

DOTA 2 Network

MARCO ORDONEZ AND DAVID
LANIGAN



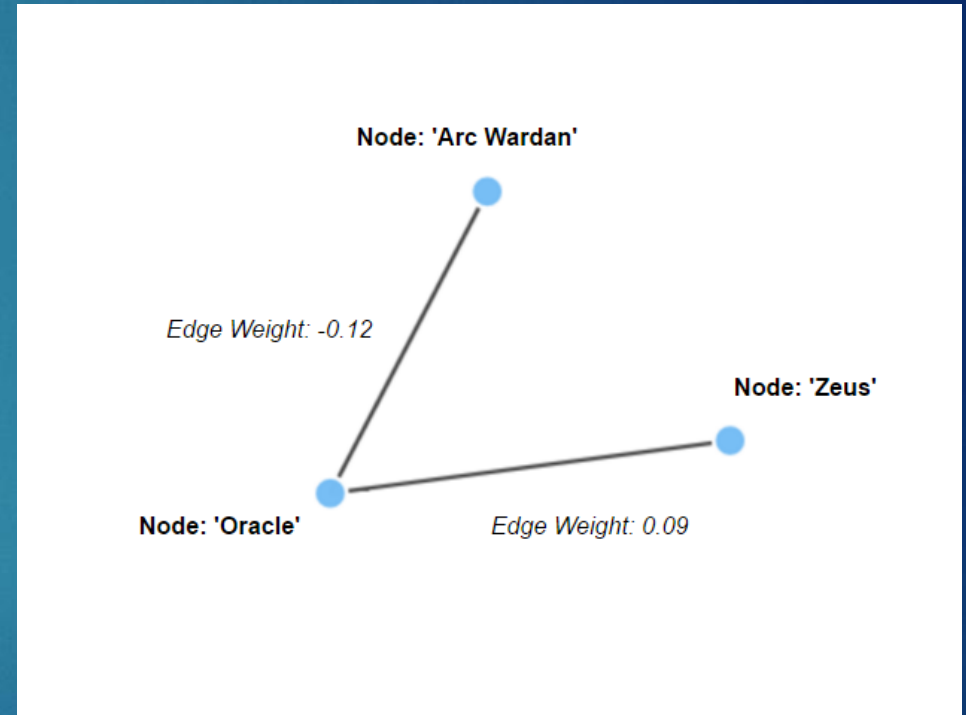
Game Background

- ▶ 5v5 Tower defense game
- ▶ 112 Unique heroes
- ▶ Different Pick Orders



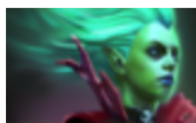
Data Acquisition and Graph Structure

- ▶ Sampled 40 million ranked, all-pick games
 - ▶ No banning
 - ▶ Only one of each hero per game
 - ▶ Patches 6.86 and 6.86b
- ▶ Raw data provided by OpenDota.com
 - ▶ Dump of all 1.2 billion games played from 2008-April 2016
- ▶ Recorded wins of heroes on the same team
- ▶ Nodes are heroes
- ▶ Edges are win rates between heroes
 - ▶ All heroes are connected to all other heroes



Patch Notes to 6.86b

► Source:
Liquipedia.com



Death Prophet

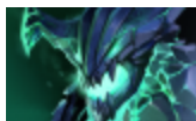
[\[edit\]](#)

- [Spirit Siphon](#) duration increased from 4 to 5 seconds



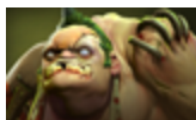
Faceless Void

- [Time Dilation](#) AoE increased from 650 to 725
- Time Dilation slow rescaled from 4/6/8/10 to 7/8/9/10%
- Time Dilation duration rescaled from 6/7/8/9 to 5.5/7/8.5/10 seconds



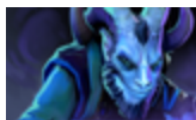
Outworld Devourer

- [Arcane Orb](#) Int steal increased from 0/1/2/3 to 1/2/3/4
- [Astral Imprisonment](#) cooldown rescaled from 20/17/14/11 to 22/18/14/10



Pudge

- [Meat Hook](#) Scepter damage reduced from 175/275/375/475 to 180/270/360/450



Riki

- [Cloak and Dagger](#) backstab damage multiplier increased from 0.4/0.6/0.8/1.0 to 0.5/0.75/1.0/1.25
- [Tricks of the Trade](#) now only affects heroes
- Tricks of the Trade AoE increased from 450 to 475
- Tricks of the Trade cooldown rescaled from 90/80/70 to 70

Analysis: Full Graph

▶ Top Four Hero Win Rates (6.68A):

- ▶ Omniknight: 61%
- ▶ Spectre: 59%
- ▶ Abaddon: 59%
- ▶ Necrophos: 58%

▶ Top Four Hero Pairs (6.68A):

- ▶ Chen – Treant Protector: 77%
- ▶ Necrophos – Pugna: 70%
- ▶ Warlock - Omniknight: 70%
- ▶ Wraith King – Elder Titan: 70%

▶ Top Four Hero Win Rates (6.68B):

- ▶ Omniknight: 61%
- ▶ Spectre: 59%
- ▶ Necrophos: 58%
- ▶ Abaddon: 58%

▶ Top Four Hero Pairs (6.68B):

- ▶ Zeus – Omniknight: 68%
- ▶ Necrophos – Omniknight: 68%
- ▶ Spectre - Omniknight: 67%
- ▶ Necrophos – Spectre: 67%

Diffusion of Death Prophet

Patch 6.68A

- ▶ Win Rate: 42%
- ▶ Top 5 neighbors:
 - ▶ Omniknight : 6.9%
 - ▶ Abaddon: 3%
 - ▶ Wraith King: 2.7%
 - ▶ Necrophos: 2.5%
 - ▶ Ursa: 1.8%
- ▶ Bottom 5 neighbors:
 - ▶ Arc Warden : -21.2%
 - ▶ Io: -18.7%
 - ▶ Beastmaster: -17.9%
 - ▶ Naga Siren: -17.8%
 - ▶ Batrider: -17.4%

Patch 6.68B

- ▶ Win Rate: 48%
- ▶ Top 5 neighbors:
 - ▶ Omniknight : 9.4%
 - ▶ Spectre: 7.6%
 - ▶ Necrophos: 7.1%
 - ▶ Abaddon: 6.1%
 - ▶ Ursa: 5.3%
- ▶ Bottom 5 neighbors:
 - ▶ Io: -12.5%
 - ▶ Broodmother: -10.9%
 - ▶ Queen of Pain: -10.8%
 - ▶ Storm Spirit: -10.5%
 - ▶ Tinker: -9.7%

Diffusion of Pudge

Patch 6.68A

- ▶ Win Rate: 52%
- ▶ Top 5 neighbors:
 - ▶ Omniknight : 13.8%
 - ▶ Spectre: 11.9%
 - ▶ Necrophos: 11.3%
 - ▶ Abbadon: 11.3%
 - ▶ Zeus: 10.2%
- ▶ Bottom 5 neighbors:
 - ▶ Arc Warden : -10.7%
 - ▶ Faceless Void: -8%
 - ▶ Oracle: -7.1%
 - ▶ Broodmother: -7.3%
 - ▶ Shadow Demon: -6.7%

Patch 6.68B

- ▶ Win Rate: 52%
- ▶ Top 5 neighbors:
 - ▶ Omniknight : 14.1%
 - ▶ Spectre: 11.3%
 - ▶ Necrophos: 10.9%
 - ▶ Abaddon: 9.6%
 - ▶ Zeus: 9.5%
- ▶ Bottom 5 neighbors:
 - ▶ Arc Warden : -10.7%
 - ▶ Faceless Void: -8%
 - ▶ Oracle: -7.1%
 - ▶ Broodmother: -7.3%
 - ▶ Shadow Demon: -6.7%

Analysis: Eigenvalues Centrality

Eigenvector centrality tells us which heroes have the biggest impact in a game... positive or negative

Patch 6.28A

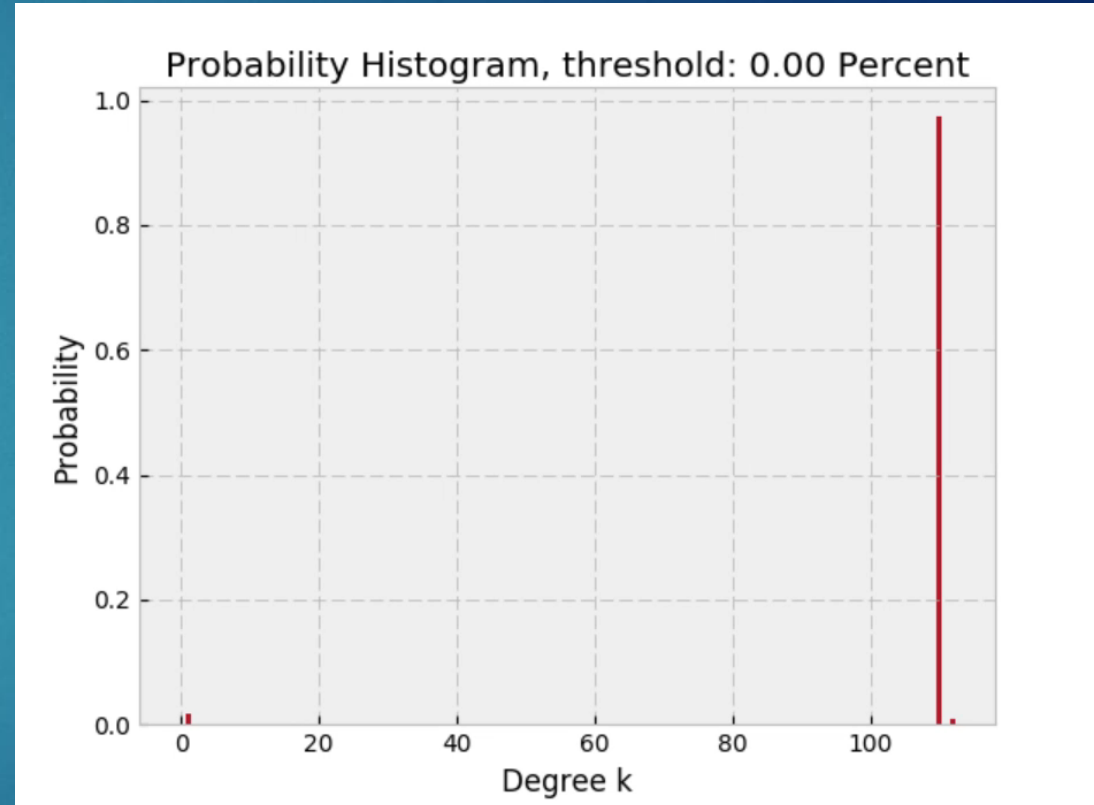
- ▶ Top centrality ordered greatest to least – win rate in parentheses:
 - ▶ Arc Warden (Win rate: -12%)
 - ▶ Faceless Void (WR: -10%)
 - ▶ Broodmother (WR: -10%)
 - ▶ Oracle (WR: -8.2%)
 - ▶ Death Prophet (WR: -7.7%)

Patch 6.28B

- ▶ Top centrality ordered from greatest to least - win rate in parentheses:
 - ▶ Broodmother (Win rate: -10%)
 - ▶ Io (WR: -9.5%)
 - ▶ Queen of Pain (WR: -7.2%)
 - ▶ Storm Spirit (WR: -7.3%)
 - ▶ Meepo (WR: -7.9%)

Analysis: Graph Percolation

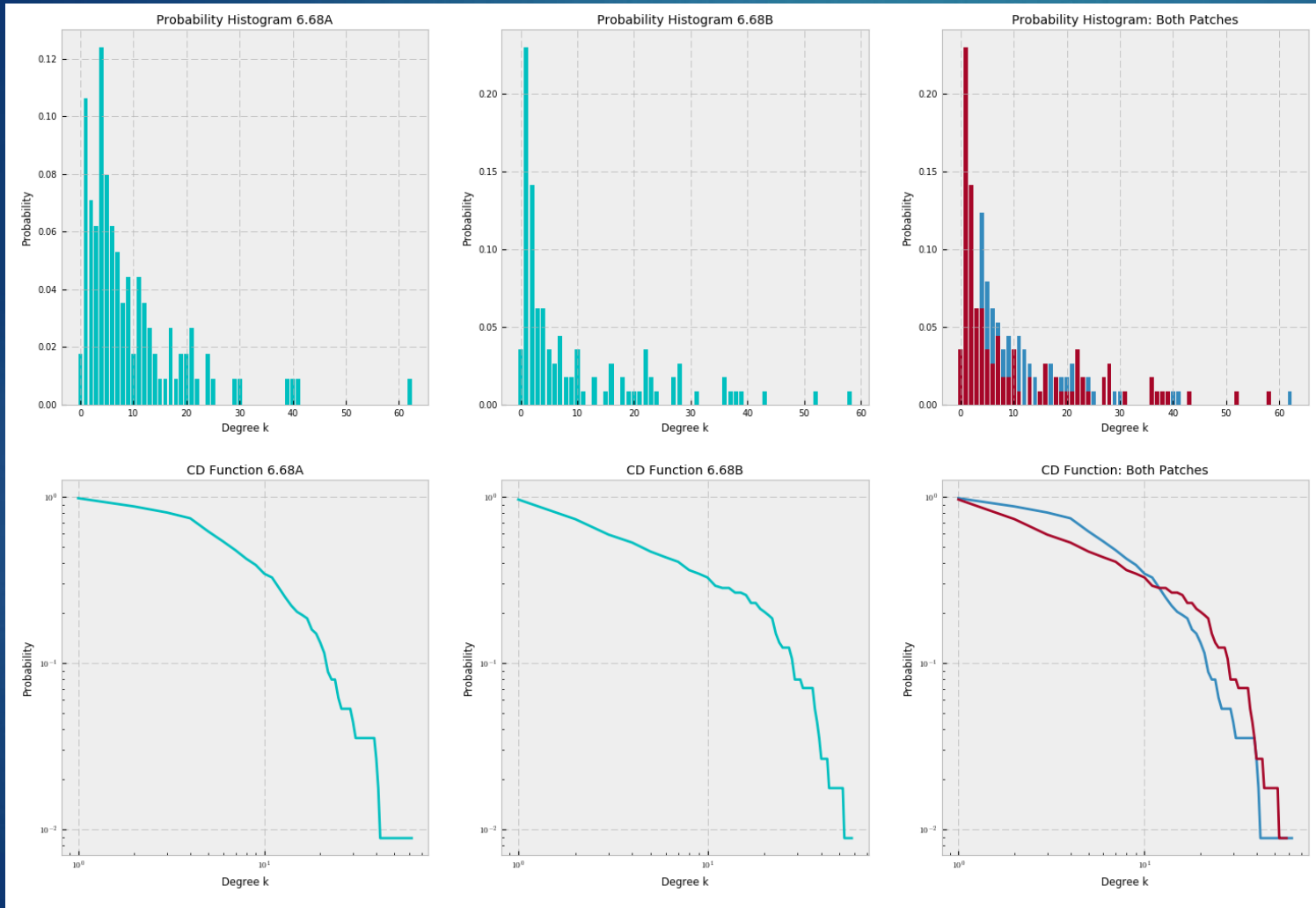
- ▶ Percolation was performed on edges according to a threshold value
 - ▶ Example: edges with less than $\pm 10\%$ fluctuation in win rate from the baseline of 50% were deemed non-significant and removed.
- ▶ Reduced complexity, saved essential information
 - ▶ Easy to work with
 - ▶ Allows for modeling with an synthetic ER or BA graph
- ▶ As the percolation threshold was increase the networks distributions moved from ER form graph to BA form



Analysis: Graph Percolation

- ▶ As the graph moves to an Scale – Free form, we are able to gain certain information more easily from the graph
 - ▶ Able to assign nodes a degree centrality
 - ▶ High impact and low impact nodes easy visible
 - ▶ High degree nodes have a high amount of impact with many different hero team mates
 - ▶ The nodes with low degree represent heroes that a have high impact but only when linked with a few specific heroes

Analysis: Scale – Free Form



► Attempt was made to fit comparable Degree Distributions

► Thresholding values:

- 6.68A: ± 0.122
- 6.68B: ± 0.11

Probability of Degree Distribution:

► (6.68A):

► $P_k \sim k^{3.88}$

► (6.68B):

► $P_k \sim k^{3.44}$

Analysis: Highest Degree Heroes

- ▶ Degree Centrality

- ▶ Hero degree for ER graph (6.68A):

- ▶ Arc Warden: 62 (Win Rate: -12%)
- ▶ Faceless Void: 41 (WR: -10%)
- ▶ Omniknight: 39 (WR: 11%)
- ▶ Death Prophet: 30 (WR: -7.7%)
- ▶ Storm Spirit: 41 (WR: -6%)

- ▶ Hero degree for ER graph (Patch 6.68B)

- ▶ Broodmother: 58 (WR: -10%)
- ▶ Io: 52 (WR: -9.5%)
- ▶ Omniknight: 43 (WR: 11%)
- ▶ Storm Spirit: 39 (WR: -7.3%)
- ▶ Oracle: 38 (WR: -7.6%)

- ▶ Only Omniknight has a high-than-50% win rate (61%)

- ▶ Compliments eigenvector centrality results

Analysis: Best Teams

Top Team: A completely connected group of five nodes with the highest average edge weight between them. Therefore, it is similar to a clique but of only five nodes maximum.

► Top 3 Hero Teams Patch 6.68A:

- Zeus, Necrophos, Spectre, Omniknight, Abaddon: 66.83%
- Zeus, Necrophos, Spectre, Omniknight, Ursa: 66.52%
- Zeus, Necrophos, Spectre, Omniknight, Pugna: 66.35%

► Top 3 Hero Teams Patch 6.68B:

- Zeus, Necrophos, Spectre, Omniknight, Abaddon: 66.81%
- Zeus, Necrophos, Spectre, Omniknight, Ursa: 66.63%
- Necrophos, Omniknight, Spectre, Ursa, Abaddon: 66.24%