



GARUDA
THE WAY BIOLOGY CONNECTS

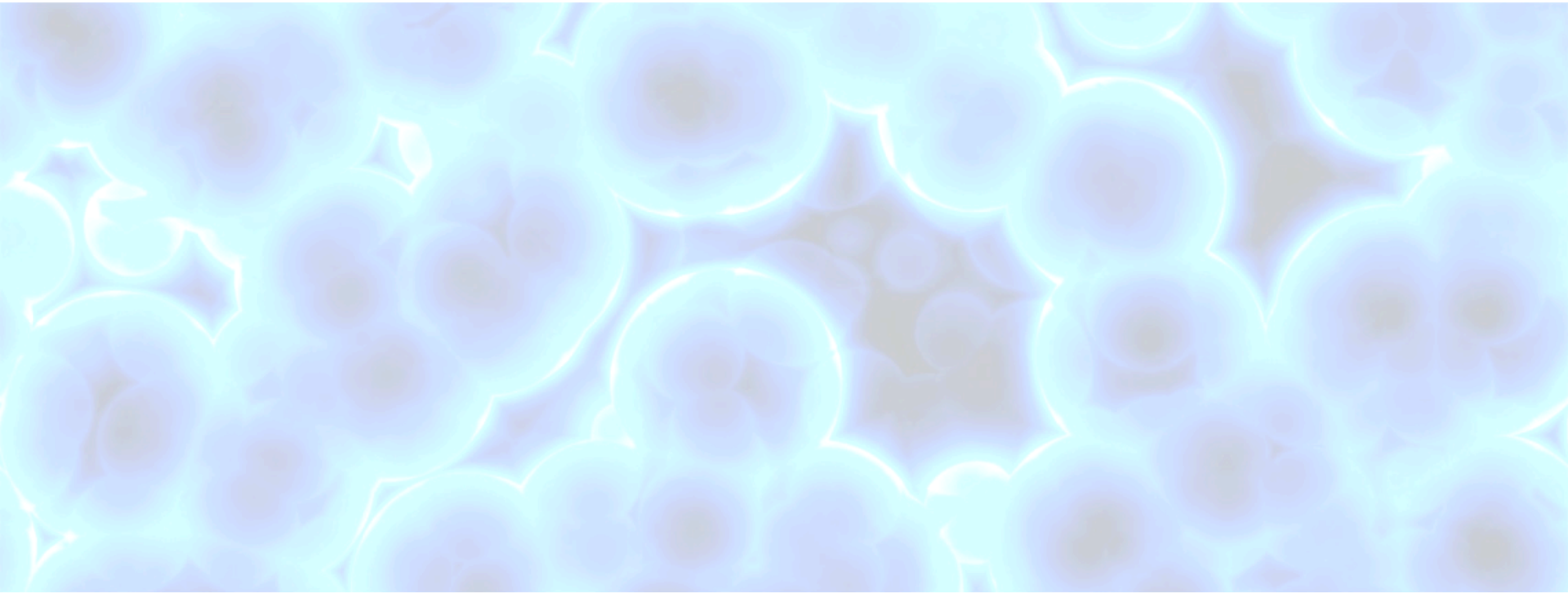
Garuda Platform

*Re-imagining connectivity
in biology and beyond*

For BioNetVisa Workshop at ICSB 2015

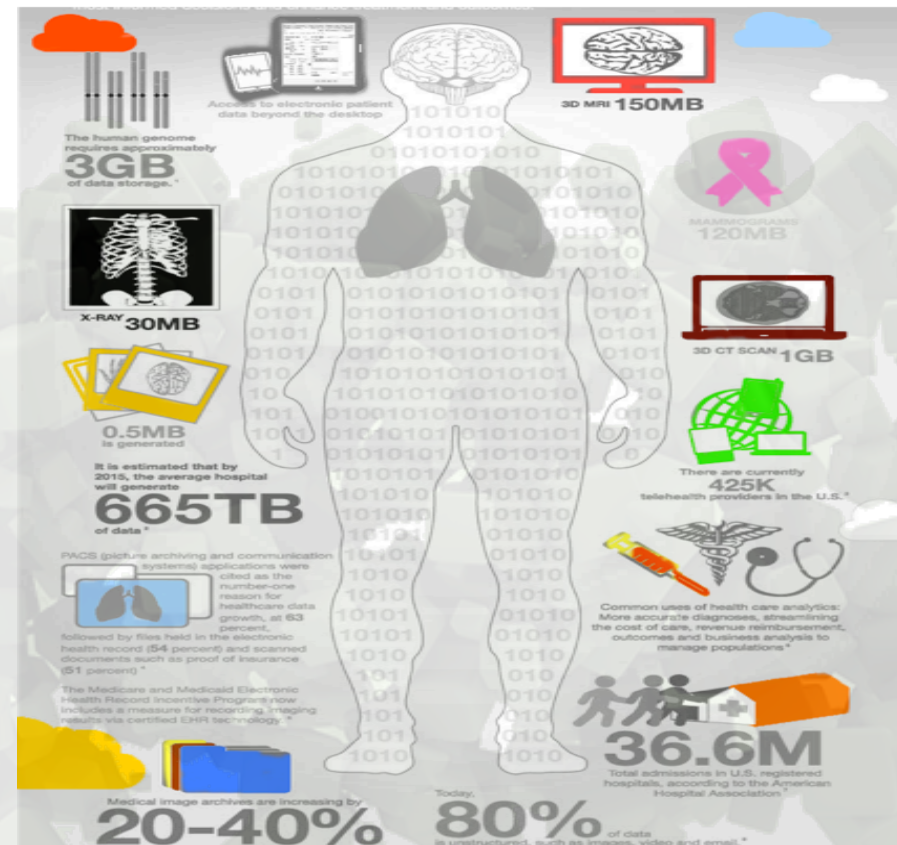
Yukiko Matsuoka
The Systems Biology Institute, Tokyo

BioMedicine & Healthcare now face ...



High Dimension DATA

VOLUME, VELOCITY, VARIETY
from Multiple Sources



Adapted from image at <http://www.dr4ward.com/dr4ward/2013/04/what-is-the-power-of-the-big-data-in-healthcare-infographic.html>

Diversity



High Dimension Analytics

Diverse set of analytic Tools, Techniques

Diversity in Data & Analytics

HD Data

High Dimension
big data from
multiple sources

HD Analytics

Diverse set of
analytics tools
and techniques



Challenges

Discoverability

how to *discover*
new analytics

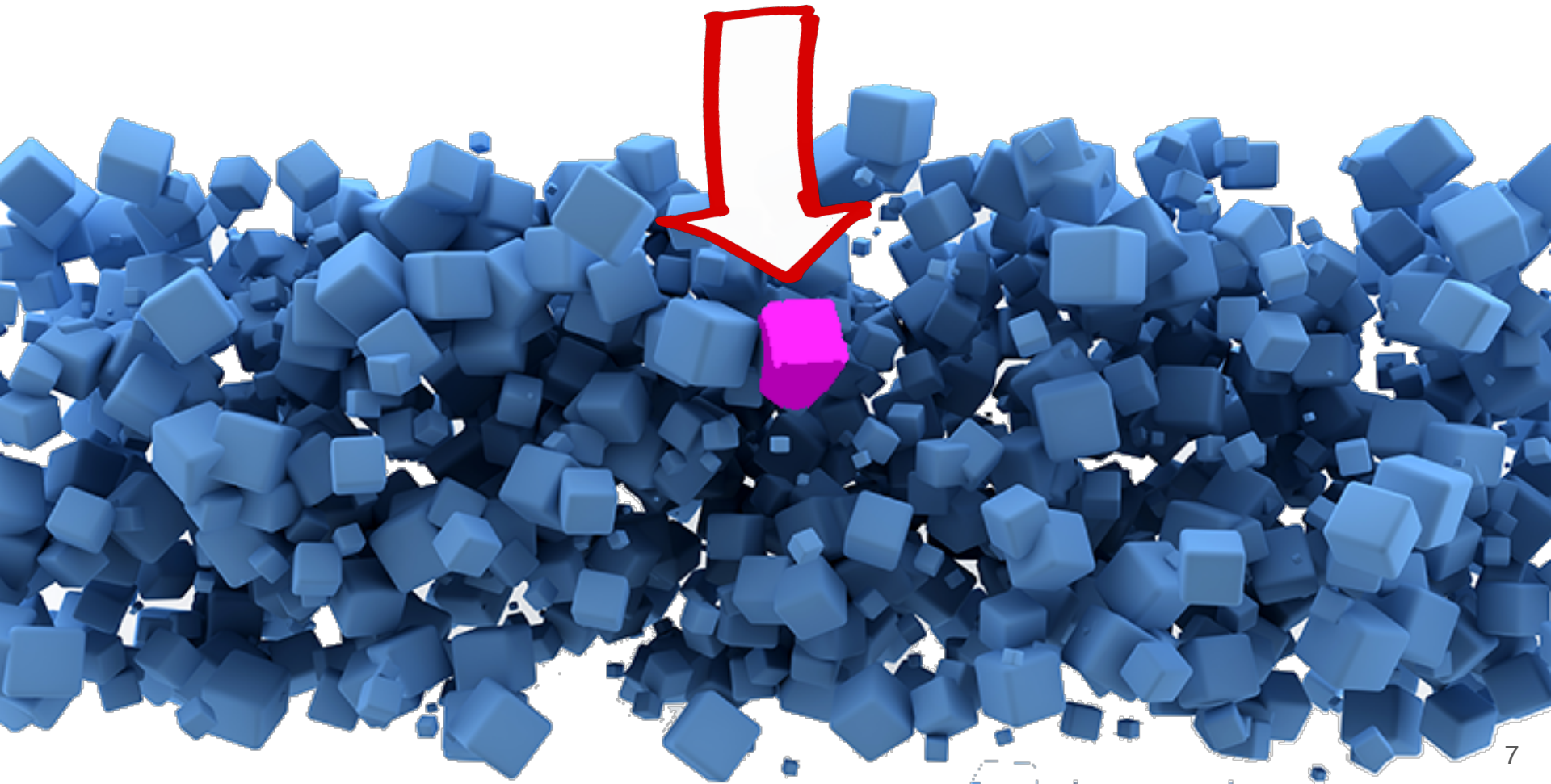
Navigability

how to *connect and*
inter-operate
different analytics

Challenges

Discoverability

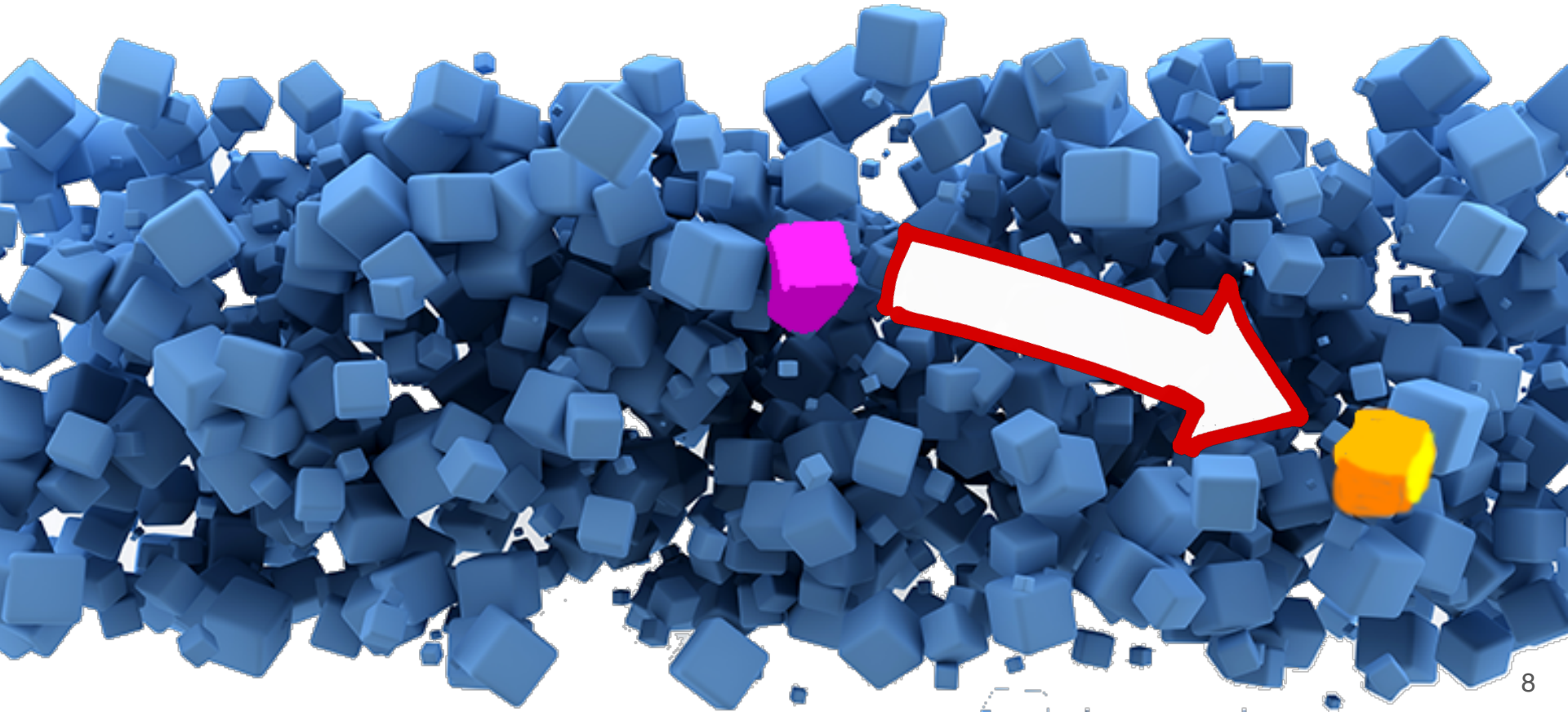
how to **discover** new analytics?



Challenges

Navigability

How to connect and inter-operate different analytics?



Platform Needs

Need a platform for bio-medical research which is

- Open - Interface with multiple analytics tools
- Discoverable - One stop access
- Navigable - Reduce friction in using multiple tools



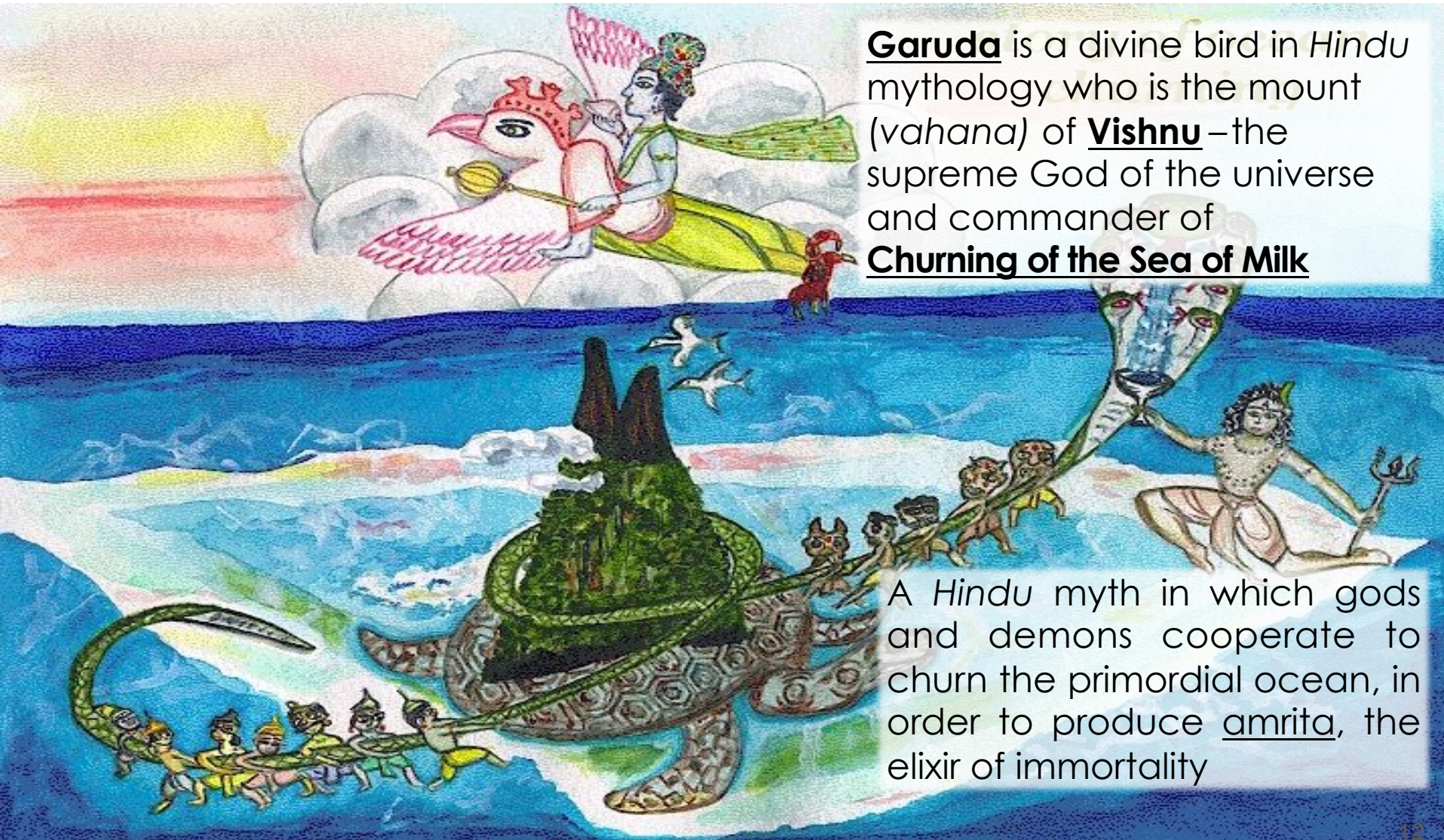
Software for systems biology: from tools to integrated platforms

Samik Ghosh¹, Yukiko Matsuoka^{1,2}, Yoshiyuki Asai³, Kun-Yi Hsin³ & Hiroaki

Kitano^{1,3,4} [About the authors](#) 2011

What is Garuda?

The Myth...Vehicle for collaboration in drug production



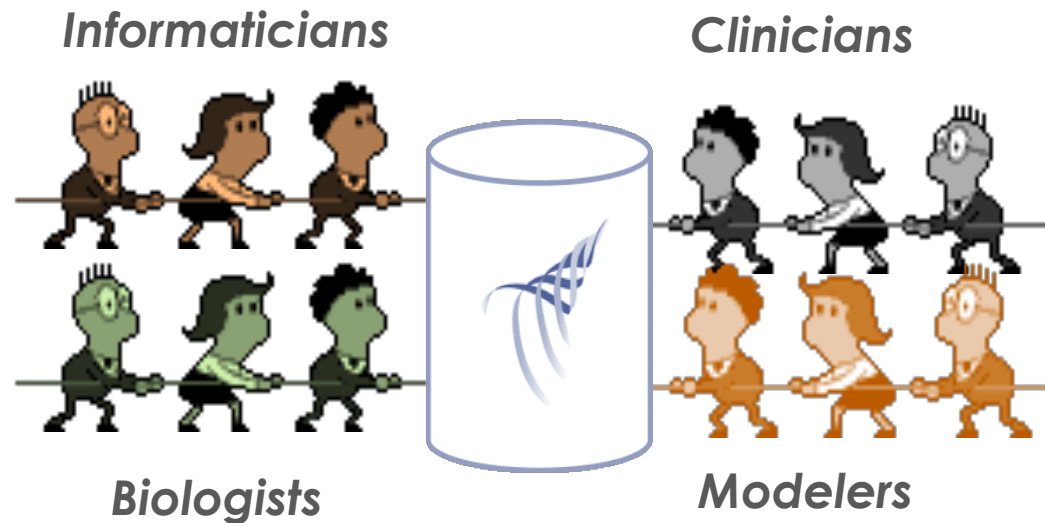
Garuda is a divine bird in *Hindu* mythology who is the mount (*vahana*) of **Vishnu** – the supreme God of the universe and commander of **Churning of the Sea of Milk**

A *Hindu* myth in which gods and demons cooperate to churn the primordial ocean, in order to produce amrita, the elixir of immortality

What is Garuda?

The Platform....

Garuda is an **open, community-driven, common platform** that provides a framework to **connect, discover, & navigate** through different applications, databases and services in bio-medical research

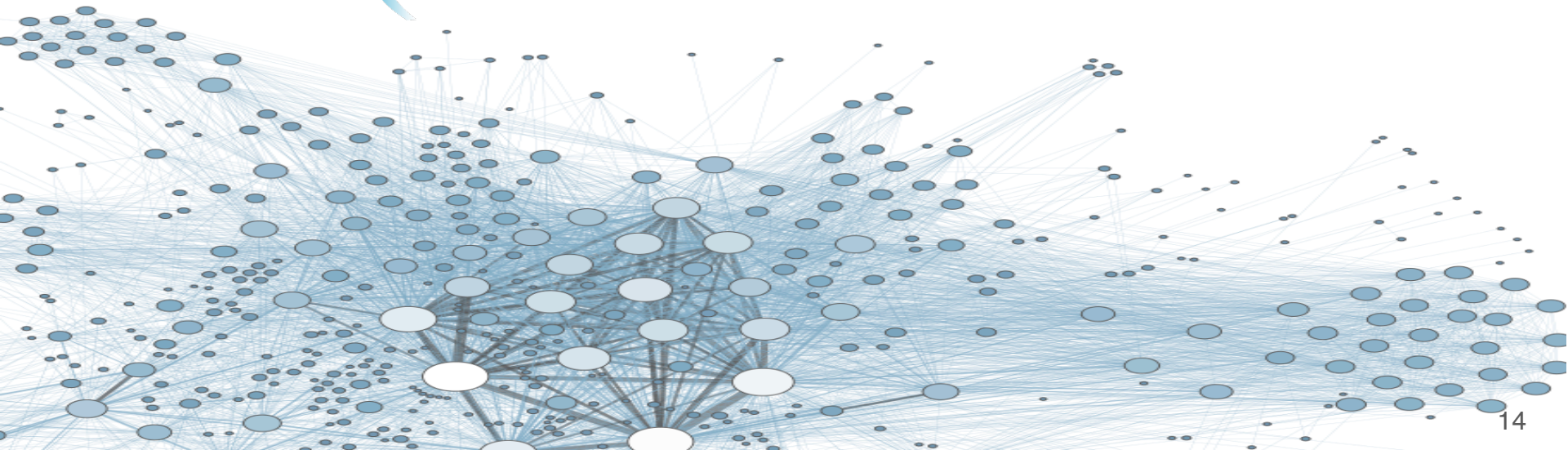


Garuda Platform

Garuda is a connectivity platform to **connect**, **discover** and **navigate** through inter-operable digital solutions with applications in healthcare and beyond



GARUDA



What is Garuda?



Garuda Dashboard

Provides the single window desktop interface to access and navigate gadgets

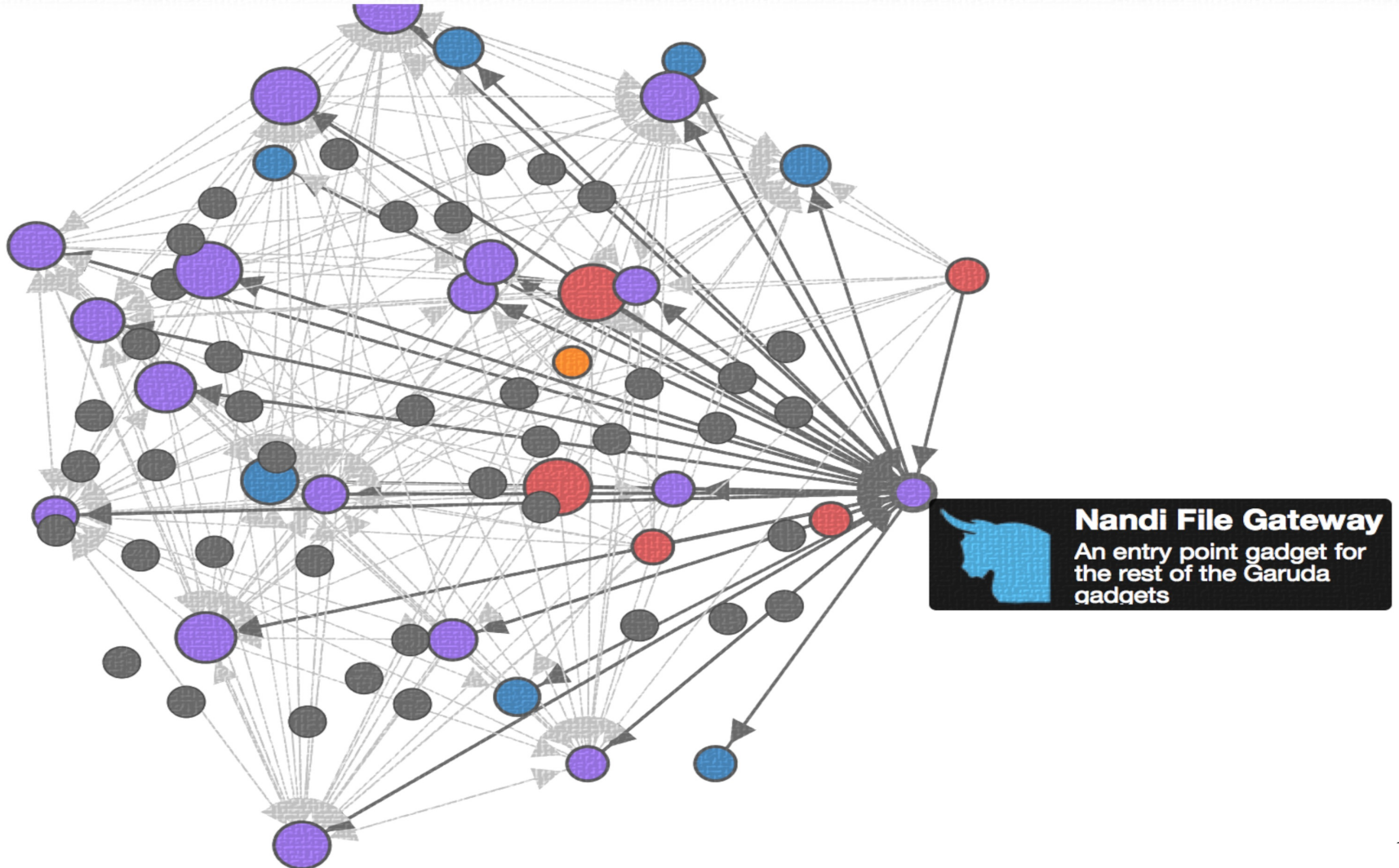
The screenshot displays the Garuda Dashboard interface, which is a single window desktop environment. The interface is divided into several sections:

- Category List (Left):** A vertical list of categories including: All (33), A Starter Kit, Analytics, Annotation, CellDesigner Plugin, Database, Feedback, Gateway, Help, Installer, Modeling, Pathways, Simulation, Viewer, and Visualization.
- Search Bar (Top):** A search bar with the text "Search for a gadget" and a magnifying glass icon.
- Gadget Grid (Center):** A grid of 30 gadget icons, each with a unique icon and label. Labels include: Getting Started, About GARUDA, NETWORK CONTROL, Cytoscape Installer, Gadgets Social, GARUDA Feedback, Gadgets Trace, GARUDA Wishlist, Get Gadgets, Genes, DB, PANTHER, TimeXNet, XM, iPAVS, iP₂, and iP₊.
- Gadget Details (Right):** A panel showing details for a selected gadget. It includes:
 - Name:** Gateway
 - Category:** Gateway
 - Provider:** SBI, Tokyo
 - Description:** Your window to the Garuda gadgets universe online. Request an account and explore gadgets to download on your dashboard.
- Preview (Bottom Right):** A small thumbnail image showing a preview of the gadget's interface.

The GARUDA logo is visible in the bottom left corner, with the tagline "THE WAY BIOLOGY CONNECTS".

Gadget Social

Connected network of gadgets

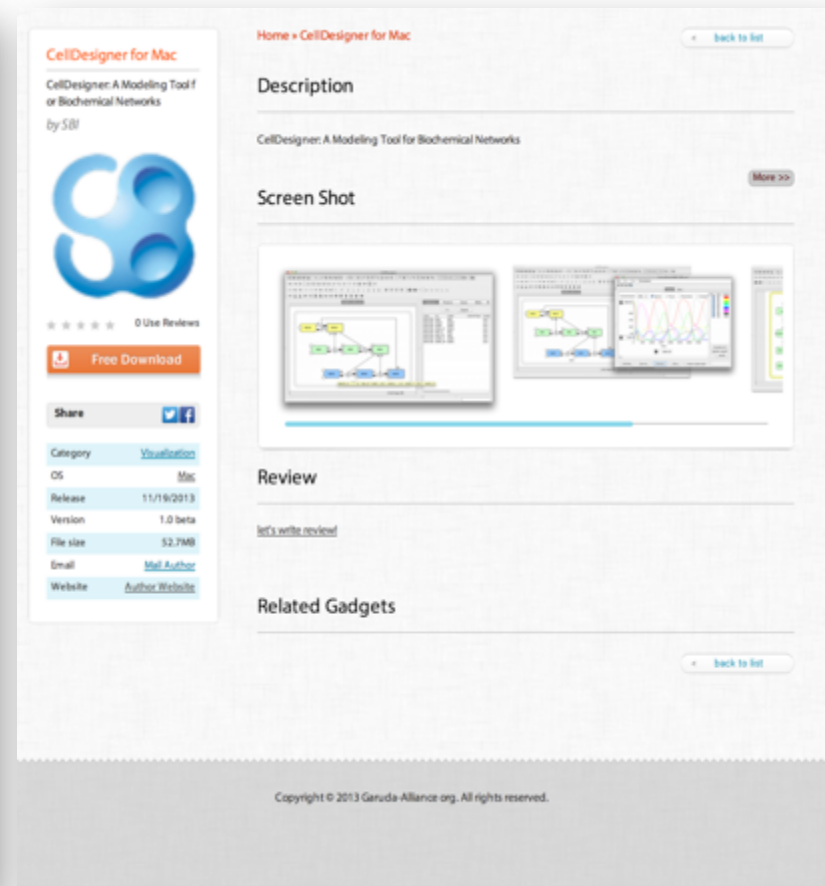


Garuda Gateway

Web-based interface to access and discover gadgets



The screenshot shows the Garuda Gateway homepage. At the top, there is a navigation bar with the logo, the text "GARUDA GATEWAY", and links for "ACCOUNT" and "LOG OUT". Below the navigation bar, there are links for "About Garuda Gateway", "Gadgets", and "Dashboard". A search bar and a "Download Dashboard" button are also present. The main content area features a large banner for "CellDesigner™ for Windows" with a description: "CellDesigner is a structured diagram editor for drawing gene-regulatory and biochemical networks." Below the banner, there is a "New Gadgets" section with a "View All" link. This section displays several gadget cards, each with a title, author, version, update date, and a "Free Download" button. The gadgets include "PhysioDesigner in staller for Mac", "Flint for Mac", "Ortho Survey for Mac", "CellDesigner for Mac", and "Gadget Social for Mac". A sidebar on the left contains a "New Gadgets" button, a "Popular Gadgets" button, and a "Category" list with options like "Visualization", "Data Analysis", "Network Analysis", and "Pathway Analysis". There is also an "OS" list with options like "Linux", "Mac", "Universal", and "Windows".



The screenshot shows the detailed page for the "CellDesigner for Mac" gadget. The page has a breadcrumb trail: "Home > CellDesigner for Mac" and a "back to list" link. The main heading is "CellDesigner for Mac" with a sub-heading "CellDesigner: A Modeling Tool for Biochemical Networks" and the author "by SBI". A large blue logo for CellDesigner is displayed. Below the logo, there is a "0 Use Reviews" section and a prominent "Free Download" button. A "Share" section includes social media icons for Twitter and Facebook. The "Category" is "Visualization" and the "OS" is "Mac". Other details include "Release" (11/19/2013), "Version" (1.0 beta), "File size" (52.7MB), "Email" (Mail Author), and "Website" (Author Website). A "Description" section follows, with a "More >>" link. Below the description is a "Screen Shot" section with a "More >>" link and a gallery of screenshots showing the software interface. A "Review" section is present with a "let's write review" link. At the bottom, there is a "Related Gadgets" section with a "back to list" link. The footer contains the text "Copyright © 2013 Garuda-Alliance.org. All rights reserved."

<http://gateway.garuda-alliance.org>

Garuda Collaborators & Clients



Garuda Platform

Horizontal Integration: from genome to lifestyle data

Vertical Integration: from cell to human data

End-to-end analytics and fast feedback

Open Innovation for Knowledge and Data Sharing

NGx,
Single cell data,
Metabolome,
and other data

Bioinformatics &
Systems Biology
Analysis



GARUDA
THE WAY BIOLOGY CONNECTS

Clinical Database
(TranSMART, etc)

Behavioral
monitoring,
Continuous vital
monitor, and IoT
& Cyberphysical
link

Garuda Basics: Flow on the go

GarudaDashboard

Tue 12:29 PM Ghosh Samik

The screenshot shows the Garuda Dashboard application window. The window title is "Garuda Dashboard". On the left, there is a "Category" sidebar with a list of categories: All (22), A Starter Kit, Analytics, Annotation, CellDesigner Plugin, Database, Feedback, Gateway, Help, Installer, Modeling, Pathways, Simulation, Views, and Visualization. The main area contains a search bar "Search for a gadget" and a grid of 22 gadget icons. The "Bioconductor Analytics" gadget is highlighted. On the right, there is a "Gadget Details" panel for the selected gadget. The details include: Name: A Getting Started; Category: A Starter Kit; Provider: SBI, Tokyo; Description: A starting point on using Garuda, with tips, how to use sample gadgets alone or in combinations Explore!; and a Preview section showing a small thumbnail of the gadget's interface.

Garuda Basics : Garuda Gateway

GarudaDashboard

The Garuda Dashboard interface is shown in a window titled "Garuda Dashboard". It features a search bar at the top with the text "Search for a gadget". Below the search bar is a "Category" list on the left, including "All (8)", "A Starter Kit", "Analytics", "Database", "Feedback", "Gateway", and "Help". The main area displays several gadget icons: "Getting Started", "About GARUDA", "Gadgets Social", "GARUDA Feedback", "GARUDA TRACE", "GARUDA Wishlist", and "Get Gadgets". On the right, the "Gadget Details" panel shows information for the "Getting Started" gadget, including its name, category, provider (SBI, Tokyo), and a description: "A starting point on using Garuda, with tips, how to use sample gadgets alone or in combinations Explore!". A "Preview" section at the bottom right shows a small image of the Garuda Gateway interface with the text "Experience Garuda!".

The Garuda Gateway website homepage is displayed in a browser window. The URL is "www.garuda-alliance.org". The page features the Garuda logo and tagline "THE WAY BIOLOGY CONNECTS". A navigation menu includes "Home", "Overview", "Garuda Alliance Members", "Garuda Resources", "User Stories", "News/Topics", "Events", and "Developer Center". A prominent banner for "GARUDA GATEWAY beta" states: "The Garuda Gateway serves as the window to the Garuda Universe. It provides access to the various gadgets available on Garuda." Below the banner, there are sections for "User Stories" and "Members Center". The "User Stories" section includes a story titled "Science in Style" dated 29 April, 2014, and another titled "How do I get started?" dated 29 April, 2014. The "Members Center" section mentions that the Garuda Alliance Member Center is the community site for members and that the Garuda Developer Centre will be announced shortly. On the right side, there are sections for "News/Topics" (including "Garuda is open for invited beta" and "Introducing Garuda"), "Events" (listing various workshops), and "Resources" (including "Garuda FAQs"). A "Membership (Coming soon)" button is also visible. The footer includes logos for SBI, FLIN, and RIKEN.

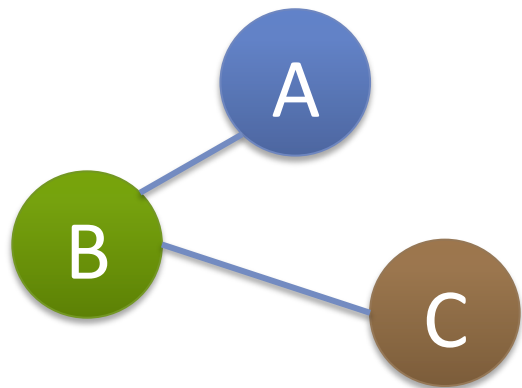
Welcome to Garuda Lite!

Garuda Data to Pathways

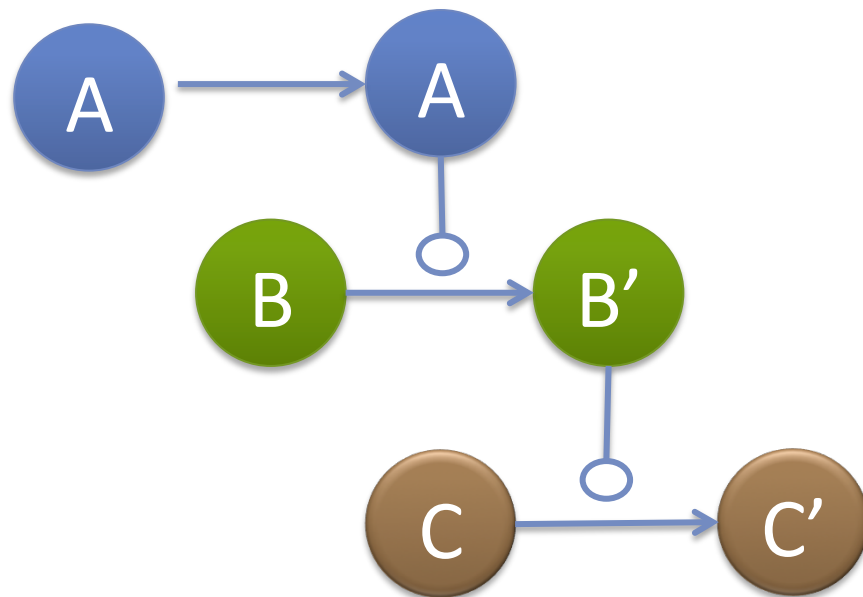
Correlation to Mechanism

ID + Data

Data-driven



Knowledge-guided



Garuda Dashboard



- News
- Pathway modeling
- Pathways**
- Prescription
- Qualitative modeling
- Simulation
- Smart Monitoring
- Terminal
- Terminal Database
- Visualization
- 方剂
- 生薬



extracted from literature by experts and depicted on the maps at the level of biochemical interactions. ACSN consists in a growing list of 5 maps covering signalling processes involved in apoptosis, cell cycle, DNA repair, cell survival, EMT and

Preview



1eeaf5a6-97d6-4341-8f43-4e482dca8acc

Garuda Dashboard

Category

- All(67)
- * Tsumura
- A Starter Kit
- Analytics
- Annotation
- CellDesigner Plugin
- Compound
- Converter
- Database
- Disease
- Experimental
- Expression Analysis
- Feedback
- Gateway
- Help
- Herb
- Installer
- KEGG
- Modeling**
- Network
- News
- Pathway modeling
- Pathways
- Prescription
- Qualitative modeling
- Simulation
- Smart Monitoring
- Terminal
- Terminal Database
- Visualization
- 方剂
- 生薬

Details

Designer
ory
ation
lization
ling


Provider

(c) 2002–2014 The Systems Biology Institute. All rights reserved.

Description

CellDesigner: A Modeling Tool for Biochemical Networks

Preview



GARUDA
THE WAY BIOLOGY CONNECTS

b1e6122d-e523-4bac-a420-c20ac569b959

Garuda Data to Pathways

QuickTime Player ファイル 編集 表示 ウィンドウ ヘルプ

Garuda Dashboard

Category

- All(64)
- * Tsumura
- A Starter Kit
- Analytics
- Annotation
- CellDesigner Plugin
- Converter
- Database
- Experimental
- Expression Analysis
- Feedback
- Gateway
- Help
- Installer
- KEGG
- Modeling
- Network
- News
- Pathway modeling
- Pathways
- Qualitative modeling
- Simulation
- Smart Monitoring
- Terminal
- Terminal Database
- Visualization

Search for a gadget

Gadget Details

Name
A Getting Started

Category
Help
A Starter Kit

Provider

Getting Started About GARUDA Files Gadgets Gadgets Social Gadgets Trace Get Gadgets 漢方 Network

NANDI
FILE GATEWAY

What do you want to do?

Show All gadgets

Load Your Data Load Sample Files File Content

Clear Export File List Show File Contents ensemble

EGFR.xml
EnsembleGenelist.csv
EnsembleGenelist.txt
GeneSymbols.txt
KEGGList.txt
M-Phase.xml
PhysiologyModel_HodgkinHuxley_1952_neuron_model.phtml
SimulationModel.xml

Discover

Garuda Discovery Engine

Send as Stream

Garuda discovered 4 gadgets which can process the selected data file.
Double click to send file to a gadget and launch it.

GARUDA
THE WAY BIOLOGY CONNECTS

GarudaTTsum
R
Samples

水 0:03

Garuda Data to Pathways

QuickTime Player ファイル 編集 表示 ウィンドウ ヘルプ

Category

- All(64)
- * Tsumura
- A Starter Kit
- Analytics
- Annotation
- CellDesigner Plugin
- Converter
- Database
- Experimental
- Expression Analysis
- Feedback
- Gateway
- Help
- Installer
- KEGG
- Modeling
- Network
- News
- Pathway modeling
- Pathways
- Qualitative modeling
- Simulation
- Smart Monitoring
- Terminal
- Terminal Database
- Visualization

Search for a gadget

Getting Started About GARUDA

NANDI FILE GATEWAY

What do you want to do?

Show All gadgets

Load Your Data Load Sample Files File Content

File Contents File List

genes	data
AKT1	0.1233
APC	0.0377
ATM	-0.3994
ATR	0.6962
CBX3	0.6042
CCNA2	0.6446
CCNB1	1.1955
CCNC	0.1716
CCND1	0.7776

navicell

Discover

Garuda Discovery Engine

Send as Stream

Garuda discovered 1 gadgets which can process the selected data file.
Double click to send file to a gadget and launch it.

Experience Garuda!

GARUDA
THE WAY BIOLOGY CONNECTS

Experience Garuda

www.garuda-alliance.org

The image shows a screenshot of the Garuda Alliance website. At the top left is the Garuda logo with the tagline "THE WAY BIOLOGY CONNECTS". A navigation menu includes Home, Overview, Garuda Alliance Members, Garuda Resources, User Stories, News/Topics, Events, and Developer Center. A search bar and a "contact" link are in the top right. A central promotional box, highlighted with a yellow border, features the Garuda logo, the text "Free Garuda is your one-stop solution", and a "Get Garuda" button. Below this are "User Stories" and a "Garuda 1.1 beta public release!" announcement. An orange arrow points from the "Get Garuda" button to a larger, semi-transparent overlay on the right. This overlay contains the text "Connect. Discover. Navigate. Fly to the future of Biology", "What is Garuda Platform?", buttons for "About Garuda" and "Getting Started", and a "Watch Garuda In Action!" section with a "Garuda Videos" button.

Free Garuda is your one-stop solution

- One window for browsing all available applications
- Instant preview of applications relevant to your task
- "Flow-on-the-go" workflow design
- Discover and Navigate Gadgets

Get Garuda

User Stories

Garuda 1.1 beta public release!

Science in Style

Connect. Discover. Navigate.
Fly to the future of Biology

What is Garuda Platform?

About Garuda -and- Getting Started

Watch Garuda In Action!

Garuda Videos

“Garudify” your tools/services

SDK available, BYOL (=Bring Your Own License)

1. Download **SDK**
<http://bit.ly/garudify>
2. Contact **Garuda Helpline**
garudahelpline@gmail.com
3. **Garudify** your Tools/Services with Garuda APIs
4. Submit your “Gadget” to be **certified**
Your Gadget become available on **Garuda Gateway!**

- JAVA
- C++, C#
- Visual Basic
Macros
- Python
- R

Acknowledgement

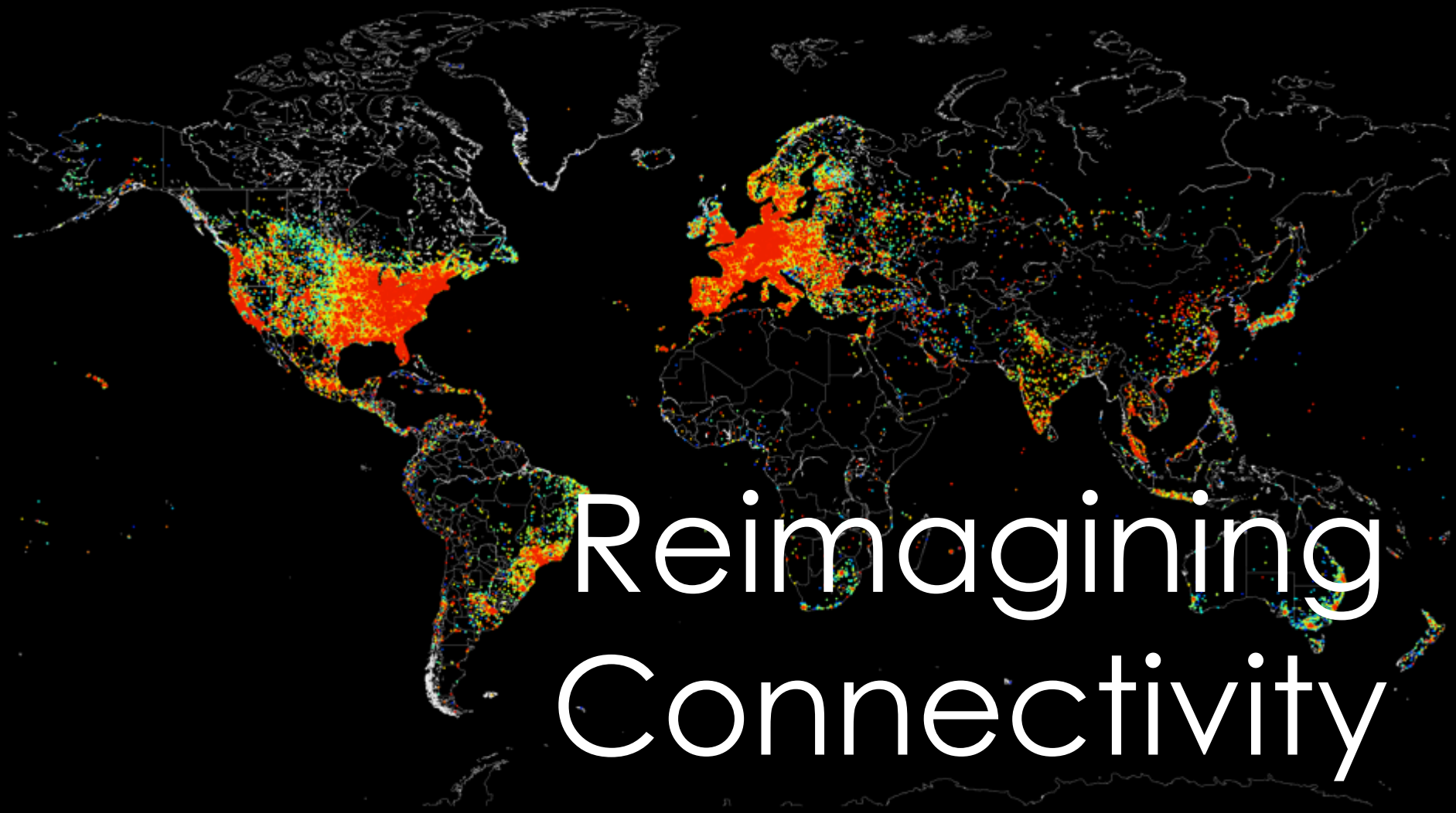
- **Garuda-Alliance Members**

- Panther Pathways (UCSF)
- NaviCell team (Institute Curie)
- Vanted team (Monash etc)
- Reactome Team

- **Systems Biology Institute (SBI)**

- **Samik Ghosh**
- Nikos Tsorman
- SBI engineering team
- Hiroaki Kitano





Reimagining Connectivity

Connect to learn more about
Garuda in Action !