Global Alzheimer's Association Interactive Network
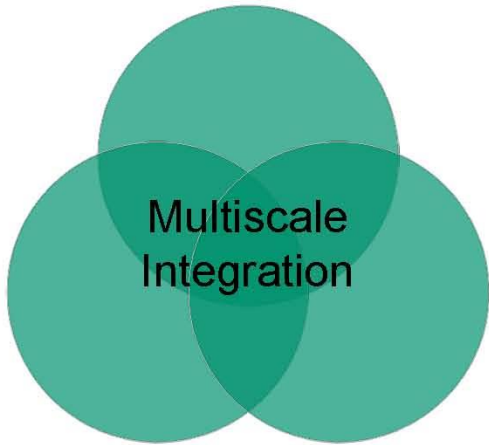

Transforming the way researchers approach the study of Alzheimer's disease

Arthur W. Toga

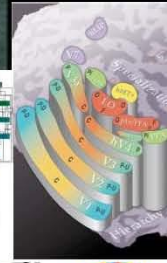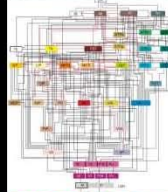July 2014

Databases

Tools

Multiscale
Integration

Models

Cognition

Whole brain

macrocircuits

mesocircuits

microcircuits

synapses

neurons
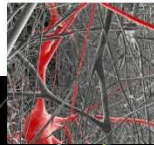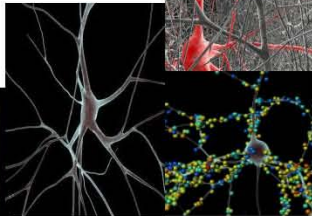
molecules

✓Databases
✓Genomics
✓Post-Genomics...
✓Systems Biology...
✓Integrative Biology...
✓Informatics...
✓Neuroscience...
✓Mathematical Modeling...
✓Supercomputer Simulation ...
✓Visualization...
✓Analysis...

Neuroimaging Study Size (Typical)

Year	Size	Equivalent to
1998	54MB	20 copies of War and Peace
2005	67MB	24 copies of War and Peace
2012	531MB	193 copies of War and Peace

Image Data Expansion

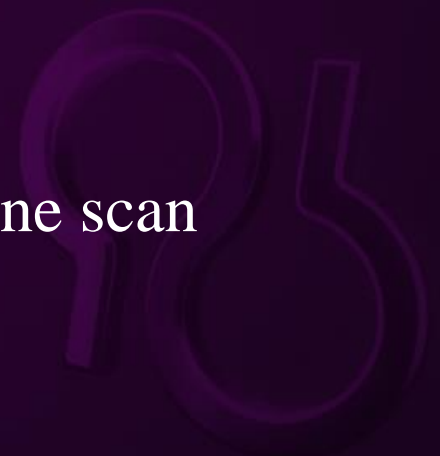Each neuroimaging scan can spawn many derived image leading to exponential growth

Typical Example:

One 22MB structural scan→

Five preprocessed images (176 MB) →

Eleven postprocessed images (222 MB)

22MB of raw data produces 420MB data for one scan

Genetic Data

- Circa 2010 GWAS Data (per sample)
  - 620,000+ rows of data
  - ~81MB
- 2012: Whole Genome Sequencing (per sample)
  - Standard output from Illumina – multiple files and formats
  - ~250GB per sample
- Example
  - 800 subjects x 250GB = 195TB
  - Time to transfer 195TB:
    - High speed internet (90 Mbit/s): 26 days
    - DSL (45 Mbit/s): 59 days
    - Dial-up (56 kbit/s): 100+ years!

http://www.ppmi-info.org/

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hdni loni

New Horizons in H... | ADNI | Alzheimer's ... | Parkinson's Progre...

Parkinson's Progression Markers Initiative

PARKINSON'S PROGRESSION MARKERS INITIATIVE
Play a Part in Parkinson's Research

About PPMI | Access Data & Specimens | PPMI News

OUR MISSION

The mission of PPMI is to identify one or more biomarkers of Parkinson's disease progression, a critical step in the development of new and better treatments for PD. This study is being sponsored by **The Michael J. Fox Foundation for Parkinson's Research.**

Subscribe to PPMI e-news
Enter email address.

WELCOME

Welcome to the Parkinson's Progression observational clinical study to comprehen PD patients and healthy subjects using a and behavioral assessments to identify bi

PPMI will be carried out over five years an and requires the participation of 400 Park Data and samples acquired from study pa comprehensive Parkinson's database and scientific community to conduct field-chan

PPMI is made possible by the concerted e sponsored by The Michael J. Fox Founda

Learn more about **Who We Are.**

LATEST NEWS FROM PPM

7:30am ET Saturday and Sunday repla Conversation with Michael J. Fox" on C
CNN replays a Thursday night special on Gupta in an exclusive interview with Mich interviewed in the segment.

MJFF Fall 2010 newsletter focuses enti
The most recent MJFF newsletter highlig study volunteers who are all integral in ma

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http://adni.loni.ucla.edu/

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ADNI Alzheimer's Disease Neuroimaging Ini

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NEWS

The Australian Imaging Biomarkers and Lifestyle Study of Aging (AIBL) Announces its Partnership with ADNI

ADNI announces a new initiative, ADNI "Grand Opportunities" (ADNI GO)

Updated Recall Speadsheet for MR Images Now Available to Researchers

More ▶

WELCOME

The mission of the Alzheimer's Disease Neuroima Disease in elderly subjects. A major goal of the st cerebral spinal fluid, and blood biomarkers as pre

ADNI Study

Alzheimer's Disease Neuroir
If you are interested in learning mo this endeavor, click on the links bel

About ADNI | About the Study | W

RELEA

ADNI-Info

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Done

Human Connectome Project

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The H

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fly throug
circuits,
comprise

The Hum
unparalle
graphical
never be
brain.

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BIRN Biomedical Informatics Research Network

SEARCH

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ICBM International Consortium for Brain Mapping

ABOUT ICBM | RESEARCH | RESOURCES | DATABASES | DOWNLOADS

ICBM

About ICBM

International Consortium for Brain Mapping

The International Consortium for Brain Mapping (ICBM) was formed in 1993 with a grant from the NIMH. The primary goal of the ICBM project is the continuing development of a probabilistic reference system for the human brain. **More**

Databases

The ICBM Subject Database is a web-based database infrastructure that simplifies image dataset collection, organization and dissemination. A web interface provides the means to query the data base using a combination of subject demographics and scan-related attributes. **More**

LONI Laboratory of Neuro Imaging

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LONI seeks to improve understanding of the brain in health and disease. The laboratory is dedicated to the development of scientific approaches for the comprehensive mapping of brain structure and function.

HCP | LONIR | ADNI | BIRN | PPMI | ICBM | ENIGMA | CCB

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Publications
Time-lapse mapping of

Hi Jason Stein | Sign Out

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ENIGMA

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TRACK HD

About TRACK-HD

TRACK-HD is a multi-centre, multi-national prospective, observational biomarker study of premanifest and early stage HD with no experimental treatment.
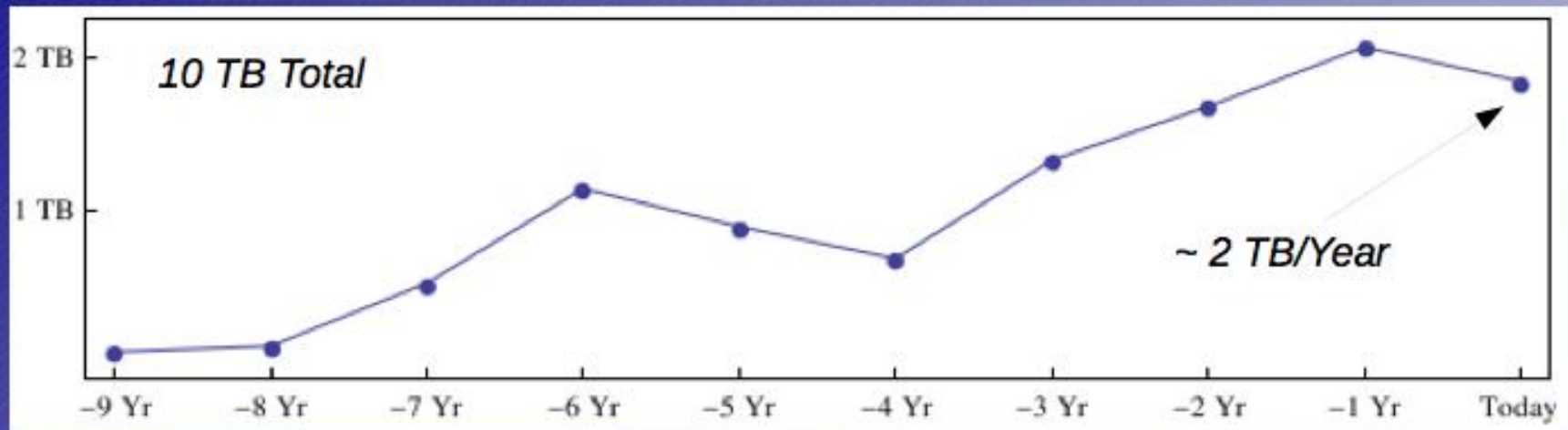
Objectives

- determine what combination of measures is the most sensitive for detecting change over the natural course of premanifest and early HD
- to validate these as potential outcome measures for use in future therapeutic trials

Design

- focused on intensive battery of novel assessments
- extensive annual assessments
- dynamic and fluid protocol
- robust evidence-based measures

Meta-Analysis

Ov

Do

Image & Data Archive (IDA)

60+ Projects

*Names scaled to amount of image data archived

Image Data Uploaded

10 TB Total

~ 2 TB/Year

(chart x-axis: -9 Yr, -8 Yr, -7 Yr, -6 Yr, -5 Yr, -4 Yr, -3 Yr, -2 Yr, -1 Yr, Today; y-axis: 1 TB, 2 TB)

MRI
fMRI
PET
SPECT
CT
MRA
DTI

- *17,200 subjects*
- *200,000 scans*
- *121,000 processed scans*
- *64 million image files*

Image Data Downloaded
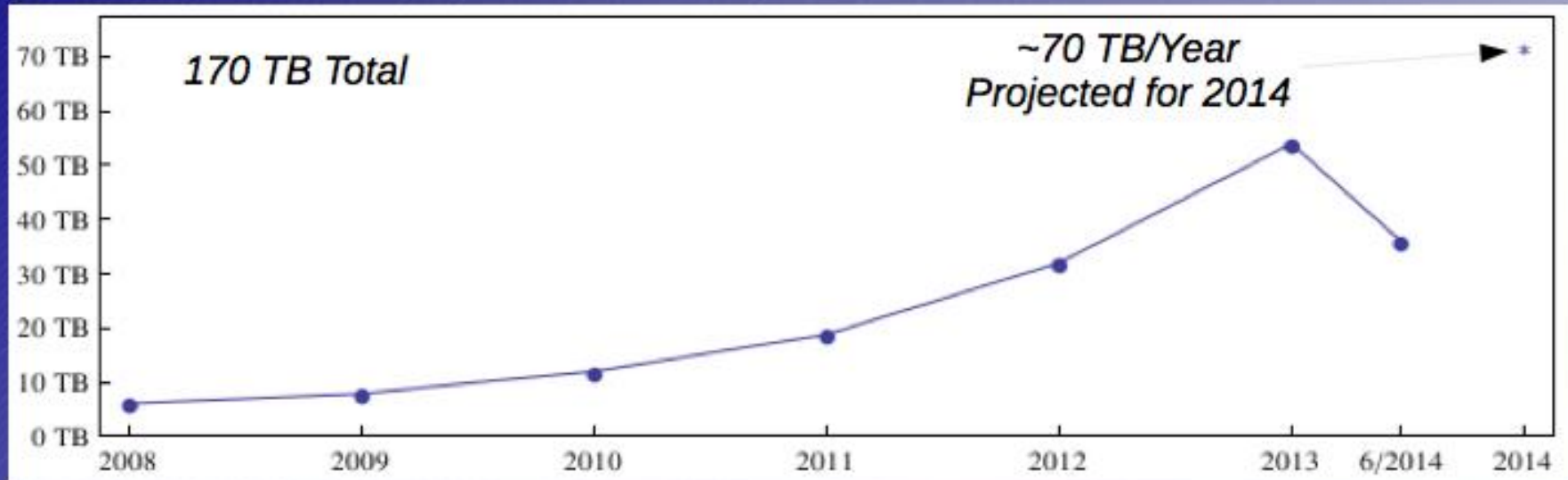
- **9,087 IDA users**
- **~50 active users / day**
- **46 countries**

Google™ Custom Search   **SEARCH**

ADNI

ALZHEIMER'S DISEASE NEUROIMAGING INITIATIVE

ABOUT   STUDY DESIGN   DATA & SAMPLES   METHODS & TOOLS   SUPPORT   NEWS & PUBLICATIONS

Sharing Alzheimer's Research Data with the World

The Alzheimer's Disease Neuroimaging Initiative (ADNI) unites researchers with study data as they work to define the progression of Alzheimer's disease. ADNI researchers collect, validate and utilize data such as MRI and PET images, genetics, cognitive tests, CSF and blood biomarkers as predictors for the disease. Data from the North American ADNI's study participants, including Alzheimer's disease patients, mild cognitive impairment subjects and elderly controls, are available from this site.

Welcome

- About the ADNI Study
- Overview of ADNI Data
- Data Use Agreement
- Request ADNI Specimens from RARC
- APPLY FOR DATA ACCESS

Returning Users

- Overview of the ADNI Standardized MRI Data Sets
- Data Dictionary Search
- Update Account Information or Add Co-Investigators
- Submit your ADNI Manuscript for Review

News

MR Study ID Changes
New rules that determine how study ID's are assigned to images archived within the...

Updated BSI measures dataset is now available
Updated BSI measures dataset is now available from the Download section of the ADNI...

MORE NEWS >

SUBSCRIBE TO RSS

	2005	2006	2007	2008	2009	2010	2011	2012	2013
Raw Scans	387	6,695	9,576	6,450	3,291	2,915	8,318	15,599	12,636
Processed Scans	0	2,844	20,104	17,234	4,795	20,466	12,784	14,809	9,456
Subjects	61	699	779	650	440	369	638	971	955
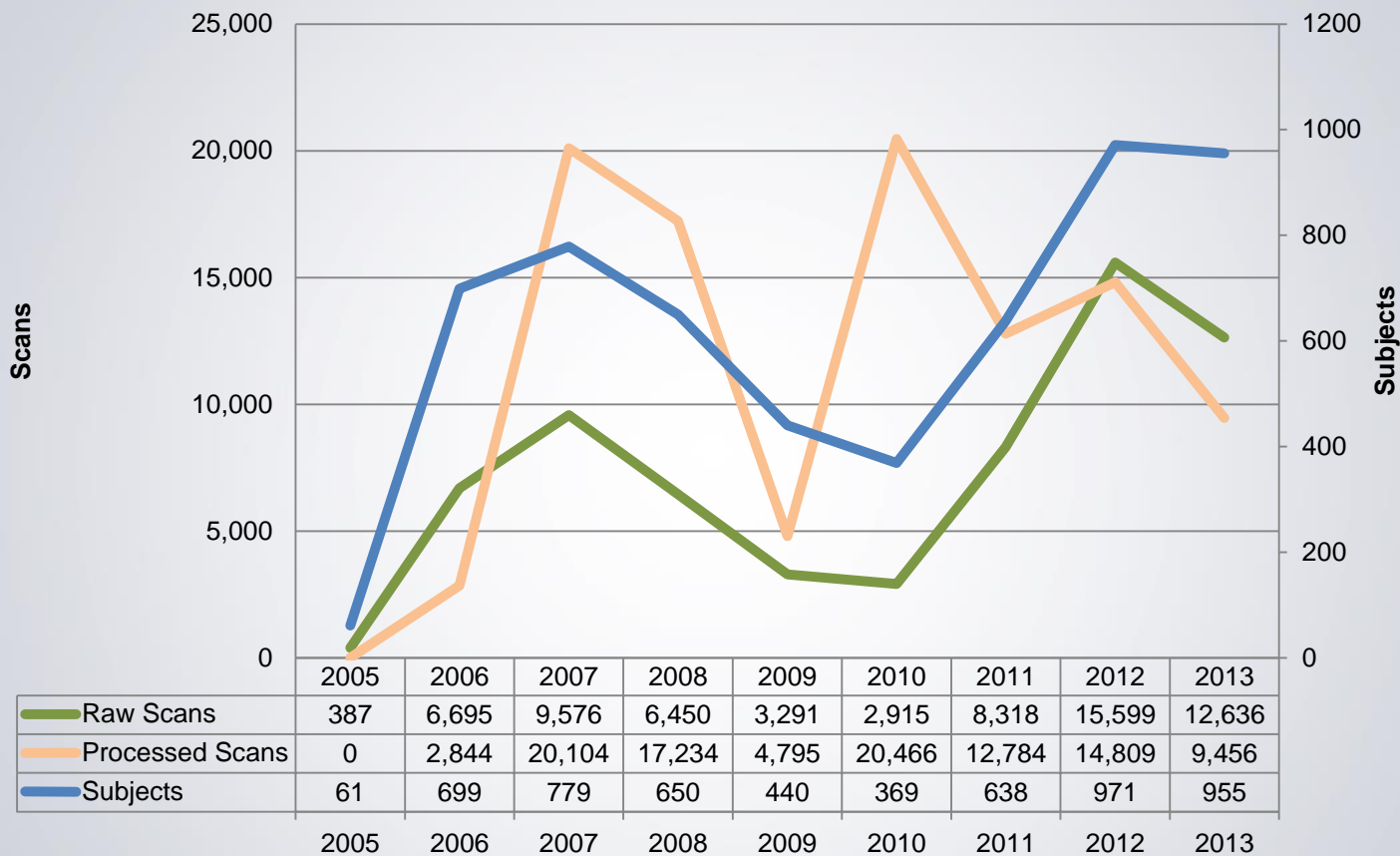
Scans Archived 2005 - 2013

Total: 190,903

Subject: 168,359

Phantom: 22,554

Number of subjects is consistent, but fewer raw MR scans were archived in 2013 due to a reduced frequency in collecting phantom scans.

Data Use Applications
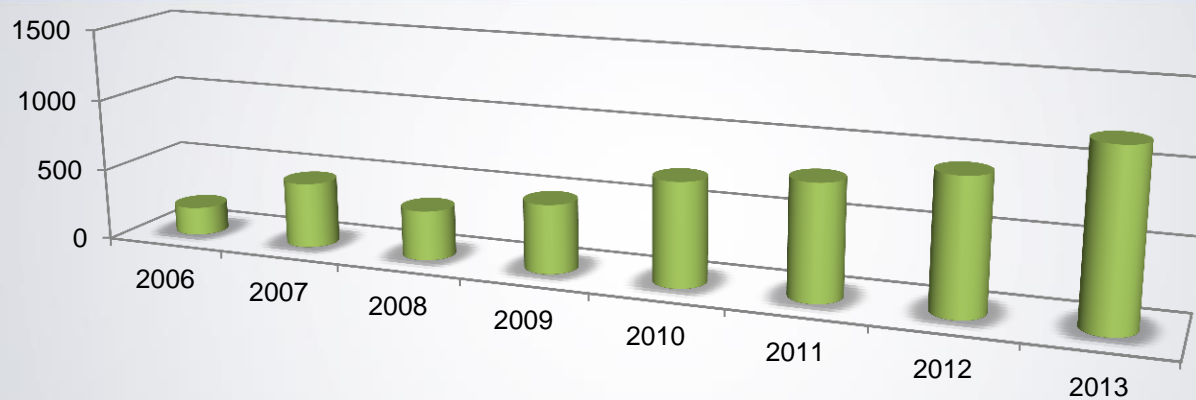
Applications received to date: 5,614

Applications received in 2013: 1,191

(29% increase from 2012)

Images Downloaded 2006 - 2013

	2006	2007	2008	2009	2010	2011	2012	2013
MR	34,575	127,341	191,914	234,253	354,848	519,121	806,083	1,342,381
PET	5,739	17,983	41,630	50,578	56,433	131,681	149,543	262,801
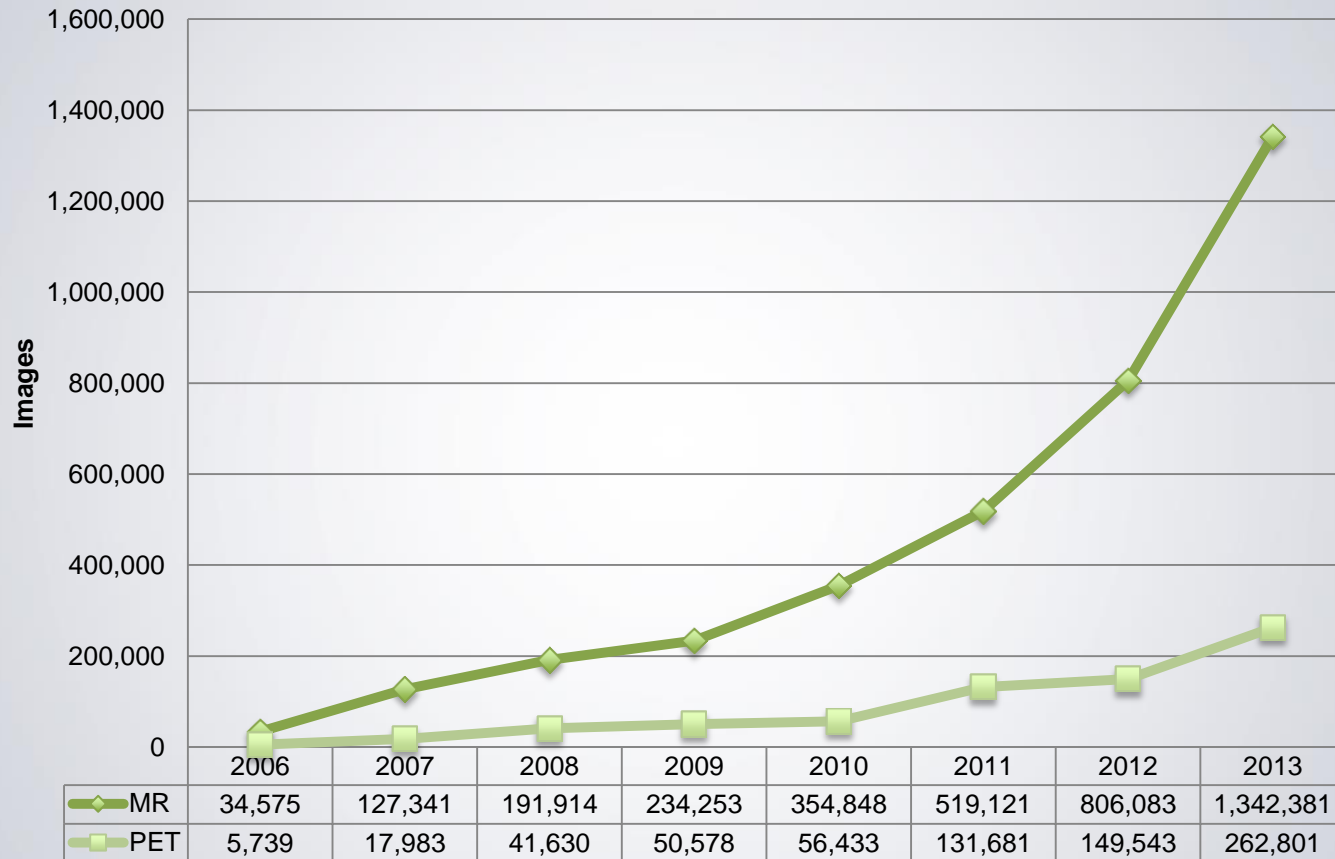
MRI: 3,610,516

PET: 716,388

Total Downloads: 4,326,904

Processes for obtaining WGS data

```
                    ┌──────────────────┐
                    │    WGS Data      │
                    └──────────────────┘
                   ┌──────────┴──────────┐
        ┌──────────────────┐    ┌──────────────────┐
        │   SNPs (VCF)     │    │  Assembly (BAM)  │
        └──────────────────┘    └──────────────────┘
          ┌────────┴────────┐      ┌──────┬──────┬──────┐
    ┌─────────┐ ┌─────────┐ ┌─────────┐ ┌─────────┐ ┌─────────┐ ┌─────────┐
    │   1)    │ │   2)    │ │   1)    │ │   2)    │ │   3)    │ │   4)    │
    │ Login   │ │ Genetic │ │ Email   │ │ Added to│ │  Send   │ │ Receive │
    │  IDA    │ │Downloads│ │ Request │ │  Queue  │ │Hardware │ │  Data   │
    └─────────┘ └─────────┘ └─────────┘ └─────────┘ └─────────┘ └─────────┘
```
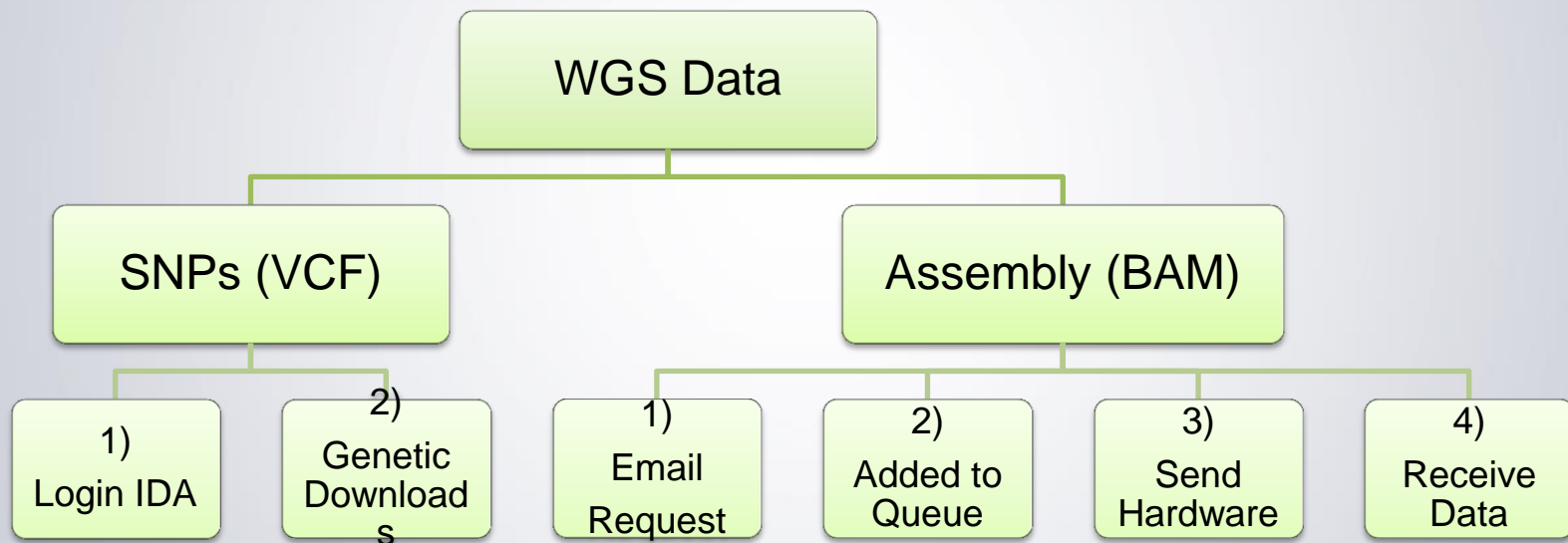
The process of obtaining genetic data follow two paths.
Smaller datasets such as SNPs are available from within the IDA and are available to all active ADNI investigators.
Large datasets, the WGS BAM assembly files require investigators to send hardware on which LONI can place of copy of the files.

WGS SNPs
(PLINK & VCF formats)

Gaain.org | Homepage

Why GAAIN?

Imagine Venice without bridges

- Isolated islets
- Inaccessible to pedestrians
- Requires a boat
- Requires special navigation skills

Why GAAIN?

Create an infrastructure that provides bridges between islets of data to form an accessible global information network easliy traversed.

Example: Tripit.com

Tripit.com aggregates a user's travel and booking information (ie: airline tickets, vacation rentals).

Problems for Investigators

Discovering data needed for investigation

Obtaining data from study investigators

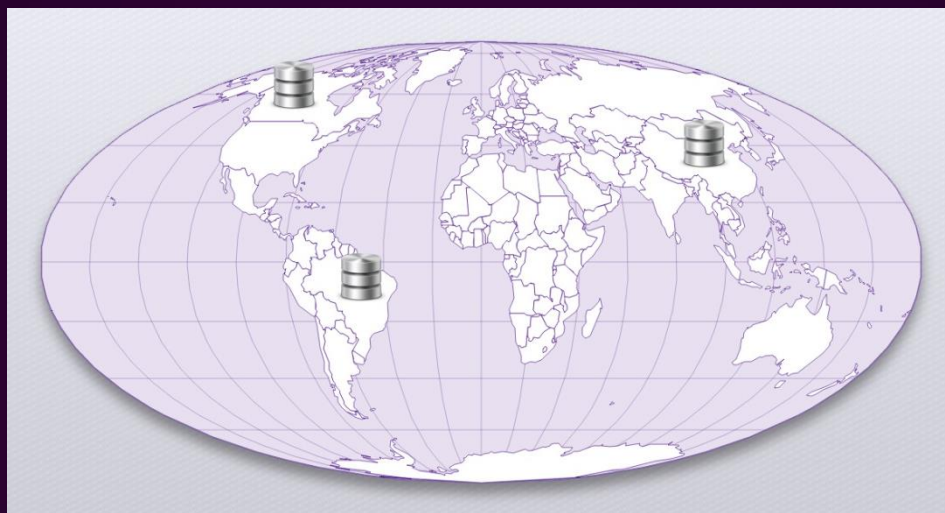Combining & interpreting data across studies

Problems for Data Holders

Protecting subject privacy

Maintaining data control

Receiving credit

Research efforts in Alzheimer's disease

Research efforts could be vastly expanded in scope and capabilities if data were linked to a global infrastructure that would enable scientists to access and utilize vast, interlinked repositories of data on thousands of subjects at risk for or already suffering from the ravages of Alzheimer's disease.

GAAIN Aggregator and Personal Dashboard

GAAIN recognizes a user's existing accounts for partnering data sources and allows him/her to analyze the data with our tools and/or apply for additional consortiums

The dashboard indicates which data sources are unavailable to the user (ie: the user must apply for access, data source is currently offline)

Comprehensive Analytical Tool Stack

Bank of sophisticated imaging and genetic analytical tools available

Tools are supported by the LONI Pipeline

Data Heterogeneity

AD Data Consortium X

XADC	XID	SEX	BIRTHYR	MMSE	

ADNI

RID	..	EXAMDATE	GENDER	DOB	MMSCORE

AIBL

RID	..	PTGENDER	PTDOB	MMSETOT	

AD Data Consortium Y

PTID	..	MF	BIRTHDATE	APOE	
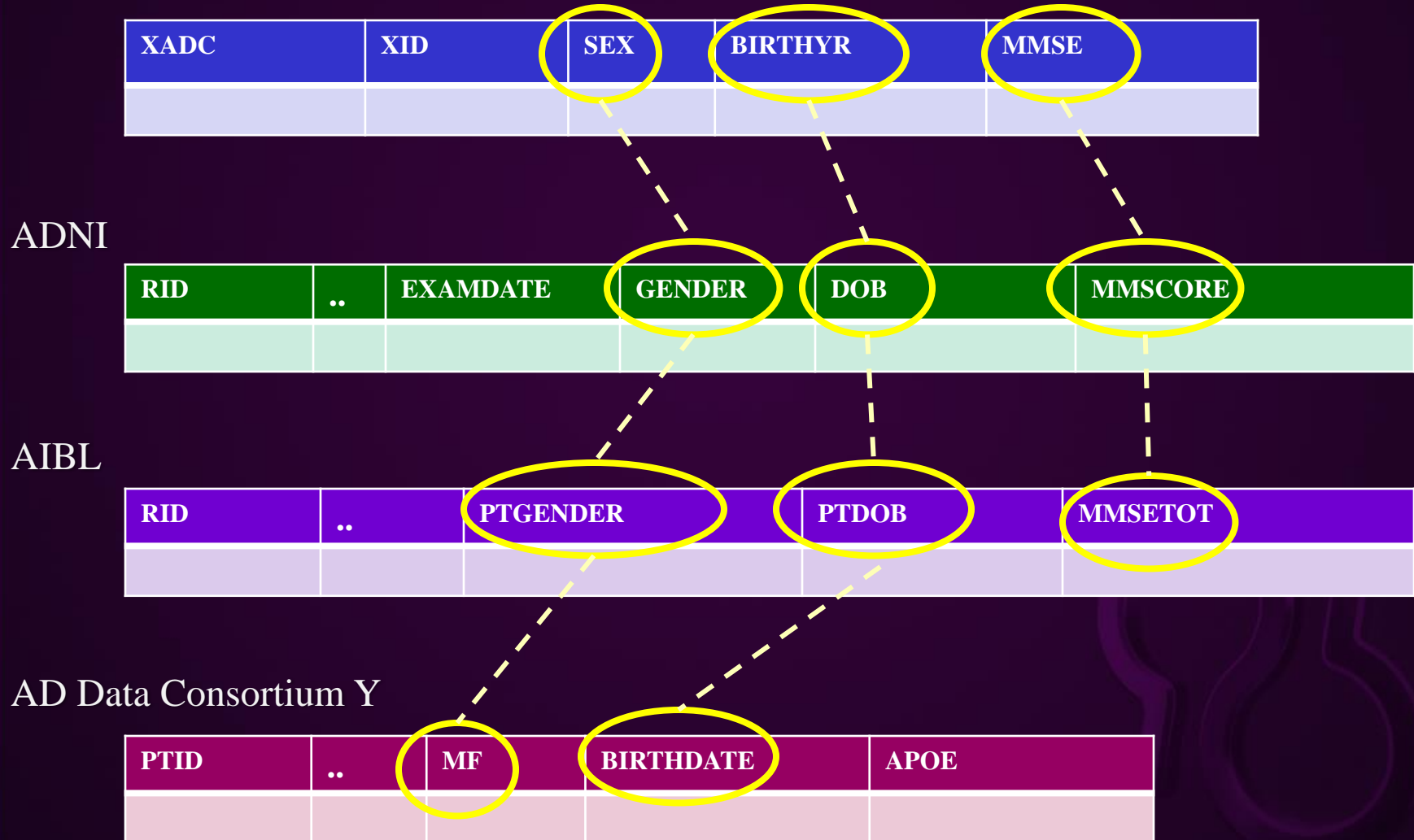
"Google with graphs" Search
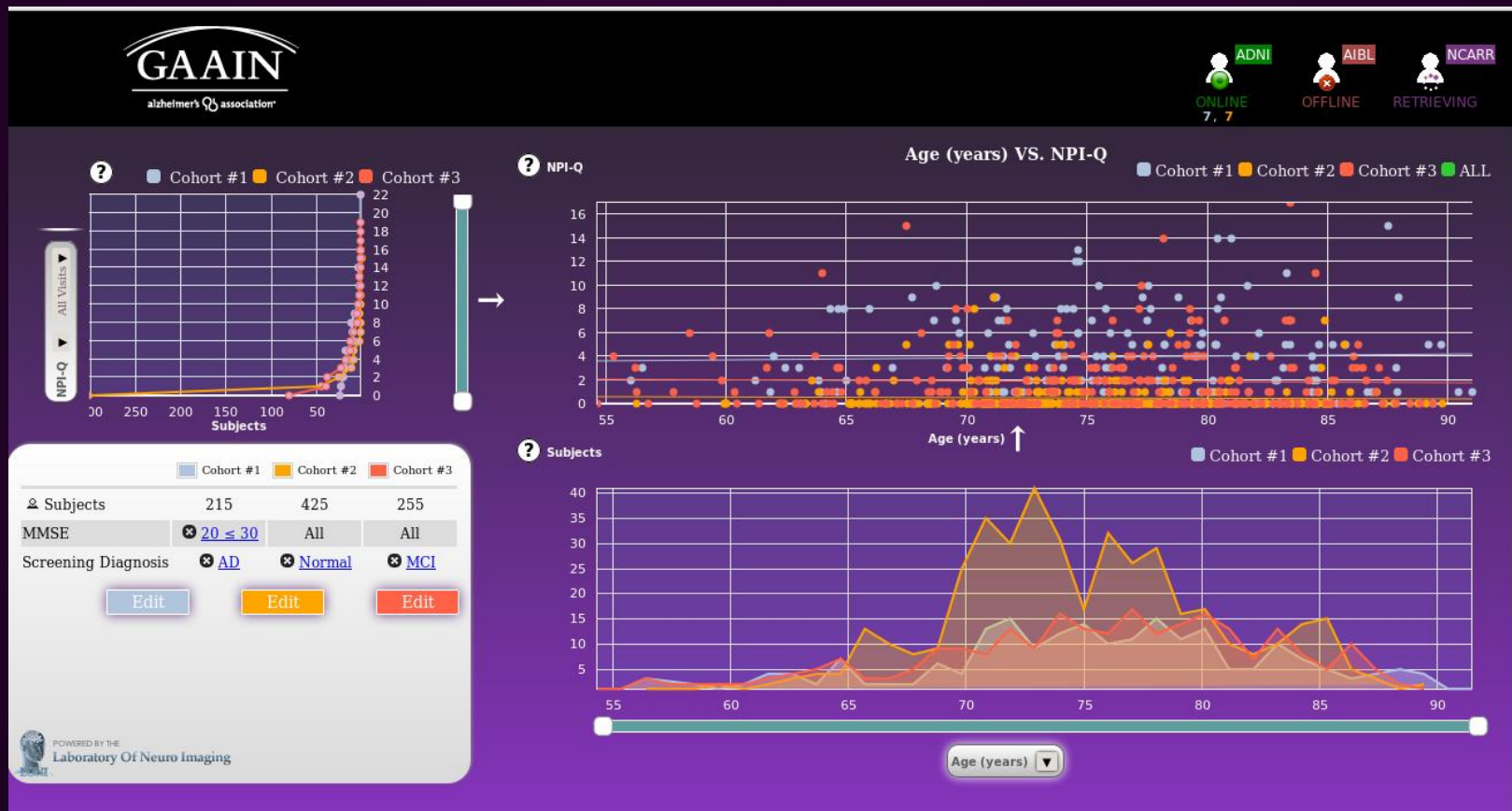
A big solution for big data

- GAAIN serves as a benchmark for large data research efforts

- Provides seamless connections of a users' existing Alzheimer's disease consortium data accounts

- Allows researchers to narrow down a study population that relates to their work across multiple partner consortiums

- Provides tools capable of analyzing clinical, imaging and genetic data types via the LONI Pipeline