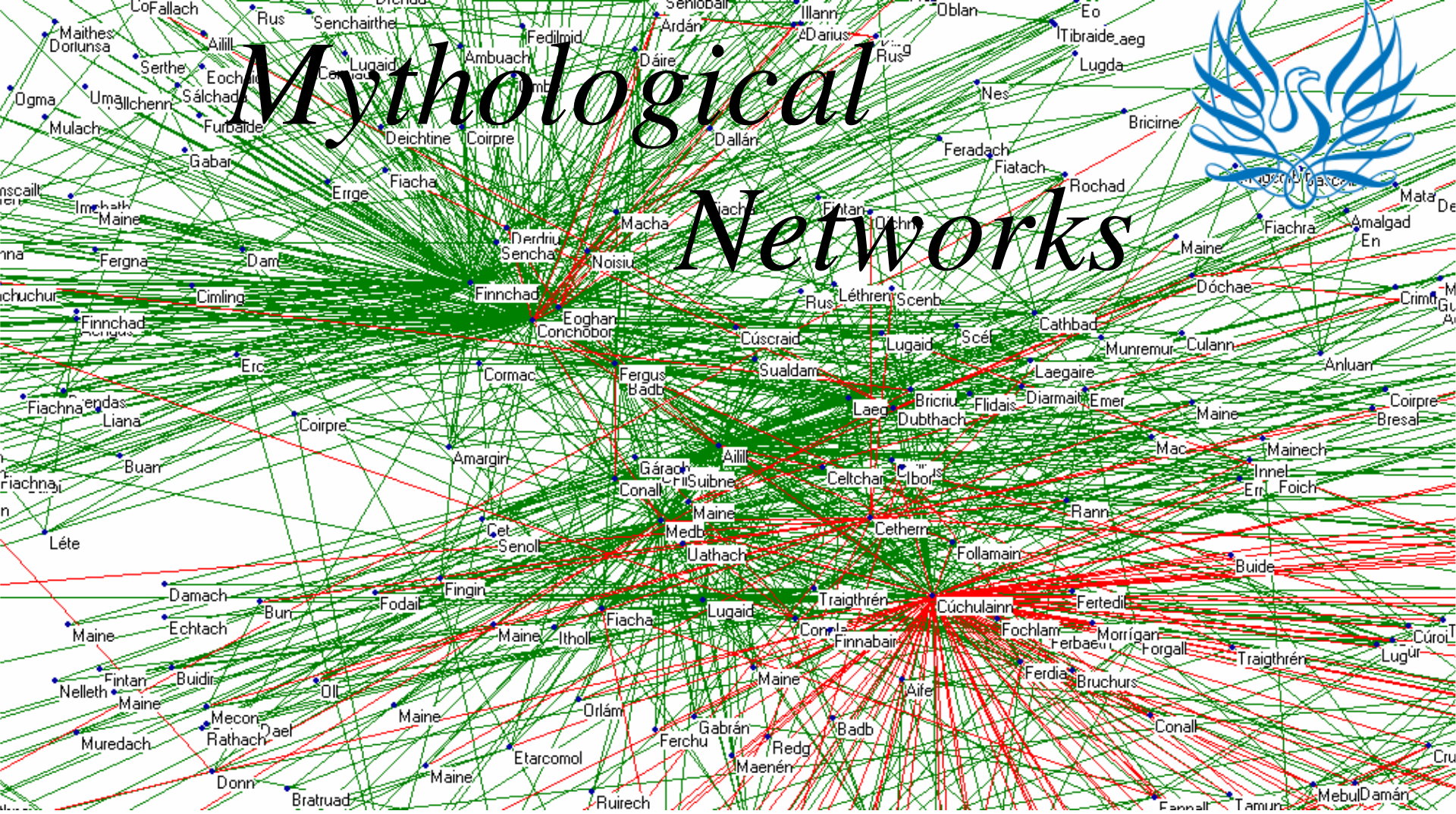
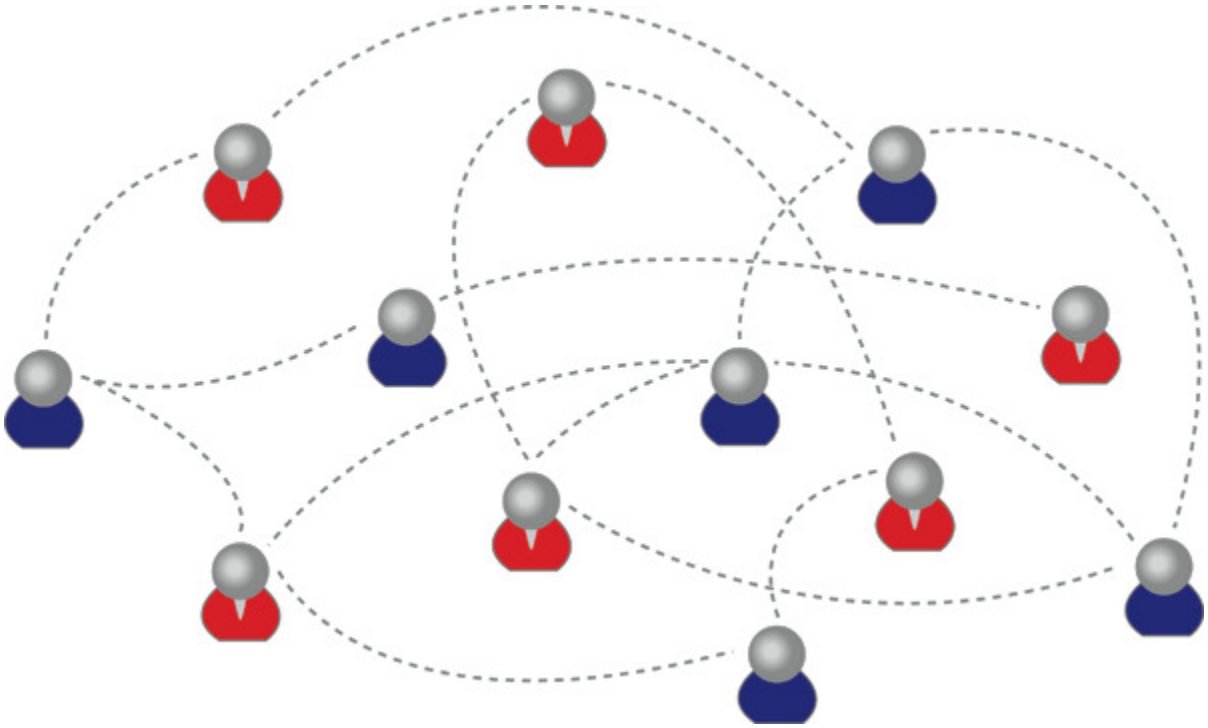


Pádraig Mac Carron

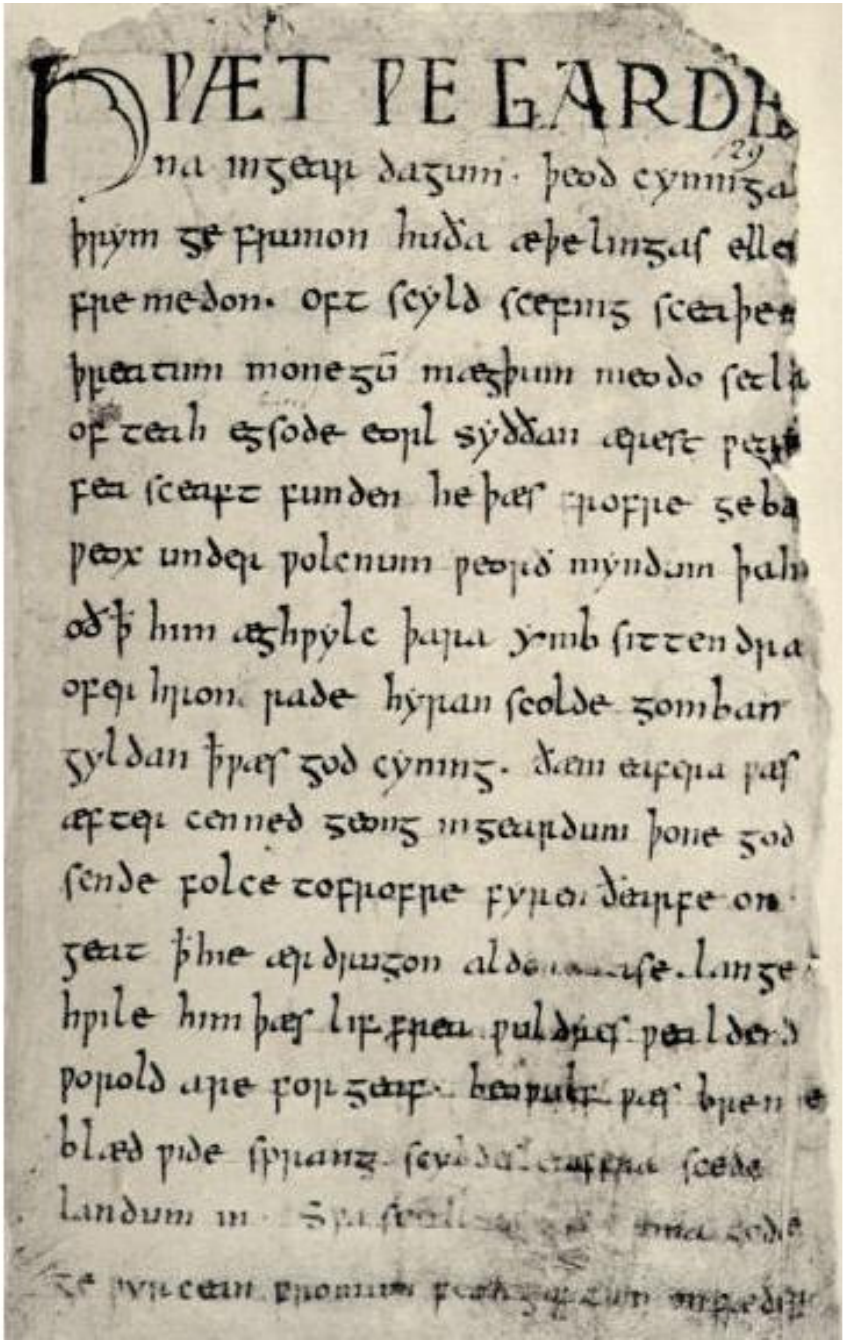
R. Kenna, C. von Ferber

Coventry University

Social Networks

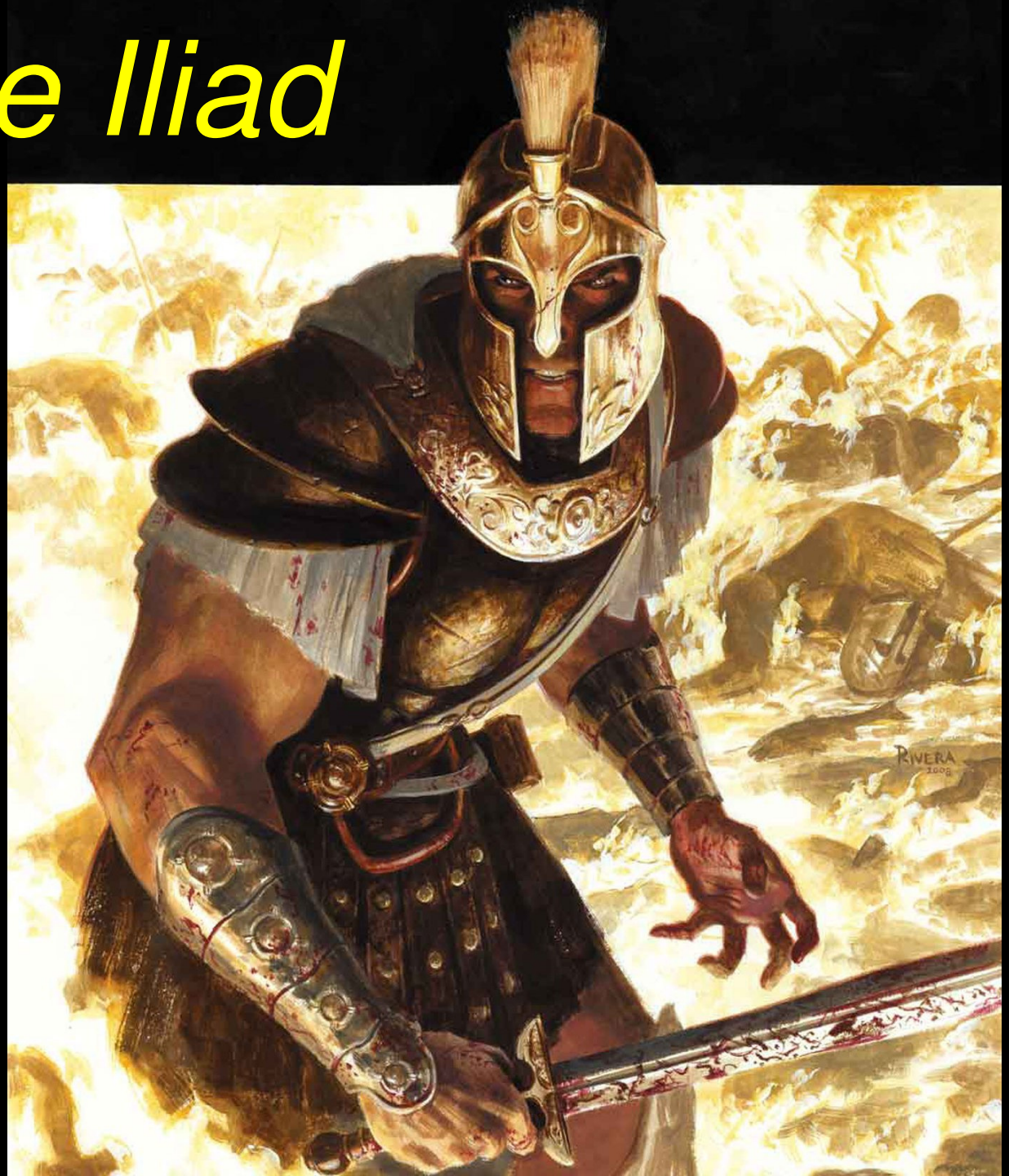


Beowulf

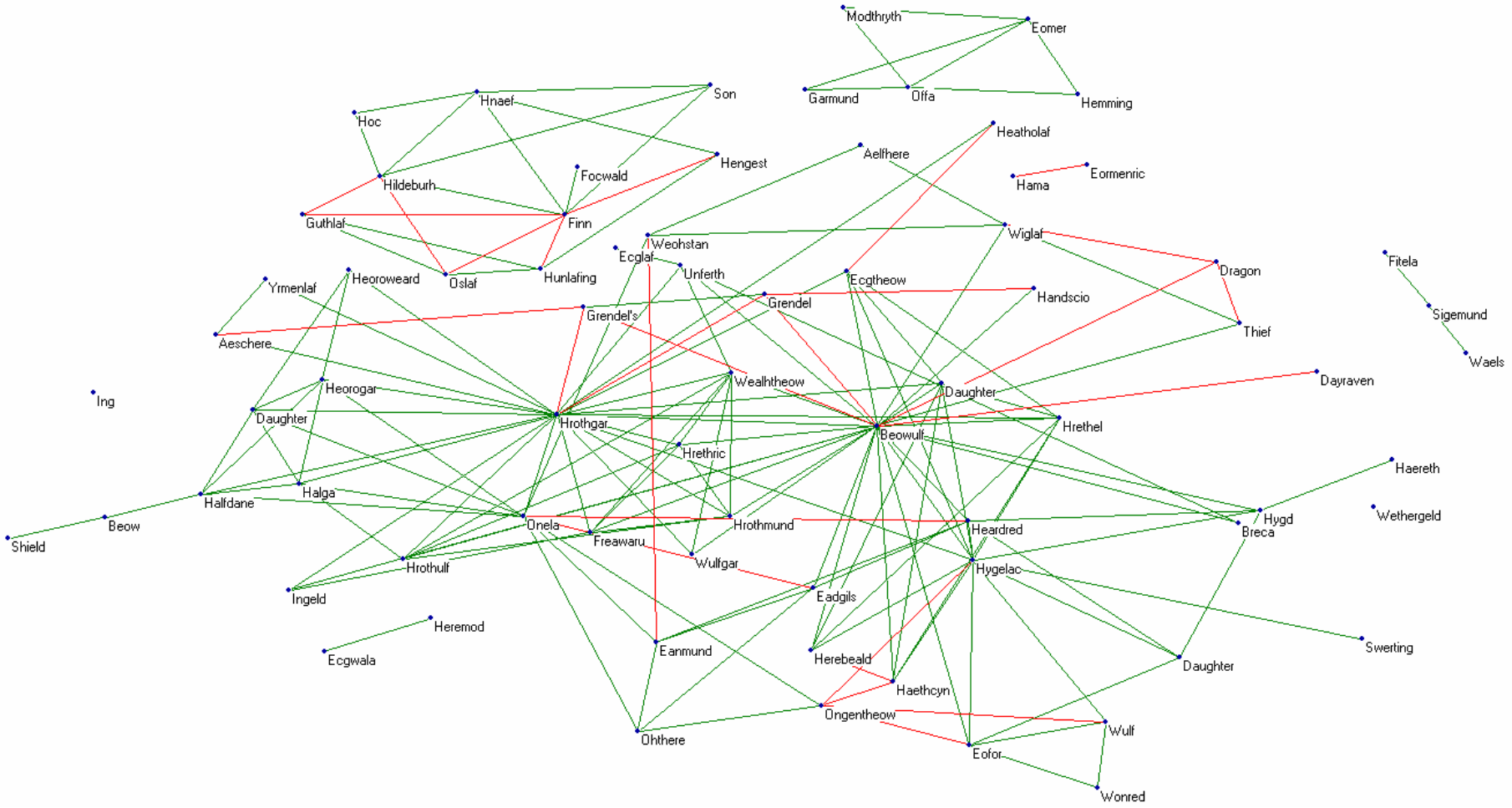


Táin Bó Cuailgne

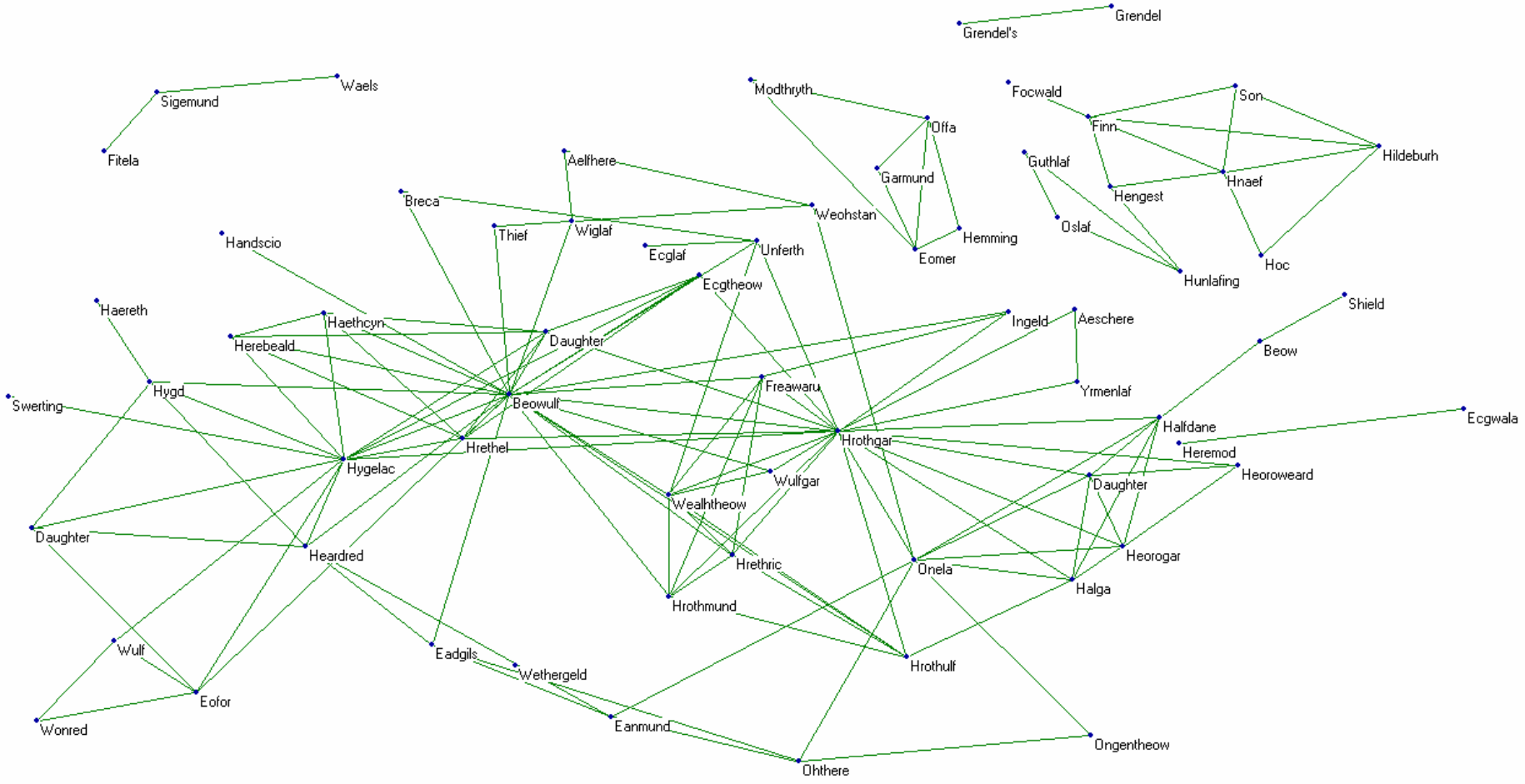
The Iliad



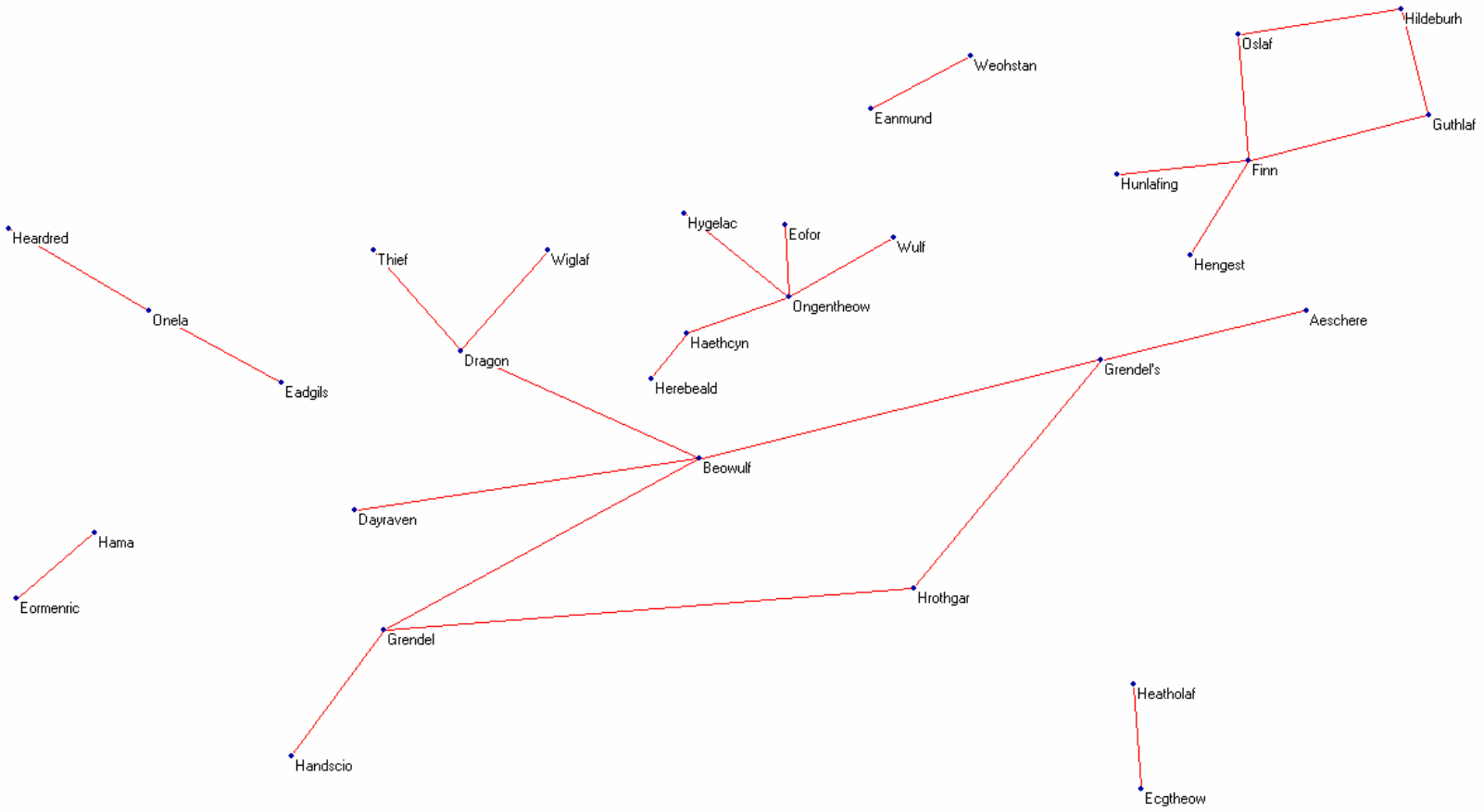
Beowulf Network



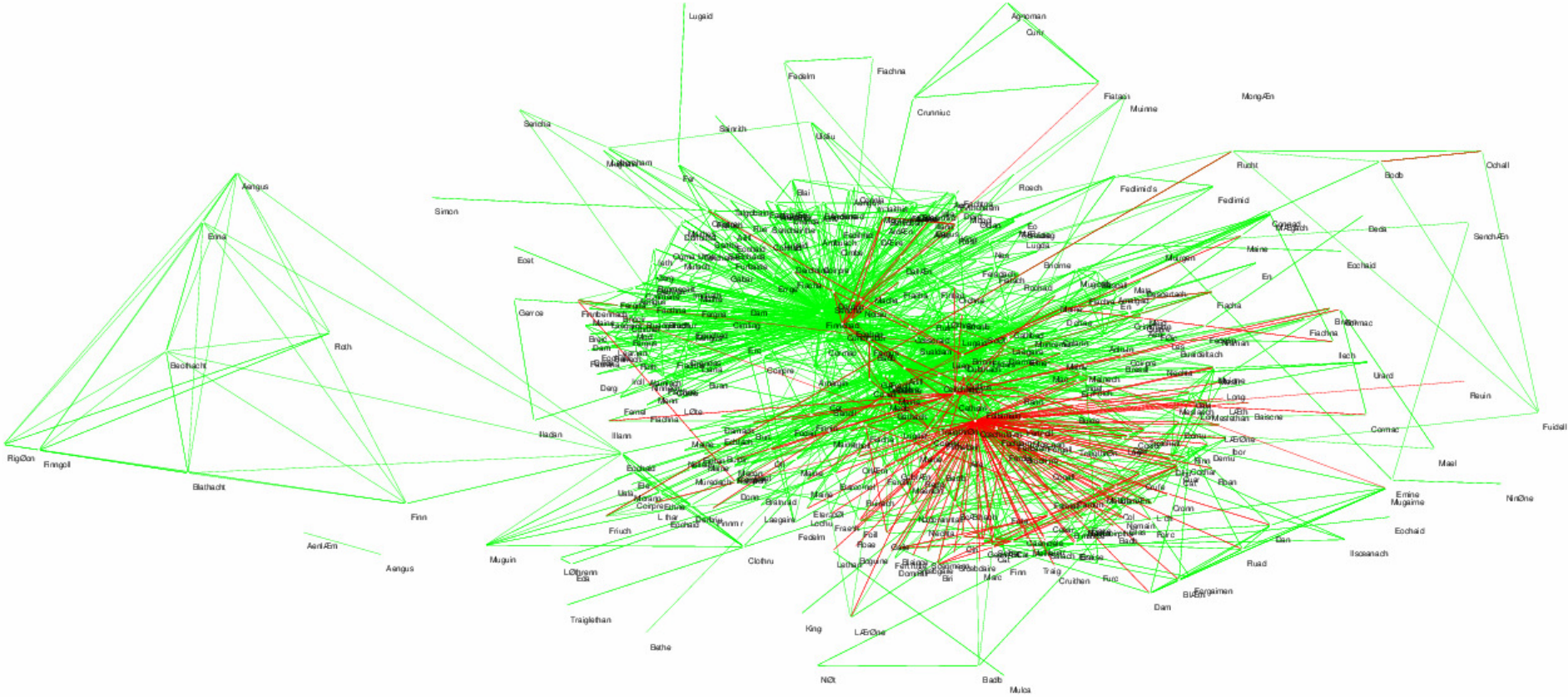
Beowulf – friendly



Beowulf – hostile



The Táin Network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Roth
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Rigdon
Finngoll
Blathacht
Finn
Aengus
Muguin
Clothru
Traigiethan
Bathe
Nidt
Badb
Mulca
Ilann
Iladin
Friuch
Fedelm
Eochaid
Ruad
Dam
Ilscenach
Ermine
Murgaime
Nindine
Fuidell
Maol
Reuin
Uiard
Iech
Cormac
Long
Ibor
Crimn
Namarh
Cruthen
Ruct
Finn
Traig
King
Labdne
Bodb
Sencha
Aengus
Erna
Aenaem
Sencha
Muirgen
Meine
Eochaid
Fiachra
Brudaitach
Basecne
Labdne
Demu
Eogan
Badb
Nemain
Parc
Bres
Ethniu
Ethlinn
Ethliu
Ethne
Eriu
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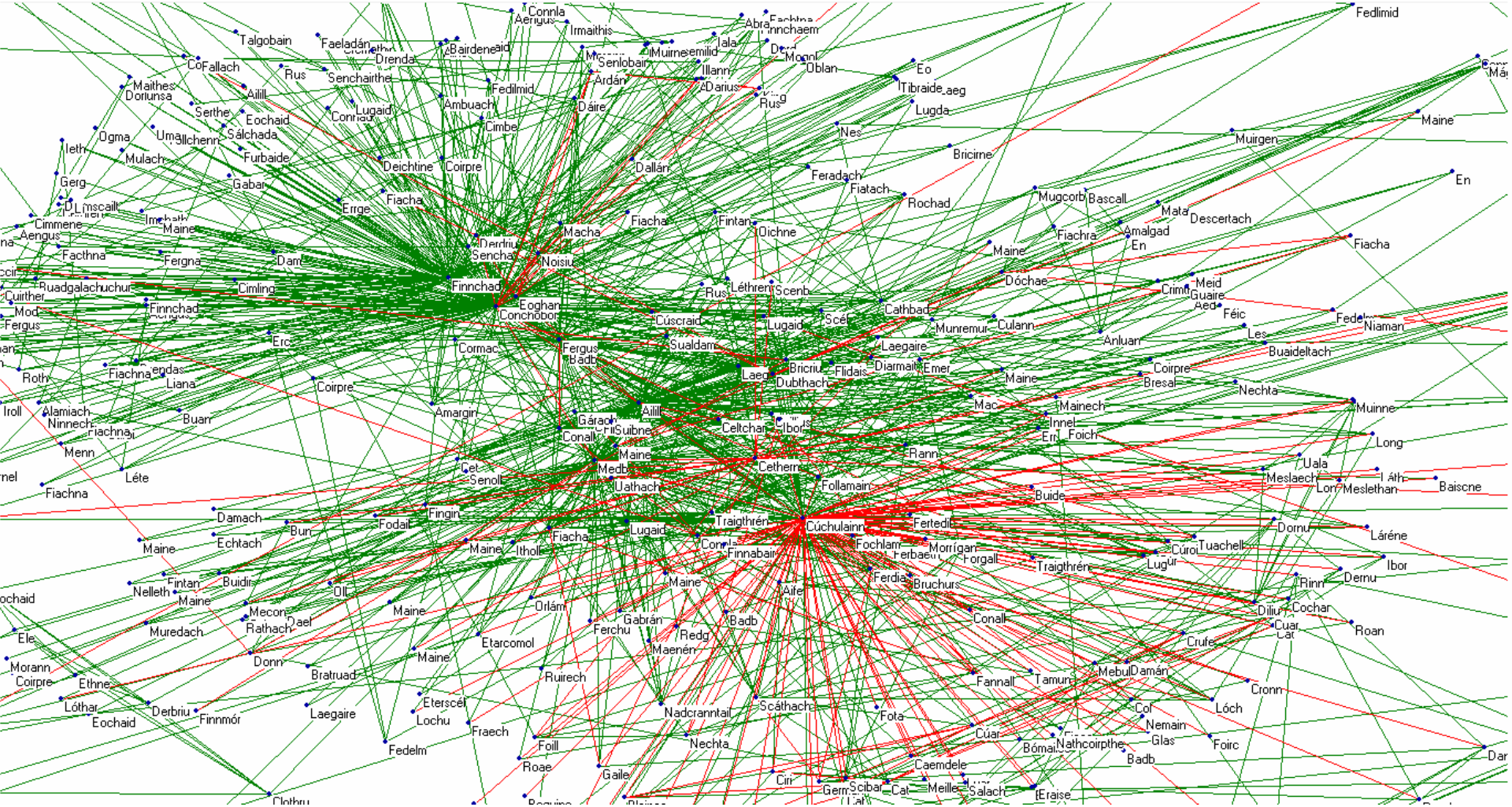
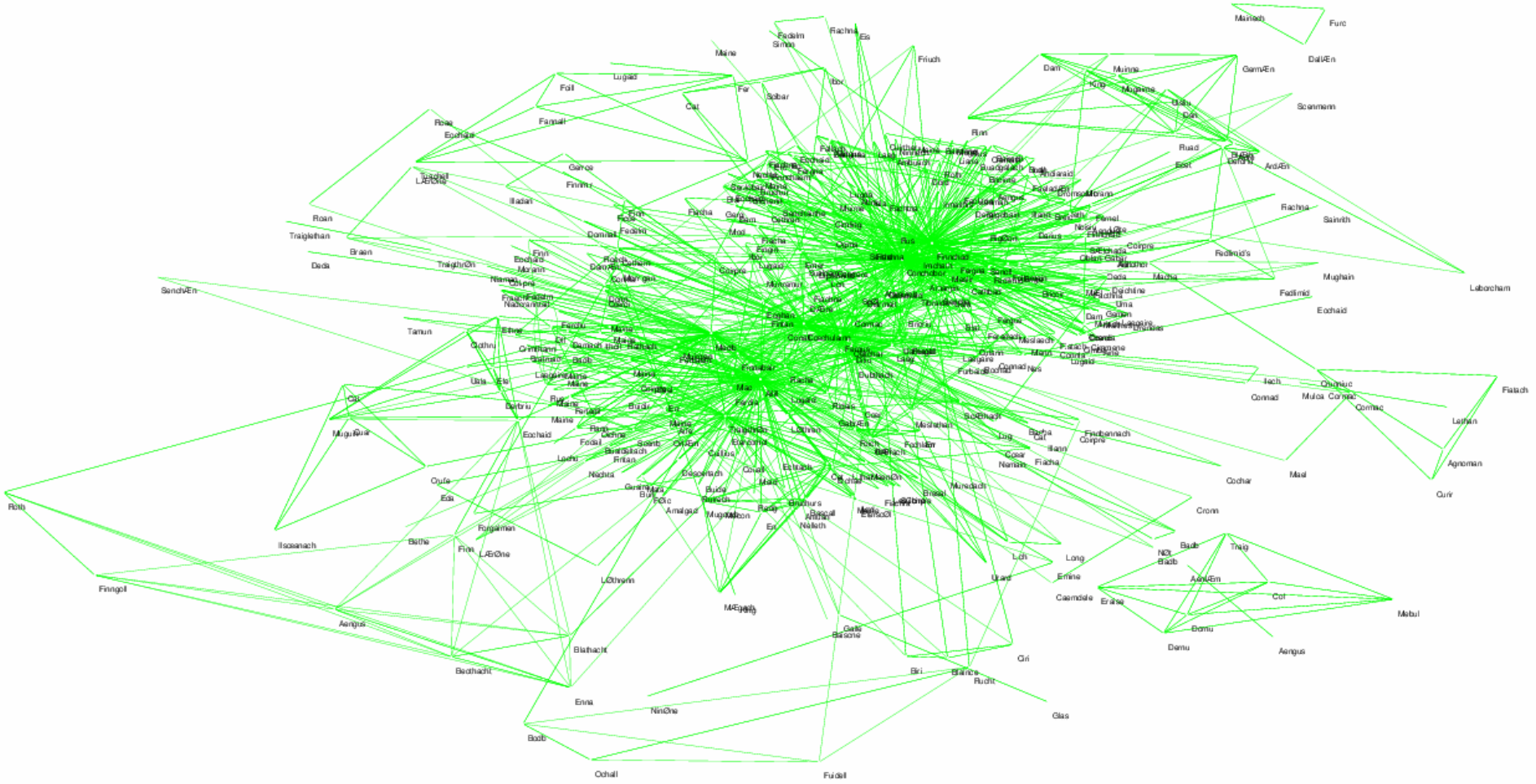
Fiatach

The Táin – detail



The Táin – friendly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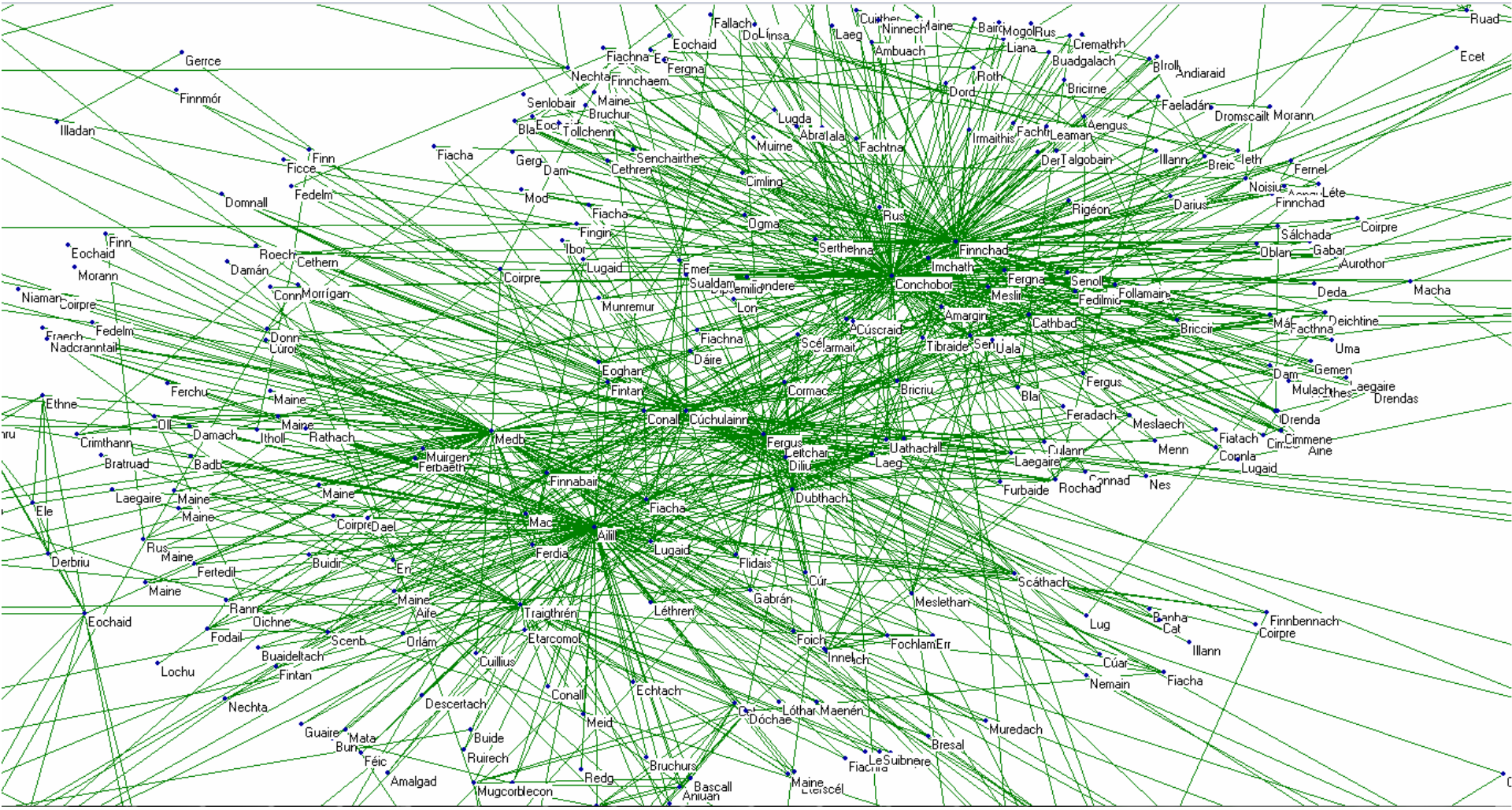
GamÆn
Scannmann
Rinn
Ruad
ArdÆn
Rachna
Sainrith
Mughain
Lebercham
Fiatach
Leithin
Agnoman
Curir
Cochar
Mael
Crom
Loch
Long
Emine
Caemdele
Erainn
Cet
Mebul
Aengus
Demu
Thaig
Buab
Finnbennach
Finngoil
Ilsceanach
Blathacht
Bechtacht
Enna
Boob
Ochall
Fudail
Glas
Bri
Ruchtt
Ciri
Tamun
Braen
Deda
Roan
Traighthan
Roth
Ilsean
Farsaman
Bethe
Fiach
Oufe
Eda
Curu
Cuthu
Ethne
Uala
Eta
Darbriu
Mugurnia
Echaid
Mainn
Fedelm
Simon
Friuch
Foill
Lugaid
Fer
Sobar
Cat
Roat
Eochaid
Farnait
Garrce
Finnmr
Iladan
Fiacha
Fedelm
Domnal
Finn
Eochaid
Moriarn
Coirpre
Morgen
Nadcrantel
Fraechnat
Fedelm
Dubtach
Mainn
Mainn
Mainn

The Táin – friendly detail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Finn
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Domnall
Fiacha
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Dam
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Fallach
Eochaid
Fiachna
Finnchaem
Fergna
Nechta
Senlobair
Maine
Bruchur
Tollchenn
Muirne
Lugda
Abratala
Fachtna
Cimling
Mod
Fingin
Ibor
Lugaid
Emer
Sualdam
Munremur
Lon
Dáire
Eoghan
Fintan
Cormac
Conall Cúchulainn
Medb
Fergus
Leitchar
Dilin
Laeg
Finnabair
Muirgen
Ferbaeth
Fiacha
Ailill
Lugaid
Flidais
Dubthach
Gabrán
Meslethan
Scáthach
Traigthrén
Léthren
Etarcomol
Foich
Innech
Fochlam
Err
Cúar
Nemain
Fiacha
Echtach
Conall
Meid
Descertach
Dóchae
Lóthar Maenén
Muredach
Bresal
Le Suibnere
Fiacha
Bascall
Aniuan
Maine
Lerscél
Bruchurs
Redg
Mugcorblecon
Amalgad
Féic
Ruirech
Buide
Guaire
Mata
Bun
Lochu
Fintan
Buaideltach
Scenb
Orlám
Fodail
Oichne
Rann
Aife
Eochaid
Derbriu
Fertedil
Buidir
En
Rus
Maine
Coirpre
Dael
Mac
Ele
Laegaire
Maine
Maine
Maine
Maine
Crimthann
Bratruad
Badb
Damach
Itholl
Rathach
Ethne
Ferchu
Maine
Oll
Maine
Fraech
Fedelm
Nadcranntail
Donn
Cúroi
Niaman
Coirpre
Morann
Eochaid
Finn
Roech
Damán
Cethern
Conn
Morrígan
Coirpre
Lugaid
Imchath
Conchobor
Fergna
Senoll
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Fedilmic
Follamain
Amargin
Cúscraid
Cathbad
Tibraide
Ualach
Fiachna
Scélarmait
Bricriu
Bricciu
Feradach
Meslaech
Fiatach
Menn
Coonla
Laegaire
Furbaide
Rochad
Connad
Nes
Lugaid
Uathachtl
Culann
Aine
Cimmene
Drenda
Drendas
Mulach
Thes
Laegaire
Gemen
Dam
Uma
Deichtine
Macha
Deda
Follamain
Fedilmic
Sálchada
Coirpre
Oblan
Gabar
Aurothor
Finnchad
Léte
Noisiu
Fernel
Breic
Ieth
Illann
Talgobain
Der
Darius
Rigéon
Rus
Serthe
Ogma
Finnchad
Irmaithis
Fachtna
Leaman
Aengus
Dromscaill
Morann
Faeladán
Bricirne
Roth
Dord
Andiaraid
Buadgalach
Cremathn
Liana
Ambuach
Ninnech
Laeg
Mogol
Rus
Baire
Maine
Do Linsa
Eochaid
Fiachna
Fergna
Nechta
Finnchaem
Senlobair
Maine
Bruchur
Bla
Eoc
Tollchenn
Fiacha
Gerg
Dam
Senchairthe
Cethern
Cimling
Mod
Fiacha
Fingin
Ibor
Lugaid
Emer
Sualdam
Coirpre
Munremur
Lon
Dáire
Eoghan
Fintan
Cormac
Conall Cúchulainn
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Nadcranntail
Donn
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Morrígan
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Senoll
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Meslaech
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Aine
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Drenda
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Mulach
Thes
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Noisiu
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Aengus
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Do Linsa
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Senlobair
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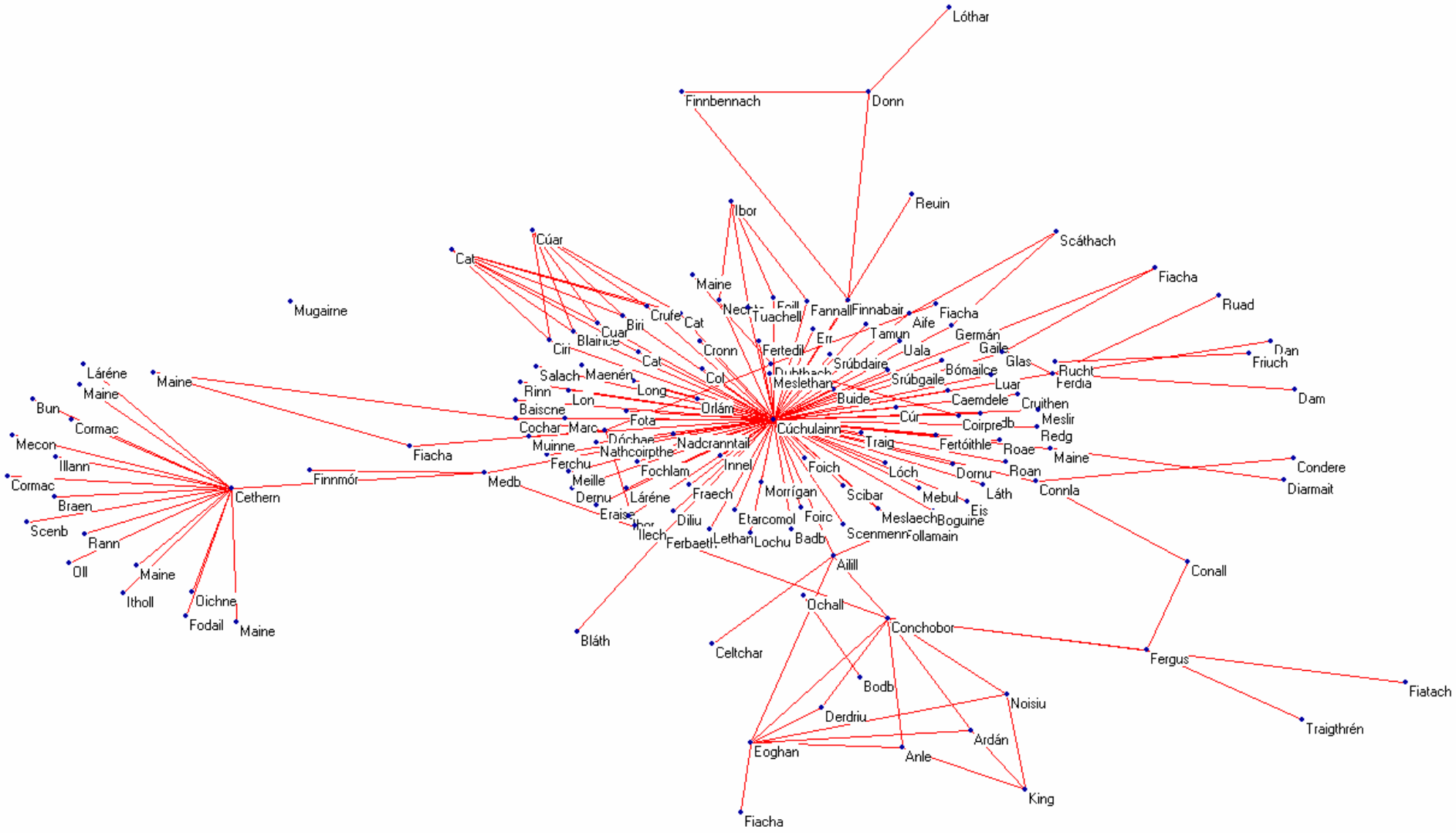
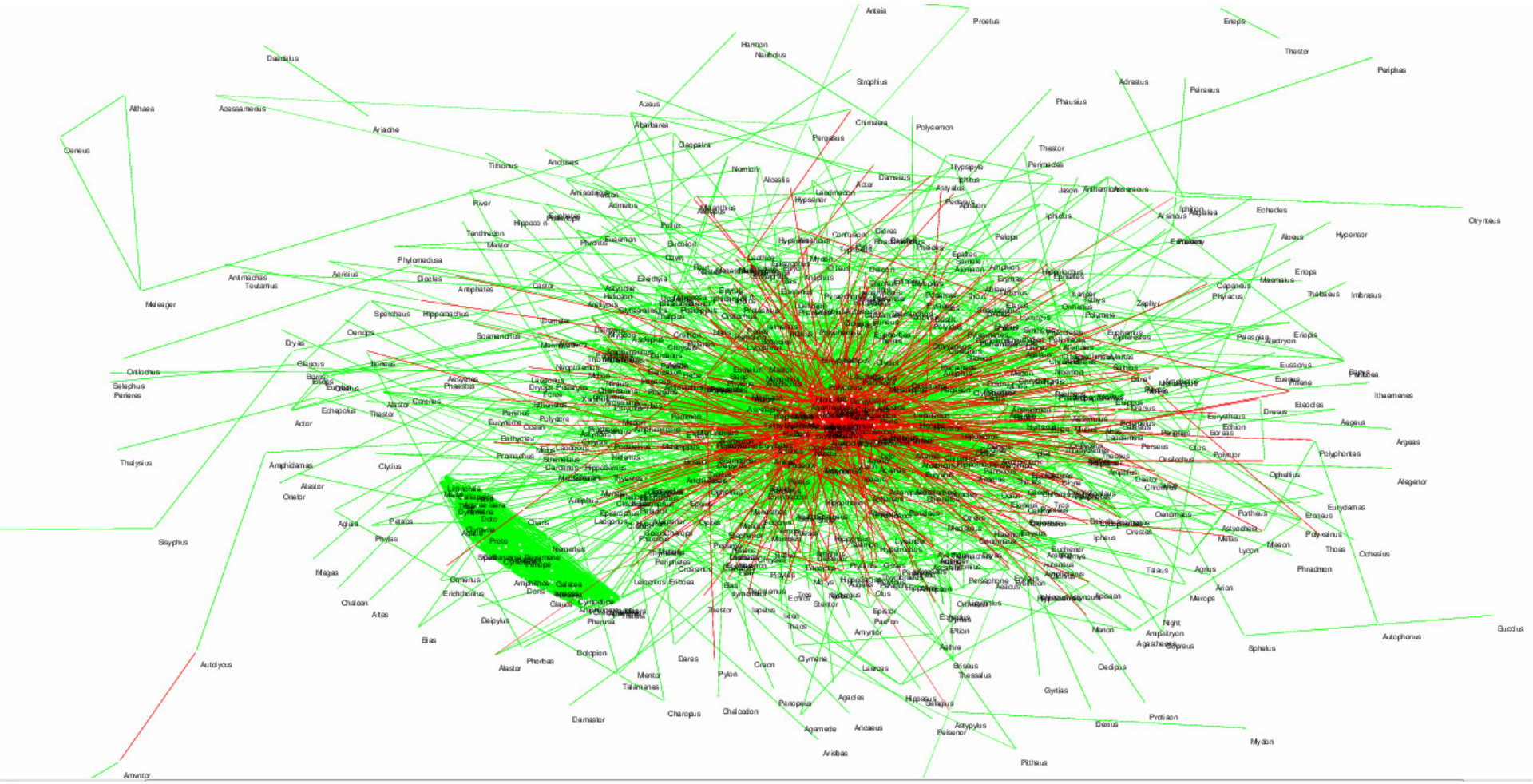
The Táin – Hostile



The Iliad Network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Helen
Priam
Hecuba
Andromache
Ajax
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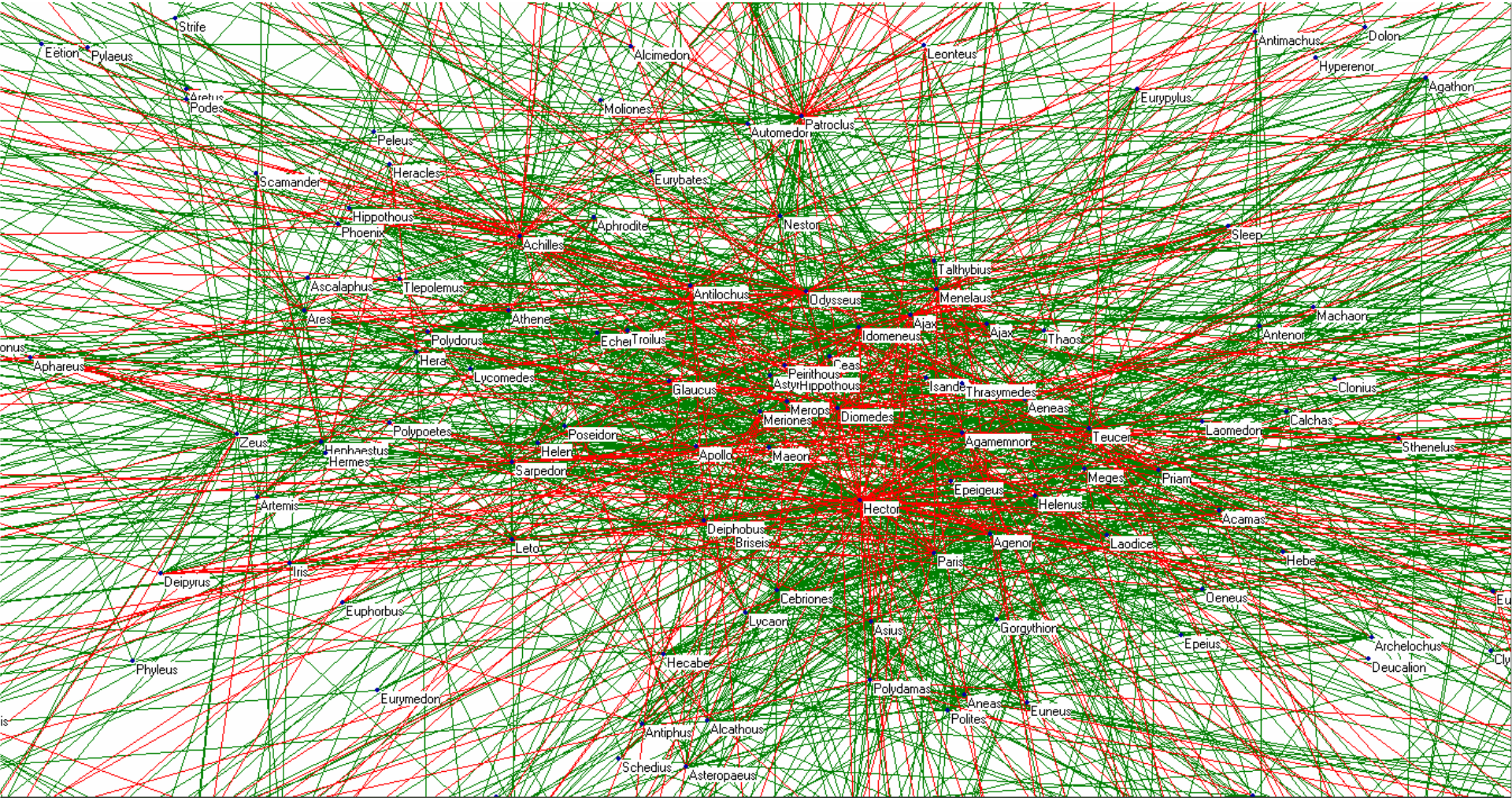
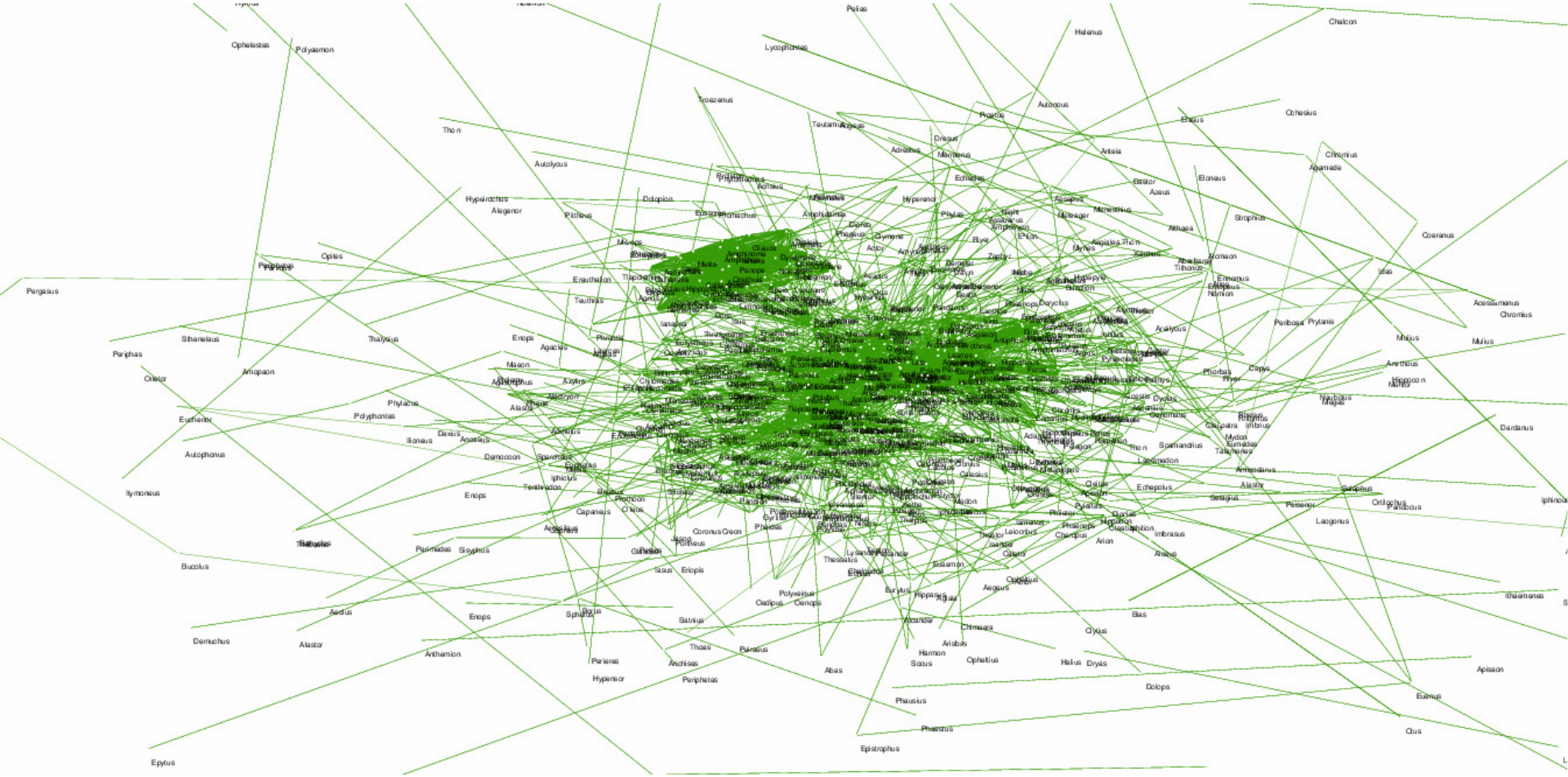
Diomedes
Nestor
Patroclus
Sarpedon
Glaucus
Aeneas
Pandarus
Thersites
Briseus
Chryseis
Calchas
Machaon
Podalirius
Eurypylus
Memnon
Penthesilea
Deiphobus
Helenus
Polydamas
Asius
Idomeneus
Meriones
Teucer
Ajax
Phoenix
Automedon
Alcimus
Laodocus
Peisander
Hippolochus
Sarpedon
Glaucus
Bellerophon
Iphinous
Lycophontes
Tlepolemus
Nireus
Aeneas
Anchises
Ascanius
Creusa
Dolon
Rhesus
Hecamede
Machaon
Podalirius
Protesilaus
Laodamia
Cycnus
Achilles
Thetis
Peleus
Nereus
Doris
Galatea
Hephaestus
Hera
Zeus
Ares
Aphrodite
Athena
Apollo
Artemis
Leto
Hermes
Iris
Poseidon
Amphitrite
Triton
Scamander
Simois
Xanthus
Troy
Ida
Olympus
Thessaly
Phthia
Scyros
Lemnos
Tenedos
Chryse
Cilla
Hypoplacian City
Thebe
Lyrnessus
Pedasus
Zeleia
Abydos
Percote
Lampsacus
Dardanus
Arisbe
Pityeia
Thymbra
Dolonci
Samothrace
Imbros
Lesbos
Tenedos
Achaea
Argos
Mycenae
Sparta
Pylos
Ithaca
Crete
Rhodes
Cos
Nisyros
Calydnae
Cnidus
Halicarnassus
Miletus
Ephesus
Colophon
Smyrna
Cyme
Phocaea
Lesbos
Methymna
Mytilene
Antissa
Eresus
Pitane
Aegae
Myrina
Grynium
Dardanus
Ilium
Troad
Thrace
Paeonia
Mysia
Lydia
Caria
Lycia
Pamphylia
Cilicia
Cyprus
Phoenicia
Egypt
Libya
Ethiopia
Scythia
Hyperborea
Thule
Atlantis
Elysium
Tartarus
Hades
Styx
Acheron
Cocytus
Phlegethon
Lethe
Asphodel
Erebus
Nyx
Hypnos
Thanatos
Moros
Ker
Oneiroi
Morpheus
Phobetor
Phantasos
Hecate
Eris
Nemesis
Dike
Eirene
Eunomia
Themis
Aidos
Peitho
Hebe
Iris
Harmonia
Aphrodite
Eros
Anteros
Himeros
Pothos
Hedone
Charites
Aglaia
Euphrosyne
Thalia
Erato
Melpomene
Terpsichore
Calliope
Clio
Urania
Polyhymnia
Muses
Pierides
Helicon
Parnassus
Pieria
Olympus
Ossa
Pelion
Thessaly
Iolcus
Aeson
Jason
Medea
Argonauts
Argo
Hylas
Heracles
Hercules
Omphale
Deianira
Nessus
Hydra
Cerberus
Geryon
Atlas
Hesperides
Amazons
Hippolyta
Theseus
Minotaur
Labyrinth
Daedalus
Icarus
Ariadne
Dionysus
Bacchus
Silenus
Satyrs
Maenads
Pan
Syrinx
Echo
Narcissus
Hyacinthus
Adonis
Persephone
Demeter
Triptolemus
Eleusis
Mysteries
Asclepius
Hygieia
Panacea
Machaon
Podalirius
Chiron
Centaurs
Lapiths
Pirithous
Hippodamia
Peleus
Thetis
Achilles
Neoptolemus
Pyrrhus
Andromache
Astyanax
Hecuba
Cassandra
Polyxena
Priam
Laomedon
Tithonus
Memnon
Eos
Aurora
Helios
Sun
Selene
Moon
Night
Nyx
Erebus
Chaos
Gaia
Uranus
Cronus
Rhea
Titans
Cyclopes
Hundred-Handers
Typhon
Giants
Olympians
Twelve
Hestia
Dione
Maia
Electra
Taygete
Alcyone
Celaeno
Sterope
Merope
Pleiades
Hyades
Orion
Sirius
Dog Star
Constellations
Zodiac
Ecliptic
Equinox
Solstice
Seasons
Horae
Eunomia
Dike
Eirene
Fates
Clotho
Lachesis
Atropos
Moirai
Necessity
Ananke
Tyche
Fortune
Nemesis
Retribution
Hubris
Arete
Kleos
Nostos
Epic
Cycle
Homer
Iliad
Odyssey
Hymns
Theogony
Hesiod
Works and Days
Shield of Heracles
Catalogue of Women
Fragments
Lost Epics
Cypria
Aethiopis
Little Iliad
Ilioupersis
Nostoi
Telegony
Thebaid
Oedipodea
Seven Against Thebes
Epigoni
Alcmaeonis
Titanomachy
Gigantomachy
Typhonomachy
Trojan War
Ten Years
Wooden Horse
Sack of Troy
Fall of Troy
Aftermath
Returns
Wanderings
Ithaca
Penelope
Telemachus
Laertes
Eumaeus
Eurycleia
Argus
Suitors
Antinous
Eurymachus
Amphinomus
Melanthius
Melantho
Irus
Phaeacians
Alcinous
Arete
Nausicaa
Scheria
Underworld
Tiresias
Elpenor
Agamemnon
Clytemnestra
Aegisthus
Orestes
Electra
Pylades
Menelaus
Helen
Nestor
Pisistratus
Antilochus
Thrasymedes
Peisistratus
Chryses
Apollo
Plague
Arrows
Lyre
Paean
Delphi
Pythia
Oracle
Tripod
Laurel
Python
Cassandra
Prophecy
Curse
Troilus
Hector
Andromache
Astyanax
Hecuba
Priam
Polyxena
Cassandra
Helenus
Aeneas
Anchises
Ascanius
Creusa
Dido
Carthage
Rome
Virgil
Aeneid
Ovid
Metamorphoses
Apollodorus
Library
Hyginus
Fabulae
Pausanias
Description of Greece
Strabo
Geography
Dictys Cretensis
Diary of the Trojan War
Dares Phrygius
Fall of Troy
Tzetzes
Posthomerica
Quintus Smyrnaeus
Coluthus
Tryphiodorus
Nonnus
Dionysiaca
Musaeus
Hero and Leander
Colluthus
Rape of Helen
Triphiodorus
Fall of Ilium
Tryphiodorus
Capture of Troy
Tryphiodorus
Sack of Troy
Tryphiodorus
Fall of Troy

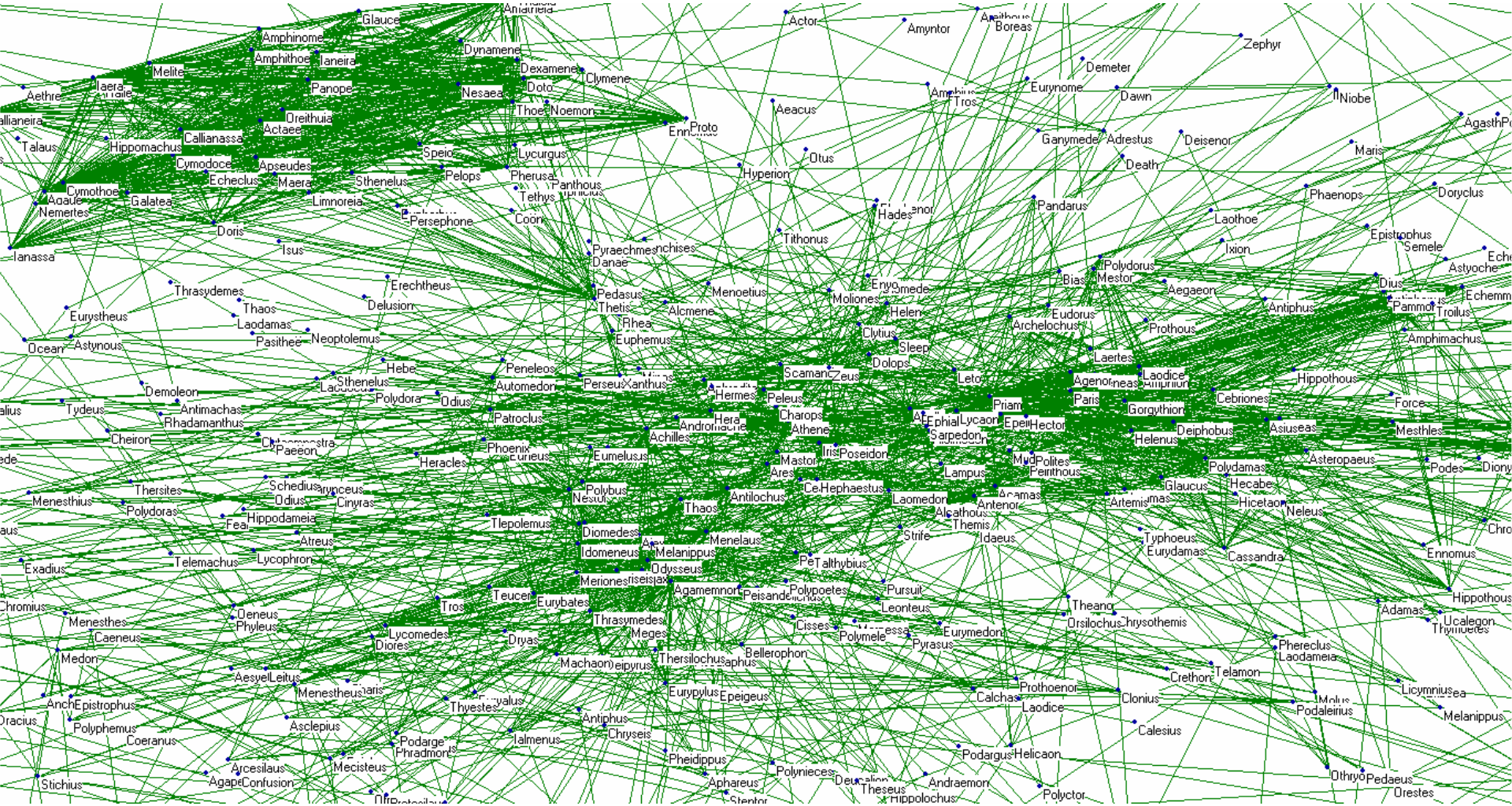
The Iliad – detail



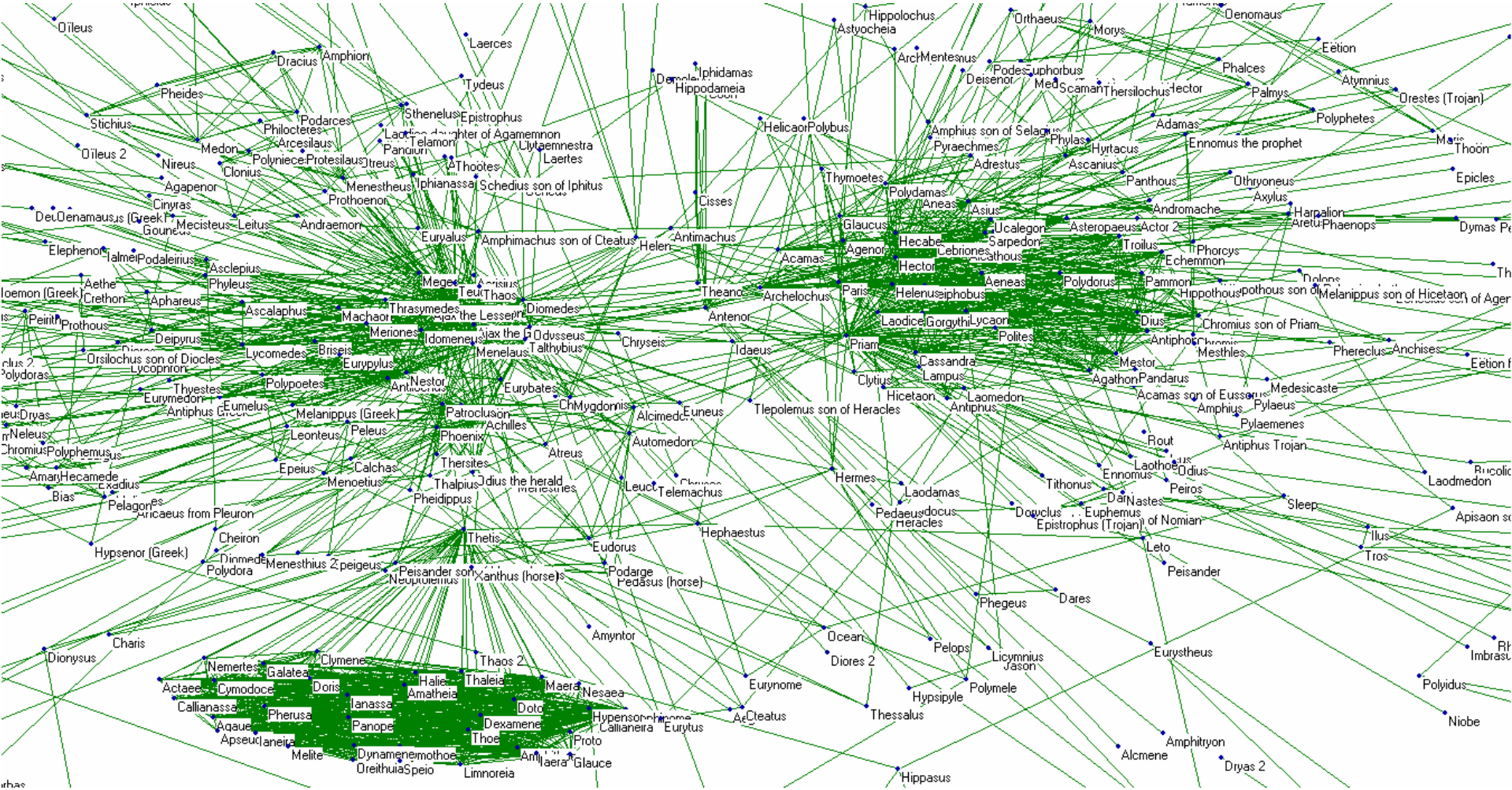
The Iliad – friendly



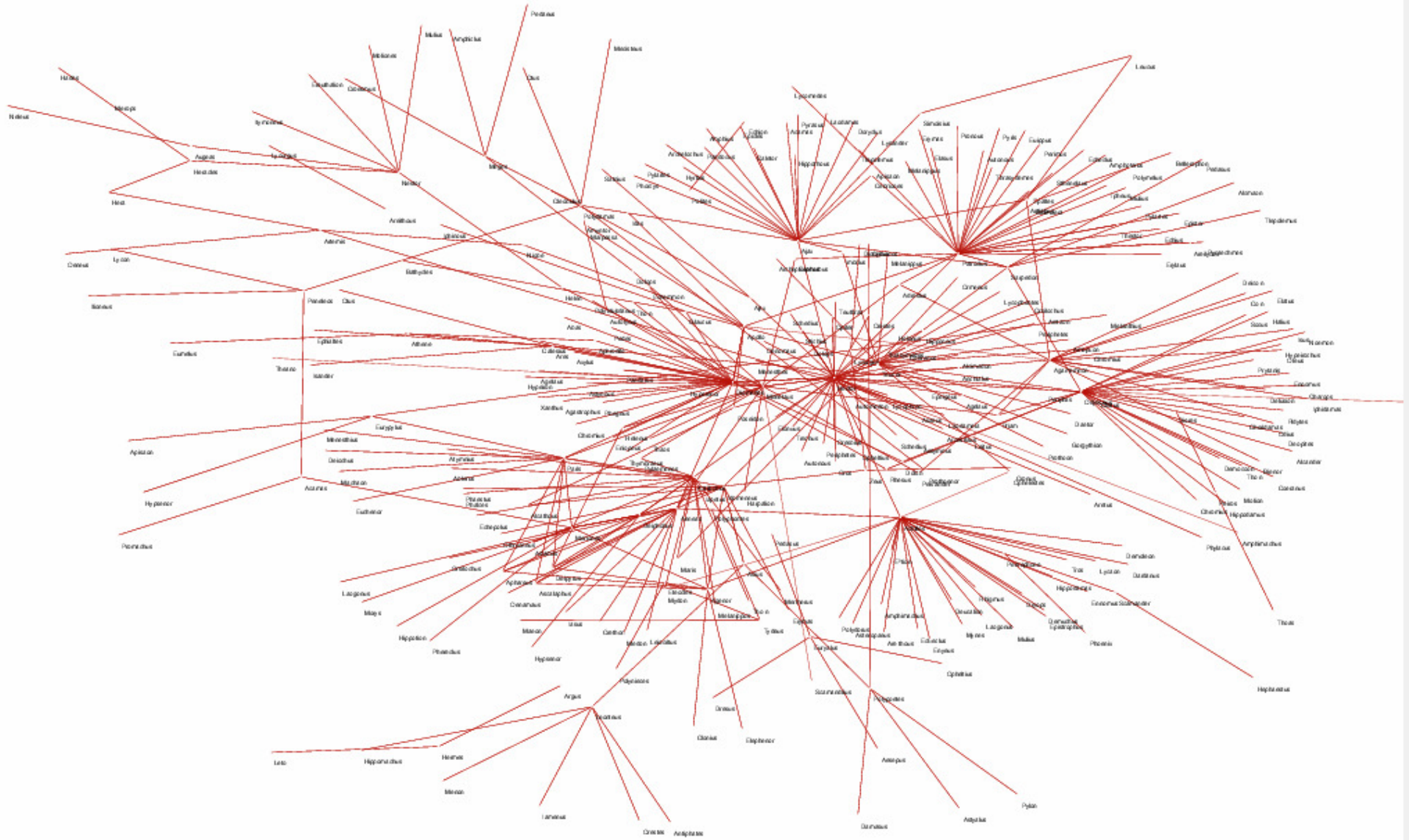
The Iliad – friendly detail



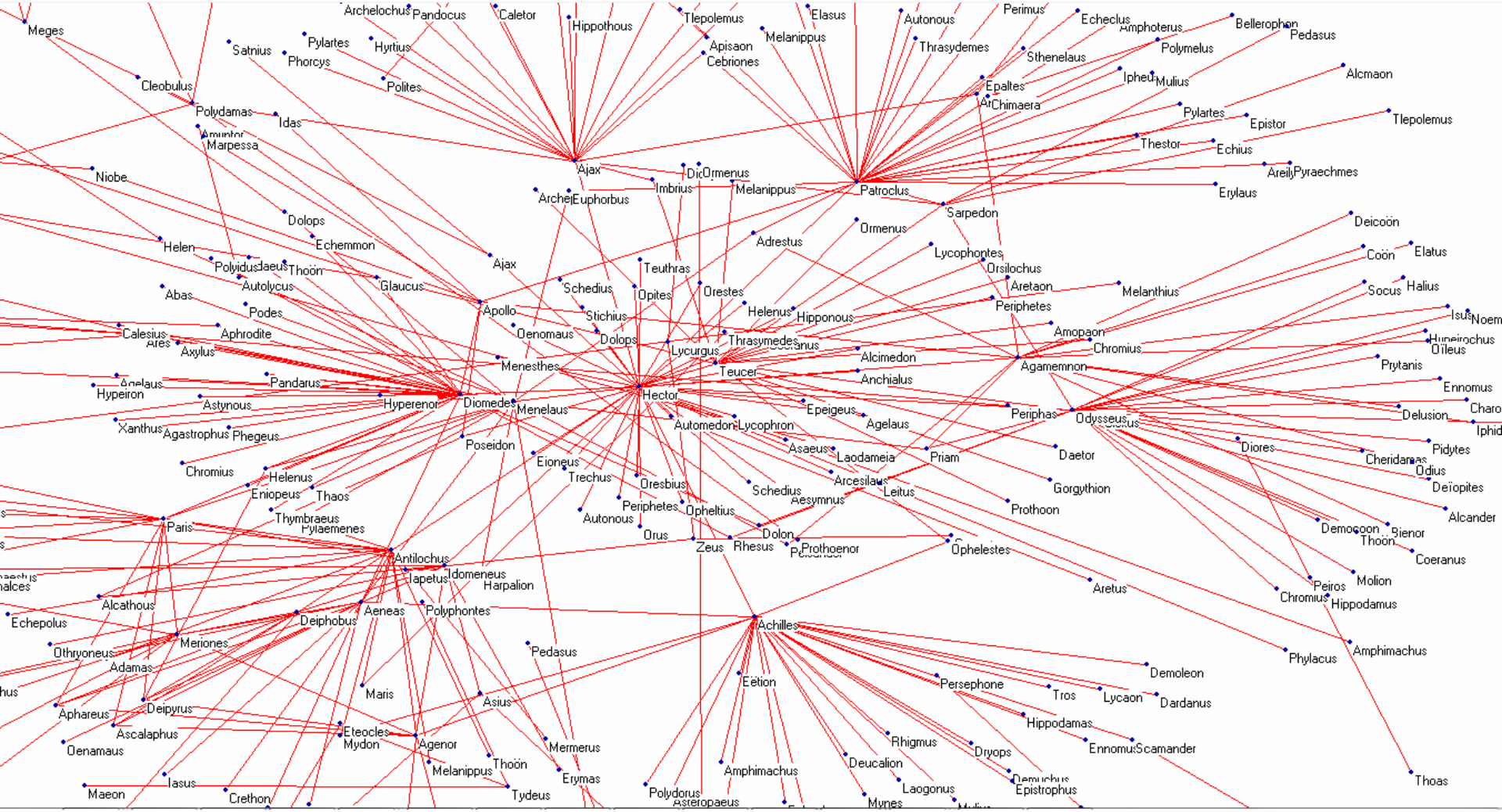
The Iliad – No Gods



The Iliad – hostile



The Iliad – hostile detail



Comparison of Networks

Network	Size	$< k >$	γ	l	l_{max}	l_{rand}	C	C_{rand}	C/C_{rand}
Beowulf	74	4.46	2.44	2.37	6	3.05	0.369	0.069	5.31
Táin	404	6.11	2.19	2.76	7	3.50	0.102	0.011	9.29
Iliad	719	7.40	2.35	3.55	11	3.52	0.454	0.009	49.58

Collaboration Networks

Network	Size	$< k >$	γ	l	l_{rand}	C	C_{rand}	C/C_{rand}
Movie Actors	212 250	28.78	2.3	4.54	3.65	0.79	0.00027	2 925.92
Co-Authors, SPIRES	56 627	173	1.2	4	2.12	0.726	0.003	242
Co-authors, neuro.	209 293	11.54	2.1	6	5.01	0.76	5.5310×10^{-5}	13 740.73
Co-authors, math.	70 975	3.9	2.5	9.5	8.2	0.59	5.4310×10^{-5}	10 863.56
NCSTRL co-authorship	11 994	3.59	–	9.7	7.34	0.496	0.0003	1653.33
Marvel	6449	51.88	0.72	2.63	2.64	0.012	0.008	1.5

Network Analysis

Average Path Length

Clustering Coefficient

Degree Distribution

Assortativity

Average Path Length

Beowulf	$n = 74$	$l = 2.37$
Táin	$n = 404$	$l = 2.76$
Iliad	$n = 719$	$l = 3.55$
Marvel	$n = 6449$	$l = 2.63$
SPIRES	$n = 56627$	$l = 4$
Actors	$n = 212250$	$l = 5.54$
Facebook	$n = 7.21 \times 10^6$	$l = 3.74$

Clustering Coefficient (Transitivity)

	C	C_{rand}	Ratio
Beowulf	0.369	0.069	5.31
Táin	0.102	0.011	9.29
Iliad	0.454	0.009	49.58
SPIRES	0.726	0.003	242
Actors	0.79	0.0003	2925
Marvel	0.012	0.008	1.5

Degree Distribution Exponent

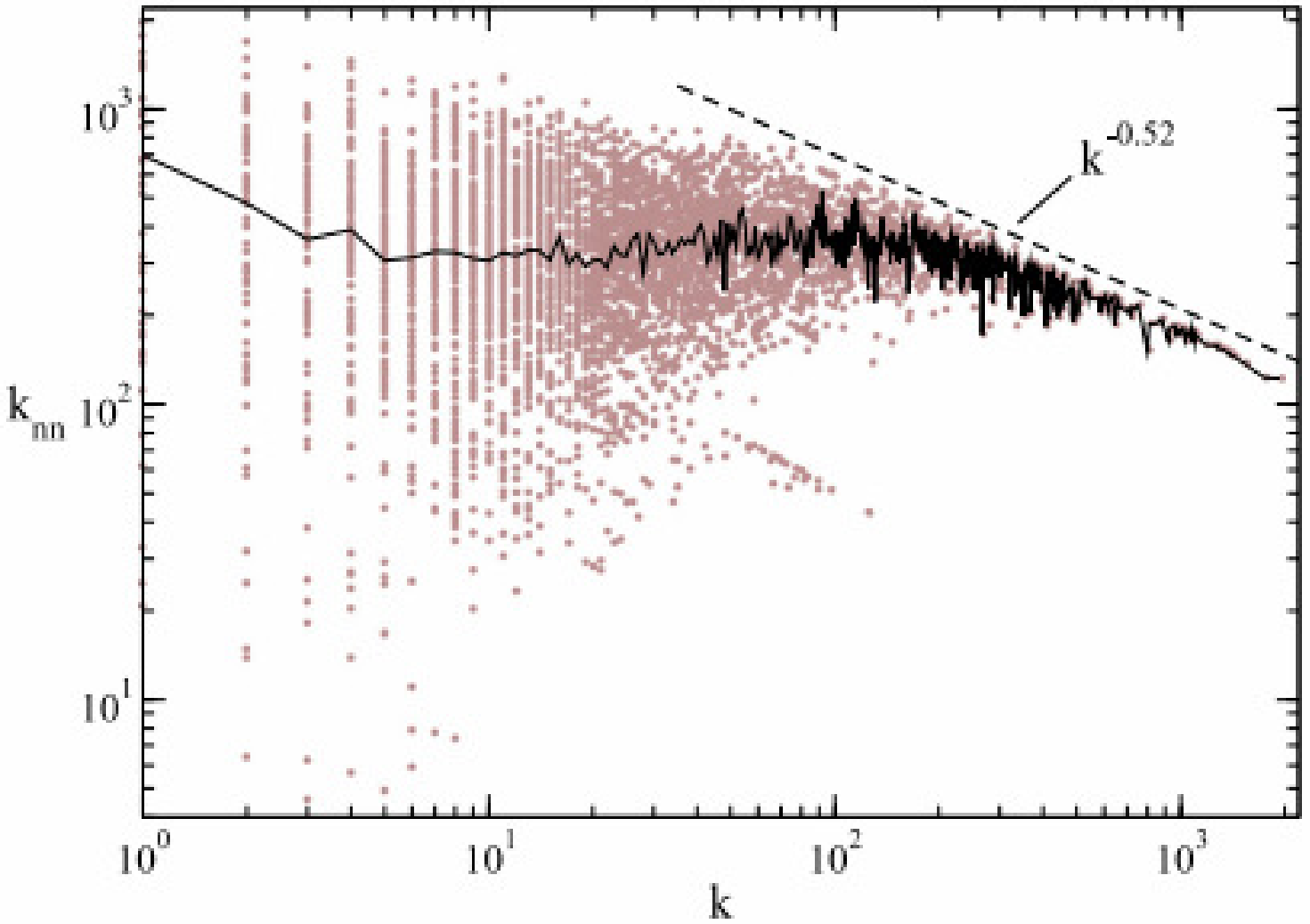
$$P(k) \sim k^{-\gamma}$$

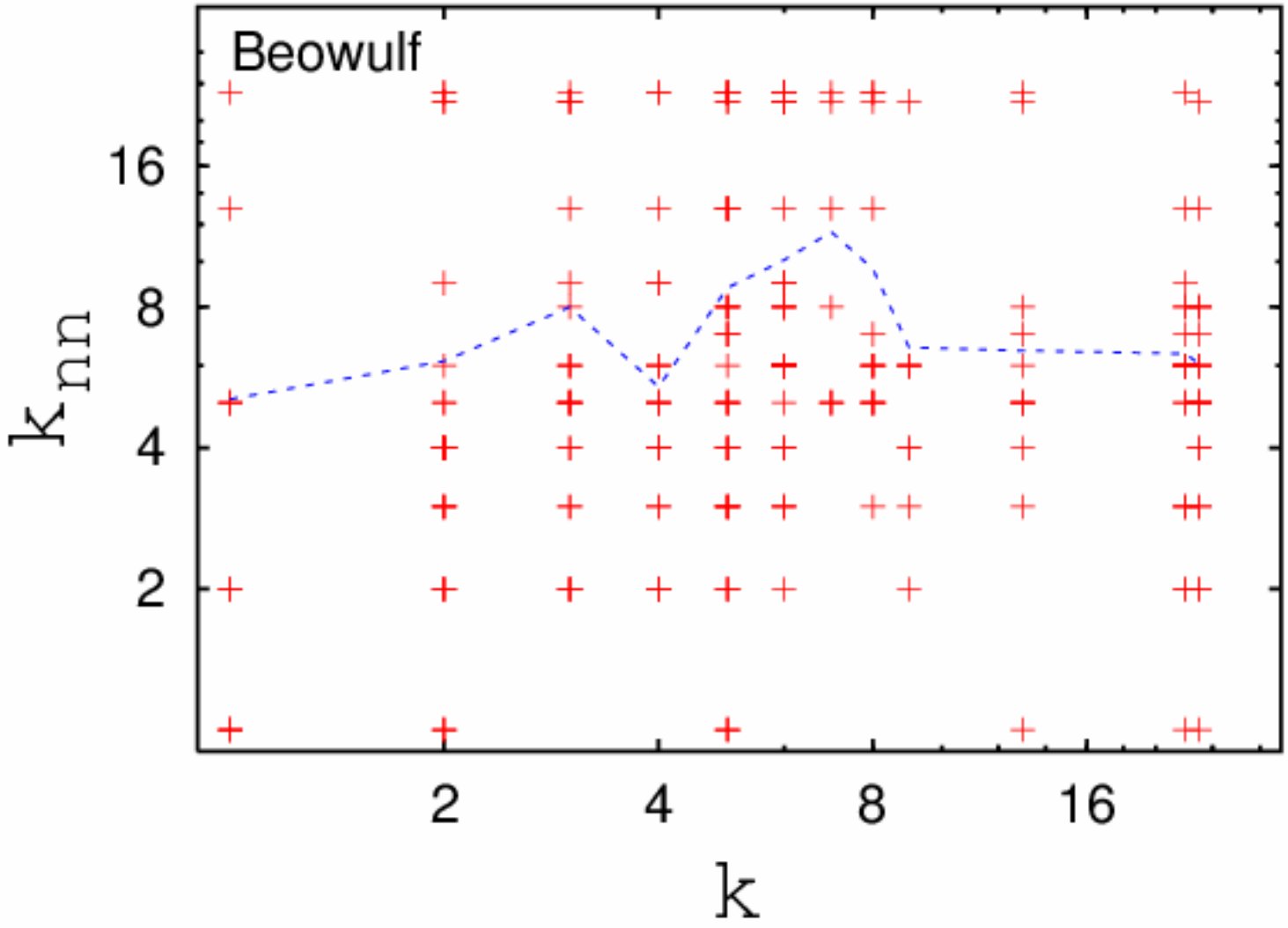
Beowulf	$\gamma = 2.44 \pm 0.16$
Táin	$\gamma = 2.19 \pm 0.06$
Iliad	$\gamma = 2.35 \pm 0.05$

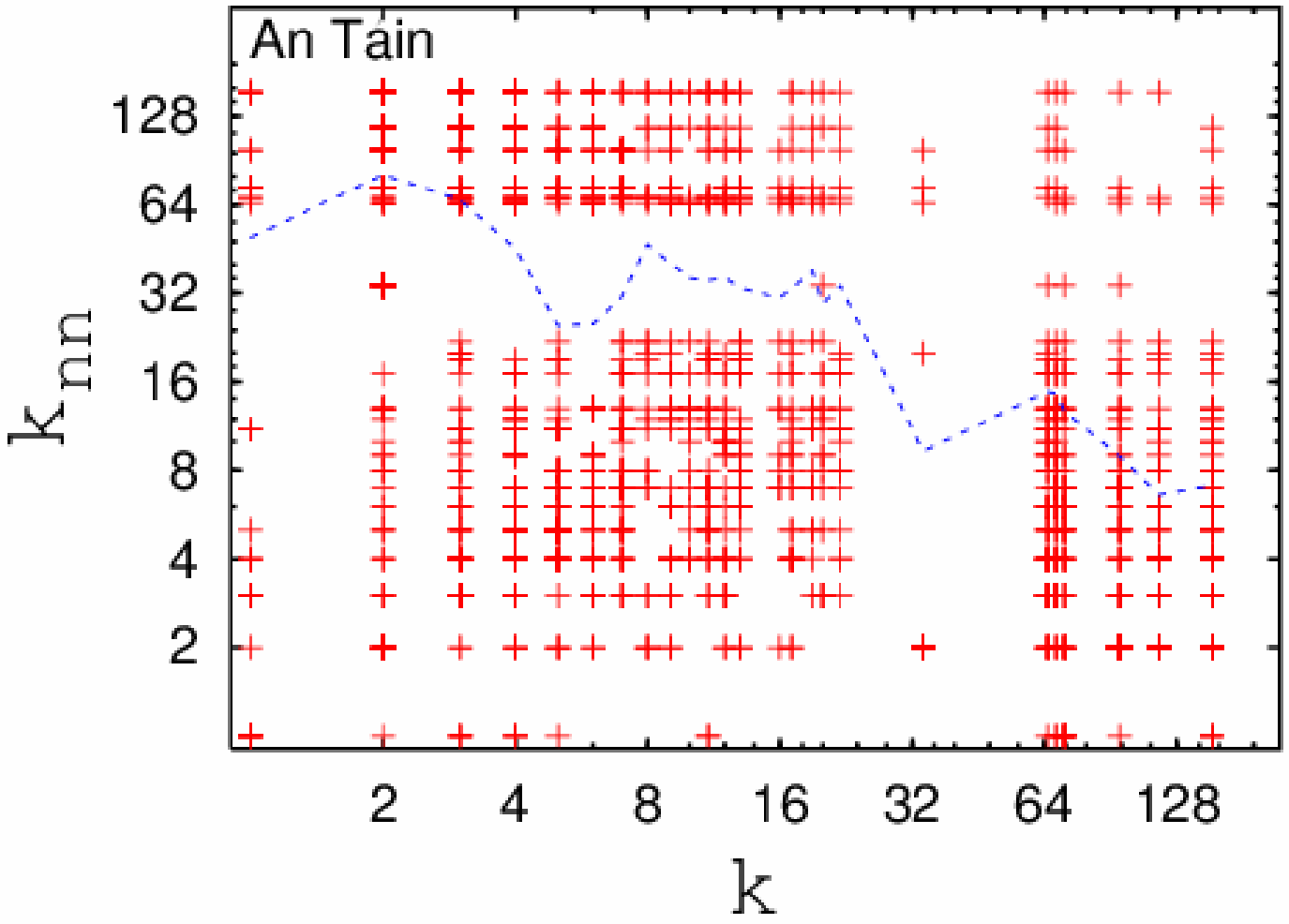
Co-authors, math	$\gamma = 2.5$
Co-authors, neuro.	$\gamma = 2.1$
Co-authors, SPIRES	$\gamma = 1.2$
Movie Actors	$\gamma = 2.3$
Marvel Universe	$\gamma = 0.72$

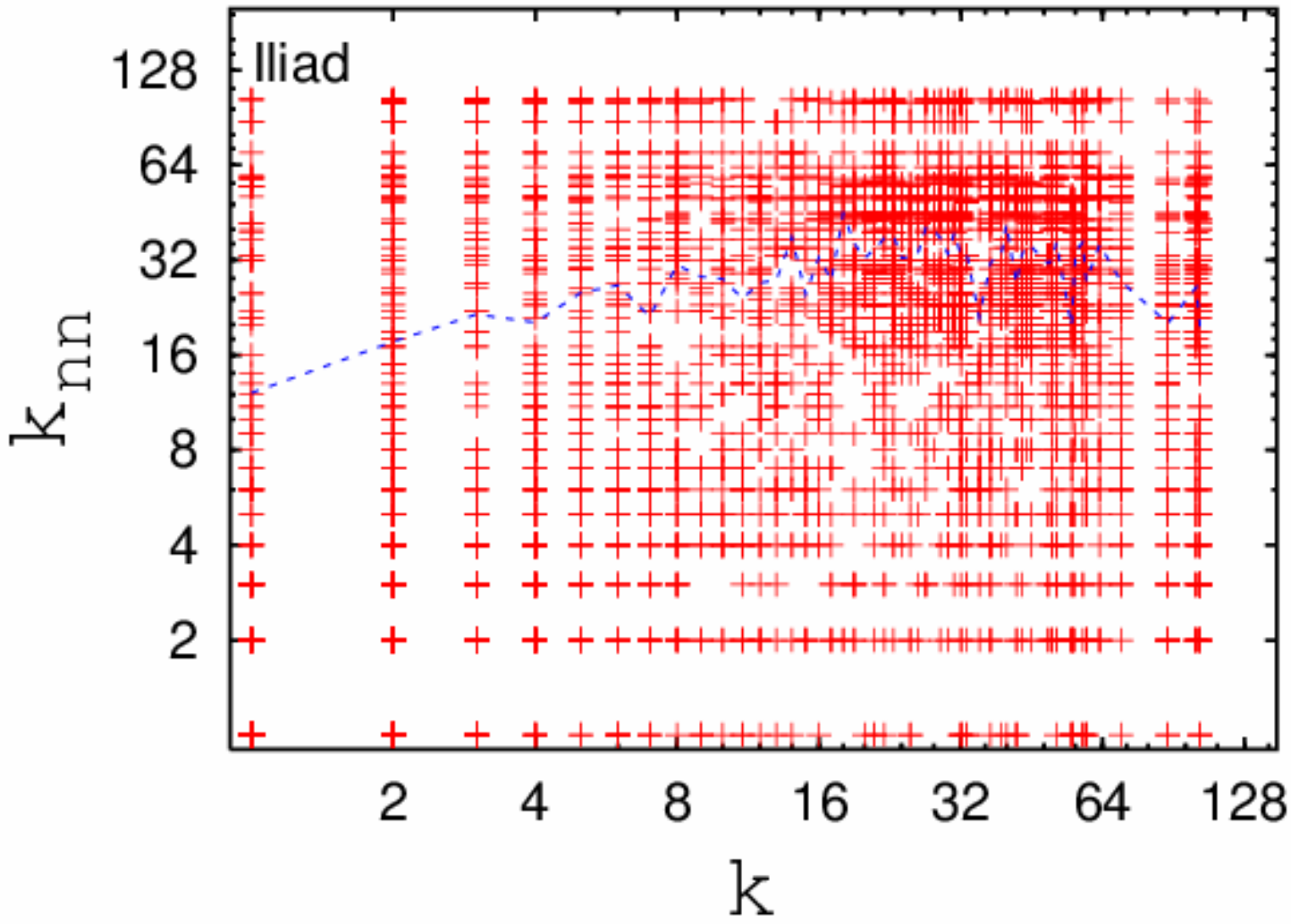
Assortativity

How to become a superhero




Beowulf
16
8
4
2
k_{nn}
2
4
8
16
k


An Tain
128
64
32
16
8
4
2
k_{nn}
2
4
8
16
32
64
128
k


Iliad
128
64
32
16
8
4
2
k_{nn}
2
4
8
16
32
64
128
k

Conclusions

- The Networks of these Mythological epics are small world and scale free.

- They behave like real collaboration networks

  – unlike the network of the Marvel Universe

- How will this compare to fiction?

Thank you