Item Prediction in Dota 2

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Background
Dota 2 is a popular online five-on-five video game with a rich competitive scene. In every game of Dota 2, players steadily accumulate gold over time from a number of sources. Gold can then be spent on items that make their characters stronger as the game progresses. My neural network predicts which items each player is most likely to purchase given the current state of the game at a given point in time.

Data
I used information about 49,867 public matches taken from Kaggle[1], a machine learning competition website. I used information about eight random times in each game. I used a 90/5/5 train/dev/test split.

Input
I wanted the network to be able to predict which items the opponents would buy with only information a player would normally have in-game, so the algorithm gets the following input:
- Current player items
- Current elapsed game time
- Which character each player has chosen to play out of the 115 available options
- The skill rating of each player

Output
There are five players on each team, and 95 possible items they could buy. The network returns the probability of each player buying each item, for a total of 950 predictions. Example outputs for two characters are shown below. Upper case item names are ones that were bought.

```
Hero: Undying
Game Time: 16:16
Current Items: ['Arcane Boots']
Future Items: ['Mekansm', 'Vladimir’s Offering', 'Guardian Greaves']
```

```
Hero: Keeper of the Light
Game Time: 16:16
Current Items: []
Future Items: ['Force Staff']
```

Predicted Future Items: Probabilities:
1. Rod of Atura
2. Mekansm
3. Arcane Boots
4. Mekansm’s scepter
5. Arcane Boots
6. Pipe of Insight
7. Bane Mail
8. Blade Mail
9. Resistance
10. Crimson Guard

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Results

<table>
<thead>
<tr>
<th></th>
<th>Train</th>
<th>Dev</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss</td>
<td>0.1089</td>
<td>0.1186</td>
<td>0.1185</td>
</tr>
<tr>
<td>AUC</td>
<td>0.9037</td>
<td>0.8854</td>
<td>0.8859</td>
</tr>
</tbody>
</table>

The true positive rate and false positive rate for various cutoff probabilities.

Discussion
These results were actually much better than I had expected. Players may make sub-optimal purchases, and there may be many viable item choices for a given situation, so the model’s performance is quite good. It takes years for players to develop an intuition for which items the opponents will buy, so this network would actually be fairly useful for newer players.

Future
If I had more time, I would definitely use a bigger dataset, and perhaps use more features about the current game state. I could also extend the functionality to predicting other player choices.

References