GeneMANIA: Introduction

- Real-time gene function prediction tool
- Available as:
  - Interactive web site (http://genemania.org)
  - Command line tool
  - Plugin for Cytoscape 2
  - App for Cytoscape 3
- Java
- LGPL licensed
- Code available upon request
GeneMANIA: Introduction

• Current:
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  – Quaid Morris (co-PI)
  – Max Franz
  – Christian Lopes
  – Jason Montojo
  – Harold Rodriguez
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  – Chris Grouios
  – Anson Maitland
  – Sara Mostafavi
  – Deb Ray
  – Quentin Shao
  – Michael Tsui
  – David Warde-Farley
  – George Wright
GeneMANIA: Overview

Guilt by association

BRCA1
## GeneMANIA: Overview

<table>
<thead>
<tr>
<th>Function</th>
<th>FDR</th>
<th>Coverage</th>
</tr>
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<tbody>
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[Diagram of gene network with nodes and edges connecting genes like BRCA1, PALB2, and others.]
GeneMANIA: Overview

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GeneMANIA: Overview

“How are these genes related in the context of these networks?”

List of gene names
List of network names

Provided by user

Gene function annotation (e.g. GO)

Functional association data (i.e. edges)

Functionally annotated network of extended list of genes
GeneMANIA: Overview

List of gene names
~150k across 7 organisms

List of network names
~1400

Gene function annotation (e.g. GO)

Functional association data (i.e. edges)
~290M

GeneMANIA

Functionally annotated network of extended list of genes

Provided by user

20+ GB data set
GeneMANIA: Challenges

• Accuracy
• Speed
  – Real-time predictions
• Scalability
  – We add new data regularly
• Portability
  – We support multiple environments with very different user interaction models
GeneMANIA: 1st Attempt

Does not scale!
GeneMANIA: 2nd Attempt

Model

View

Controller

Domain Model

cglib-based Mapper

MANIA Engine

MANIA Model

Serialized Objects

(Graph model, domain model mappings)

Lucene

Lucene

Lucene

Lucene
GeneMANIA: Web Site

- **Web Browser**
  - Cytoscape Web

- **Tomcat**
  - Web Back-end

- **MANIA Engine**
  - MANIA Model
  - Job Queue
  - ActiveMQ
  - Serialized Objects
    - (Graph model, domain model mappings)

- **Domain Model**
  - cglib-based Mapper

- **Lucene**
  - Lucene
  - Lucene
  - Lucene
GeneMANIA: Cytoscape

- Cy2 Plugin
- Cy2 App
- Cy3 Plugin
- Cy3 App
- Swing UI
- Command Line UI
- MANIA Engine
  - MANIA Model
    - Domain Model
    - cglib-based Mapper
      - Lucene
      - Lucene
      - Lucene
      - Lucene
- Serialized Objects (Graph model, domain model mappings)
Cytoscape: Introduction

• Extensible network analysis and visualization platform
• Desktop application
• Java
• Open source
  – LGPL
  – http://cytoscape.org
Cytoscape: Introduction

• Funded by:
  – NIGMS Division of Biomedical Technology, Bioinformatics, and Computational Biology (BBCB), National Resource for Network Biology (NRNB) under award numbers P41 RR031228 and GM103504
  – U.S. National Institute of General Medical Sciences (NIGMS) of the National Institutes of Health (NIH) under award number GM070743
Cytoscape: Introduction

- Annette Adler
- Nada Amin
- Mark Anderson
- Iliana Avila-Campillo
- Gary Bader
- Hamid Bolouri
- Ethan Cerami
- Rowan Christmas
- Melissa Cline
- Mike Creech
- Yue Dong
- Paul Edlefsen
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- Roza Ghamari
- Oriol Guitart
- Tim Hull
- Trey Ideker
- Liz Kain
- Larissa Kamenkovich
- Ryan Kelley
- Sarah Killcoyne
- Michael Kirby
- Brad Kohlenberg
- Allan Kuchinsky
- Nerius Landys
- Willem Ligtenberg
- Christian Lopes
- Samad Lotia
- Andrew Markiel
- James McIninch
- Jason Montojo
- Scooter Morris
- Keiichiro Ono
- Owen Ozier
- Alexander Pico
- David Reiss
- Chris Sander
- Paul Shannon
- Robert Sheridan
- Benno Shwikowski
- Mike Smoot
- James Taylor
- Aditya Vailaya
- Jonathan Wang
- Peng-Liang Wang
- Chris Workman

Cytoscape: 2.X “Architecture”
Cytoscape: Challenges

- Cytoscape API
- Dependencies (e.g. JDOM, Lucene)
- 140+ third-party plugins
- Large user community
Cytoscape: Challenges

- Evolving Cytoscape API
- Dependencies (e.g. JDOM, Lucene)
- 140+ third-party plugins
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Cytoscape: Challenges

- Evolving Cytoscape API
- Conflicting dependencies (e.g. JDOM, Lucene)
- 140+ third-party plugins
- Large user community
Cytoscape: Challenges

- Evolving Cytoscape API
- Many broken third-party plugins
- Large unhappy user community
- Conflicting dependencies (e.g. JDOM, Lucene)
Cytoscape: Solutions

• Evolving API
  – Semantic versioning

3.0.0. beta2

major  minor  micro  qualifier

API breakage  API addition  Non-API change
Cytoscape: Solutions

• Conflicting dependencies

Plugin A  \(\rightarrow\)  Plugin B

Lucene 2.9  \(\rightarrow\)  Lucene 2.9

Common Classloader
Cytoscape: Solutions

• Conflicting dependencies
Cytoscape: Solutions

• Conflicting dependencies
  – OSGi: dynamic module framework
Cytoscape: Solutions

• Conflicting dependencies
  – OSGi: dynamic module framework

A’s API
A’s Impl.
Lucene 2.9

Plugin B

Lucene 3.0
Bundle B Classloader
Cytoscape: 3.0 Architecture

- I/O
- Application
- Layout
- Work
- Session
- Presentation
- Property
- VizMap
- View Model
- Data Model
- Event

Diagram showing the relationships between the various components of the Cytoscape 3.0 architecture.