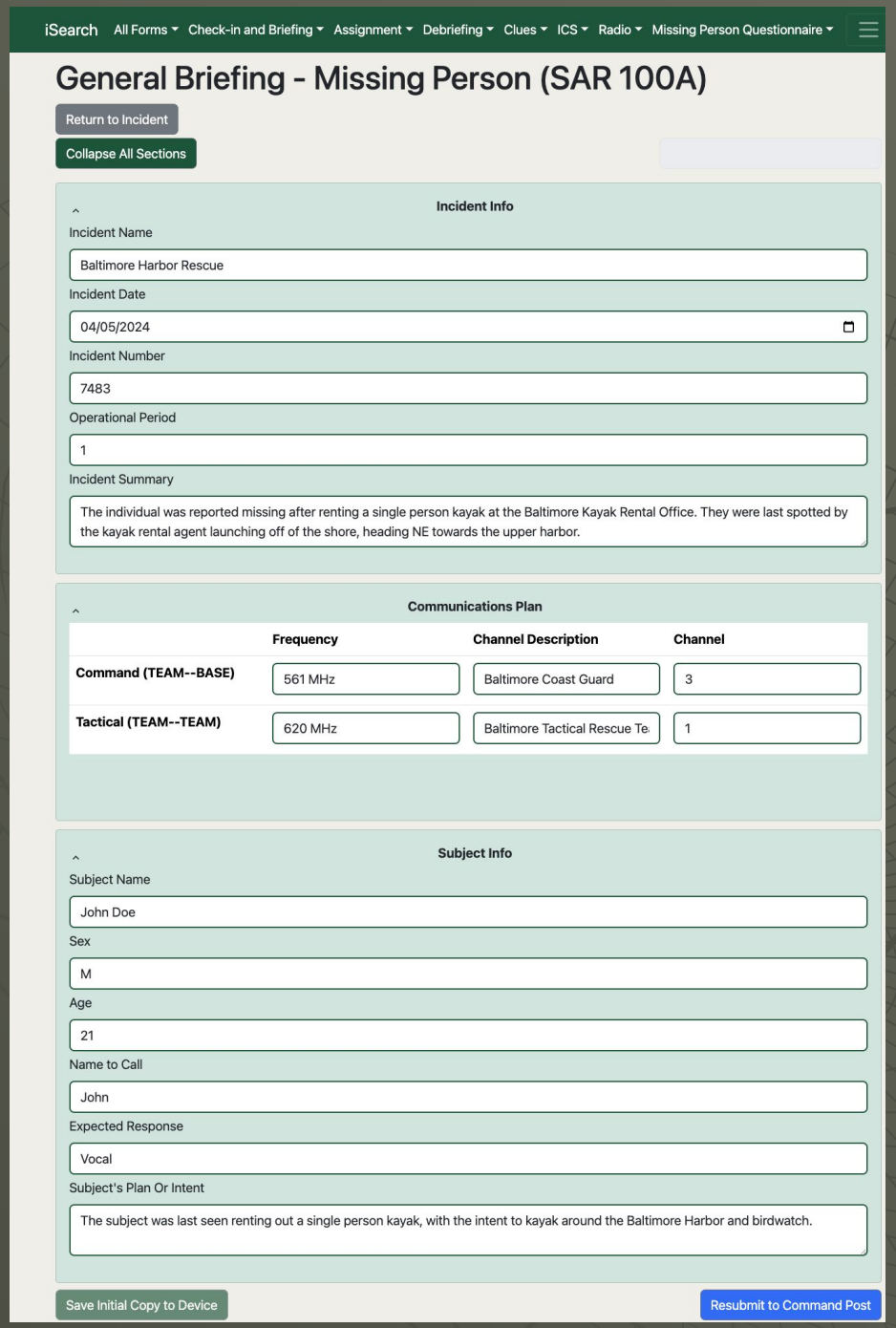
Move the entire search operation to an online system where information is collected in a database in real-time - - improving productivity, the flow of information and ultimately, search outcomes

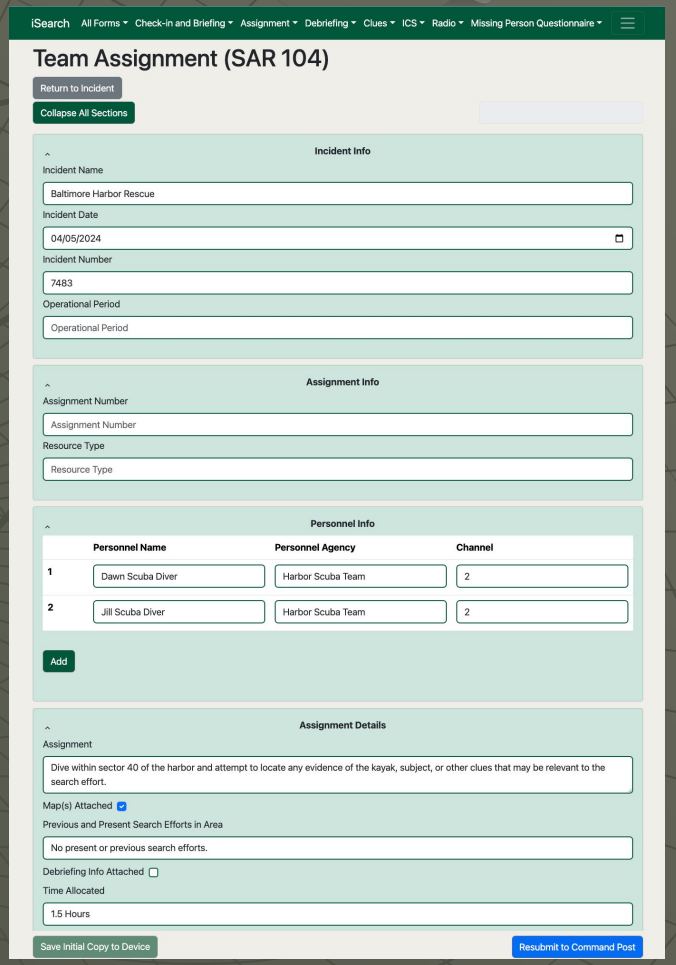
Enrich the Real-Time Data with External Data Sources (Step Two)

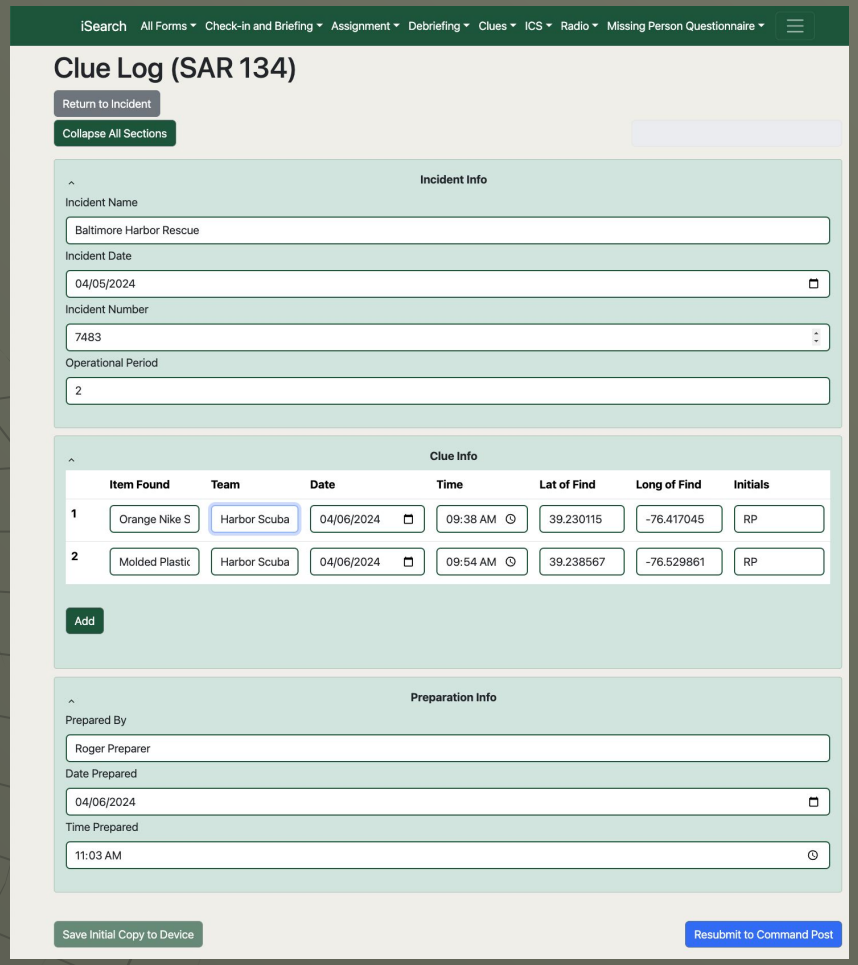
- Dr. Robert Koester's historical data set (ISRID)
- Public data sets
  - New York
  - Yosemite…
- Mapping data – Google Maps™, Terrain maps, CalTopo™ data, ESRI ArcGIS™

Apply AI to the Enriched Data to Improve Search Outcomes and Predict in Real-Time Where the Missing Will be Located (Step 3)

Step One: Real-Time Electronic Collection of Search Data







Demonstration of Step 1: Real Time Data Collection and Search Management Platform

Logan Barker

IntelliSAR

Hello, Julian Duran

Incidents

Create New Incident

JPD Rescue Incident	Gary Bloom - Simple Pre-...	Leo Demo Incident	Gary Bloom - redo simple...	Demo - First Pass
Incident Name: JPD Rescue Incident	**Incident Name:** Gary Bloom - Simple Pre-test prior to starting more extensive testing	**Incident Name:** Leo Demo Incident	**Incident Name:** Gary Bloom - redo simple pre-test as saved version of this form is listed, but will not reload	**Incident Name:** Demo - First Pass
Incident Number: 82374	**Incident Number:** 500	**Incident Number:** 815311	**Incident Number:** 600	**Incident Number:** 1
Incident Date: 2018-02-14	**Incident Date:** 2024-02-04	**Incident Date:** 2024-04-04	**Incident Date:** 2024-02-04	**Incident Date:** 2024-03-18

IntelliSAR

Hello, Julian Duran

Incidents

Create New Incident

JPD Rescue Incident	Gary Bloom - Simple Pre-...	Leo Demo Incident	Baltimore Harbor Rescue	Gary Bloom - redo simple...	Demo - First Pass
Incident Name: JPD Rescue Incident	**Incident Name:** Gary Bloom - Simple Pre-test prior to starting more extensive testing	**Incident Name:** Leo Demo Incident	**Incident Name:** Baltimore Harbor Rescue	**Incident Name:** Gary Bloom - redo simple pre-test as saved version of this form is listed, but will not reload	**Incident Name:** Demo - First Pass
Incident Number: 82374	**Incident Number:** 500	**Incident Number:** 815311	**Incident Number:** 7483	**Incident Number:** 600	**Incident Number:** 1
Incident Date: 2018-02-14	**Incident Date:** 2024-02-04	**Incident Date:** 2024-04-04	**Incident Date:** 2024-04-05	**Incident Date:** 2024-02-04	**Incident Date:** 2024-03-18

IntelliSAR All Forms Check-in and Briefing Assignment Debriefing Clues ICS Radio Missing Person Questionnaire

Baltimore Harbor Rescue

Dashboard My Saved Forms My Submitted Forms All Submitted Forms

Missing Person Information

Name: John Doe
Age:
Height:
Sex: M
When reported missing:
4/5/2024

Clues

No clues to display

Map

Clues Command Post Location

Resources

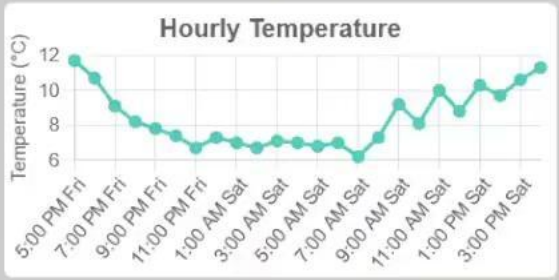
Agency	Headcount

No resources to display

Timeline

Last Seen:	Unknown
Time Since Last Seen:	Unknown
Reported Missing:	04/05/2024, 05:08:59 PM
SAR Arrived:	No agencies have arrived yet.

Weather



1 Temperature Precipitation Humidity Cloud Cover Wind Speed Wind Direction

Missing Person Information

Name: John Doe
Age: 21
Height: 5'11
Sex: M
When reported missing:
4/5/2024

Clues

No clues to display

Map

Clues Command Post Location

Resources

Agency	Headcount

No resources to display

Timeline

Last Seen:	Unknown
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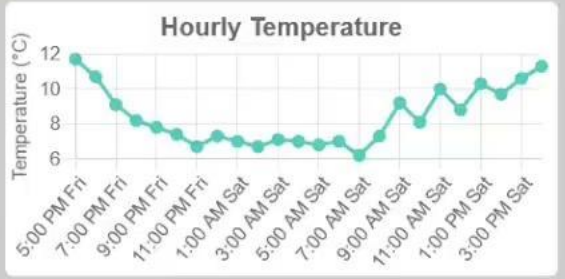
Weather



1 Temperature Precipitation Humidity
Cloud Cover Wind Speed Wind Direction

IntelliSAR All Forms Check-in and Briefing Assignment Debriefing Clues ICS Radio Missing Person Questionnaire

Dashboard My Saved Forms My Submitted Forms All Submitted Forms

Missing Person Information

Name: John Doe
Age: 21
Height: 5'11
Sex: M
When reported missing: 4/5/2024

Clues

No clues to display

Map

Clues Command Post Location

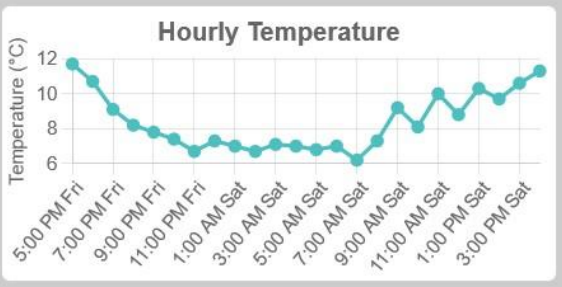
Resources

Agency	Headcount
Harbor Scuba Team	6
Baltimore Sheriff's Office	1

Timeline

Last Seen:	Unknown
Time Since Last Seen:	Unknown
Reported Missing:	04/05/2024, 05:08:59 PM
SAR Arrived:	Harbor Scuba Team Baltimore Sheriff's Office

Weather



1 Temperature Precipitation Humidity Cloud Cover Wind Speed Wind Direction

IntelliSAR All Forms Check-in and Briefing Assignment Debriefing Clues ICS Radio Missing Person Questionnaire

Dashboard My Saved Forms My Submitted Forms All Submitted Forms

Missing Person Information

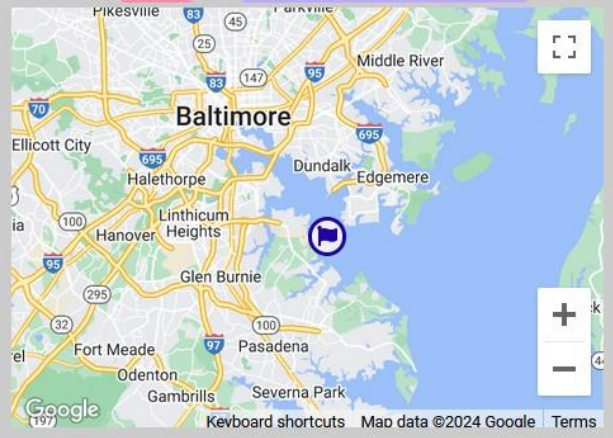
Name: John Doe
Age: 21
Height: 5'11
Sex: M
When reported missing: 4/5/2024

Clues

No clues to display

Map

Clues Command Post Location



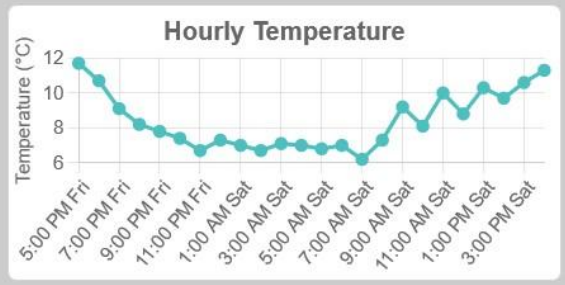
Resources

Agency	Headcount
Harbor Scuba Team	6
Baltimore Sheriff's Office	10

Timeline

Last Seen:	Unknown
Time Since Last Seen:	Unknown
Reported Missing:	04/05/2024, 05:08:59 PM
SAR Arrived:	Harbor Scuba Team Baltimore Sheriff's Office

Weather



1 Temperature Precipitation Humidity Cloud Cover Wind Speed Wind Direction

IntelliSAR All Forms Check-in and Briefing Assignment Debriefing Clues ICS Radio Missing Person Questionnaire

Dashboard My Saved Forms My Submitted Forms All Submitted Forms

Missing Person Information

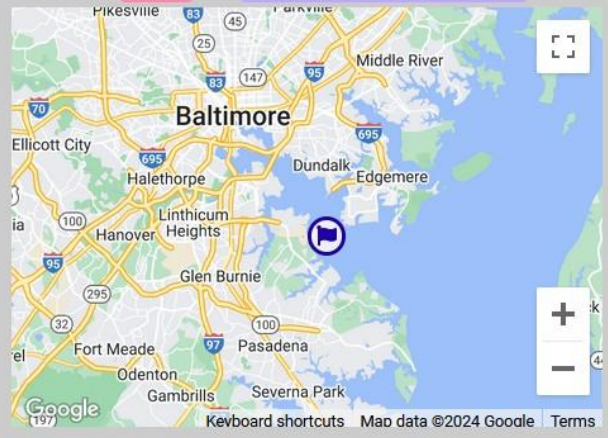
Name: John Doe
Age: 21
Height: 5'11
Sex: M
When reported missing: 4/5/2024

Clues

No clues to display

Map

Clues Command Post Location



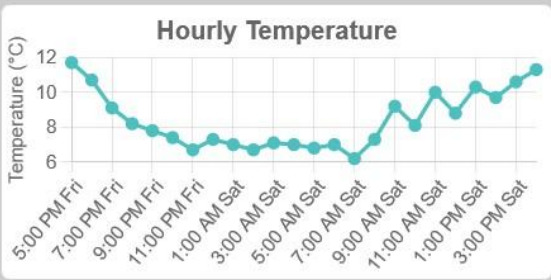
Resources

Agency	Headcount
Baltimore SAR Team 1	4
Harbor Scuba Team	6
Baltimore Sheriff's Office	10

Timeline

Last Seen:	Unknown
Time Since Last Seen:	Unknown
Reported Missing:	04/05/2024, 05:08:59 PM
SAR Arrived:	Baltimore SAR Team 1 Harbor Scuba Team Baltimore Sheriff's Office

Weather



1 Temperature Precipitation Humidity Cloud Cover Wind Speed Wind Direction

Return to Incident

Team Assignment (SAR 104)

Collapse All Sections

Personnel Info

	Personnel Name	Personnel Agency	Channel
1	Regina Searcher	Baltimore SAR Team 1	3
2	Phillip Searcher	Baltimore SAR Team 1	3
3	Alexander Searcher	Baltimore SAR Team 1	3

Add

Assignment Details

Assignment

Drive to lifeguard station 3, and interview the lifeguard manager to get any relevant information. Collect the name and contact information of the lifeguard who was on duty when the subject went missing. Inquire about CCTV footage of the harbor roads and footpaths.

Map(s) Attached ☑

Previous and Present Search Efforts in Area

No present or previous search efforts.

Debriefing Info Attached ☐

Save Initial Copy to Device

Submit to Command Post

Return to Incident

Team Assignment (SAR 104)

Collapse All Sections

Personnel Info

	Personnel Name	Personnel Agency	Channel
1	Dawn Scuba Diver	Harbor Scuba Team	2
2	Jill Scuba Diver	Harbor Scuba Team	2

Add

Assignment Details

Assignment

Dive within sector 40 of the harbor and attempt to locate any evidence of the kayak, subject, or other clues that may be relevant to the search effort.

Map(s) Attached ☑

Previous and Present Search Efforts in Area

No present or previous search efforts.

Debriefing Info Attached ☐

Time Allocated

1.5 Hours

Save Initial Copy to Device

Submit to Command Post

IntelliSAR All Forms Check-in and Briefing Assignment Debriefing Clues ICS Radio Missing Person Questionnaire

- Team Debriefing (SAR 110)
- Team Debriefing - Dog Supplement(SAR 111)
- Team Debriefing - Area Search Supplement (SAR 112)
- Team Debriefing - Equestrian Supplement (SAR 113)
- Team Debriefing - Tracking Team Supplement (SAR 115)
- Team Debriefing - Hasty Search Supplement (SAR 116)
- Team Debriefing Supplement (SAR 119)

Baltimore Harbor Rescue

Dashboard My Saved Forms My Submitted Forms All Submitted Forms

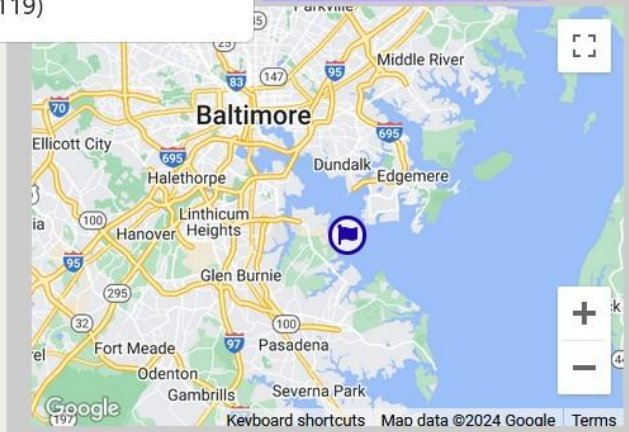
Missing Person Information

Name: John Doe
Age: 21
Height: 5'11
Sex: M
When reported missing: 4/5/2024

No c

Map

Command Post Location



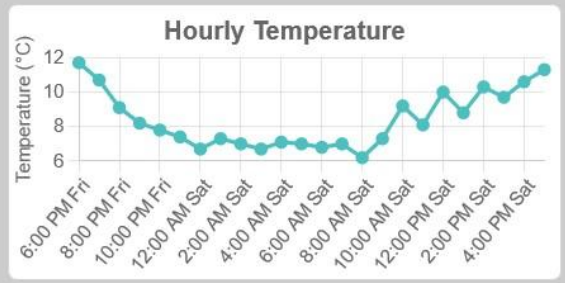
Resources

Agency	Headcount
Baltimore SAR Team 1	4
Harbor Scuba Team	6
Baltimore Sheriff's Office	10

Timeline

Last Seen:	Unknown
Time Since Last Seen:	Unknown
Reported Missing:	04/05/2024, 05:08:59 PM
SAR Arrived:	Baltimore SAR Team 1 Harbor Scuba Team Baltimore Sheriff's Office

Weather



1 Temperature Precipitation Humidity Cloud Cover Wind Speed Wind Direction

Return to Incident

Team Debriefing (SAR 110)

Collapse All Sections

Search Details

Describe Search Efforts

The team was underwater for a total of 1 hour 14 minutes, of which 58 minutes were spent searching the harbor floor. The team spread out and swept the sector East to West, at a distance of about 20 feet from each other. Oxygen supplies during and after the search effort were normal.

Describe Portions You Were Unable To Search

The NE corner of the sector was not searched thoroughly due to time constraint. The team is requesting another assignment to explore this corner further.

Describe any Hazards or Problems Encountered

No hazards were encountered. The water clarity was low, which is normal for the harbor, making search efforts more difficult and time consuming. The dive team noted that they will bring additional flashlights for the next assignment.

Search Results

Describe Any Clues, Tracks, Or Sign Located, Or Any Pertinent Trail Interviews

An orange Nike shoe matching the clothing description was recovered floating on the water by the dive support team. The dive team also found a piece of molded plastic that could have possibly originated from a kayak.

Suggestions For Further Search Efforts In Or Near Your Assignemnt

Sector 45, which is adjacent to sector 40 should be searched, as well as the NE corner of sector 40, which was not searched as thoroughly as the dive team would have liked.

Save Initial Copy to Device

Submit to Command Post

Return to Incident

Team Debriefing (SAR 110)

Collapse All Sections

Search Details

Describe Search Efforts

The team was underwater for a total of 1 hour 14 minutes, of which 58 minutes were spent searching the harbor floor. The team spread out and swept the sector East to West, at a distance of about 20 feet from each other. Oxygen supplies during and after the search effort were normal.

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An orange Nike shoe matching the clothing description was recovered floating on the water by the dive support team. The dive team also found a piece of molded plastic that could have possibly originated from a kayak.

Suggestions For Further Search Efforts In Or Near Your Assignemnt

Sector 45, which is adjacent to sector 40 should be searched, as well as the NE corner of sector 40, which was not searched as thoroughly as the dive team would have liked.

Save Initial Copy to Device

Submit to Command Post

Clue Log (SAR 134)

Return to Incident

Collapse All Sections

Incident Info

Incident Name

Baltimore Harbor Rescue

Incident Date

04/05/2024

Incident Number

7483

Operational Period

2

Clue Info

	Item Found	Team	Date	Time	Lat of Find	Long of Find	Initials
1	Orange Nike Sho	Harbor Scuba Te	04/06/2024	09:38 AM	39.229405	-76.529661	SSD
2	Molded Plastic Sl	Harbor Scuba Te	04/06/2024	09:54 AM	39.234567	-76.525639	SSD

Save Initial Copy to Device

Submit to Command Post

Missing Person Information

Name: John Doe
Age: 21
Height: 5'11
Sex: M
When reported missing: 4/5/2024

Clues

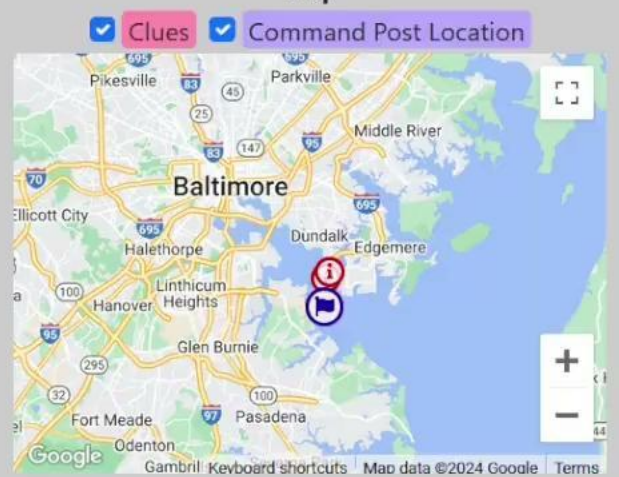
Molded Plastic Shard

Date: 2024-04-06 **Team:** Harbor Scuba Team
Time: 09:54
Lat: 39.234567 **Initials:** SSD
Long: -76.525639

Orange Nike Shoe

Date: 2024-04-06 **Team:** Harbor Scuba Team
Time: 09:38
Lat: 39.229405 **Initials:** SSD

Map



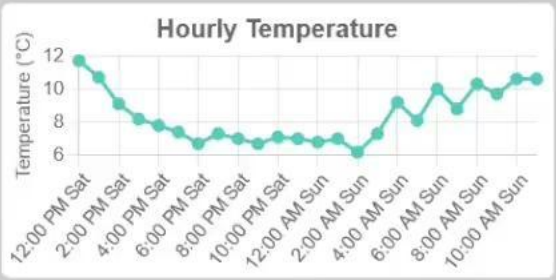
Resources

Agency	Headcount
Baltimore SAR Team 1	4
Harbor Scuba Team	6
Baltimore Sheriff's Office	10

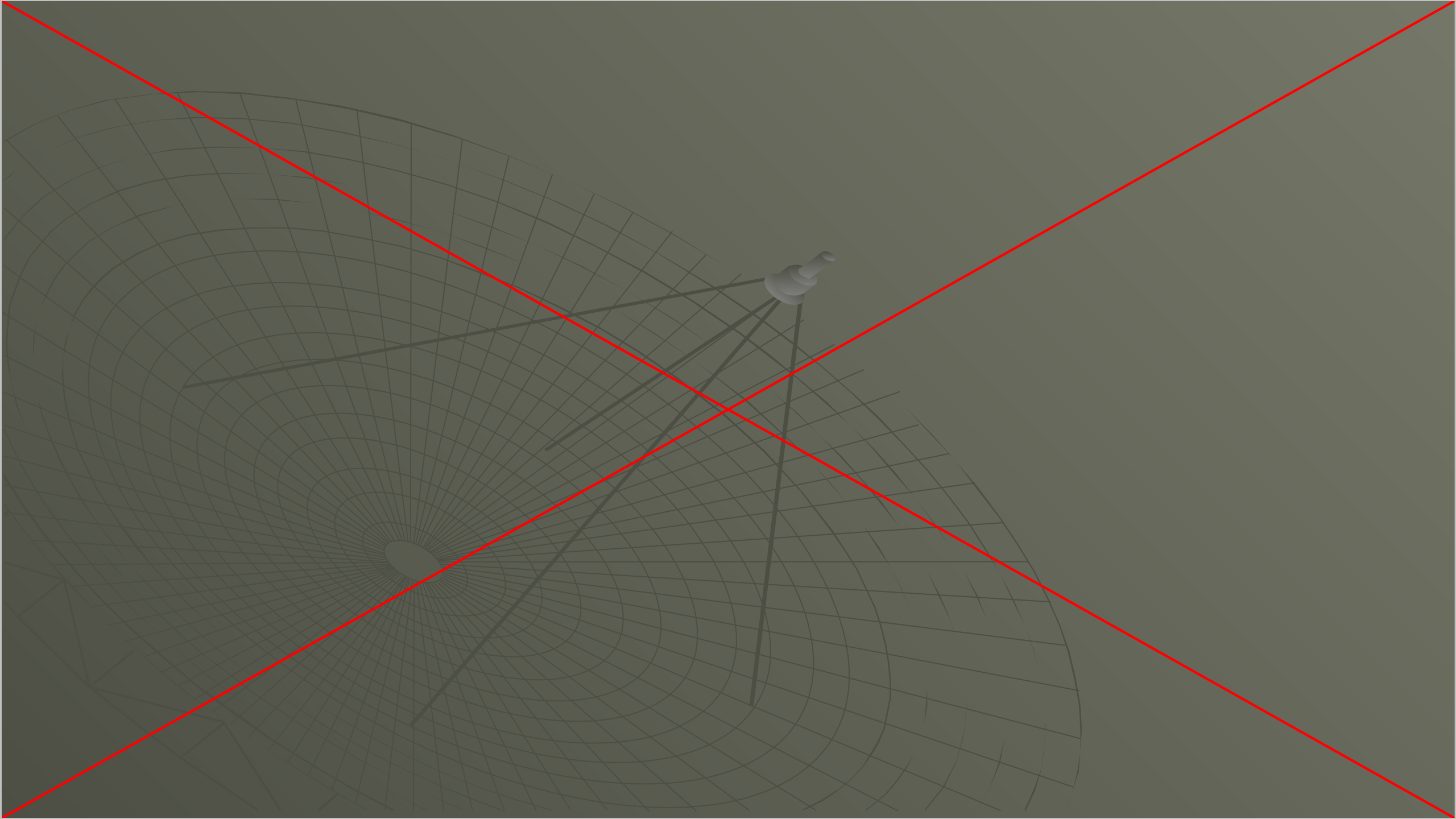
Timeline

Last Seen: Unknown
Time Since Last Seen: Unknown
Reported Missing: 04/05/2024, 05:08:59 PM
SAR Arrived: Baltimore SAR Team 1
Harbor Scuba Team
Baltimore Sheriff's Office

Weather



1 Temperature Precipitation Humidity
Cloud Cover Wind Speed Wind Direction



Current Status

- Integrated search for full text and semantic search
- Dashboard complete and populating automatically as data is entered
- Mobile applications moving to App Stores
- BASARC and ICS forms field tested with Contra Costa County (California) SAR mock search
- AI Insights linked to dashboard

Applying AI Technology

Dr. Franz Kurfess

Aspect	*Generative AI*	*SAR AI Insights*
Foundation	Shallow: Correlations extracted from large sets of documents	Deep: Information from SAR-specific sources
Interpretation	Implied from statistical similarities	Based on domain knowledge
Context	Very broad, general knowledge	Focused on SAR
Interaction	Separate tool (browser window)	IntelliSAR dashboard integration
Timeliness	Static repository of documents, possibly augmented by generic Web search	Direct integration of ongoing search information
Explainability	Recent attempts at exposing "reasoning" steps	Use of decision trees derived from historical data (in addition to those created by domain experts)

Find missing persons faster: Support SAR personnel through a digital platform with AI technologies

Goal	Approach	Technology	AI Methods	Buzzwords
Reduce cognitive load	*capture information digitally*	mobile forms, dictation, photos	speech transcription, image processing	**Intelligent Assistant, Deep Learning**
	extract and filter information	database, information retrieval	natural language processing, machine learning	**Deep Learning**
	assemble knowledge repository	database	ontology, knowledge graph	**Knowledge Graphs, LLMs**
	unearth connections	graph analysis	LLM, multimodal representation	**LLMs, Deep Learning**
	prioritize clues	database	recommendation system	**machine learning**
Support decision-making	*access to historical cases*	ISRID, previous cases	ontology, knowledge graph	**Knowledge Graphs, LLMs**
	specialized knowledge, skills (e.g., medical)	access to external systems	decision trees, expert systems	
	what-if scenarios	case repository	simulation, decision trees, planning systems	**LLMs, Agents, Agentic Design, Generative AI**
Utilize resources effectively	*catalog of resources (capabilities, availability)*	database		
	planning and coordination	database	planning, constraint reasoning, agents	**Agents, Reasoning**
	Information sharing	communication	agents	**Agents, MCP**

Limitations

- Lack of data
  - gaps and quality issues in most historical data
  - some data may also be outdated
- Limited experience with technologies
  - LLMs, GenAI are only a few years old
- Over-reliance on technology
  - lack of experience
  - suspension of common sense

Our Primary Approaches After Experimenting with Multiple Emerging AI Technologies

- Machine Learning
- Deep learning
- Explainable AI
- Knowledge Graphs and Large Language Models
- Agentic Design (the newest trend)

Machine Learning Models

Vasanth Pugalenthi

Train machine learning models on SAR datasets to predict, reduce and analyze costs, resources, and time

Data ML Training Pattern Analysis

Expected Outcome

- Enhance the efficiency of search and rescue missions
- Direct searchers to high probability areas
- This approach will reduce both the time and financial costs associated with search efforts

Data Sources

- Digital and scanned physical reports
- Datasets include ISRID 2, ISRID 3, etc
- Close to 62k observations recorded
- Features span from broad categories such as age to more precise details like latitude.

Priority Score Model

Machine Learning Beats Standard Checklists

- Predicts actual survival risk by learning from past cases, not just scores.
- Finds deeper patterns in terrain, time, age, and activity.
- Improves with more data and handles missing info well.

Subject Profile Age

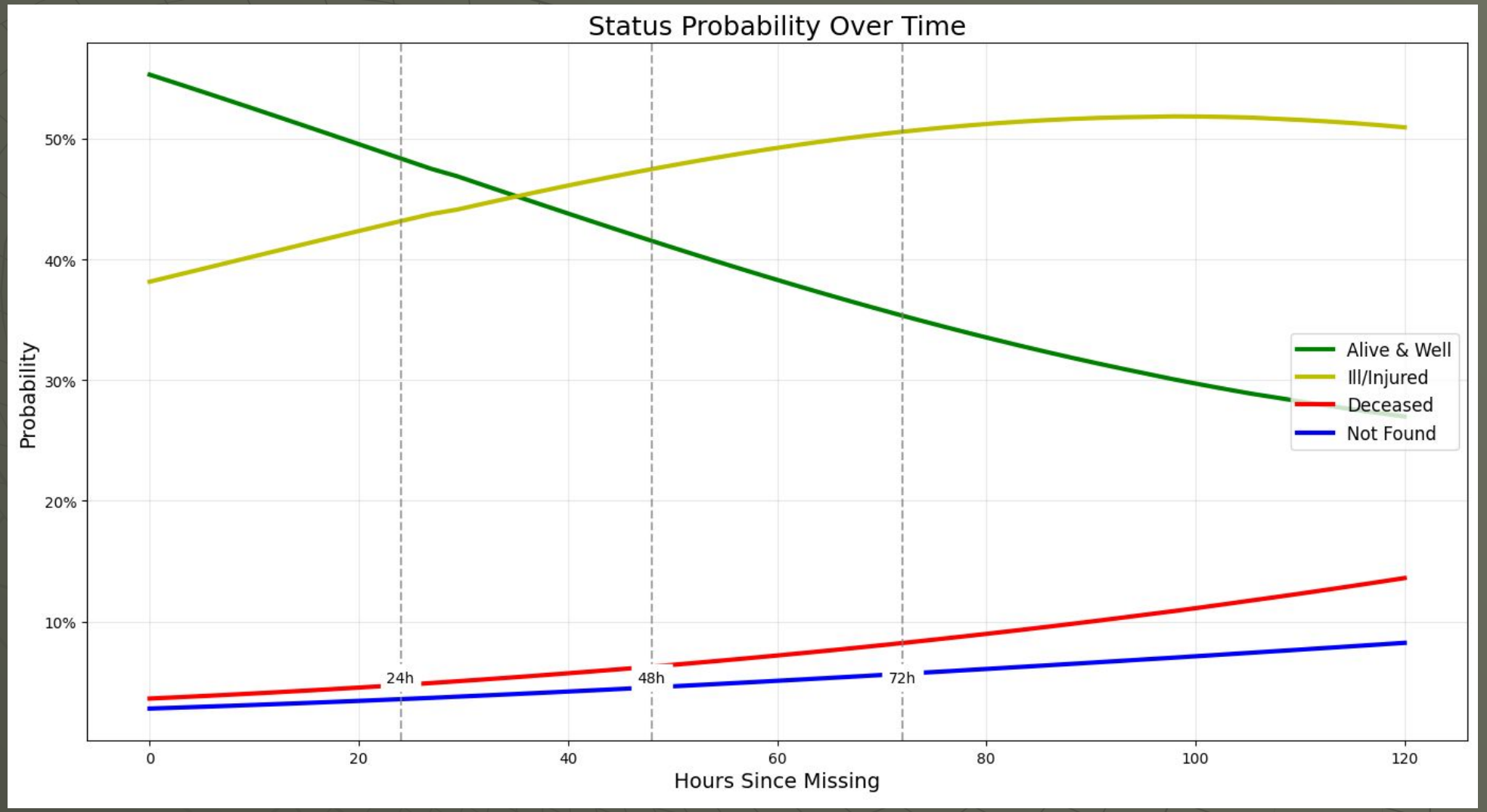
Very Young 1
Very Old 1
Other 2-3

Medical condition

Known or suspected ill or injured 1-2
Healthy 3
Known Fatality 3

Number of Subjects

One Alone. 1
More than one (unless separation suspected)....2-3

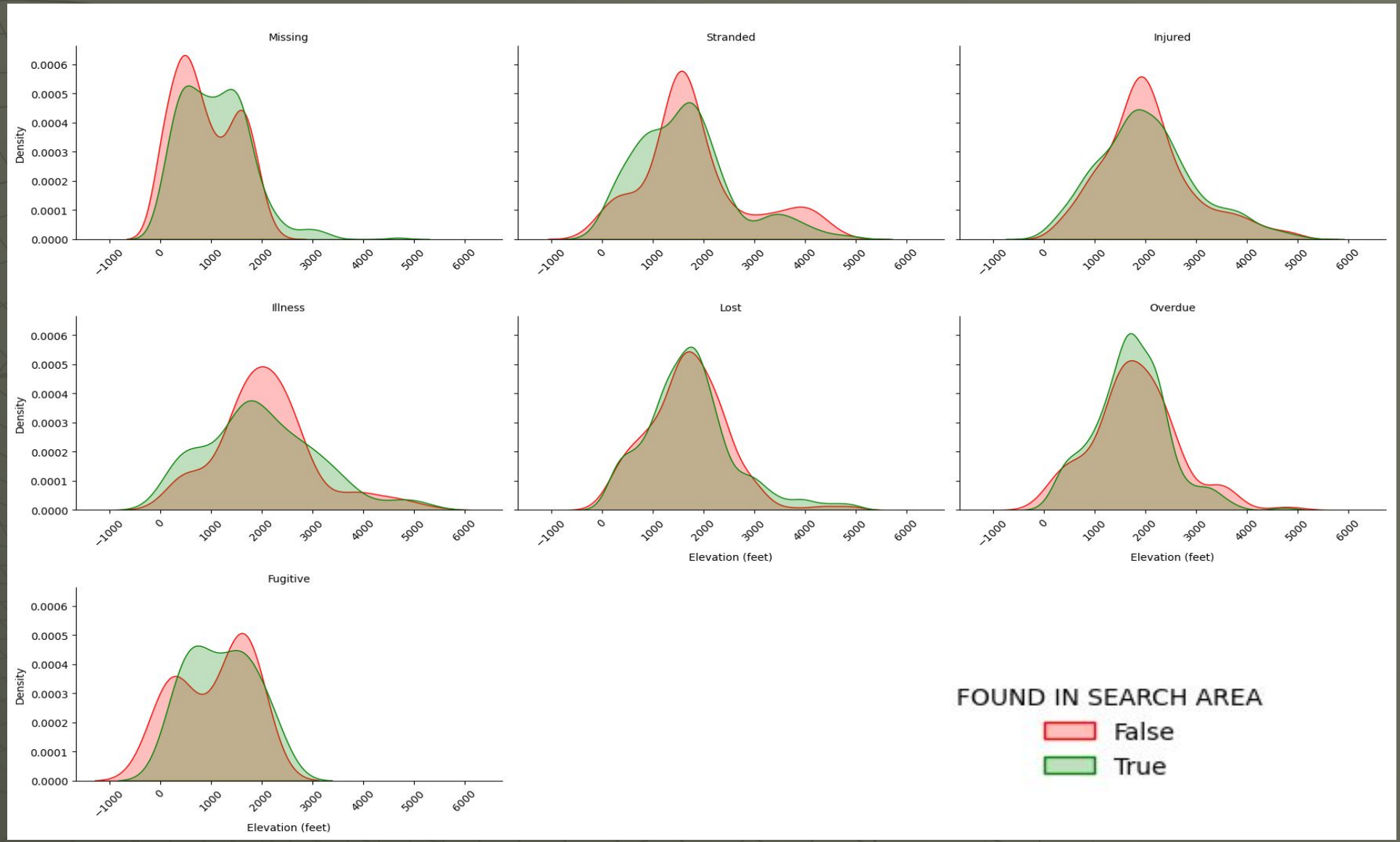


Subject Profile

- Age 35
- Physical Fitness: Good
- Experience: Experienced
- Environment: Forest

How Elevation Influences Subject Situation and Discovery

Population Density



Elevation(Feet)

K-Nearest-Neighbors Wander Status Prediction Model

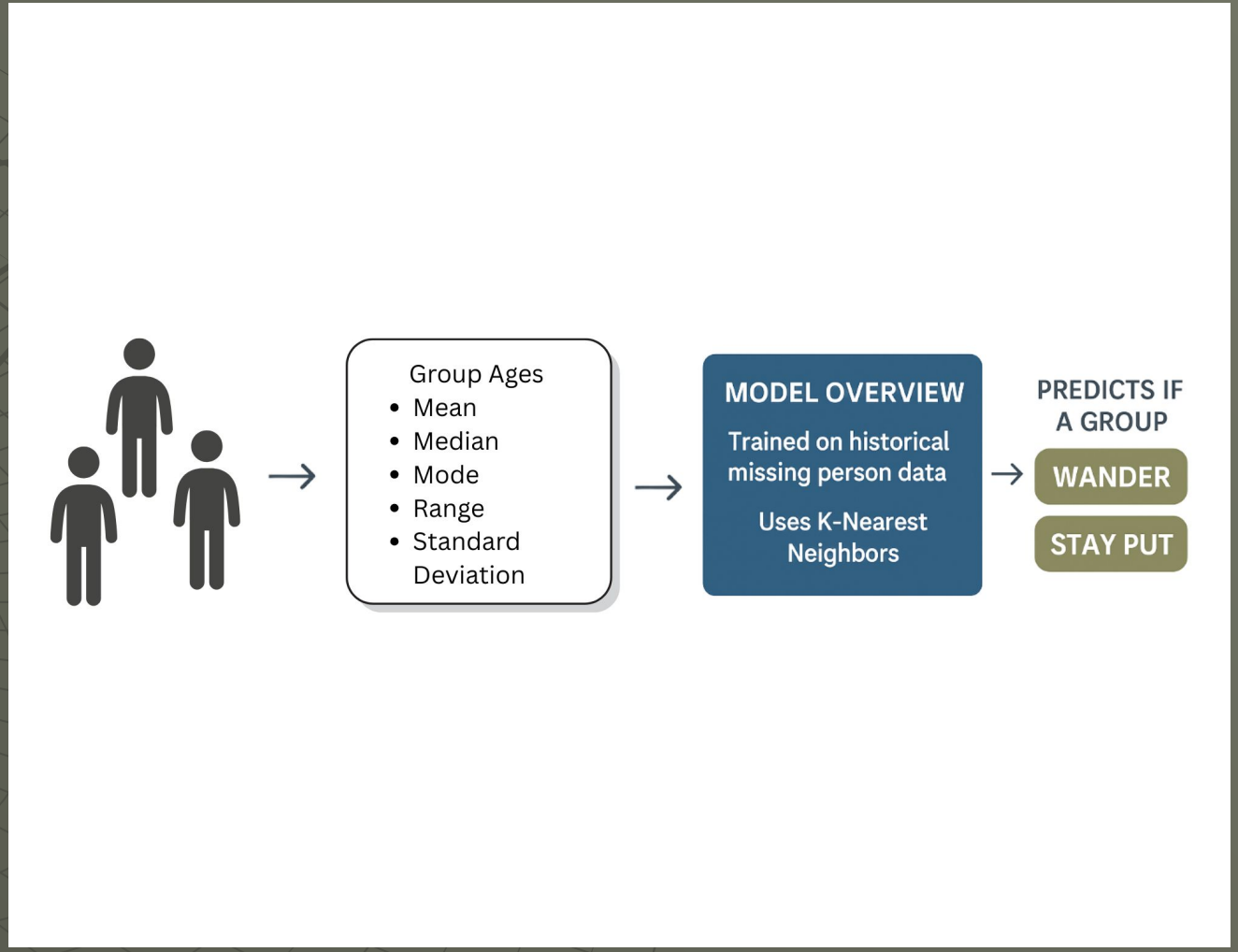
Model Overview:

- Input Features: Group size and ages of people in group

How It Works:

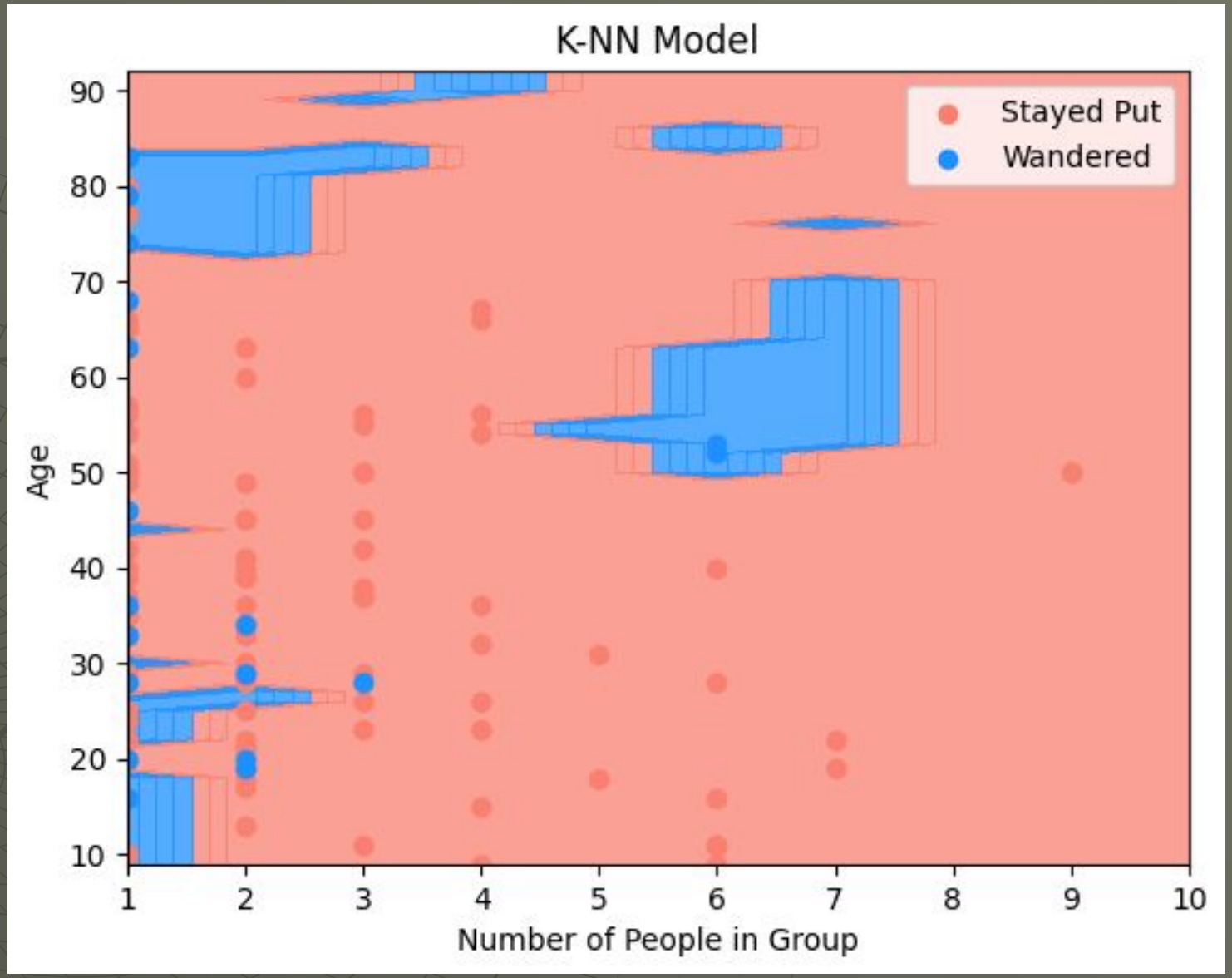
- Trained on historical missing person data
- Uses K-Nearest Neighbors to identify patterns in group behavior

Predicts if a group is likely to "Wander" or "Stay Put"



Relationship between age, group size, and wandering behavior

- Individuals aged 75-85, in groups of 1-3, show a higher tendency to wander, consistent with prior dementia-related findings.



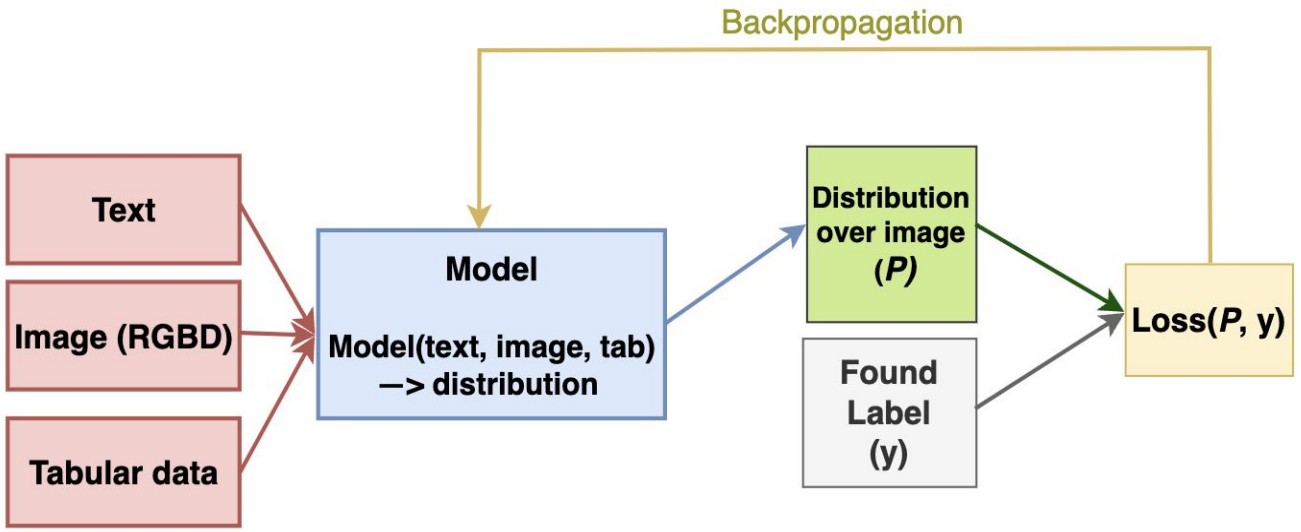
Deep Learning

Brandon Kim

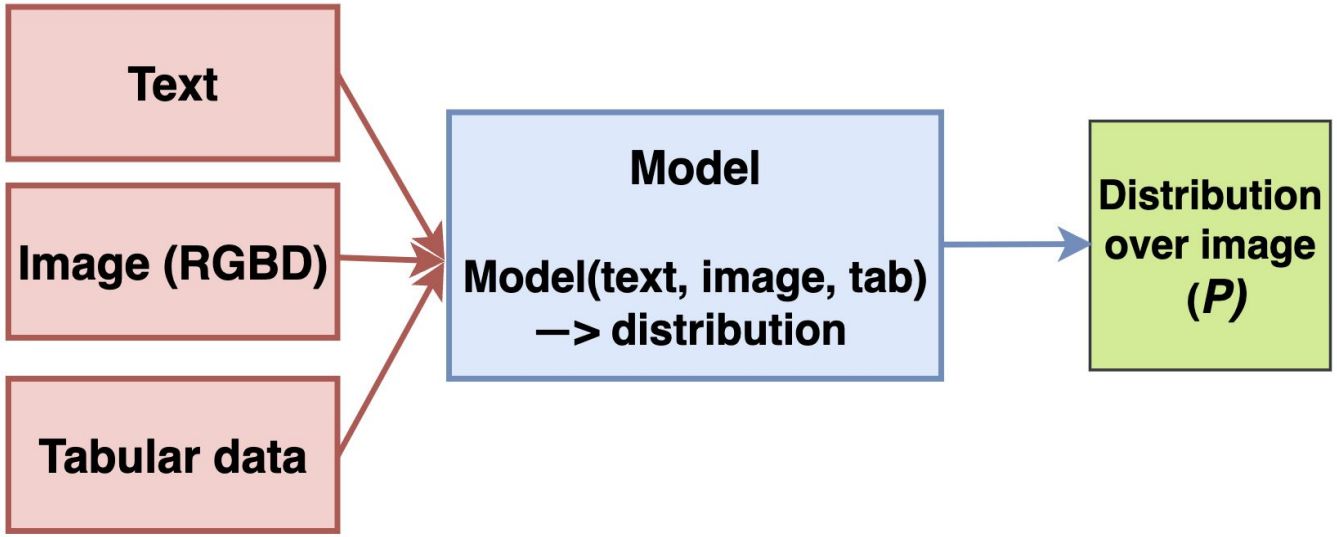
Process

SARFormer Architecture

Training process:



Inference process:



Text:

Mammoth Cave National Park (Southeast Region, Kentucky)
Start: 2019-05-10, 11:43:00
Due to: inattention, judgment error, physical condition
4 subjects, boating:

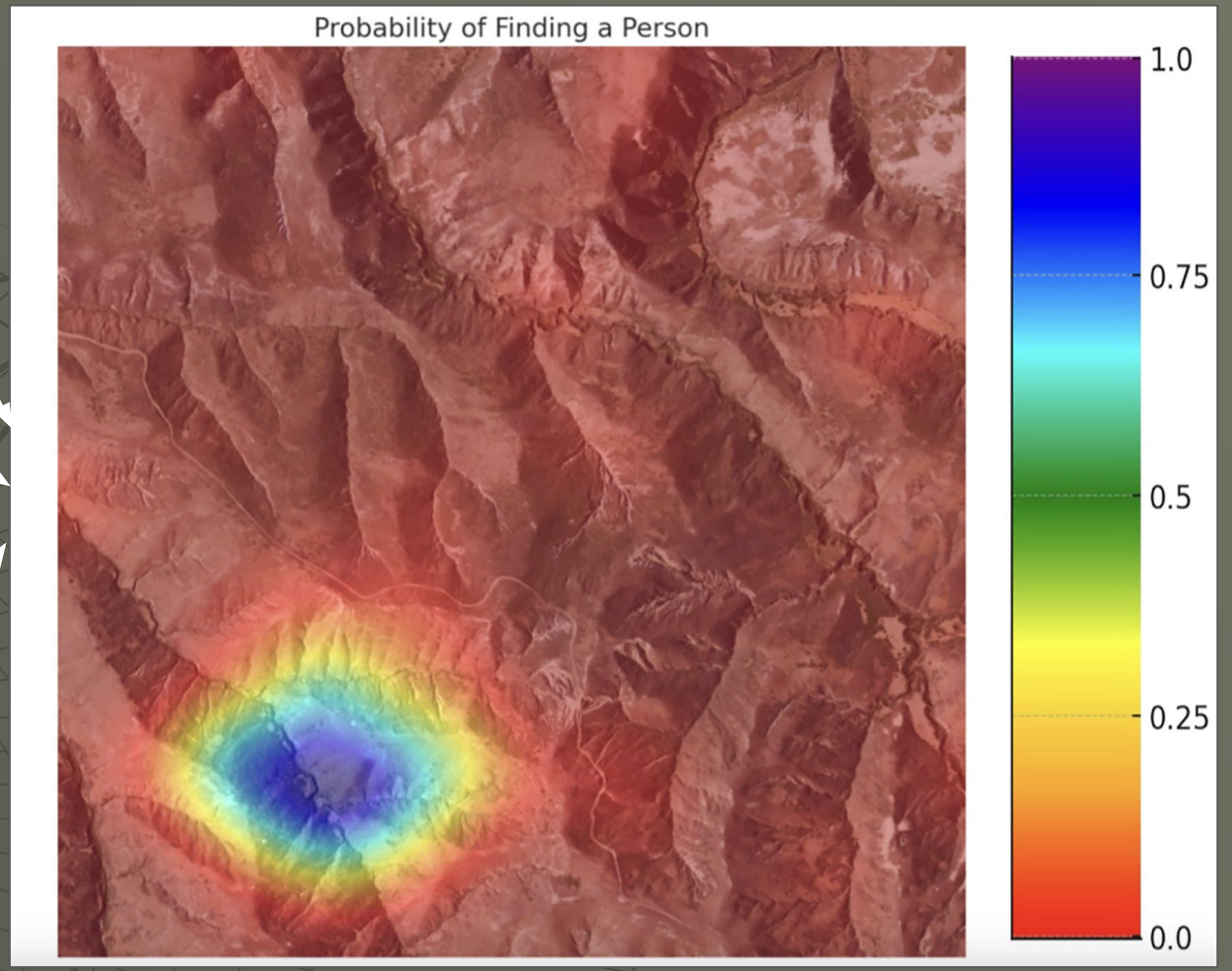
- 31 yo female, poor physical condition
- 21 yo female, poor physical condition
- 21 yo female, poor physical condition
- 21 yo female, poor physical condition

IPP: (-86.11017551, 37.20051619)

Tabular:

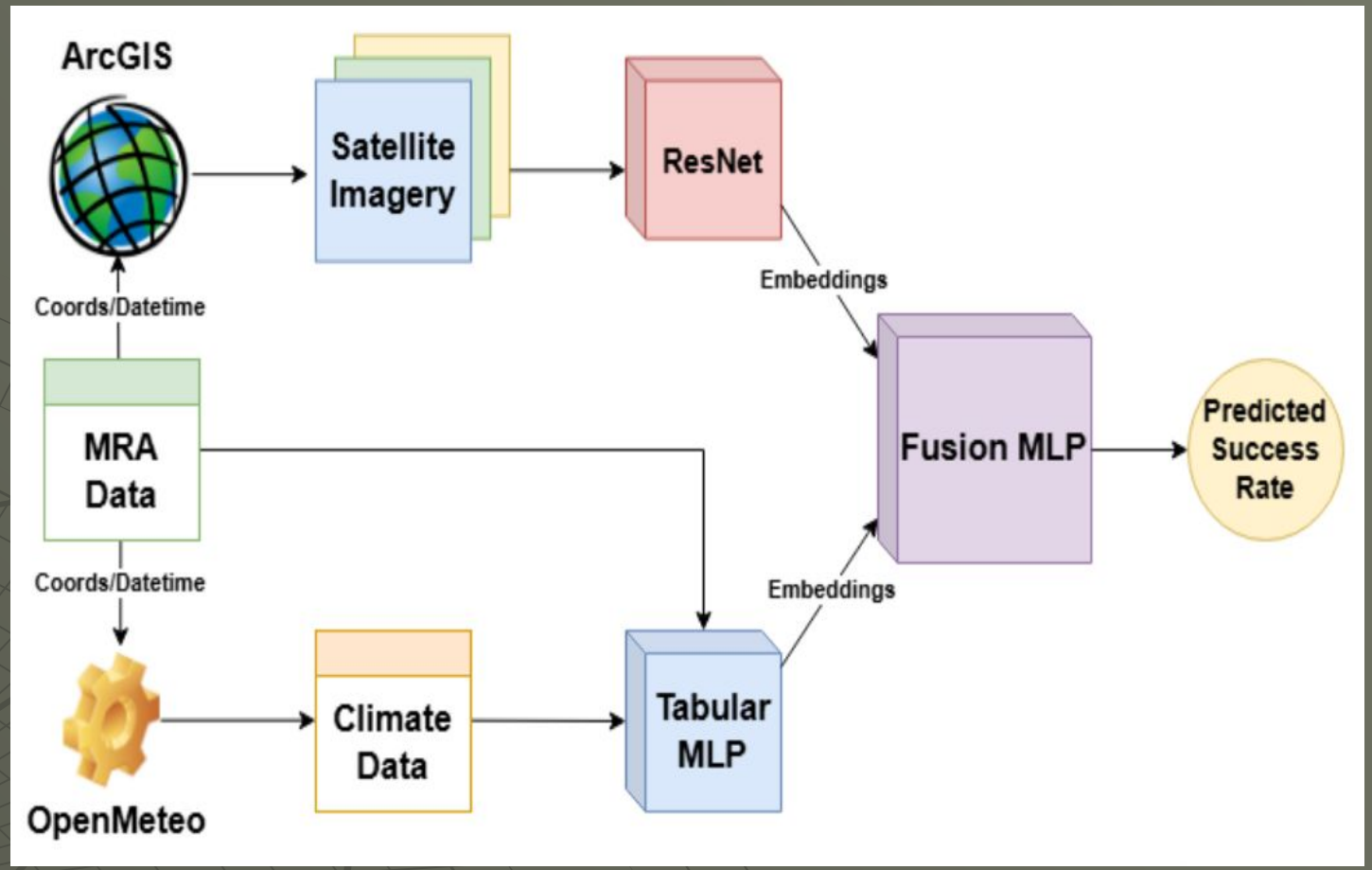
Cloud Cover	Wind (free-air)	Afternoon Max. Temp. Adj. (°C)	Morning Min. Temp. Adj. (°C)
clear	Light/Mod	0 to 3	-8 to -10

Images:

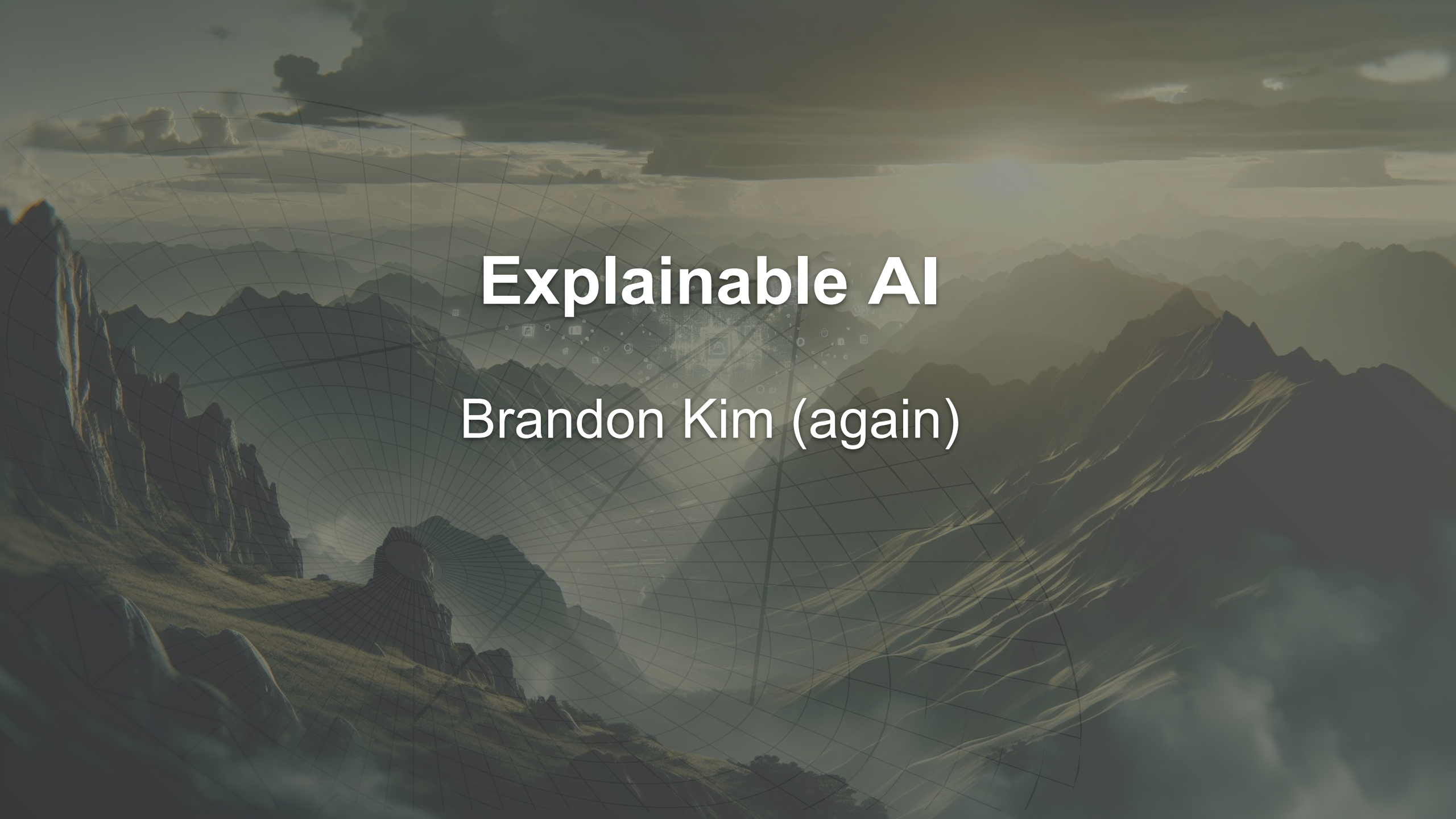


SuccSARNet

- Predicts success rate of search and rescue case
- Statistical analysis approach, rather than predictive modeling
- Data split: 14% unsuccessful



Metric	Score
Recall	86%
Precision	75%
Accuracy	74%



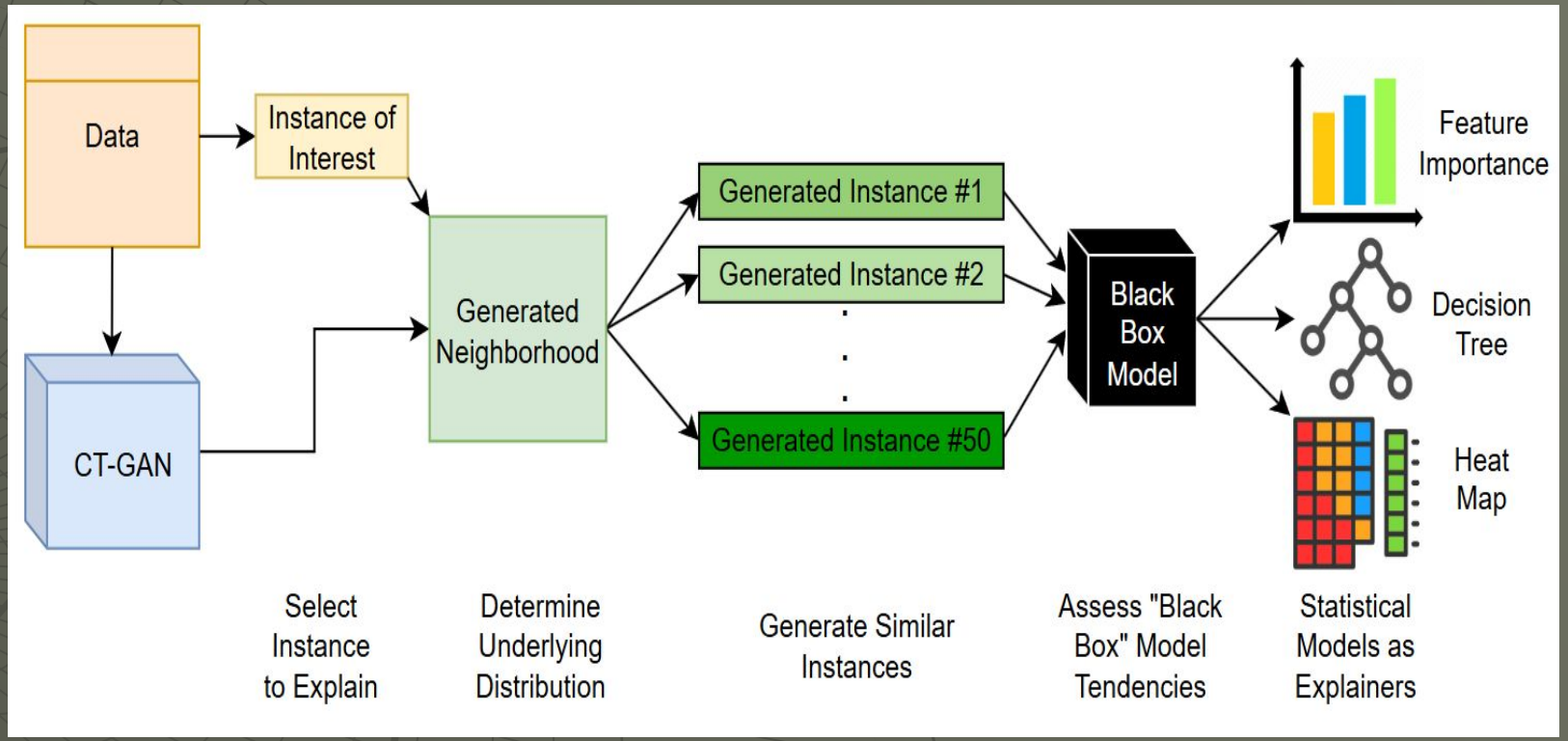
Explainable AI

Brandon Kim (again)

What is Explainable AI

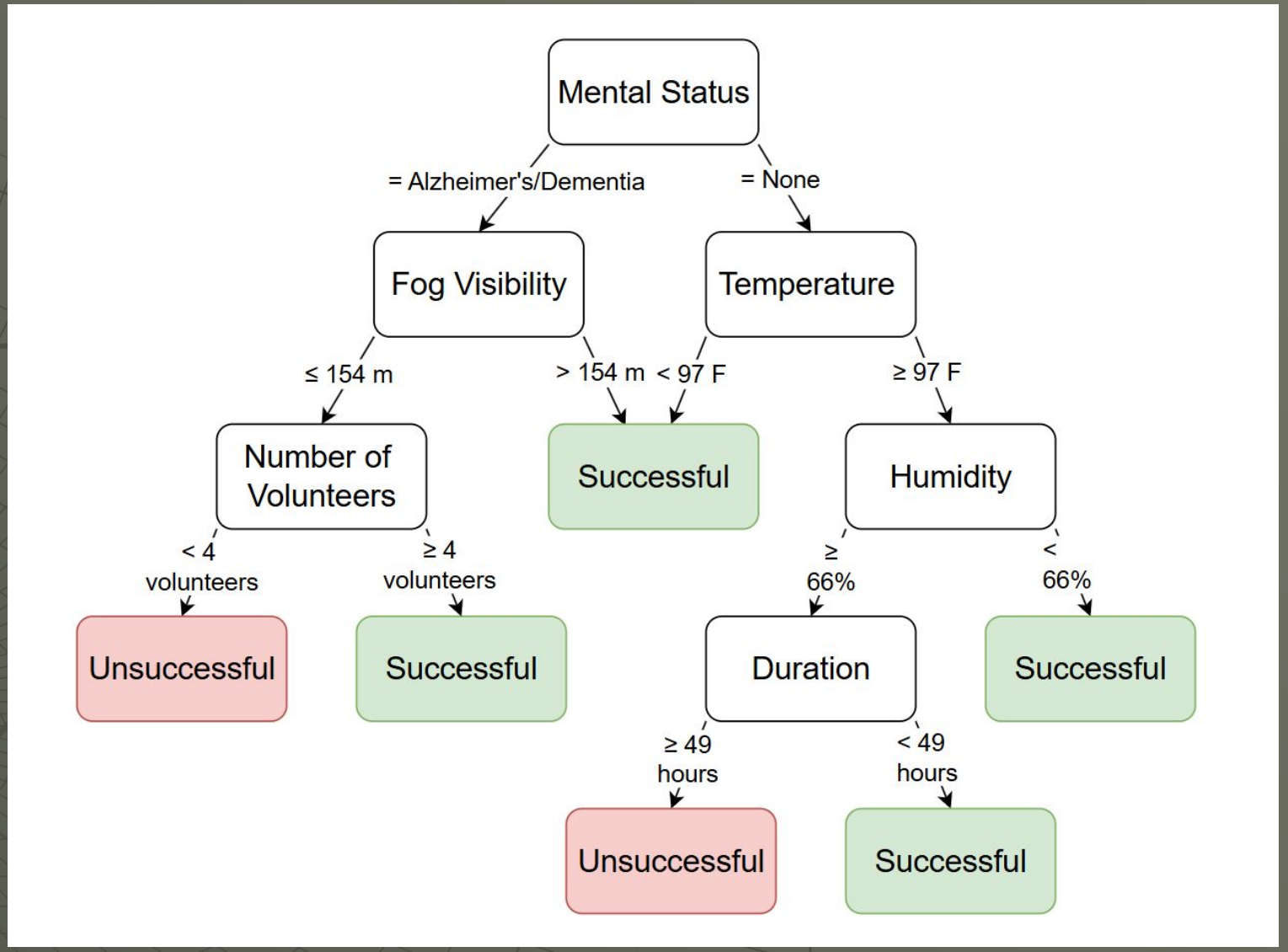
- Explaining “black box” models, which are inherently uninterpretable
- Utilizes statistical analysis techniques, which are interpretable
- Developed a new explainer technique:

  Rule-based **E**xplanations for **G**enerated neighborhoods **A**round **L**ocalized cases **(REGAL)**



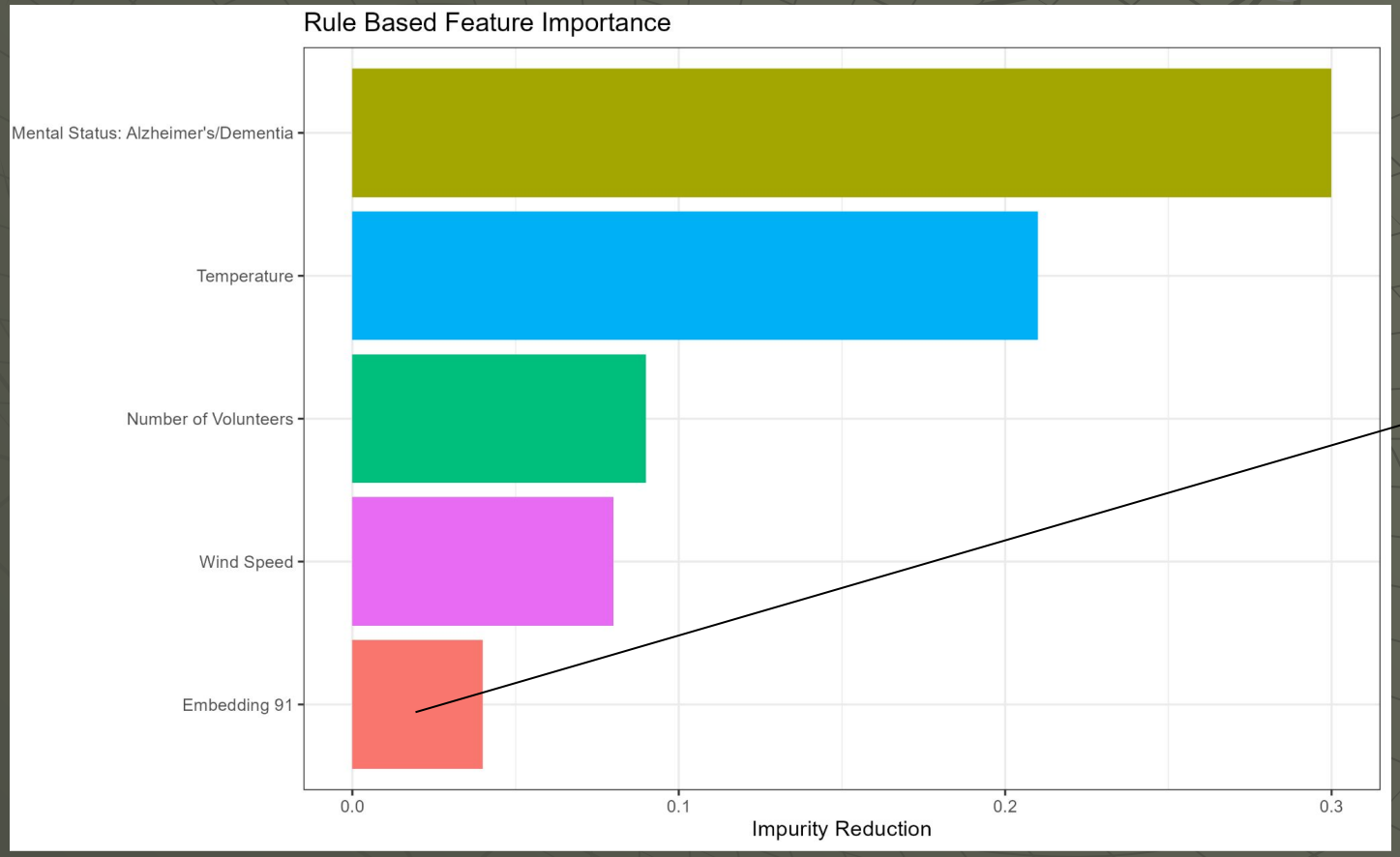
Decision Trees Explainers

- Localized decision trees
- Based on Young (2021)

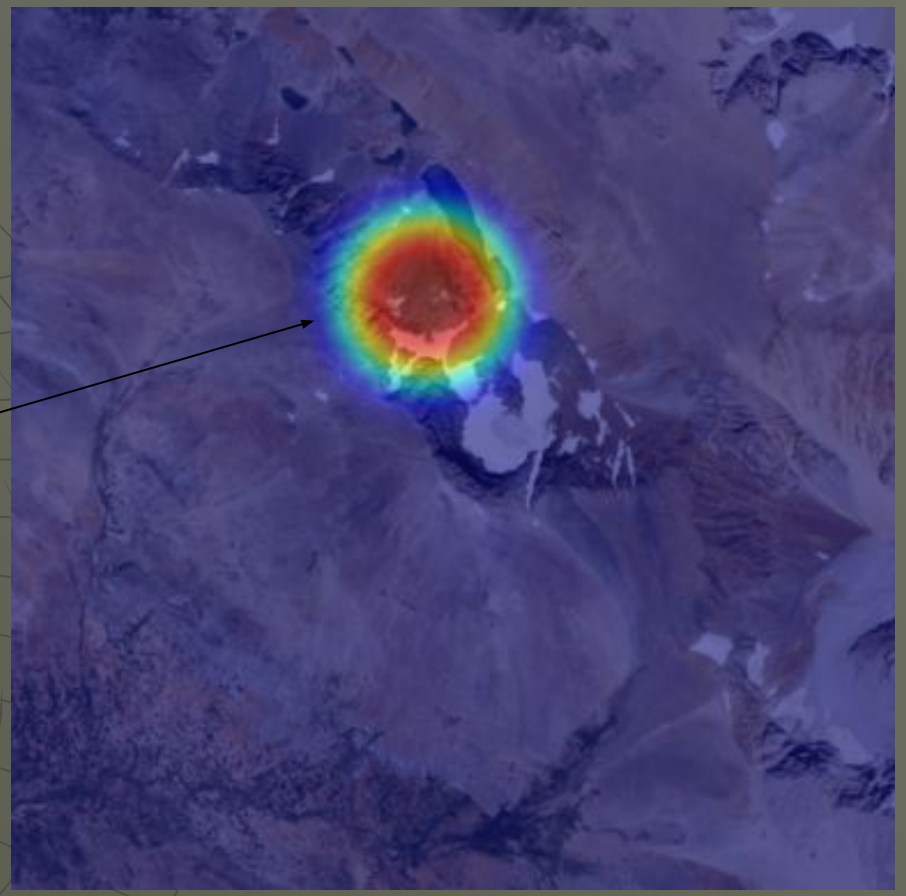


Feature Importance + Heat Map

Initial Split Candidates



Mapping Embeddings Via Grad-CAM

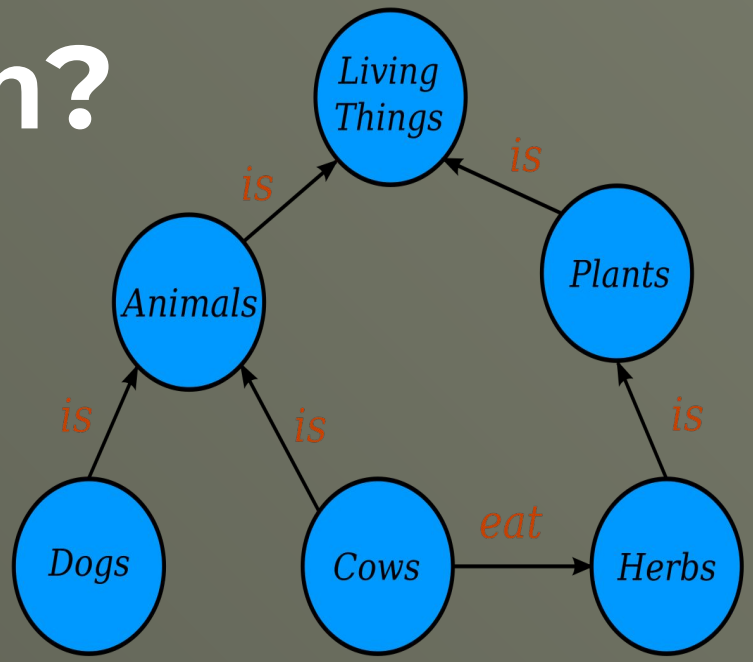


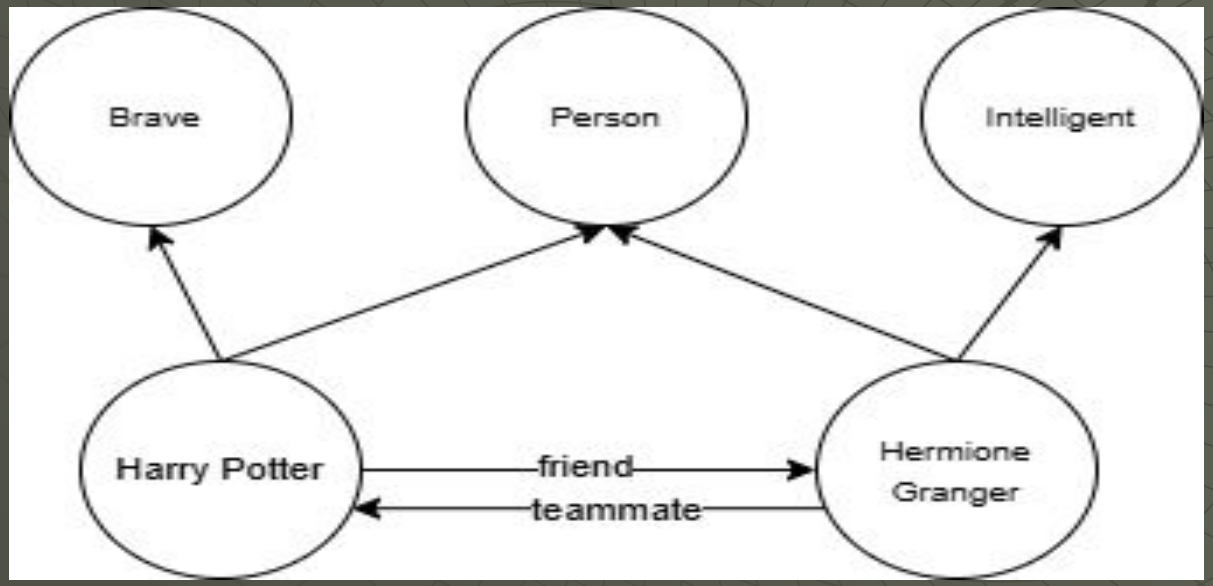
Knowledge Graphs and Large Language Models

Yayun Tan

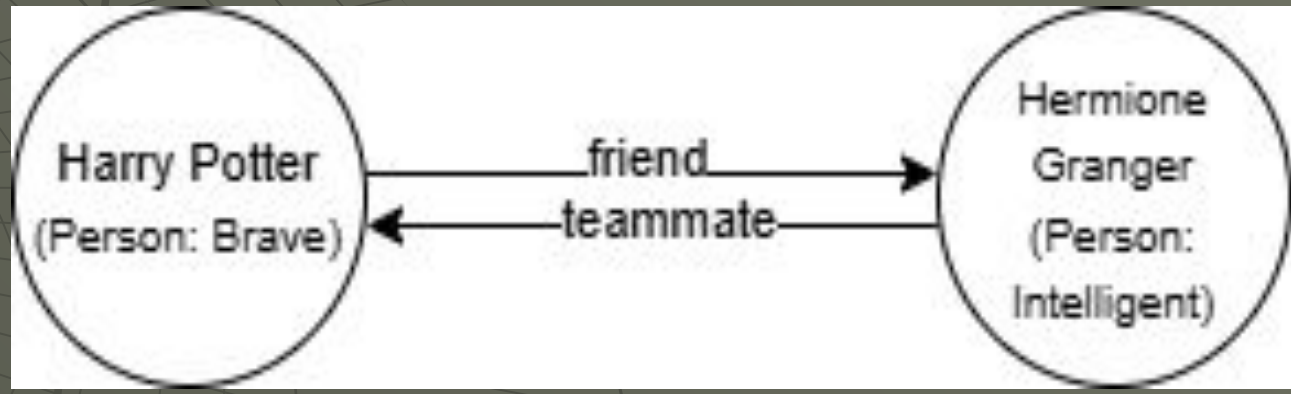
What is a Knowledge Graph?

- A knowledge graph is a semantic network composed of nodes (entities) and edges (relationships).
- Two Common Types – Resource Description Framework (RDF) and Labeled Property Graph (LPG)



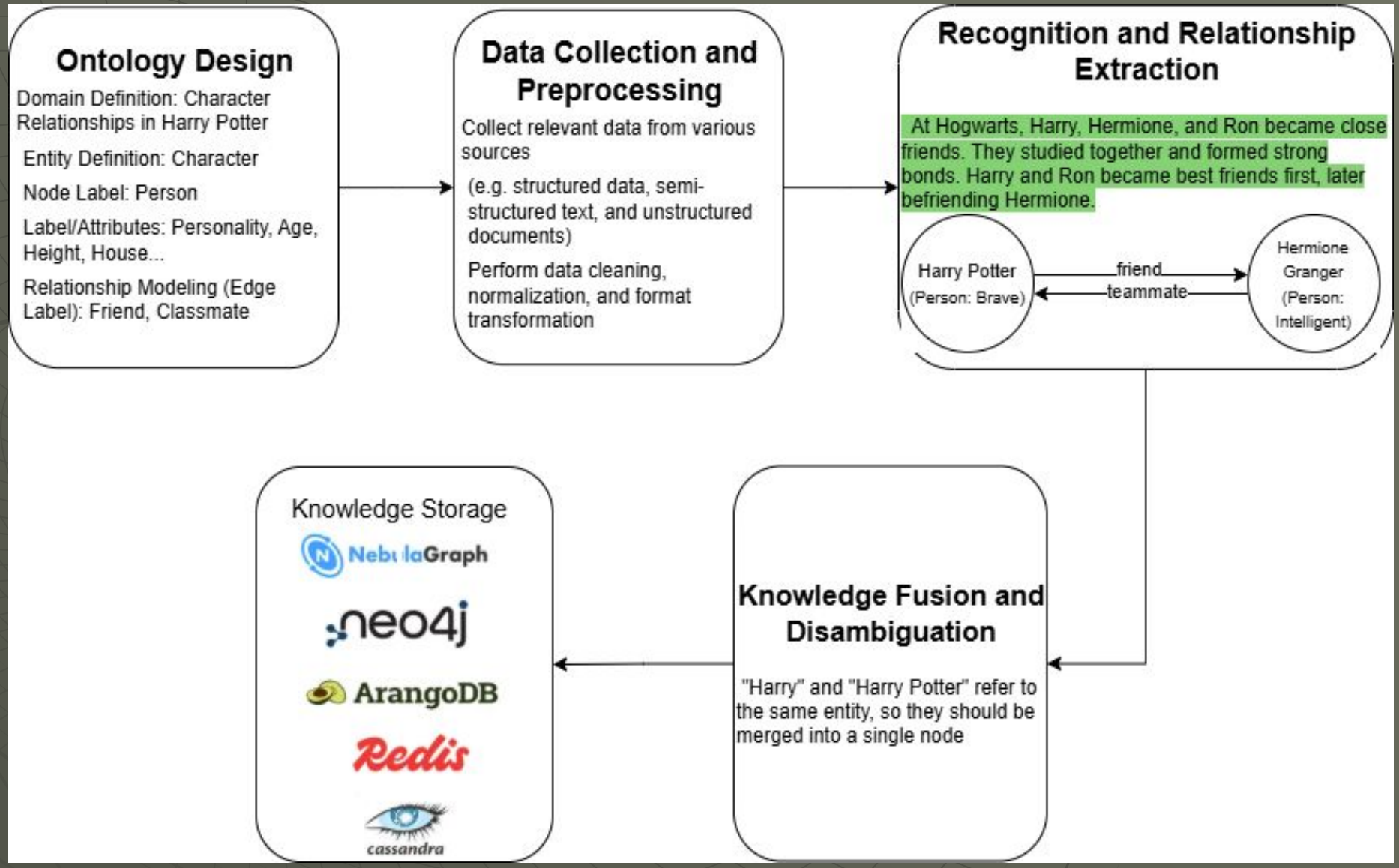


RDF example



LPG example

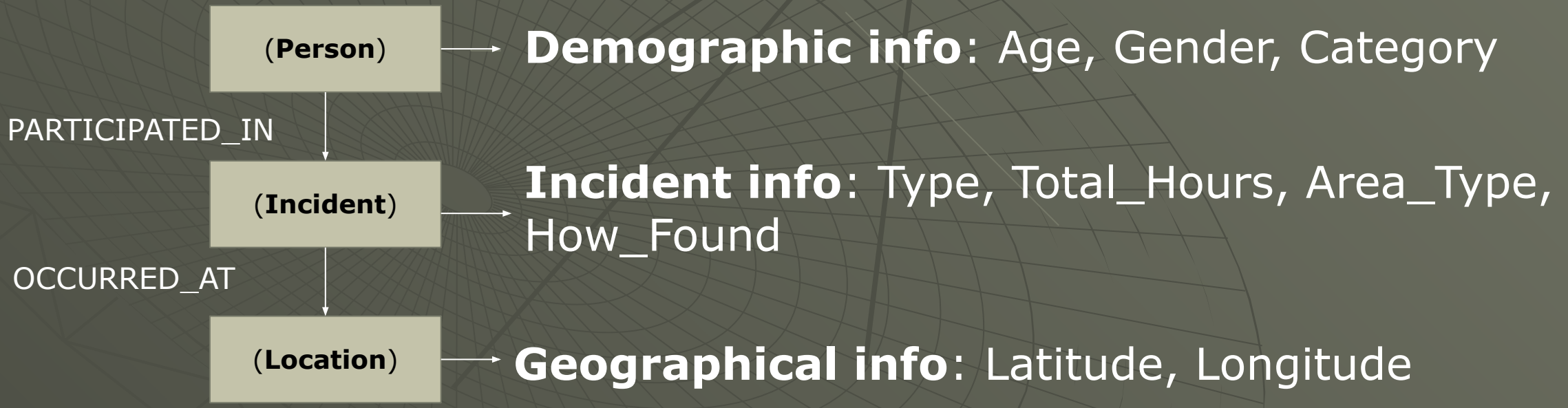
How to Build a Knowledge Graph



Application: SAR Knowledge Graph

- Dataset: ISRID (Koester)

longitude	latitude	globalid	Type	Total_Hours	Area_Type	Category	Age	Gender	How_Found
-79.8548	40.36169	{28F4259E-	SEARCH	5	URBAN	ALZHEIMERS_DEMENTIA	79	MALE	FAMILY/FRIENDS
-80.43129	41.11171	{7228A2A3-	SEARCH	32	RURAL	ALZHEIMERS_DEMENTIA	55	MALE	FAMILY/FRIENDS
-106.5122	39.60306253	{FD50AF14-	SEARCH	1	OTHER	SNOW_SKIING	0	MALE	SELF-RESCUED



Application: Query Example

Find people older than 70 years who were involved in incidents classified as "Alzheimers/Dementia"

```
1 MATCH (p:Person)-[:PARTICIPATED_IN]→(i:Incident)
2 WHERE p.age > 70 AND p.category = "ALZHEIMERS_DEMENTIA"
3 RETURN p.globalid, p.age, p.category, i.type, i.total_hours
4
```

Table | Text | Code

	p.globalid	p.age	p.category	i.type	i.total_hours
1	"{28F4259E-B894-4A59-B611-0E628B492642}"	79	"ALZHEIMERS_DEMENTIA"	"SEARCH"	5
2	"{FDF59CA0-280B-4115-B703-60882219AE6B}"	76	"ALZHEIMERS_DEMENTIA"	"SEARCH"	13
3	"{03C38311-7263-4630-94DC-BA4EE0450986}"	71	"ALZHEIMERS_DEMENTIA"	"SEARCH"	60

Application: KG-Augmented LLM

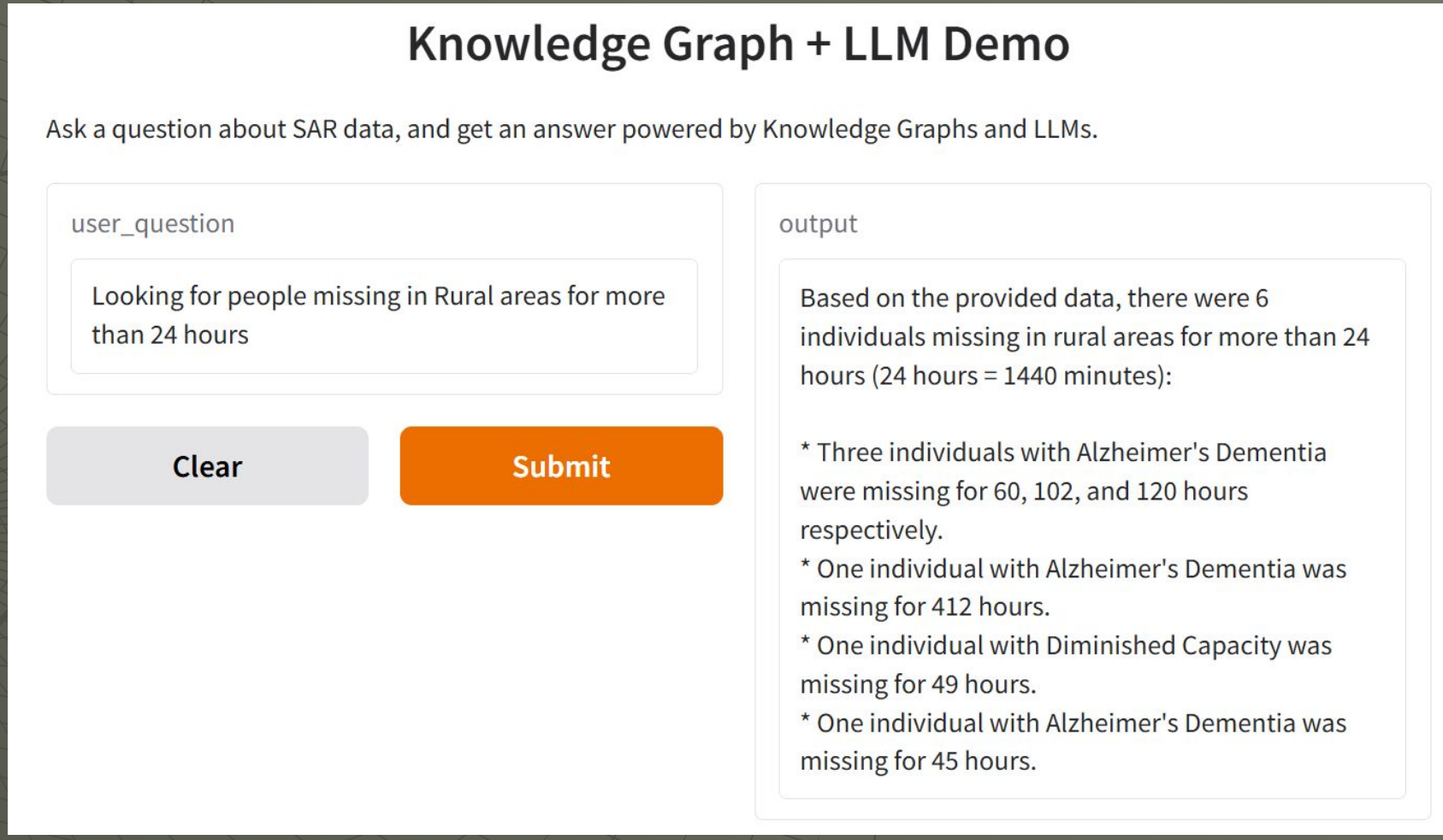
Method: KG-enhanced Inference

Knowledge Graph Construction: Neo4j

LLM Integration: Gemini 1.5 Flash

User Interface: Gradio

Query Capability: Complex KG-enhanced Queries

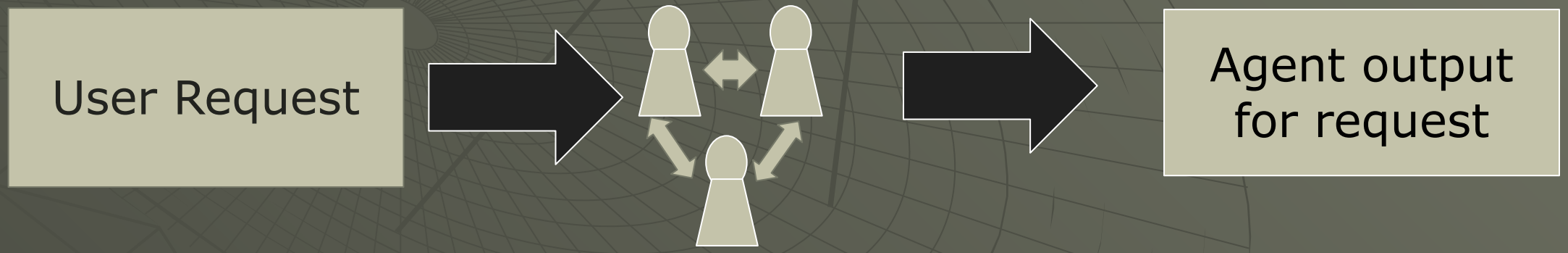


Agentic Design

Brandon Eng, Antonio Chen

What is Agentic Design?

- Agentic design focuses on creating AI agents that can act autonomously toward goals
- These agents follow user instructions, make decisions, and take actions on their own
- Involves combining learning, planning, and reasoning capabilities
- Useful for building systems that adapt and operate with minimal human input

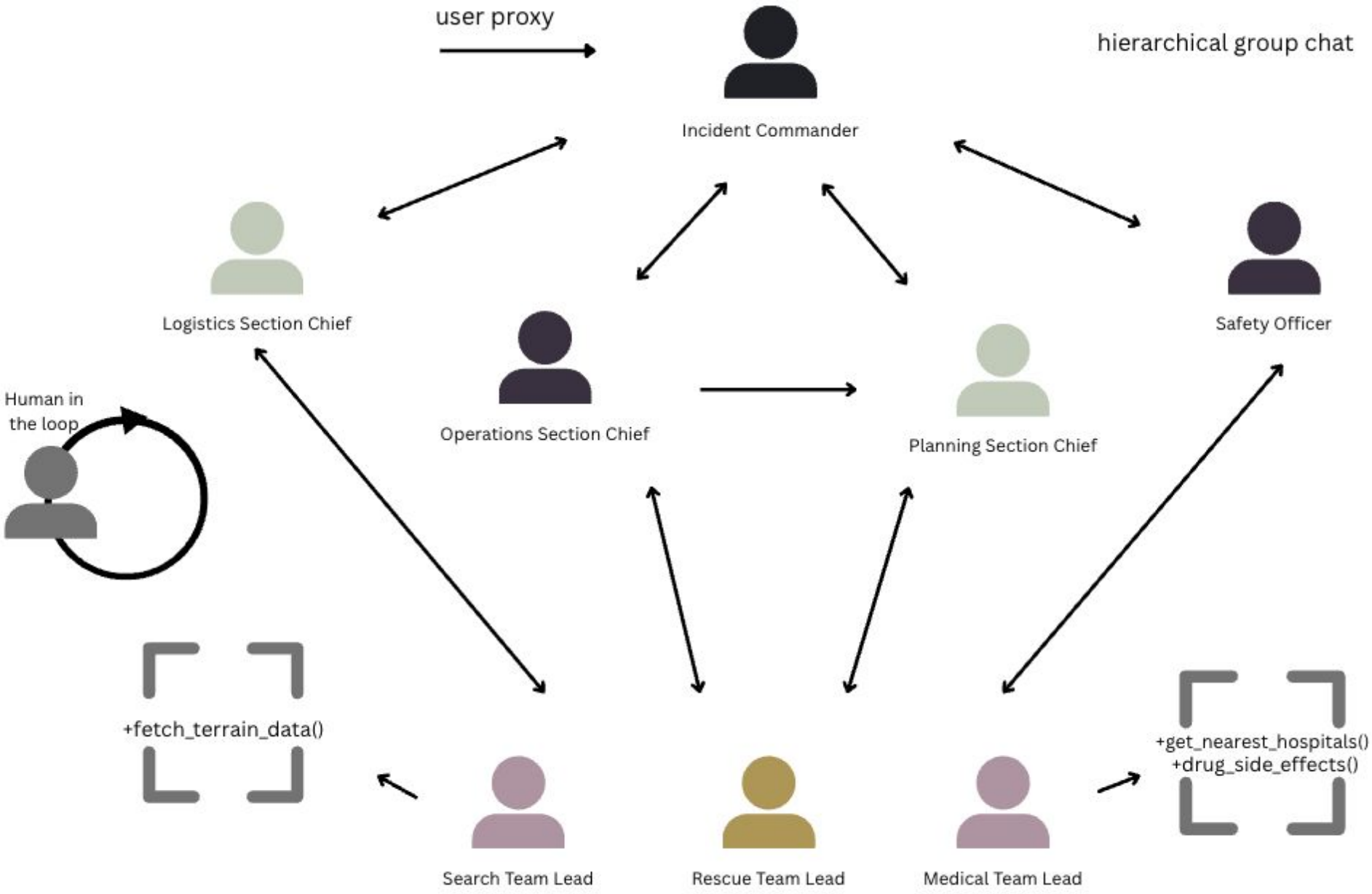


Expected Outcomes

- Improved coordination and workflow efficiency across SAR teams through more intelligent task management
- Reduce manual burden through task automation
- Faster and more informed decision-making
- Offer greater operational support through adaptable, goal-driven AI agents in dynamic environments

SAR Example Agents

- **Incident Commander -** Oversee entire operation
- **Logistics Chief** - Manage equipment and supplies
- **Operations Sections Chief** - Manages all field operations
- **Safety Officer** - Ensure safety protocols are followed
- **Planning Section Chief** - Develop Search strategies
- **Search Team Lead** - Lead search team in field operations
- **Medical Team Lead** - Provide medical care to injured personnel
- **Rescue Team Lead** - Lead rescue team in technical operations

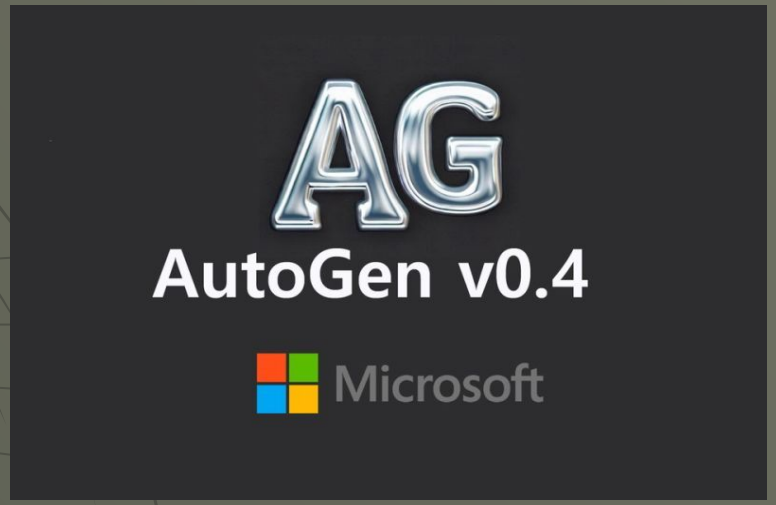

user proxy
hierarchical group chat
Incident Commander
Logistics Section Chief
Operations Section Chief
Planning Section Chief
Safety Officer
Human in
the loop
+fetch_terrain_data()
+get_nearest_hospitals()
+drug_side_effects()
Search Team Lead
Rescue Team Lead
Medical Team Lead

AutoGen

- AutoGen is Microsoft's open-source framework for building multi-agent systems

Why Autogen?

- On demand code generation and execution
- Asynchronous, event-driven architecture
- Context aware agent selection
- Greater customizability options
- Human-agent collaboration



Future Work

- Adaptive agents that learn from missions
- Real-time collaboration between multiple agents
- Context-aware decision support in crises
- Personalize agents for different SAR roles and environments

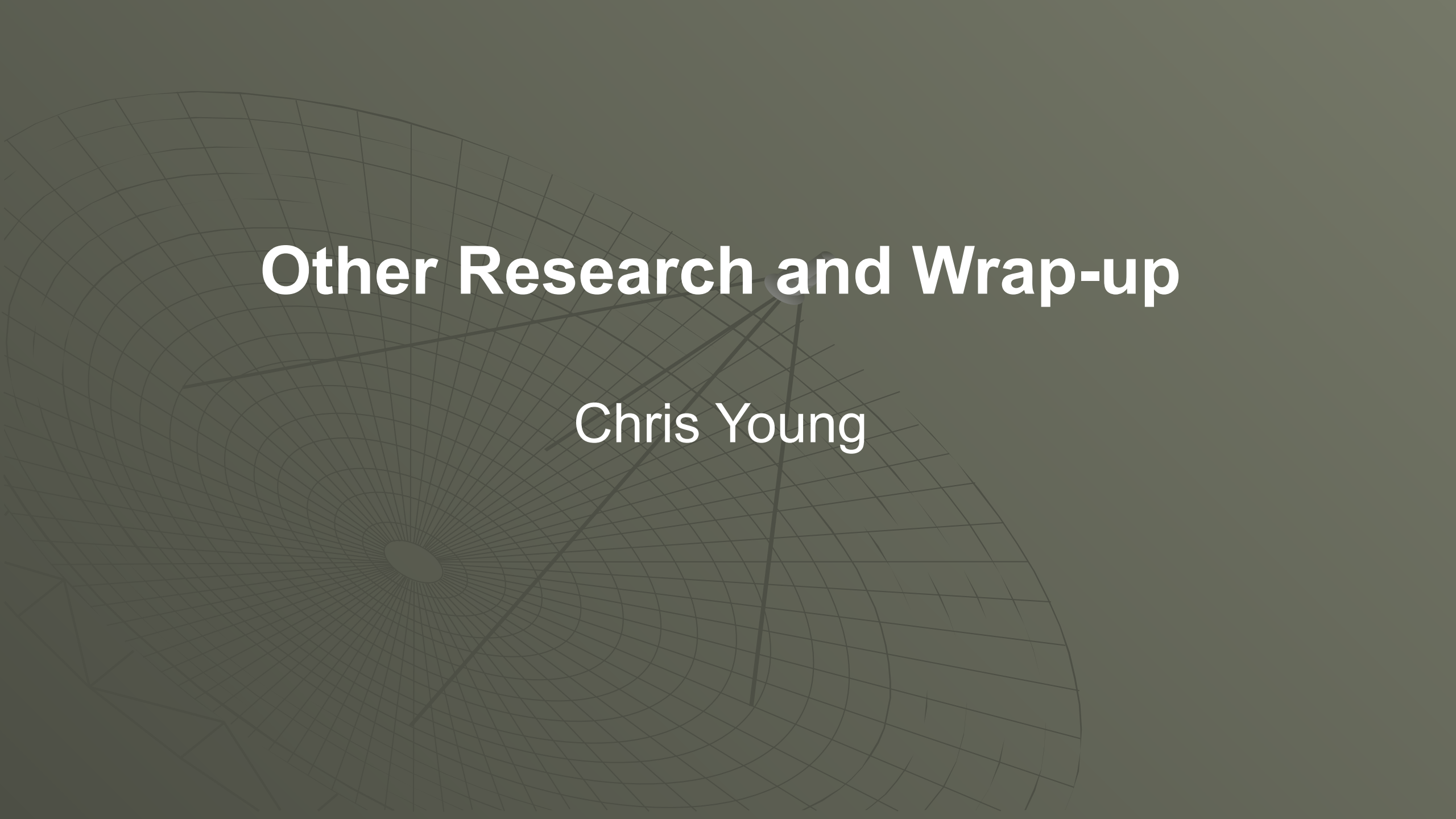
Usability Testing

Emi Dinh, Brian Mai

Usability Testing

- Understand how real users interact with a system
- Identify pain points
- Improve the experience before it's too late
- Ensure platform is working as intended and free from bugs

Please Stop By Our Booth and Give Us Your Feedback!!

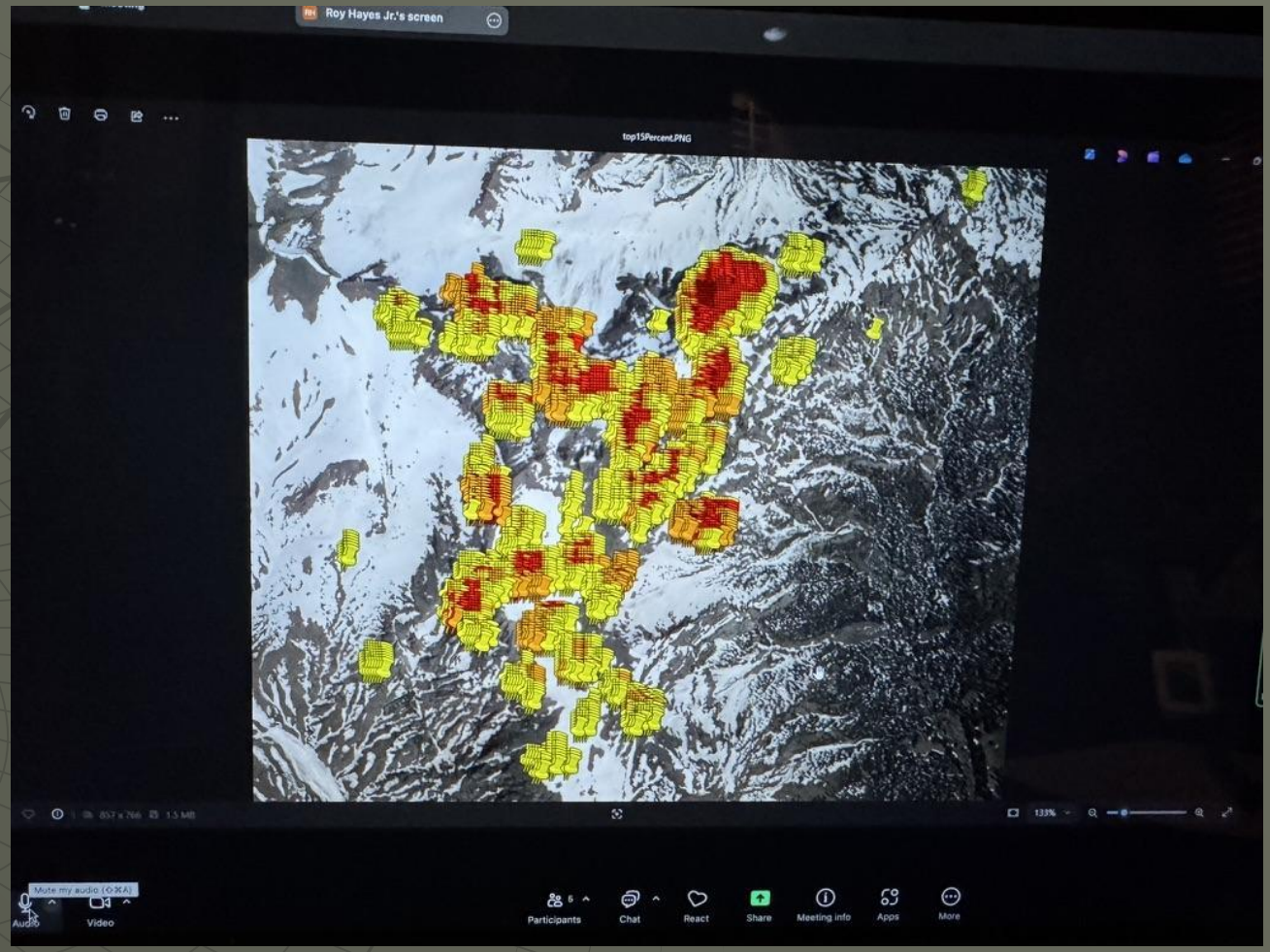


Other Research and Wrap-up

Chris Young

US Air Force – locating downed pilots

- Air Force funded project in Virginia, Dr. Roy Hayes, System Engineering, Inc.
- Based off of same underlying research that our deep learning team is using
- Predicts search areas and generates a heat map
- Based primarily on geospatial data and the “missing pilot” profile



SAR Technology, Inc

- Canada based company supporting SAR missions
- Similar management platform
- Familiar NIMS and Canada based search models and forms

https://sartechnology.ca/

Additional Projects.....

- New Zealand, Terrian-Based Probability Modelling for Advanced SAR Operations in Autearoa New Zealand

- Evaluation of terrain characteristics influencing the likelihood of locating the missing person

Acknowledgments

- **Computing Resources** provided by National Center for Supercomputing Applications (NCSA)
  - NCSA ACCESS through project “Artificial Intelligence in Search and Rescue” (CIS240458)
- Microsoft Azure Educational & Research Grant
- International Search & Rescue Incident Database (ISRID) **ISRID Dataset** access courtesy of Dr. Robert Koester

Moving IntelliSAR from Research to Production

- Move from private funding to production funding
- Move from donated capacity to production capacity
- Commercial ownership required for 24-hour support, long term development, marketing and distribution

Question and Answer

- After Hour Discussion and Q&A
- Time: 5:15 - 6:15 PM this evening
- Location: Melrose 3
- Also, posters and developers at our booth

Questions ?