Lucile Packard Children's Hospital AT STANFORD

ImmPort
Bioinformatics For The Future of Immunology

Discovering new drugs and diagnostics from 300 trillion points of data

Atul Butte, MD, PhD abutte@stanford.edu

Chief, Division of Systems Medicine, @atulbutte
Department of Pediatrics, @ImmPortDB
Department of Medicine, and, by courtesy,
Computer Science

Center for Pediatric Bioinformatics, LPCH

Stanford University

Butte Lab
Systems Medicine • Stanford Pediatrics • Packard Children's Hospital

Disclosures

- Scientific founder and advisory board membership
  - Genstruct
  - NuMedii
  - Personalis
  - Carmenta
- Past or present consultancy
  - Lilly
  - Johnson and Johnson
  - Roche
  - NuMedii
  - Genstruct
  - Tercica
  - Ansh Labs
  - Prevendia
  - Samsung
  - Assay Depot
  - Regeneron
  - Verinata
  - Geisinger
- Honoraria
  - Lilly
  - Pfizer
  - Siemens
  - Bristol Myers Squibb
- Speakers' bureau
  - None
- Companies started by students
  - Carmenta
  - Serendipity
  - NuMedii
  - Stimulomics
  - NunaHealth
  - Praedicat
  - Flipora

The Economist

FEBRUARY 27TH–MARCH 5TH 2010 Economist.com

Obama the warrior

Misgoverning Argentina

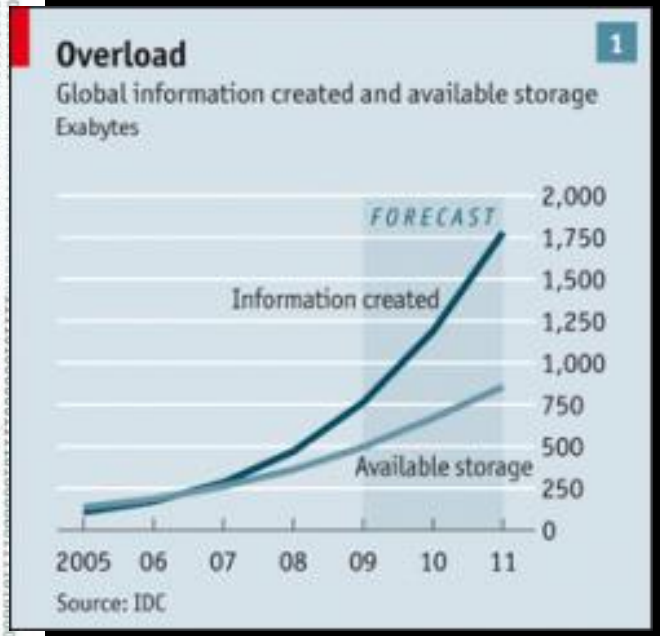
The economic shift from West to East

Genetically modified crops blossom

The right to eat cats and dogs

The data deluge

AND HOW TO HANDLE IT: A 14-PAGE SPECIAL REPORT



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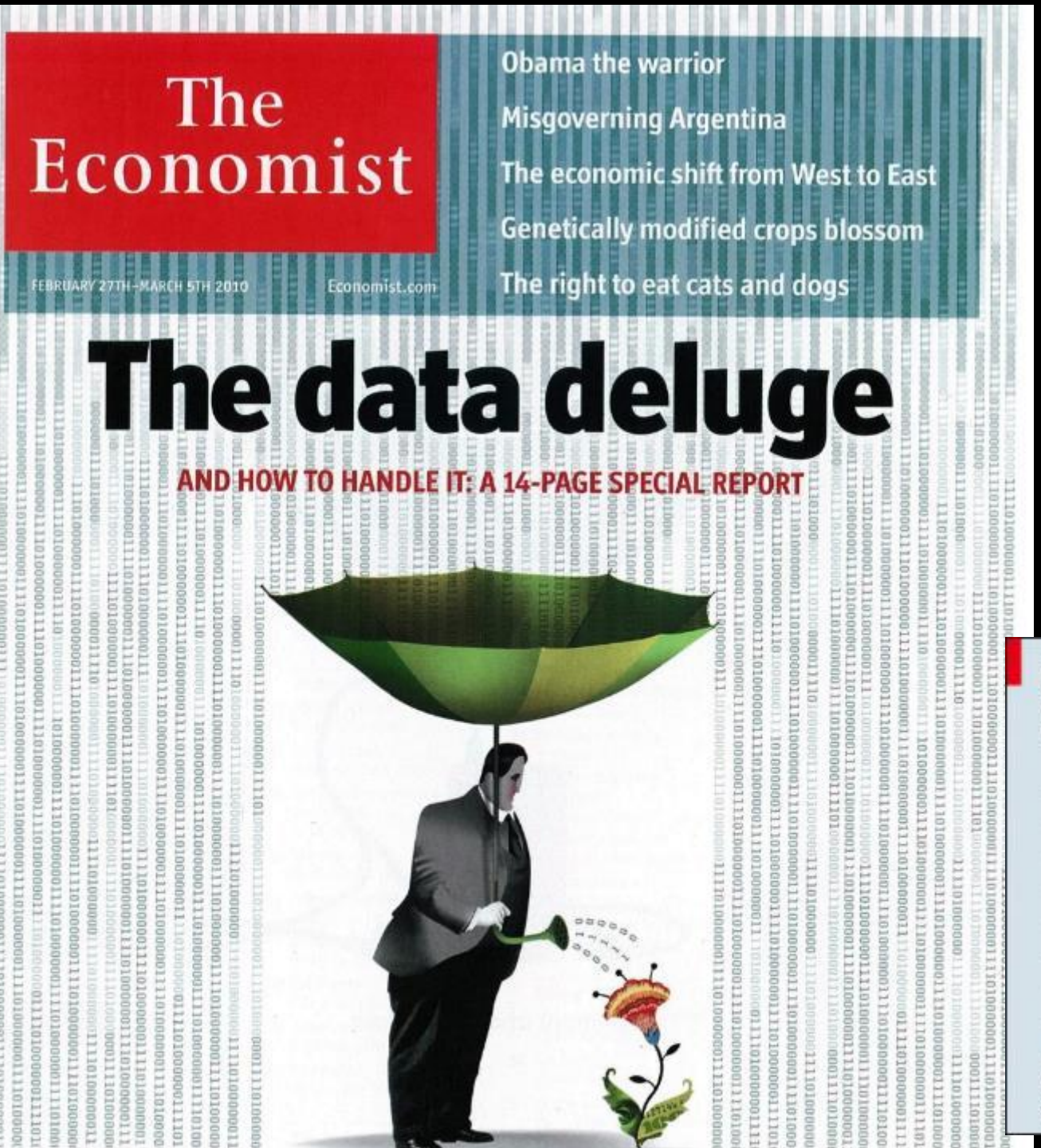
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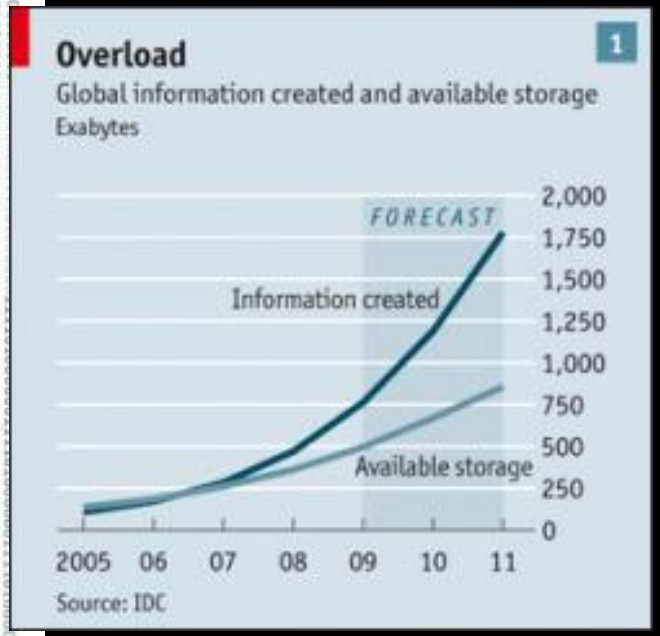
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Global information created and available storage
Exabytes
FORECAST
Information created
Available storage
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1,750
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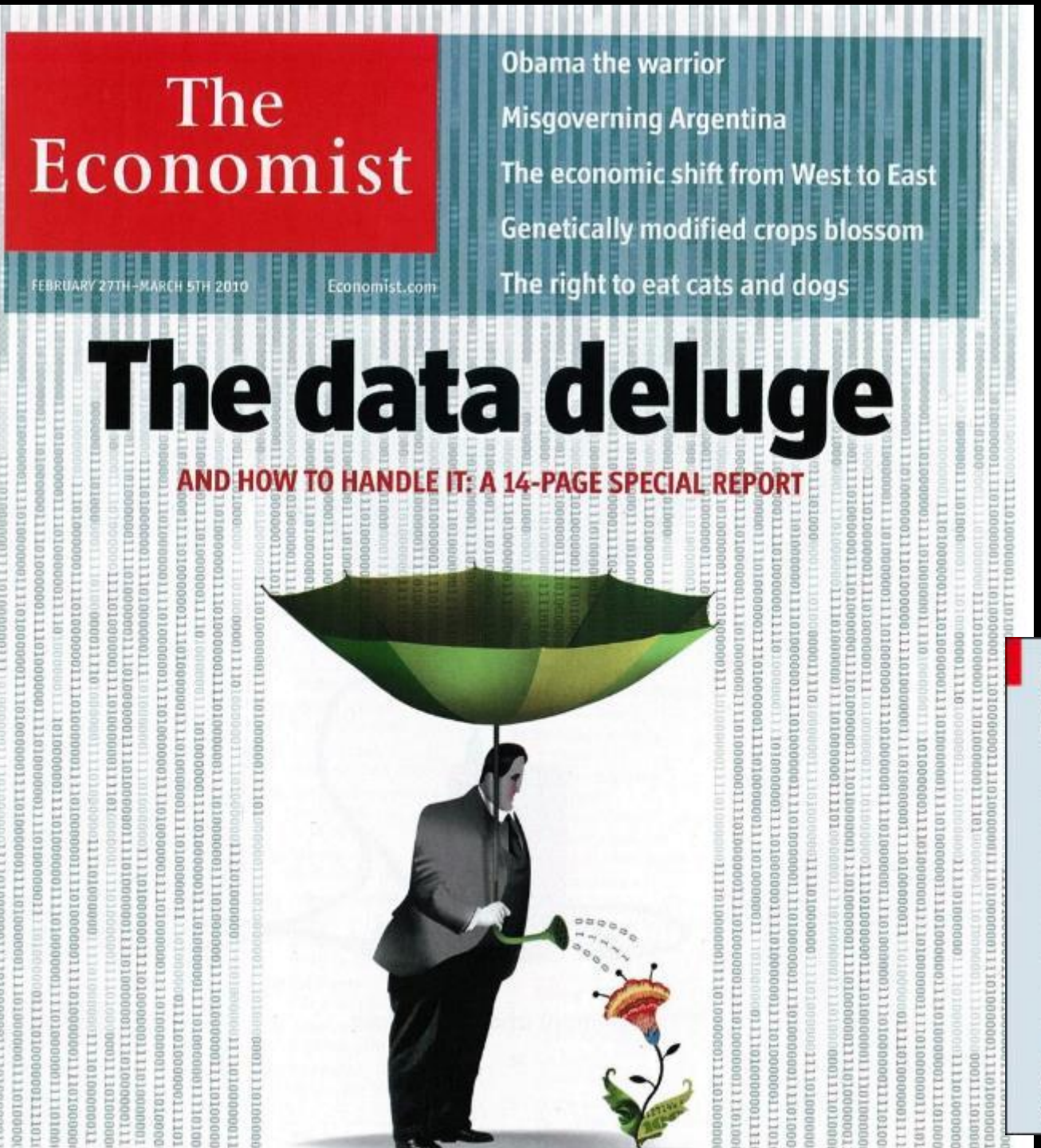
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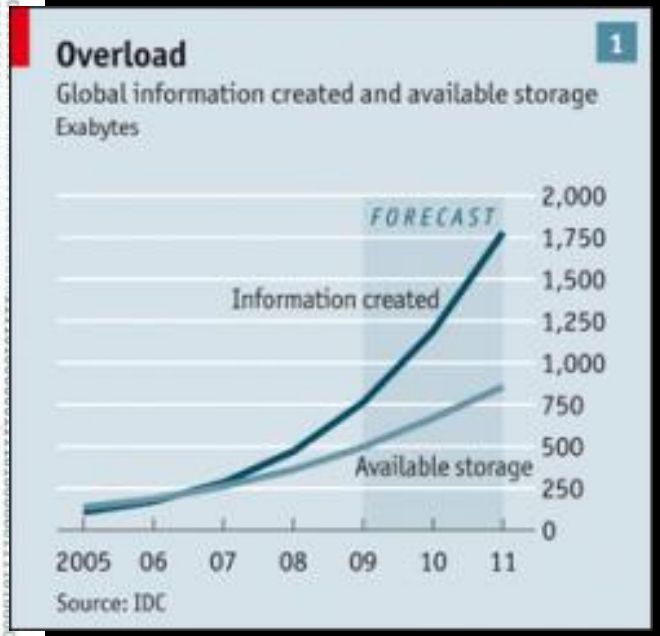
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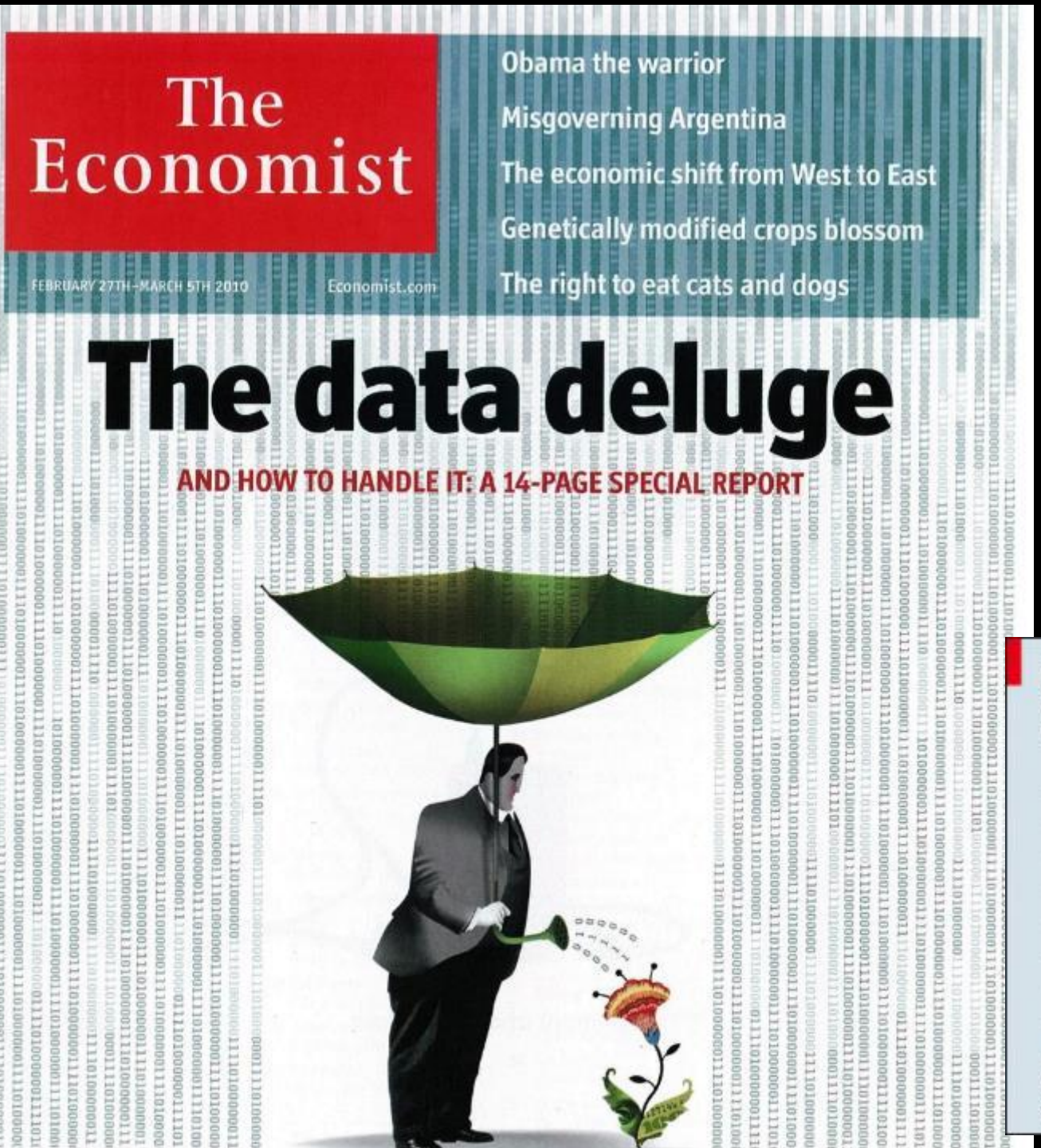

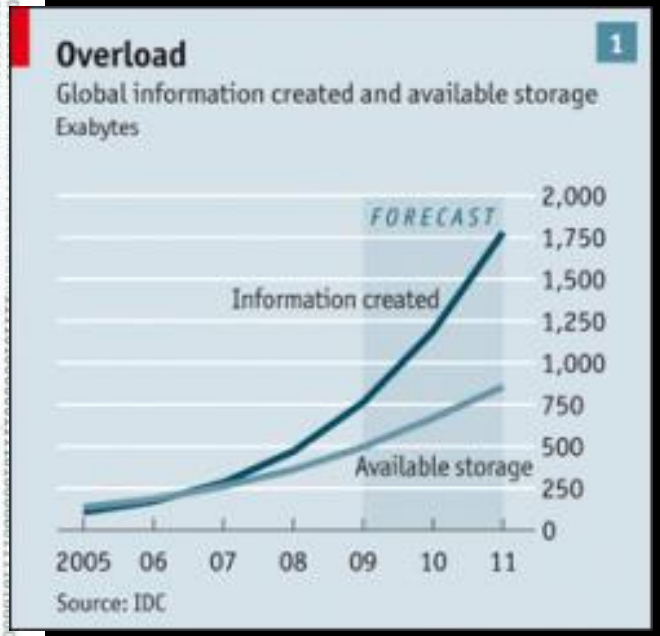

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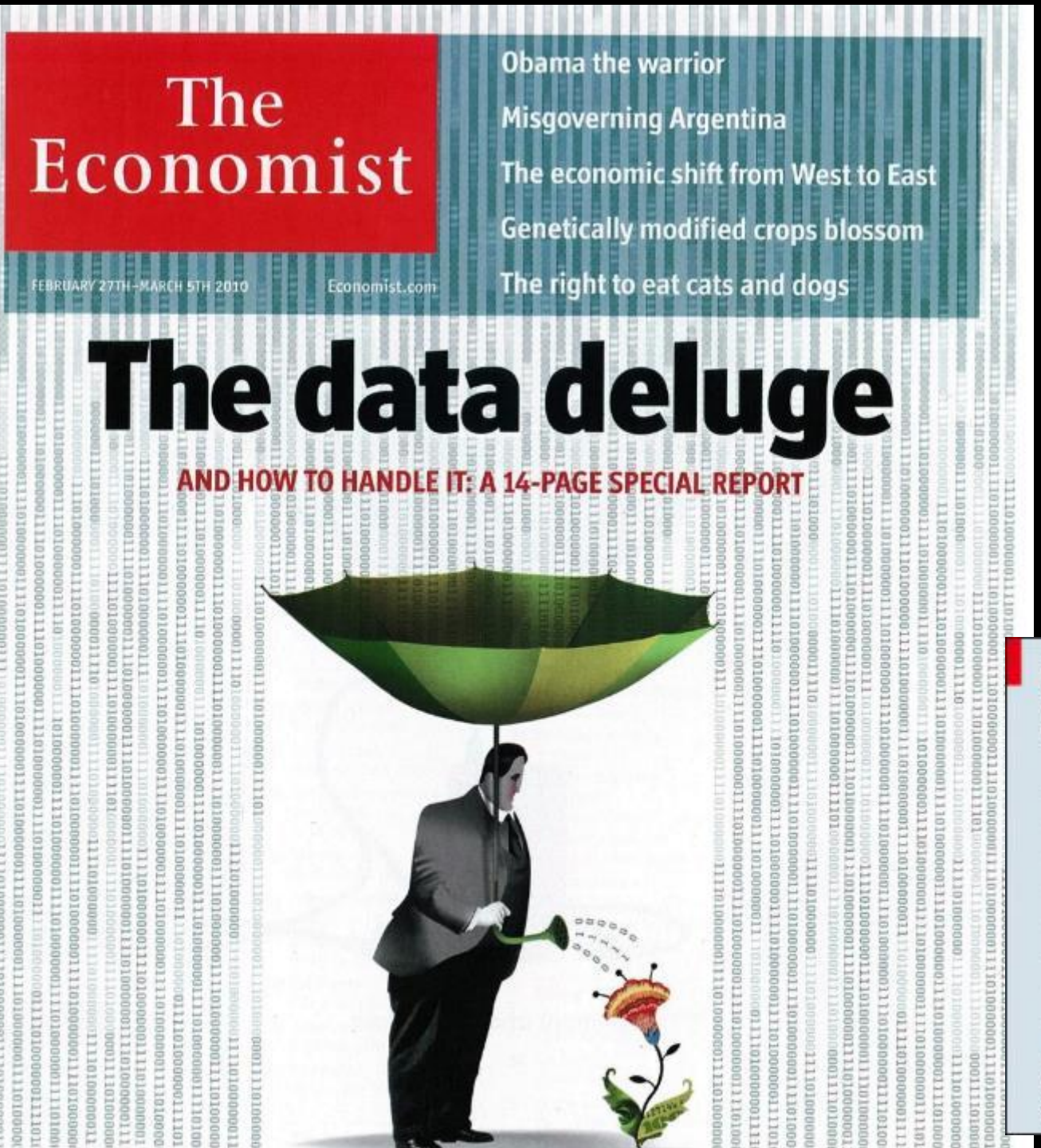

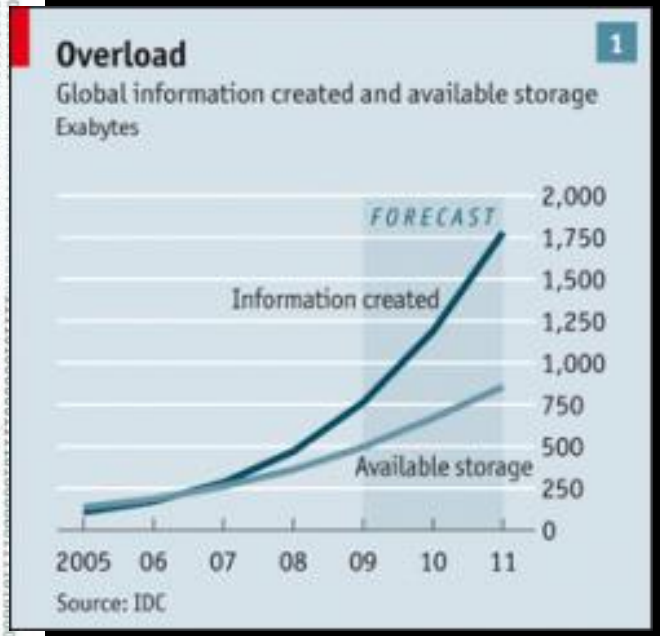

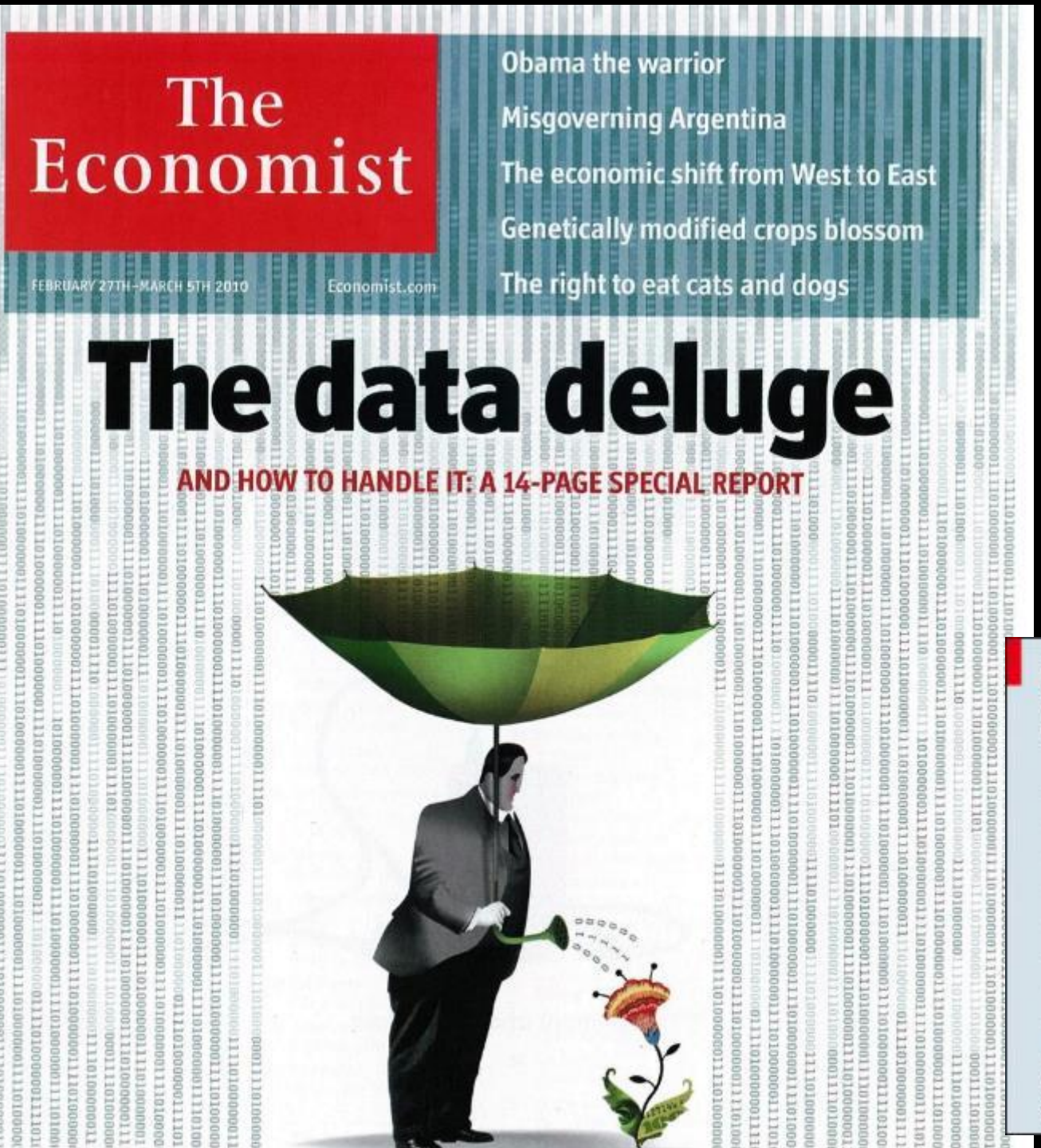

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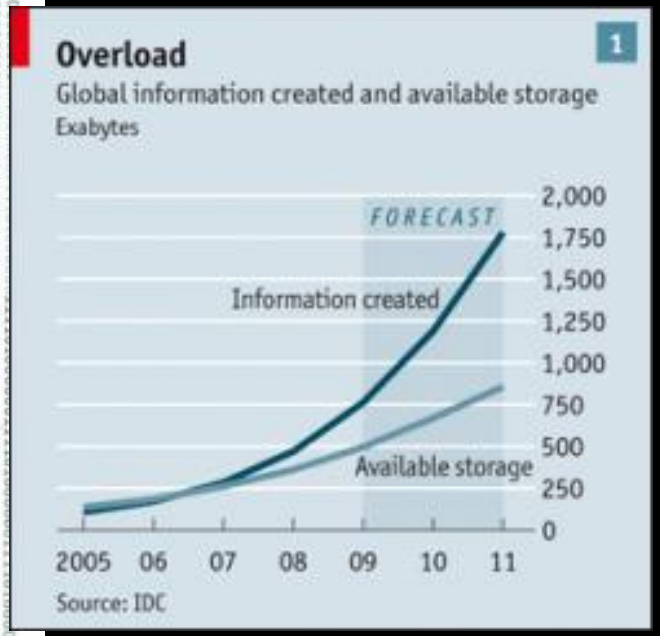

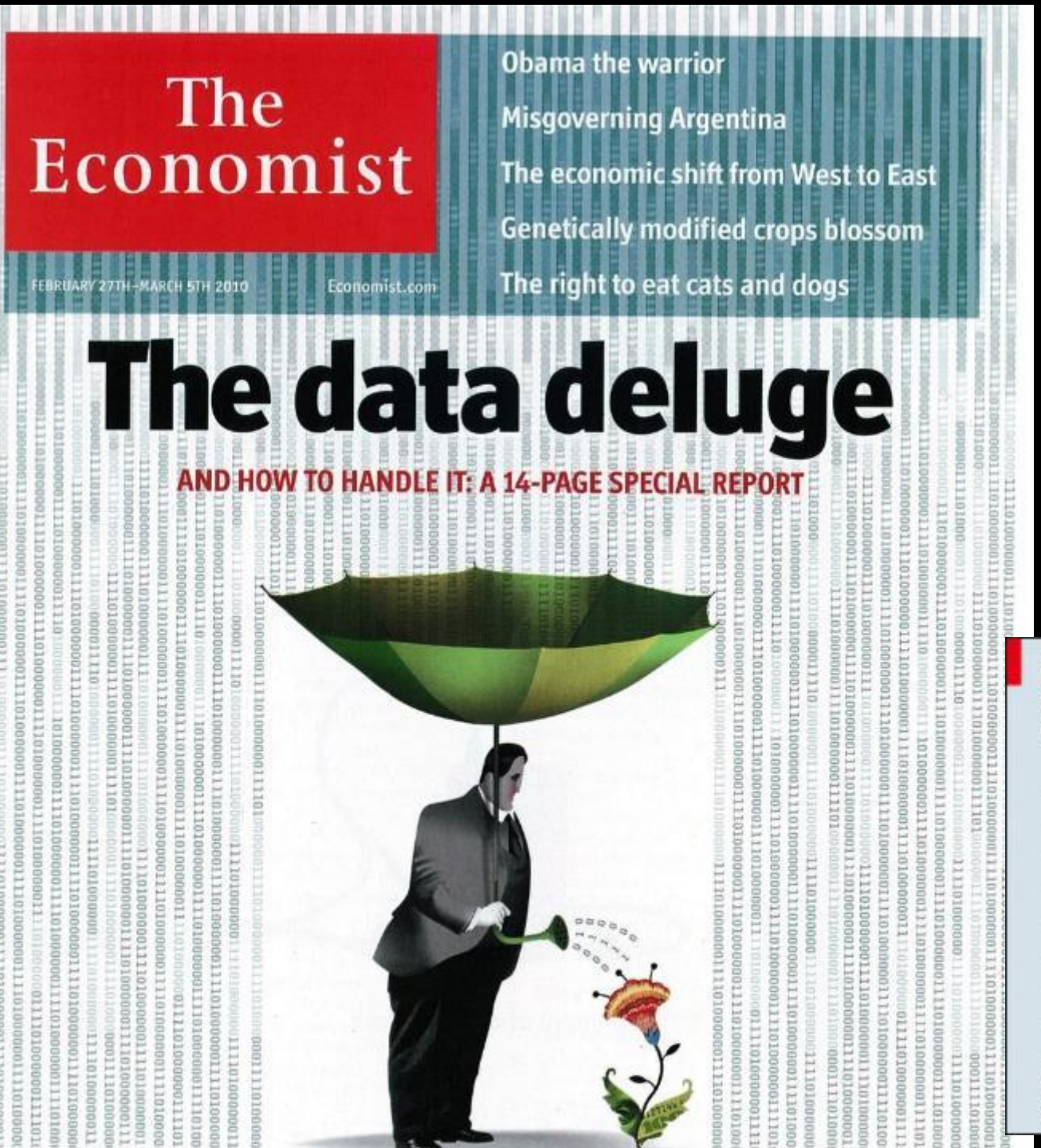

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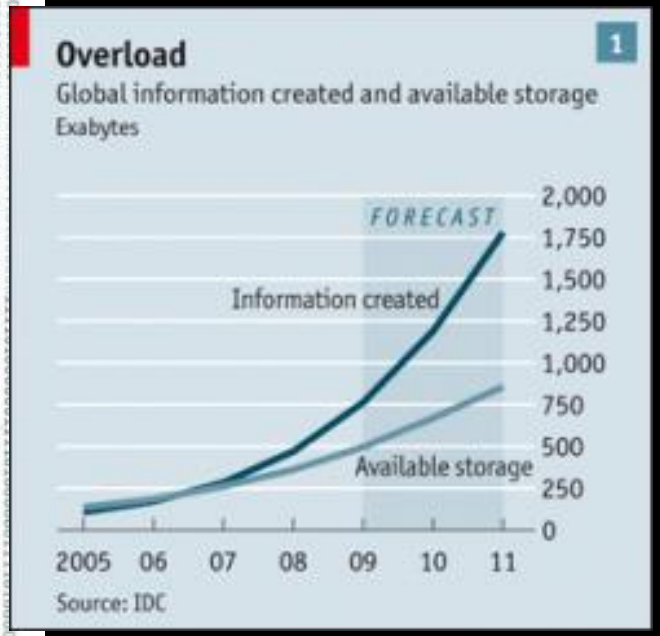

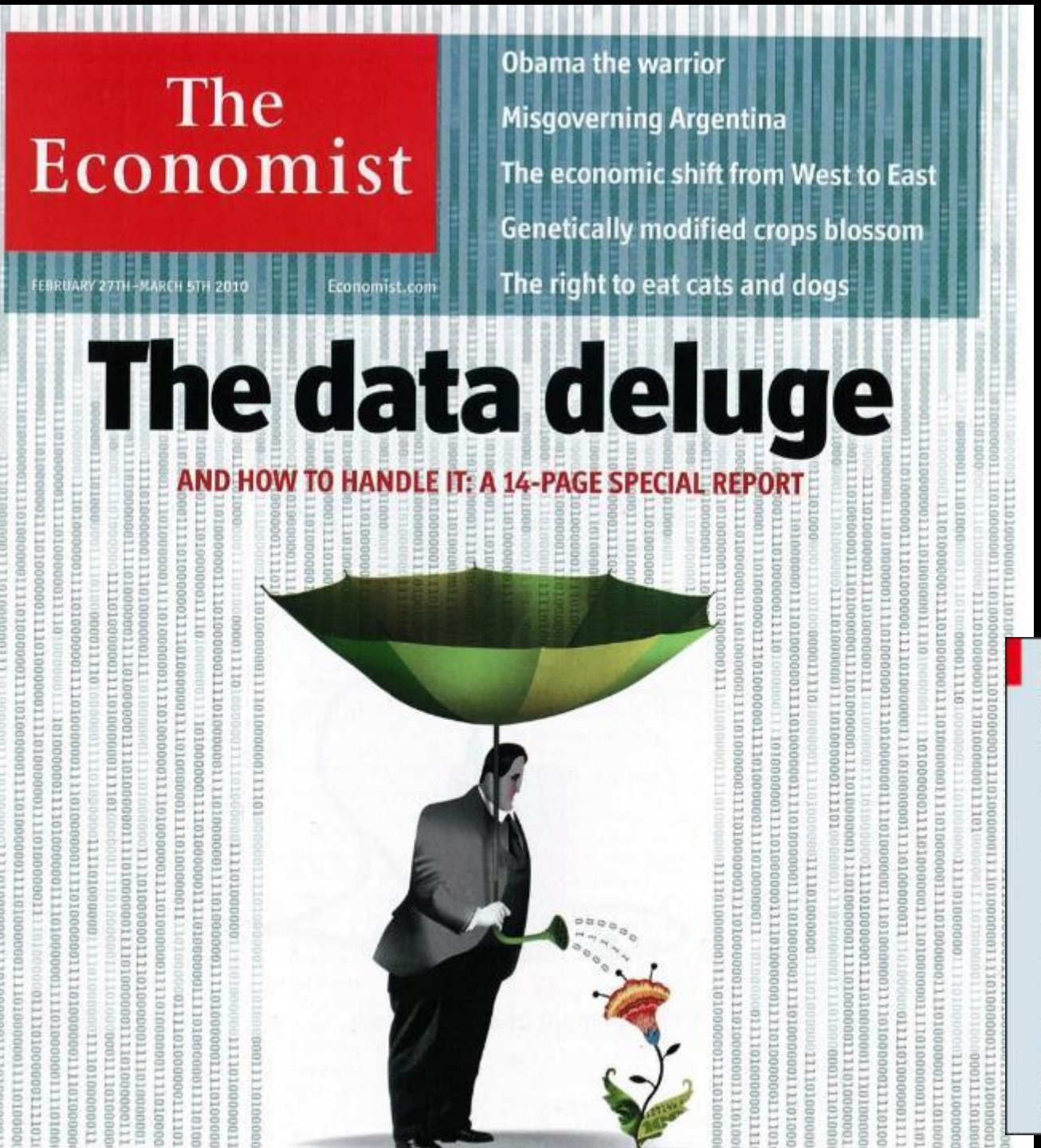

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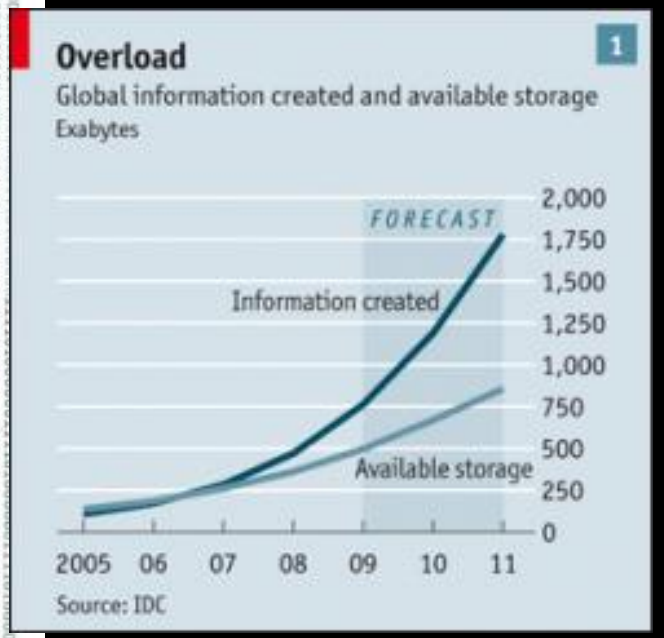


WIRED MAGAZINE: 16.07

SCIENCE : DISCOVERIES

The End of Theory: The Data Deluge Makes the Scientific Method Obsolete

By Chris Anderson 06.23.08

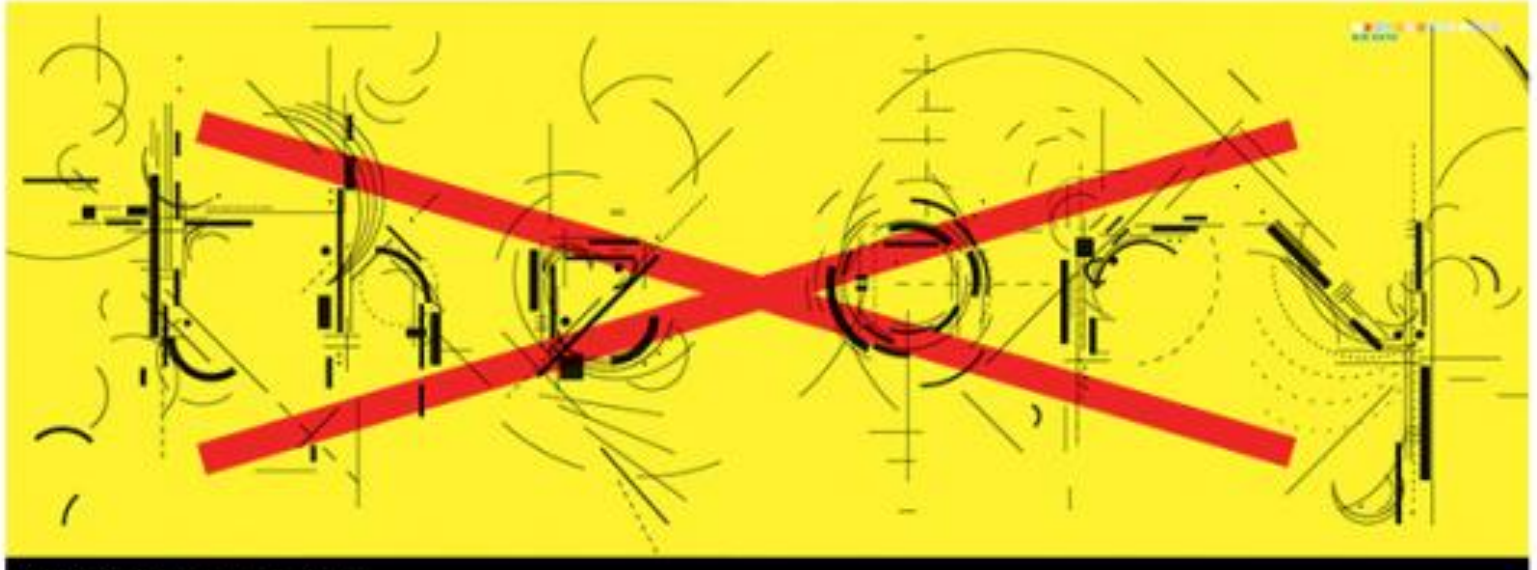
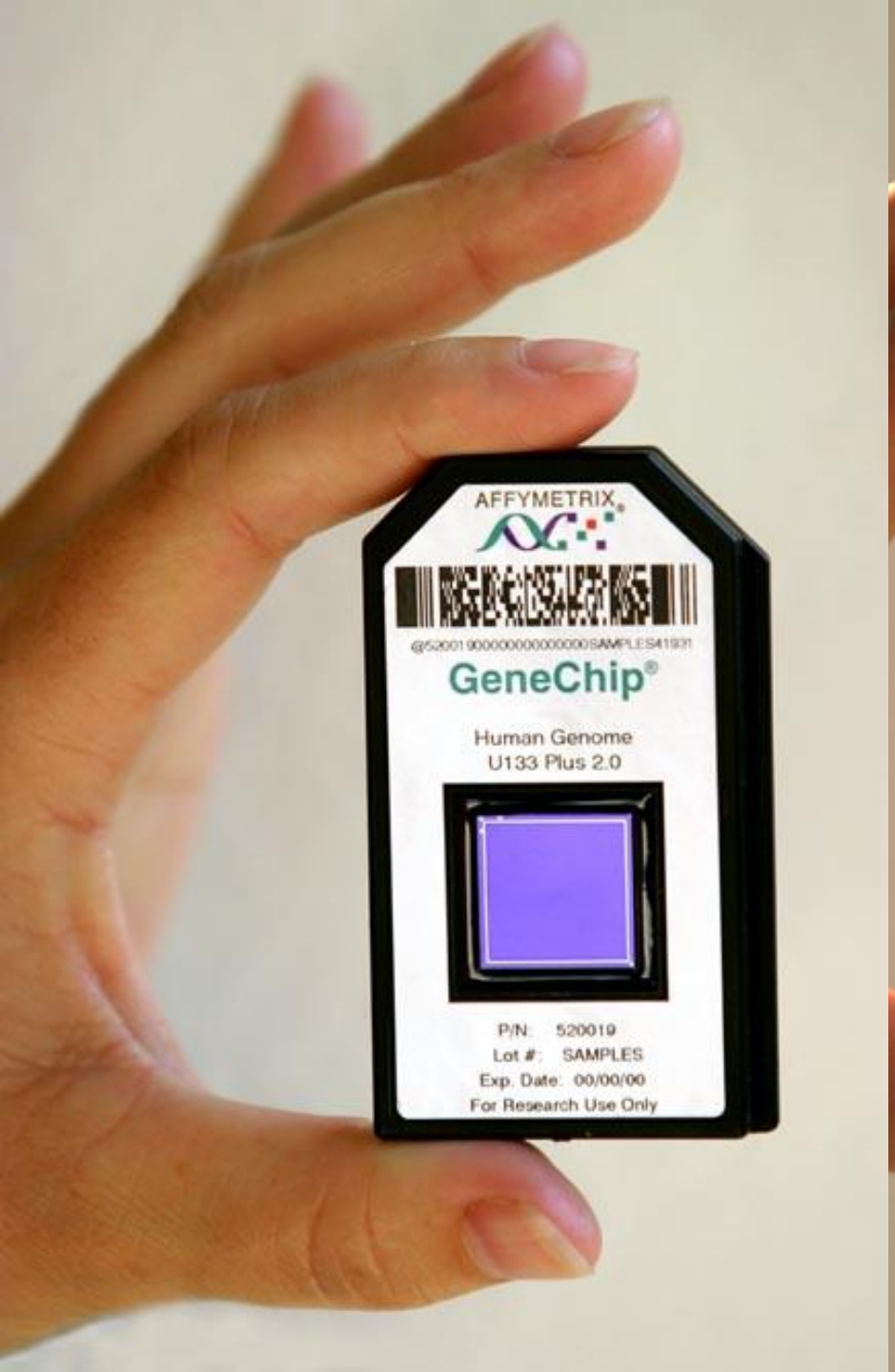


Illustration: Marian Bantjes

THE PETABYTE AGE:
Sensors everywhere. Infinite storage. Clouds of processors. Our ability to capture, warehouse, and understand massive amounts of data is changing science, medicine, business, and technology. As our collection of facts and figures grows, so will

"All models are wrong, but some are useful."

So proclaimed statistician George Box 30 years ago, and he was right. But what choice did we have? Only models, from cosmological equations to theories of human behavior, seemed to be able to consistently, if imperfectly, explain the world around us. Until now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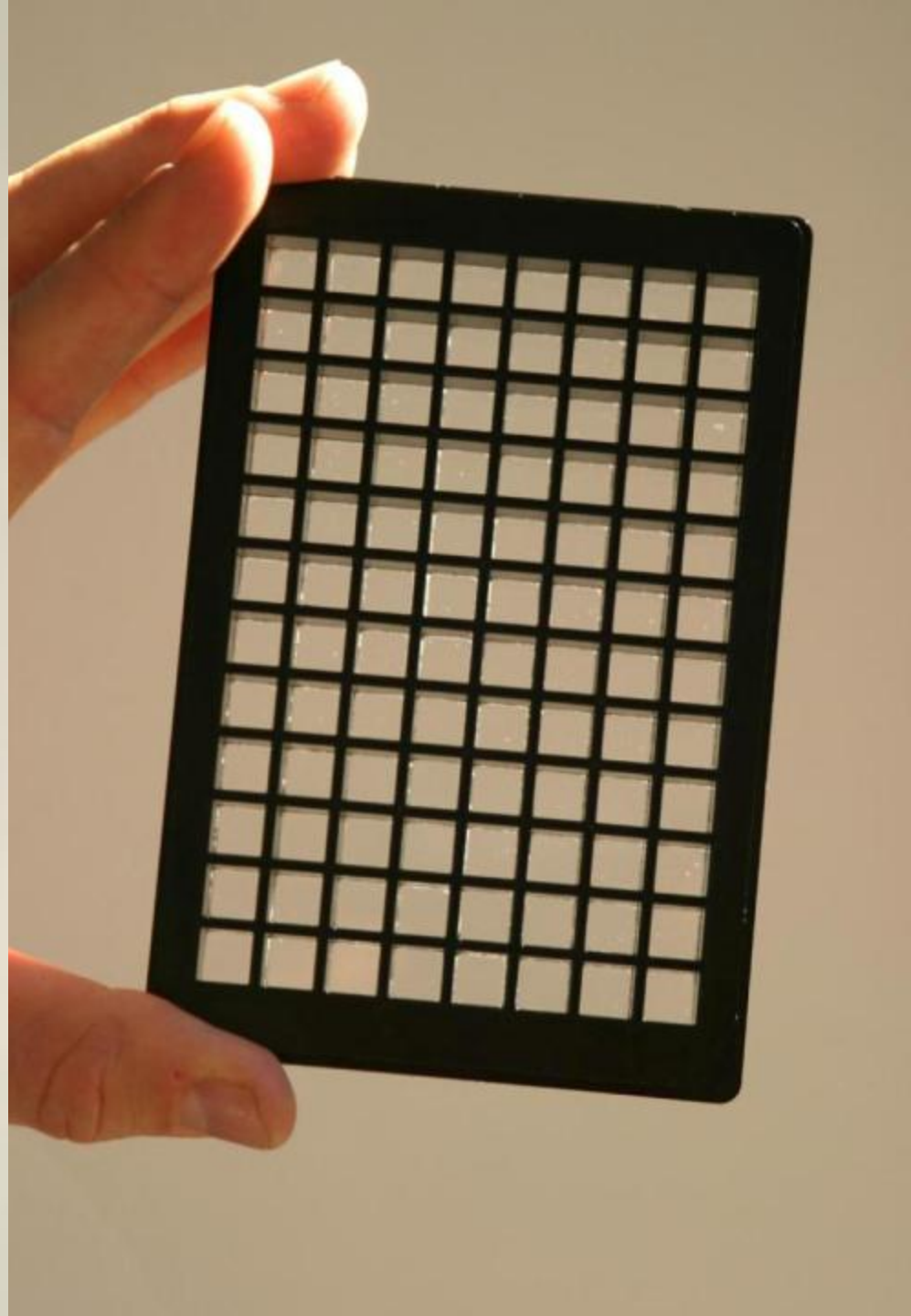

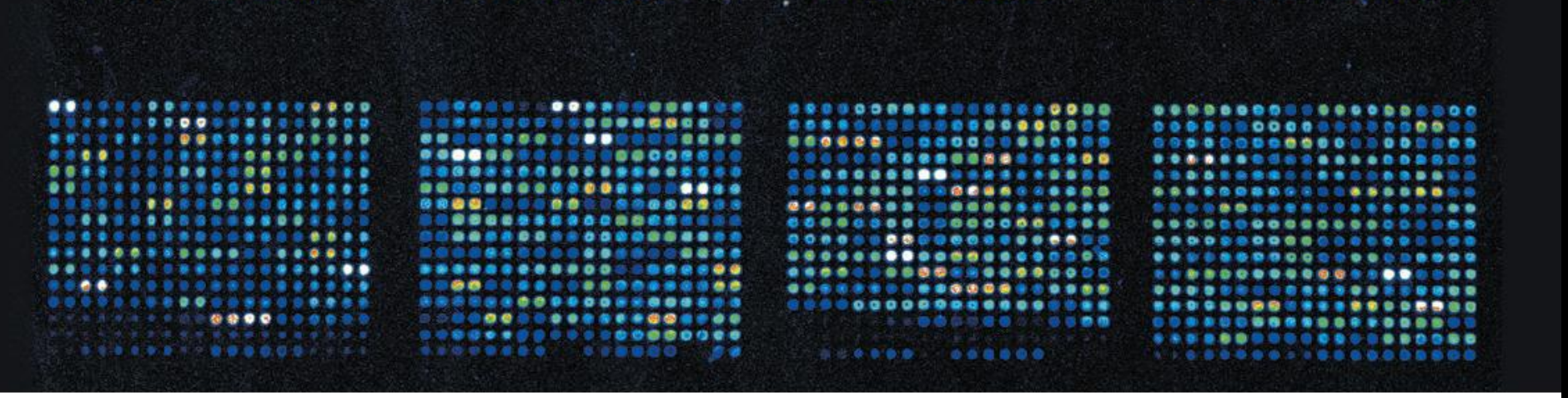

DNA microarrays allow researchers to analyse the expression of a huge number of genes simultaneously.

GENOMICS

Gene data to hit milestone

With close to one million gene-expression data sets now in publi researchers can identify disease trends without ever having to e

BY MONYA BAKER

Purvesh Khatri sits in front of an oversized computer screen, trawling for treasure in a sea of genetic data. Entering the search term 'breast cancer' into a public repository called the Gene Expression Omnibus (GEO), the postdoctoral researcher retrieves a list of 1,170 experiments, representing nearly 33,000 samples and a hoard of gene-expression data that could reveal previously unseen patterns.

That is exactly the kind of search that led Khatri's boss, Atul Butte, a bioinformatician at the Stanford School of Medicine in California, to identify a new drug target for diabetes. After downloading data from 130 gene-expression

for discovery," he says. Those are for validating hypotheses. The beauty of analysing data from multiple experiments is that biases and artefacts should cancel out between data sets, helping true relationships to stand out, Butte says. "There is safety in numbers."

And those numbers are rising rapidly. Since 2002, many scientific journals have required that data from gene-expression studies be deposited in public databases such as GEO, which is maintained by the National Center for Biotechnology Information in Bethesda, Maryland, and ArrayExpress, a large gene-expression

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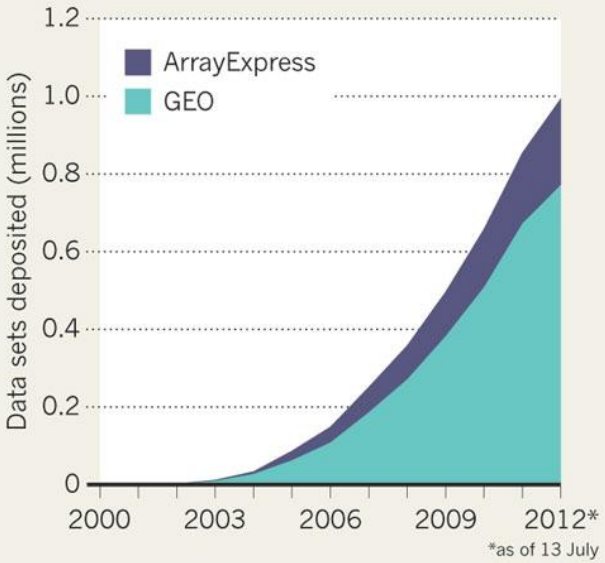
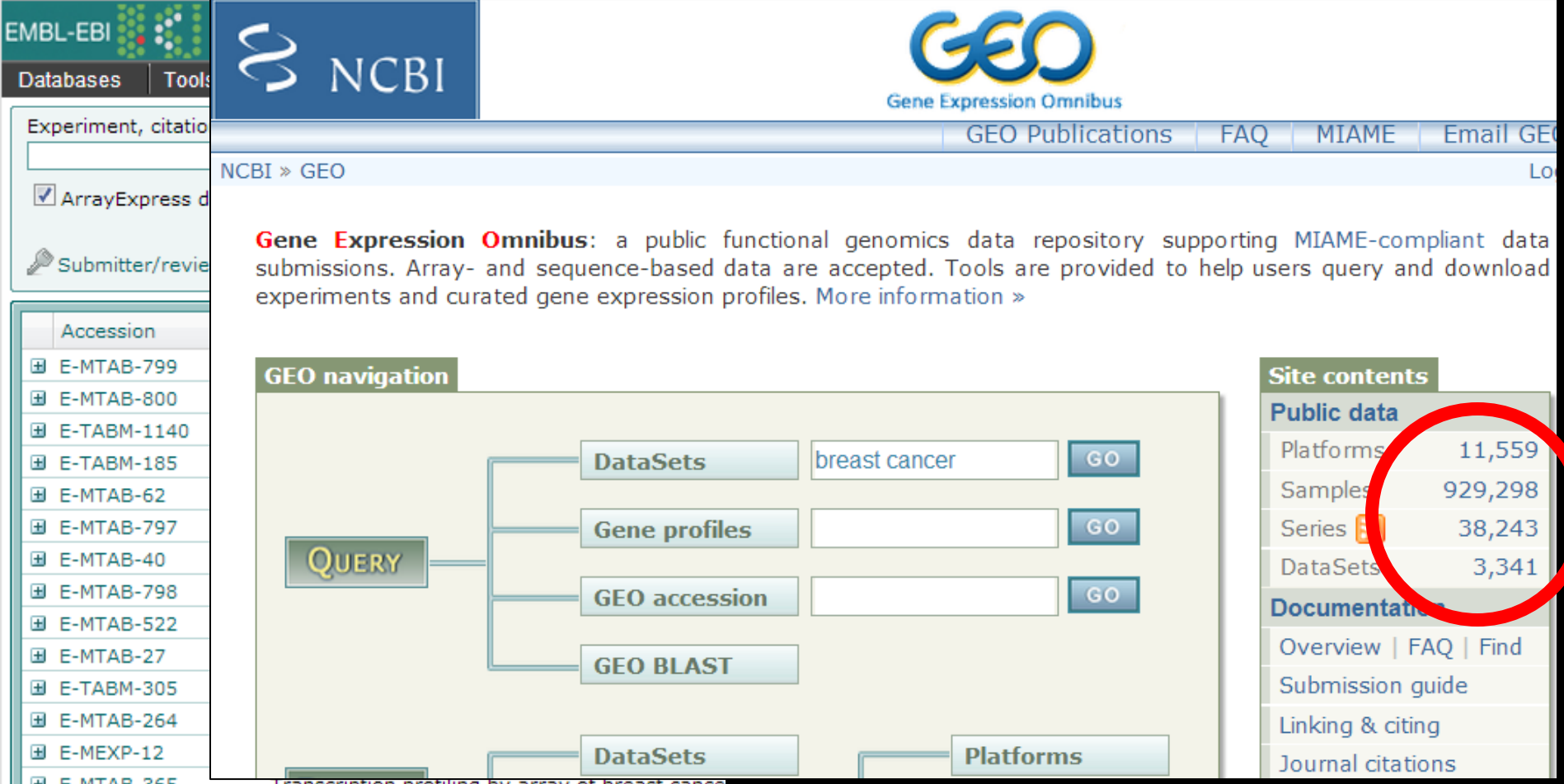
DATA DUMP

DATA DUMP

The number of gene-expression data sets in publicly available databases has climbed to nearly one million over the past decade.





Total 1.2 million microarrays available

Doubles every 2-3 years

Butte AJ. Translational Bioinformatics: coming of age. *JAMIA*, 2008.

NCBI

GEO Gene Expression Omnibus

Sign in to NCBI

GEO DataSets | GEO DataSets | breast cancer | Search

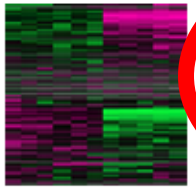
Save search | Limits | Advanced | Help

Display Settings: Summary, 20 per page, Sorted by Default order **Send to:**

Results: 1 to 20 of 39372

<< First | < Prev | Page 1 of 1969 | Next > | Last >>

1. [Leukemia inhibitory factor effect on Sin3a-silenced MCF7 **breast cancer** cell line]



Analysis of SIN3 transcription regulator homolog A (Sin3a)-depleted MCF7 cells stimulated with LIF cytokine to activate signal transducer and activator of transcription 3 (STAT3). STAT3 transcription factor is a potent oncogene. Results provide insight into role of Sin3a in mediating STAT3 activity.

Organism: Homo sapiens

Type: Expression profiling by array, transformed count, 2 agent, 2 genotype/variation sets

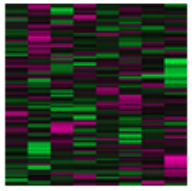
Platform: GPL570 Series: GSE35696 11 Samples

Download data: GEO (CEL)

DataSet Accession: GDS4388 ID: 4388

PubMed | Full text in PMC | Similar studies | GEO Profiles | Analyze DataSet

2. [Co-expression of tyrosine kinase receptors HER2 and HER3 in mammary epithelial cells MCF10A grown in three-dimensional cultures]



Analysis of MCF10A mammary epithelial cells expressing HER2, HER3, or HER2/HER3 heterodimer. Co-expression of HER2 and HER3 induced migration and invasion of MCF10A cells. Results provide insight into the role of HER2 and HER3 in **breast cancer**.

Organism: Homo sapiens

Type: Expression profiling by array, transformed count, 4 genotype/variation sets

Filter your results:

All (39372)

Platforms (34)

Samples (37742)

Series (1455)

Manage Filters

Top Organisms [Tree]

Homo sapiens *(36547)*

Mus musculus *(2686)*

Rattus norvegicus *(182)*

Canis lupus familiaris *(31)*

Human herpesvirus 8 *(5)*

More...

Find related data

Database: Select

Find items

NCBI

GEO Gene Expression Omnibus

Sign in to NCBI

GEO DataSets | GEO DataSets | breast cancer | Search

Save search Limits Advanced Help

Display Settings: Summary, 20 per page, Sorted by Default order

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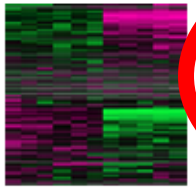

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DataSet

PubMed

2. Co-expre

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MCF10A

cancer.

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Type: Expr

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Series (1455)

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Rattus norvegicus *(182)*

Canis lupus familiaris *(31)*

Human herpesvirus 8 *(5)*

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nd related data

tabase: Select

Find items

Intel and Siemens Competition finalist

- **Andrew Liu** (2010)

Intel Science Talent Search semi-finalists

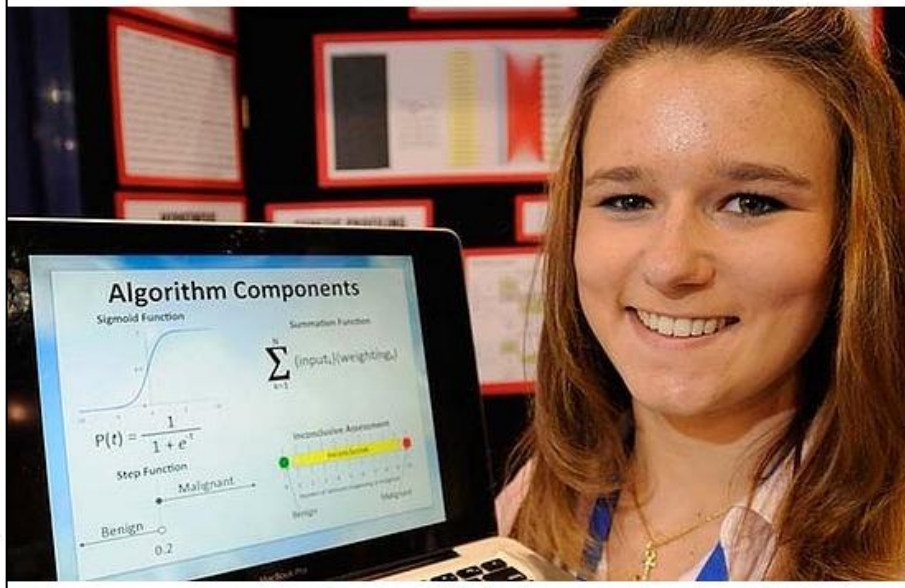
- **Rohan Chakicherla** (2009)
- **Denzil Sikka** (2009)
- **Tony Ho** (2010)
- **Irving Hsu** (2011)

The Sydney Morning Herald
Technology

Teen develops algorithm to diagnose leukaemia

8:44AM

achandran



rove that the infrastructure I built could work with multiple diseases": Brittany Wenger. *Photo: Intel*

as originally published on Mashable.

enger isn't your average high-school student: she taught a computer how to diagnose

most amazing part about science is you can answer stions and really revolutionise the world and our uledge base.

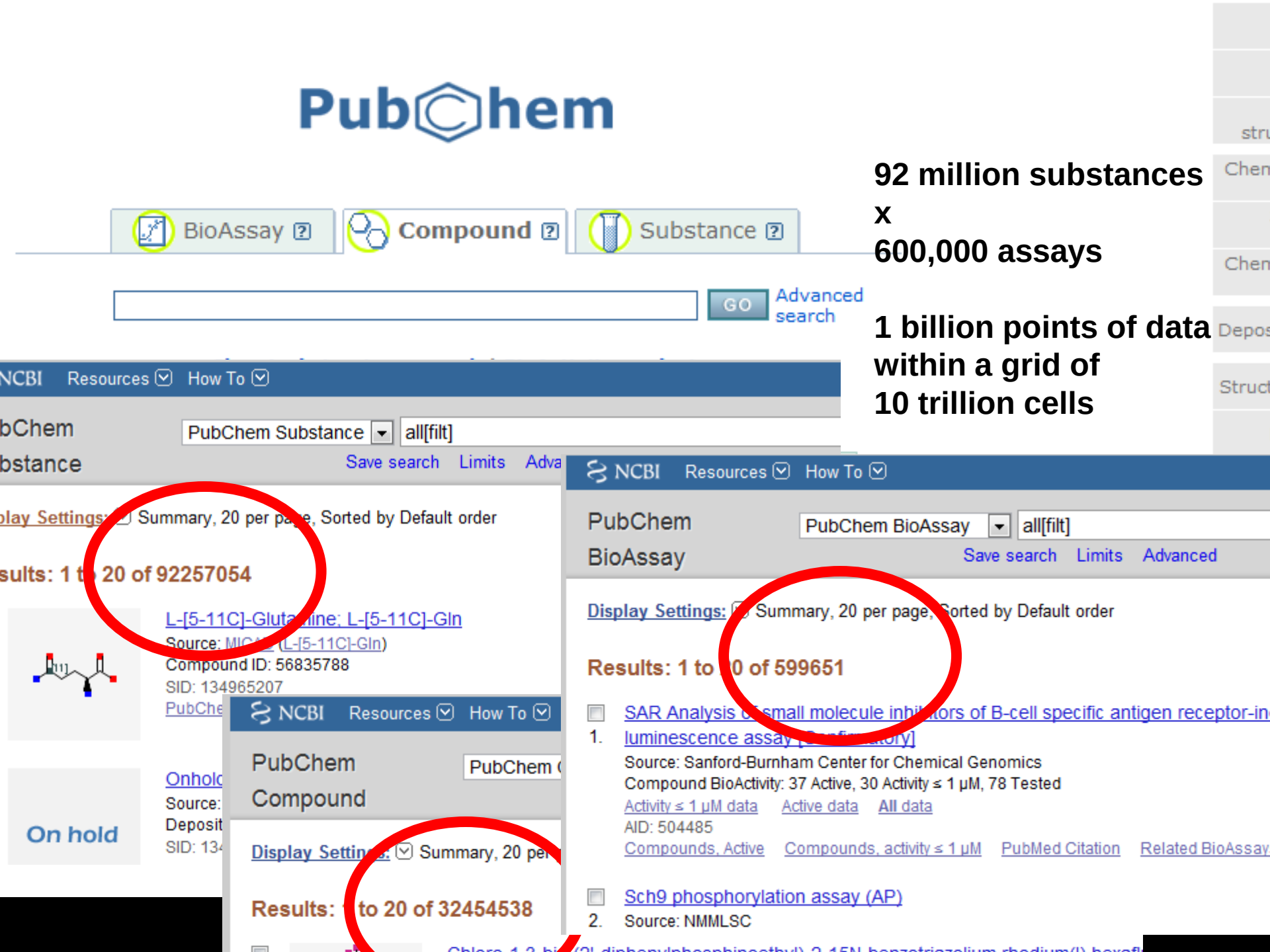
17-year-old programs artificial 'brain' to diagnose breast cancer

Published July 25, 2012 / InnovationNewsDaily Staff

A high school junior has created a computer brain that can diagnose breast cancer with 99 percent sensitivity.

Seventeen-year-old Brittany Wenger of Sarasota, Fla., wrote a breast cancer-diagnosing app based on an artificial neural network, basically a computer program whose structure is inspired by the way brain cells connect with one another. She won grand prize at the Google Science Fair for her invention in ceremony held in Palo Alto, Calif. last night (July 23).

Like other artificial intelligence programs, artificial neural networks "learn" what


PubChem
BioAssay
Compound
Substance
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x
600,000 assays
1 billion points of data
within a grid of
10 trillion cells
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Summary, 20 per page, Sorted by Default order
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L-[5-11C]-Glutamine; L-[5-11C]-Gln
Compound ID: 56835788
SID: 134965207
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PubChem Compound
Results: 1 to 20 of 32454538
PubChem BioAssay
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Display Settings: Summary, 20 per page, Sorted by Default order
Results: 1 to 20 of 599651
1. luminescence assay
Source: Sanford-Burnham Center for Chemical Genomics
Compound BioActivity: 37 Active, 30 Activity ≤ 1 µM, 78 Tested
Activity ≤ 1 µM data Active data All data
AID: 504485
Compounds, Active Compounds, activity ≤ 1 µM PubMed Citation Related BioAssay
Sch9 phosphorylation assay (AP)
2. Source: NMMLSC

Complete genomics

Revolutionizing human genome discovery

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Sample Sequence Data

Complete Genomics has recently made several complete human genome data sets available. The genomes were sequenced at the Complete Genomics commercial genome sequencing center in Mountain View, California as part our Complete Genomics Analysis Service (CGA™ Service). These data are largely consistent with the quality and attributes of other data provided to Complete Genomics customers.

When using these data in your research please cite the Complete Genomics website and our publication "Human Genome Sequencing Using Unchained Base Reads on Self-assembling DNA Nanoarrays." Science 1 January 2010 Vol. 327, no. 5961, pp. 78 - 81 DOI: 10.1126/science.1181498

69 Genome Data Set | Documentation

Overview

Complete Genomics is releasing a set of public genome sequences on its FTP server (ftp2.completegenomics.com). There are four sets of data: a Yoruba trio; a Puerto Rican trio; a 17-member 3-generation pedigree; and a diversity panel representing 9 different populations. The CEPH samples within

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Go Further. Foster.

products | services | company

blog | my account (login) | saved items | need assistance? | your c

Home › Products › By Disease

browse by disease

— A —

› Acute Cancer

› Anemia

— I —

› Idiopathic Pulmonary Fibrosis

— R —

› Rheumatoid Arthritis

browse by disease

---- A ----
- Anal Cancer
- Anemia
- Asthma

---- B ----
- Bladder Cancer
- Brain Cancer
- Breast Cancer

---- C ----
- Carcinoid
- Cervical Cancer
- Chronic Obstructive Pulmonary Disease
- Colorectal Cancer
- Crohn's Disease

---- E ----
- Esophogeal Cancer

---- F ----
- Fibromyalgia

---- G ----
- Gastric Cancer
- Gout

---- H ----
- Head and Neck Cancer
- Hodgkin's Lymphoma

---- I ----
- Idiopathic Pulmonary Fibrosis

---- K ----
- Kidney Cancer

---- L ----
- Leukemia
- Liver Cancer
- Lung Cancer

---- M ----
- Melanoma
- Monoclonal Gammopathy
- Multiple Myeloma
- Myelodysplastic Syndrome
- Myeloproliferative Disorders

---- N ----
- Non-Hodgkin's Lymphoma
- Normal

---- O ----
- Osteoarthritis
- Osteosarcoma
- Ovarian Cancer

---- P ----
- Pancreatic Cancer
- Prostate Cancer
- Psoriasis

---- R ----
- Rheumatoid Arthritis

---- S ----
- Sarcoidosis
- Scleroderma
- Systemic Lupus Erythematosus

---- T ----
- Testicular Cancer

---- U ----
- Uterine Cancer

Search Results

You've Selected:

Disease: Leukemia (X)

Clear All Selections

Category

Products (21)

Tissue

Bone Marrow (9)
Peripheral Blood (12)

Cell Type

B Cells CD19 (2)
B Cells Negative Selection (2)
Buffy Coat (1)
CD45 (2)
Fresh (2)
Mononuclear Cells (2)
Plasma (1)
Serum (1)
Special Processing (2)
T Cells CD3 (2)
T Cells Negative Selection (2)
Viable Plated Cells (2)

Units

0.3mL (1)
0.5 million cells (10)
0.5mL (2)
1 unit (2)
5.0 million cells (2)

Price

$0.00 - $1,000.00 (17)
$1,000.00 - $2,000.00 (2)
$2,000.00 - $3,000.00 (2)

Relevant Esoteric Tests

ABL1 (21)
ATM (21)
CDKN2A (21)
CEBPA (21)
FLT3 (21)
NPM1 (21)
NRAS (21)
TP53 (21)

Relevant Cell Markers

Leukemia

bma
Bone Marrow | B Cells, Negative Selection | Leukemia
SKU: BMA-BCE-LE
$500.00

bma
Bone Marrow | B Cells, CD19 | Leukemia
SKU: BMA-CD19-LE
$500.00

bma
Bone Marrow | T Cells, CD3 | Leukemia
SKU: BMA-CD3-LE
$500.00

bma
Bone Marrow | CD45 | Leukemia
SKU: BMA-CD45-LE
$500.00

bma
Bone Marrow | Fresh | Leukemia
SKU: BMA-FRE-LE
$2,500.00

bma
Bone Marrow | Mononuclear Cells | Leukemia
SKU: BMA-MON-LE
$750.00

bma
Bone Marrow | Special Processing | Leukemia
SKU: BMA-SPE-LE
$500.00

bma
Bone Marrow | T Cells, Negative Selection | Leukemia
SKU: BMA-TCE-LE
$500.00

bma
Bone Marrow | Viable Plated Cells | Leukemia
SKU: BMA-VPC-LE
$2,750.00

pbl
Peripheral Blood | B Cells, Negative Selection | Leukemia
SKU: PBL-BCE-LE
$600.00

pbl
Peripheral Blood | Buffy Coat | Leukemia
SKU: PBL-BUF-LE
$50.00

pbl
Peripheral Blood | B Cells, CD19 | Leukemia
SKU: PBL-CD19-LE
$500.00

Search Results

You've Selected:

Disease: Leukemia (X)

Clear All Selections

Category

Products (21)

Tissue

Bone Marrow (9)
Peripheral Blood (12)

Cell Type

B Cells CD19 (2)
B Cells Negative Selection (2)
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CD45 (2)
Fresh (2)
Mononuclear Cells (2)
Plasma (1)
Serum (1)
Special Processing (2)
T Cells CD3 (2)
T Cells Negative Selection (2)
Viable Plated Cells (2)

Units

0.3mL (1)
0.5 million cells (10)
0.5mL (2)
1 unit (2)
5.0 million cells (2)

Price

$0.00 - $1,000.00 (17)
$1,000.00 - $2,000.00 (2)
$2,000.00 - $3,000.00 (2)

Leukemia

21 Items Previous 1 2 Next View as:

15 Items Per Page

pbl

Peripheral Blood | Mononuclear Cells | Leukemia
SKU: PBL-MON-LE
$500.00

pbl

Peripheral Blood | Plasma | Leukemia
SKU: PBL-PLA-LE

pbl

Peripheral Blood | Serum | Leukemia
SKU: PBL-SER-LE
$55.00

pbl

Peripheral Blood | Special Processing | Leukemia
SKU: PBL-SPE-LE
$500.00

pbl

Peripheral Blood | T Cells, Negative Selection | Leukemia
SKU: PBL-TCE-LE
$600.00

pbl

Peripheral Blood | Viable Plated Cells | Leukemia
SKU: PBL-VPC-LE
$1,000.00

Previous 1 2 Next

pbl

Peripheral Blood | Plasma | Leukemia

SKU: PBL-PLA-LE

$55.00

Be the first to review this product

Quick Overview: 0.5mL Plasma specimen collected in K2EDTA tube and stored in 1.0mL cryovial. Sample stored at -80C and shipped on dry ice.

# of Samples per Patient

-- Please Select --
-- Please Select --
1
2 +$55.00
3 +$110.00
4 +$165.00
5 +$220.00
6 +$275.00
7 +$330.00

Disease subtype

-- Please Select --

Units

-- Please Select --

add to cart

Add to Saved Items | Email A Colleague

Overview › | Product Reviews ›

Additional Information

SKU	PBL-PLA-LE
Treatment Status	Any Treatment, Pre Treatment, Post Treatment, Active Treatment, Recurrent/Refractory Disease, Remission

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the marketplace for pharmaceutical research services

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biology chemistry dmpk pharmacology toxicology

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biology | chemistry | dmpk | pharmacology | toxicology

Bone Models

Bone Metastases
Osteoarthritis
Osteoporosis

Cardiovascular Models

Atrial Arrhythmias
Coronary Artery Disease
Hypertension
Ischemia
Myocardial Infarction
Restenosis
Ventricular Tachycardia

Dermatology Models

Acne
Atopic Dermatitis
Hair Growth
Lupus
Psoriasis
Rosacea
Skin Graft
Wound Healing

Diabetes Models

BB/W Rats
Food Intake
Goto-Kakizaki Rats
Non Obese Diabetic Mice
Obese Mice
Primate Diabetes
Streptozotocin Mice
Streptozotocin Rats
More...

Genitourinary Models

Chronic Kidney Disease
Cystometry
Endometriosis
IGA Glomerulonephritis
Interstitial Cystitis
Spinalized Rats

In Vitro Models

In Vitro Bone Models
In Vitro CVD Models
In Vitro Diabetes Models
In Vitro Eye Models
In Vitro Oncology Models
In Vitro Skin Models

In Vivo Technologies

Cognition
EEG
Electrophysiology
Imaging
Microdialysis

Infectious Disease

Bacterial Infection
Dengue Virus
Hepatitis C Virus
Influenza
LCMV Mouse
Malaria

Inflammation Models

Arthritis
Delayed Type Hypersens
Edema
Hemophilia
Irritable Bowel Disease
Irritant
LPS Acute Response
Mucositis
More...

Neurological Models

Alzheimer's Disease
Anxiety
Behavioral Tests
Cerebral Palsy
Circadian Profiling
Depression
Epilepsy
Olfactory Testing
More...

Oncology Models

Angiogenesis
Cachexia

Ophthalmic Models

Cataract
Corneal Dystrophy

Otology Models

Hearing Loss
Meniere's Disease

Pain Models

General Pain
Inflammatory Pain

Respiratory Models

Ascaris Lung Allergy
Cough

ob/ob Diabetes Model - 16 Mice

Service Description

Provider: Links Biosciences is a US company with laboratories in Hangzhou, China. The laboratory has been offering exploratory (non-GLP) pharmacology services to US and Chinese biopharma since 2004.

Background: The obese mutant mouse model was first reported by Ingalls A *et al* from the Jackson Laboratory in 1951 (Obese, a New Mutation in the House Mouse [164 KB]). The obese mouse resulted from a spontaneous mutation in a gene that was named *ob* in the V stock. Mice homozygous for the obese spontaneous mutation, (Lep^ob^; commonly referred to as *ob* or *ob/ob*), are first recognizable at about 4 weeks of age. Homozygous mutant mice gain weight rapidly and may reach three times the weight of wild-type controls. In addition to obesity, mutant mice exhibit hyperphagia, a diabetes-like syndrome of hyperglycemia, glucose intolerance, elevated plasma insulin, subfertility, impaired wound healing, and an increase in hormone production from both pituitary and adrenal glands. Friedman J *et al* reported leptin in 1994, and demonstrated that leptin, the product of the *ob* gene, was produced in white adipose tissue and served as the peripheral signal to the central nervous system of nutritional status.

Service Details: This service offers a 28 day db/db mouse model of T2DM and obesity. Customer has various options that are conveyed to Links Biosciences using a Service Order Form. Customer assigns up to 16 mice to

assay depot

biology | chemistry | dmpk | pharmacology | toxicology

Home » Pharmacology » Diabetes and Obesity » Obese Mice

ob/ob Diabetes Model - 16 Mice

$9,000.00 USD
per service

9 week
turn around time

Provided By
Links Biosciences

Request Info

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Validation methods are increasingly commoditized

Scroll down to browse a list of available research models for **Type I and Type II diabetes, hyperglycemia, insulin resistance, diet-induced obesity and related diseases**. Use the filters on the left to refine the list and then click on any listing to view technical information or to ask a question.

Click on the Vendors tab to view a complete list of CROs that offer diabetes and obesity pharmacology models.

VIEW SERVICES | VIEW VENDORS | **133 results** | get help

Search Filters

Diabetes and Obesity

- BB/W Rats
- Food Intake
- Goto-Kakizaki Rats
- Non Obese Diabetic Mice
- Obese Mice
- Obese Primates
- Primate Diabetes
- Streptozotocin Mice
- Streptozotocin Rats
- db/db Diabetic Mice
- fa/fa Zucker Diabetic Rats

Certifications help

- GLP (48)
- AAALAC (28)
- GMP (20)
- ISO 9001 (7)
- GCP (7)
- FDA (5)
- USDA (4)

more

Locations

United States (64)

Univ. of Maryland School of Medicine Obesity and Diabetes Research Center

University of Maryland School of Medicine Obesity and Diabetes Research Center focuses on research of obesity, diabetes, and aging in nonhuman primates.

vendor info | Add

Transgenic Rabbit Models

Transgenic Rabbit Models offers transgenic rabbit models for the study of atherosclerosis, ophtalmology, hypertrophic myopathies, diabetes, obesity, hemostasis, respiratory diseases, AIDS, and cancer.

vendor info | Add

Ophthy-DS

Ophthy-DS offers ophthalmic model services for macular degeneration, diabetes, uveitis, and dry eye.

vendor info | Add

PharmaNess

PharmaNess offers pharmacokinetics, pharmacodynamics, formulations, behavioral assay, in vivo screening, ex vivo screening, microscopy, stereology and histology staining services.

vendor info | Add

Wisconsin National Primate Research Center

Wisconsin National Primate Research Center focuses on research of regenerative medicine, reproduction, immunology, virology, aging, and metabolic diseases.

vendor info | Add

Selected Vendors

Scroll down to browse a list of available research models for **Type I and Type II diabetes, hyperglycemia, insulin resistance, diet-induced obesity and related diseases**. Use the filters on the left to refine the list and then click on any listing to view technical information or to ask a question.

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vendor info | Add

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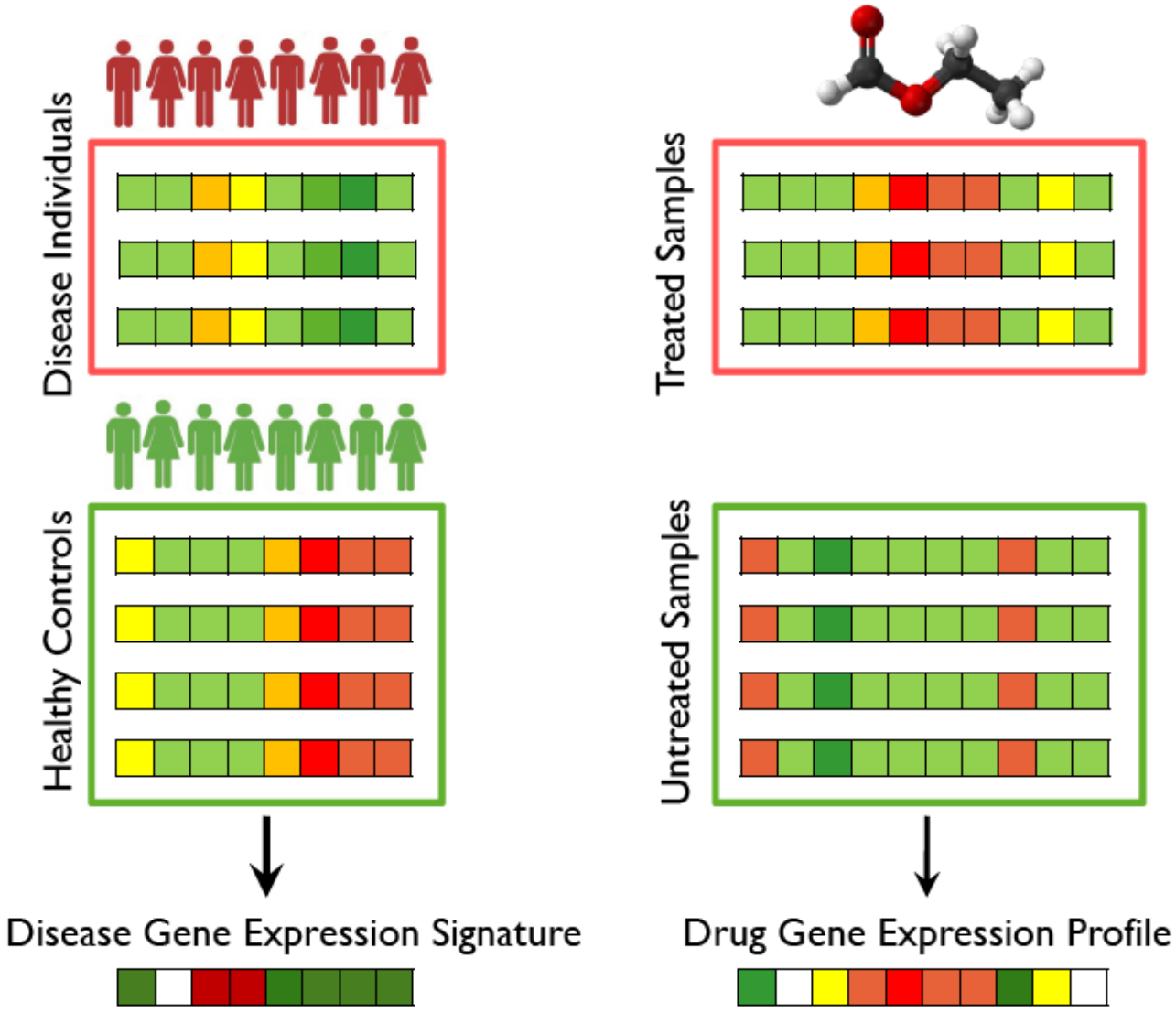
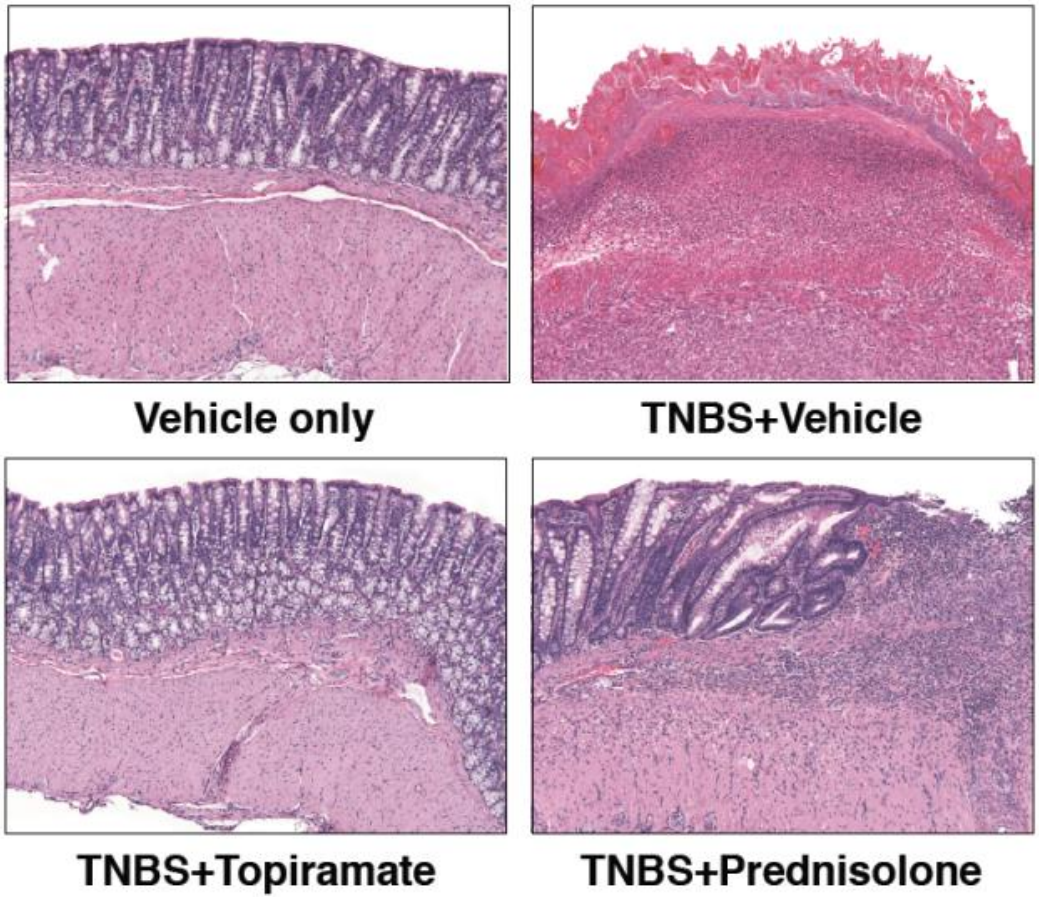
vendor info | Add

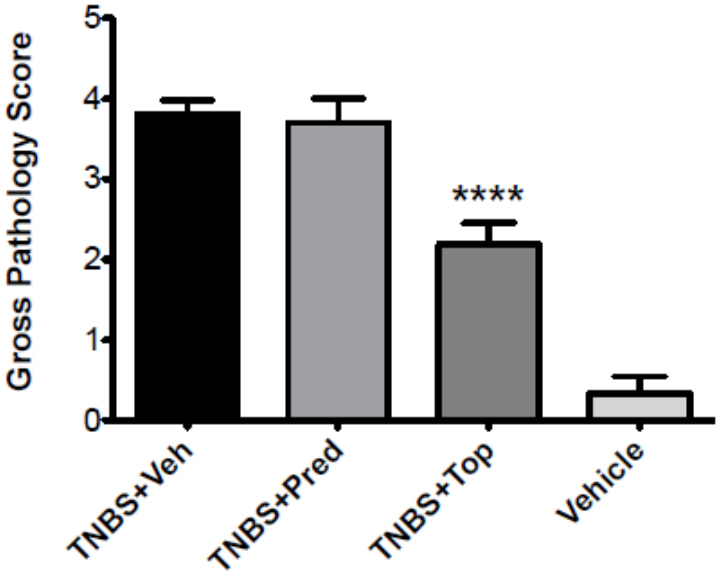


Marina Sirota
Joel Dudley

Lamb J, ..., Golub TR. *Science*, 2006.
Sirota M, Dudley JT, ..., Sweet-Cordero A, Sage J, Butte AJ. *Science Translational Medicine*, 2011.

Anti-seizure drug works against a rat model of inflammatory bowel disease





Marina Sirota
Joel Dudley
Mohan M Shenoy
Jay Pasricha

Dudley JT, Sirota M, ..., Pasricha J, Butte AJ. *Science Translational Medicine*, 2011.

Anti-seizure drug works against a rat model of inflammatory bowel disease

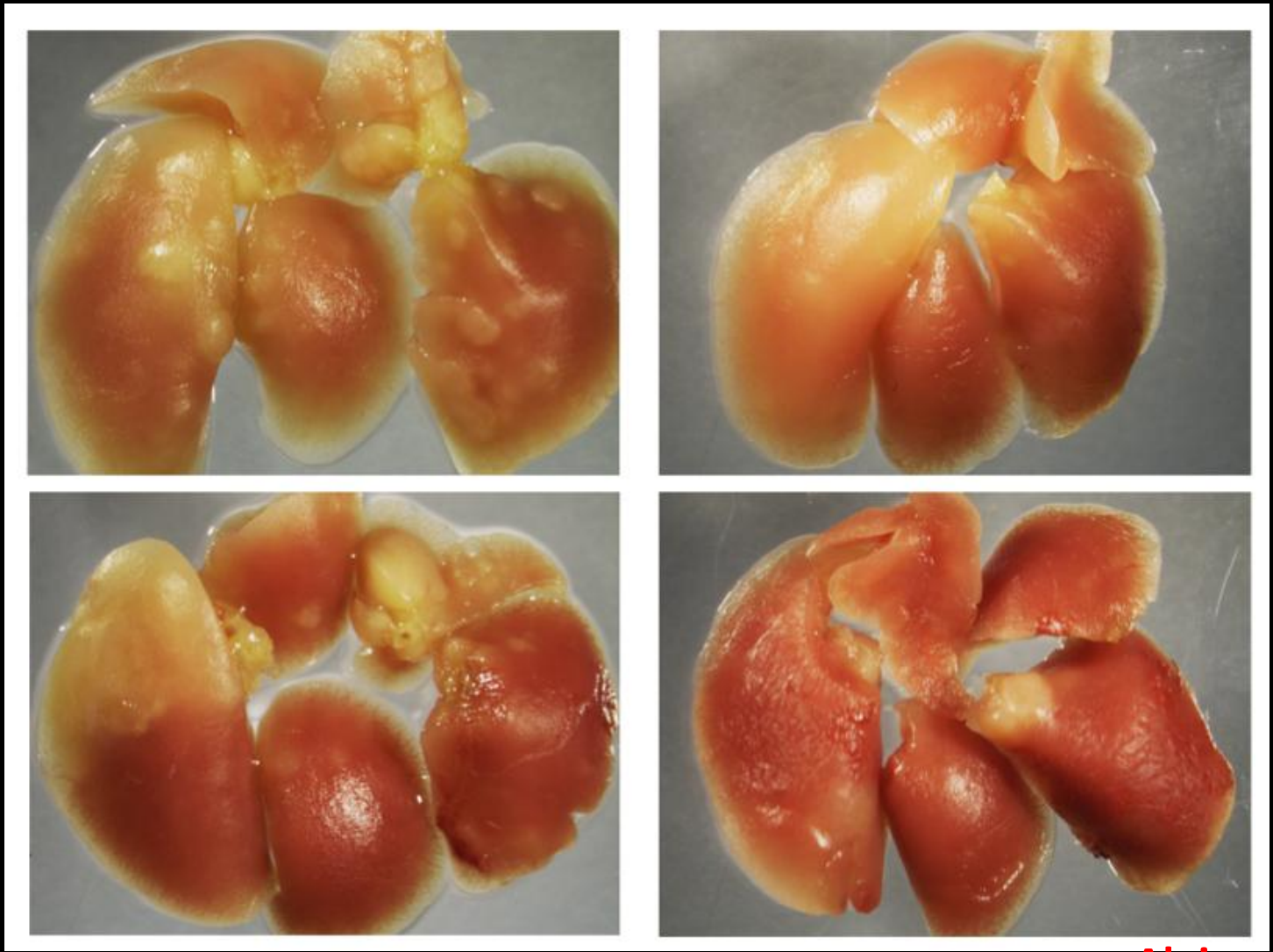
Rat colonoscopy

Rat with Inflammatory Bowel Disease

Inflammatory Bowel Disease After Anti-seizure Drug

Dudley JT, Sirota M, ..., Pasricha J, Butte AJ. *Science Translational Medicine*, 2011.

Drug X Shows Significant Activity Against Small Cell Lung Cancer



Vehicle control

Drug X

p53/Rb/p130 triple knockout model of SCLC

Mice dosed after tumor formation

Joel Dudley
Nadine Jahchan
Julien Sage
Alejandro Sweet-Cordero
NuMedii

We are used to kids starting computer, mobile, and Internet companies in garages and dorm rooms...

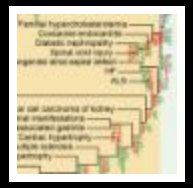
We are used to kids starting computer, mobile, and Internet companies in garages and dorm rooms...

Maybe kids today need to start "garage pharma companies" and "dorm room biotechs"?


The Tech
Museum

Take Home Points

- Big Data is out there: molecular, clinical, individual, epidemiological.
  Deciding what to do is the hard (and fun) part.



- We can use big data to understand why diseases occur and what we can do about treating them.

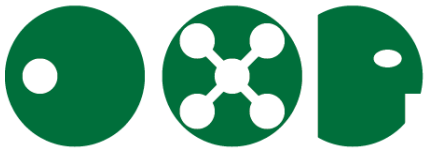
- We need new scientists (even kids) to ask questions of big data, not just tool builders.

Lessons Learned on the Way

- We are only as junior as we want to be
- Train as much as you can afford
- Set the level of your peers as high as you can
- You determine your future, not NIH
- Enable yourself first, and the world will be enabled
  - What are you going to do with the tools you build?
- Innovate beyond your university
- There is no difference between launching a startup and launching a lab
  - Writing a grant = writing a business plan
  - Convince folks with money to give some to you, to change the world
  - Impact doesn't end at a publication
- Shoot for changing the world

Collaborators

- Jeff Wiser, Patrick Dunn, Mike Atassi / Northrop Grumman
- Ashley Xia and Quan Chen / NIAID
- Takashi Kadowaki, Momoko Horikoshi, Kazuo Hara, Hiroshi Ohtsu / U Tokyo
- Kyoko Toda, Satoru Yamada, Junichiro Irie / Kitasato Univ and Hospital
- Shiro Maeda / RIKEN
- Alejandro Sweet-Cordero, Julien Sage / Pediatric Oncology
- Mark Davis, C. Garrison Fathman / Immunology
- Russ Altman, Steve Quake / Bioengineering
- Euan Ashley, Joseph Wu, Tom Quertermous / Cardiology
- Mike Snyder, Carlos Bustamante, Anne Brunet / Genetics
- Jay Pasricha / Gastroenterology
- Rob Tibshirani, Brad Efron / Statistics
- Hannah Valantine, Kiran Khush/ Cardiology
- Ken Weinberg / Pediatric Stem Cell Therapeutics
- Mark Musen, Nigam Shah / National Center for Biomedical Ontology
- Minnie Sarwal / Nephrology
- David Miklos / Oncology



Butte Lab

Systems Medicine • Stanford Pediatrics • Packard Children's Hospital

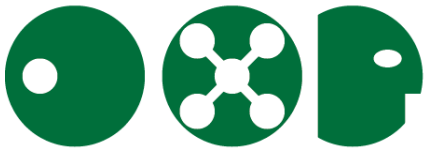
Support

- Lucile Packard Foundation for Children's Health
- NIH
- March of Dimes
- Hewlett Packard Foundation
- Howard Hughes Medical Institute
- California Institute for Regenerative Medicine
- Clayville Research Fund
- Stanford Cancer Center, Bio-X

- Tarangini Deshpande
- Kimayani Butte

Admin and Tech Staff

- Susan Aptekar
- Meelan Phalak
- Camilla Morrison
- Alex Skrenchuk



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