Multi-Agent Simulation of the Battle of Ankara

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Introduction

For years, historians argue that the betrayal of Anatolian and Rumelian cavalries was the major reason behind Ottoman's defeat at the hand of Tamerlane. In 1402, the battle took place at the north of Ankara. Here, I intend to use simple rules to simulate the Battle of Ankara, thereby exploring what actually determines the outcome.

Objective

This study focuses on the question: is there a decisive factor that alone can determine the battle outcome? If not, what are the important factors?

Simulation

- Implemented in C++, without other tools.
- Agent-Based: 116 Agent with Ottoman (55) and Tamerlane (61).
- Each agent is a military unit of a certain number of soldiers who shared the same training background, similar weapons and armors.
- The flow of actions and states is based on a finite state machine in Figure 2.

Data

- 4320 battles (instances).
- 1 Class {Ottoman Victory, Tamerlane Victory, Draw}
- 5 Attributes (possible factors to the defeat)
  - Ottoman endured a forced march
  - Ottoman soldiers drank poisoned water
  - Ottoman was on the defensive
  - Betrayal took place in Ottoman wings
  - Ottoman could have more soldiers

Results

- The chance of Tamerlane Victory is 100%, no matter how large Ottoman Size is.

Analysis

- Graph
  - When Ottoman size is increased to 127K, chance of Ottoman victory rises from 0 to 3.3%. When Ottoman has 140.5K soldiers, the chance is boosted to 90%.
  - Betrayal will eliminate all chances of Ottoman winning.

Figure 1. Battle procedure. Tamerlane troops are represented by black rectangle.

Figure 2. the Finite State Machine controls the actions and states of the agent

Figure 3. As Ottoman has more soldiers, the chance of Ottoman victory boosts to

Figure 4. The chance of Tamerlane Victory is 100%, no matter how large Ottoman Size is.

Future Development

I plan to deviate the fixed numbers and initial values and try to find one set of those numbers best characterizing the battle

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**WEKA**

- J48 does not have statistical significance to other classifiers (except NaiveBayes).
- **AttributeSelection** Classifier: There is no statistical significance among different rankers and evaluators (except Wrapper + Greedy). Those classifiers disagree with the ranking of the first two most important factors (Betrayal or Size).

- Compare accuracy after remove certain attribute. Removing Betrayal will result a significantly worse accuracy. Therefore Betrayal is the most important attribute.