Asymmetric Threat Response and Analysis Program

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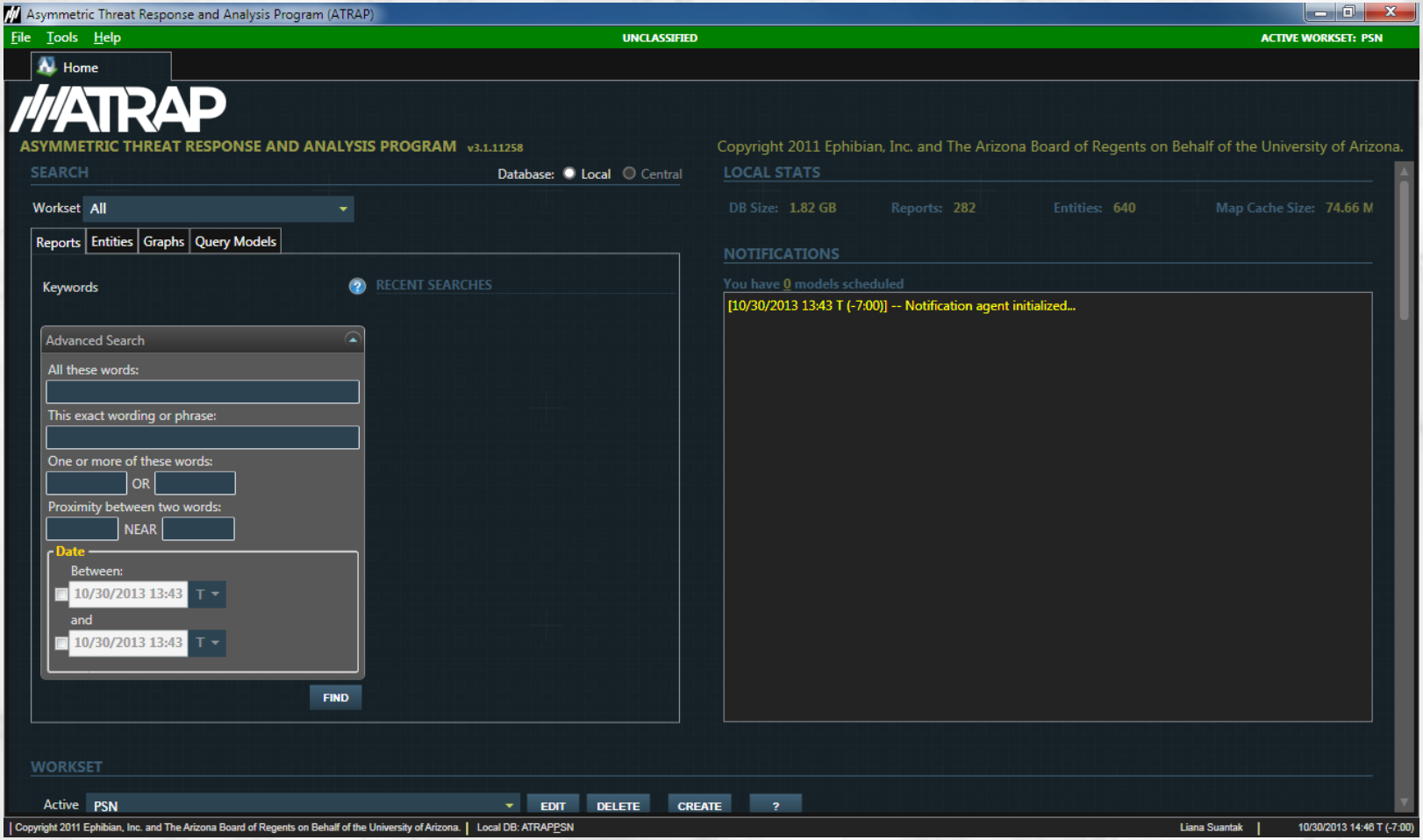
Overview

- What is the Asymmetric Threat Response and Analysis Program (ATRAP)?
- Data Ingestion
  - Structured vs. unstructured
- Link Charts
- Game Theoretic Decision Support Tool

Note

- We apologize in advance
  - The original security data has ITAR restrictions
  - Thus we cannot show this data publically
- Instead we have medical data
  - Statically correct, but sanitized
  - Can still be used to show ATRAP's features

Asymmetric Threat Response and Analysis Program



ATRAP

- Originally a tool for military intelligence analysts
- Built upon a “human-in-the-loop” philosophy
  - Avoids a fully automated tool making mistakes
  - Provides transparency and introspection into data processing
- Much like a toolbox of individual tools
  - Like Matlab, except for security
  - Due to the number of tools, we will only show a few tools
- Now encompasses many security domains

ATRAP – Motivation

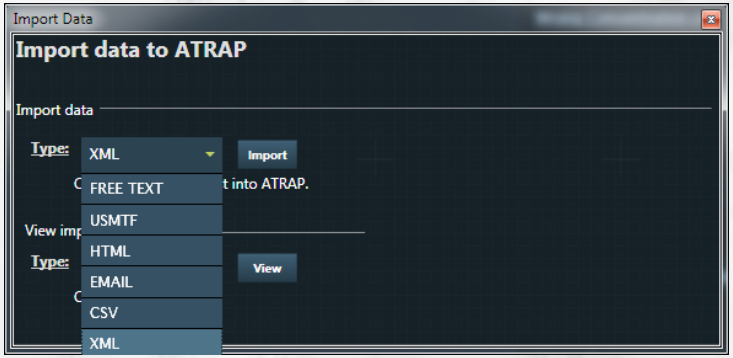
- Think about this
  - Inside jobs cause the majority of damage
  - This tool helps an analyst/detective trace from evidence back to the insider(s)
- Suppose
  - Network traffic is available and events have already been detected via some other tool
  - Some connections between individuals, computers, and events are known

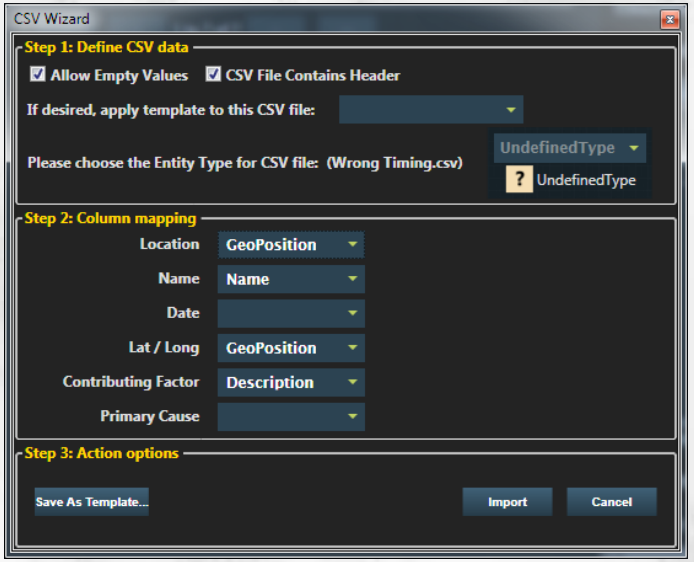
Data Ingestion

- ATRAP operates on databases (Microsoft or Oracle)
- Data can be structured (xml, csv, html, etc.)
- Data can be unstructured (free text)
  - Free text data can be structured with a text-processing tool which includes some basic natural language processing

Data Ingestion

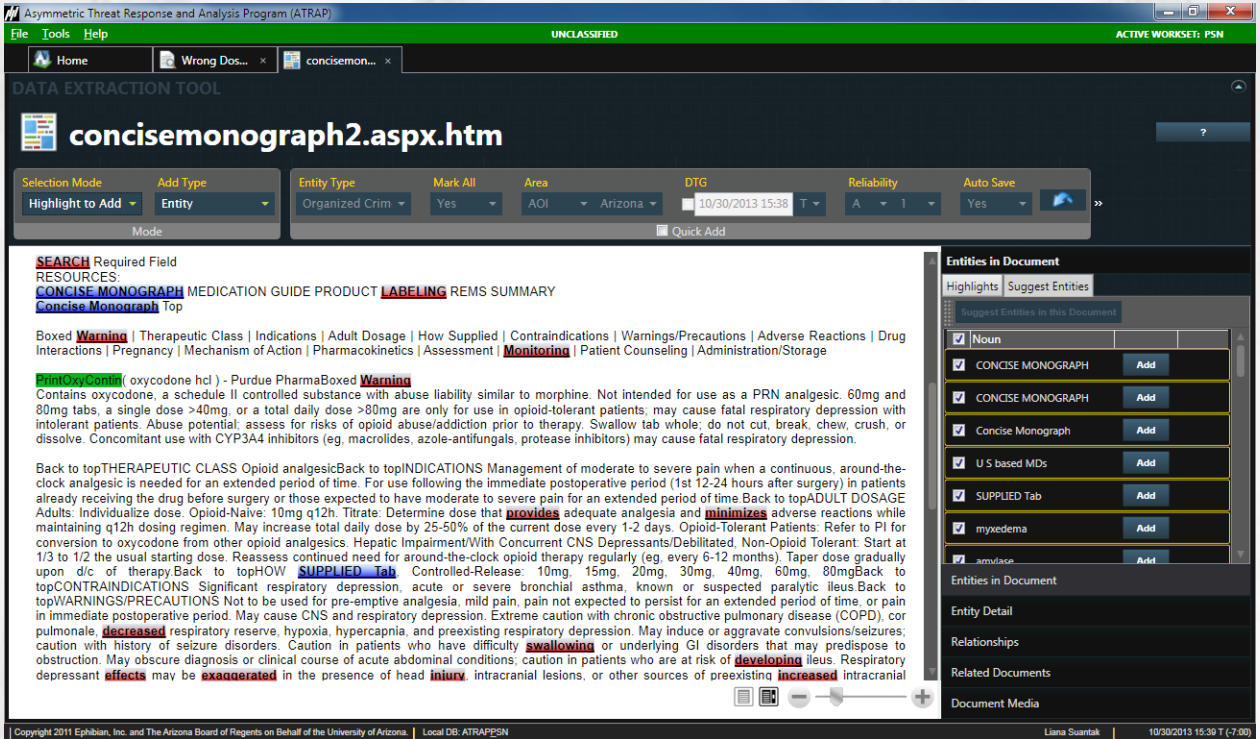
- Structured data can be directly imported as any user defined types.
  - E.g., provided a user defined meta-protocol, each field can be imported from the structured data
  - Nonstandard protocols can be user defined or subtyped





Data Ingestion – free text

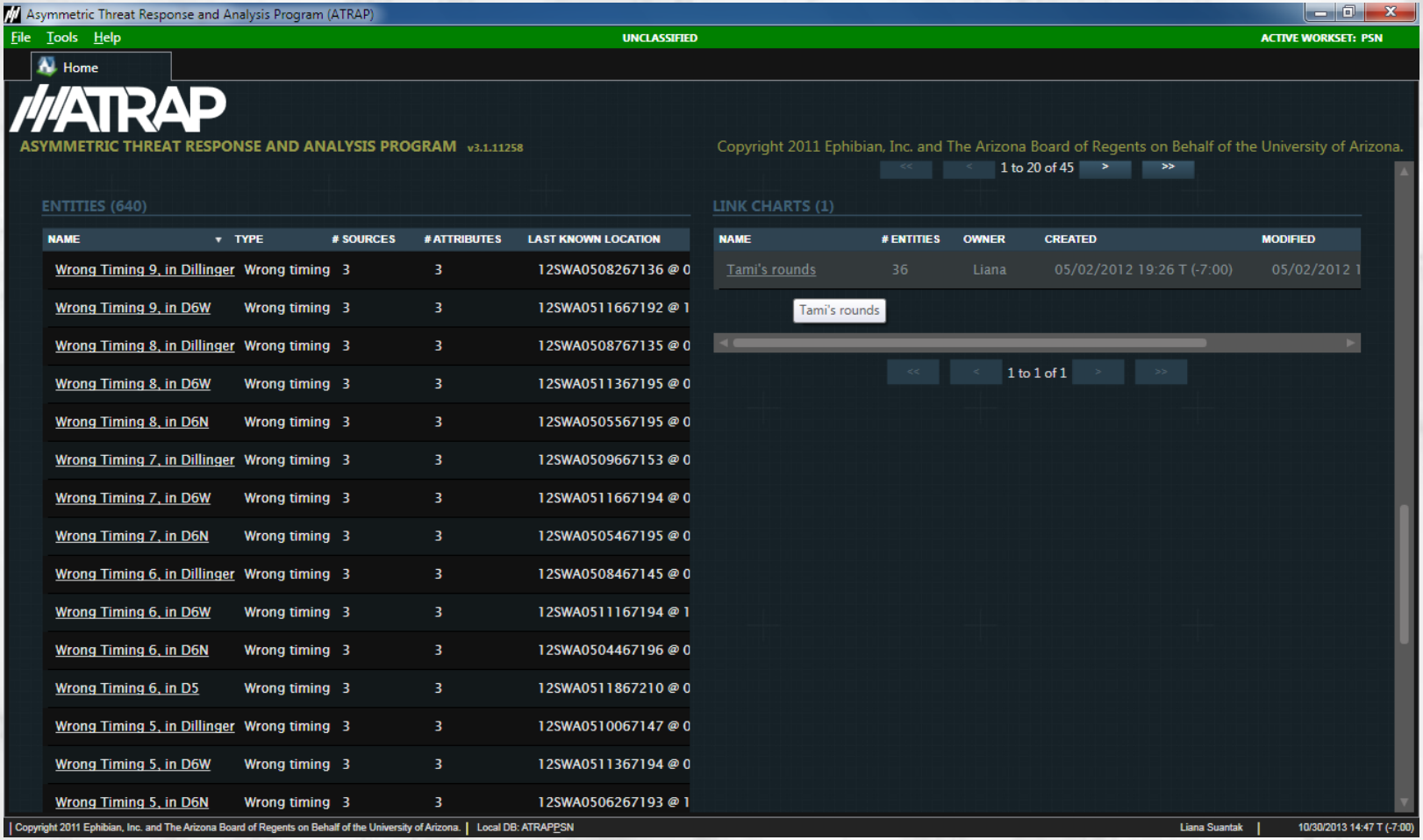
- Entities (structured information) can be extracted from free text
  - ATRAP provides some natural language processing
  - Still requires the use of a person to create a structured piece of information from the text



Entities (structured data)

- Entities (any structured data) may have
  - Meta-data
  - Data-time information
  - Attributes
  - Associated files (multimedia, reports, etc.)
  - Relationships with other entities
- ATRAP has tools to perform queries on any of these properties

Link Charts


Asymmetric Threat Response and Analysis Program (ATRAP)
File Tools Help
UNCLASSIFIED
ACTIVE WORKSET: PSN
Home
ATRAP
ASYMMETRIC THREAT RESPONSE AND ANALYSIS PROGRAM v3.1.11258
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1 to 20 of 45
ENTITIES (640)
NAME TYPE # SOURCES # ATTRIBUTES LAST KNOWN LOCATION
Wrong Timing 9, in Dillinger Wrong timing 3 3 12SWA0508267136 @ 0
Wrong Timing 9, in D6W Wrong timing 3 3 12SWA0511667192 @ 1
Wrong Timing 8, in Dillinger Wrong timing 3 3 12SWA0508767135 @ 0
Wrong Timing 8, in D6W Wrong timing 3 3 12SWA0511367195 @ 0
Wrong Timing 8, in D6N Wrong timing 3 3 12SWA0505567195 @ 0
Wrong Timing 7, in Dillinger Wrong timing 3 3 12SWA0509667153 @ 0
Wrong Timing 7, in D6W Wrong timing 3 3 12SWA0511667194 @ 0
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Wrong Timing 6, in Dillinger Wrong timing 3 3 12SWA0508467145 @ 0
Wrong Timing 6, in D6W Wrong timing 3 3 12SWA0511167194 @ 1
Wrong Timing 6, in D6N Wrong timing 3 3 12SWA0504467196 @ 0
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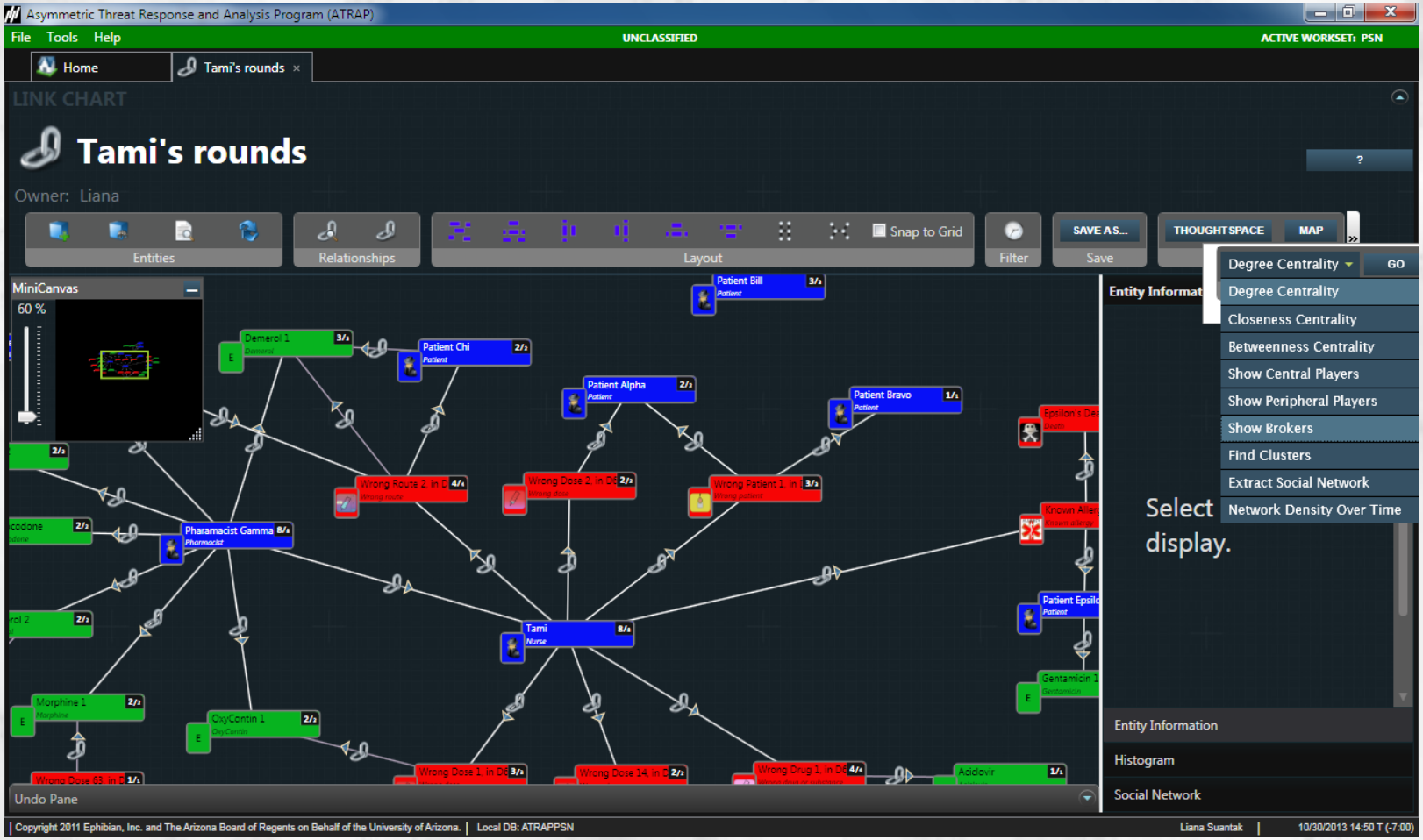
LINK CHARTS (1)
NAME # ENTITIES OWNER CREATED MODIFIED
Tami's rounds 36 Liana 05/02/2012 19:26 T (-7:00) 05/02/2012 1
Tami's rounds
1 to 1 of 1
Copyright 2011 Ephibian, Inc. and The Arizona Board of Regents on Behalf of the University of Arizona.
Local DB: ATRAPPSN
Liana Suantak
10/30/2013 14:47 T (-7:00)

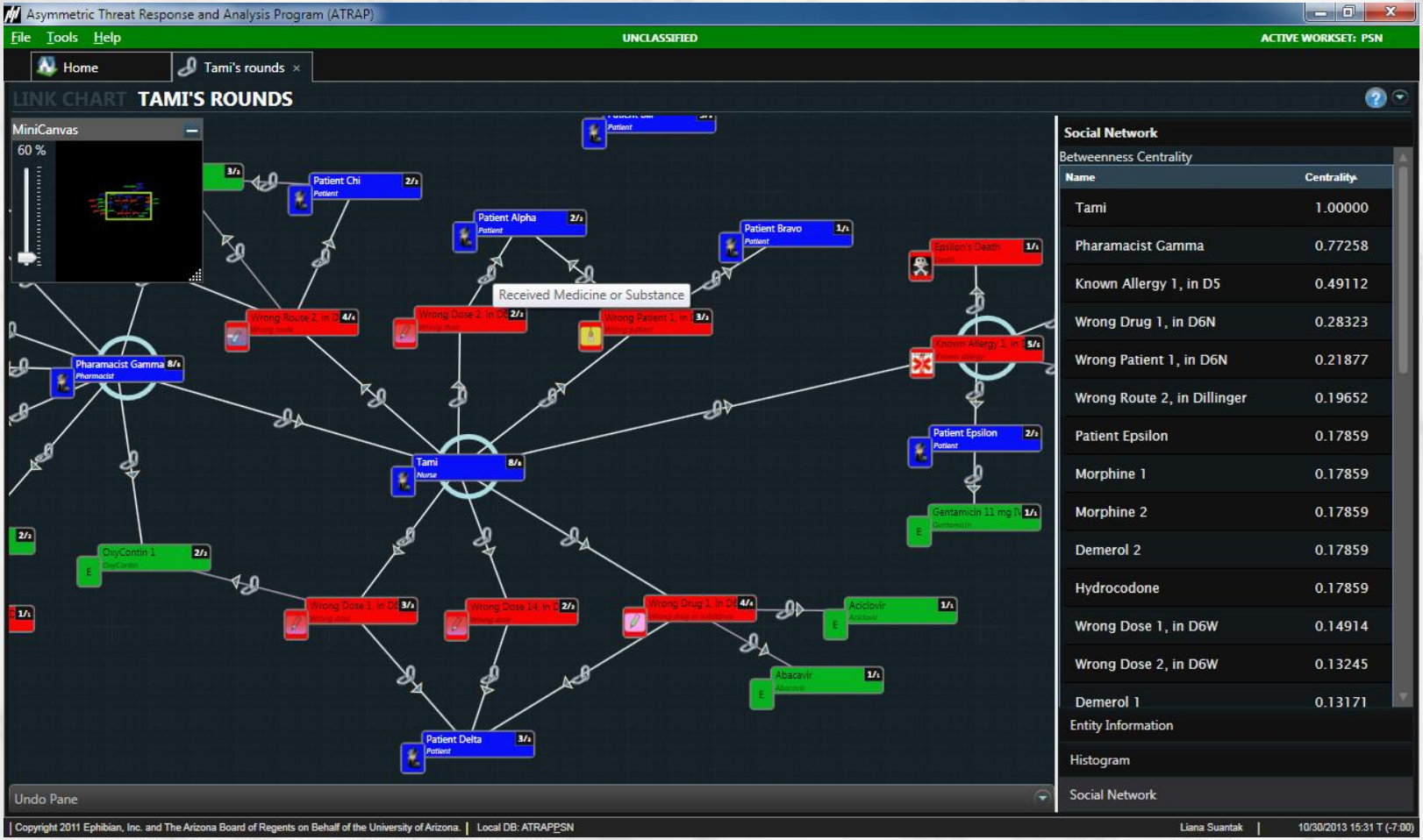
Link Charts

- Link charts are used to display and explore relationships between entities
  - Color represents a type of entity
    - Icons are used to distinguish between subtypes
  - Relationships are directional and typed
  - Many common graph tools including
    - Clustering
    - Searching by connection patterns
    - Displaying central and broker nodes
    - Extracting subgraphs

Link Charts – Several Tools



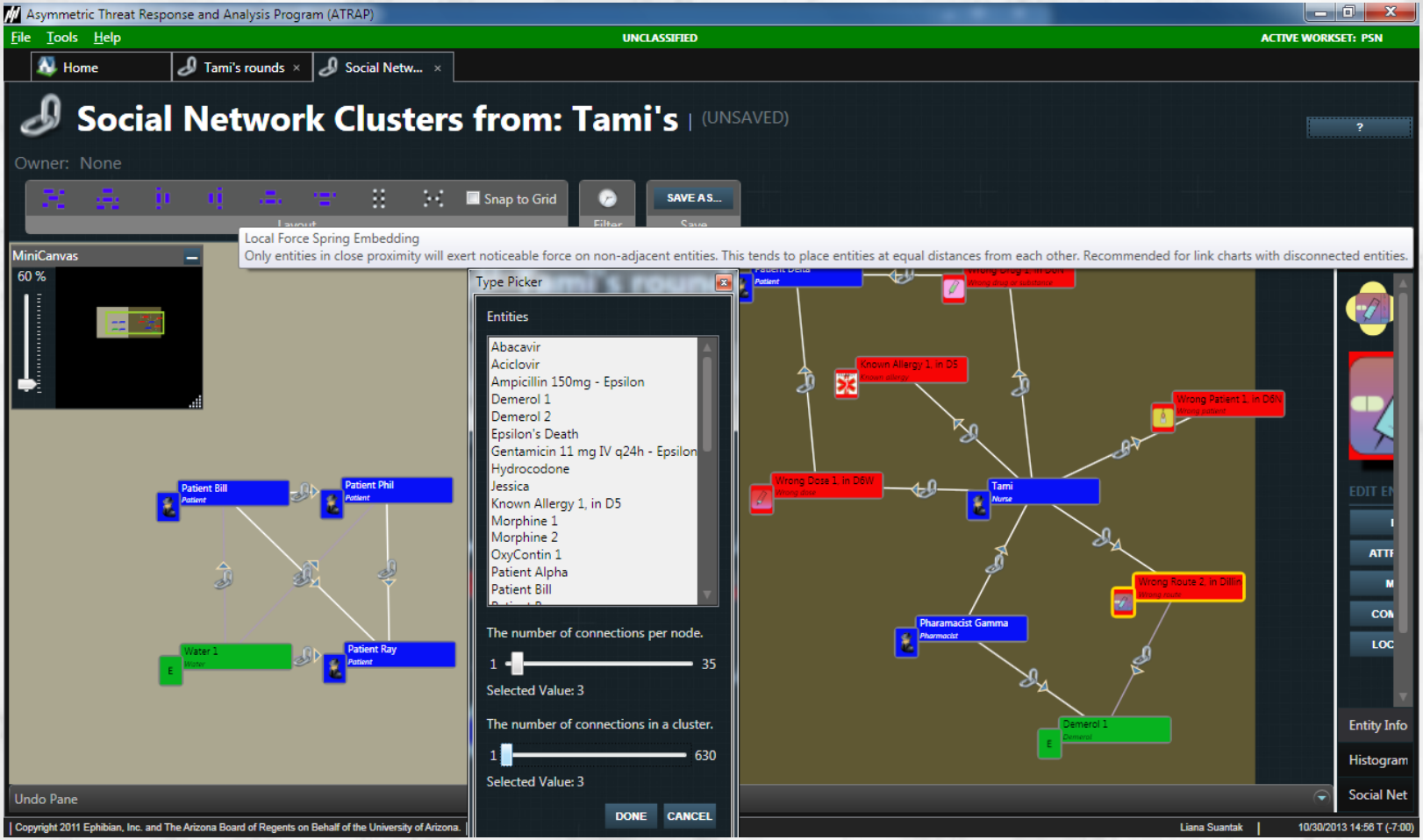
Link Charts – Showing Brokers and Betweenness Centrality



Link Charts

- No limits on the size of the link charts
  - Except those that storage and memory impose
- Sometimes it is better to work with smaller groups of entities
- ATRAP allows this through extracting clusters
- Entities can be organized neatly through the use of spring embedders

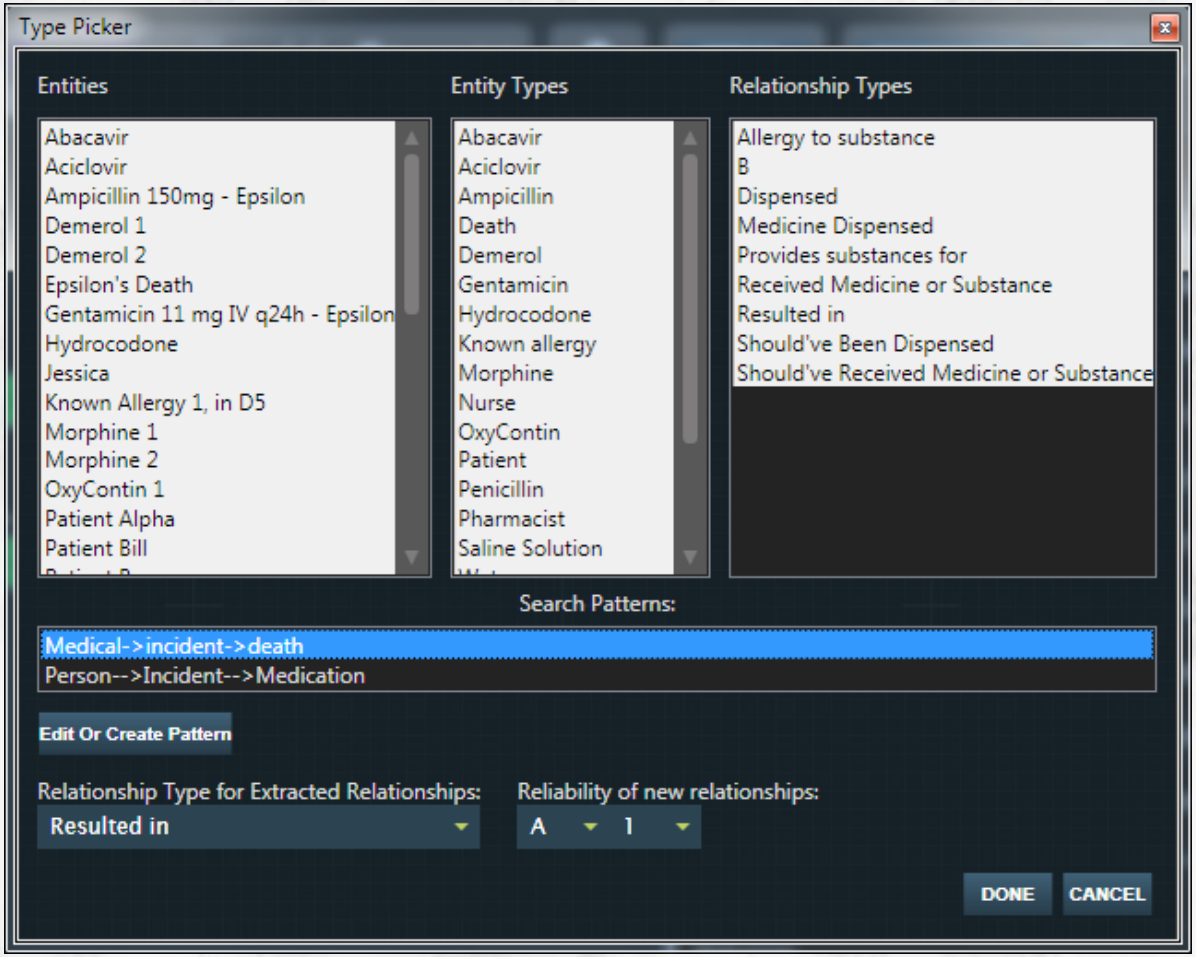
Link Charts – Data Reduction by Clusters



Link Charts – Growing New Connections

- Suppose the investigator has a hunch as to how entities may be related
- Assuming this can be codified based on the
  - Entities,
  - Types of entities,
  - Types of relationships, and
  - A relationship pattern
- New suspected connections can be made

Link Charts – Growing New Connections



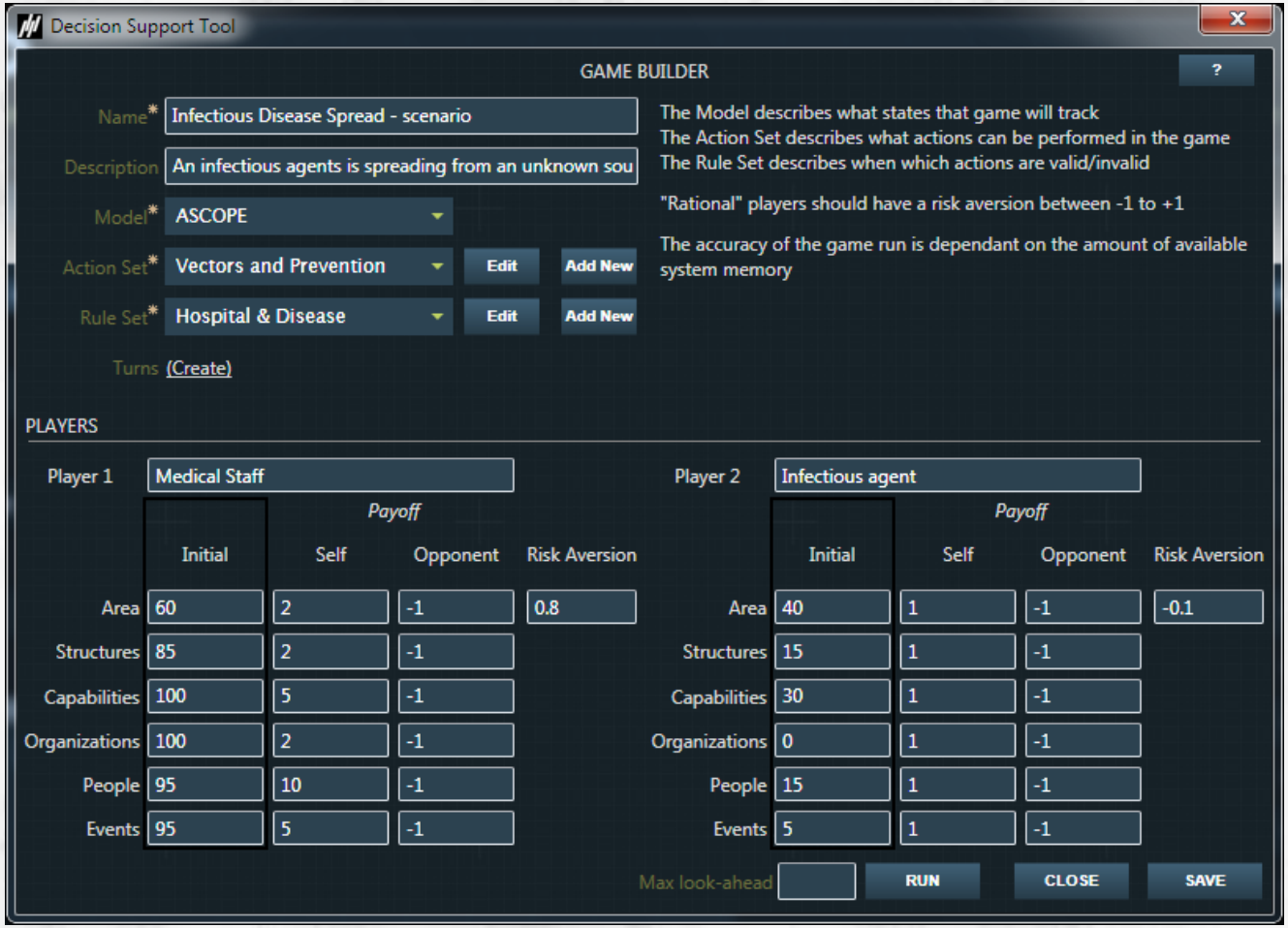
Link Charts – Growing New Connections

- Suppose a network administrator want to generate a list of insider suspects
- The administrator could create suspect-links using:
  AttackEvent→Computers→Users→Coworkers
- The results could be further processed with additional filters and queries

Game Theoretic Decision Support

- Game theory has been applied to cyber-security to
  - Resource allocation [1-4]
  - Countermeasures or responses to an attack [5-11]
- We present a tool for determining optimal responses to an attacker
  - Grounded in stochastic game theoretic context

Game Theoretic Decision Support



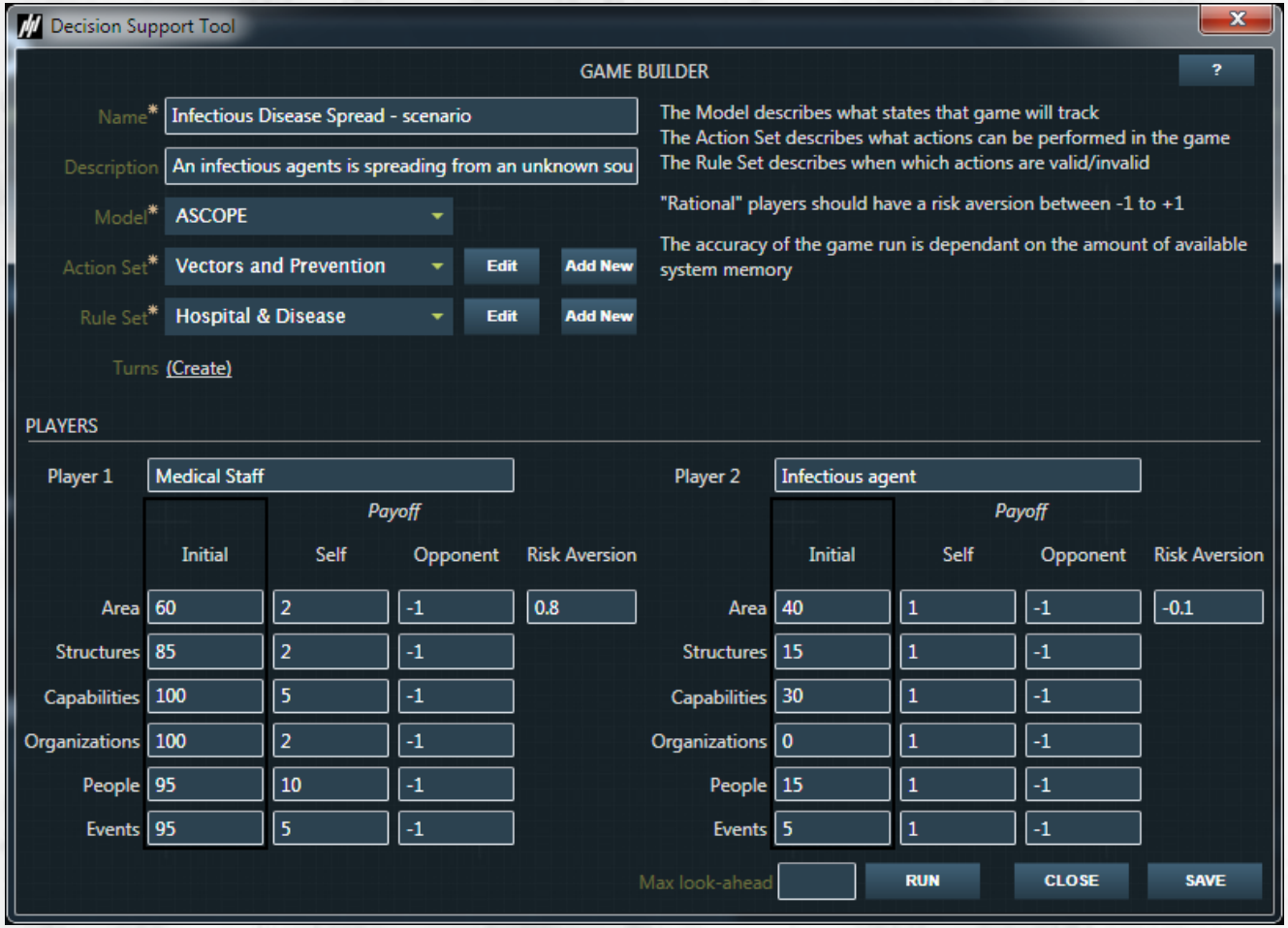
Game Theoretic Decision Support – Stochastic Context

- A play may not take the optimal action, only probabilistically
- This results in outcome/payoff distributions
  - Need a certainty equivalent to recover a payoff
  - A second-order model takes the expected value and variance into account
  - The relative importance of the variance is determined by the player's risk aversion

Game Theoretic Decision Support – The Components

- Two players
  - Initial state, payoff function, and risk aversion
- State
  - Defined by user-defined model (*e.g.*, ASCOPE)
    - Area, structures, capabilities, organizations, people, events
- Actions
- Rules
  - Determines when actions are valid and for whom

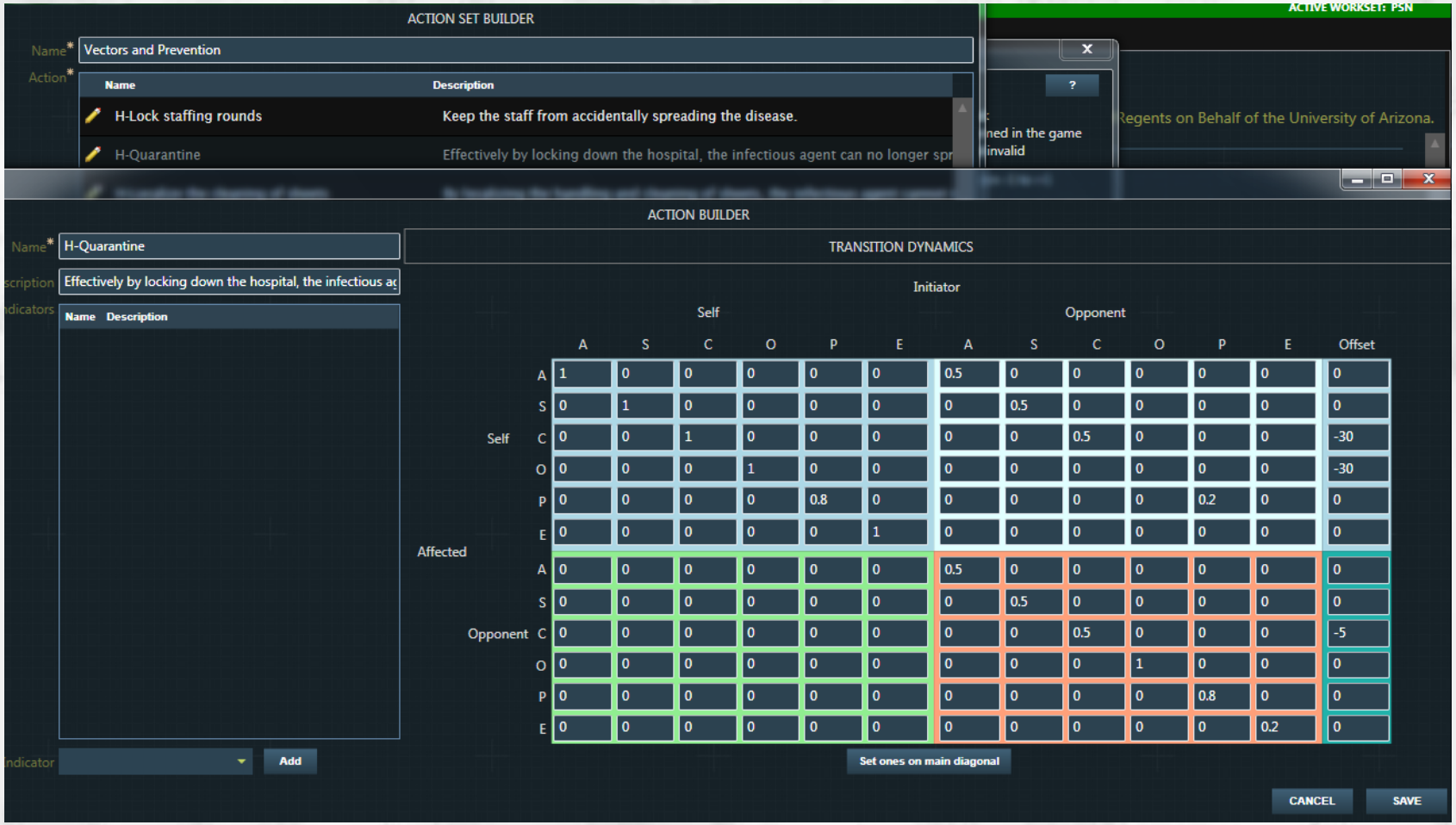
Game Theoretic Decision Support



Game Theoretic Decision Support – The Action Set

- The most costly part of game theoretic analysis comes from the construction of the actions in a game
- ATRAP allows the user to recycle actions from other games and to create new actions
- Each action invokes an affine transformation on the game state
  - For an *n*-dimensional model, each action has an $2n \times 2n+1$ transformation matrix.

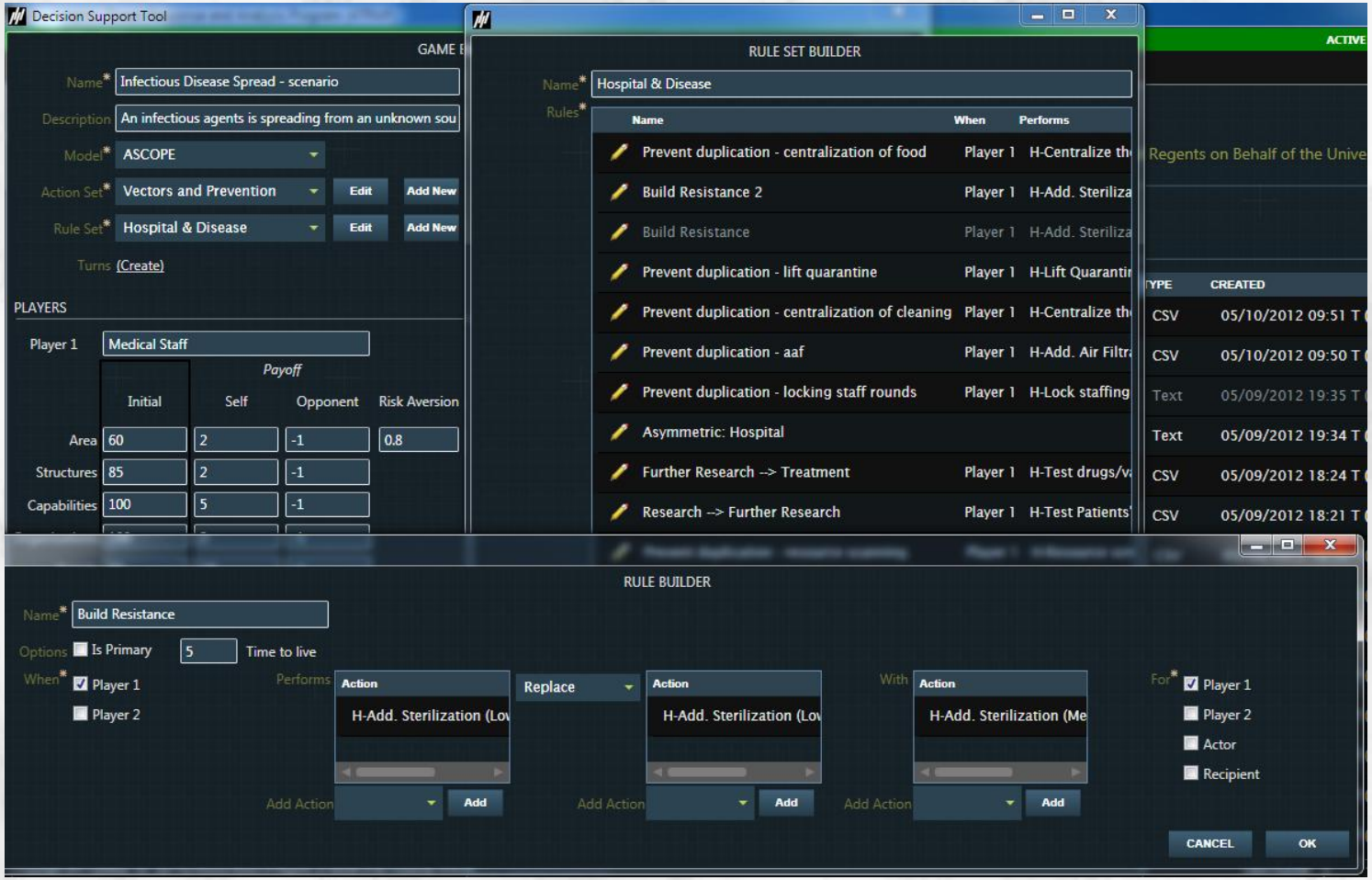
Game Theoretic Decision Support – The Action Set



Game Theoretic Decision Support – The Rule Set

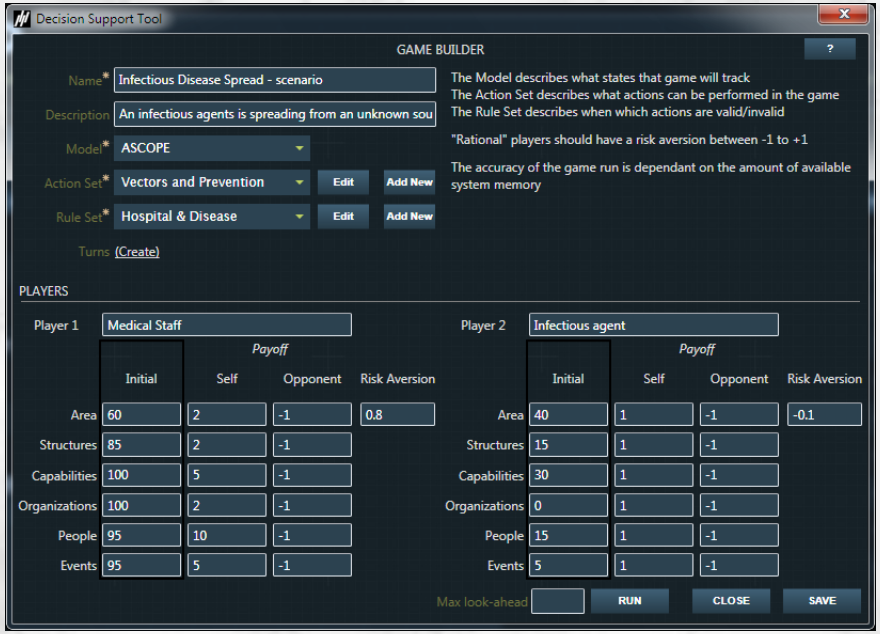
- Not all actions are always valid
  - An action maybe replaced with a more/less effective action provided certain circumstances have been met
- Each action may trigger a rule
  - Allowing/disallowing/replacing one set of actions with another set of actions
  - These may last for any number of turns
  - May affect either player

Game Theoretic Decision Support – The Rule Set

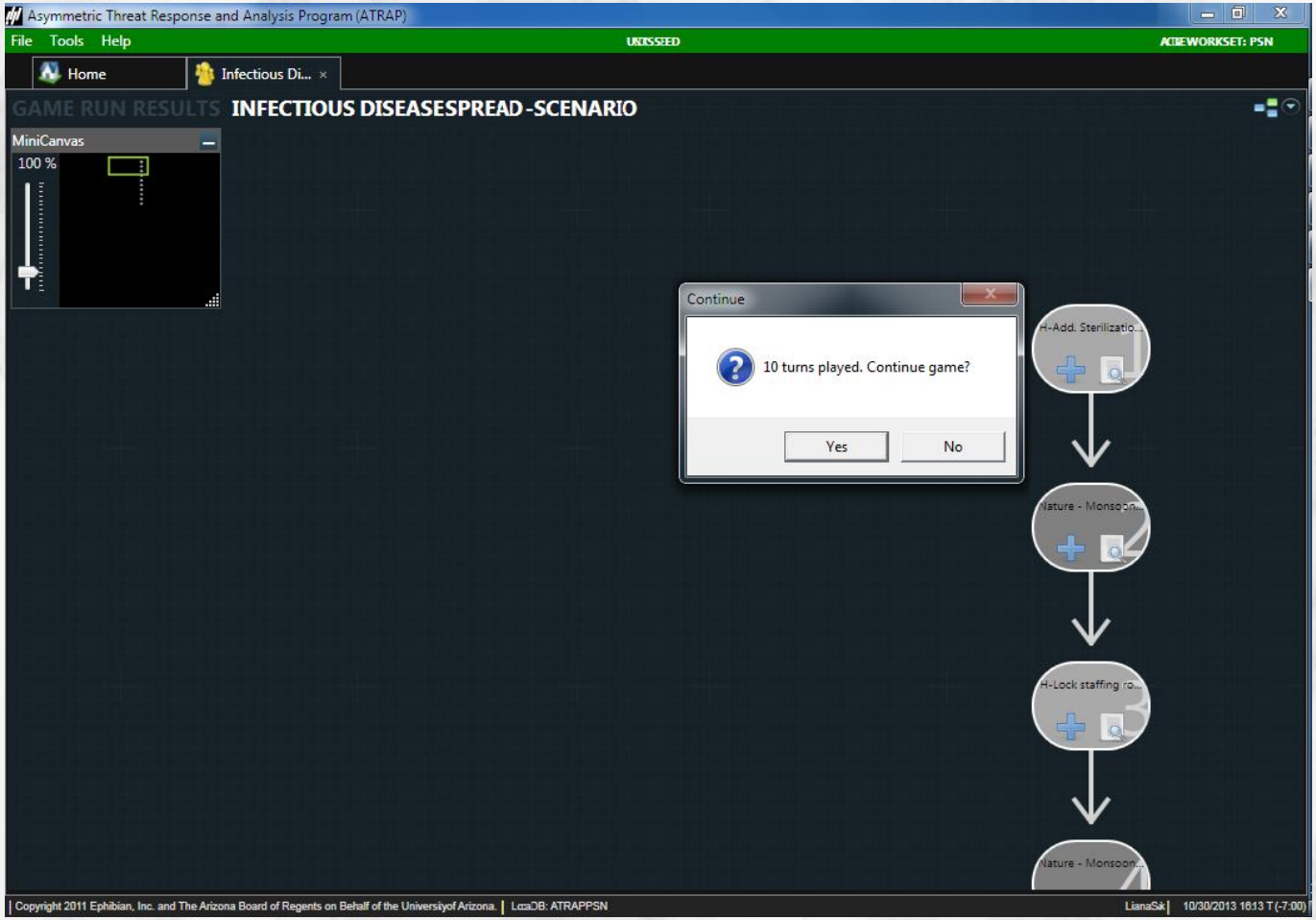


Game Theoretic Decision Support – Running the Game

- The user may optionally enter a look-ahead amount for the game
  - Otherwise the system takes its best guess at how far it can look ahead without exhausting memory.



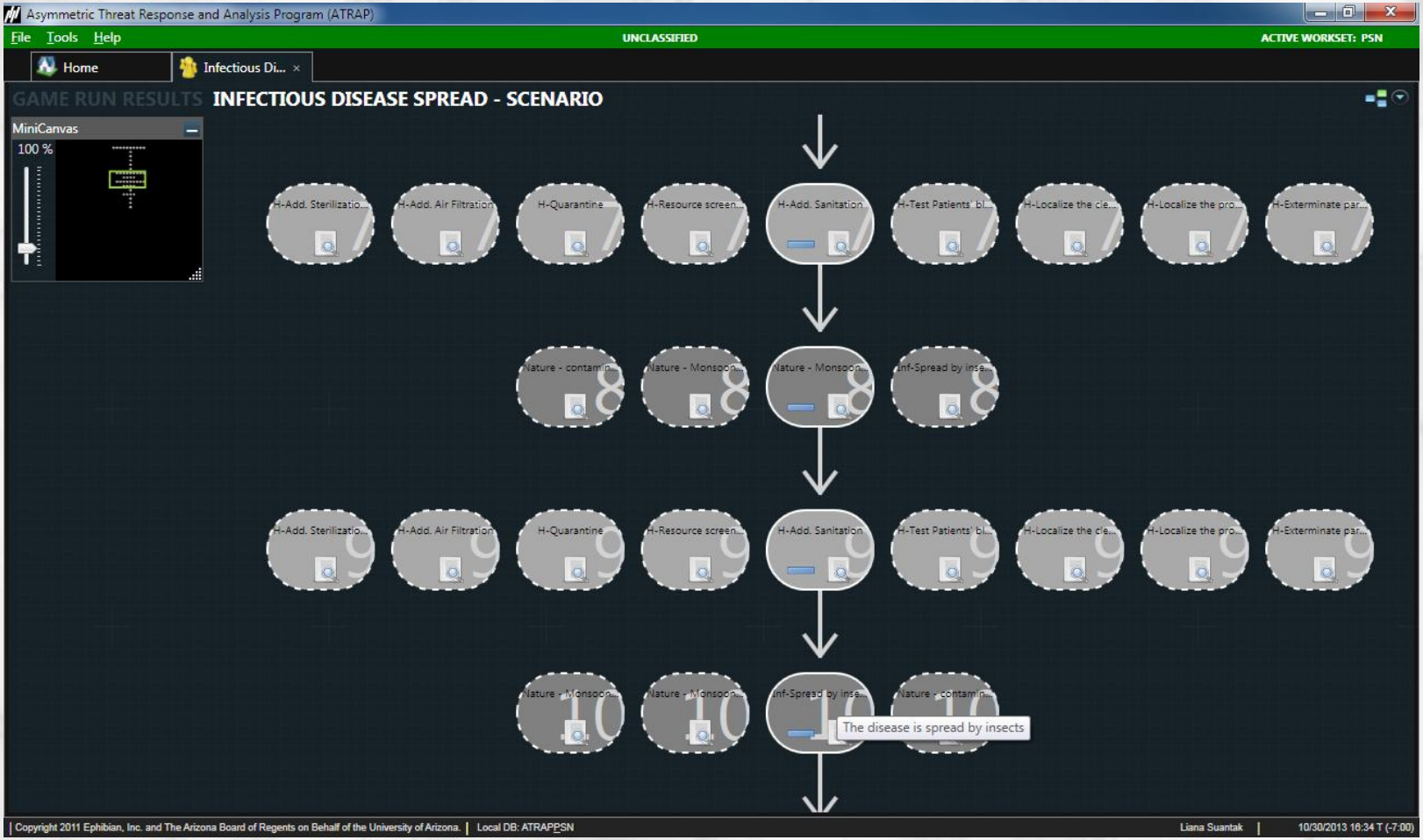
Game Theoretic Decision Support – Running the Game



Game Theoretic Decision Support – Running the Game

- Our game avoids artifacts by technically having no end
  - Even the last move shown is still looking as far ahead as the look-ahead permits
  - Actions remain valid until a rule disallows them
- The light (dark) gray boxes represent the first (second) player's actions
- The resulting path through the game tree is the one each player thinks is optimal under uncertainty

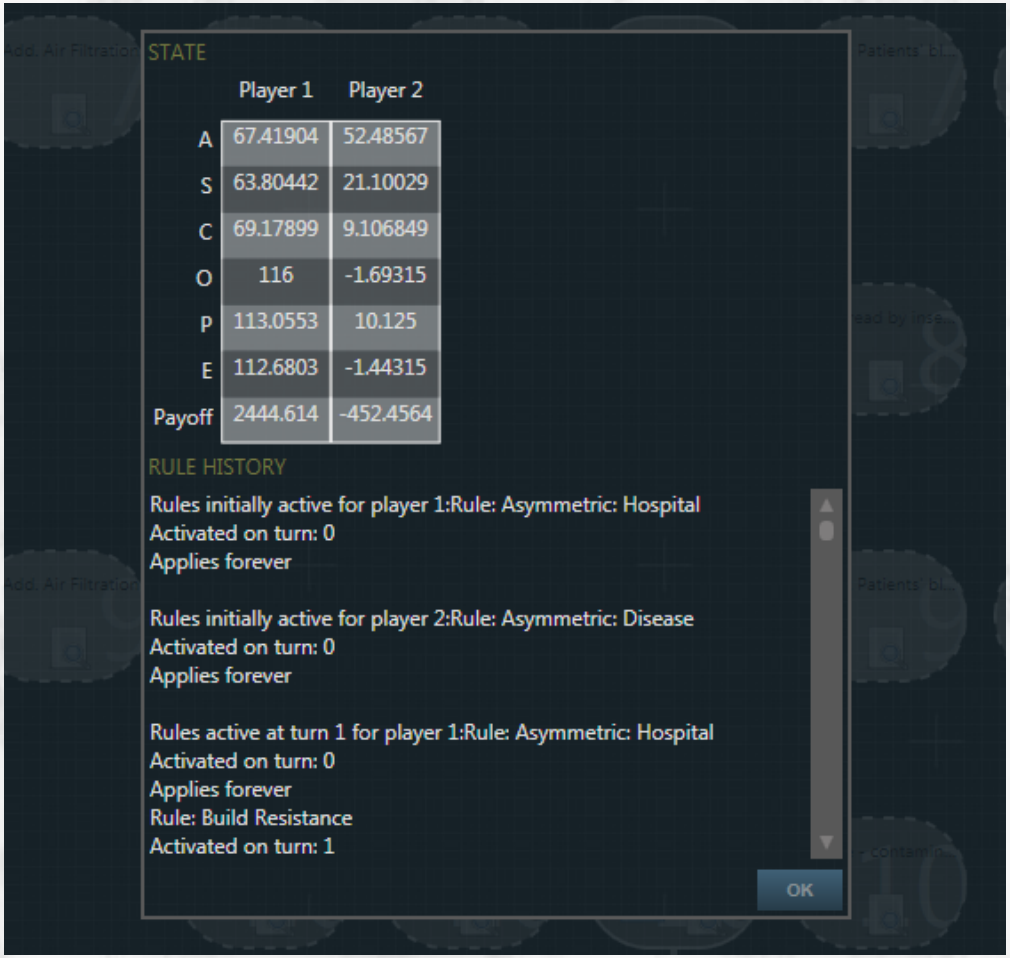
Game Theoretic Decision Support – Introspection



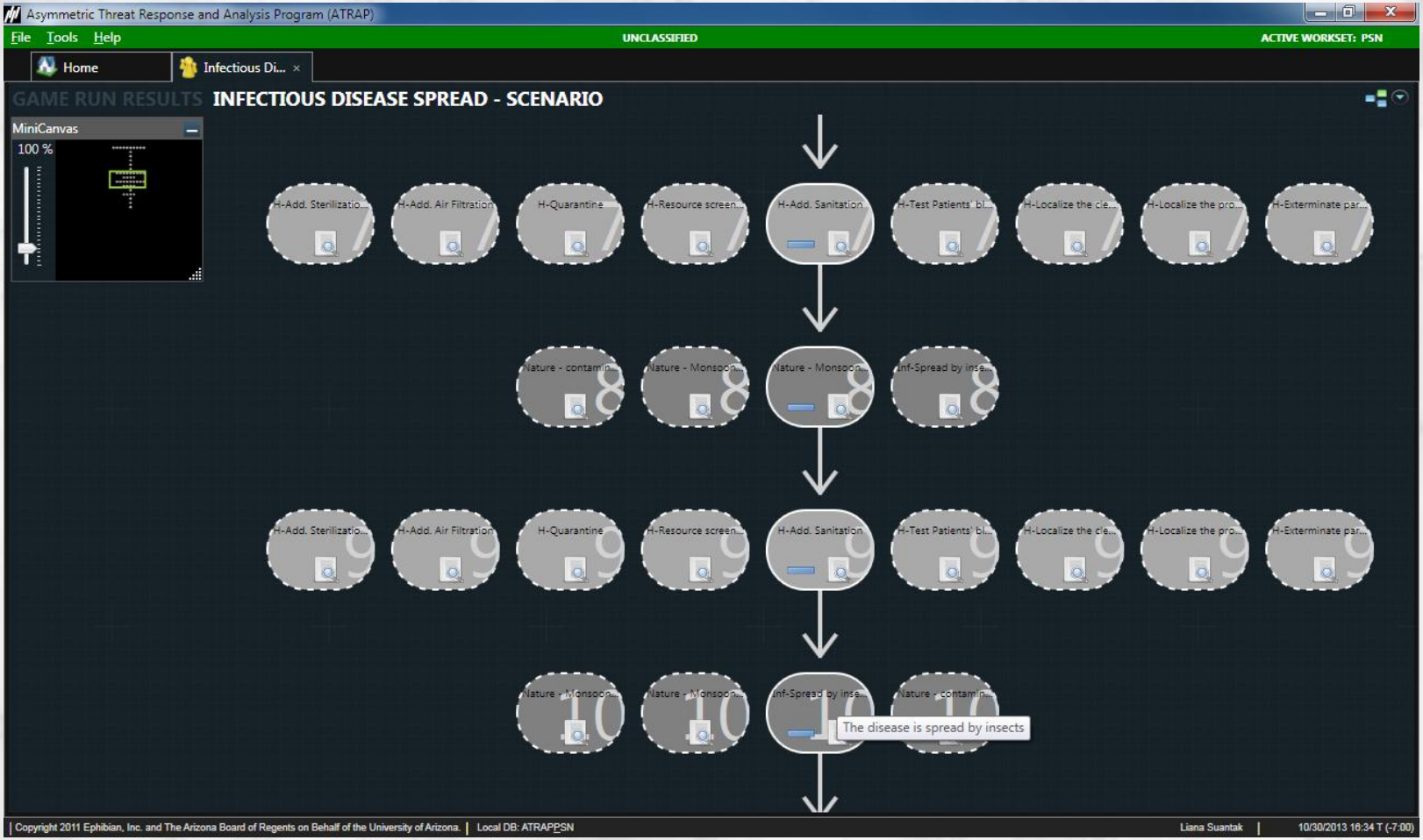
Game Theoretic Decision Support – Introspection

- Each action can be expanded to show alternatives at that point in time
- Each alternative can have its state inspected
- When inspecting an action or its alternative, a description of the rules that triggered are also provided
  - Much like code, complex games may require debugging

Game Theoretic Decision Support – Introspection

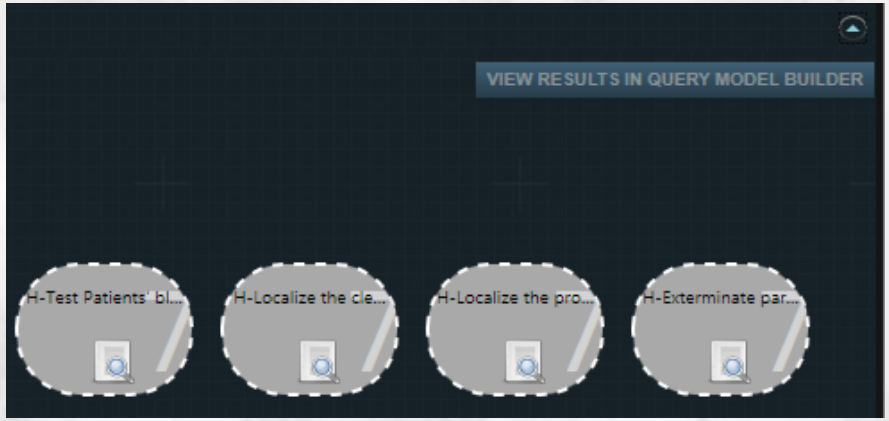


Game Theoretic Decision Support – Converting to a Query

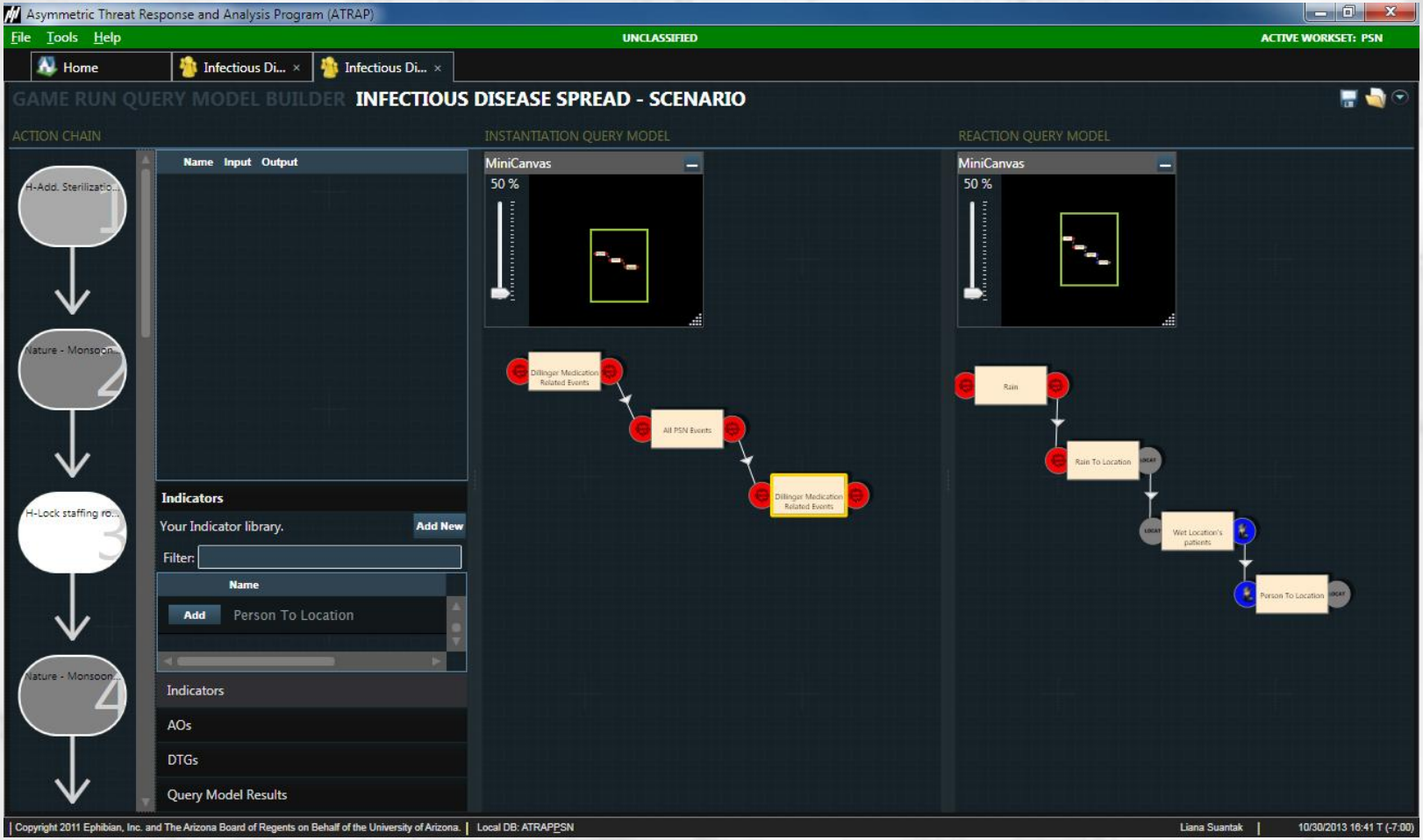


Game Theoretic Decision Support – Converting to a Query

- In the top right corner there is an option to send the resulting path through the game tree to another tool
- This query model builder allows the game to be instantiated as a series of queries
  - Allows for the search of empirical evidence supporting such an outcome



Game Theoretic Decision Support – Converting to a Query



Game Theoretic Decision Support – Converting to a Query

- Queries have an input and output type
- Queries can search any entity data
- Queries may be chained together
- Queries may be modified by soft-factors (skillfulness or organization size)
  - Allows for better sorting of suspects

Conclusions

- ATRAP is a toolbox full of human-in-the-loop data analysis tools
  - Analysis of relationships between entities
  - Game Theory to help predict potential outcomes and how to best respond
- Geared toward security data mining

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