MITRE Technology Program

Supporting Chat Exploitation in DoD Enterprises

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The MITRE Corporation

June 19-21, 2007

MITRE

Problem Statement

- Use of internet chat in DoD enterprises is pervasive
  - Widespread use in Air Operations Centers (AOCs)
  - Making its way onto airborne platforms (e.g., AWACS, JSTARS)
- Operators gain awareness by monitoring chat rooms
  - Activity in the chat rooms gives viewpoints on the current situation
  - Often many chat rooms at a time must be monitored
- An operator must not miss anything important
  - No time for breaks
  - No allowance for inattention
- Chat exploitation needs vary across DoD enterprises
  - Alerts on “interesting” events in chat may be required for tactical operations
  - Summaries of events in chat may be required at command levels

Need tools to help a broad set of users better manage and exploit military chat

MITRE Technology Program Research Project

- MITRE's Technology Program funds internal research projects through its sponsors, e.g., the Air Force
  - Projects with a near-term, customer-specific focus are known as Mission Oriented Investigation and Experimentation (MOIE) projects
- Today, we present the results of a second-year Air Force MOIE project, "Facilitating Sense Making for Situational Awareness"
  - Focus is on the management and exploitation of military chat for a broad set of users within DoD
- Project objectives
  - Apply MITRE's Alembic information extraction system to the problem of extracting tactically relevant data from military chat
  - Develop a set of tools to help the user best exploit Alembic's products
    - User interfaces
    - Functionality for retrospective analysis and summarization of chat
  - Develop a software prototype to demonstrate our research
    - Chat Exploitation Tool (ChET) is our laptop-based demo

Technical Approach – Extracting Entity Class Data from Chat

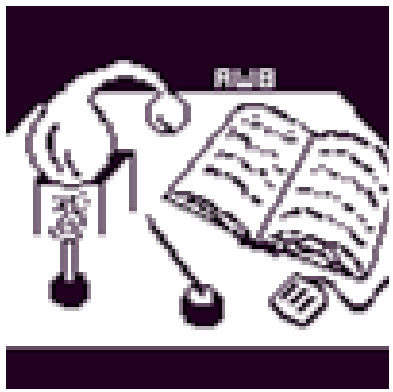
[12:24] <Exec_Dir> CCO-where's Jake? He's heading to Medford - and we swing him straight there?
[12:26] <Exec_Dir > We're thinking Jake's going to be faster than pulling Trapper 11 from Gat D. However, we are checking with TF-11 if we can pull Trapper.
[12:26] <HQ_CCO> Yes. We can move Jake that way now.
[12:26] <HQ _CCO> Rough estimate 20-30 min
[12:27] <Exec_Dir > Great – Jake's on the way.
[12:28] <Boss_OPS> We've got Trapper 11 in Gat d and GCAS ready for launch
[12:30] <Exec_Dir > CCO Boss –we got an airpower gap when Jake departs at 1300 for 1 hr. May need GCAS to fill the GAP if this goes that long.
[12:30] <Exec_Dir > CCO - 15 NM from the border – please call Bulldog.

10 minutes of chat from a single chat room

A military language pre-processor (MLPP) uses a regular expression to *extract an aircraft voice call sign* (e.g., Misty 11):

"([a-zA-Z]{4,12})(\\s?\\d{1,2})"

Alembic Information Extraction



Extracted <AirMission> Class

<AirMission>		
	<ACType>	
	<ACCallSign>	
	<MissionType>	
	<MissionNumber>	
	<ATONumber>	
	<State>	
		<Location>
		<ZTime>
	<Activity>	
		<Location>
		<ZTime>

How Alembic Extracts Entity Class Attributes

- **Wordlists**
  - <AirMission><ACType>: B-52
  - <Missile><Name>: Patriot
- **Regular expressions (i.e., rules) with help from context**
  - "…msn# 8462AC…"
- **Context alone**
  - " …bty 1124 is ready to…"
    - This is an <AirDefense><Unit>, not a <AirMission><MissionNumber>
  - "…Scud launch is expected IVO…"
    - "launch" refers to a <Missile><Activity>, not an <AirDefense><Activity>
    - Here, words (e.g., "Scud") tagged first by the MLPP provide context
- **Also considers**
  - Different form/same meaning: Fire/fired/firing/fires, unit 436/114
  - Telegraphic speech: "…missile ivo camp…"

Shorthand for "battery" helps determine that what follows is a air defense unit

Alembic information extraction models are being developed for ELINT, AirTarget, AirMission, Missile, Location, MASINT, ErrorEllipse, AirDefense and GroundTarget entity classes

Entity Class “White Papers”

- Provides an unclassified set of lists, rules, contexts for the development of Alembic information extraction models
  - <Air Defense>, <AirMission>, <ELINT> and <Missile> entity classes

<AirMission><MissionNumber>:

ATO format [1-8ANBS] ***AND*** preceded or followed by

msn
msn#
mission#
mission num
mission number
msn#s

<AirMission><State>:

on station, on-station
on (the) deck, on-deck
off station, off-station
airborne

<AirMission><Activity>:

launch, launched, launches, launching
escort, escorted, escorts, escorting
refuel, refueled, refuels, refueling
recover, recovered, recovers, recovering

<AirMission><ACType>:

Designator	Name	Nickname
B-52H	Stratofortress	
B-1B	Lancer	
B-2	Spirit	
S-3B	Viking	
P-3C	Orion	
P-7		
AH-1W	Super Cobra	
A-4	Skyhawk	
OH-6A	Cayuse	
AH-6J	Little Bird	
A-6E	Intruder	
EA-6B	Prowler	
A-7	Corsair II	
AV-8B	Harrier	
A-10	Thunderbolt II	Warthog, Hog
OA-10	Thunderbolt II	Warthog, Hog
A-12	Avenger II	
AH-64A	Apache	
AH-64D	Apache	Longbow , LBA
RAH-66	Comanche	
F-111		
FB-111		

<AirMission><MissionType>:

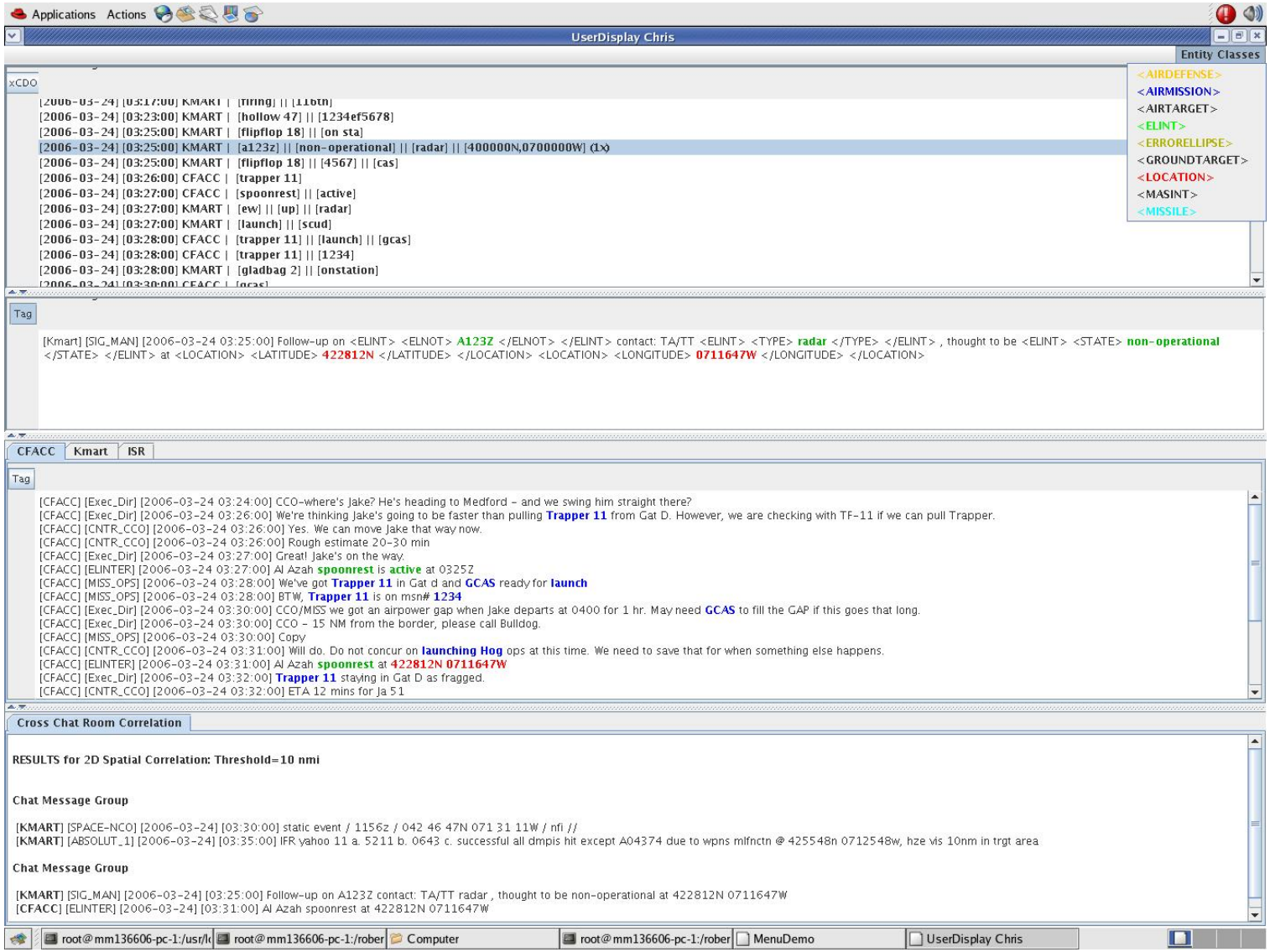
Mission Data Code	Mission Type Name
CAS	CLOSE AIR SUPPORT
GCAS	GROUND ALERT CLOSE AIR SUPPORT
XCAS	AIRBORNE ALERT CLOSE AIR SUPPORT
AI	AIR INTERDICTION
ATK	ATTACK
AH	ATTACK HELICOPTER
BAI	BATTLEFIELD AIR INTERDICTION
SEAD	SUPPRESSION ENEMY AIR DEFENSE
ATK	ATTACK
ILLUM	FLARE ILLUMINATION

Alembic Performance

- **The information extraction performance of Alembic is measured against a set of test chat logs, separate from the training set, using the F-score measure**
- **The *F-score* is a measure of how well the system did, weighted by Precision and Recall**
  - ***Precision* takes false positives into account, i.e., the degree to which the model applies incorrect tags**
  - ***Recall* takes false negatives into account, i.e., the degree to which the model doesn't tag a phrase that should be tagged**
- **Results for two chat rooms**
  - Combined Forces Air Component Commander (CFACC)
  - Combined Forces Land Component Commander (CFLCC)

Chat Room									
	Entity Class	# Correct	# of Tags	% Correct	# False Positive	# False Negative	Precision	Recall	F-score
CFACC									
	<AirDefense>	336	437	76.9	38	63	0.90	0.84	0.87
	<AirMission>	17	30	56.7	6	7	0.74	0.71	0.72
	<ELINT>	129	157	82.2	6	22	0.96	0.93	0.94
	<Missile>	31	48	64.6	4	13	0.89	0.70	0.78
CFLCC									
	<AirMission>	163	212	76.9	25	40	0.85	0.79	0.82

Chat Exploitation Tool (ChET) – UserDisplay GUI



List of chat alerts

Detail for selected chat alert

All chat in rooms specified by user "Chris"

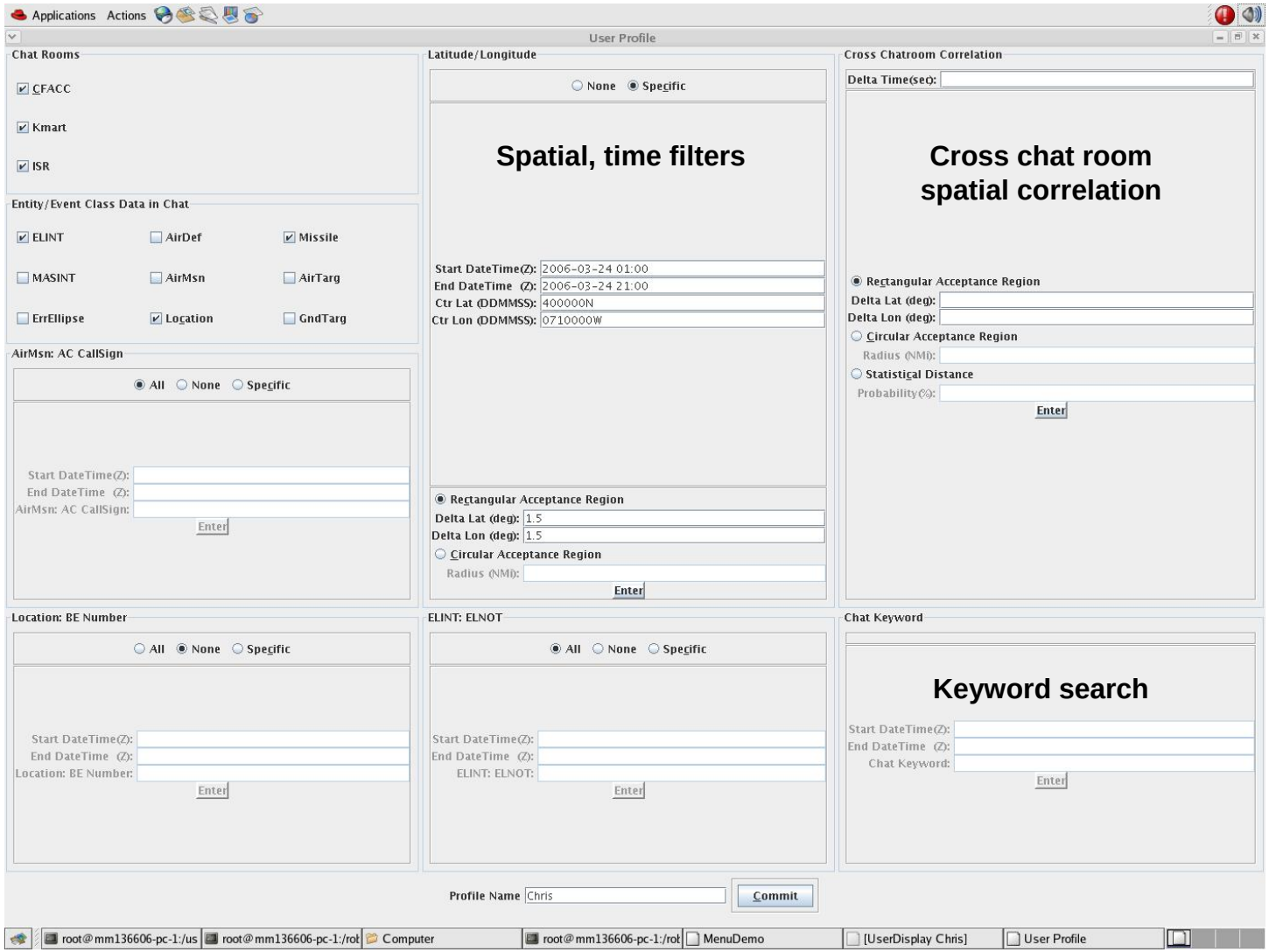
Correlated chat utterances across chat rooms

ChET – UserProfile GUI

List of chat rooms

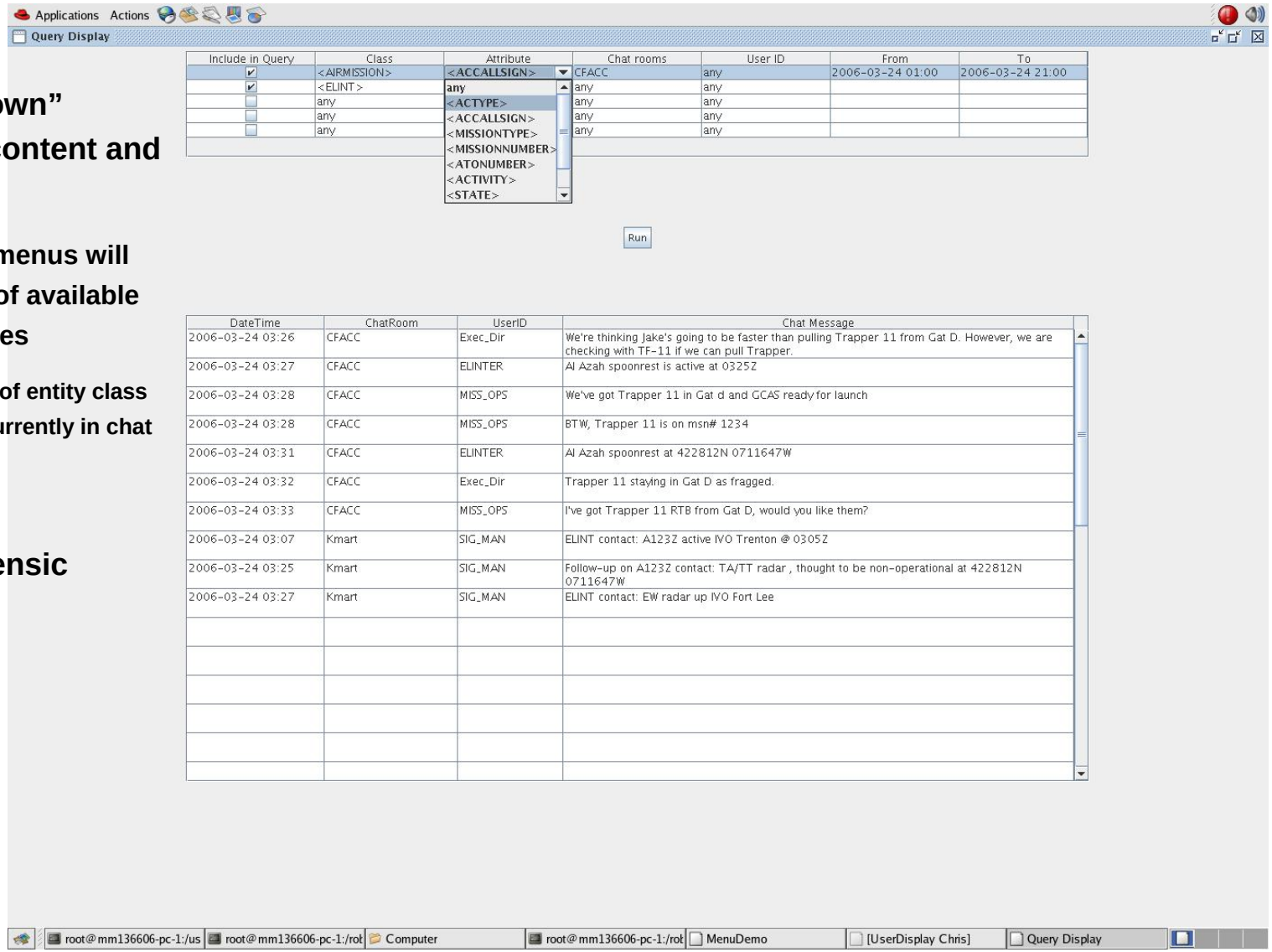
List of entity classes

Filter (list, time) for aircraft call sign



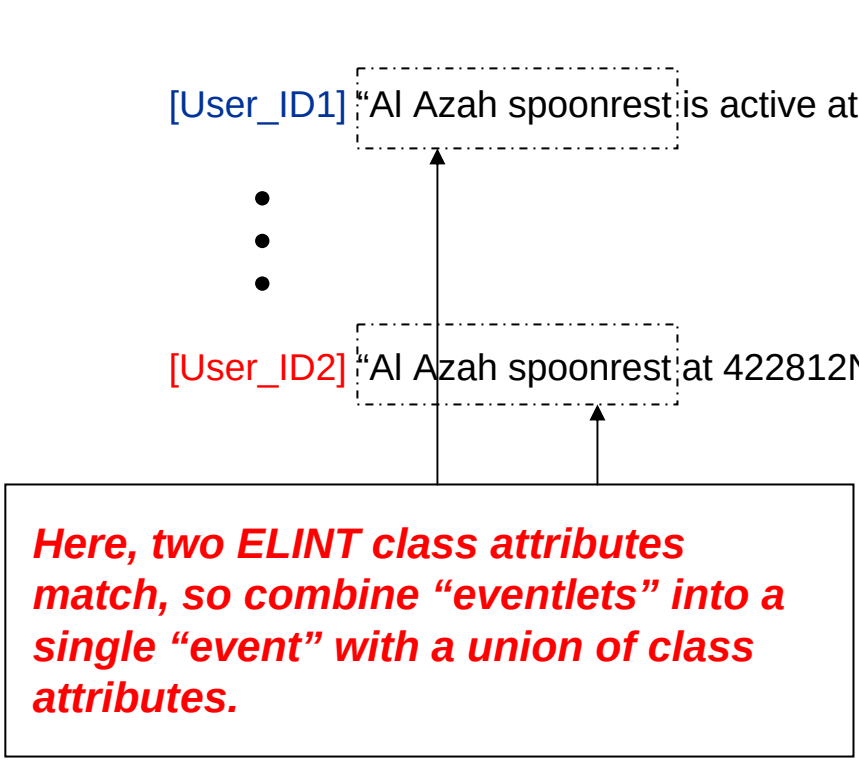
ChET – QueryPanel GUI

- **GUI for "drill down" analysis of chat content and participants**
  - **Drop-down menus will provide list of available column values**
    - **e.g., List of entity class names currently in chat database**
- **Provides a retrospective/forensic capability**



On-going Research – Extracting Event Classes

- **Use Alembic's facility for *inferencing* to combine "eventlets" in a single chat room that describe parts of the same full event**
  - **Heuristic: "Eventlets" are contained in a single chat message**



<ELINT>	
	<Name>
	<Type>
	<ELNOT>
	<Location>
	<State>
	<ZTime>

<Location>		
	<Name>	
	<Latitude>	
	<Longitude>	

<ELINT>	
	<Name>
	<Type>
	<ELNOT>
	<Location>
	<State>
	<ZTime>

<Location>			
	<Name>		
	<Latitude>		
	<Longitude>		
		<ErrorEllipse>	
<ErrorEllipse>			
	<SMajAxis>		
	<SMinAxis>		
	<Orientation>		

On-going Research – Correlating Entities/Events Across Chat Rooms

- Correlating data across chat rooms
  - Compute similarity measure between pairs of entity/event class instances
- Numeric and non-numeric attributes

<AirDefense> entity class extracted from Chat room "A"

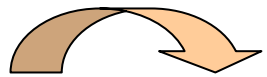
(Chat "object" #1)

<AirDefense>	
	<Name>
	<Type>
	<Location>
	<Activity>
	<State>
	<ZTime>
	<Unit>

<ELINT>	
	<Name>
	<Type>
	<ELNOT>
	<Location>
	<State>
	<ZTime>

<ELINT> entity class extracted from Chat room "B"

(Chat "object" #5)



Similarity Matrix

	1	2	3	4	5	6	7	8
1	1	0	0	0	0.9	0.3	0.55	0
2	0	1	0	0	0	0.85	0	0.4
3	0	0	1	0	0	0	0	0
4	0	0	0	1	0	0	0	0
5	0.9	0	0	0	1	0	0	0
6	0.3	0.85	0	0	0	1	0	0
7	0.55	0	0	0	0	0	1	0
8	0	0.4	0	0	0	0	0	1

Only show users pairs of Chat objects with similarity >= 90%

- Threshold ("hard" correlation) or cluster ("soft" correlation) groups of similar chat objects
- Initially, only location and time attributes are used to correlate pairs of chat objects
  - e.g., Distance between pairs of chat utterances containing latitude/longitude < 10 mi

Summary

- MITRE's Alembic information extraction system has been applied to military-style chat
  - Entity class data can be accurately extracted and tagged
    - Allows a means to index into chat
- A research prototype has been designed around Alembic to serve a broad range of chat exploitation needs:
- Alerts/Monitoring –
  - Real-time alerts on data types of interest, tailored by a set of user-specified preferences
- High-level Reporting/Summaries –
  - Querying the prototype's database containing indexed chat utterances by entity class and class attributes
    - Means to generate summaries of chat sessions by topic (entity class), chat room or user
- Forensics –
  - The ability to correlate extracted chat utterances across multiple chat rooms