**Results of Network Analysis**

**Co-hashtag** (top 2000 nodes) (check meanings of some hashtags at the appendix)

**1. basic info**

|  |  |  |  |
| --- | --- | --- | --- |
| network type | # edges | # nodes | network density |
| undirected | 36669 | 1999 | 0.01834367183591796 |

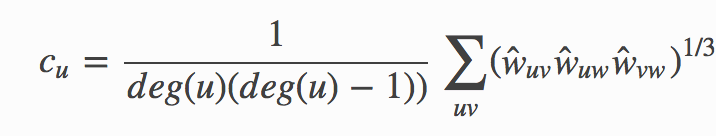
**2. edges with most weight** (top 50)

|  |  |  |  |
| --- | --- | --- | --- |
| **edges** | **weight** | **edges** | **weight** |
| **('alexa', 'amazon')** | 32874 | **('echo', 'virtualassistants')** | 1342 |
| **('alexa', 'talkradio')** | 5128 | **('alexa', 'jeffbezos')** | 1323 |
| **('alexa', 'apple')** | 3719 | **('alexa', 'blog')** | 1313 |
| **('heygoogle', 'ad')** | 3393 | **('amazon', 'echo')** | 1286 |
| **('alexa', 'googlehome')** | 3162 | **('alexa', 'aws')** | 1238 |
| **('alexa', 'homeautomation')** | 2971 | **('siri', 'apple')** | 1223 |
| **('siri', 'cortana')** | 2736 | **('website', 'blog')** | 1220 |
| **('amazonecho', 'homeautomation')** | 2640 | **('amazon', 'tech')** | 1161 |
| **('alexa', 'camiq')** | 2579 | **('alexa', 'win')** | 1085 |
| **('technews', 'camiq')** | 2578 | **('iot', 'amazon')** | 1022 |
| **('apple', 'technews')** | 2558 | **('cortana', 'microsoft')** | 989 |
| **('alexa', 'tech')** | 2517 | **('smart', 'virtualassistants')** | 967 |
| **('alexa', 'google')** | 2131 | **('amazon', 'echodot')** | 962 |
| **('alexa', 'smarthome')** | 2109 | **('smart', 'usa')** | 956 |
| **('siri', 'artificialintelligence')** | 2094 | **('google', 'apple')** | 947 |
| **('siri', 'virtualassistants')** | 1969 | **('alexa', 'amazonalexa')** | 942 |
| **('alexa', 'superbowl')** | 1634 | **('alexa', 'privacy')** | 933 |
| **('alexa', 'website')** | 1575 | **('alexa', 'prize')** | 927 |
| **('alexa', 'seo')** | 1571 | **('siri', 'homepod')** | 922 |
| **('iot', 'siri')** | 1524 | **('free', 'prize')** | 913 |
| **('alexa', 'voice')** | 1447 | **('alexa', 'cloudcomputing')** | 876 |
| **('amazon', 'google')** | 1373 | **('siri', 'cloudcomputing')** | 844 |
| **('amazon', 'jeffbezos')** | 1359 | **('virtualassistants', 'cloudcomputing')** | 844 |
| **('alexa', 'googleassistant')** | 1347 | **('cortana', 'cloudcomputing')** | 839 |
| **('echo', 'usa')** | 1343 | **('artificialintelligence', 'cloudcomputing')** | 838 |

**3. clustering coefficient** (weighted)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **node** | alexa | heygoogle | siri | cortana | entire network average |
| **coefficient** | 2.141190746740446e-05 | 2.42860793988339e-05 | 1.9303507474375952e-05 | 2.690836009174613e-05 | 0.0004951335175398307 |

notes: a clustering coefficient is a measure of the degree to which nodes in a graph tend to cluster together. Evidence suggests that in most real-world networks, and in particular social networks, nodes tend to create tightly knit groups characterised by a relatively high density of ties; this likelihood tends to be greater than the average probability of a tie randomly established between two nodes. For weighted graphs, the clustering is defined as the geometric average of the subgraph edge weights,



**4. distance measurement**

average shortest path length: 2.029621310655328

eccentricity: The eccentricity of a node v is the maximum distance from v to all other nodes in G.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| node | siri | alexa | heygoogle | cortana |
| eccentricity | 2 | 2 | 2 | 2 |

radius: 2 (minimum eccentricity)

diameter: 3 (maximum eccentricity)

Periphery: the set of nodes with eccentricity equal to the diameter

center: the set of nodes with eccentricity equal to the radius

**center**: 'alexa', 'ai', ‘iot', 'speaker', 'amazon', 'siri', 'amazonecho', 'smarthome', 'cortana', 'tech', 'googlehome', 'virtualassistant', 'echo', 'echodot', 'bixby', 'samsung', 'assistant', 'health', 'news', 'ml', 'bots', 'machinelearning', 'voicefirst', 'google', 'windows', 'android', 'halo', 'home', 'voice', 'developer', 'googleassistant', 'voicesearch', 'heygoogle', 'howto', 'technology', 'automation', 'future', 'apple', 'seo', 'ifttt', 'iphone', 'smartassistant', 'microsoft', 'homepod', 'spotify', 'nyc', 'mom', 'homeautomation', 'app', 'startup', 'youtube', 'bigdata', 'smartspeaker', 'india', 'artificialintelligence', iphonex', 'ios', 'podcast', 'twitter', 'music', 'androiddev', 'video', 'womenintech', 'intel', 'digital', 'love', 'robot', 'digitalassistant', 'privacy', 'computer', 'amazonalexa', 'watson', 'vui', 'cx', 'data', 'technews', 'digitalmarketing', 'wtf', 'search', 'marketing', 'help', 'vr', 'mobile', 'nest', 'sales', 'funny', 'mac', 'innovation', 'blockchain', 'retail', 'hue', 'facebook', 'customerexperience', 'thursdaythoughts', 'stem', 'blackfriday', 'voiceassistant', 'uber', 'fun', 'okgoogle', 'holiday', 'chrome', 'trends', 'smarthomes', 'dev', 'trump', 'smart', 'thanks', 'smartspeakers', 'useless', 'highered', 'free', 'fridayfeeling', 'blog', 'hilarious', 'email', 'netflix', 'googlehomemini', 'design', 'ar', 'creepy', 'personalassistant', 'learning', 'humor', 'pixel2', 'travel', 'heysiri', 'black', 'datascience', 'mondaymotivation', 'the', 'cybersecurity', 'dad', 'joke', 'bitcoin', 'nfl', 'huawei',

'googlenow', 'azure', 'ces2018', 'mrx', 'okaygoogle', 'christmas', 'awesome', 'savage', 'xbox', 'internet', 'instagram', 'ces', 'ces18',

'donaldtrump', 'wow', 'hey', 'monday', 'commercial', 'demo', 'qanon', 'singularity', 'notifications', 'scottish', 'feedly', 'hal', 'lg', 'chromebook', 'valentinesday', 'superbowl', 'lgbt', 'oscars', 'mwc18', 'googleio', 'io18'

notes:

The key words mostly are about voice-first and related products, AI conference, e-commerce, digital marketing research, IT concepts, home automation, digital entertainment, political jokes, information security, perspectives on the future of high-tech society, sports and other miscellaneous topics.

**5. network robustness**

is connected: True, each node has a path to any other node in the graph

node connectivity: 1

Node connectivity is equal to the minimum number of nodes that must be removed to disconnect the graph.

edge connectivity: 1

Edge connectivity is equal to the minimum number of nodes that must be removed to disconnect the graph.

**6. different centrality**

***degree centrality***: the fraction of nodes they are connected to.

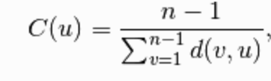
|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| node | alexa | siri | heygoogle | cortana |
| degree centrality | 0.9374687343671835 | 0.6263131565782891 | 0.15107553776888444 | 0.336168084042021 |

nodes ranked by degree centrality (top 50):

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| node | centrality | node | centrality | node | centrality |
| **alexa** | 0.93746873 | **googleassistant** | 0.17408704 | **video** | 0.10655328 |
| **amazon** | 0.62981491 | **iphone** | 0.17158579 | **ces2018** | 0.10155078 |
| **siri** | 0.62631316 | **heygoogle** | 0.15107554 | **security** | 0.09654827 |
| **ai** | 0.41670835 | **microsoft** | 0.14407204 | **gadgets** | 0.09404702 |
| **tech** | 0.35267634 | **echodot** | 0.14307154 | **innovation** | 0.09304652 |
| **echo** | 0.34017009 | **music** | 0.14057029 | **digital** | 0.09204602 |
| **cortana** | 0.33616808 | **ios** | 0.13656828 | **app** | 0.09004502 |
| **google** | 0.33416708 | **voicefirst** | 0.13606803 | **funny** | 0.08954477 |
| **apple** | 0.30765383 | **artificialintelligence** | 0.12956478 | **privacy** | 0.08904452 |
| **amazonecho** | 0.27313657 | **technews** | 0.12856428 | **vui** | 0.08904452 |
| **technology** | 0.26763382 | **business** | 0.12806403 | **aws** | 0.08904452 |
| **voice** | 0.26163082 | **assistant** | 0.12556278 | **marketing** | 0.08804402 |
| **iot** | 0.24362181 | **android** | 0.12056028 | **tv** | 0.08704352 |
| **smarthome** | 0.22461231 | **homepod** | 0.12056028 | **mobile** | 0.08704352 |
| **googlehome** | 0.2126063 | **home** | 0.11555778 | **speaker** | 0.08554277 |
| **amazonalexa** | 0.20510255 | **smart** | 0.11455728 | **skills** | 0.08504252 |
| **news** | 0.19009505 | **machinelearning** | 0.10705353 |  |  |

Notes: The hashtags are mostly key words related to technology, marketing, and homeautomation.

***closeness centrality***: Closeness centrality of a node u is the reciprocal of the sum of the shortest path distances from u to all n-1 other nodes. Since the sum of distances depends on the number of nodes in the graph, closeness is normalized by the sum of minimum possible distances n-1.



|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| node | alexa | siri | heygoogle | cortana |
| closeness centrality | 0.9411487758945386 | 0.7279679533867444 | 0.5408549783549783 | 0.6010222489476849 |

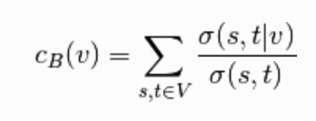
nodes ranked by closeness centrality (top 50):

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| node | centrality | node | centrality | node | centrality |
| **alexa** | 0.94114878 | **googleassistant** | 0.54767123 | **video** | 0.52813738 |
| **amazon** | 0.7298284 | **iphone** | 0.54692202 | **ces2018** | 0.52674572 |
| **siri** | 0.72796795 | **heygoogle** | 0.54085498 | **security** | 0.52480966 |
| **ai** | 0.63159558 | **microsoft** | 0.53881402 | **innovation** | 0.52439664 |
| **tech** | 0.60704525 | **echodot** | 0.53852371 | **gadgets** | 0.52425911 |
| **echo** | 0.60247137 | **music** | 0.5377993 | **digital** | 0.52412166 |
| **cortana** | 0.60102225 | **ios** | 0.5366443 | **app** | 0.52357255 |
| **google** | 0.6003003 | **voicefirst** | 0.53650027 | **funny** | 0.52343545 |
| **apple** | 0.59089565 | **artificialintelligence** | 0.53463493 | **privacy** | 0.52329843 |
| **amazonecho** | 0.57908459 | **technews** | 0.5343491 | **vui** | 0.52329843 |
| **technology** | 0.57724516 | **business** | 0.53392094 | **aws** | 0.52302459 |
| **voice** | 0.5752518 | **assistant** | 0.53349346 | **marketing** | 0.52302459 |
| **iot** | 0.56935346 | **android** | 0.53207346 | **mobile** | 0.52275105 |
| **smarthome** | 0.56325726 | **homepod** | 0.53207346 | **speaker** | 0.52234126 |
| **googlehome** | 0.55947383 | **home** | 0.530661 | **tv** | 0.52206843 |
| **amazonalexa** | 0.55713489 | **smart** | 0.53037941 | **skills** | 0.52193211 |
| **news** | 0.5525152 | **machinelearning** | 0.52827696 |  |  |

Notes: The list of top 50 nodes measured by closeness centrality is exactly the same as degree centrality.

***betweenness centrality (weighted)***:

node: Betweenness centrality of a node v is the sum of the fraction of all-pairs shortest paths that pass through v.

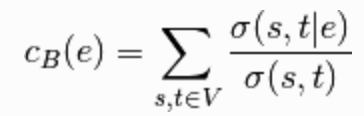


|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| node | alexa | siri | heygoogle | cortana |
| betweenness cen | 0.14598287574813562 | 0.08832168346530446 | 0.022140905426458985 | 0.04979213514637725 |

nodes ranked by betweenness centrality (top 50):

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| node | centrality | node | centrality | node | centrality |
| **alexa** | 0.14598288 | **iphone** | 0.01646159 | **app** | 0.00689179 |
| **siri** | 0.08832168 | **iot** | 0.01641783 | **usa** | 0.00670677 |
| **amazon** | 0.05345581 | **googleassistant** | 0.01516267 | **homepod** | 0.00663434 |
| **cortana** | 0.04979214 | **video** | 0.01309953 | **skills** | 0.00639898 |
| **tech** | 0.0390155 | **echodot** | 0.011936 | **smartspeaker** | 0.00620893 |
| **google** | 0.03824042 | **voicefirst** | 0.01188978 | **retail** | 0.00613267 |
| **apple** | 0.03353029 | **artificialintelligence** | 0.0114119 | **skill** | 0.00607152 |
| **ai** | 0.02989616 | **microsoft** | 0.0109272 | **facebook** | 0.00605032 |
| **voice** | 0.02944664 | **business** | 0.01091416 | **ads** | 0.00604705 |
| **echo** | 0.02895732 | **ios** | 0.01086149 | **marketing** | 0.00600175 |
| **amazonecho** | 0.02676855 | **technews** | 0.00920342 | **free** | 0.0059702 |
| **technology** | 0.02591095 | **funny** | 0.00878474 | **alexaskills** | 0.00587415 |
| **heygoogle** | 0.02214091 | **music** | 0.00871478 | **smart** | 0.00580343 |
| **googlehome** | 0.02174124 | **android** | 0.00818332 | **aws** | 0.00544486 |
| **amazonalexa** | 0.02062301 | **assistant** | 0.00818196 | **new** | 0.00523173 |
| **smarthome** | 0.01941338 | **home** | 0.00734097 | **search** | 0.00522871 |
| **news** | 0.01834668 | **tv** | 0.0070517 |  |  |

edge: Betweenness centrality of an edge e is the sum of the fraction of all-pairs shortest paths that pass through e



|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| edge | centrality | edge | centrality | edge | centrality |
| **('alexa', 'learningdisabilities')** | 0.00395849 | **('alexa', 'electronics')** | 0.00193575 | **('alexa', 'hard')** | 0.0015941 |
| **('alexa', 'retail')** | 0.00329417 | **('siri', 'video')** | 0.00190234 | **('alexa', 'computers')** | 0.00158401 |
| **('alexa', 'free')** | 0.00322714 | **('alexa', 'family')** | 0.0018877 | **('alexa', 'insight')** | 0.00151176 |
| **('alexa', 'grasmere')** | 0.002997 | **('alexa', 'london')** | 0.0018685 | **('iot', 'cortana')** | 0.00150957 |
| **('cortana', 'eurovision')** | 0.00279525 | **('alexa', 'digitalassistants')** | 0.00186555 | **('alexa', 'text')** | 0.00150319 |
| **('alexa', 'echoshow')** | 0.00266068 | **('siri', 'bigboobs')** | 0.0018528 | **('alexa', 'ps4')** | 0.00149222 |
| **('alexa', 'smartphone')** | 0.00230241 | **('alexa', 'halo')** | 0.00185157 | **('smartspeaker', 'blogpost')** | 0.00148371 |
| **('cortana', 'dorkypickuplines')** | 0.00224311 | **('talkradio', 'trumpkimsummit')** | 0.00184088 | **('alexa', 'features')** | 0.00147621 |
| **('alexa', 'black')** | 0.00219464 | **('alexa', 'mother')** | 0.0018389 | **('china', 'scotus')** | 0.00147358 |
| **('alexa', 'sales')** | 0.00218436 | **('alexa', 'big')** | 0.00182092 | **('alexa', 'bbc')** | 0.0014731 |
| **('alexa', 'phone')** | 0.00215659 | **('autism', 'love')** | 0.00180046 | **('feminism', 'snl')** | 0.00146372 |
| **('alexa', 'podcasts')** | 0.00203805 | **('alexa', 'invoke')** | 0.00173279 | **('seotools', 'ads')** | 0.00145303 |
| **('alexa', 'fail')** | 0.0020331 | **('alexa', 'voicerecognition')** | 0.00171755 | **('alexa', 'xboxone')** | 0.00144787 |
| **('siri', 'talkradio')** | 0.00201481 | **('onairnow', 'eurovision')** | 0.00168363 | **('alexa', 'lights')** | 0.00143864 |
| **('alexa', 'porn')** | 0.00200163 | **('alexa', 'wwdc')** | 0.00167981 | **('siri', 'ads')** | 0.00142234 |
| **('cortana', 'csharpcon18')** | 0.001999 | **('siri', 'healthyliving')** | 0.0016224 | **('alexa', 'financial')** | 0.00140149 |
| **('thermostat', 'heating')** | 0.001999 | **('usa', 'spygate')** | 0.00161909 |  |  |

**notes:**

1. Many of the important nodes identified by different centrality algorithms actually have very low rate of appearance with below 50 tweets.

2. Unlike other centrality, nodes with high betweenness edge centrality are pertinent to more diverse fileds, related to healthcare, political talk radio, finance and etc.

top edges with high edge betweenness centrality by nodes:

**Alexa**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| edge | centrality | edge | centrality | edge | centrality |
| **('alexa', 'learningdisabilities')** | 0.00395849 | **('alexa', 'sales')** | 0.00218436 | **('alexa', 'london')** | 0.0018685 |
| **('alexa', 'retail')** | 0.00329417 | **('alexa', 'phone')** | 0.00215659 | **('alexa', 'digitalassistants')** | 0.00186555 |
| **('alexa', 'free')** | 0.00322714 | **('alexa', 'podcasts')** | 0.00203805 | **('alexa', 'halo')** | 0.00185157 |
| **('alexa', 'grasmere')** | 0.002997 | **('alexa', 'fail')** | 0.0020331 | **('alexa', 'mother')** | 0.0018389 |
| **('alexa', 'echoshow')** | 0.00266068 | **('alexa', 'porn')** | 0.00200163 | **('alexa', 'big')** | 0.00182092 |
| **('alexa', 'smartphone')** | 0.00230241 | **('alexa', 'electronics')** | 0.00193575 | **('alexa', 'invoke')** | 0.00173279 |
| **('alexa', 'black')** | 0.00219464 | **('alexa', 'family')** | 0.0018877 |  |  |

**Siri**

|  |  |  |  |
| --- | --- | --- | --- |
| edge | centrality | edge | centrality |
| **('siri', 'talkradio')** | 0.00201481 | **('siri', 'marketing')** | 0.00120972 |
| **('siri', 'video')** | 0.00190234 | **('siri', 'windows')** | 0.00107732 |
| **('siri', 'bigboobs')** | 0.0018528 | **('siri', 'superbowl')** | 0.00107228 |
| **('siri', 'healthyliving')** | 0.0016224 | **('siri', 'beautiful')** | 0.00100259 |
| **('siri', 'ads')** | 0.00142234 | **('siri', 'wrestlemania')** | 0.00100096 |
| **('siri', 'skill')** | 0.00133981 | **('siri', 'serp')** | 0.00100057 |
| **('siri', 'rickross')** | 0.00133004 |  |  |

**HeyGoogle**

|  |  |  |  |
| --- | --- | --- | --- |
| edge | centrality | edge | centrality |
| **('heygoogle', 'biggov')** | 0.00100003 | **('heygoogle', 'iphone')** | 0.00064469 |
| **('heygoogle', 'rhop')** | 0.0009928 | **('heygoogle', 'lenovoces')** | 0.00063718 |
| **('heygoogle', 'podernfamily')** | 0.00093767 | **('heygoogle', 'artificialintelligence')** | 0.00063469 |
| **('heygoogle', 'releasethememo')** | 0.00076033 | **('heygoogle', 'zwave')** | 0.00060334 |
| **('heygoogle', 'croatia')** | 0.00074965 |  |  |
| **('heygoogle', 'jesuschrist')** | 0.0007463 |  |  |
| **('heygoogle', 'maythe4thbewithyou')** | 0.00068802 |  |  |

**Cortana**

|  |  |  |  |
| --- | --- | --- | --- |
| edge | centrality | edge | centrality |
| **('cortana', 'eurovision')** | 0.00279525 | **('cortana', 'vaporwave')** | 0.00107245 |
| **('cortana', 'dorkypickuplines')** | 0.00224311 | **('cortana', 'fifa2018')** | 0.001 |
| **('cortana', 'csharpcon18')** | 0.001999 | **('cortana', 'w10')** | 0.0009995 |
| **('iot', 'cortana')** | 0.00150957 | **('cortana', 'bluescreenofdeath')** | 0.0009995 |
| **('cortana', 'singapore')** | 0.00118228 | **('cortana', 'azurefunctions')** | 0.00098854 |
| **('cortana', 'echodot')** | 0.00109716 | **('cortana', 'alexainternet')** | 0.00090792 |
| **('cortana', 'wrestlemania')** | 0.00109156 | **('cortana', 'voiceover')** | 0.00085706 |

***eigenvector centrality (weighted)***:

Eigenvector centrality computes the centrality for a node based on the centrality of its neighbors. The eigenvector centrality for node ***i*** is the ***i***-th element of the vector x defined by the equation Ax=λx, where A is the adjacency matrix of the graph G with the largest eigenvalue λ.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| node | alexa | siri | heygoogle | cortana |
| eigenvector cent | 0.6984399740042048 | 0.017954912161364453 | 0.0020185169227929026 | 0.013613344260788328 |

nodes ranked by eigenvector centrality (top 50):

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| node | centrality | node | centrality | node | centrality |
| **alexa** | 0.69843997 | **amazonalexa** | 0.03036943 | **enter** | 0.01475436 |
| **amazon** | 0.66633035 | **googleassistant** | 0.03017828 | **cumbria** | 0.01452313 |
| **talkradio** | 0.10145503 | **blog** | 0.02743217 | **reinvent** | 0.01444889 |
| **apple** | 0.07896276 | **win** | 0.02714466 | **morning** | 0.01439166 |
| **tech** | 0.07448921 | **iot** | 0.02673844 | **podcast** | 0.0141087 |
| **google** | 0.07175086 | **privacy** | 0.02535987 | **microsoft** | 0.01382327 |
| **googlehome** | 0.06507739 | **echodot** | 0.02147969 | **cortana** | 0.01361334 |
| **homeautomation** | 0.0611473 | **cloudcomputing** | 0.01957499 | **chance** | 0.0135349 |
| **jeffbezos** | 0.05189422 | **healthcare** | 0.01874887 | **bots** | 0.0130856 |
| **camiq** | 0.05185997 | **homepod** | 0.01859966 | **chatbots** | 0.01287239 |
| **smarthome** | 0.04590745 | **prize** | 0.01852933 | **shopping** | 0.01260771 |
| **aws** | 0.03948047 | **siri** | 0.01795491 | **lakedistrict** | 0.01260385 |
| **superbowl** | 0.03656844 | **intelligent** | 0.01676521 | **ifttt** | 0.01260285 |
| **echo** | 0.03355123 | **home** | 0.01638718 | **chatbot** | 0.01204643 |
| **seo** | 0.03290716 | **parenting** | 0.01564914 | **technews** | 0.01150814 |
| **voice** | 0.03269775 | **fire** | 0.0150185 | **cloud** | 0.01103711 |
| **website** | 0.0323296 | **virtualassistants** | 0.01477278 |  |  |

Notes: they are mostly key words about virtual assistants’ skills (parenting, sports, trip planning, shopping, etc.)

***katz centrality (weighted)***:

Katz centrality computes the relative influence of a node within a network by measuring the number of the immediate neighbors (first degree nodes) and also all other nodes in the network that connect to the node under consideration through these immediate neighbors.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| node | alexa | siri | heygoogle | cortana |
| katz cent | -0.00062072767101663 | -0.000327052968626332 | -0.000172974021617173 | -0.0040723432000113 |

nodes ranked by katz centrality (top 50):

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| node | centrality | node | centrality | node | centrality |
| **amazonaffiliate** | 0.14225219 | **winners** | 0.0826089 | **bigboobs** | 0.06153099 |
| **investing** | 0.12803952 | **nlu** | 0.08032365 | **commerce** | 0.06103929 |
| **hear** | 0.11988277 | **lingerie** | 0.07872609 | **techupdates** | 0.06081739 |
| **philipshue** | 0.11328412 | **brand** | 0.07741599 | **crm** | 0.0590285 |
| **echoplus** | 0.11221277 | **ios11** | 0.07562748 | **livestream** | 0.05840201 |
| **fire7** | 0.11105104 | **asr** | 0.07546137 | **blowjob** | 0.0581958 |
| **p2p** | 0.10577709 | **voip** | 0.07467321 | **ass** | 0.05739934 |
| **chess** | 0.10524782 | **unboxing** | 0.07180981 | **control** | 0.0564562 |
| **humans** | 0.10411262 | **mood** | 0.07095563 | **tgif** | 0.05531732 |
| **whisfc18** | 0.10383492 | **in** | 0.0708407 | **commercials** | 0.05495825 |
| **firetvcube** | 0.10158014 | **wallstreet** | 0.07060195 | **appliances** | 0.05479175 |
| **ge** | 0.09659404 | **webcam** | 0.06885604 | **smarttv** | 0.05425648 |
| **amazonappsummit** | 0.09509143 | **mvb** | 0.06615659 | **worldcup** | 0.05377648 |
| **london** | 0.08661255 | **jpmorgan** | 0.06576989 | **flogo** | 0.05361032 |
| **perfect** | 0.08337285 | **outlet** | 0.0654692 | **fcc** | 0.05349054 |
| **ehealth** | 0.08324304 | **ioe** | 0.06238892 | **northkorea** | 0.05191417 |
| **rp** | 0.08303766 | **productive** | 0.06161607 |  |  |

**Notes:**

The hashtags related to porn (lingerie, bigboobs, etc) should be concerned with a porn star named after Alexa or a porn website named after Siri.

The list turns out to be divergent from the previous ranks, and news events, e-commerce.

**Appendix:**

***hashtag***

***alexandria***: The Alexa name was meant to evoke the legendary Library of Alexandria from ancient Egypt.

***AR***: Augmented Reality (AR) is an interactive experience of a real-world environment whereby the objects that reside in the real-world are "augmented" by computer-generated perceptual information, sometimes across multiple sensory modalities, including visual, auditory, haptic, somatosensory, and olfactory.

***ASR***: Automated speech recognition is a technology that allows users of information systems to speak entries rather than punching numbers on a keypad.

***Azure***: Microsoft Azure is a cloud computing service created by Microsoft for building, testing, deploying, and managing applications and services through a global network of Microsoft-managed data centers

***bixby***: Bixby is a virtual assistant developed by Samsung Electronics.

***blockchain***: A blockchain, originally block chain, is a growing list of records, called blocks, which are linked using cryptography. Each block contains a cryptographic hash of the previous block, a timestamp, and transaction data.

**BlueScreenofDeath**: A stop error, better known as a Blue Screen of Death is an error screen displayed on a Windows computer system after a fatal system error, also known as a system crash: when the operating system reaches a condition where it can no longer operate safely.

***CES***: CES is the world's gathering place for all those who thrive on the business of consumer technologies. It has served as the proving ground for innovators and breakthrough technologies for 50 years — the global stage where next-generation innovations are introduced to the marketplace. Owned and produced by the Consumer Technology Association (CTA), it attracts the world's business leaders and pioneering thinkers.

chess: Alexa & HeyGoogle have a skill to play chess.

***CRM***: Customer relationship management is an approach to manage a company's interaction with current and potential customers.

***CX***: Customer experience

***echo***: Amazon Echo (shortened and referred to as Echo) is a brand of smart speakers developed by Amazon.com. The devices connect to the voice-controlled intelligent personal assistant service Alexa, which responds to the name "Alexa".

***echodot***: Amazon's Echo Dot is a 360 degree speaker that uses far-field voice recognition powered by the Amazon Alexa voice service/assistant.

***echoplus***: A smart speaker by Amazon.

***edtech***: educational technology

***Eurovision***: The Eurovision Song Contest, often simply called Eurovision, is an international song competition held primarily among the member countries of the European Broadcasting Union.

***feedly***: Feedly is a news aggregator application for various web browsers and mobile devices running iOS and Android, also available as a cloud-based service.

***fire7***: A tablet by Amazon

***firetvcube*:** a streaming media player by Amazon

***flogo***: Project Flogo is an open source framework to simplify building efficient & modern serverless functions and edge microservices.

***ge***: GE Appliances is an appliance company headquartered in Louisville, Kentucky. It is owned by Haier, a Chinese conglomerate. It is one of the largest appliance brands in the United States and manufacturers.

***googlehome*:** Google Home is a brand of smart speakers developed by Google.

***grasmere:*** A skill for finding out about Lake View Country House, a luxury bed and breakfast with private access to Grasmere lake. Users can ask about the rooms, future availabilty, and the local area.

***HAL***: HAL 9000 is a fictional character and the main antagonist in Arthur C. Clarke's Space Odyssey series.

***halo***: Halo is a military science fiction first-person shooter video game franchise created by Bungie and now managed and developed by 343 Industries, a subsidiary of Microsoft Studios.

***hipaa***: Health Insurance Portability and Accountability Act

***HIMSS18***: The leading health information and technology conference

***homepod***: Apple HomePod is a breakthrough speaker that senses its location and tunes the music to sound amazing wherever you are in the room. HomePod is also an intelligent assistant that controls your smart home.

***hue***: Philips Hue works with Amazon Alexa to control your lights with your voice. Use the Alexa Voice Service to switch on your Philips Hue lights before getting out of bed, to dim your Hue lights from the couch to watch a movie, or to set the lights for reading in your favorite chair —all without lifting a finger.

***IFTTT***: If This Then That, also known as IFTTT, is a free web-based service to create chains of simple conditional statements, called applets.

***IIoT***: Industrial Internet of Things. It is the application of IoT to the manufacturing industry, and it is revolutionizing industrial automation.

***infosec***: informationa security

***IoE***: Internet of Everything

***jeffbezos***: Jeffrey Preston Bezos is an American technology entrepreneur, investor, and philanthropist. He is best known as the founder, chairman, and CEO of Amazon.

***jpmorgan***: <https://www.bloomberg.com/news/articles/2018-01-30/amazon-berkshire-jpmorgan-to-set-up-a-health-company-for-staff>

***LenovoCes***: At CES 2018, Lenovo Refreshes ThinkPad X1 Lineup, Launches ARM- And Google Assistant-Powered Devices.

***maythe4thbewithyou*:** May the Fourth be with you is the catchphrase of Star Wars Day on May 4th, the unofficial holiday celebrating the Star Wars franchise. It is a pun on a famous line from Star Wars, May the Force be with you.

***mhealth***: mHealth (mobile health) is a general term for the use of mobile phones and other wireless technology in medical care.

***mom***: Michael Kennedy @MomVoiceTexts collected texts from his mother who only replied via voice to text. She didn’t check or edit them and sent regardless. The tweets are attached with #mom. <https://twitter.com/MomVoiceTexts>

***mrx***: MRX is a common shorthand for market research - initially used frequently on Twitter and other social networks, it has now become a well-known standard

***MVB***: MVB is a file extension for Multimedia Viewer Book file format used by Microsoft Windows Help to store video and sound clips used in the help files and other parts of the operating system.

***Nest***: Nest Labs is an American home automation producer of programmable, self-learning, sensor-driven, Wi-Fi-enabled thermostats, smoke detectors, security cameras, and other security systems.

***NLU***: Natural language understanding or natural language interpretation is a subtopic of natural language processing in artificial intelligence that deals with machine reading comprehension. Natural language understanding is considered an AI-hard problem.

***northkorea***: <https://www.newyorker.com/cartoons/daily-cartoon/friday-march-9th-trump-korea-alexa-laughing>

***Obamacare***: Patient Protection and Affordable Care Act

***okgoogle***: "OK Google" is the voice command used to activate Google Assistant on your Android devices. But Google is slowly letting people say 'Hey Google' to activate its Assistant on their phones. You'll soon no longer be chained to using "OK Google" to access the Google Assistant on your phone.

***QAnon***: QAnon (/kjuːəˈnɒn/) is a conspiracy theory which began with an October 2017 post on the anonymous, unmoderated imageboard 4chan by someone using the handle Q, a presumably American individual that may have later grown to include multiple individuals claiming to have access to classified information involving the Trump administration and its opponents in the United States.

***p2p***: Peer-to-peer computing or networking is a distributed application architecture that partitions tasks or workloads between peers.

***PhilipsHue***: Philips makes a wide number of smart LED lights that offer a mix of colors and effects that you can control remotely. Philips Hue lights integrate with Amazon's Alexa, Google Home, and Apple HomeKit (among many other smart home platforms) so you can use your voice to change the lights.

***RickRoss***: an American rapper

***RP***: role play

***SERP***: search engine result page

***SoundingBoard:*** the 2017 winners of the Alexa Prize from University of Washington

***Singularity***: The technological singularity is the hypothesis that the invention of artificial superintelligence will abruptly trigger runaway technological growth, resulting in unfathomable changes to human civilization.

***SNL***: Saturday Night Life. Live from New York for more than four decades, celebrity hosts join an award-winning ensemble cast to perform comedic sketches, satirical news and digital shorts, alongside popular musical acts.

***Tesla***: an American multinational corporation based in Palo Alto, California, that specializes in electric vehicles, lithium-ion battery energy storage and solar panel manufacturing.

***TGIF***: "Thank God It's Friday"

***unboxing***: Unboxing is the unpacking of products, especially high tech consumer products, where the process is captured on video and uploaded to the Internet. The item is then also explained in detail and also can sometimes be demonstrated as well.

***vaporwave***: Vaporwave is a microgenre of electronic music and an Internet meme that emerged in the early 2010s. The style is defined by its appropriation of 1980s and 1990s mood music styles such as smooth jazz, elevator music, R&B, and lounge music, typically sampling or manipulating tracks via chopped and screwed techniques and other effects.

***Voice***: VOICE is this year's largest voice tech conference that brings the conversational design ecosystem together in one place for three days of jampacked content, networking and fun.

***voicefirst:*** Voice-first Interaction refers to a system which primarily accepts user input via voice commands, and may augment audio output with a tightly integrated screen display.

***VoIP***: Voice over Internet Protocol is a methodology and group of technologies for the delivery of voice communications and multimedia sessions over Internet Protocol networks, such as the Internet.

***VUI***: voice user interface

***Waston***: Watson is a question-answering computer system capable of answering questions posed in natural language, developed in IBM's DeepQA project by a research team led by principal investigator David Ferrucci.

***WHISFC18***: World Health Innovation Summit Fylde Coast 2018 - an international conference held to support our health services while creating community value.

***WrestleMania:*** WrestleMania is a professional wrestling event produced annually between mid-March to early April by WWE, an American professional wrestling promotion based in Stamford, Connecticut.

***WWDC***: The Apple Worldwide Developers Conference is a conference held annually by Apple Inc. in San Jose, California. Apple uses the event to showcase its new software and technologies f or software developers.

***Xbox***: Xbox is a video gaming brand created and owned by Microsoft of the United States.

***zwave***: Z-Wave is a wireless communications protocol used primarily for home automation. It is a mesh network using low-energy radio waves to communicate from appliance to appliance, allowing for wireless control of residential appliances and other devices, such as lighting control, security systems, thermostats, windows, locks, swimming pools and garage door openers.