

- # Artificial Intelligence



PIENSE
THINK
SMAOUIJS
बेर
EKEWOY
DENKE
PENSER

\$2,000
\$13,400
\$5,000

Ken
WATSON
BRAD

Albinism	98%
Albino	10%
Porphyria	7%

CBC

A Jeopardy! game board with three contestants: Ken (\$2,000), Watson (\$13,400), and Brad (\$5,000). The board features various words and a central image of a green brain. A bar chart at the bottom shows the prevalence of Albinism (98%), Albino (10%), and Porphyria (7%). The CBC logo is in the bottom right.



HBR.ORG

Harvard Business Review

JUNE 2015

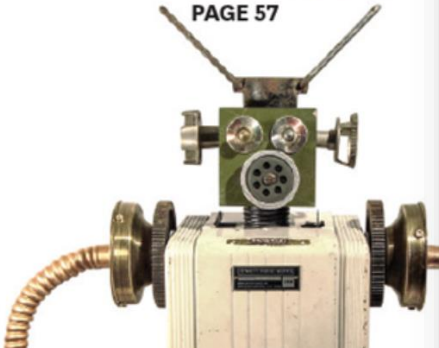
44 **The Big Idea**
You Need an Innovation Strategy
Gary A. Pisano

88 **Organization**
Luxury's Talent Factories
Andrew Shipilov and Frédéric Godart

110 **Managing Yourself**
Conquering Digital Distraction
Larry Rosen and Alexandra Samost

Meet Your New Employee

How to manage the man-machine collaboration
PAGE 57



What it takes to end an AIDS epidemic p. 226

Polar bears suffer through lean summers p. 265

Sperm produced in ovary of mutant fish p. 328

Science

\$10
17 JULY 2015
sciencemag.org

AAAS

SPECIAL ISSUE
ARTIFICIAL INTELLIGENCE

A glowing blue fiber optic network with many small lights at the ends of the fibers, resembling a complex neural network or data flow.

INSIDE: A 14-PAGE SPECIAL REPORT ON FINANCIAL TECHNOLOGY

The Economist

ISSN 0950-0804

economist.com

- How to fix America's inner cities
- The self-service economy
- Time to open up Indonesia
- Inside the anti-bribery business
- Why humans cause heatwaves

Artificial Intelligence

The promise and the peril



WRITTEN AND DIRECTED BY
ALEX GARLAND THE WRITER OF
28 DAYS LATER

EX_MACHINA

THERE IS NOTHING MORE HUMAN
THAN THE WILL TO SURVIVE

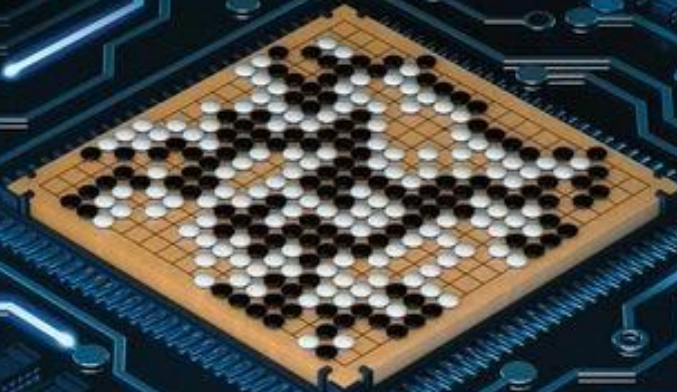
COMING SOON

UNIVERSAL PICTURES INTERNATIONAL and FILM4 present AIONA FRANKS produces EX_MACHINA starring DOMINALL GIBSON, ALICIA VIKANDER and ESCAR ISAAC
with FRANCIS MANSER, BEN SAUSBOURY and GERT BARROW, JOHN GLENN FREEMANTLE with SAMMY SHELTON DEER, MARK OUSBY
and MARK TAY, JOSEPH RIBE HARRY, JEFF JEANNE SANDR, CAROLINE LEVY, JAMES CROFT BROWN, ELI BUSCH and TESSA ROSS
with ANDREW MACDONALD and ALISON REEK, ALEX GARLAND FILM4

www.exmachinafilm.com [/ExMachinaMovie](https://www.facebook.com/ExMachinaMovie)

nature

THE INTERNATIONAL WEEKLY JOURNAL OF SCIENCE



At last — a computer program that
can beat a champion Go player **PAGE 484**

ALL SYSTEMS GO

CONSERVATION

SONGBIRDS À LA CARTE

Illegal harvest of millions
of Mediterranean birds

PAGE 452

RESEARCH ETHICS

SAFEGUARD TRANSPARENCY

Don't let openness backfire
on individuals

PAGE 459

POPULAR SCIENCE

WHEN GENES GOT 'SELFISH'

Darwin's 'calling
card' 40 years on

PAGE 462

NATUREASIA.COM

20 January 2016

Vol 529, No 7587



Humankind vs Computer



AlphaGo vs Lee Sedol

人類と人工知能の叡智をかけた
史上最強の五番勝負が始まる。

勝つのは、李世石か？ Googleか？

賞金100万ドル

対局日程：3月9、10、12、13、15日／対局場：韓国ソウル

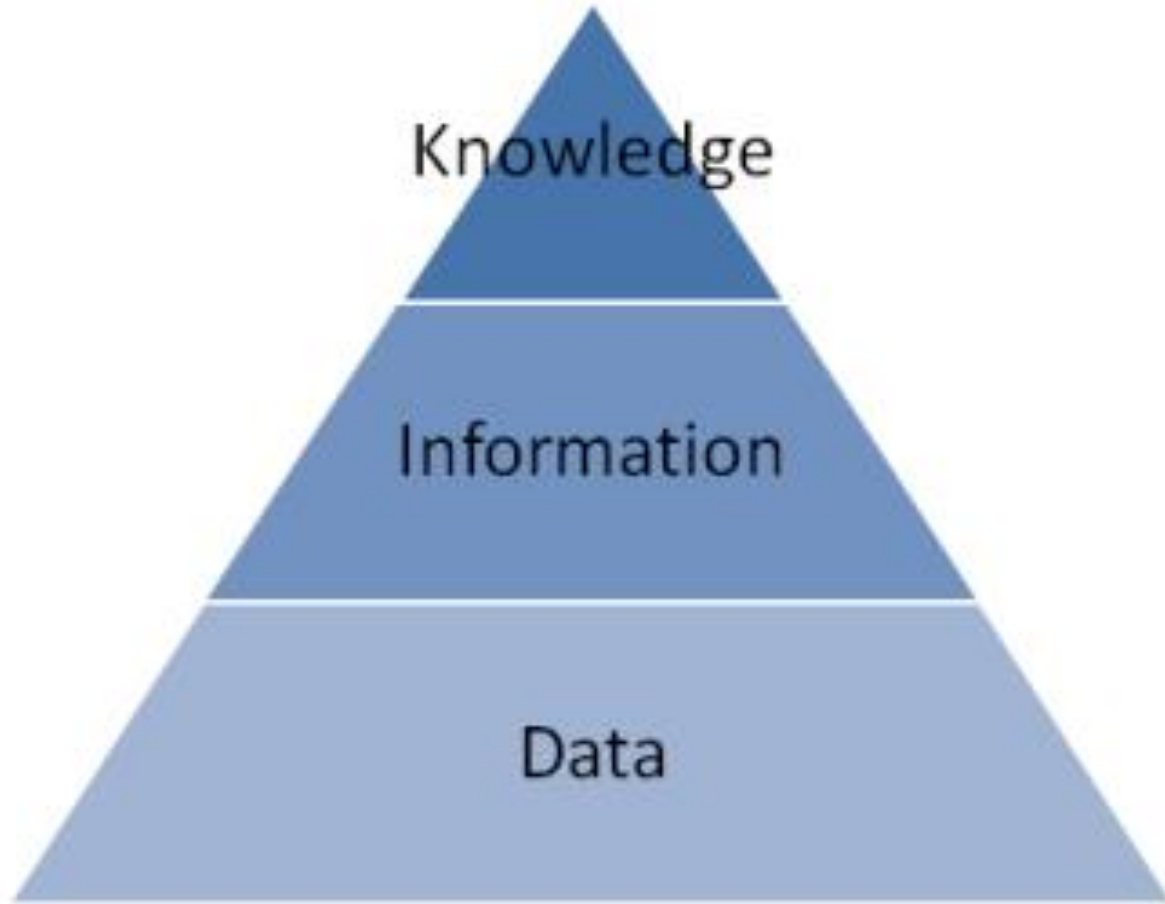
Intelligence



Knowledge

Information

Data



- Artificial Intelligence

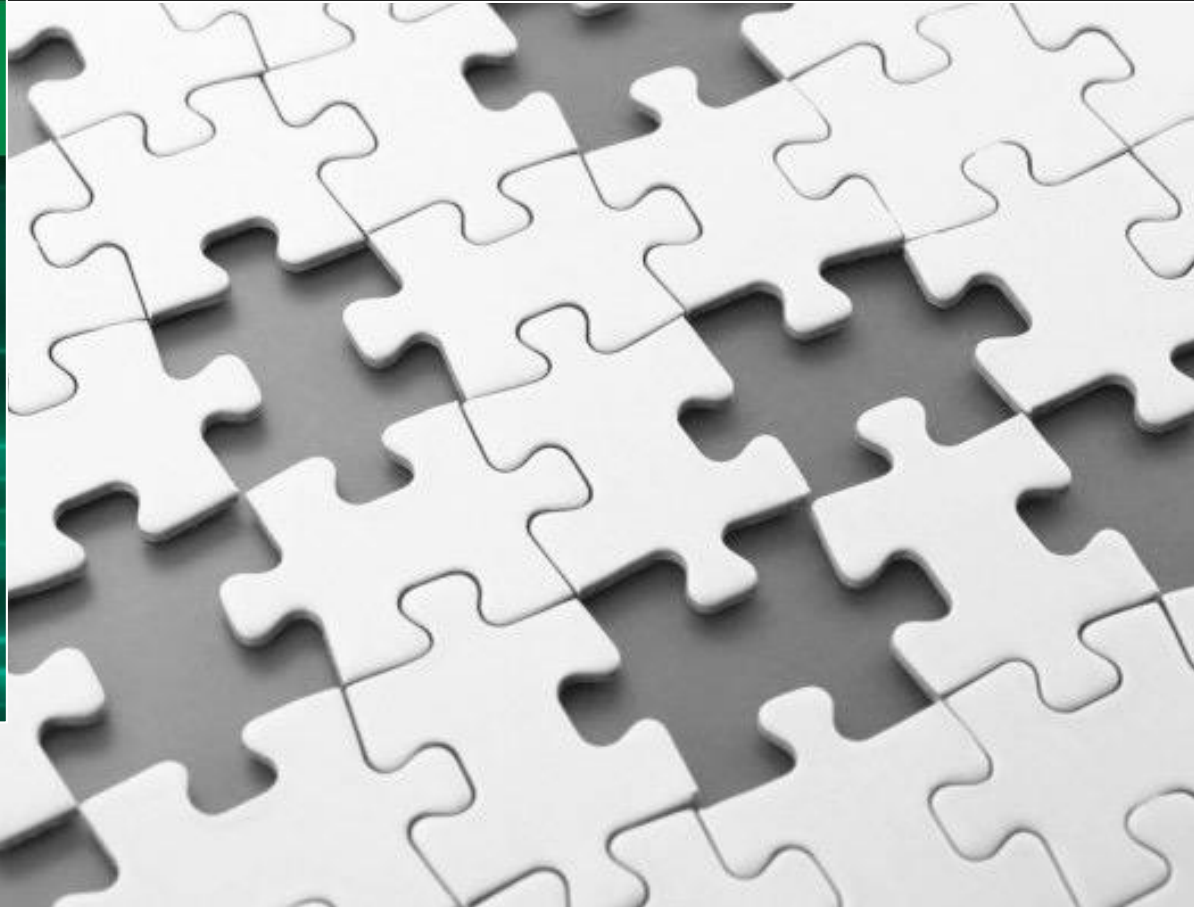
- Artificial Intelligence in Medicine
 (“Medical Intelligence”)



Missing Data

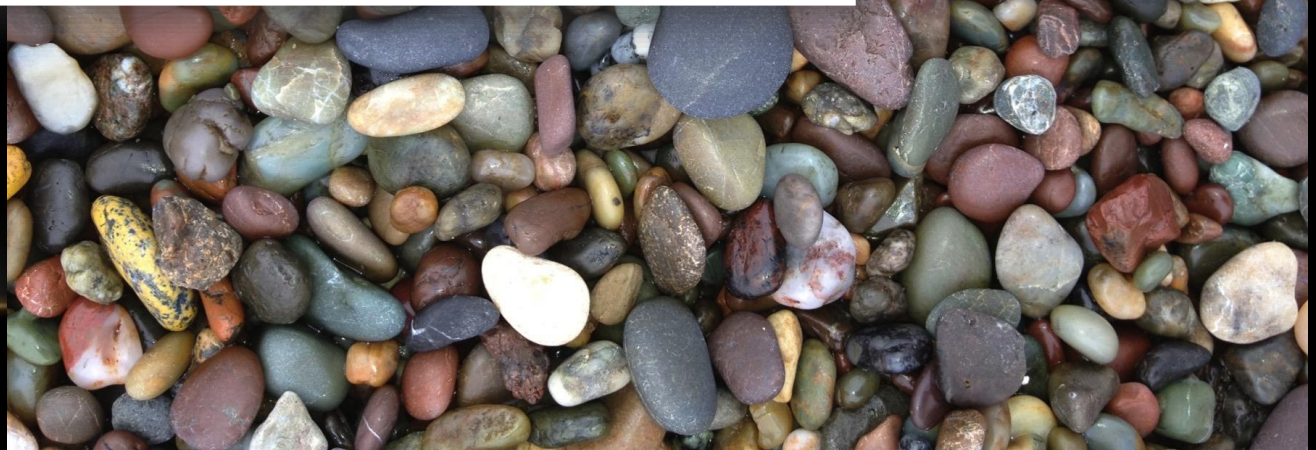
The Prevention and Treatment of
Missing Data in Clinical Trials

NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES



Unstructured Data

9 Family meeting: parents okay with trach, PD and broviac i
mplications, diuril started 4/10 Bumex gtt, Decadron 0.3mg
1 wean TiVol. Incr Bumex drip. Wean meth. 4/12 wean
DB. Feeds held (only got ~12cc). Huge leak around trach.
lg air leak, vent back to PRVC, mannitol 4/14- Febrile 38
4/16 DC Bicitra, PEEP 5, clamp pigtail (=pneumo), DC
nex to scheduled. 4/18 CT to -10, start trophics 4/19 Co
s. Diuril to PO. 4/23 Fever/cx/antibx 4/24 UGI nml. i
n decadron. Blood cx (both PICC and peripheral) positiv
ratory acidosis with pH 7.1, CO 80-90 and ongoing agi



Excessive Data



By 2020, doctors will face

200x

the amount of medical data and facts that a human could possibly process.¹



And it will get worse...
The volume of medical data

doubles

every five years.²



81% of physicians
can't even spare

5 hours per month

to keep up.³



Future Data

New Health Sciences Data Sources



Drug Research



Social Media



Patient Records



Gene Sequencing



Test Results



Claims



Home Monitoring

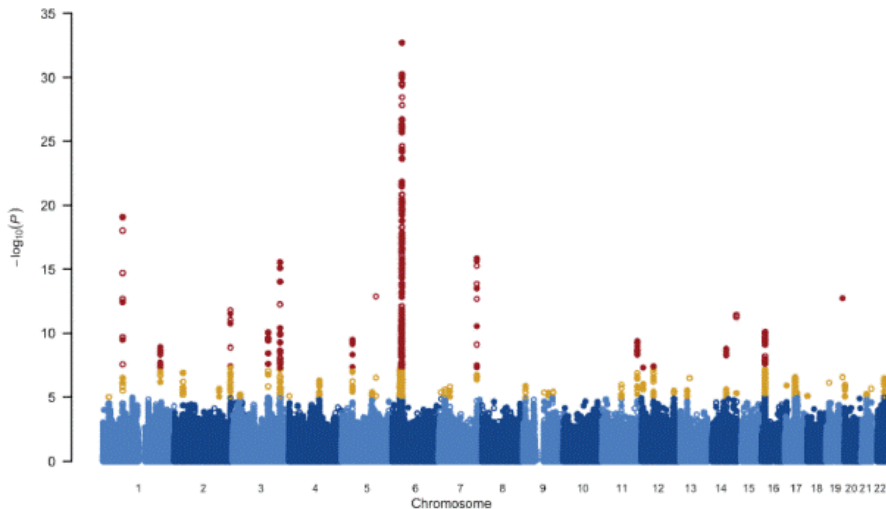
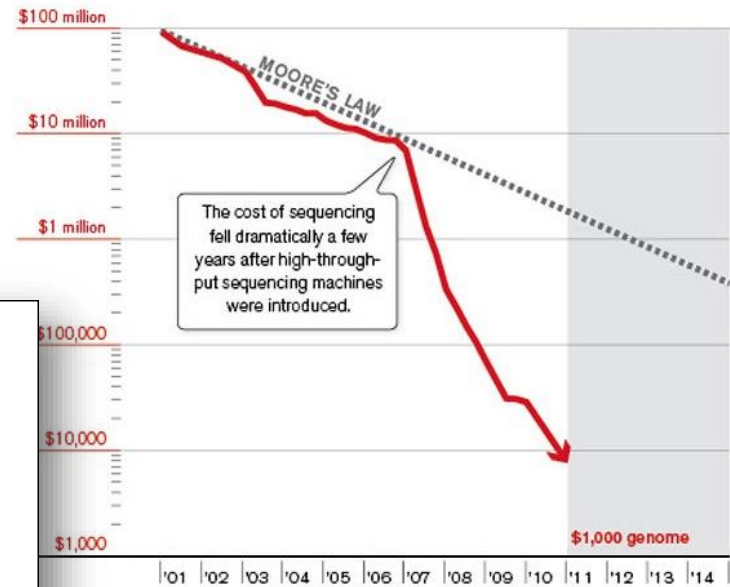


Mobile Apps

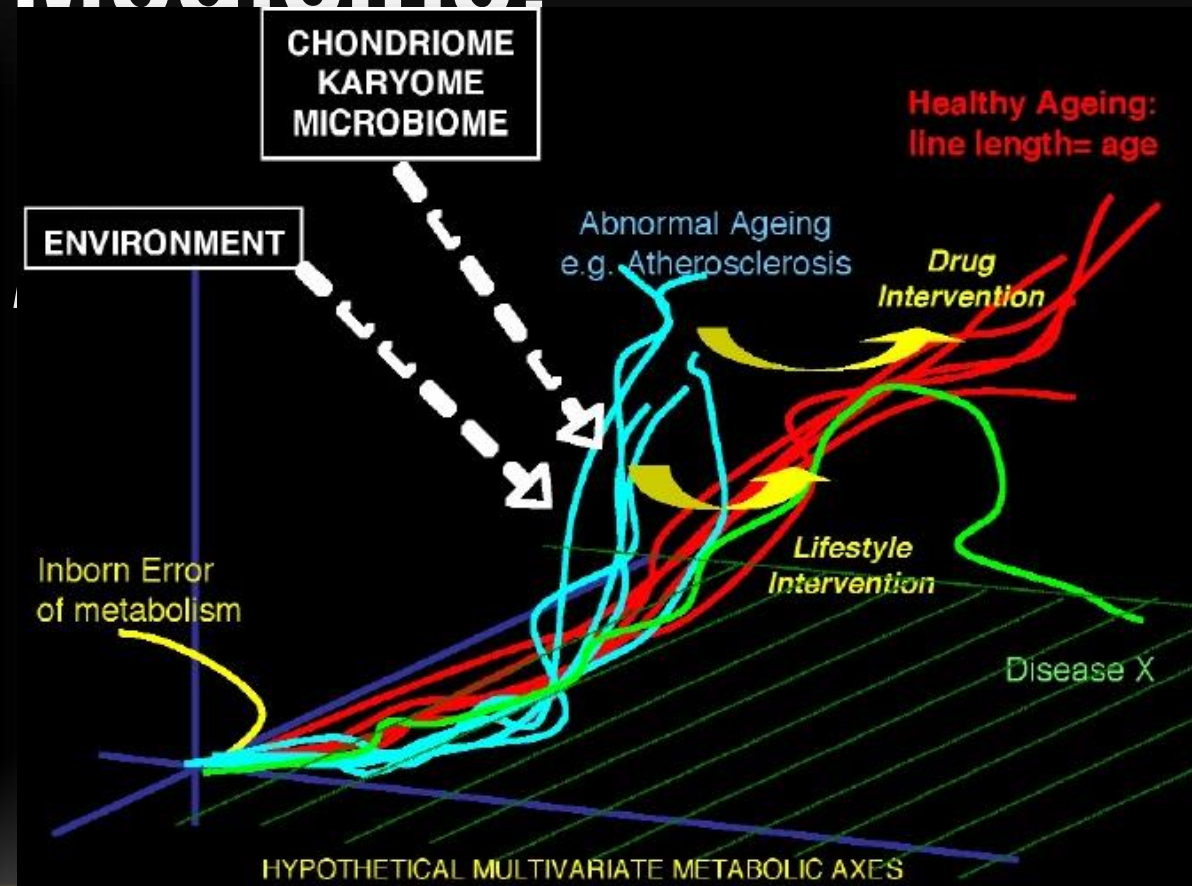
Genomic Medicine: *Next Generation*

Sequencing Costs Plummeting

Cost per genome



Precision Medicine:



Pharmacogenomics: Personalized Medicine



Internet of EveryThing *Patient*

THE HUMAN SIDE OF DATA

People go to hospitals to get well. Unfortunately, many will become even sicker because of exposure to bacteria and other germs.

They will be the unwilling recipients of Hospital-Acquired Infections, known as HAIs.

1 IN 20 PATIENTS WILL GET AN HAI — 99,000 WILL DIE

Previous methods to track hand washing proved challenging for care providers.

HOWEVER, EMPOWERING PEOPLE WITH INFORMATION AND TOOLS MAKES A BIG DIFFERENCE.

GE'S AGILETRAC

is core to the hand washing monitoring system that closes the gap between intention and reality. Information-sharing and alerts can lead to healthier outcomes.

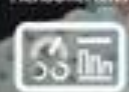
1. SENSORS



2. COMPLIANCE TRACKING



3. REAL-TIME MEASUREMENT



WITH AWARENESS COMES ACTION

When people feel informed about their behavior they are more likely to react and change it.



A 30% sustained improvement in hand washing compliance was tracked in the first eight weeks after implementing AgileTrac.

The outpatient system collects better data quality than traditional manual tracking systems.

THE RESULTS

HAI INCIDENCE OPPORTUNITIES TRACKED PER YEAR

THEN
700

NOW
1.8M

Softer hand-washing procedures have the potential to reduce the number of HAIs, decrease risk to patients and caregivers.

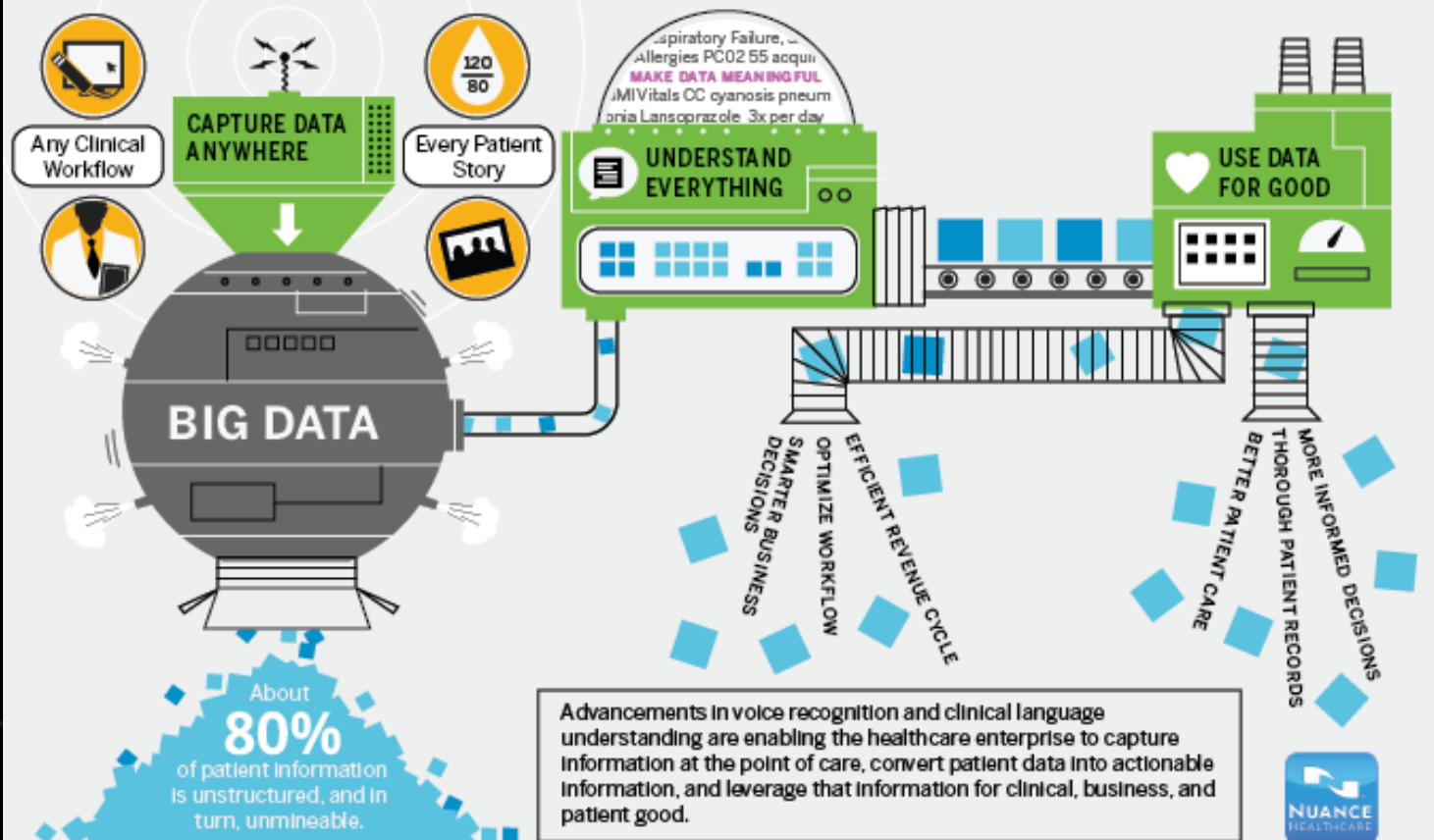
DATA BECOMES A POWERFUL TOOL FOR COLLABORATION.

Little Information

HEALTHCARE'S DATA CONUNDRUM

FROM DISPARATE DATA TO MEANINGFUL INFORMATION

We can empower healthcare organizations, providers and payers to unify the capture, analysis, and use of data to drive smarter care and business.





Knowledge and Intelligence Network

Disparate types of information are linked into multiscalar, multilateral, multidimensional relationships



Disparate
Information

- The end of theory: The data deluge makes the scientific method (randomized controlled trials) *obsolete*.

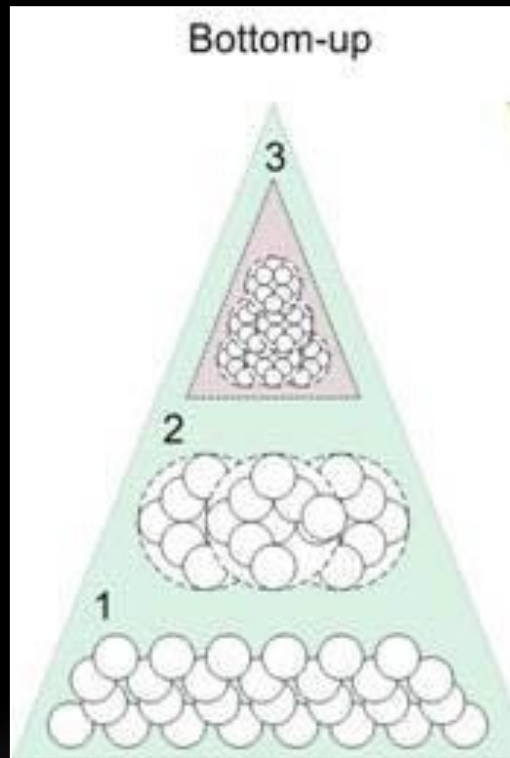
Chris

Anderson, *Wired*



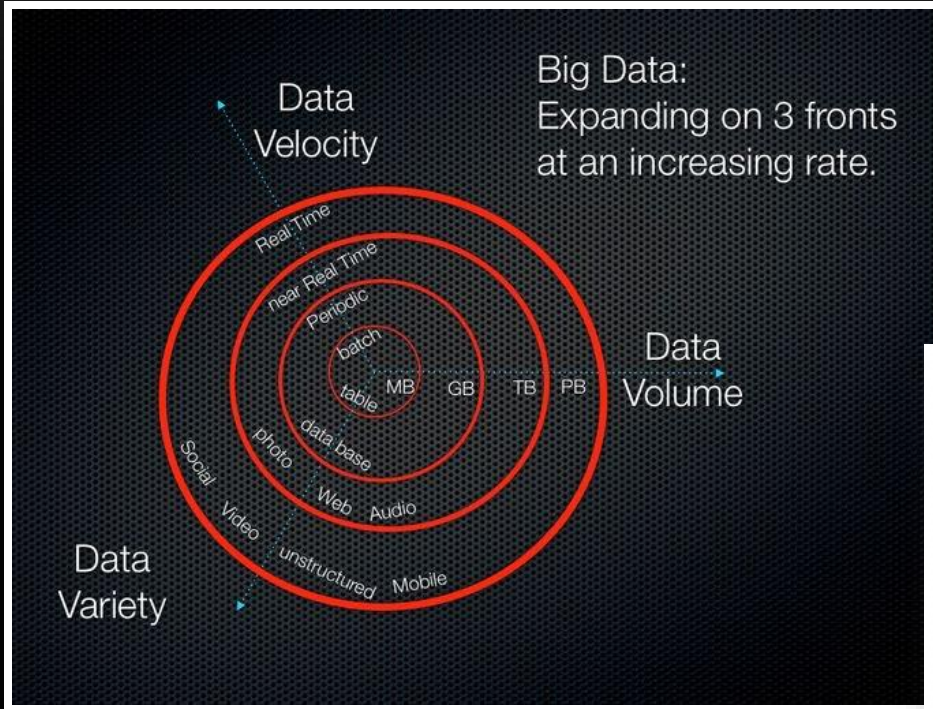
Brett Ryder

Algorithms

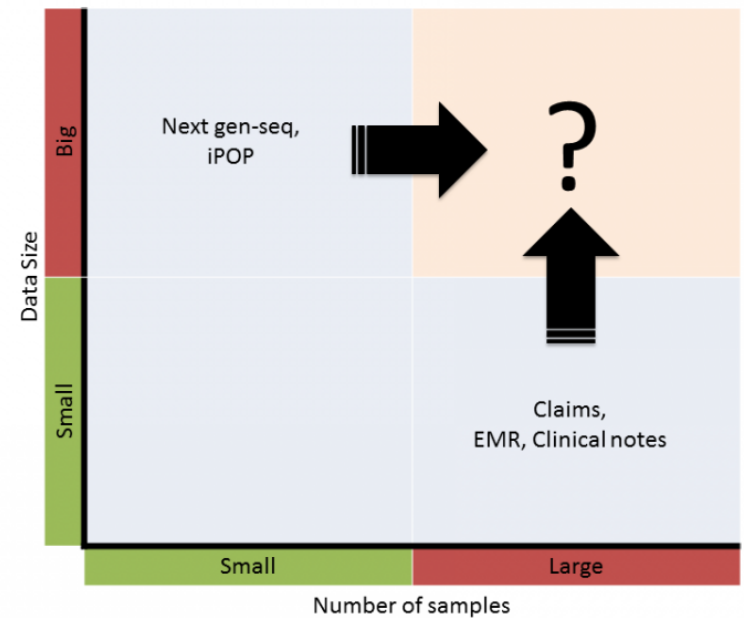


```
1 rm(list=ls())
2 library(dplyr)
3 library(gplots)
4 library(survival)
5 library(maxstat)
6 library(glmnet)
7 library(qvalue)
8
9
10 #source("https://bioconductor.org/biocLite.R")
11 #biocLite()
12 #biocLite(c("qvalue"))
13
14 # Setting the working directory here
15 setwd("~/HW2/")
16
17 # Reading in data
18
19 clinical<-read.table("~/HW2/HNSC.clin.merged.txt",
20                     sep="\t",
21                     fill=T,
22                     # skipNul=T,
23                     row.names=1,
24                     colClasses="character")
25
26 # Setting up assigned variables
27 variables<-
28   c("patient.bcr_patient_barcode", "patient.days_to_death", "patient.days_to_
29     last_followup", "patient.vital_status")
30 clinical<-clinical[variables,]
31
32 # Transposing column and row
33 clinical<-t(clinical)
34 clinical<-data.frame(clinical, row.names=NULL, stringsAsFactors = FALSE)
35
36 # Converting to numeric
37 clinical$patient.days_to_death<-as.numeric(clinical$patient.days_to_death)
38 clinical$patient.days_to_last_followup<-as.numeric(clinical
39   $patient.days_to_last_followup)
```

Big Data



[Big] Data in Medicine



Computational Power

EXPONENTIAL GROWTH OF COMPUTING

Computing Power / Per \$1,000

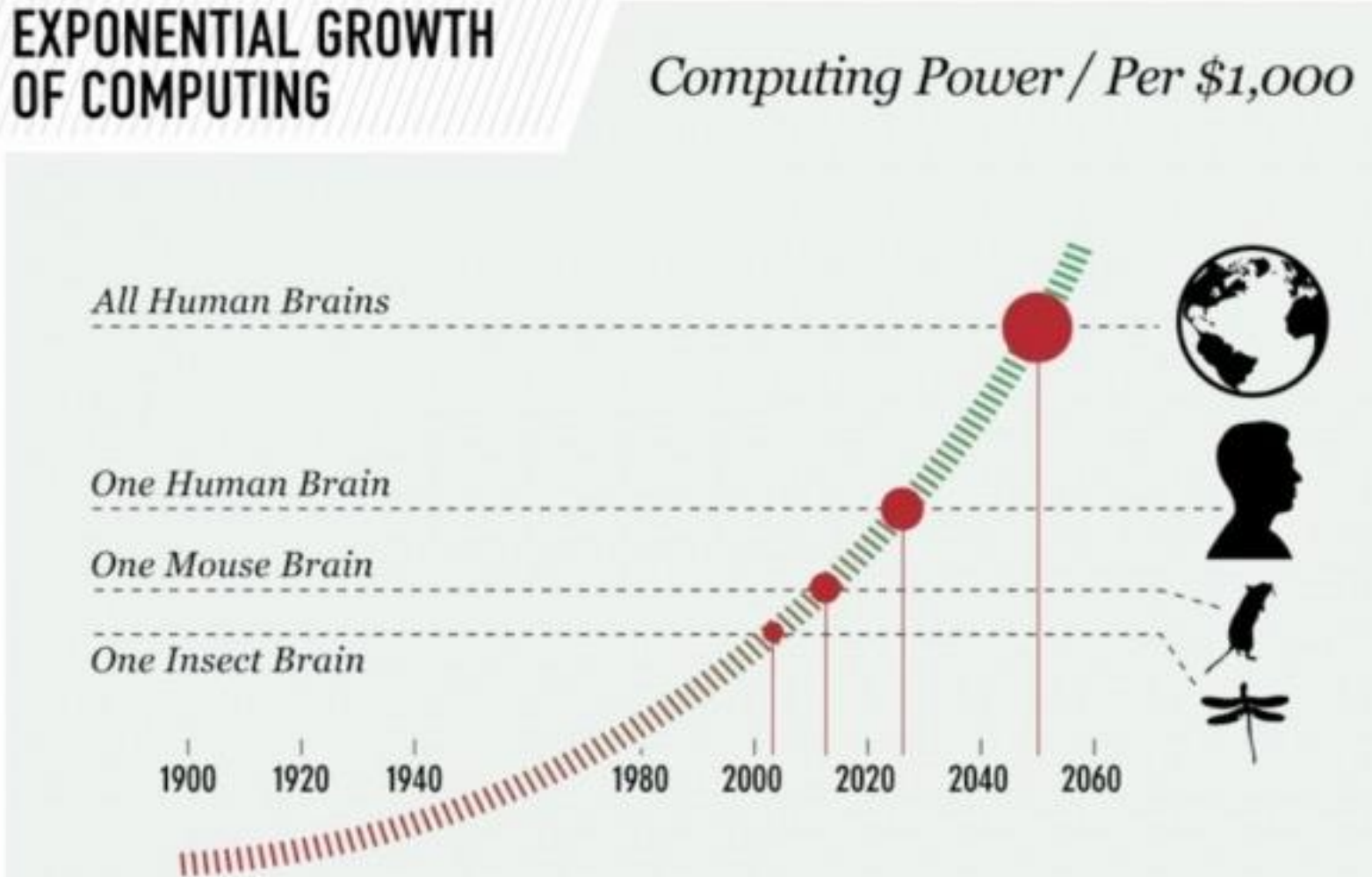
All Human Brains

One Human Brain

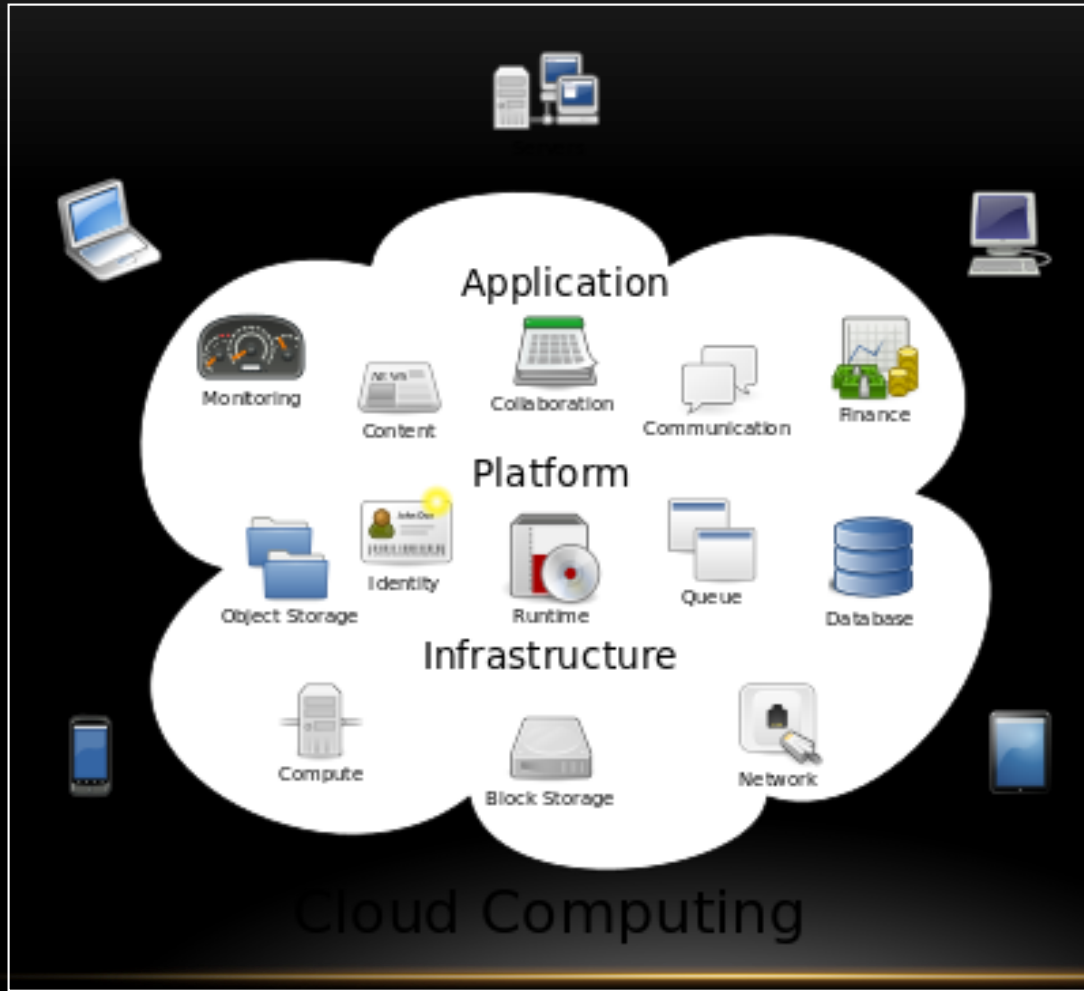
One Mouse Brain

One Insect Brain

1900 1920 1940 1980 2000 2020 2040 2060



Cloud Computing



Cognitive Computing:

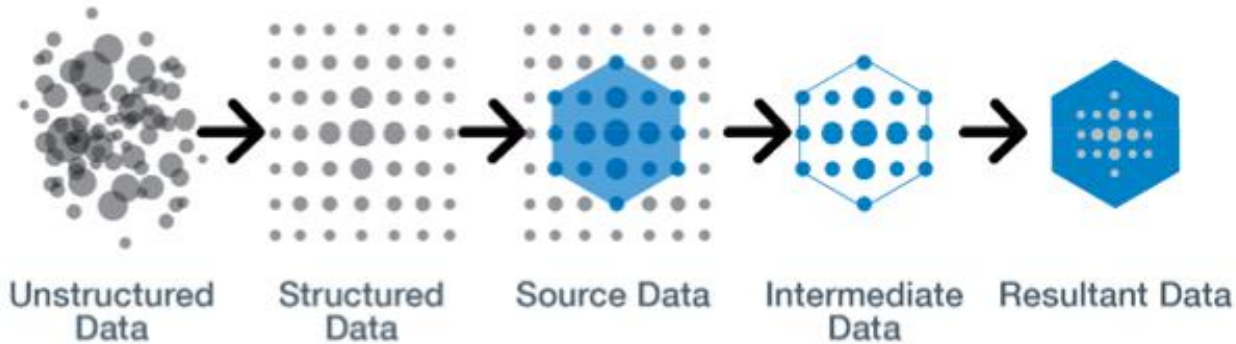
The image shows a Jeopardy! game board for a round on 'Cognitive Computing'. Three contestants are at their respective podiums: Ken with \$2,000, Watson with \$13,400, and Brad with \$5,000. The board features a central question icon of a brain with neural connections. The background displays the word 'THINK' in various languages: PIENSE, SINAOMIS, THINK, ΣΚΕΨΟΥ, DENKE, and PENSER. At the bottom, a bar chart shows the prevalence of three conditions: Albinism (98%), Albino (10%), and Porphyria (7%). The CBC logo is in the bottom right corner.

Contestant	Score
Ken	\$2,000
WATSON	\$13,400
BRAD	\$5,000

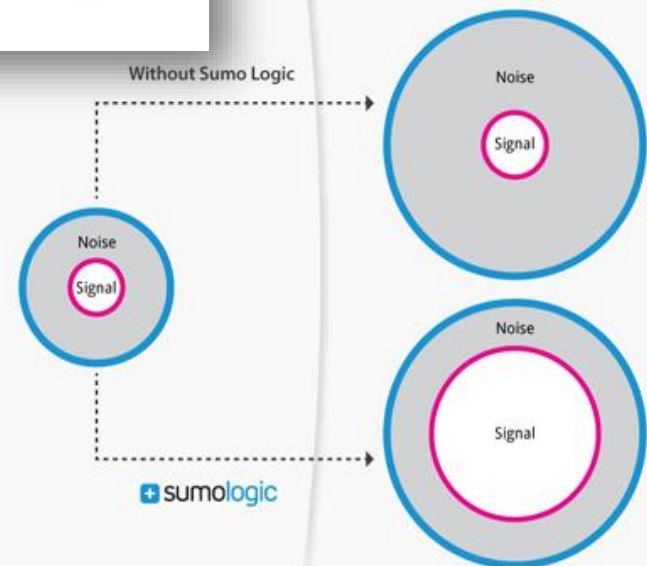
Condition	Prevalence
Albinism	98%
Albino	10%
Porphyria	7%

Data Mining: *New Knowledge from Big*

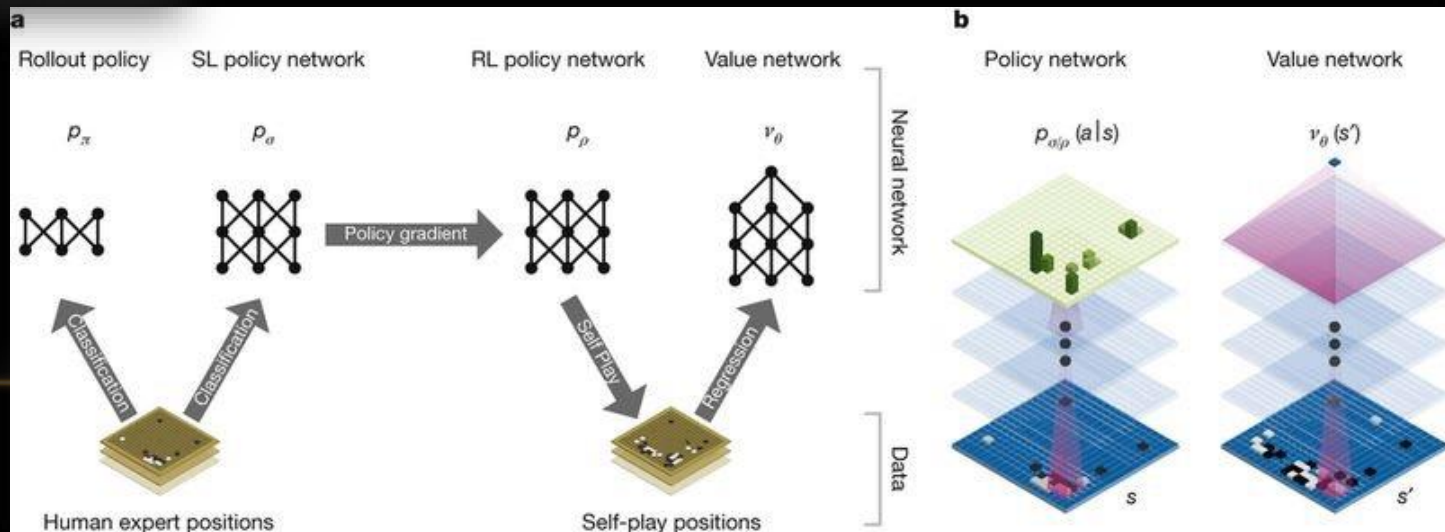
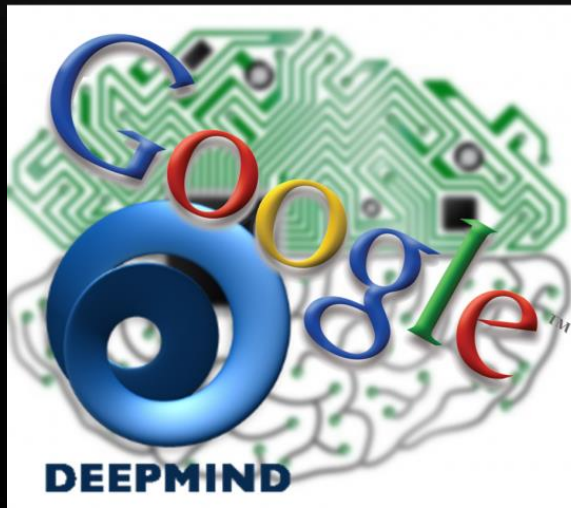
UNSTRUCTURED DATA TO RESULTS



Machine Data Tomorrow



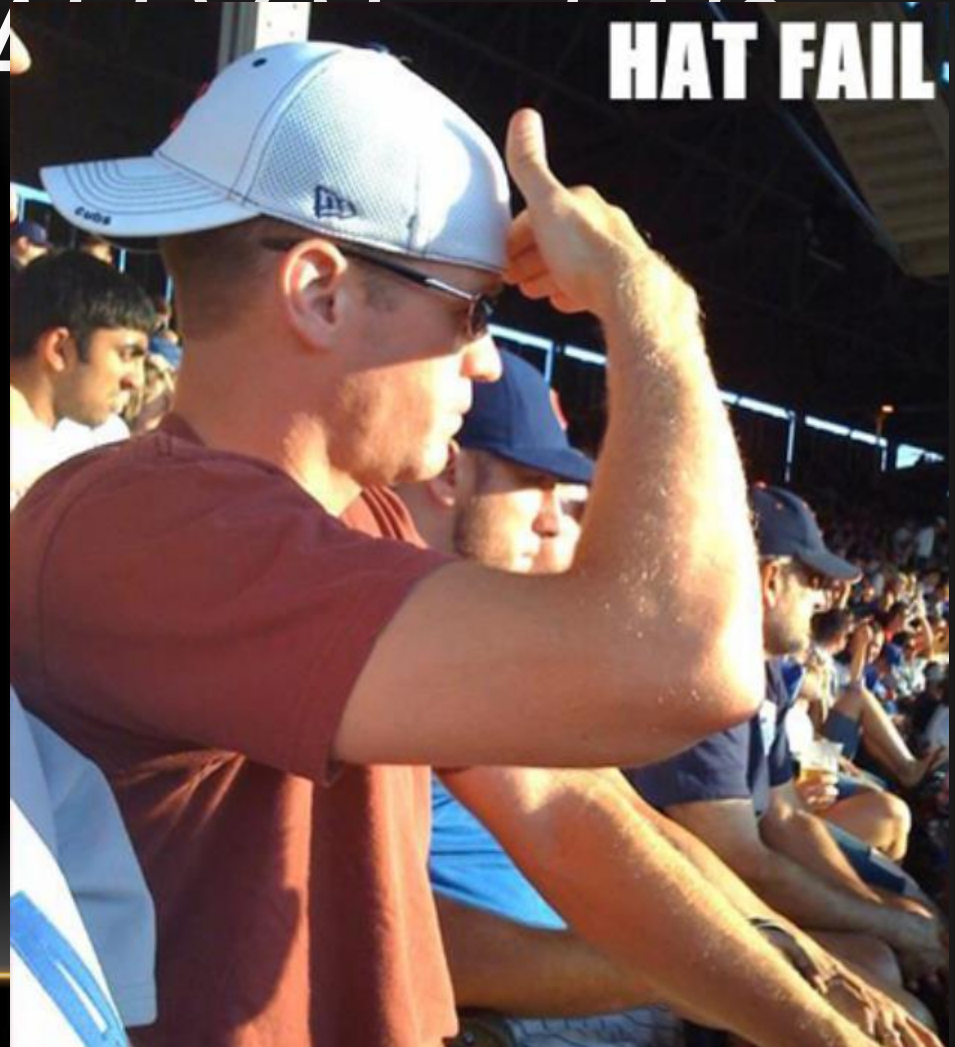
Deep Learning: *Machine Learning/ Neural Networks*

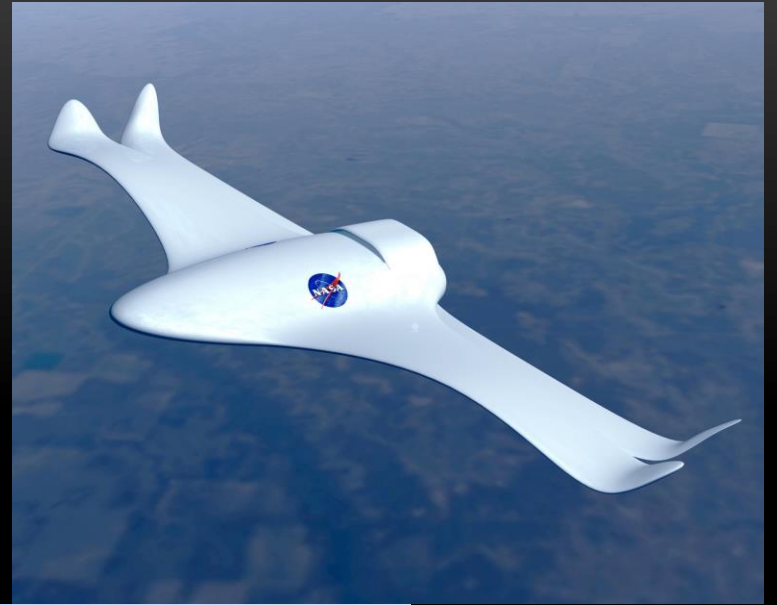


Do We Humans

REA

HAT FAIL





The Artificial Intelligence Brain

IMAGE
RECOGNITION



NATURAL LANGUAGE
PROCESSING

MACHINE
LEARNING



DECISION
SUPPORT SYSTEM



EME STREAMING ANALYTICS ARCHITECTURE

Patient Bedside Monitoring
Network

Hospital Network



ICU
Monitors



Med Surg
Monitors



OR
Monitors



ED
Monitors



Telemetry
System



Ancillary Monitoring Devices
(vents, oximeters, video, etc)

Excel Medical
BedMasterEx
& BedComm



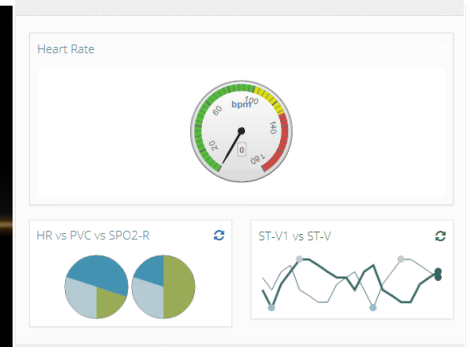
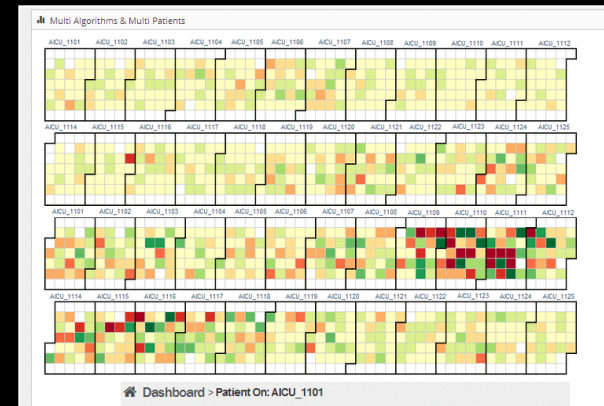
IBM Infosphere
Streams



Hospital EMR
and other data sources



Various dashboards or notifications
for clinicians & investigators



The Artificial Intelligence Brain

IMAGE
RECOGNITION



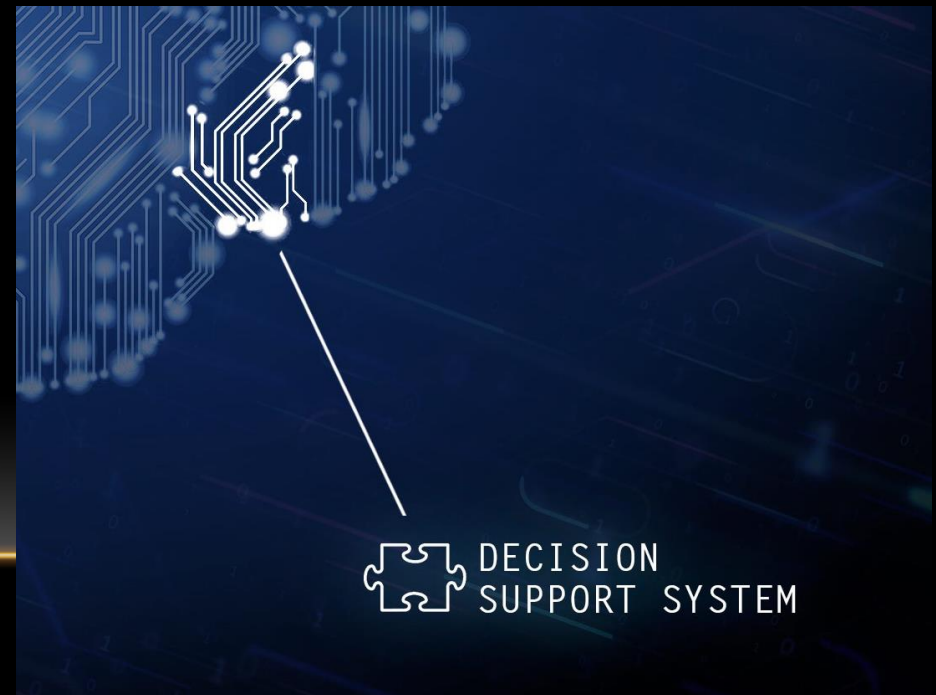
NATURAL LANGUAGE
PROCESSING

MACHINE
LEARNING



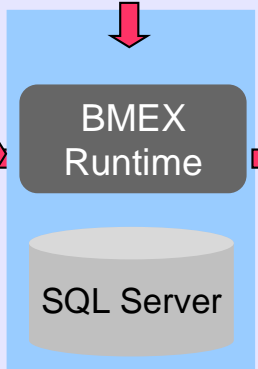
DECISION
SUPPORT SYSTEM

The Artificial Intelligence Brain

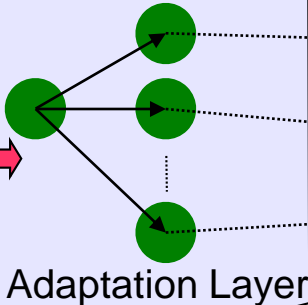


Acquiring

BedComm

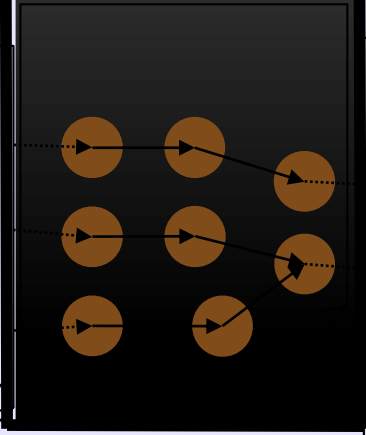


real-time / replay



SQL/NoSQL/HTTP

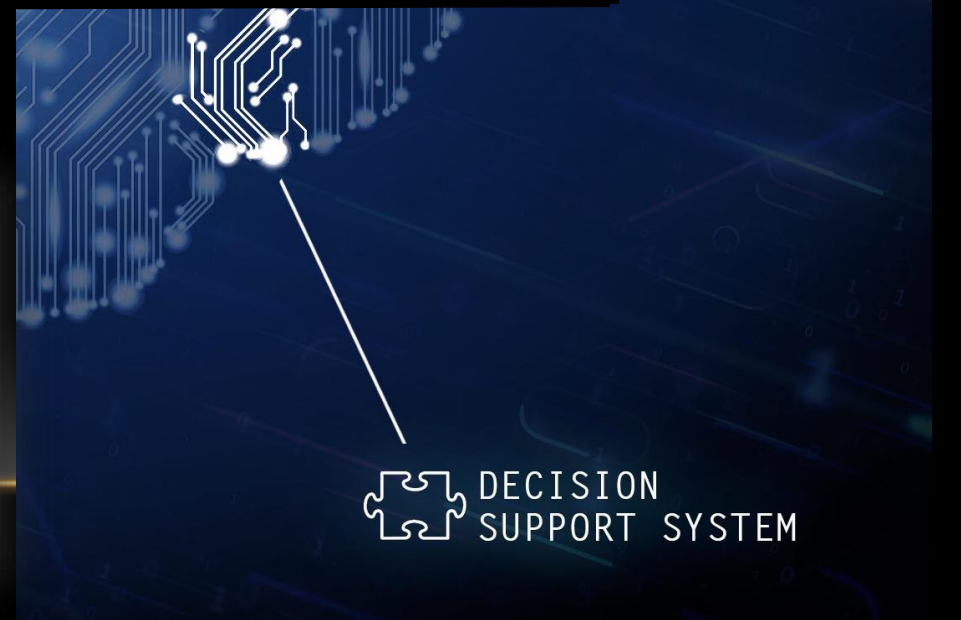
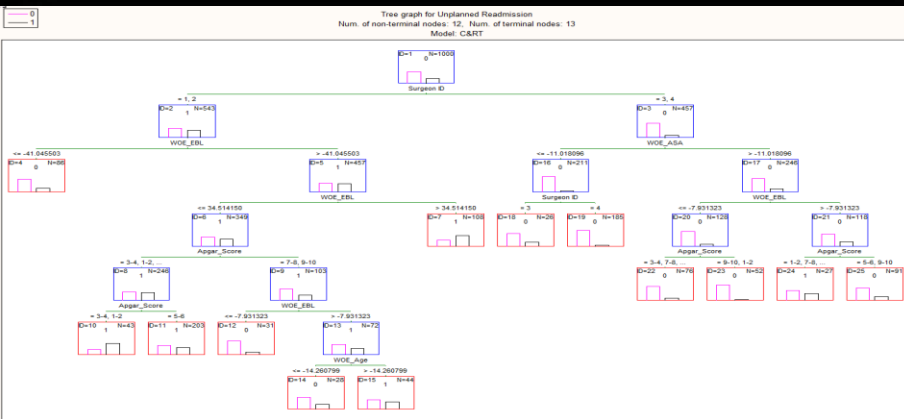
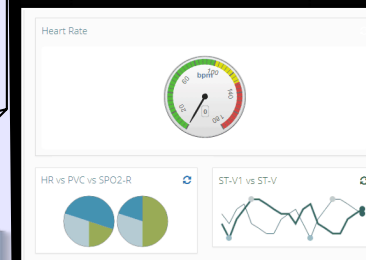
Delivery Layer



BedMasterEx



InfoSphere Streams



DECISION SUPPORT SYSTEM

The Artificial Intelligence Brain

IMAGE
RECOGNITION



NATURAL LANGUAGE
PROCESSING

MACHINE
LEARNING

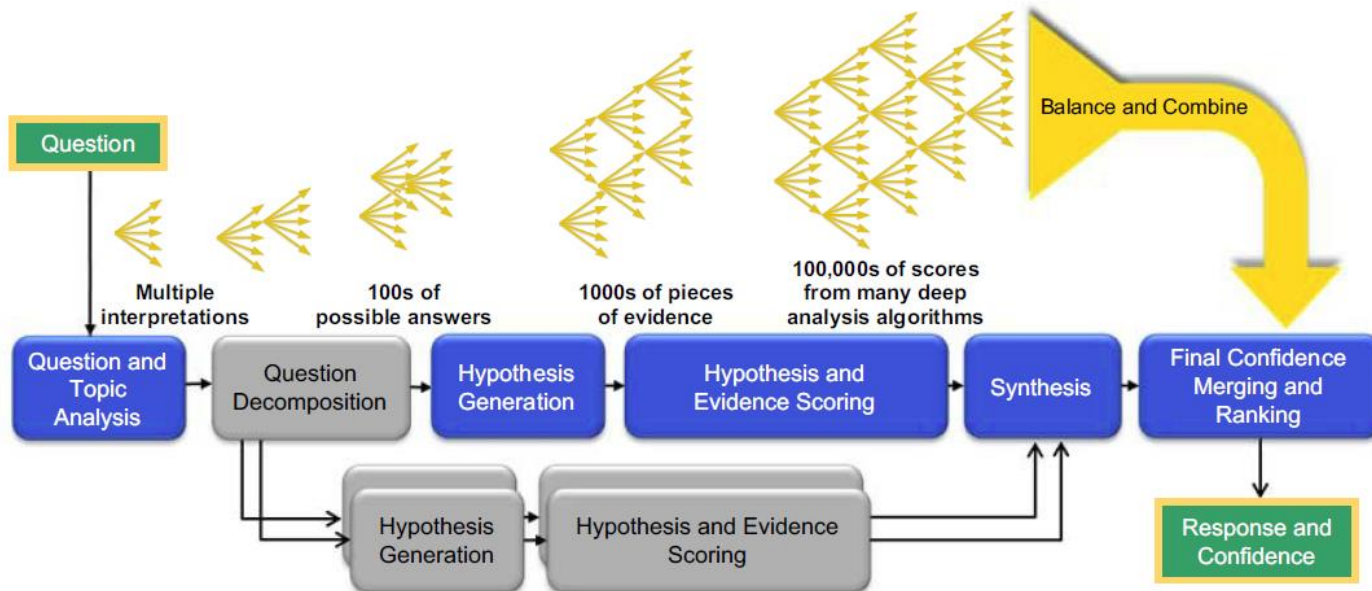


DECISION
SUPPORT SYSTEM

The Artificial Intelligence Brain



NATURAL LANGUAGE PROCESSING



The Artificial Intelligence Brain

IMAGE
RECOGNITION



NATURAL LANGUAGE
PROCESSING

MACHINE
LEARNING



DECISION
SUPPORT SYSTEM

Mag: 3\3x
(BSpline)

192 x 99

R

L

2015 May 11

IMAGE
RECOGNITION



```
function newImg = myconv2(img, kernel)
newImg = zeros(size(img));

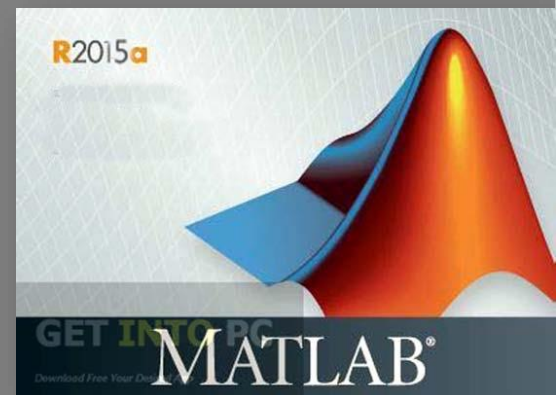
imgRow = size(img,1);
imgCol = size(img,2);

shift = (size(kernel,1)-1)/2; % maximum of how far we may go past border of img

for row = 1:imgRow
    for col = 1:imgCol
        newImgVal = 0;
        for x = -shift:shift
            for y = -shift:shift
                newRow = row - x;
                if (newRow < 1)
                    continue;
                elseif (newRow > imgRow)
                    continue;
                end

                newCol = col - y;
                if (newCol < 1)
                    continue;
                elseif (newCol > imgCol)
                    continue;
                end

                newImgVal = newImgVal + img(newRow, newCol)*kernel(x+shift+1,y+shift+1);
            end
        end
        newImg(row,col) = newImgVal;
    end
end
```



The Artificial Intelligence Brain

IMAGE
RECOGNITION



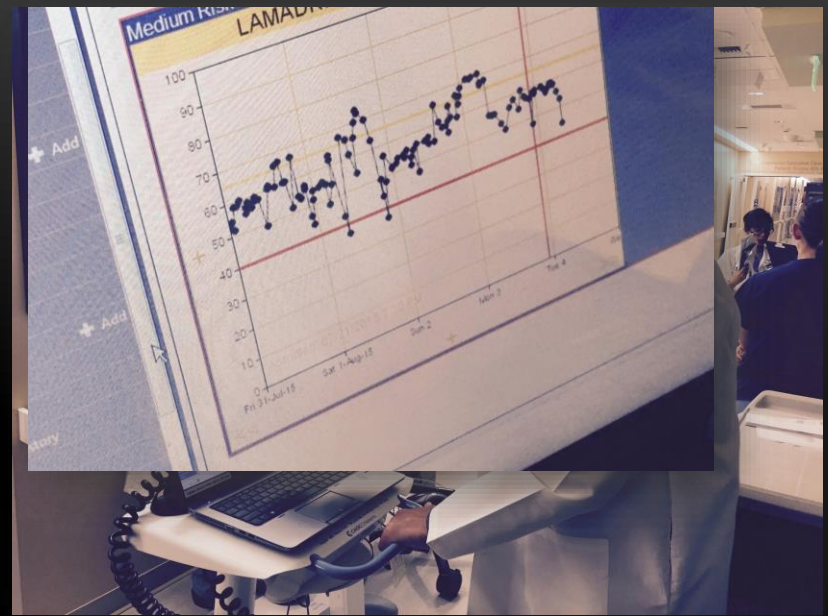
NATURAL LANGUAGE
PROCESSING

MACHINE
LEARNING

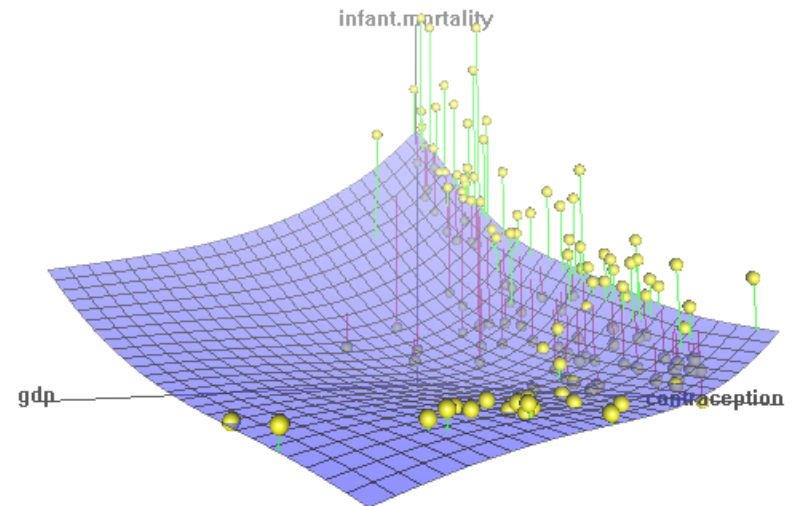


DECISION
SUPPORT SYSTEM


```
dens <- density(data, n = npts)
dx <- dens$x
dy <- dens$y
if(add == TRUE)
  plot(0., 0., main,
       ylab)
if(orientati == 'yso')
  dx2 <- (dx - min(dx)) / (max(dx) - min(dx))
  x[1.]
  dy2 <- (dy - min(dy)) / (max(dy) - min(dy))
  y[1.]
seqbelow <- rep(y[1.], length(dx))
if(Fill == T)
  confshade(dx2, seqbelow, dy2)
```



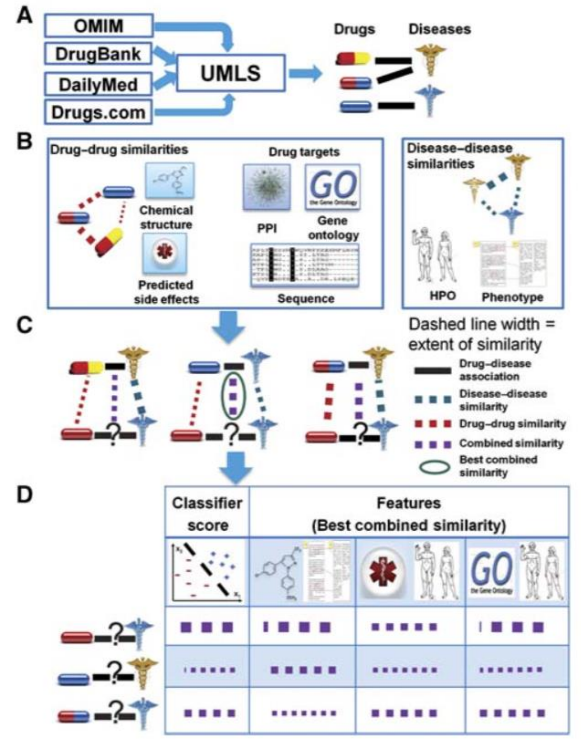
MACHINE
LEARNING



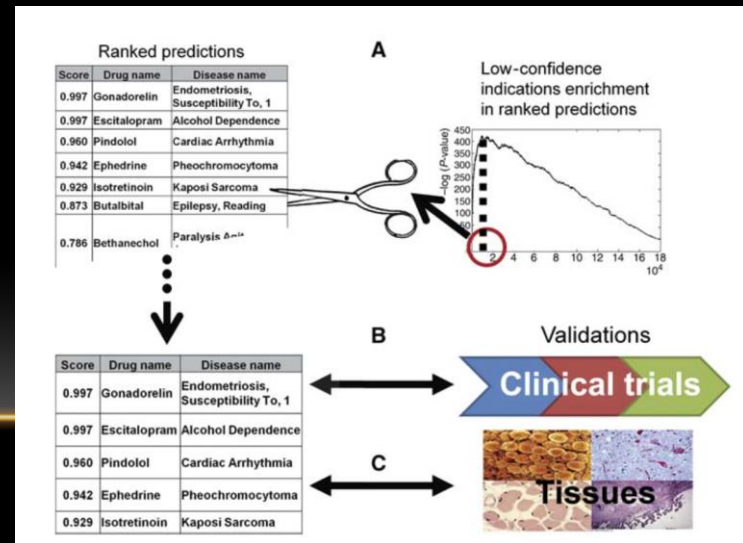
```

dens <- density(data, n = npts)
dx <- dens$x
dy <- dens$y
if(add == TRUE)
  plot(0., 0., main, ylab)
if(orientati == 'yso')
  dx2 <- (dx - min(dx)) / (max(dx) - min(dx))
  x[1.]
  dy2 <- (dy - min(dy)) / (max(dy) - min(dy))
  y[1.]
seqbelow <- rep(y[1.], length(dx))
if(Fill == T)
  confshade(dx2, seqbelow, dy2)

```



MACHINE
LEARNING



The Artificial Intelligence Brain

IMAGE
RECOGNITION



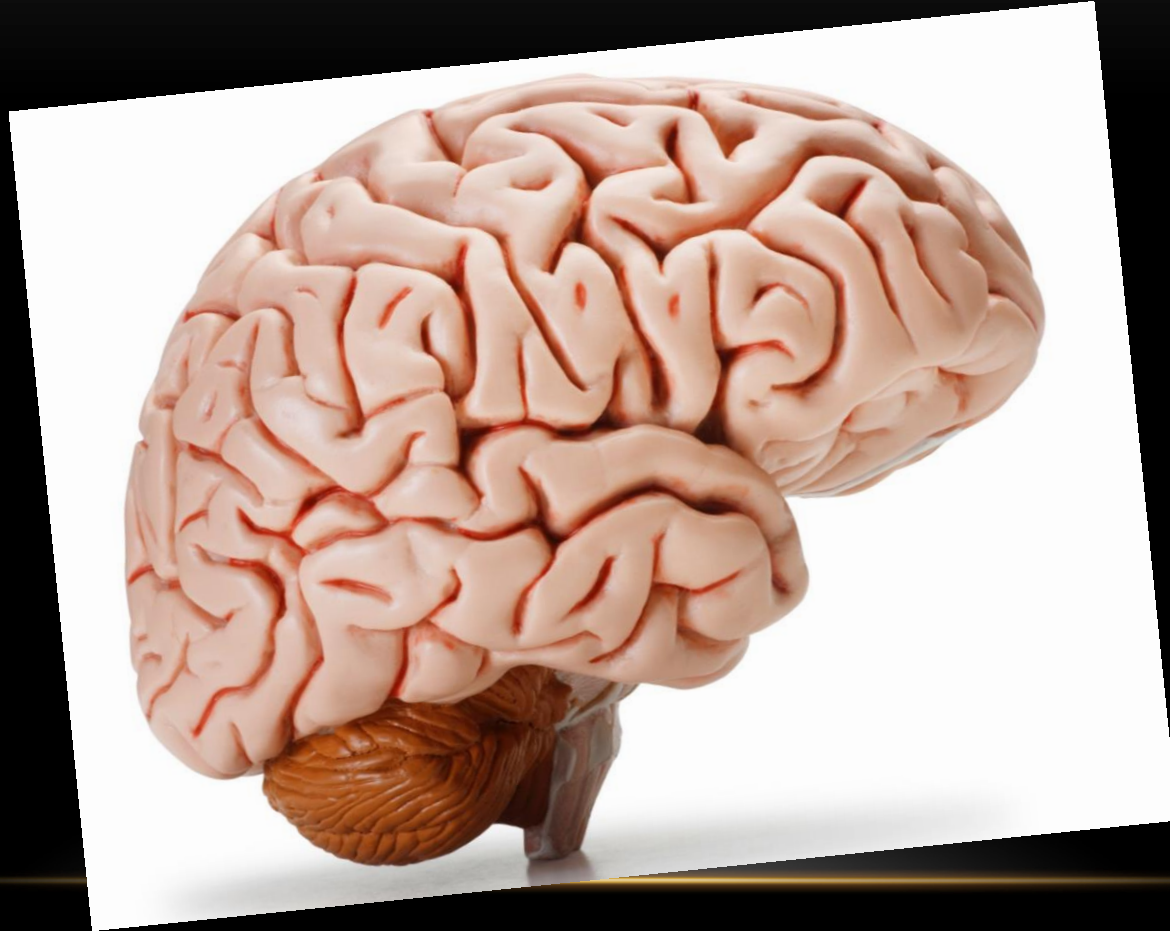
NATURAL LANGUAGE
PROCESSING

MACHINE
LEARNING



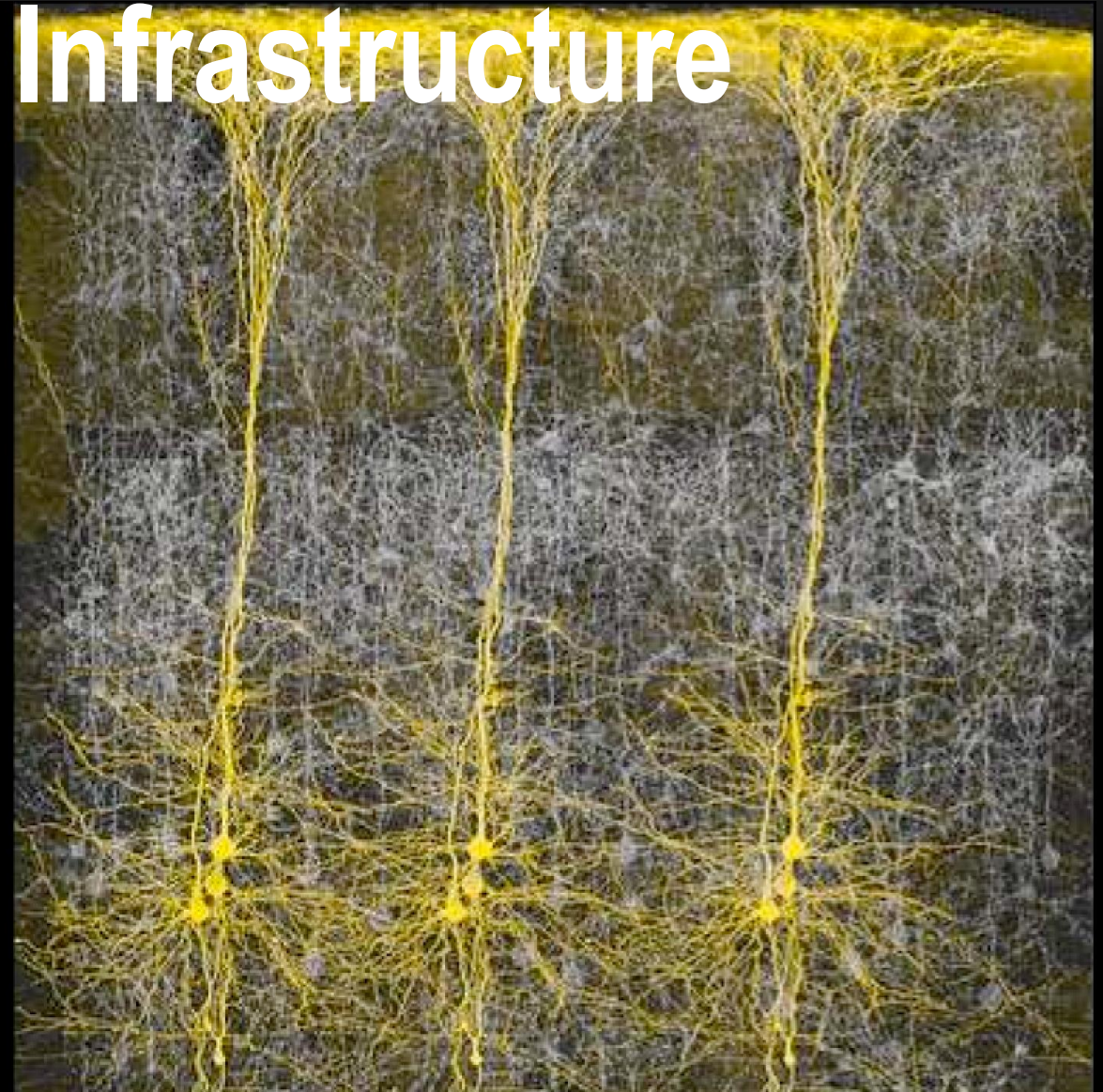
DECISION
SUPPORT SYSTEM

- # Cortical Infrastructure



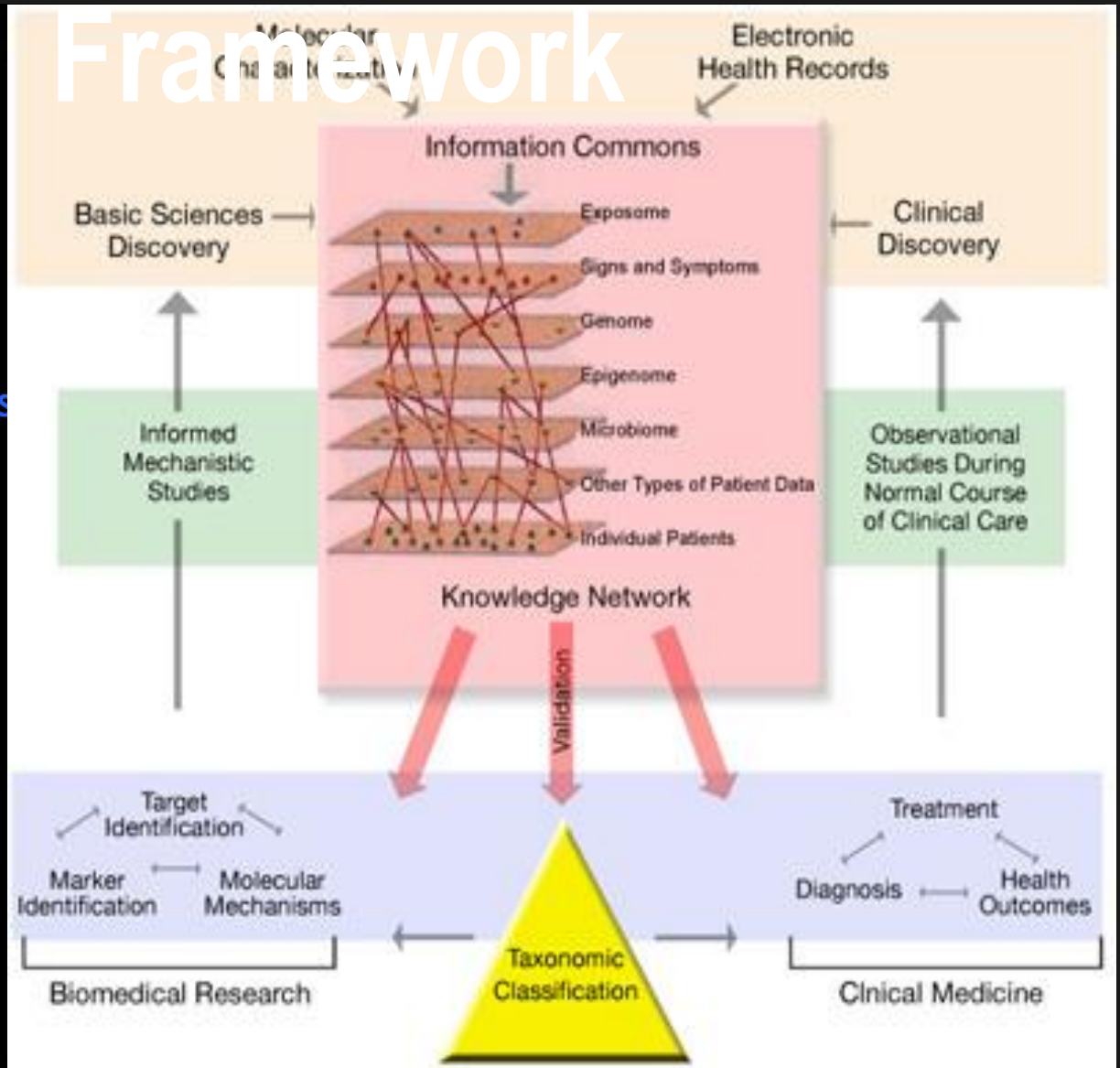
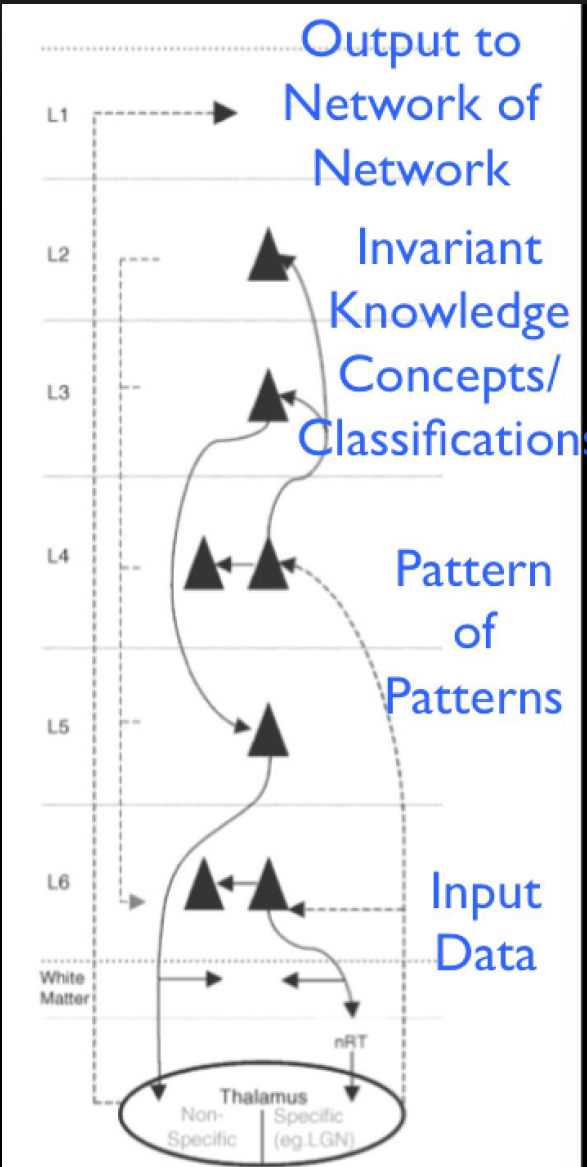
● **Cortical**

Infrastructure



BioIntelligence

Framework



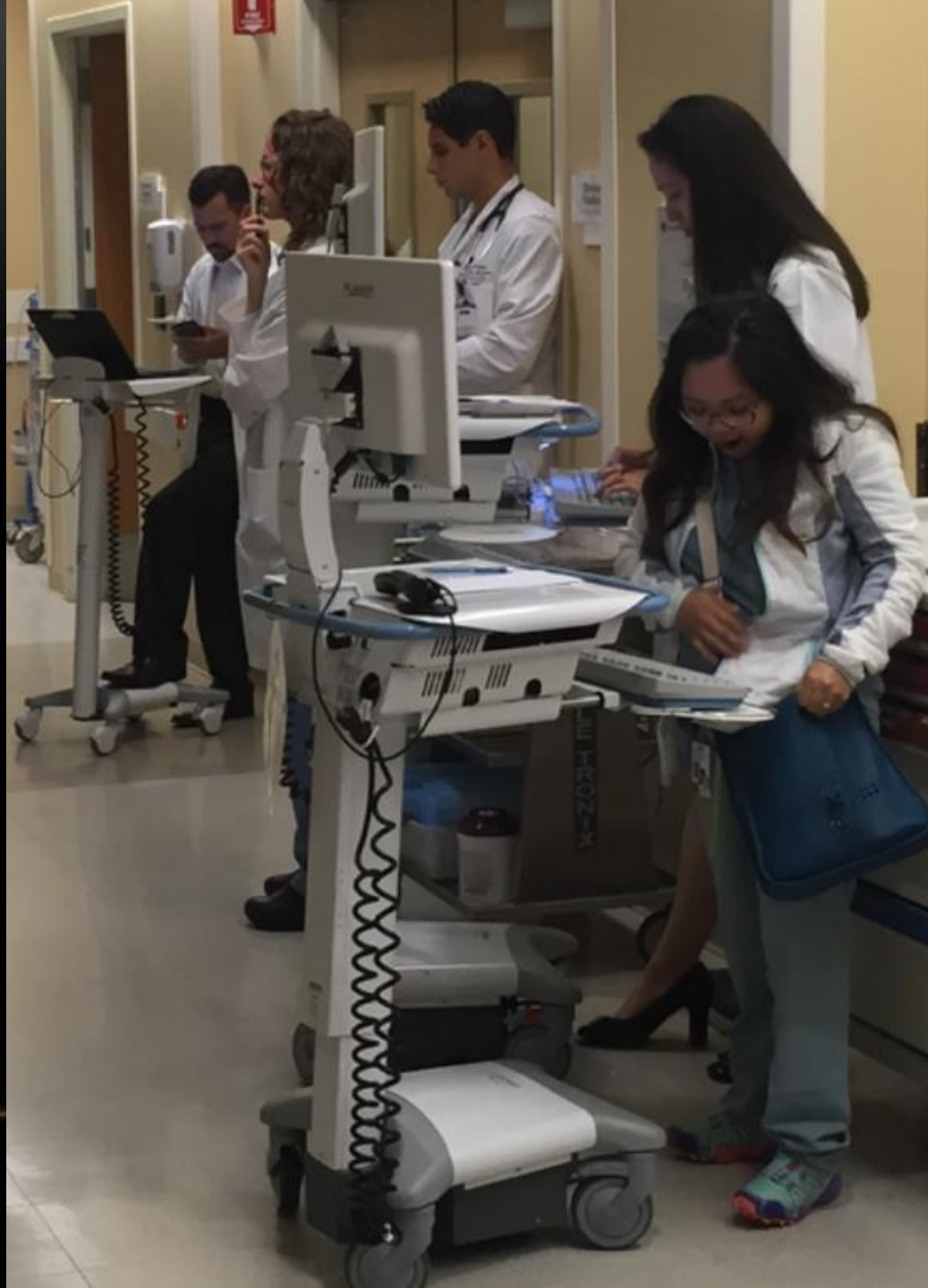
- # BioIntelligence Framework:

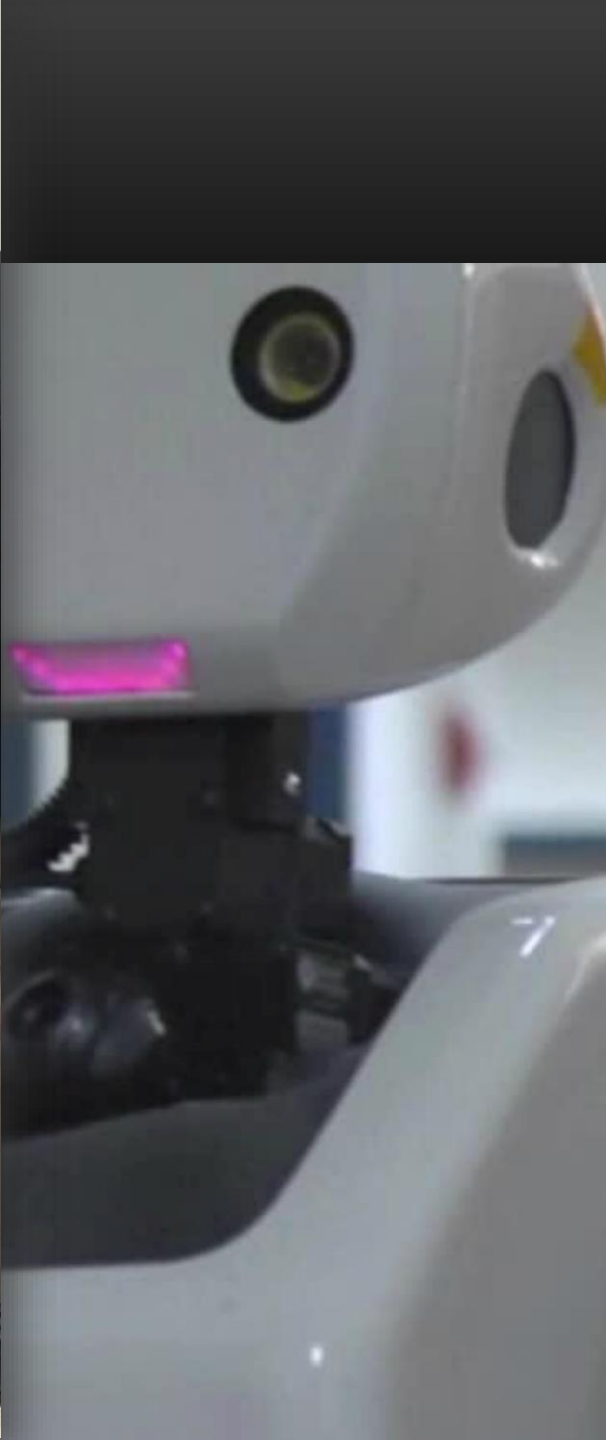
A Living Expert Neural Network



Making the visible *invisible*



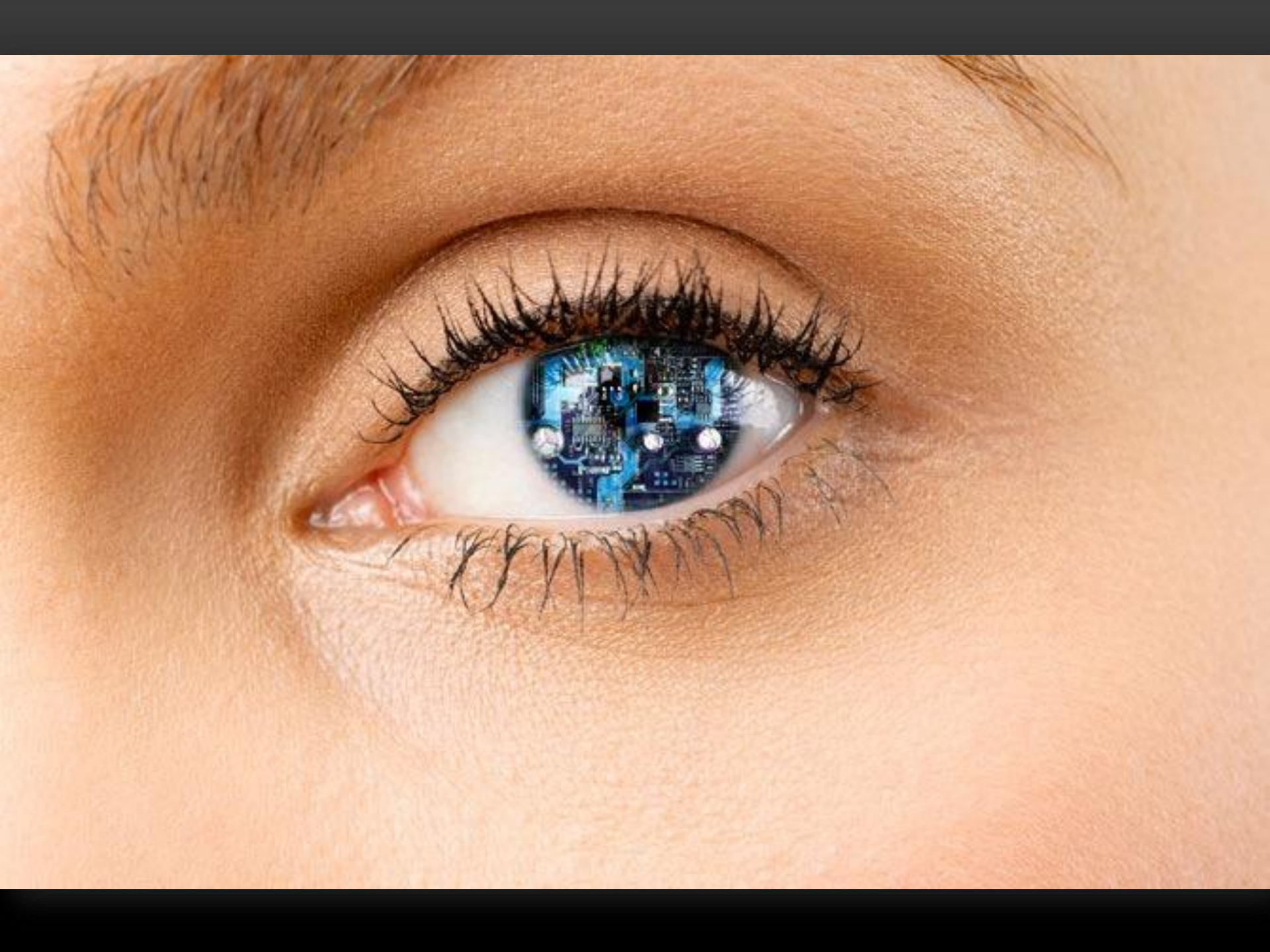




Making the invisible *visible*

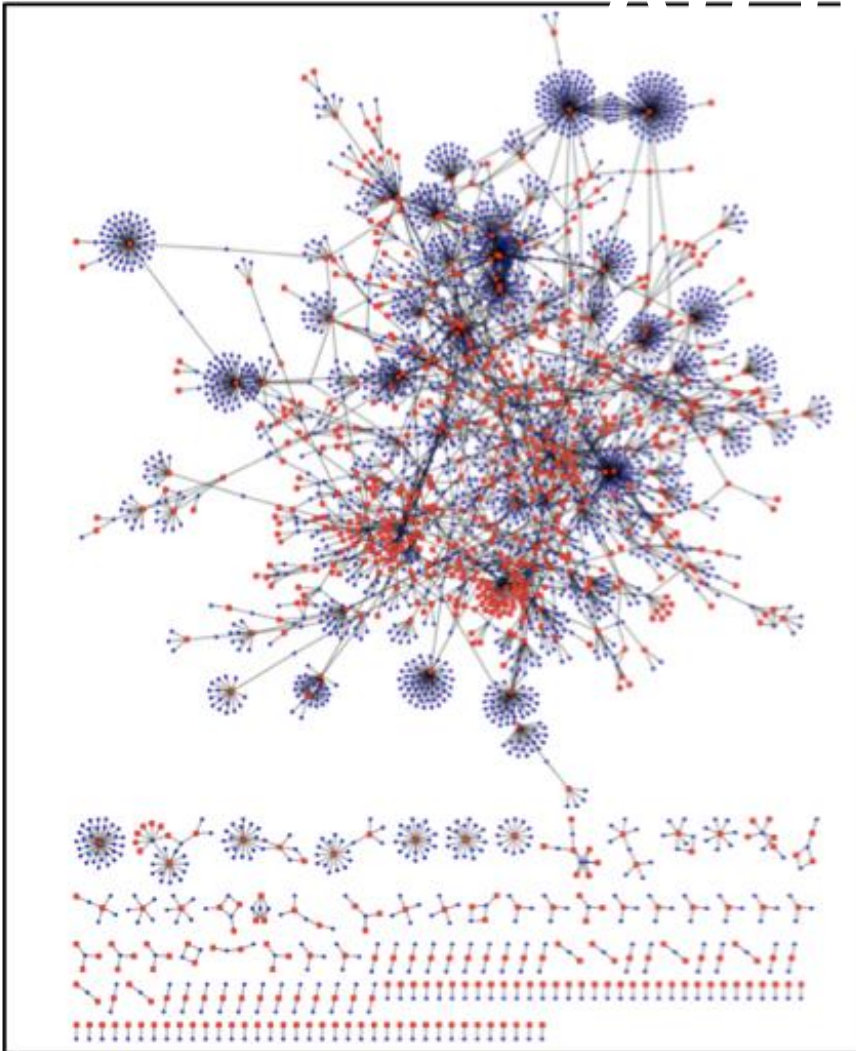




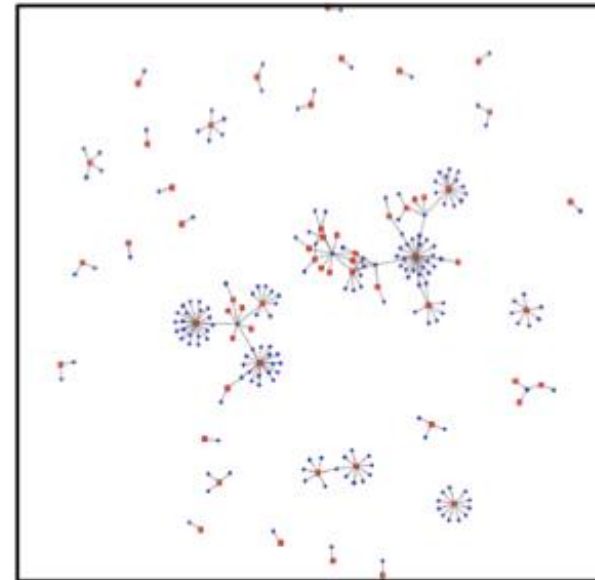


HyperGraph

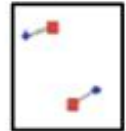
Architecture



induce



filter



Intelligence-Based Medicine

IMAGE
RECOGNITION

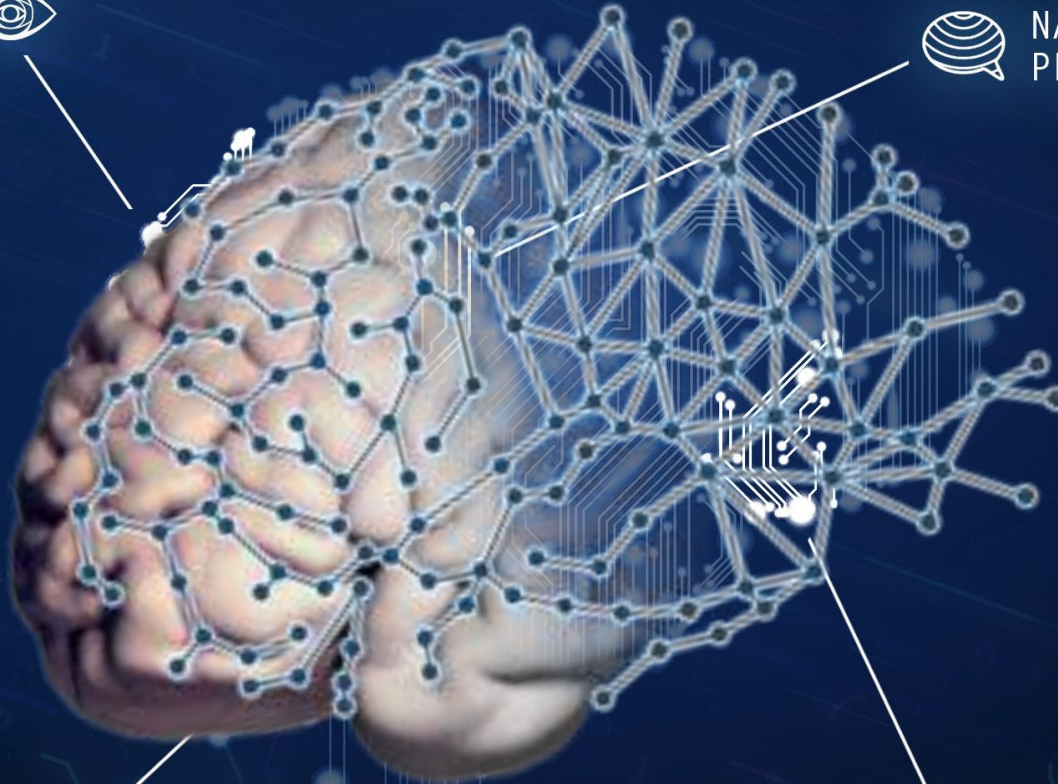


NATURAL LANGUAGE
PROCESSING

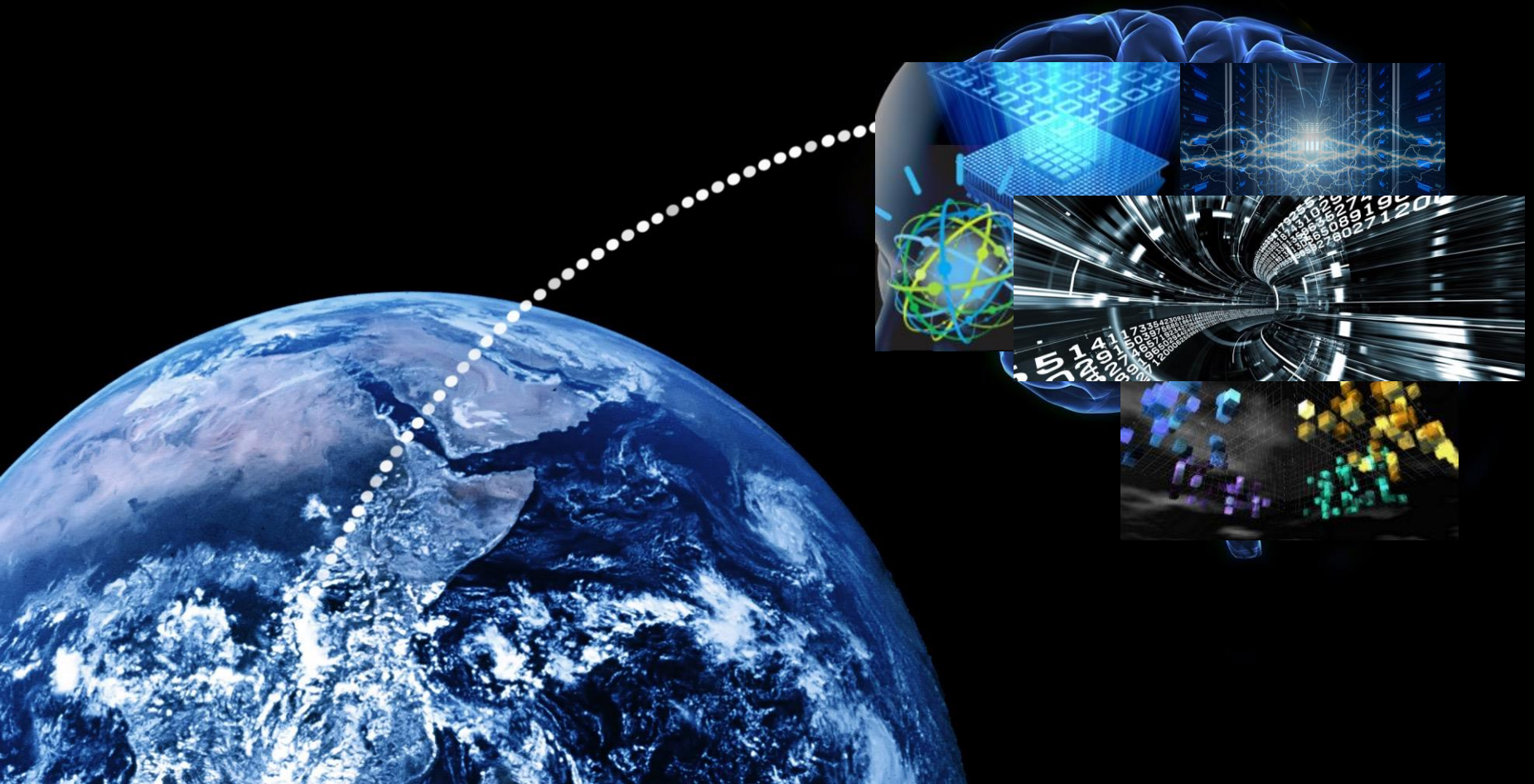
MACHINE
LEARNING



DECISION
SUPPORT SYSTEM



Intelligence-Based Medicine



- **Intelligence-as-a-**



Collective





VERY SPECIAL THANKS TO:

Sharon Disney Lund Medical Intelligence and Innovation Institute (MI3)



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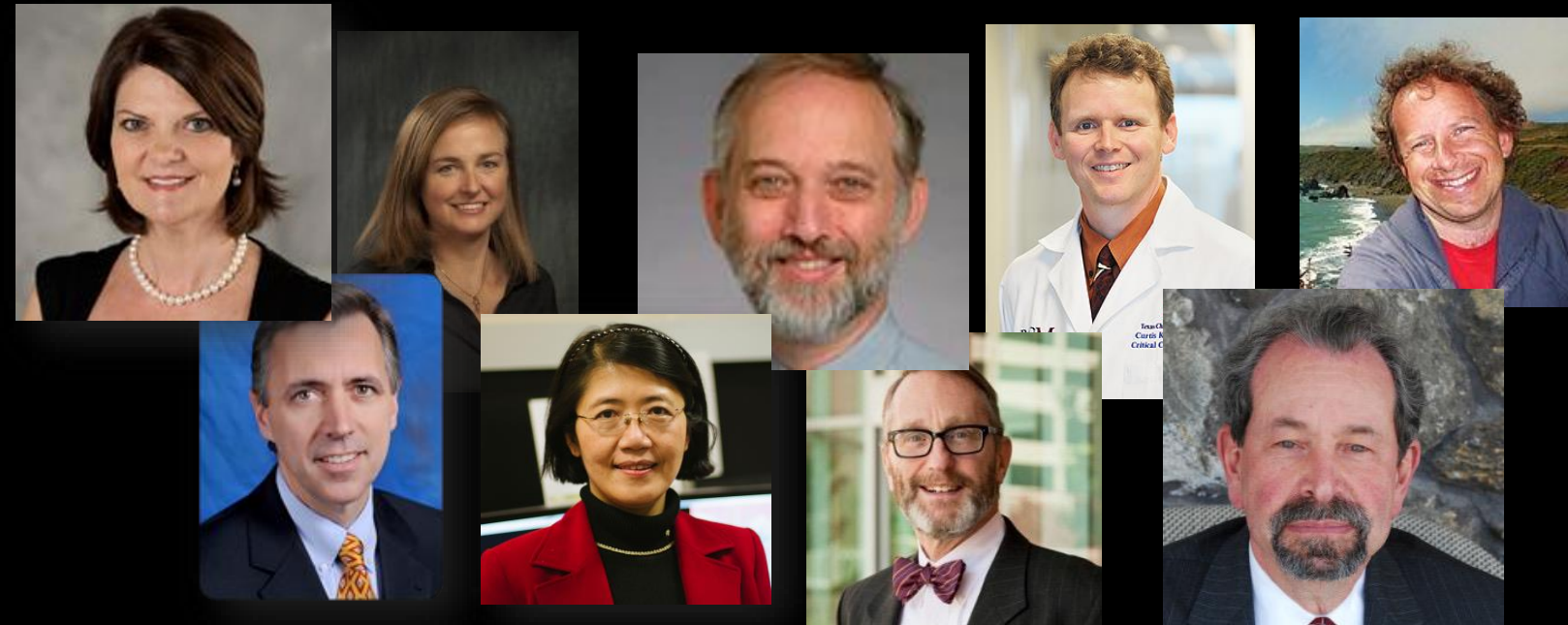
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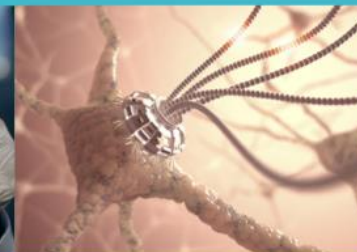
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