The Art of Carrying

By Ryan and Grace

Introduction

"Carrying" is a word that is all-too-often associated with League of Legends. "I totally carried that game last night." "Master Yi can carry games so hard!" "Bjergsen just carries TSM". However, carrying is ultimately an abstract concept that is difficult to concretely define. So, we decided to tackle this problem of defining "carrying" while also taking a look at how the recent AP item changes affected carrying in League of Legends.

Our Model

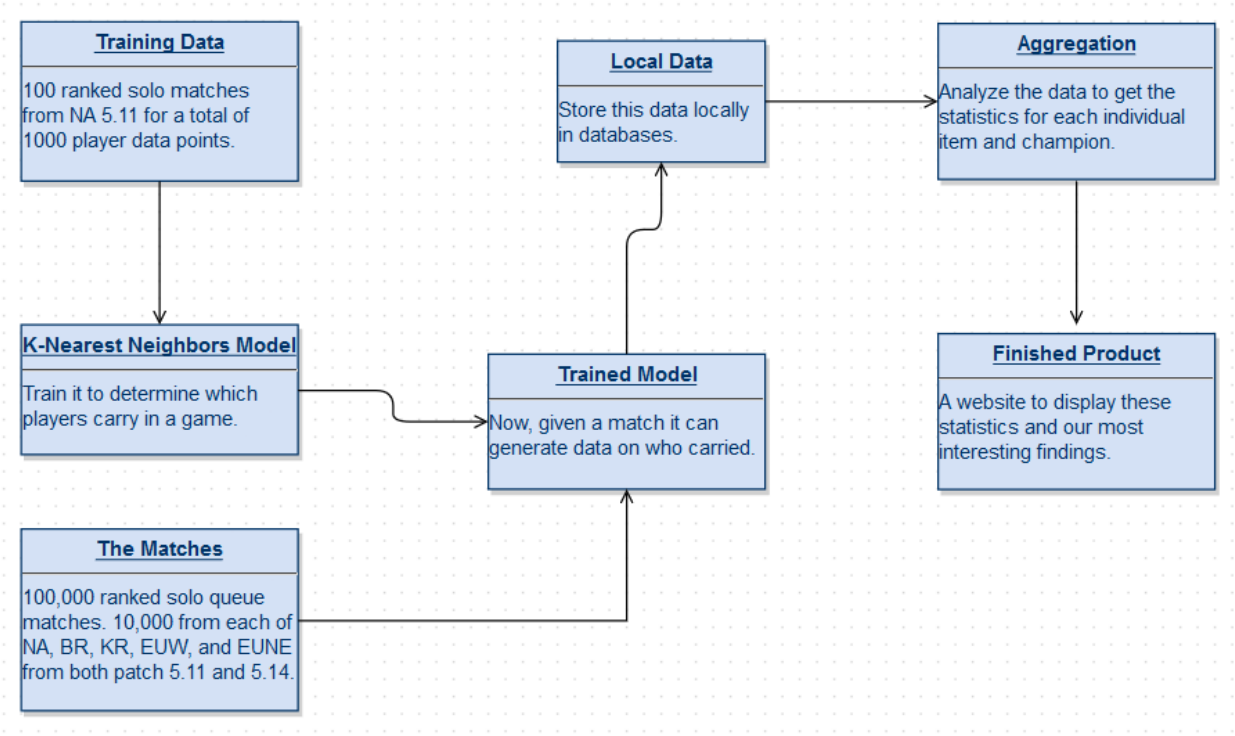
We used a simple machine learning algorithm, K-Nearest Neighbors, to determine whether or not a player carried in a given game. In order to train this model, we manually looked at 100 matches and determined which players carried in each game by looking at a variety of variables such as KDA, gold earned, damage dealt, percent of team's damage, and kill participation. We wrote a python script to generate simple csv files to display this match information. Here's a clear example of someone who carried:

Champion	Kills	Deaths	Assists	KDA	Gold	Damage	avgKdaDif	avgGoldDi	avgDamag	killPart	damagePe	goldPerc
Fizz	4	3	6	2.33	11920	7586	0.64	-151	-13585	31%	8%	18%
Zed	7	5	8	2.2	13156	17809	0.5	1222	-2226	47%	19%	20%
Vayne	14	6	9	3.08	16394	40555	1.48	4820	23047	72%	44%	25%
Nasus	2	4	5	1.13	13606	17863	-0.69	1722	-2166	22%	19%	21%
Leona	5	5	13	2.3	10415	8633	0.61	-1823	-12422	56%	9%	16%
Varus	6	10	7	0.95	11615	24778	-0.89	-490	5517	56%	23%	21%
Morgana	3	4	10	2	9601	10983	0.28	-2728	-9811	56%	10%	17%
Maokai	3	5	4	1	9984	23482	-0.84	-2302	4077	30%	22%	18%
Azir	4	6	6	1.17	12281	30503	-0.65	250	11878	43%	28%	22%
Wukong	7	7	5	1.36	11585	15929	-0.44	-523	-4315	52%	15%	21%

Other times, it was trickier to determine who, if anyone, carried. We decided that in order for someone to hard carry a game, they had to stand out. Thus, even though some of these players did well, none of them particularly carried:

Champion	Kills	Deaths	Assists	KDA	Gold	Damage	avgKdaDif	avgGoldDi	avgDamag	killPart	damagePe	goldPerc
Nasus	8	5	3	1.9	11519	23001	-0.16	380	5602	46%	28%	23%
Master Yi	5	8	8	1.13	9747	10398	-1.02	-1589	-8401	54%	13%	19%
Leona	3	6	12	1.5	9272	10473	-0.61	-2116	-8318	63%	13%	18%
Diana	6	11	5	0.77	10397	20538	-1.42	-866	2865	46%	25%	21%
Sivir	2	9	8	0.67	9351	16592	-1.53	-2029	-1519	42%	20%	19%
Fizz	12	4	4	3.5	13274	20412	1.61	2330	2725	41%	21%	22%
Ryze	7	6	12	2.17	11412	26001	0.14	261	8935	49%	26%	19%
Braum	4	5	15	2.3	9205	10845	0.28	-2191	-7905	49%	11%	15%
Jinx	8	5	13	2.9	14459	26454	0.95	3647	9439	54%	27%	24%
Xin Zhao	8	4	13	3.63	13128	14873	1.76	2168	-3429	54%	15%	21%

Once we manually trained our model, we could then put it to work on the large data sets at hand. We ran it on 100,000 matches total. 10,000 Ranked solo queue games from each of NA, BR, KR, EUW, and EUNE in both patches 5.11 and 5.14 were analyzed.



The Results

The visualization of our data enabled us to make some interesting discoveries, with a focus on how the AP item change affected players who hard carried. Here are some statistics from the main AP items that changed in patch 5.13:

- **Rabadon's Deathcap**: 1.7% decrease in carry rate. No significant change in how many times it was built, suggesting that Deathcap is still an **essential** foundation for an AP carry build.
- **Zhonya's Hourglass**: 1.7% decrease in carry rate. No significant change in how many times it was built. Built the most out of any of these items, suggesting that it serves a useful purpose for a **variety** of champions. Vladimir carried much less with Zhonya's after the AP item change, whereas Nidalee carried a lot more.
- **Luden's Echo**: Suffered an 15% decrease in how many times it was built, suggesting that Luden's strayed away from being an essential item for carries and instead became a more **niche** item to build for certain champions.
- **Rylai's Crystal Scepter**: Experienced a big **46% increase** in how many times it was built, suggesting that the change made Rylai's a **viable** build choice for several AP carries such as Brand and Elise.
- **Seraph's Embrace**: 27% decrease in how many times it was built. Certain champions that rely on Seraph's as a core item, such as **Ryze and Cassiopeia** suffered big drops in

their carry rates, suggesting that the small buff to Seraph's may have been outshined by other AP item changes.

- **Rod of Ages**: 17% decrease in how many times it was built. Like Seraph's, ROA is an item that **specific champions**, such as Cho'Gath and Ryze rely on. However, several of these champions suffered decrease in carry rates, perhaps as a result of the other AP item changes.
- **Liandry's Torment**: Experienced a 24% increase how many times it was built while maintaining a decent carry rate of 18-19%. Caused champions that usually build it, such as Brand and Elise, to experience an **increased** carry rate.
- **Void Staff**: Suffered a 25% decrease in how many times it was built, suggesting that it is no longer an essential item for AP carries. However, when it is built, it usually carries. It boasts a carry rate of over **30%** following the AP item change.
- **Nashor's Tooth**: Experienced a whopping **66% increase** in how many times it was built. However, it still holds a very **niche** role and it only viable on certain AP carries such as Azir and Kayle.

Overall, when it comes to carrying, this AP item change allowed many champions to have more choices when it comes to which items to build. There were significant changes in build rates of these AP items across the board. By evening out some of the AP stats of these items, Riot gave AP carries more **build diversity**, something that AD carries are currently lacking.

Champions that benefit from Liandry's and Rylai's, like Elise, have majorly improved carry rates. Other AP champions with the highest increase in carry rates include Swain, Galio and Kayle. Surprisingly, late game AP champions such as Karthus, Cassiopeia and Vladimir have the highest decrease in carry rates.

The Technology

- Python scripts for parsing data:
  - processMatches.py – the main script for going through match ids, issuing PAI requests, marking carries, and storing the data locally.
  - analyzeChamp.py/analyzeItem.py – these scripts process the locally stored data and aggregate carry statistics for each item and champion.
  - sklearn library for K-Nearest Neighbors classifier.
- SQLite for storing data locally.
- Django backend with Javascript/HTML5 frontend for nicely displaying our data.
  - jQuery library better coding
  - typeahead.js for the search bar
- Heroku for free web hosting.