

AI Applications 워크샵 – 생활속의 인공지능

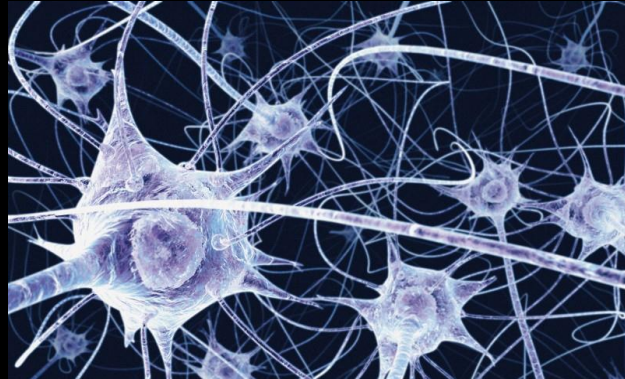
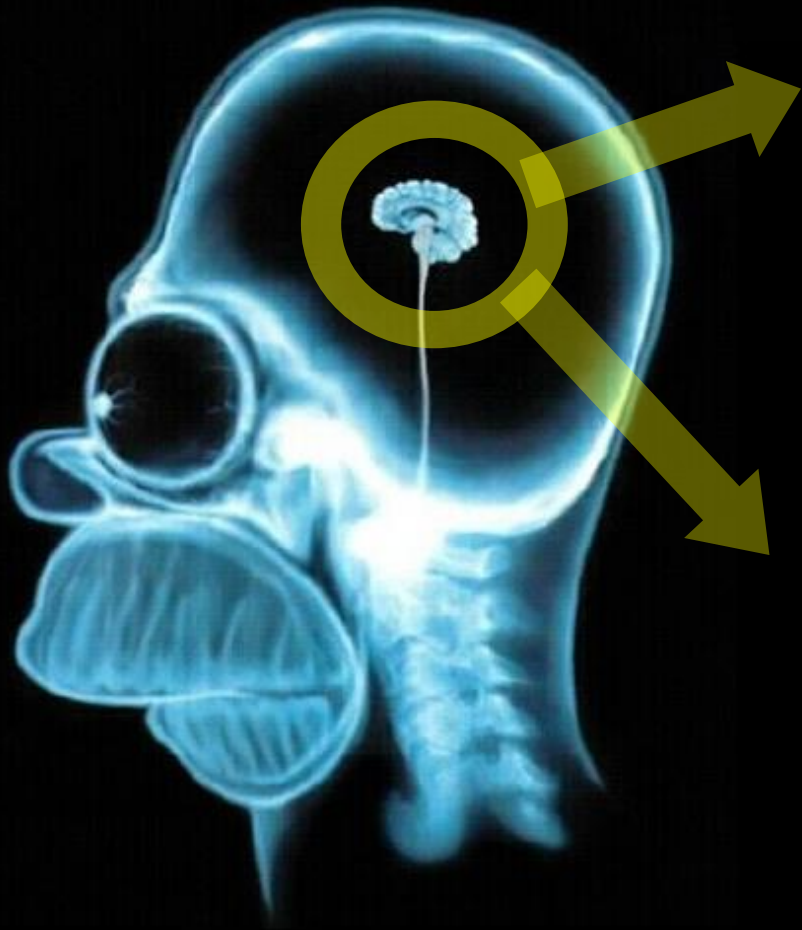
인공지능연구회 / 한국정보과학회 / 네이버 그린팩토리 Connect Hall / 2016.6.3

# 초연결 지식과 인공지능

이 경 일 / Saltlux, Inc.

Act One

# Hyper-Connection



## Neuron

~100 Billion #  
~ # of  
Web Pages

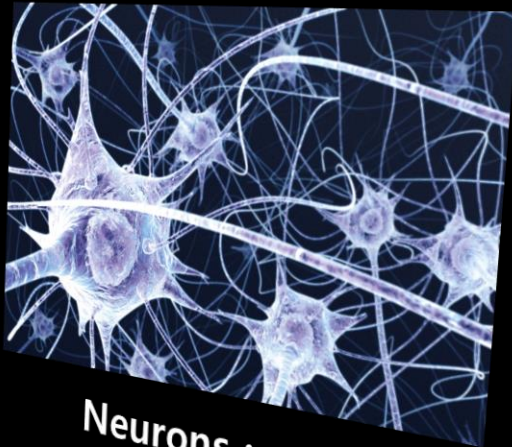


## Synapse

~100 Trillion #  
~ # of  
Web Links

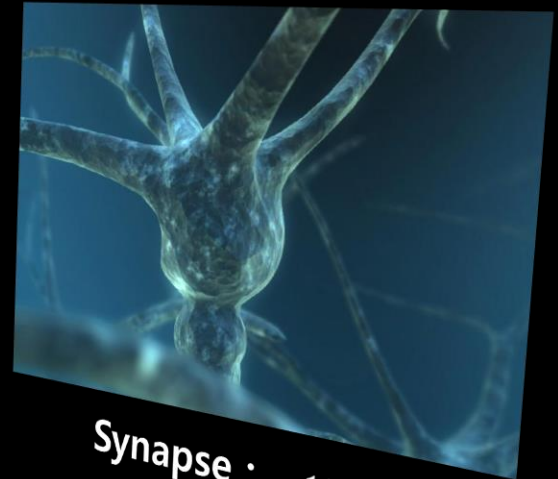


X 1,300

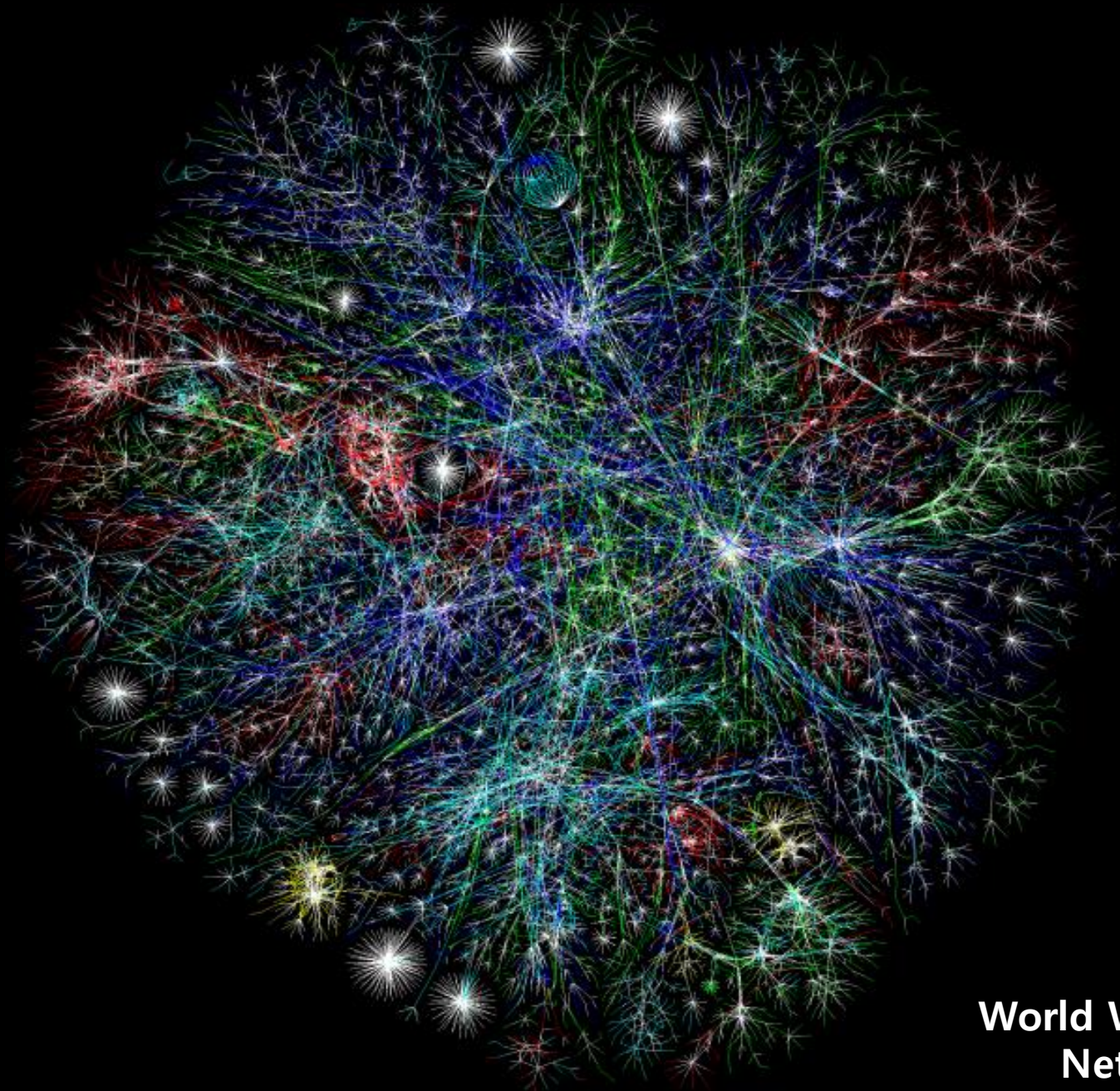


Neurons : 100B #

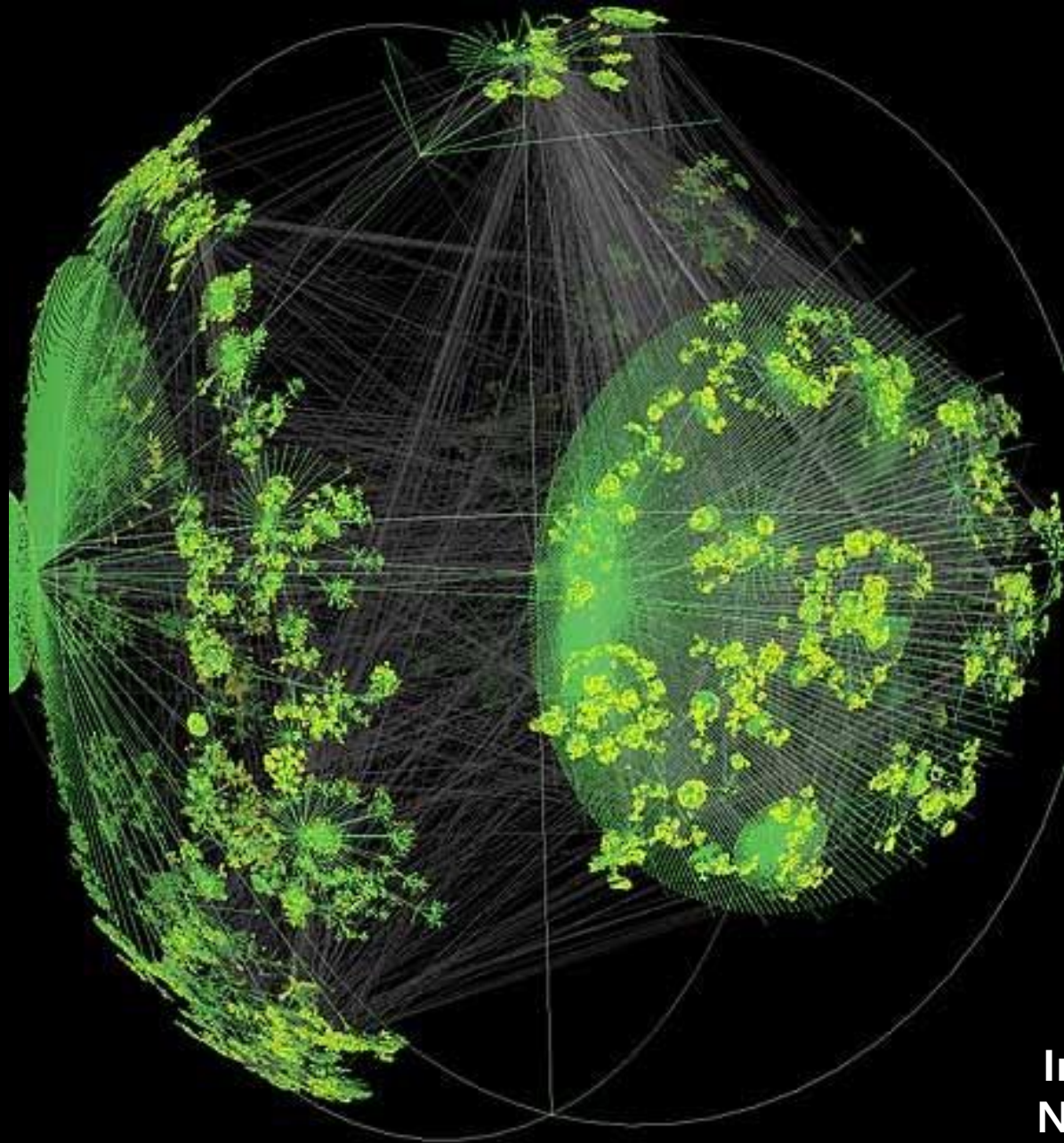
**1 : 1000**



Synapse : ~100T #



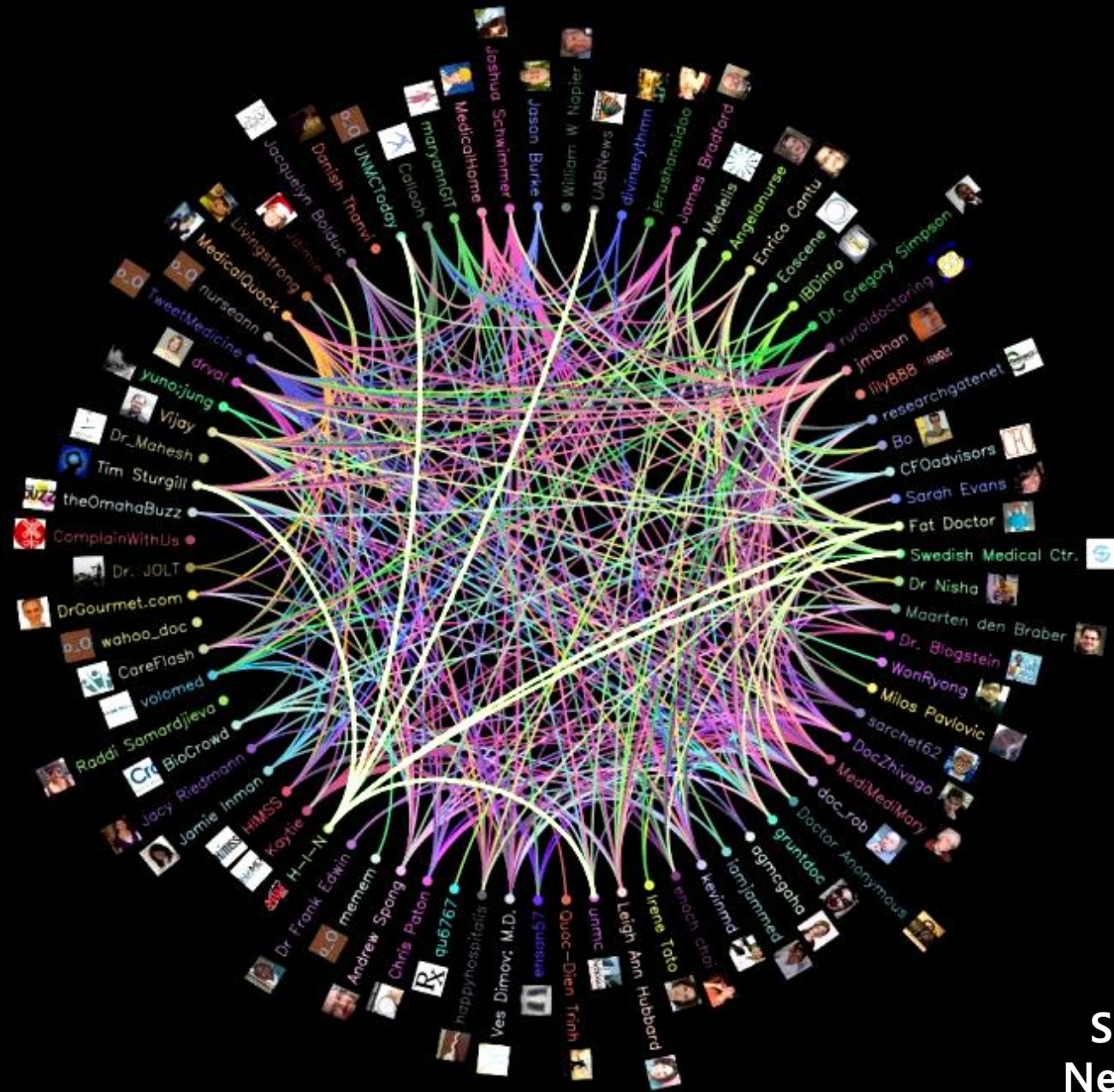
**World Wide Web  
Network**



**Internet  
Network**

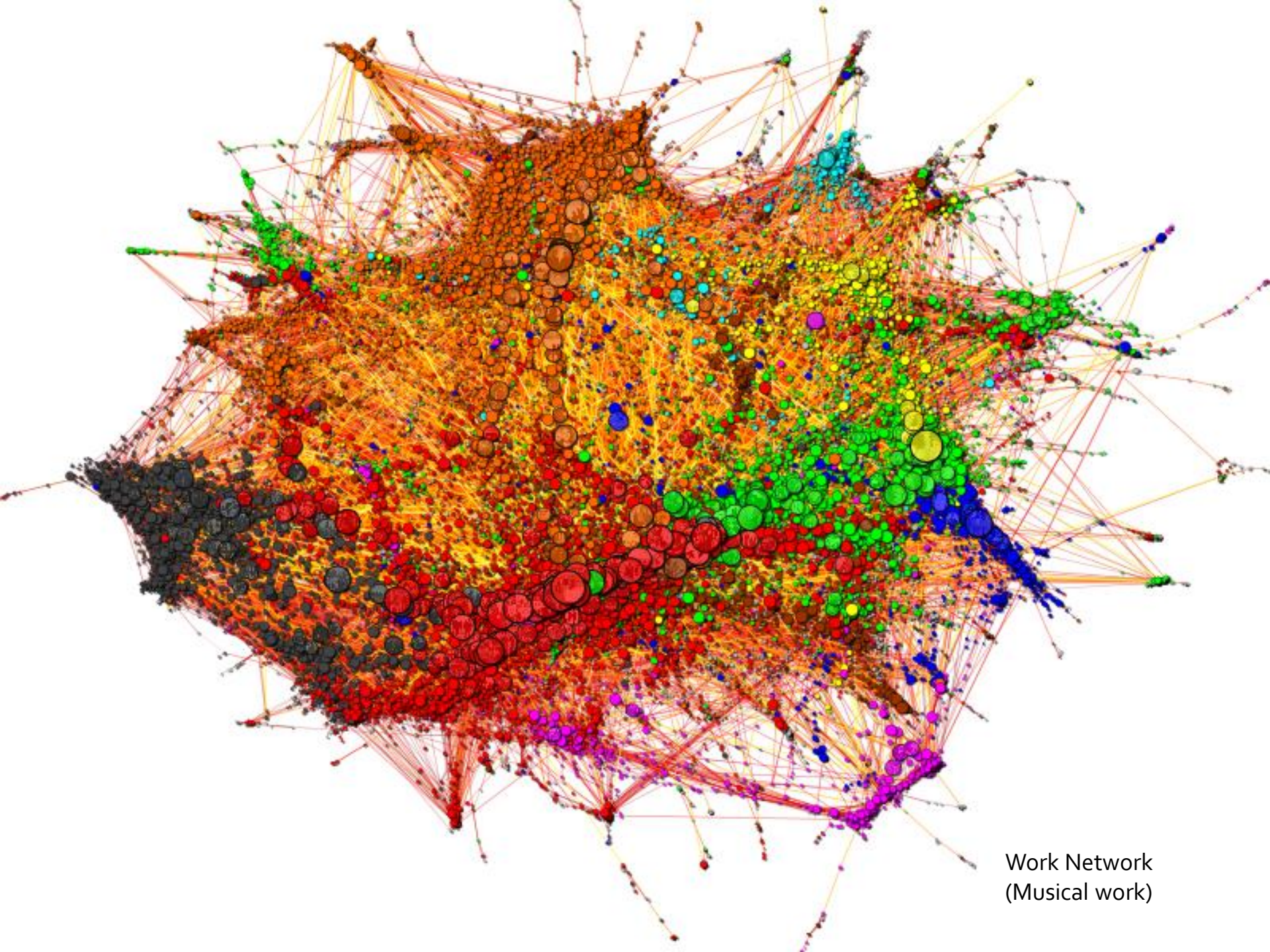


**Mobile  
Network**

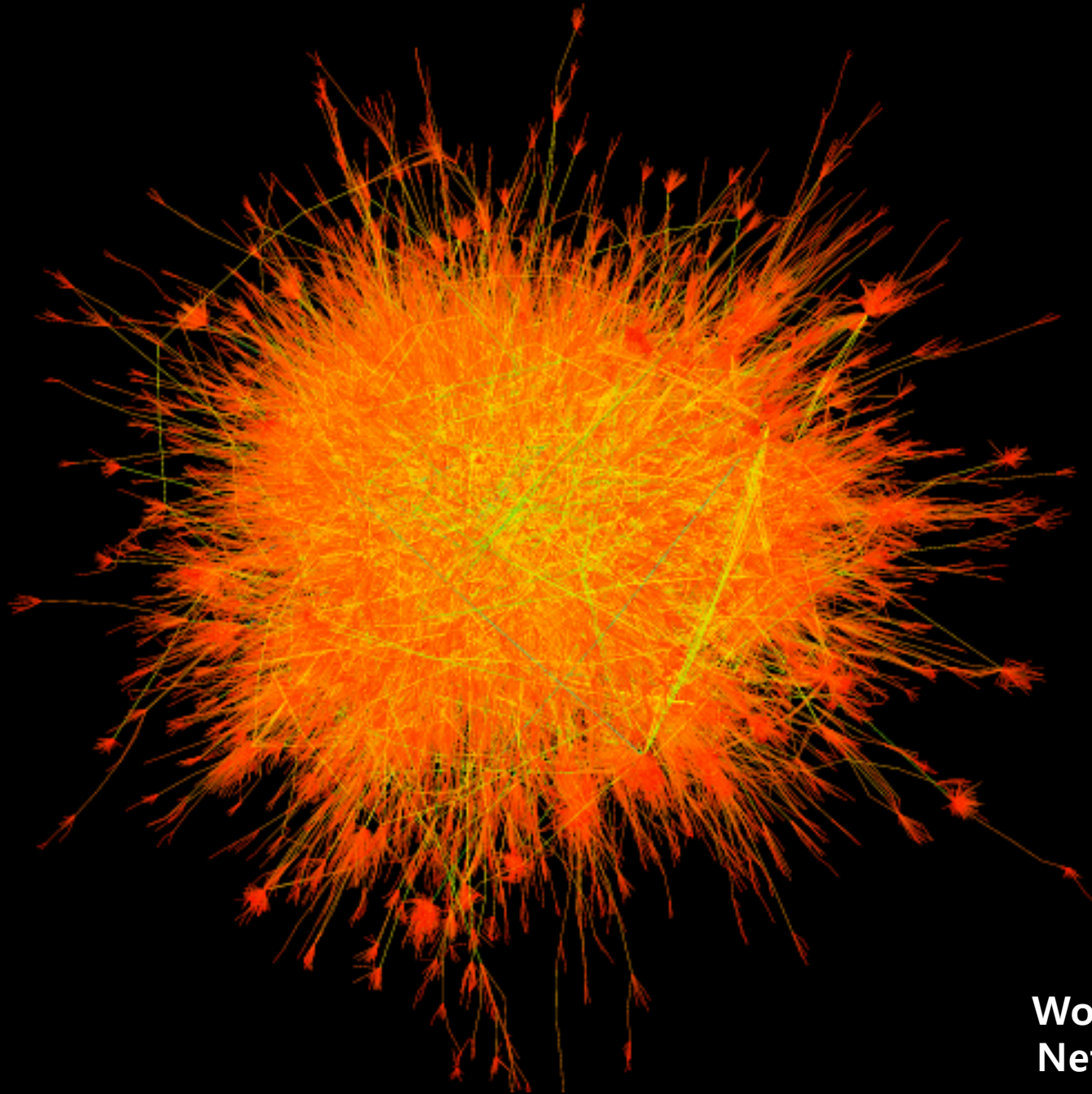


Social Network

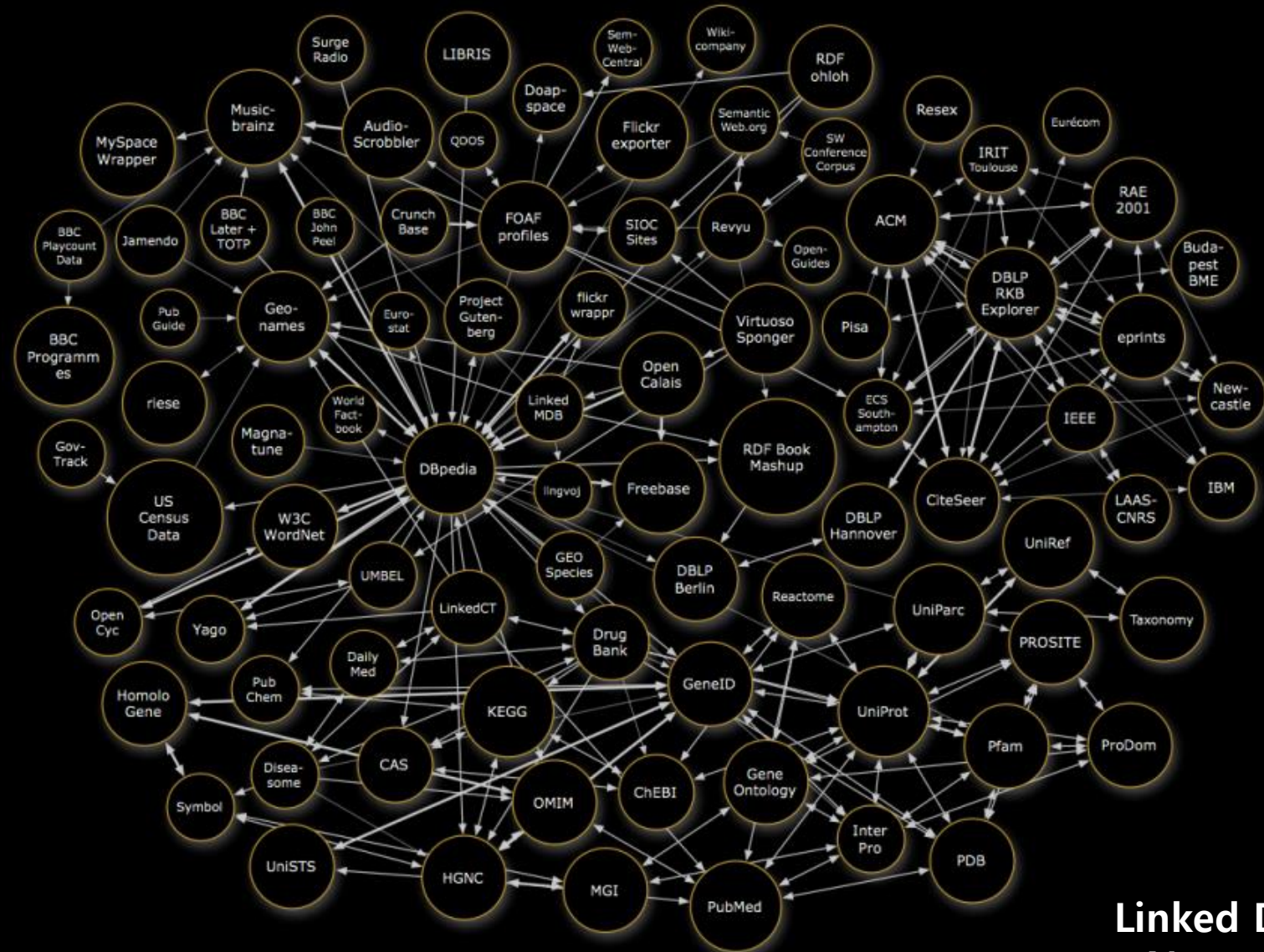




Work Network  
(Musical work)

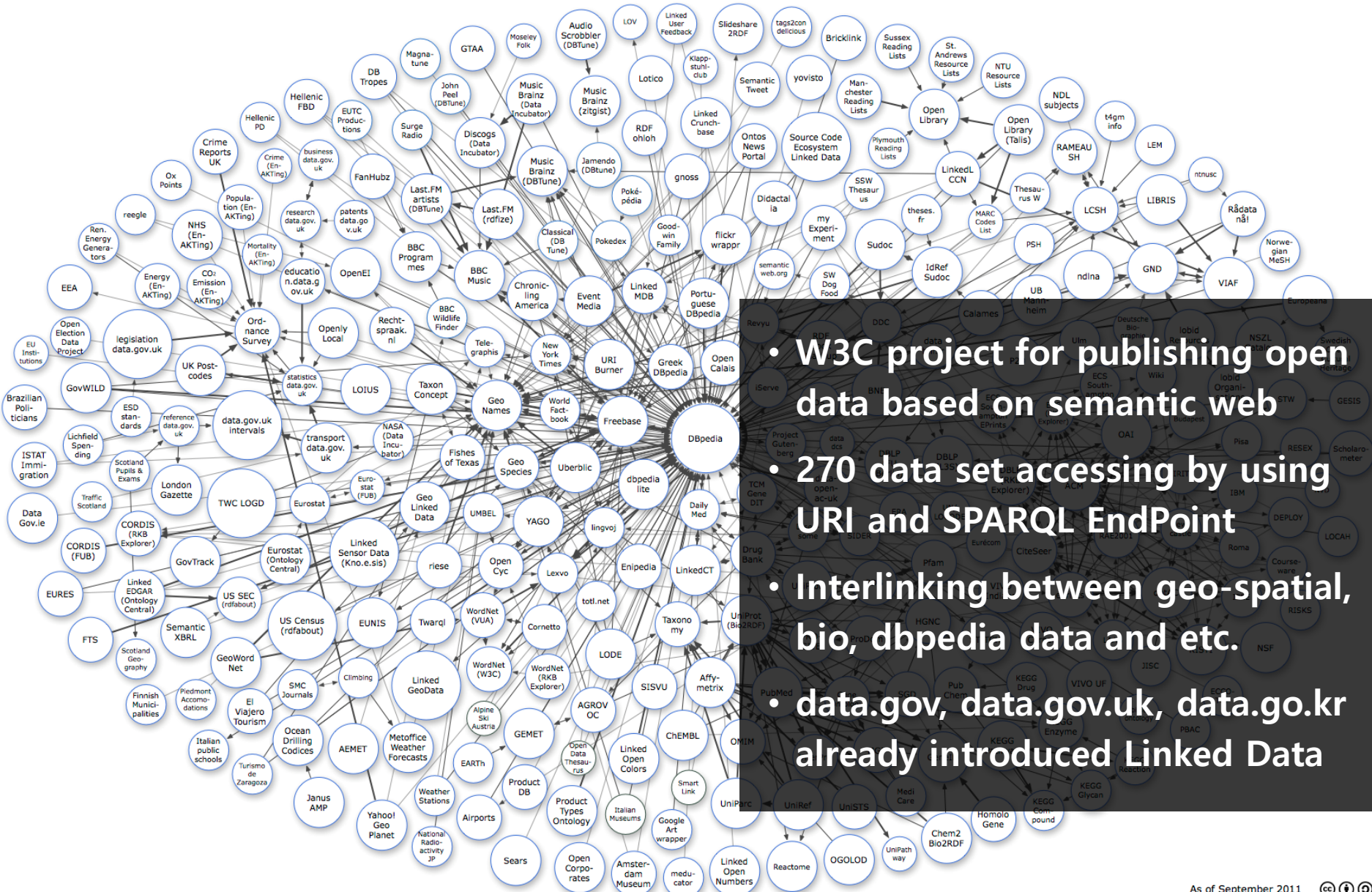


**WordNet  
Network**



**Linked Data Network**

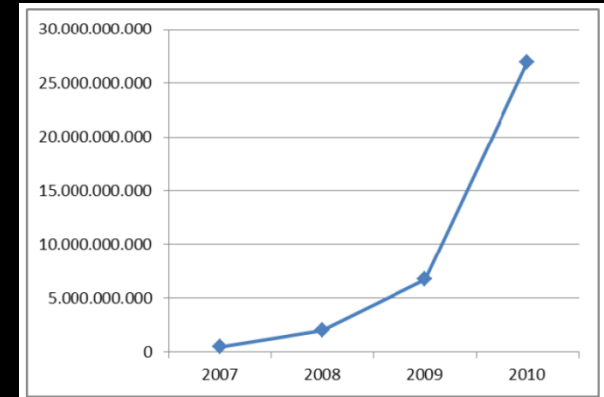
# LOD project (Linking Open Data)



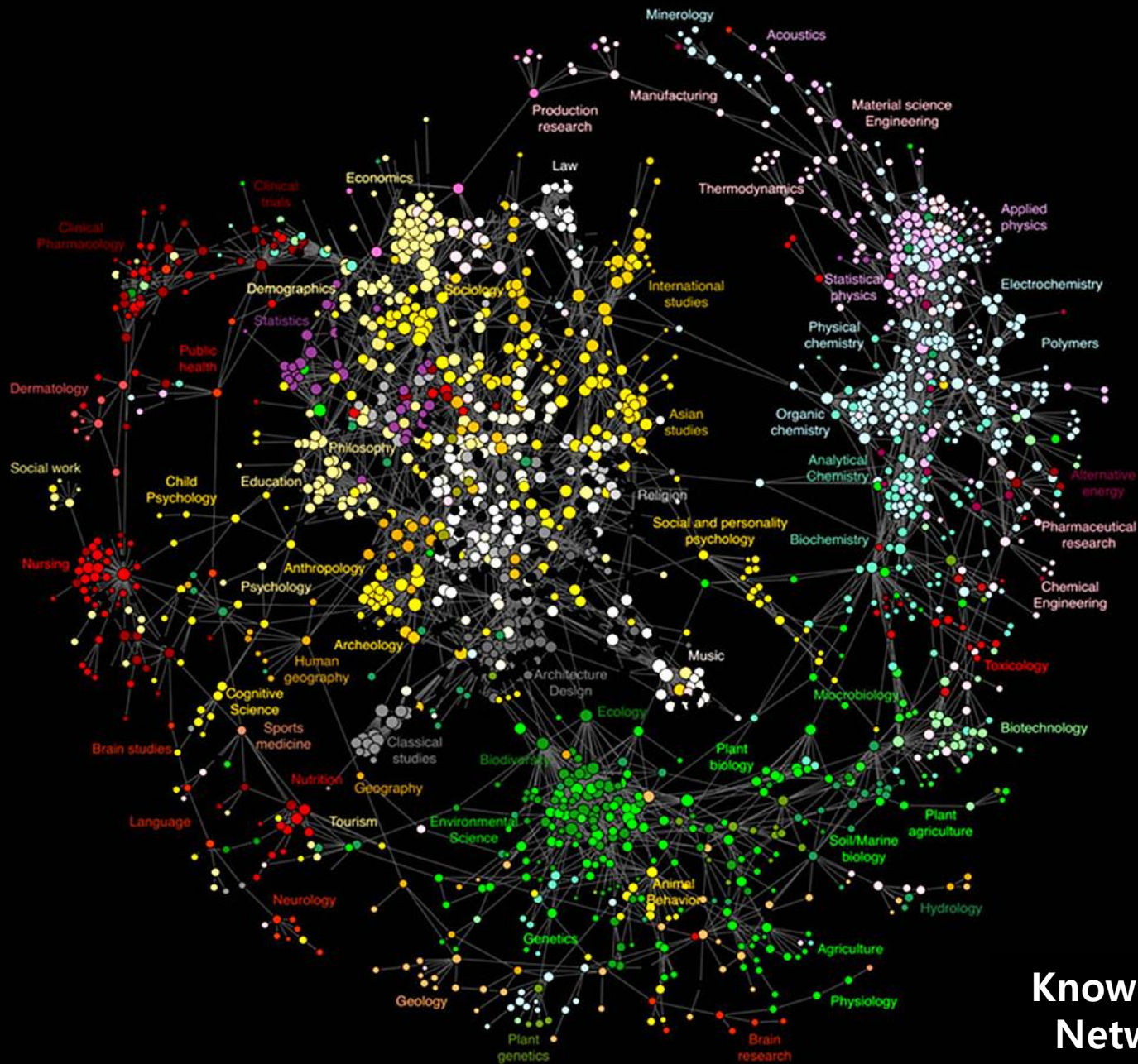
- W3C project for publishing open data based on semantic web
- 270 data set accessing by using URI and SPARQL EndPoint
- Interlinking between geo-spatial, bio, dbpedia data and etc.
- data.gov, data.gov.uk, data.go.kr already introduced Linked Data

# LOD project Statistics

Year	Datasets	Triples	Growth
2007	12	500.000.000	
2008	45	2.000.000.000	300%
2009	95	6.726.000.000	236%
2010	203	26.930.509.703	300%



Domain	Data Sets	Triples	Percent	RDF Links	Percent
Cross-domain	20	1,999,085,950	7.42	29,105,638	7.36
Geographic	16	5,904,980,833	21.93	16,589,086	4.19
Government	25	11,613,525,437	43.12	17,658,869	4.46
Media	26	2,453,898,811	9.11	50,374,304	12.74
Libraries	67	2,237,435,732	8.31	77,951,898	19.71
Life sciences	42	2,664,119,184	9.89	200,417,873	50.67
User Content	7	57,463,756	0.21	3,402,228	0.86
	<b>203</b>	<b>26,930,509,703</b>		<b>395,499,896</b>	



Knowledge  
Network

# Intellectual Activity of Human



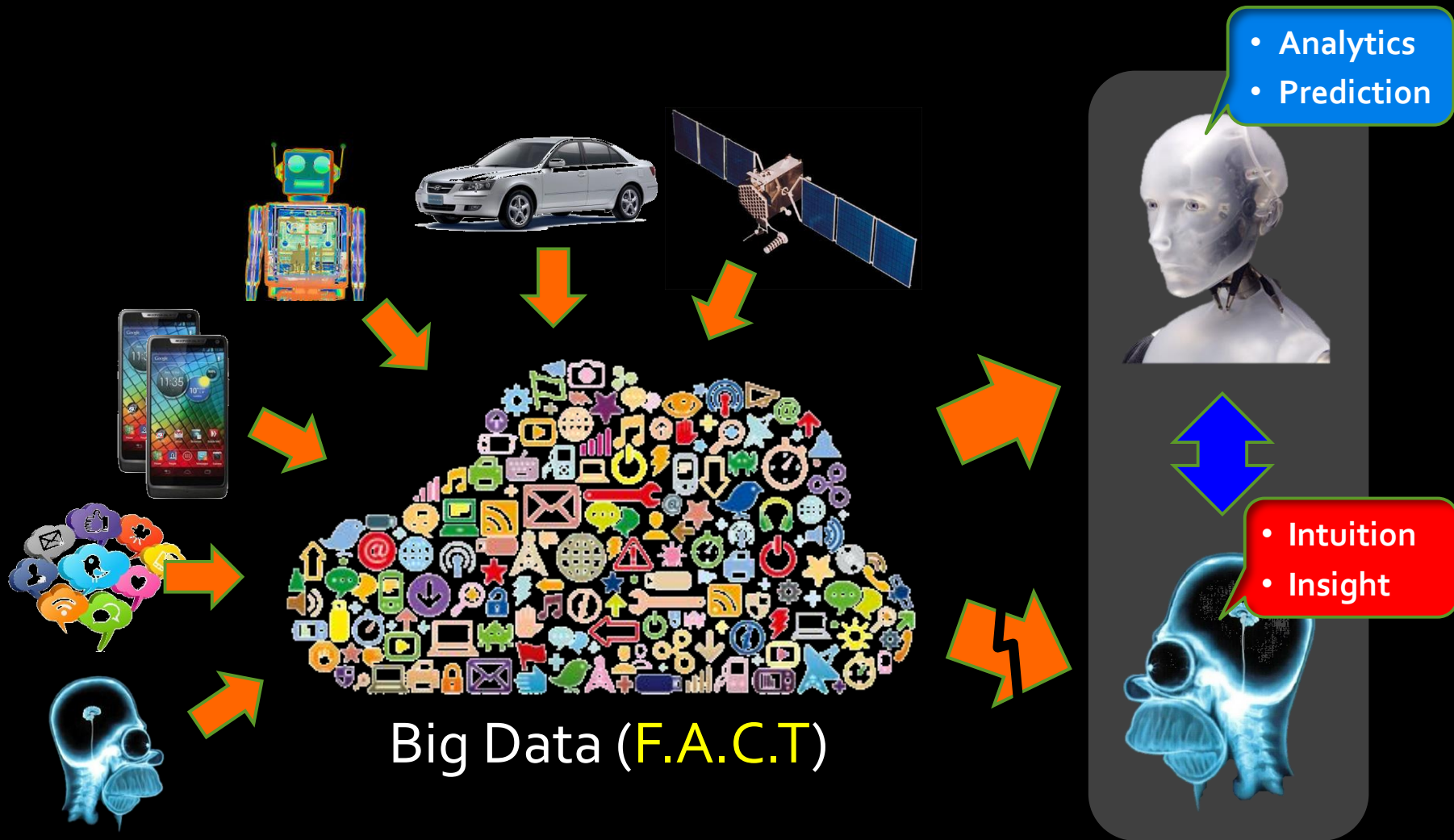
Pre-Historic Era  
(12,000BC~3,000BC)



Historic Era  
(~1,900AD)



# Big Data Era ( 2000~ )



• Analytics  
• Prediction

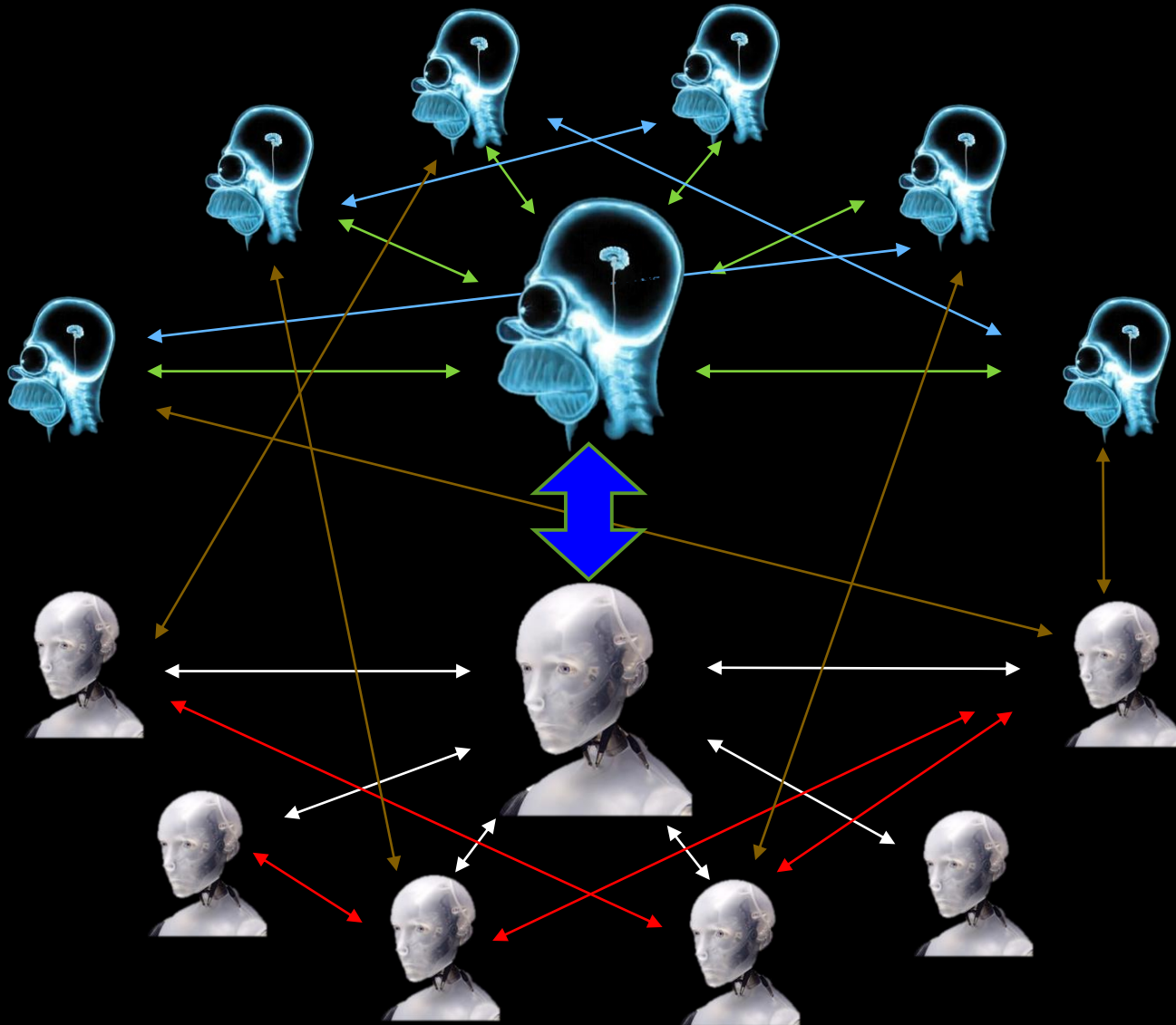
• Intuition  
• Insight

Big Data (F.A.C.T)

Augmented Brain?



# New Collective Intelligence Era (2020~)



Hyper Connected People

Hyper Connected Devices

Hyper Connected Machines

Hyper Connected Services

Hyper Connected Data

Hyper Connected Knowledge

Act Two

# Artificial Intelligence

God created 'Human being' based on their characteristics.

Human have a anxiety to create a 'Machine' like us?

A Space Odyssey (1968/2001)



Matrix (1999/2199)



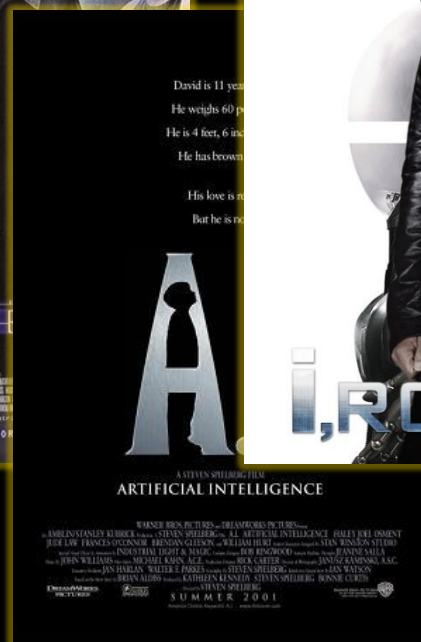
I-Robot (2004/2035)



EX Machina (2015/2020?)



Terminator (1984/2029)



AI (2001/2090)



HER (2013/2025)

# Don't let AI take our jobs (or kill us): Stephen Hawking and Elon Musk sign open letter warning of

- Letter says there is a 'broad
- Areas benefiting from AI re
- But in the short term, it wa
- In the long term, robots co
- Elon Musk has previously machines to 'summoning t

By ELLIE ZOLFAGHARIFARD FOR DAILY  
PUBLISHED: 19:08 GMT, 12 January 2015 | U



Artificial Intelligence has been desc  
Now a group of scientists and entrep  
signed an open letter promising to e  
The letter warns that without safegu  
dark future.



## Elon Musk worries AI could delete along with sp

CEO of SpaceX and Tesla suggest  
might one day decide the solutio  
humans.

by Steven Musil [@stevenmusil](#) / October 8, 20



Elon Musk has made no secret of his worries about the possible destructive power of artificial intelligence.

The billionaire chief executive of SpaceX and Tesla Motors may be a techno-optimist when it comes to solar power, space exploration and electric cars, but he continues to express his concerns that superintelligent machines might one day pose a threat to human existence.



Tesla

## Microsoft's Bill Gates insists AI is a threat

By Kevin Rawlinson  
BBC News



GETTY IMAGES

Bill Gates said he could not understand why people were not concerned by AI

**Humans should be worried about the threat posed by artificial intelligence, Bill Gates has said.**

The Microsoft founder said he didn't understand people who were not troubled by the possibility that AI could grow too strong for people to control.

Mr Gates **contradicted one of Microsoft Research's chiefs, Eric Horvitz**, who has said he "fundamentally" did not see AI as a threat.

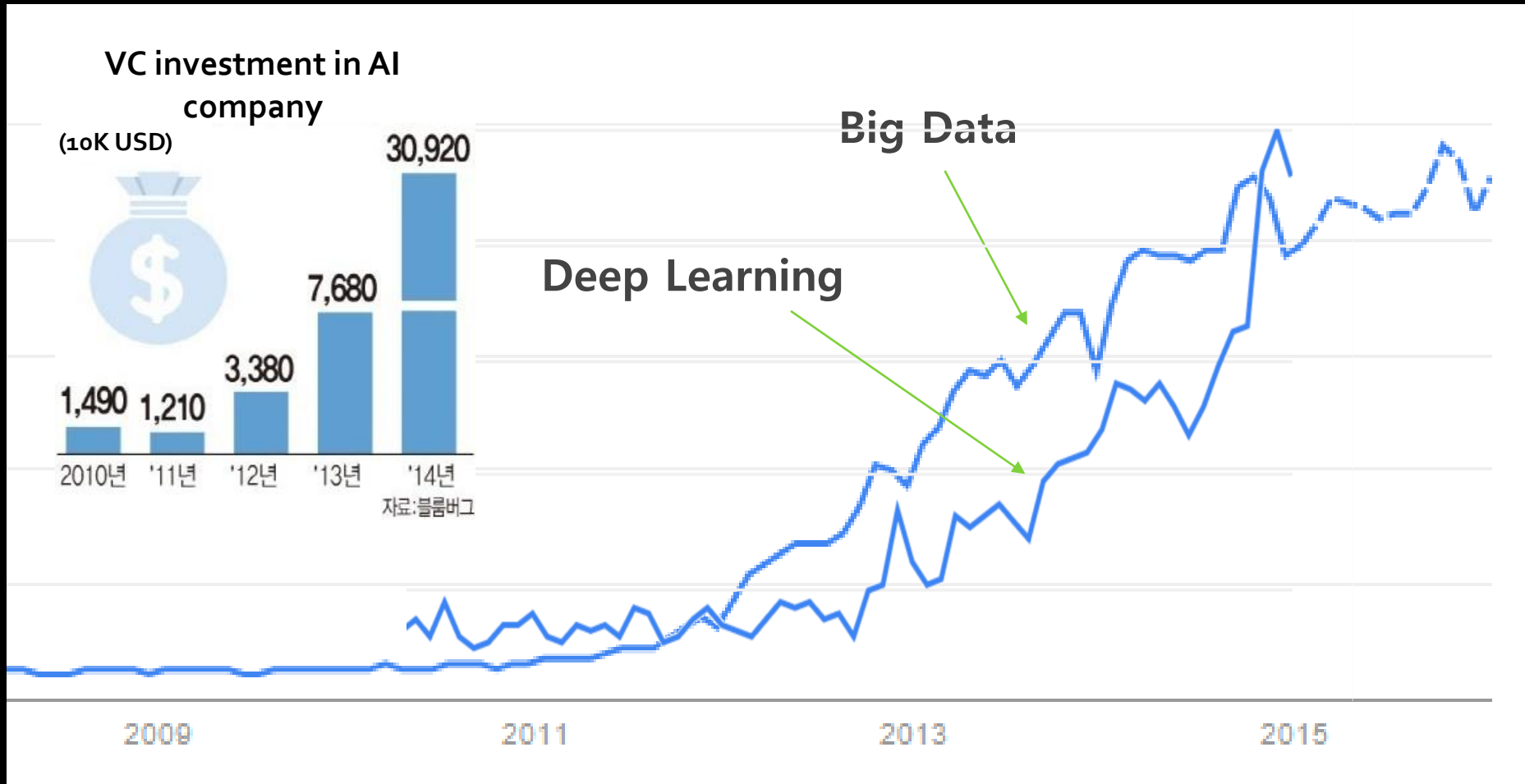
### Related Stories

AI won't run amok, says Microsoft

Does AI really threaten the future of the human race?

Hawking: AI could end

# Artificial Intelligence Hypes?



# HISTORY OF AI & Big Data

**350 B.C.**  
Aristoteles  
Predicate Logic, Ontology 개념 제안

**1629**  
Rene Descartes  
공통어 기반 자동번역 아이디어

## Before 1930s

**150 B.C**  
Antikythera mechanism  
세계 최초의 아날로그 컴퓨터

**1837**  
Charles Babbage  
최초의 범용 컴퓨터인 Analytical Engine 설계

**1941**  
Alonzo Church  
Lambda(람다)계산 해설서 발행

**1943**  
Warren McCulloch, Walter Pitts  
신경망(Neural Network)의 기초를 세움

**1945**  
Alan Turing, Alonzo Church  
처치-튜링 명제 (Church-Turing Thesis) 발표

**1949**  
Donald Hebb  
뉴런간의 연결 정도를 변화시킬 수 있는 학습 규칙 (Hebbian Learning Rule)을 제안

## 1940s

**1944**  
맨하탄 프로젝트(美)  
핵연쇄반응의 컴퓨터 시뮬레이션 수행

**1949**  
정보이론  
'정보의 아버지' C. Shannon  
팬치카드, 사진 등의 대용량 데이터 저장 연구를 수행함

**1950**  
Alan Turing  
Computing Machinery and Intelligence 출간

Isaac Asimov  
I Robot(나는 로봇) 출간

**1951**  
Minsky, Edmond  
SNARC(신경회로망 컴퓨터)

**1952**  
Bell Labs  
최초의 음성인식기 개발

**1954**  
Yehoshua Bar-Hillel  
최초의 자동번역 엔진 구현

**1955**  
Allen Newell, J.C. Shaw, Herbert Simon  
최초의 AI 프로그램 Logic Theorist (LT)를 선보임

**1956**  
J. McCarthy, M. Minsky, A. Newell, H. Simon  
Dartmouth workshop에서 '인공지능(AI)'란 용어를 최초로 사용

**1958**  
John McCarthy, Marvin Minsky  
프로그램 언어인 Lisp 발명

## 1950s

**1950**  
범용 컴퓨터 ENIAC  
최초의 범용 컴퓨터 ENIAC을 날씨 예측에 활용함

**1957**  
데이크스트라 알고리즘  
'최단경로문제(SPP)' 해결 알고리즘 발표(Dijkstra)

**1958**  
컴퓨터의 예측모델  
FICO사(美)가 신용리스크 결정에 예측모델을 적용 시작

**1960**  
Bernard Widrow, Marcian Hoff  
perceptron 모델의 선형화와 유사한 워드로 호프 모델을 제안

**1962**  
Frank Rosenblatt  
퍼셉트론 수렴이론 (Perceptron Convergence Theorem)을 발표

**1963**  
M. Ross Quillian  
지식표현 수단으로서의 Semantic Networks을 소개  
Marvin Minsky  
Steps Towards Artificial Intelligence 논문 발표

**1965**  
Bruce Buchanan, Edward Feigenbaum, Lederberg  
DENDRAL 전문가시스템 프로젝트  
MIT ELIZA  
최초의 자연언어처리 시스템

## 1960s

**1962**  
IBM 1311 HDD  
작업 가능한 최초의 상용 하드디스크  
세탁기 크기로 2M비트 저장 가능

**1964**  
CODASYL / IDS  
최초의 상용 DBMS

**1967**  
데이터 압축 알고리즘  
BA Marroni이 "자동 데이터 압축"에 관한 논문을 ACM에 발표함

**1970**  
Jaime Ca  
SCHOLAR

**1972**  
Alain Col  
컴퓨터 언어  
Edward H  
간염성 혈액  
항생제를 처

**1973**  
금융공학  
옵션가격결

**1974**  
Paul Wer  
역전파 (Back  
신경망의 기

**1976**  
MRP 시스  
Material Re  
컴퓨터가 본

## 1970s

**1970**  
Edgar F.  
ROB 모델

**1974**  
SQL  
IBM에서 최

**1977**  
통계컴퓨터  
국제 통계학

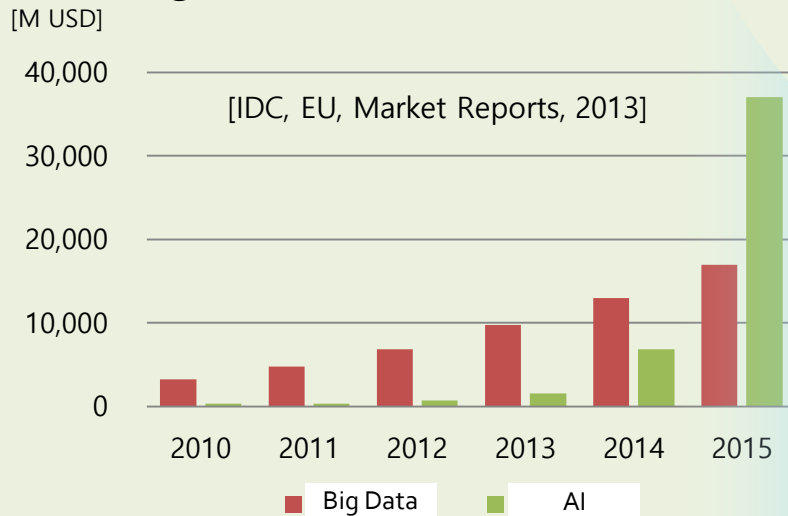
애플 개인  
최초의 대용  
(1MHz CPU)

**1978**  
Oracle 출  
Larry Ellison

**1979**  
관계형 DB  
최초의 상용

# Big Data and AI Market

## Big Data and AI Market Trends



- Big Data market will grow at a 27% compound annual growth rate (CAGR) to \$32.4 billion through 2017
- Global Industry Analysts forecast the big data based Artificial Intelligence market to exceed €27 billion by 2015

## Application Markets



Smart Robot / Wearable Services



Virtual Agent / Decision Support



Self-driving Car / Smart Factory



# Machine Intelligence LANDSCAPE

## CORE TECHNOLOGIES

### ARTIFICIAL INTELLIGENCE

IBM WATSON MetaMind  
 Numenta ai-one  
 Cyncorp Research nara  
 Reactor SCALED INTELLIGENCE

### DEEP LEARNING

vicarious Vision Factory  
 facebook Google  
 Baidu DL ersatz  
 SKYMIN D SignalSense

### MACHINE LEARNING

rapidminer context  
 Oxdata H2O DATA RIPA  
 LiftIgniter SHIBBOLETH  
 Azure ML what Tulse Sense  
 GraphLab Alteryx

### NLP PLATFORMS

cortical.io idibon  
 LUMINOSO wit.ai  
 Maluba

### PREDICTIVE APIS

AlchemyAPI MINDOPS  
 Google big Indico  
 ALGORITHMIA Expect  
 PredictionIO Labs

### IMAGE RECOGNITION

clarifai MADBITS  
 DNNresearch DEXTRO  
 VISENZE lookflow

### SPEECH RECOGNITION

GRIDSPACE  
 popUP archive  
 NUANCE

## RETHINKING ENTERPRISE

### SALES

Preact AVISO  
 RelateIQ NGDATA  
 ELABORATE FRAMED  
 infer ATTENTIVE causata

### SECURITY / AUTHENTICATION

CROSSMATCH  
 EYEVEERY BIT SIGHT  
 CYLANCE bionym

### FRAUD DETECTION

sift science SOCURE  
 ThreatMetrix feedzai  
 Brighterion VERAFIN

### HR / RECRUITING

TalentBin entelo  
 predikt Connectifier  
 gild hiQ

### MARKETING

brightfunnel bloomreach  
 CommandIQ AIRPR  
 RADIUS  
 Telkpart people pattern

### PERSONAL ASSISTANT

Siri Cortana Google now  
 clevsense Rebinlabs  
 tempo fuse machines  
 KASISTO CLARA LABS  
 VIV

### INTELLIGENCE TOOLS

ADATAD Palantir  
 Quid Digital Reasoning  
 FirstRain

## RETHINKING INDUSTRIES

### ADTECH

METAMARKETS dstillery  
 rocketfuel YieldMo  
 ADBRAIN

### AGRICULTURE

BLUE RIVER Terraviva  
 cereasmaging HOKI  
 THE CLIMATE CORPORATION tute

### EDUCATION

edClara coursera  
 KNEWTON kidaptive

### FINANCE

Bloomberg FinGenius  
 alphasense KENSHC  
 Dataminr minetabrook  
 BINATIX

### LEGAL

Lex Machina brightleaf  
 COUNSELYTICS RAVEL  
 JUDICATA Brevia  
 Diligence Engine

### MANUFACTURING

SIGHT MACHINE  
 MICROSCAN  
 IVISYS

### MEDICAL

Parzival transcriptic  
 Genesient ZEPHYR  
 grand mand table bino TUTE

### OIL AND GAS

kaggle AYASDI  
 TACHYUS biota  
 Futura

### MEDIA / CONTENT

Outbrain newstle ARRIA  
 SAILTHRU wavii  
 NarrativeScience  
 Prismatic ai

### CONSUMER FINANCE

affirm inVenture  
 finance BILL GUARD LendUp  
 LendingClub Kabbage

### PHILANTHROPIES

DataKind thorn  
 DATA GUILD

### AUTOMOTIVE

Google Continental  
 T Manave CRUISE

### DIAGNOSTICS

enlitic 3SCAN  
 lumiaata ENTOS

### RETAIL

BAY SENSORS  
 PRISM SKYLABS  
 celect euclid

## RETHINKING HUMANS / HCI

### AUGMENTED REALITY

APX blippar  
 META layar

### GESTURAL COMPUTING

THALMICLABS omek  
 LEAP  
 eyeSight 3Gear  
 Gesturetek nod

### ROBOTICS

intel Liquid Robotics  
 iRobot SoftBank  
 jibo Amazon  
 ONI

### EMOTIONAL RECOGNITION

affectiva BEYOND-VERBAL  
 EMOTION  
 cogito

## SUPPORTING TECHNOLOGIES

### HARDWARE

NVIDIA XILINX  
 QUALCOMM NERVANA  
 rigetti

### DATA PREP

TRIFACTA Paxata  
 tamr Alation

### DATA COLLECTION

diffbot kimono  
 CrowdFlower Connotate  
 WorkFusion Import

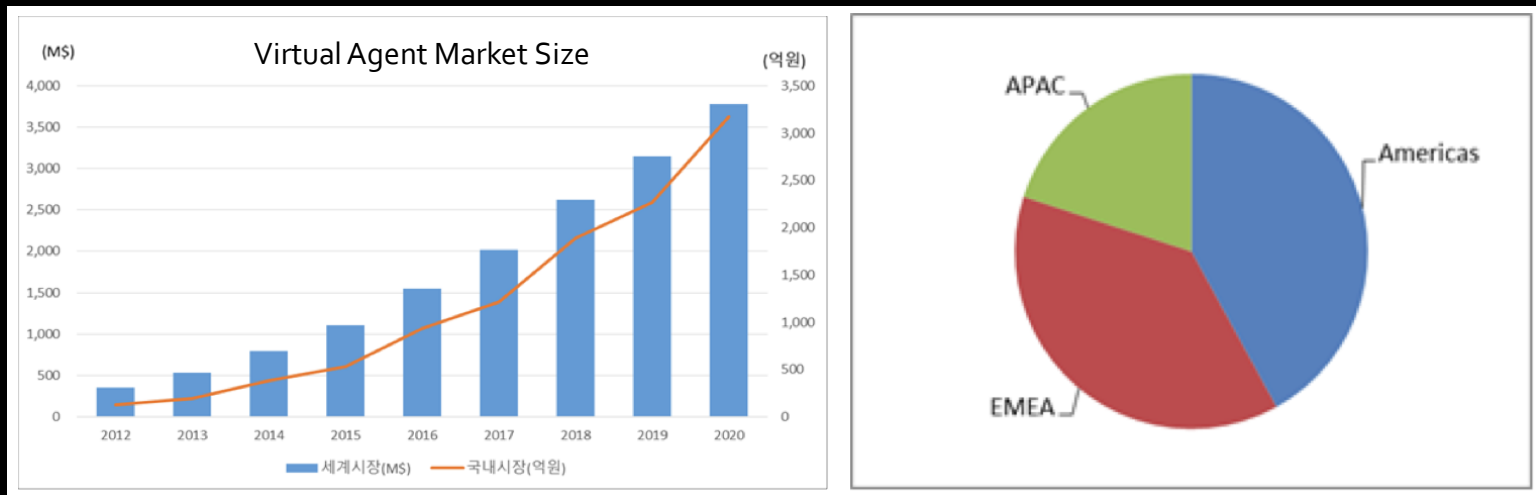
# AI Market Expectation?

- Growing exponentially over the coming years
- Apple, Google, Microsoft and Facebook invest in the AI



# Virtual Agent Market

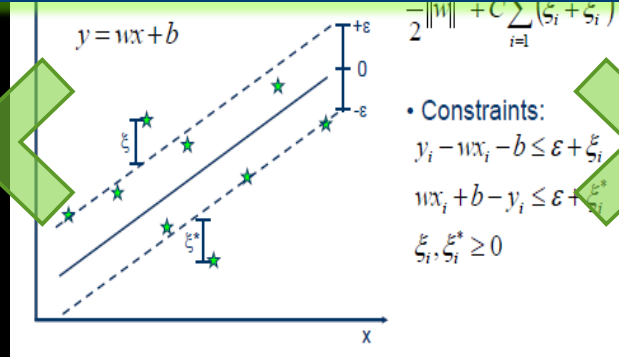
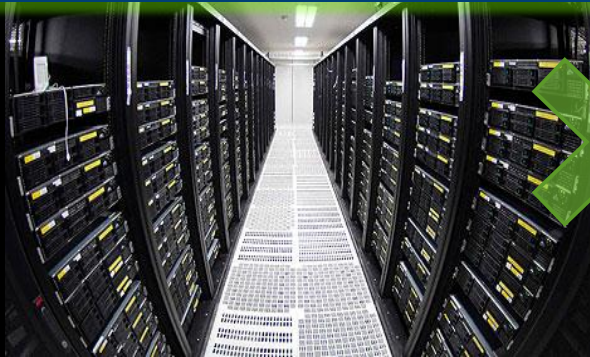
- BusinessWire (2015)
  - Global Market size is **growing 30%** per year: 0.35 (2012) to **3.1 billion dollars** (2020)
  - **Communication service to O2O**(Online 2 Offline) service with Q&A
  - Korean market will grow up to 0.24 billion dollars (2020)
- GrandViewResearch (2015), TechNavio (2014)
  - North America centric → Europe and **Asia market is growing rapidly**, up to 20% in 2018



\* TechNavio, 2014



Going to be almost FREE!  
(except data...)



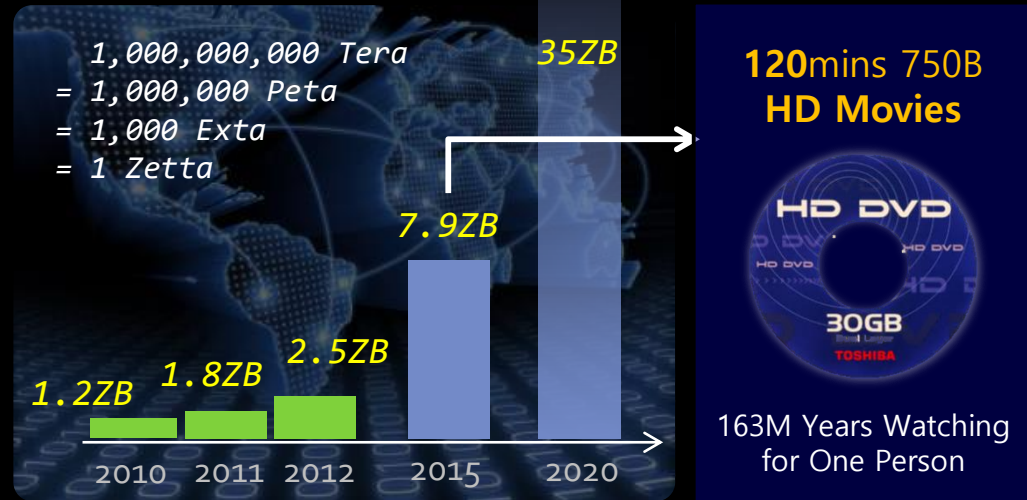
Cloud Infrastructure

AI Algorithms

Big Data

# Big Value from Big Data?

## Size?



## 3V?

Volume

Velocity

Variety



3M/sec  
e-mails



20hrs  
Movies  
/min



50M  
Tweets  
/day



DBMS



Sensor



Log



Text



e-Mail



Office



Image



Audio



Video

# The **Facts** of Big Data?

Big Data Technology :

“Complex and large data sets that it becomes difficult to process using traditional technologies”

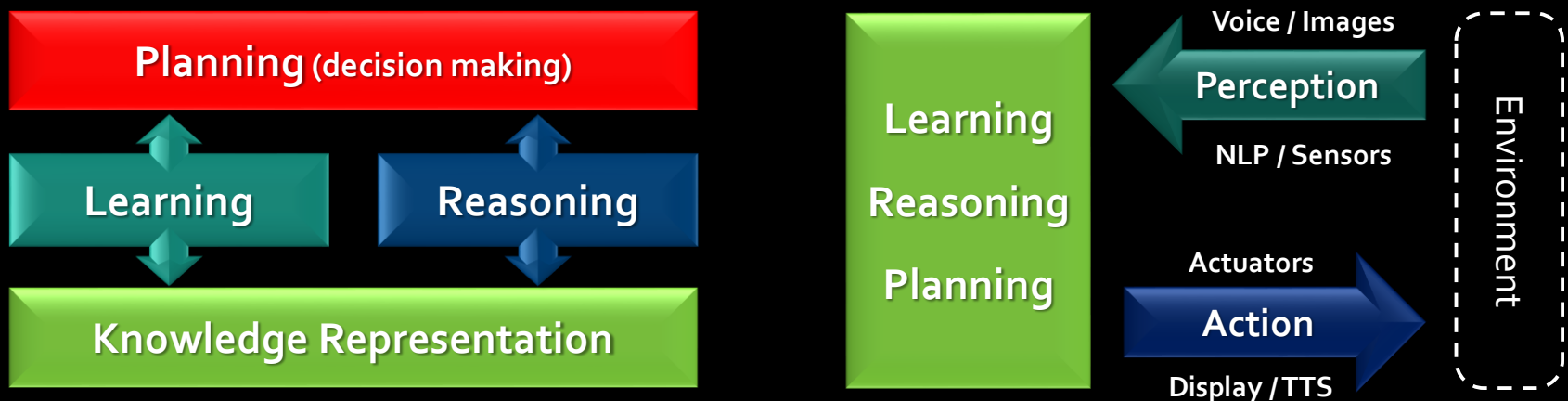
Why is it so difficult to process?

**3V x F.A.C.T !!**

(Fragment x Ambiguity x Context x Trustability)

# What is Artificial Intelligence?

- The science and engineering of **making intelligent machines**. (John McCarthy)
- The study and design of **intelligent agent system** that perceives its environment and takes actions that maximize its chances of success. (Stuart Russell)
- The study how to create computers and computer software that are **capable of intelligent behavior**. (Wikipedia)



# What is Artificial Intelligence?

- **Strong AI**

Artificial general intelligence. Computers can be made to think on a level at least equal to humans, that they can **be conscious** and experience emotions.

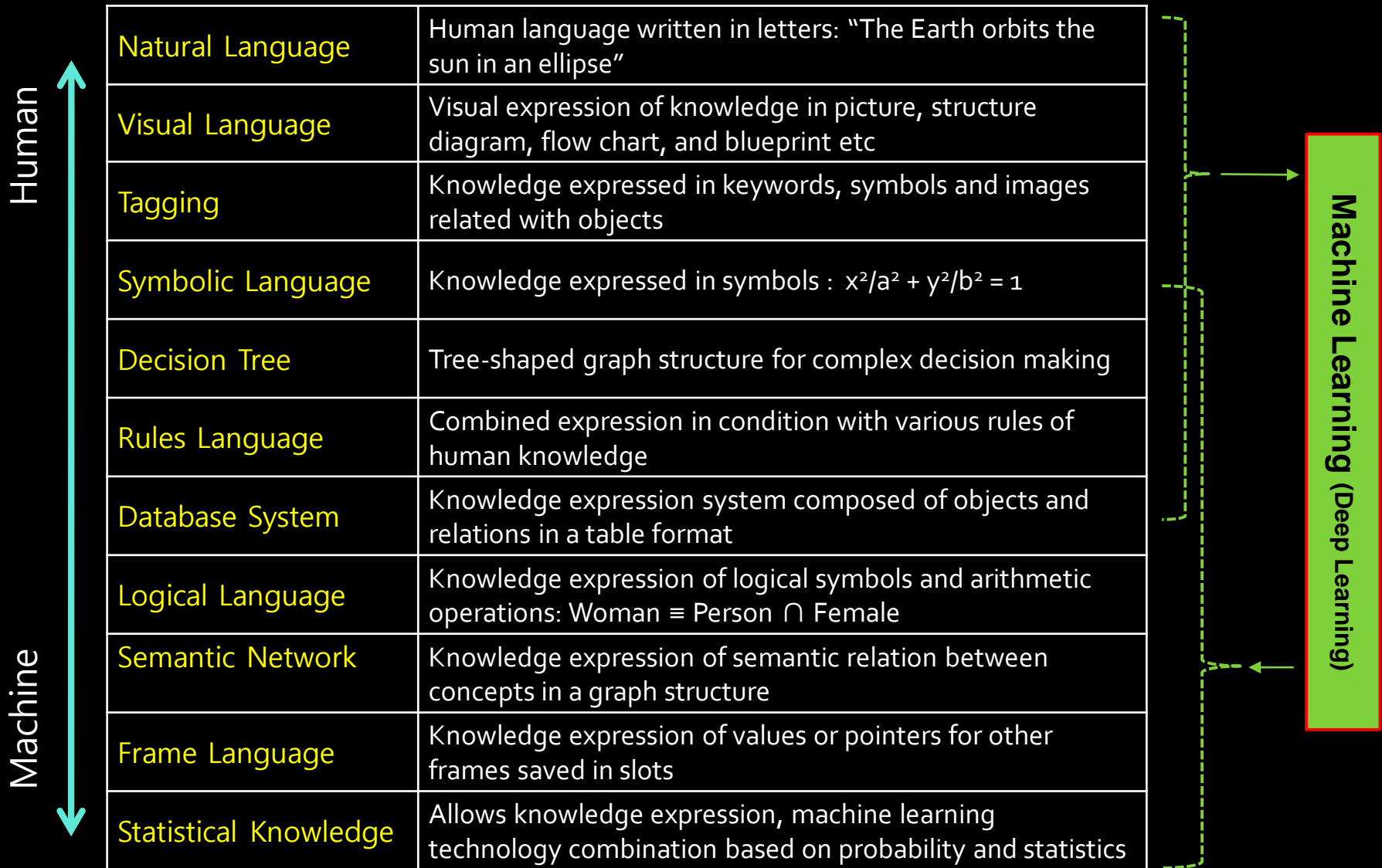
- **Weak AI**

Non-sentient computer intelligence or AI that is **focused on one narrow task**. All real-world systems labeled "artificial intelligence" of any sort are weak AI at most.

Systems that <b>think</b> like <b>humans</b>	Systems that <b>think</b> <b>rationally</b>
Systems that <b>act</b> like <b>humans</b>	Systems that <b>act</b> <b>rationally</b>



# Knowledge Representations?



# Knowledge Representations

## Natural Language

"Employees working for a company are humans; the company and the employees are legal entities. The company is able to make a reservation for an employee's trip. The trip is available by plane or train that travels in cities within Korea or the U.S.. The companies and destinations for business trip are located in the cities. Saltlux reserved OZ510 with a round trip of Seoul and New York for Hong, Kildong."

## Rule Language

**(Rule)** If someone is flying, he must be on trip.

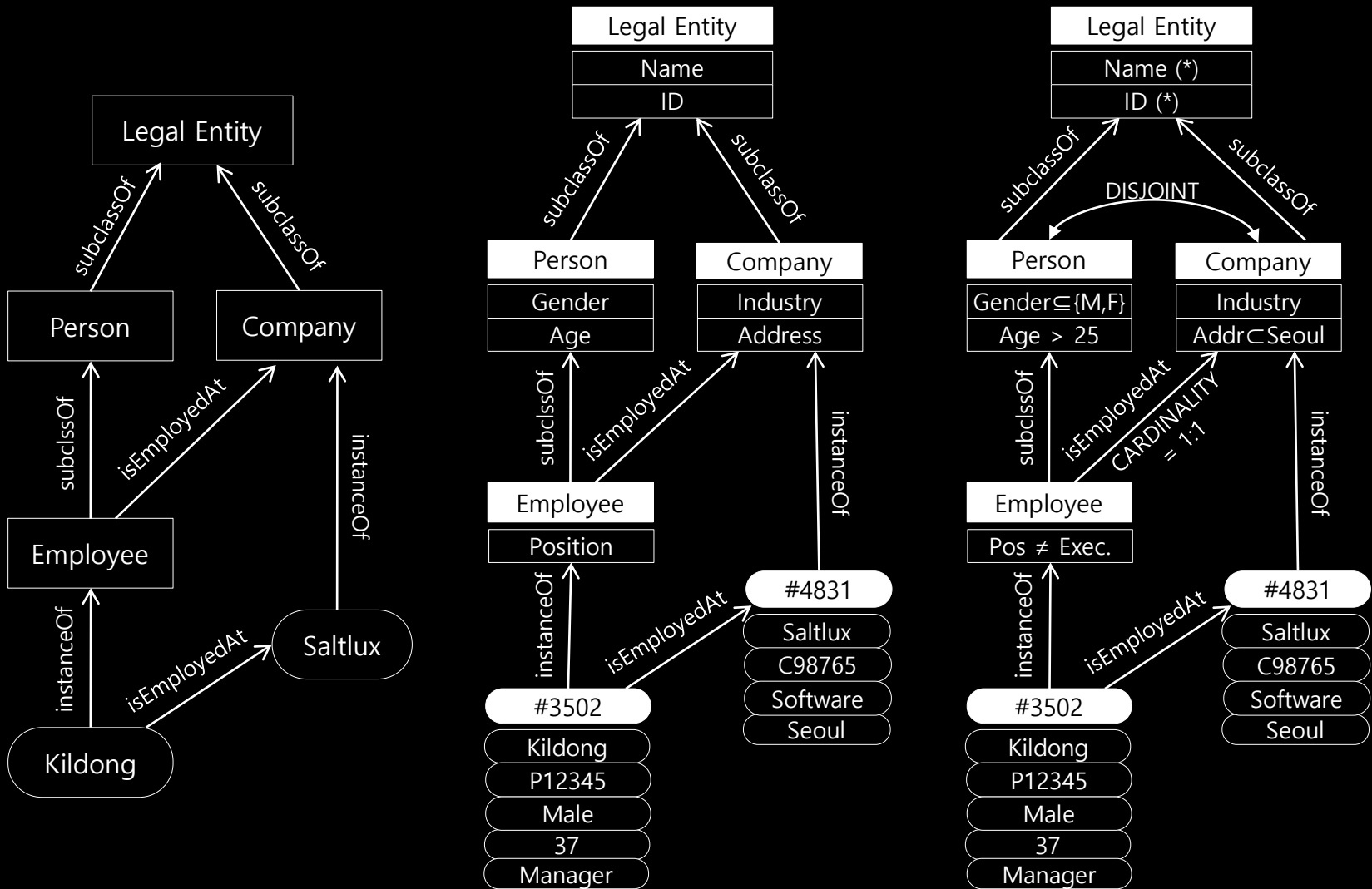
**(Rule)** If someone's trip is reserved in a company, he is an employee of the company.

**(+ Rule)** For short trip in the same country, an employee should take a train.

**(Deduction)** Hong kil-dong whose flight is in reservation is an employee of Saltlux.

**(Deduction)** OZ510 is a flight for the U.S. and Korea.

# Building Explicit Knowledge Base

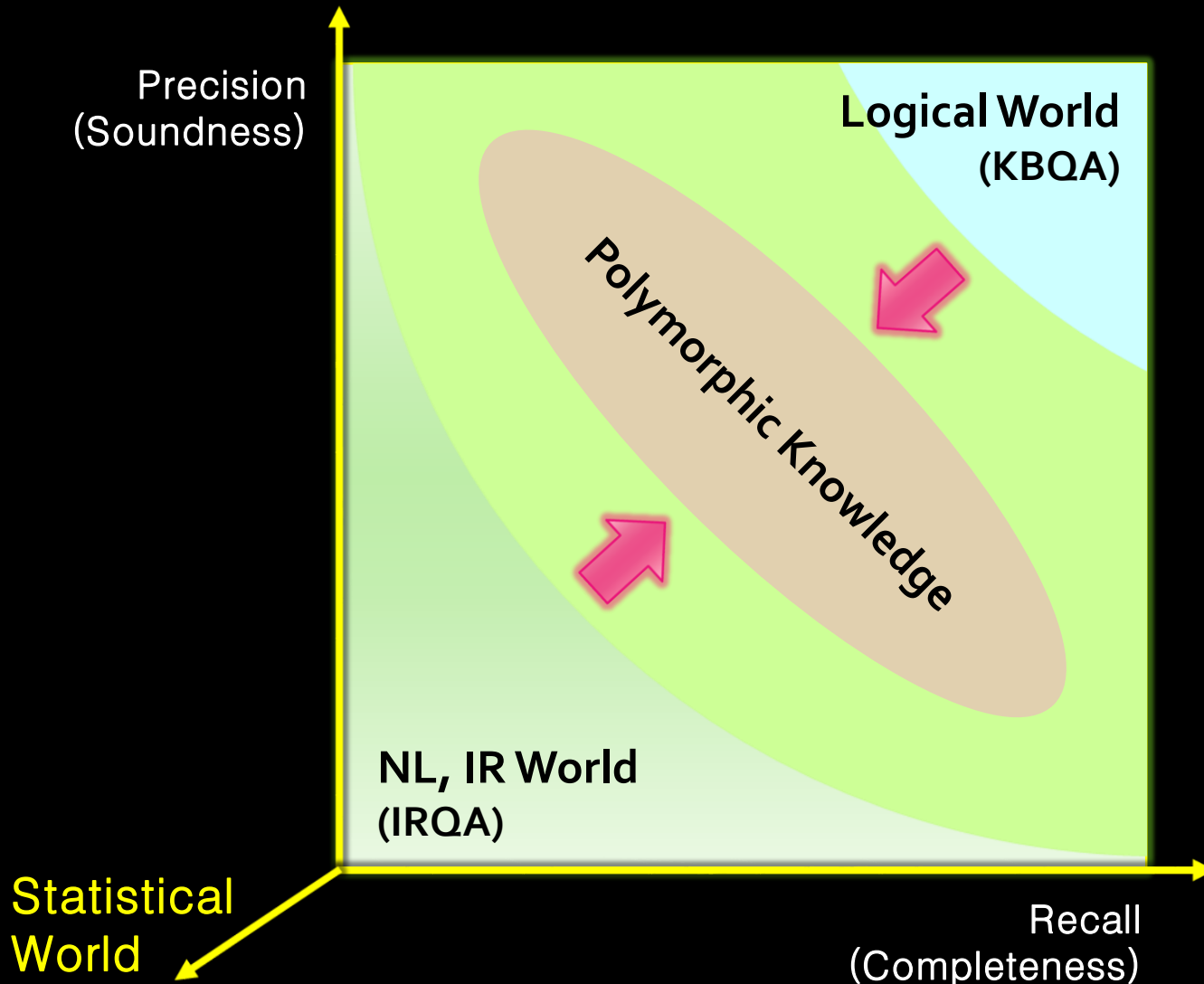


(a) Semantic Network

(b) (a) + Frame (Slots)

(c) (b) + Logical Restrictions

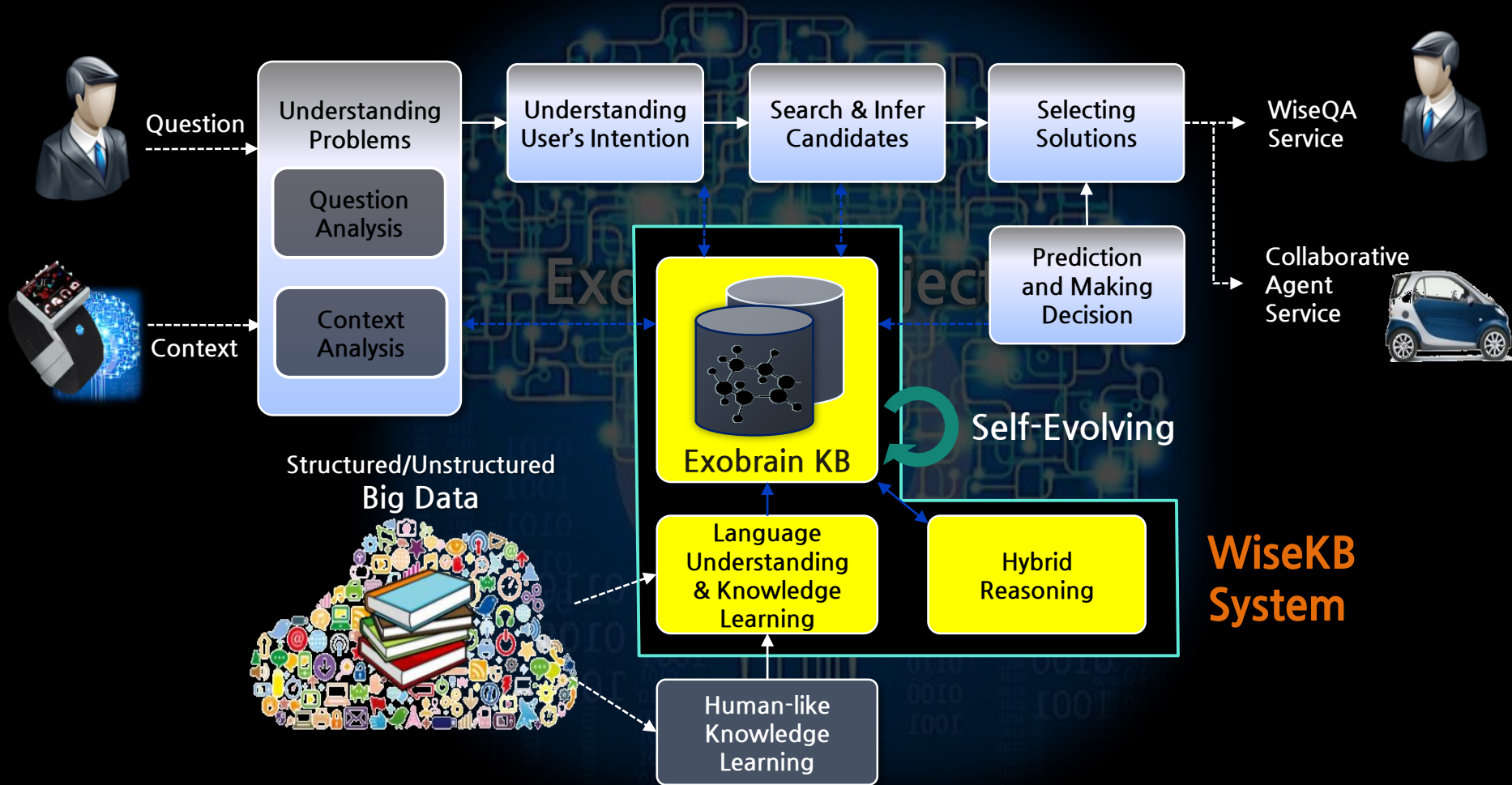
# Building Polymorphic Knowledge Base



Act Three

Exobrain and WiseKB

# Exobrain is a future AI that can learn, think and make decision like human



# Knowledge Learning and Reasoning for QA



Who is this person? He/she was born in Gyungsang-do between remarried father, a soldier and mother, a teacher. He/she has an elder sister and lost his/her mother on independence day.

WiseQA



박근혜는 1952년 2월 2일 경상북도 대구시 삼덕동(현재의 대구광역시 중구 삼덕동 5-1번지, 5-2번지 일대)에서 전시(戰時) 대구 주재 육군본부 작전·교육국 작전차장 박정희 대령과 중등학교 교사 출신인 그의 부인 육영수의 딸로 태어났다. 어머니 육영수에게는 첫 소생이었으나 아버지 박정희는 이혼 경력과 전처소생의 장녀 박재옥이 있었으므로 박정희에게는 차녀가 된다. 여동생 박근령과 남동생 박지만이 있다.

Learning and Augmentation

Whols(?x) :-

- hasMother(?x, ?mother),
- job(?mother, teacher),
- becomes(?x, 60),
- home(?x, Gyungsang-do),
- hasFPosition(?x, 2nd),
- hasFather(?x, ?father),
- job(?father, soldier),
- remarriage(?father, ?mother)
- .....

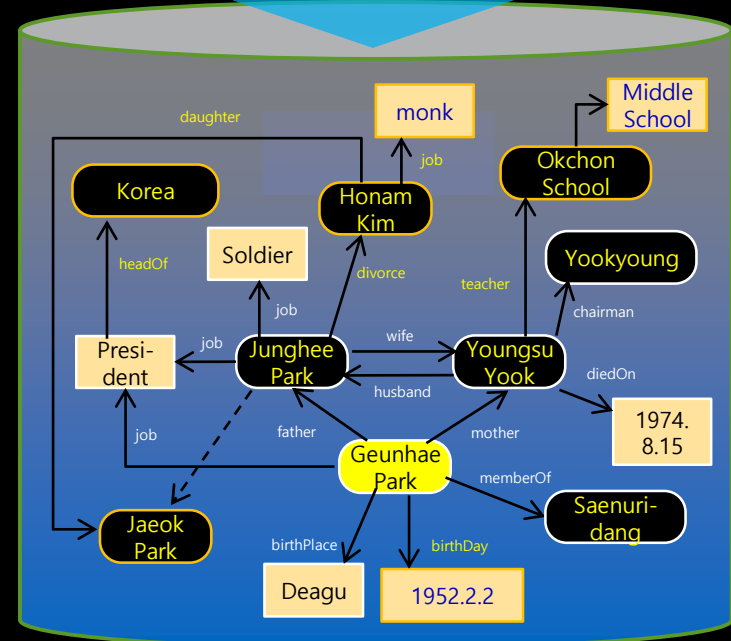
Search  
(graph-  
matching)

Ara Ko,  
Jeaho Kim,  
Jun Han...

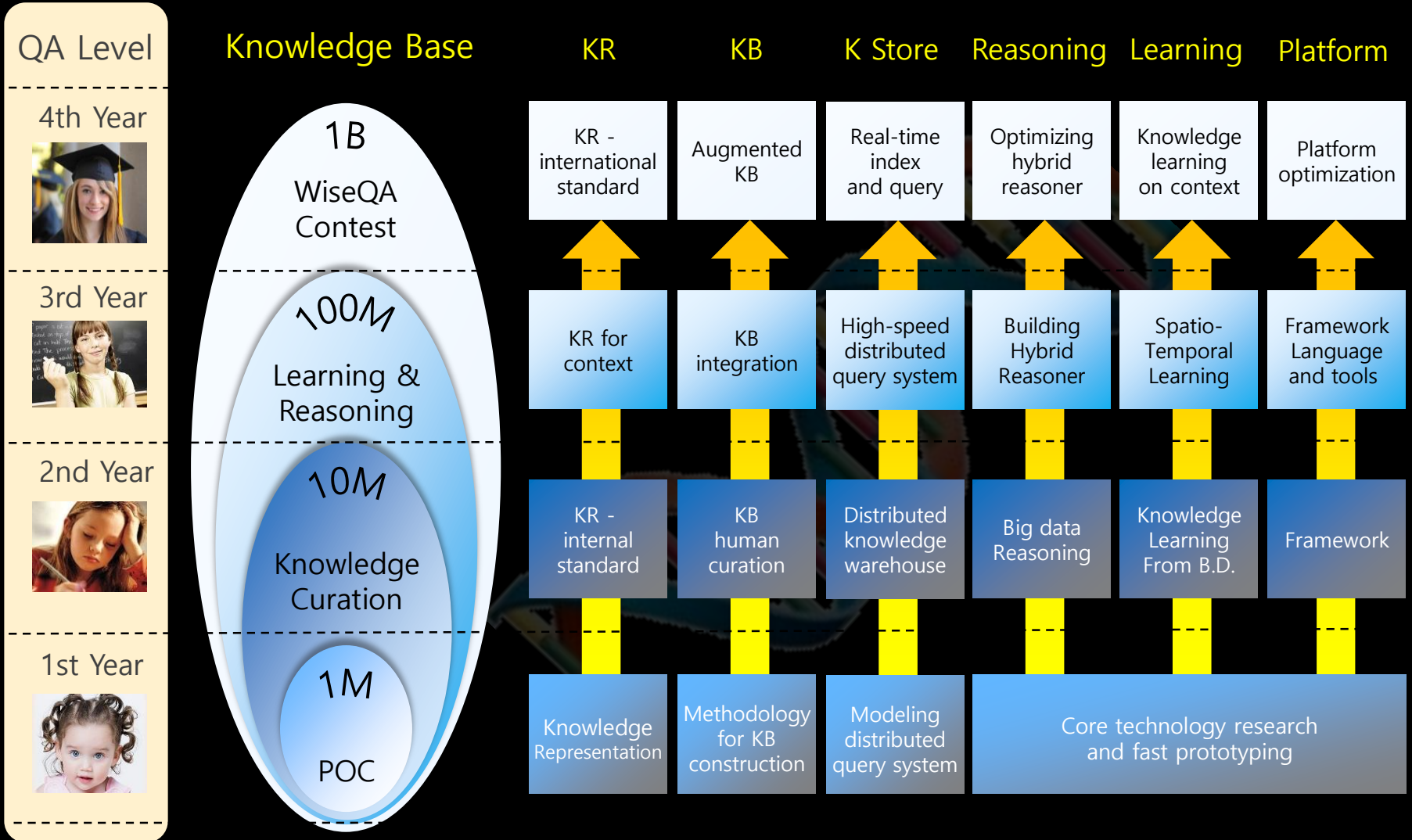
Reasoning

- Semantic
- Temporal
- Geospatial
- Uncertain

G.H. Park(90%)  
Ara Ko(10%)  
Jaeho Kim(5%)  
...

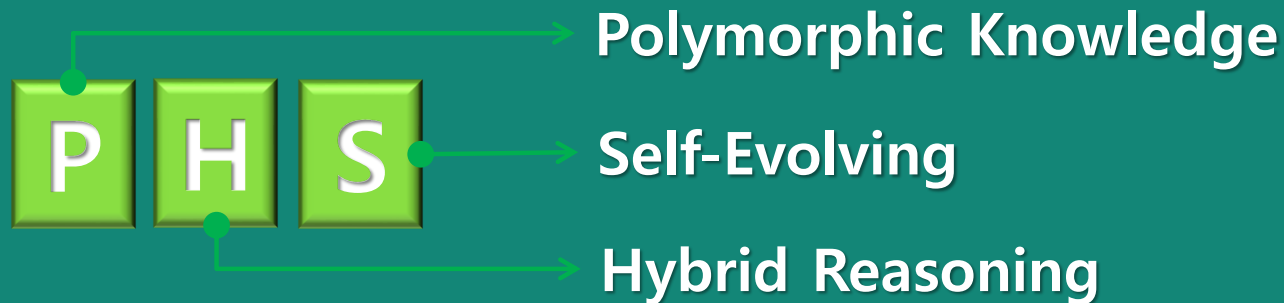


# R&D Milestones and Goals





# WiseKB - Distinguished Features



Feature	Feature	Comparison	WiseKB Uniqueness
<b>P</b>	Knowledge Representation	<ul style="list-style-type: none"> <li>• CyCorp Cyc</li> <li>• IBM Watson</li> </ul>	<ul style="list-style-type: none"> <li>• Integration of logical, linguistic and statistic knowledge</li> </ul>
	High Quality and Volume	<ul style="list-style-type: none"> <li>• Google Graph</li> <li>• Wolfram Alpha</li> </ul>	<ul style="list-style-type: none"> <li>• Dual Spiral methodology for knowledge acquisition</li> </ul>
<b>S</b>	Knowledge Learning	<ul style="list-style-type: none"> <li>• IBM Watson</li> <li>• Google Graph</li> </ul>	<ul style="list-style-type: none"> <li>• Hybrid Learning (ML+Rules)</li> </ul>
	Self-Verify and Proof	<ul style="list-style-type: none"> <li>• CMU NELL</li> <li>• Google Graph</li> </ul>	<ul style="list-style-type: none"> <li>• Big data based confidence prediction</li> </ul>
<b>H</b>	Diversity of Reasoning	<ul style="list-style-type: none"> <li>• EU LarKC</li> <li>• CyCorp Cyc</li> </ul>	<ul style="list-style-type: none"> <li>• Semantic, geospatial, temporal and uncertainty reasoning</li> </ul>
	Economic efficiency	<ul style="list-style-type: none"> <li>• VU WebPie</li> <li>• Franz AllegroG</li> </ul>	<ul style="list-style-type: none"> <li>• Parallelism in memory, GPGPU</li> </ul>

# Dual-Spiral methodology for building KB



## Domain Experts

- QA tests
- Verifying learned KB

## Crowd Sourcing

- Gamification (Quiz game)
- Acquisition and proving

## Knowledge Curation

- High quality KB
- Semantic annotation
- KB integration

## Reasoning

- Hybrid logic reasoning
- Spatio-temporal reasoning
- Statistic and uncertainty

## Self-Learning

- Learning by reading
- Learning by taking advice

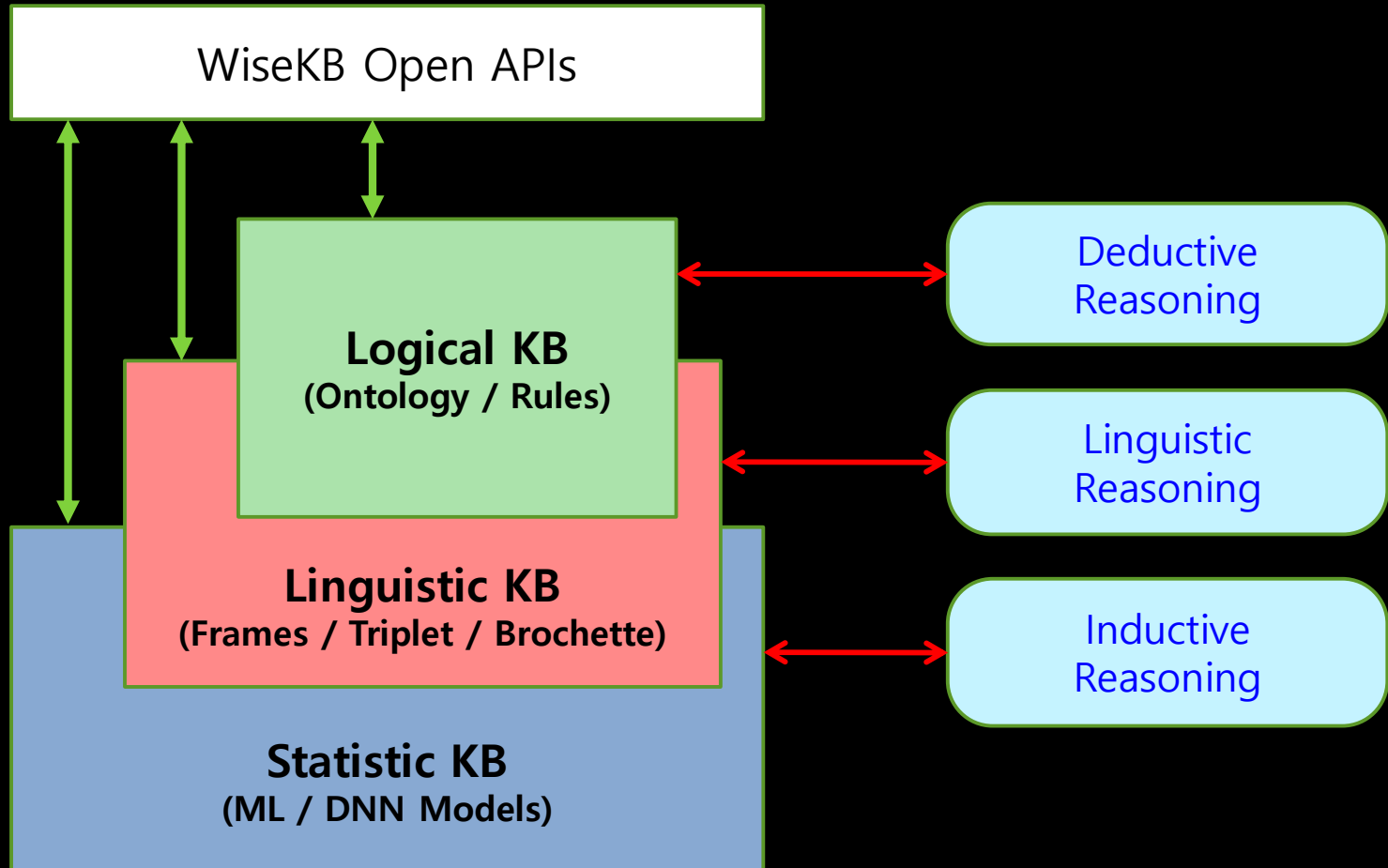
## Data Governance

- Acquisition of big data and knowledge resources
- Automatic resource discovering for lack-knowledge
- Semantic data integration

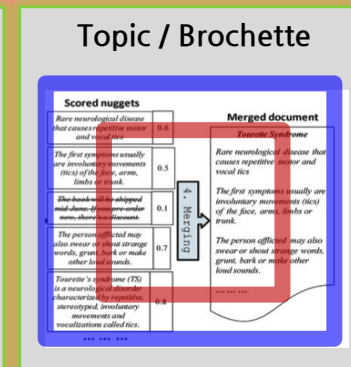
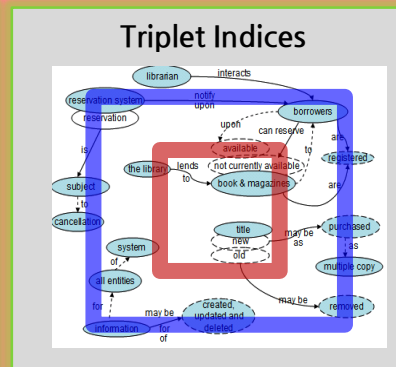
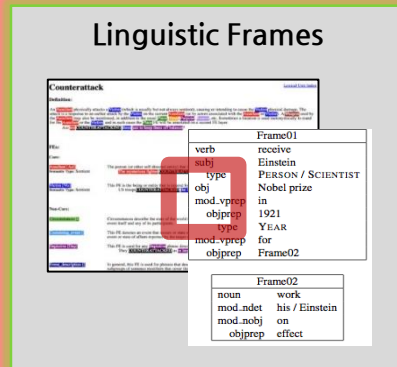
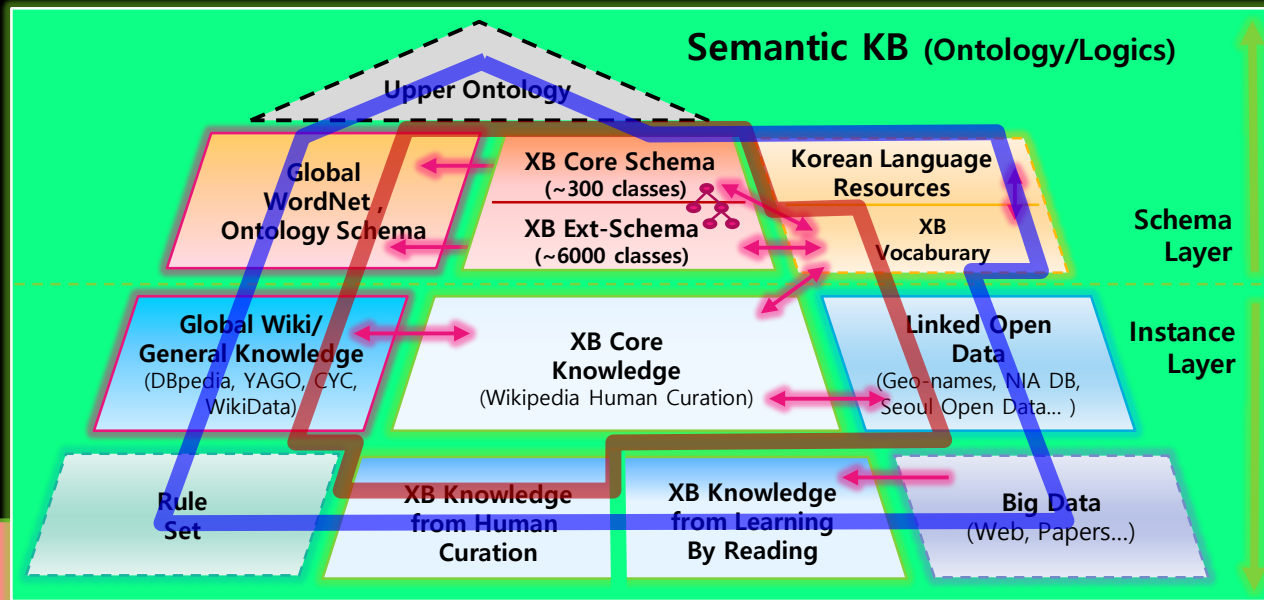
Human Centric  
Lifecycle Management for  
Knowledge Augmentation  
Machine Centric



# Polymorphic Knowledge Base



# Exobrain KB for Polymorphic Knowledge and Hybrid Reasoning

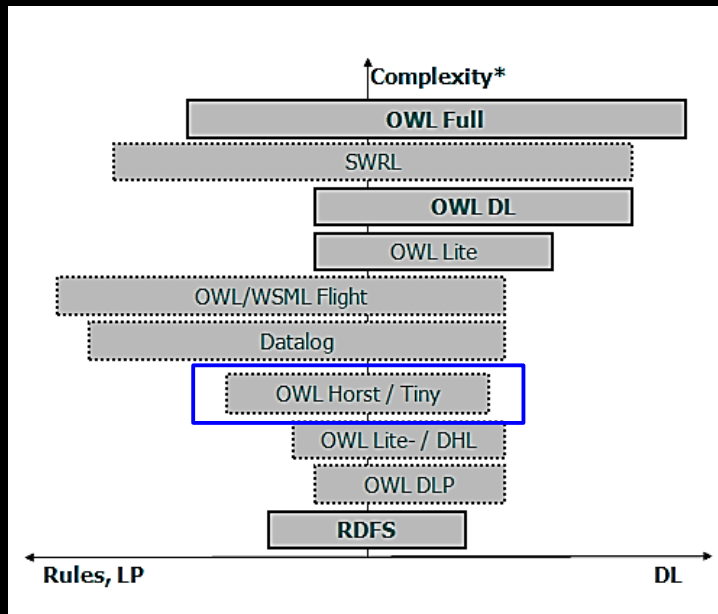


**Linguistic KB (Frame/Triplet)**

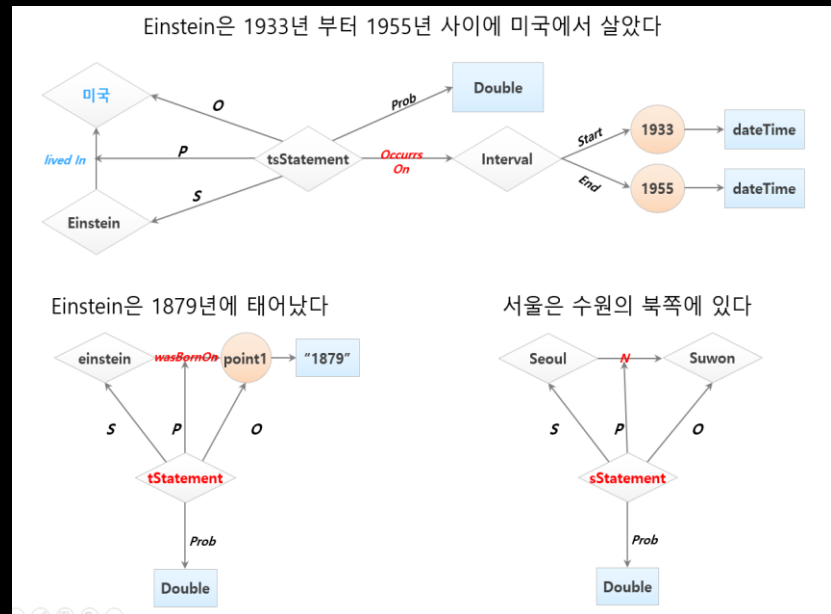
**Statistic KB (ML-Models/Uncertainty)**

# Logical Knowledge Representation

- Labeled graph/Triple(s p o) based KR
- Using reification for temporal, spatial and probabilistic knowledge
- Expressivity of OWL horst level
- SPARQL query language for KB accessing



Logical expressivity for KR



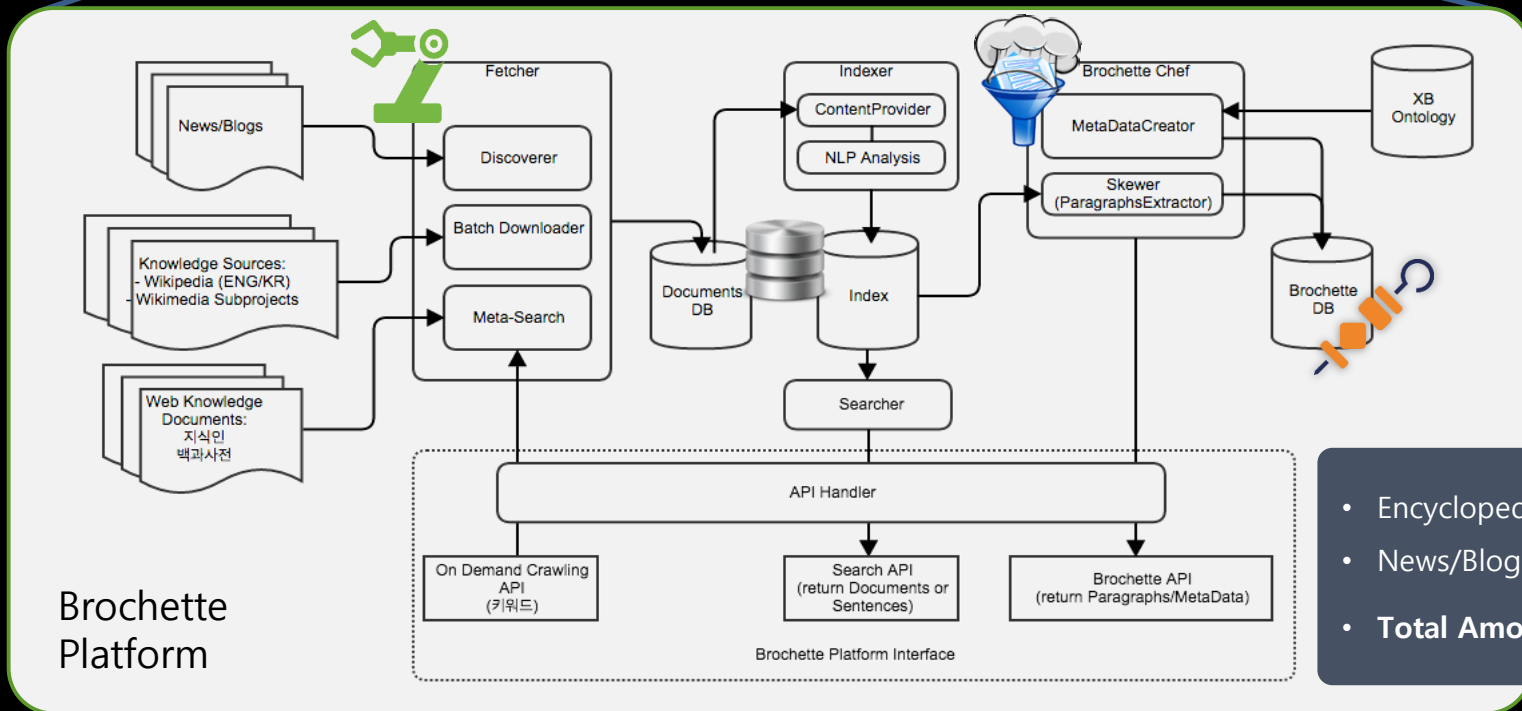
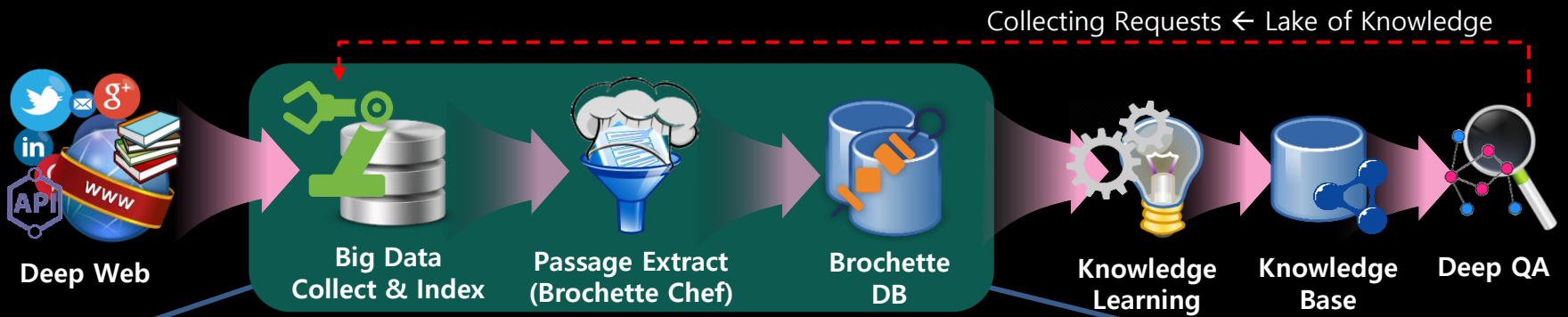
Reification for KR

# Constructed XB - Core KB

- High quality and huge-scale knowledge base development based on dual spiral methodology
- Manual knowledge curation, semi-automatic knowledge importing and validation from Wikipedia and Linked Open Data.
- Current volume: 186M triples (Biggest KB in Asia)

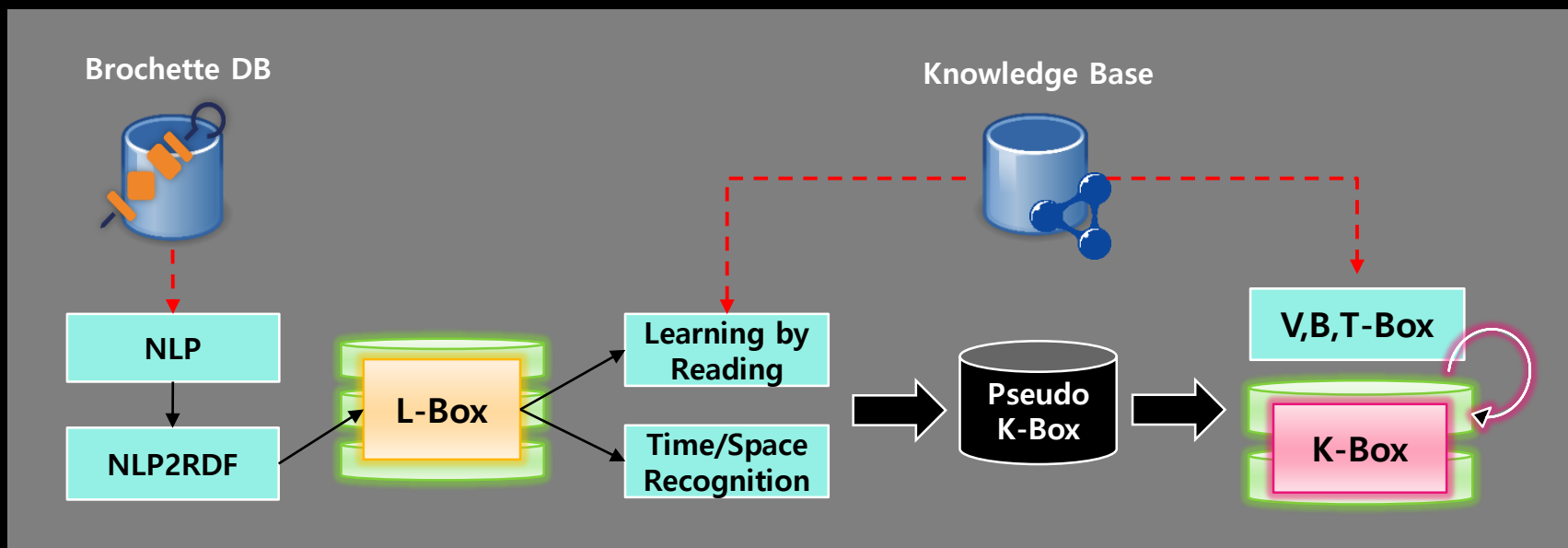
Type	2nd year	3rd year	Difference
Classe	6,132	6,315	▲ 183
Property	504	991	▲ 487
Instance	1,554,489	23,399,338	▲ 20M
Triple	10,639,996	186,000,000	▲ 80M
Domain	General(wiki), History, Person, Organization	+ General(news, blogs), GeoSpatial, Art work, Science, Events, and etc.	

# Knowledge Resource Acquisition



- Encyclopedia: 2M articles
- News/Blogs: 72M articles
- **Total Amount: 370K Books**

# Knowledge Learning from Big Data

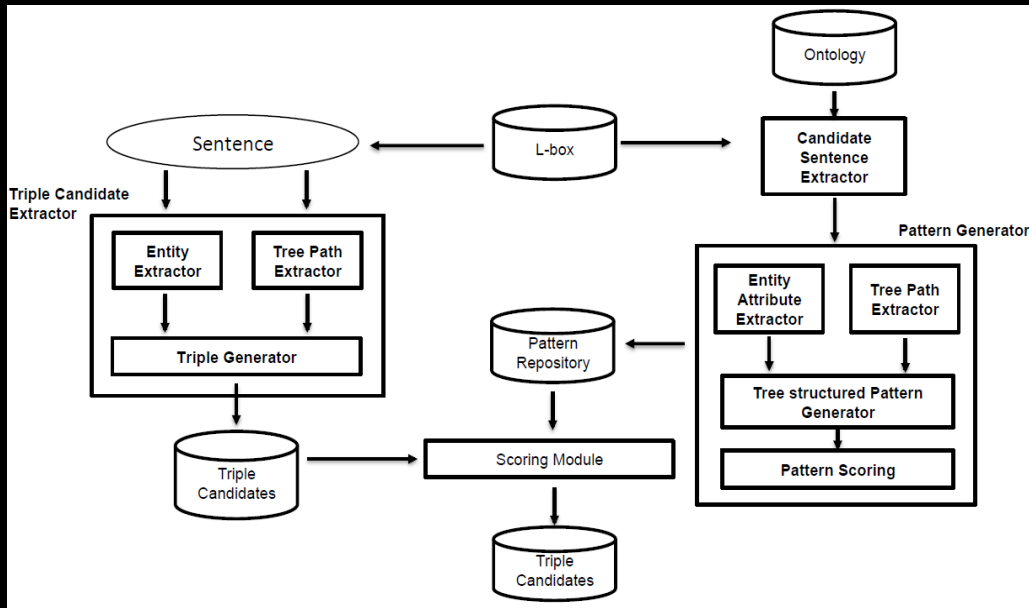


- Development of knowledge learning and automatic validation from unstructured big data
- Learning by Reading based on NLP and Machine Learning
- 1B triples in L-Box, 40M triples in K-Box with 79% accuracy of entity learning and 60% accuracy of relationship learning

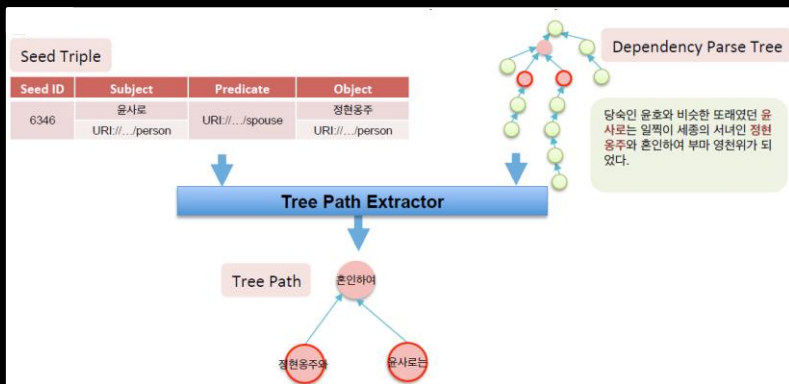




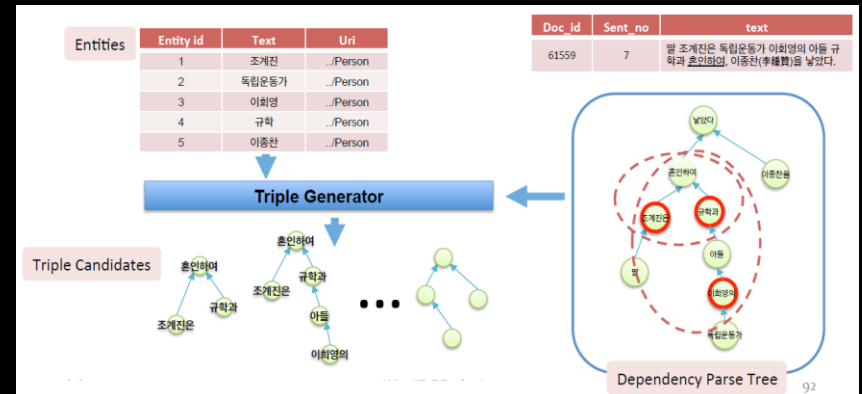
# ML based Learning by Reading



- Learning knowledge patterns from seed triple and L-Box (70.8 % accuracy)
- Learning new knowledge (triples) from learned patterns and L-Box
- Knowledge learning from the body text of Korean Wikipedia (57.1% accuracy, 76% w/ p-error)



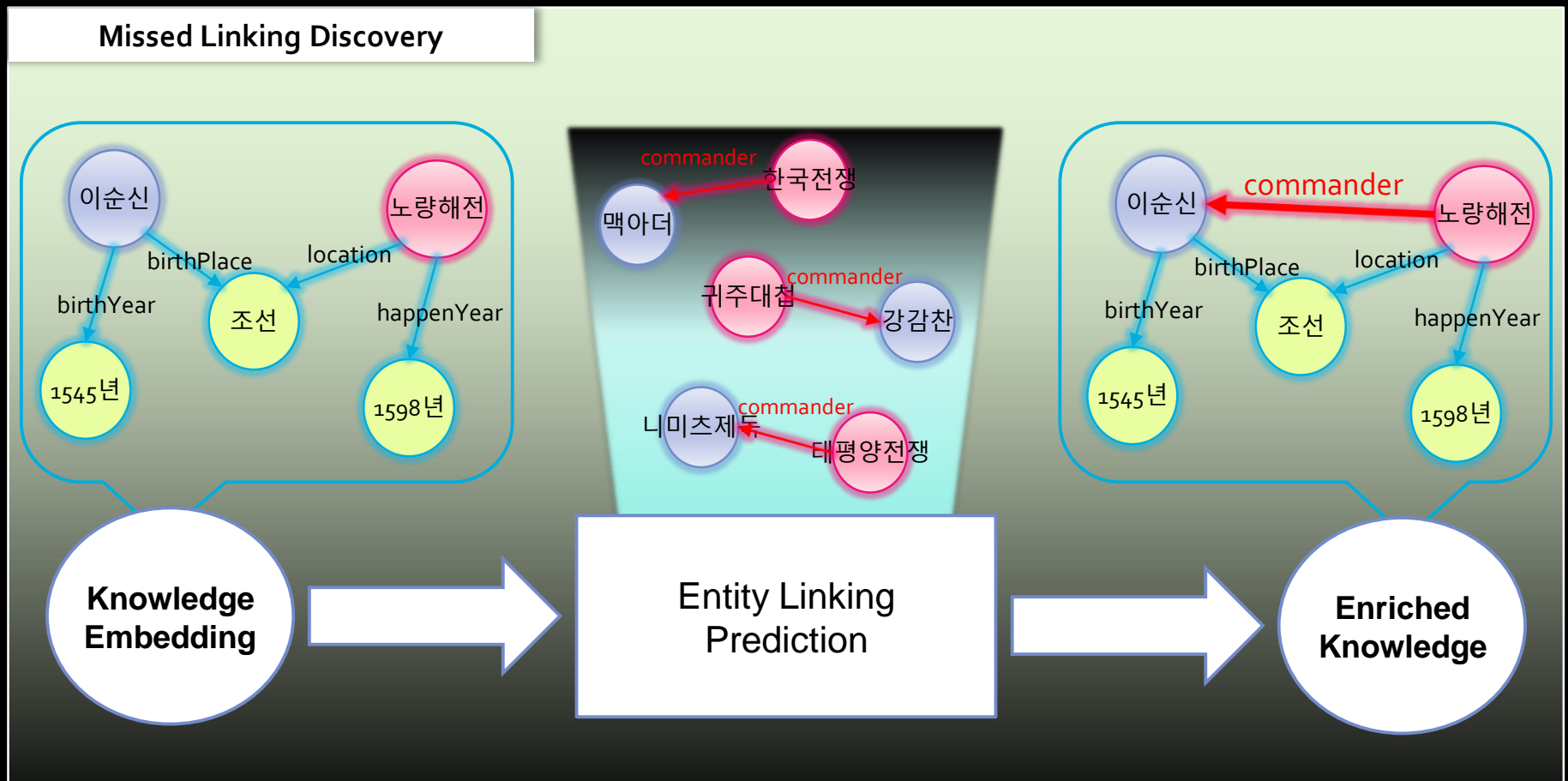
1. Pattern Learning



2. Knowledge Learning

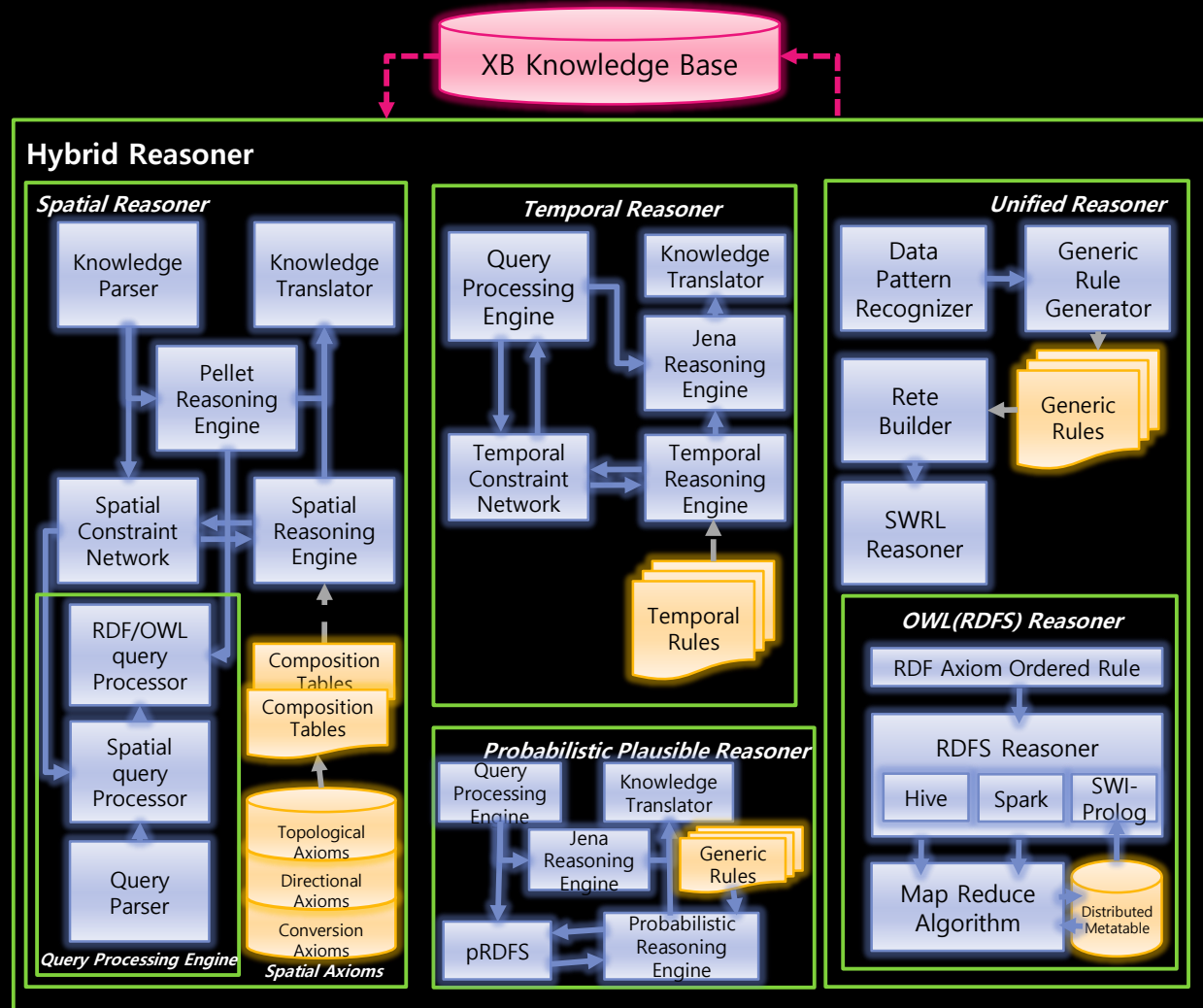
# Knowledge Embedding and Link Prediction

Applying deep learning and knowledge embedding technology for missing link prediction (80% accuracy)



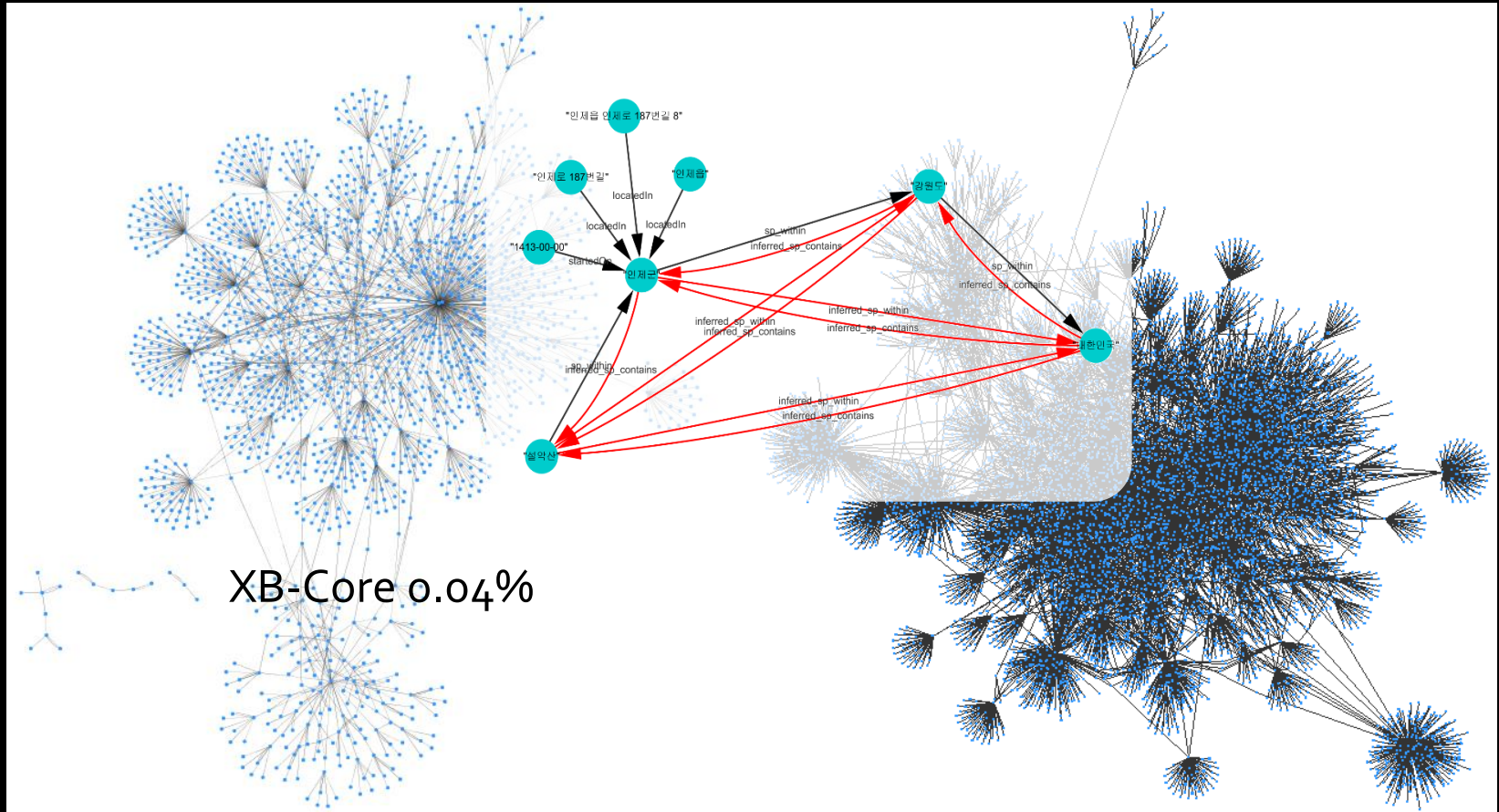
# Hybrid Reasoning

- Huge scale and fast DL-horst reasoner working on in-memory and map-reduced architecture  
→ World fastest reasoner
- Developing spatial and temporal reasoner based on CSD-9, RCC-8 and Allen's algebra
- 2.6M inferred triples from 3.4M XB ontology
- 460 k triples/s throughput on Spark



# Semantic Reasoning and Knowledge Enrichment

World fastest reasoning performance based on OWL Horst expressivity



<Before Reasoning>

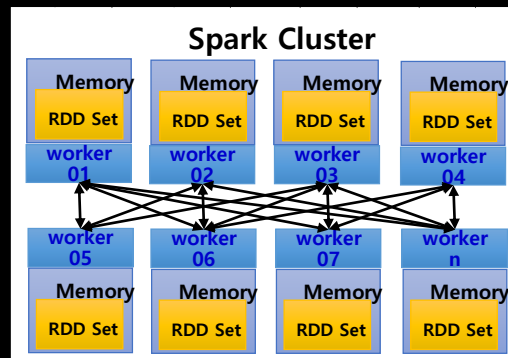
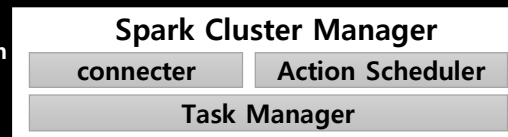
<After Reasoning>

# Spark based Parallel Reasoner

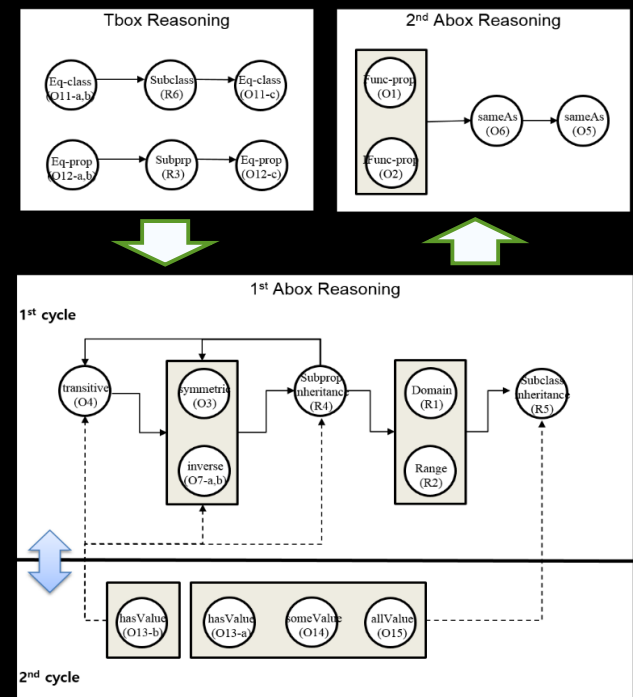
- World fastest OWL Reasoner working on Spark architecture – implementing DL rules on key-value data abstraction (Pair RDD)
- Optimization of reasoning sequence and recursive algorithm for improving the performance of OWL horst reasoning working on smaller memory



connection  
operation



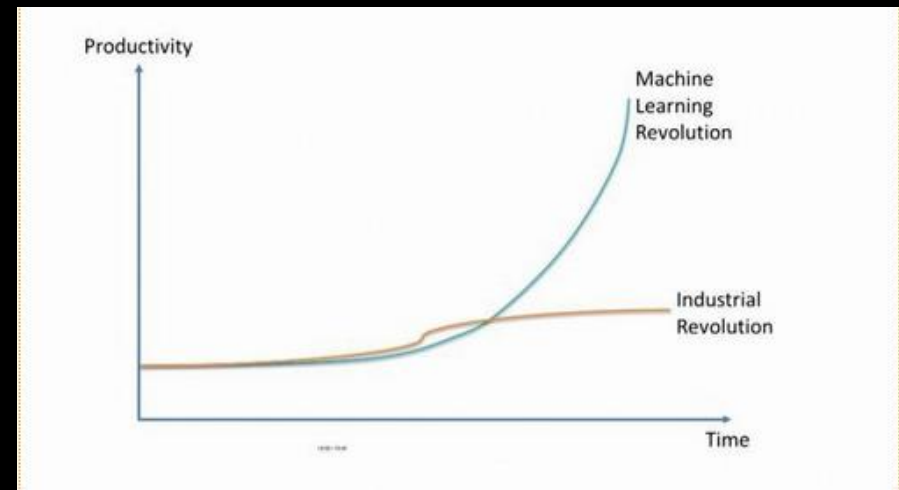
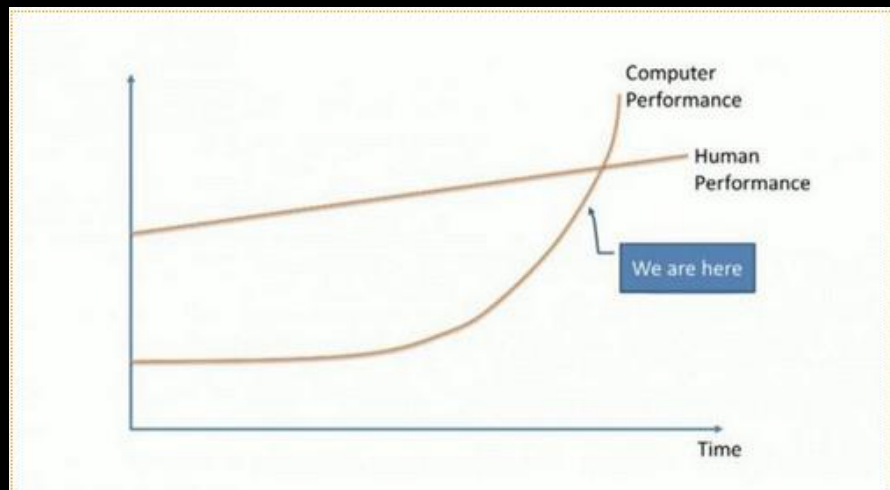
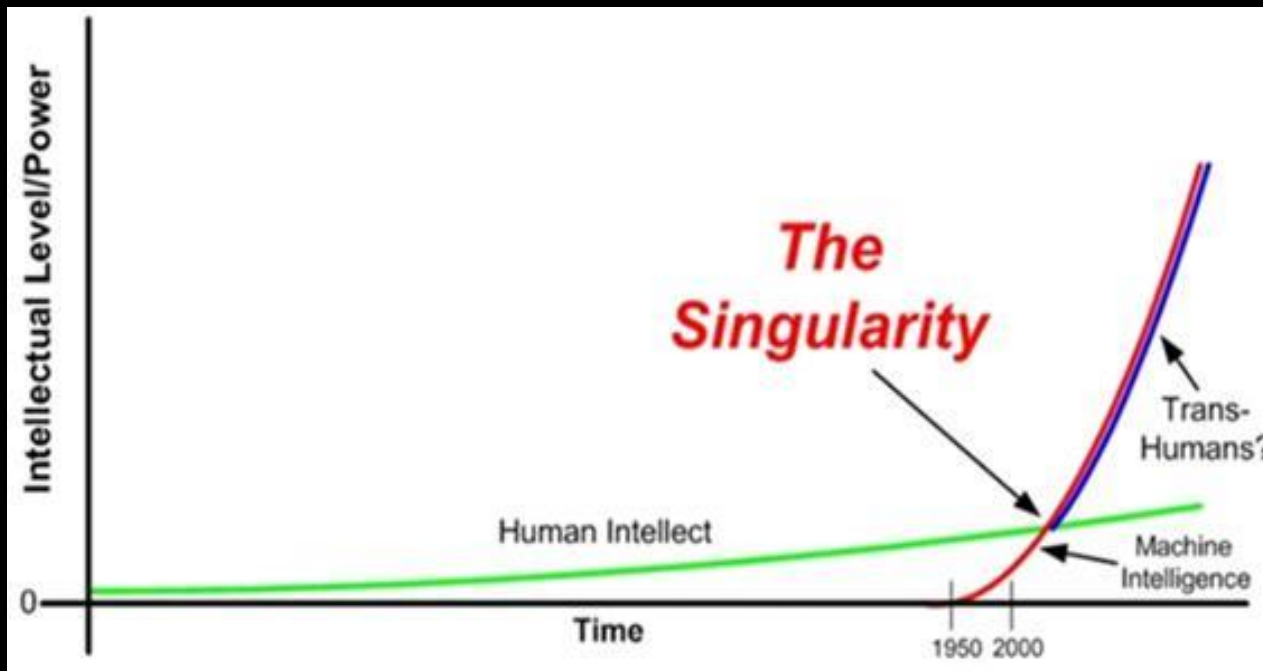
Configuration of Spark Reasoner



Optimization of reasoning sequence

Act Four

# The Future of AI?





Intuition and Insight

Cost and Productivity

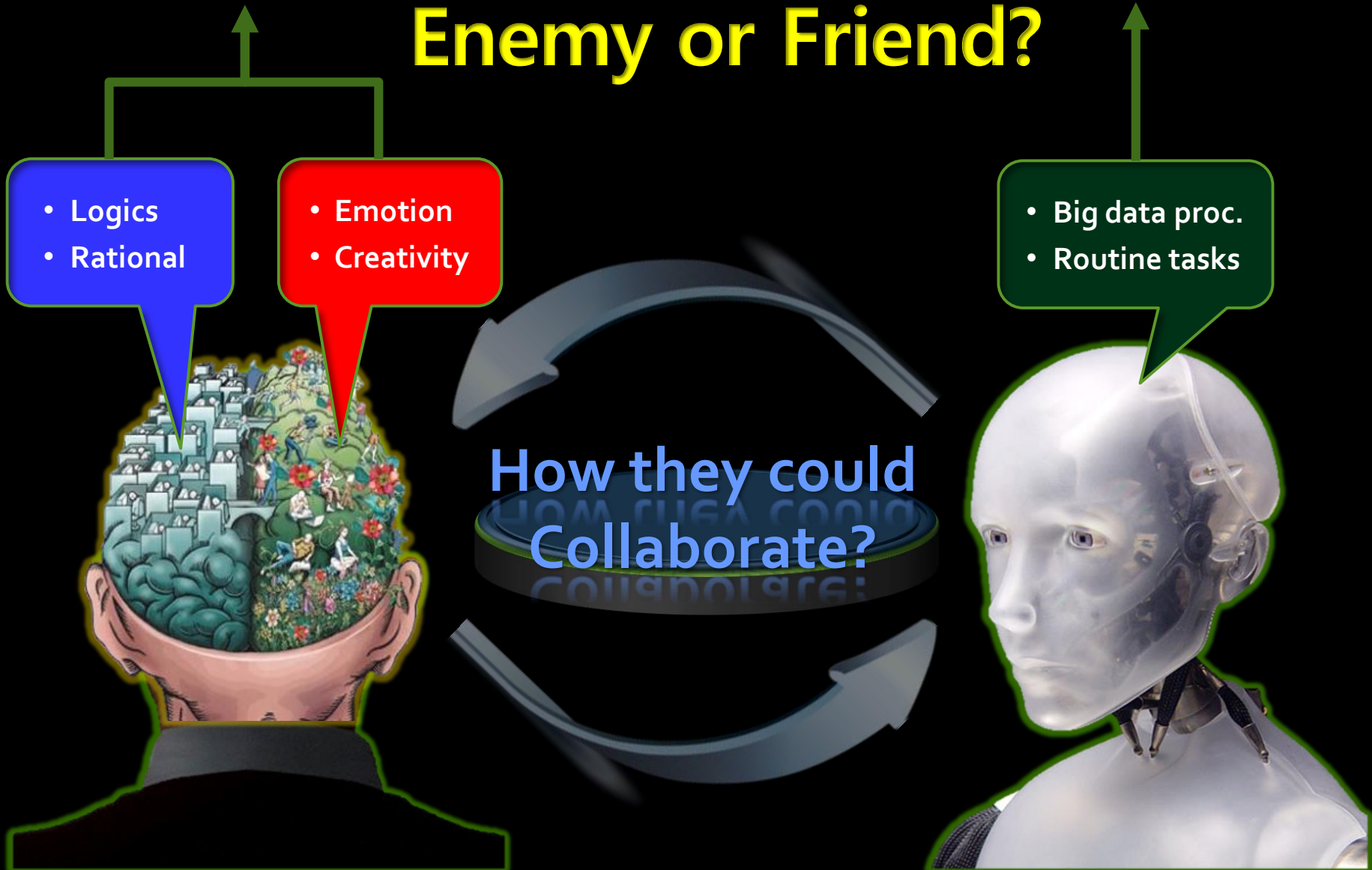
# Enemy or Friend?

- Logics
- Rational

- Emotion
- Creativity

- Big data proc.
- Routine tasks

How they could Collaborate?



# Conclusion

“Computers are incredibly fast, accurate, and stupid.  
Human beings are incredibly slow, inaccurate, and brilliant.  
Together they are powerful beyond imagination.”

- Albert Einstein -

- The era of human and machine collaboration.
- Healthy goose rather than big golden egg.