The Network Data Exchange in 2017

Trey Ideker, Dexter Pratt, UCSD

aka the “Cytoscape Cloud”

NDEx is a public commons, where users store, share, and publish their networks.

Scientists can search for networks and access them from the NDEx site or with their own scripts and applications.

NDEx networks have stable, unique identifiers and URIs, enabling reference from publications.
NDEx Project Goals

- Networks in Next-Generation Cancer Genome Analysis
- Hallmark Cancer Pathways via Social Organization and Automation
- Analysis
- Community
- Publishing
- Scale

- Publishing of Interactive Networks on Journal Websites
- Scaling the NDEx Framework to Support a Growing Community of Users and Tools.
Updated Daily by the RAS Machine agent
Owned by the Sorger Lab

Unpublished work by Ben Gyori, John Bachman, Peter Sorger and others in the Sorger Lab at HMS
### Access by Users and Applications

**Access by Users and Applications**

**Owned by the Sorger Lab**

**Updated Daily by the RAS Machine agent**

---

**The RAS Machine**

**Nodes:** 820  **Edges:** 2688

**PUBLIC**  **Read Only**

**Created:** May 5, 2016 8:55:04 PM  
**Last Modified:** Jun 1, 2017 7:14:50 AM  
**UUID:** 50e3dff7-133e-11e6-a039-06603eb7f303  
**Format:** Unknown

**Description:**
The RAS Machine reads new literature on RAS daily, and extracts and assembles mechanisms into a computational model using INDRA.

**Version:** 3.184

**Properties:**

<table>
<thead>
<tr>
<th>Source</th>
<th>Interaction</th>
<th>Target</th>
<th>Citations</th>
<th>INDRA</th>
</tr>
</thead>
<tbody>
<tr>
<td>CREBBP</td>
<td>Acetylation</td>
<td>TP53</td>
<td>2</td>
<td>Acety/</td>
</tr>
<tr>
<td>EP300</td>
<td>Acetylation</td>
<td>TP53</td>
<td>1</td>
<td>Acety/</td>
</tr>
<tr>
<td>KAT5</td>
<td>Acetylation</td>
<td>TP53</td>
<td>1</td>
<td>Acety/</td>
</tr>
<tr>
<td>KSR1</td>
<td>Acetylation</td>
<td>TP53</td>
<td>1</td>
<td>Acety/</td>
</tr>
<tr>
<td>AGT</td>
<td>Activation</td>
<td>AKT</td>
<td>1</td>
<td>Activat</td>
</tr>
<tr>
<td>AKT1</td>
<td>Activation</td>
<td>CREB1</td>
<td>1</td>
<td>Activat</td>
</tr>
<tr>
<td>AKT2</td>
<td>Activation</td>
<td>EZR</td>
<td>1</td>
<td>Activat</td>
</tr>
<tr>
<td>AKT</td>
<td>Activation</td>
<td>BRAF</td>
<td>1</td>
<td>Activat</td>
</tr>
<tr>
<td>AKT</td>
<td>Activation</td>
<td>BCL2</td>
<td>3</td>
<td>Activat</td>
</tr>
<tr>
<td>AKT</td>
<td>Activation</td>
<td>CNS</td>
<td>2</td>
<td>Activat</td>
</tr>
</tbody>
</table>

Total Items: 500
The RAS Machine

Nodes: 819   Edges: 2685
PUBLIC   Read Only

Created: May 5, 2016 8:55:04 PM
Last Modified: May 31, 2017 7:10:55 AM
UUID: 50e3dff7-133e-11e6-a039-06603eb7f303
Format: Unknown
Your Privileges: None

Description:
The RAS Machine reads new literature on RAS daily, and extracts and assembles mechanisms into a computational model using INDRA.

Version: 3.183

Properties:
Search

Search Examples

- Mentioning any term in a list: "TP53 MDM2 RB1 CDK4"
- With "AND" for co-occurrence: "TP53 AND BARD1"
- By wildcard and property: "name:mel**"
- By numeric property range: "nodeCount:[11 TO 79]"
- By UUID: "uuid:c53894ce-8e47-11e5-b435-06603eb7f303"
- Created between 1.1.16 and 4.27.16: "creationTime:[2016-01-01T00:00:01Z TO 2016-04-27T23:59:59Z]"

Documentation on Searching in NDEx
<table>
<thead>
<tr>
<th>Network Name</th>
<th>Format</th>
<th>Ref.</th>
<th>Disease</th>
<th>Tissue</th>
<th>Nodes</th>
<th>Edges</th>
<th>Visibility</th>
<th>Owner</th>
<th>Last Modified</th>
</tr>
</thead>
<tbody>
<tr>
<td>The RAS Machine</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>820</td>
<td>2688</td>
<td>PUBLIC</td>
<td>rasmachine</td>
<td>6/1/17 7:14 AM</td>
</tr>
<tr>
<td>The Diabetes Machine</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>396</td>
<td>668</td>
<td>PUBLIC</td>
<td>rasmachine</td>
<td>5/31/17 8:05 AM</td>
</tr>
<tr>
<td>indra_assembled</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>134</td>
<td>180</td>
<td>PUBLIC</td>
<td>bgyori</td>
<td>4/8/16 7:36 PM</td>
</tr>
<tr>
<td>rasmachine</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>232</td>
<td>292</td>
<td>PUBLIC</td>
<td>bgyori</td>
<td>4/11/16 2:21 PM</td>
</tr>
<tr>
<td>Ras signaling in the CD4 TCR pathway</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>14</td>
<td>24</td>
<td>PUBLIC</td>
<td>nci-pid</td>
<td>12/20/16 4:59 PM</td>
</tr>
<tr>
<td>tcell-net-model-viz.txt</td>
<td>XGMML</td>
<td></td>
<td></td>
<td></td>
<td>123</td>
<td>191</td>
<td>PUBLIC</td>
<td>gaten</td>
<td>12/16/16 5:08 AM</td>
</tr>
<tr>
<td>insulin_secretion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>104</td>
<td>331</td>
<td>PUBLIC</td>
<td>bgyori</td>
<td>4/28/16 2:16 PM</td>
</tr>
<tr>
<td>The Heart Machine</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>647</td>
<td>1365</td>
<td>PUBLIC</td>
<td>rasmachine</td>
<td>5/31/17 9:05 AM</td>
</tr>
<tr>
<td>EGF receptor (ErbB1) signaling pathway</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>38</td>
<td>172</td>
<td>PUBLIC</td>
<td>nci-pid</td>
<td>4/6/17 12:22 PM</td>
</tr>
<tr>
<td>RAS_227</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>164</td>
<td>916</td>
<td>PUBLIC</td>
<td>bgyori</td>
<td>5/5/16 1:29 PM</td>
</tr>
<tr>
<td>Regulation of Ras family activation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>35</td>
<td>74</td>
<td>PUBLIC</td>
<td>nci-pid</td>
<td>12/20/16 4:59 PM</td>
</tr>
<tr>
<td>nci_pid_preview</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>212</td>
<td>492</td>
<td>PUBLIC</td>
<td>aarongary</td>
<td>4/7/17 3:12 PM</td>
</tr>
<tr>
<td>!!! NEW !!! PID MAP !!! NEW !!!</td>
<td></td>
<td></td>
<td>Cancer</td>
<td></td>
<td>212</td>
<td>492</td>
<td>PUBLIC</td>
<td>nci-pid</td>
<td>4/10/17 2:17 PM</td>
</tr>
<tr>
<td>net_of_nets_uuids.txt</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>214</td>
<td>21722</td>
<td>PUBLIC</td>
<td>decarlin</td>
<td>4/27/16 4:12 PM</td>
</tr>
<tr>
<td>BindingDB - High Affinity Compounds vs mouse targets (Commercially available)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>105</td>
<td>134</td>
<td>PUBLIC</td>
<td>bindingdb</td>
<td>5/5/16 2:04 PM</td>
</tr>
</tbody>
</table>
Hallmark Pathway\(^2\) Hypothesis

Social pathways to enable molecular pathways

**Hallmark Pathway\(^2\)**

- **REACH**
- **INDRA**
  - “RAS Machine” Technology

**Process**

- **Select by Pathway**
- **Recent Literature**
- **New Findings**

**Integrate & Compare**

- **Reference Pathways**

**Expanded Model**

- **Experts Review, Correct and Revise**
- **Published Model**
Review and Publish

Anonymous Pre-Publication Access via a Shareable URL

Review

Reference from Article

Collect in Network Set

Make Public

Visualization

CytoScape

Python

R
ndexr : Access from R

• Successful Outreach and Collaboration with Bioconductor
• Special thanks to Frank Kramer\(^1\), Florian Auer\(^1\), Aleksandar Ishkin\(^2\)

---

\(^1\)Department of Medical Statistics, University Medical Center Göttingen, Humboldtallee 32, 37099 Göttingen, Germany.
\(^2\)Discovery Science, Clarivate Analytics, 22 Thomson Pl, Boston, MA 02210, US
Cytoscape and NDEx communicate via the novel CX exchange format. Seamless integration with Cytoscape core in Summer 2017.

CyNDEex allows users to seamlessly transfer networks between NDEx and Cytoscape, and, in certain cases, even perform network updates in NDEx.
Hierarchical Organization of a Large Network


Nodes in the hierarchy link to the corresponding pathway network in NDEx

Supporting Pathway Aligned to Hierarchy
Term Aligned with a GO Term
Scaling with Network Sets

Network Sets are named, collections: destinations with unique IDs and URLs.

Network Sets can be published resources, such as collections reviewed by an organization.

The Network Set contains 101 public networks.

Sets provide user-driven structure as NDEx grows to very large numbers of networks.

Thanks to Brin Rosenthal for sharing excerpts from work in progress.
Patient Similarity Networks

Very Large: Genome-Scale Patient Data

Large: Patient Similarity Network

Small: Patients Most Similar to Patient X

NDEx 2.0 Server Handles Networks that Span a Broad Range of Sizes

Thanks to Dan Carlin and Justin Huang for sharing excerpts from work in progress.
And thanks to collaborators at the Karchin and Sorger Labs
Integration with Analysis Tools (rachel)

• Python client
• R Client
• Outreach at hackathons
  – Use-case driven feedback and prototyping
• NDEx access built into next Cytoscape release
The RAS Machine

Nodes: 819  Edges: 2685
PUBLIC  Read Only

Created: May 5, 2016 8:55:04 PM
Last Modified: May 31, 2017 7:10:55 AM
UUID: 50e3df7-133e-11e6-a039-06603eb7f303
Format: Unknown
Your Privileges: None

Description:
The RAS Machine reads new literature on RAS daily, and extracts and assembles mechanisms into a computational model using INDRA.

Version: 3.183

Properties:
Architecture for Reproducing the FanGO Analysis for Any Disease

Pratt et al. “NDEx, the Network Data Exchange”. *Cell Systems*. (2016)

**Local machine:**
Python package

**NDEx:**
Upload data and call REST API (or run your own server instance)
FanGO: Fanconi Anemia Hierarchy

Hierarchical Pathway Models Managed in NDEx

20 known FA genes

Data-derived gene similarity network

Thanks to Mike Yu for sharing excerpts from work in progress.
Automation

Python Utilities:

Apply Style Templates Created in Cytoscape

Apply a Layout to All Networks in a Set

Next:

Automated Update from Tabular Data Sources and Literature Mining