

A background network diagram consisting of a series of interconnected nodes and lines, forming a complex, web-like structure. The nodes are represented by small circles, and the lines are thin, light gray lines connecting the nodes. The overall appearance is that of a digital or computational network.

# **Global computational intelligence**

## **State of affairs, treats and opportunities**

Anton Kolonin  
2013, May 4

# Global computational intelligence

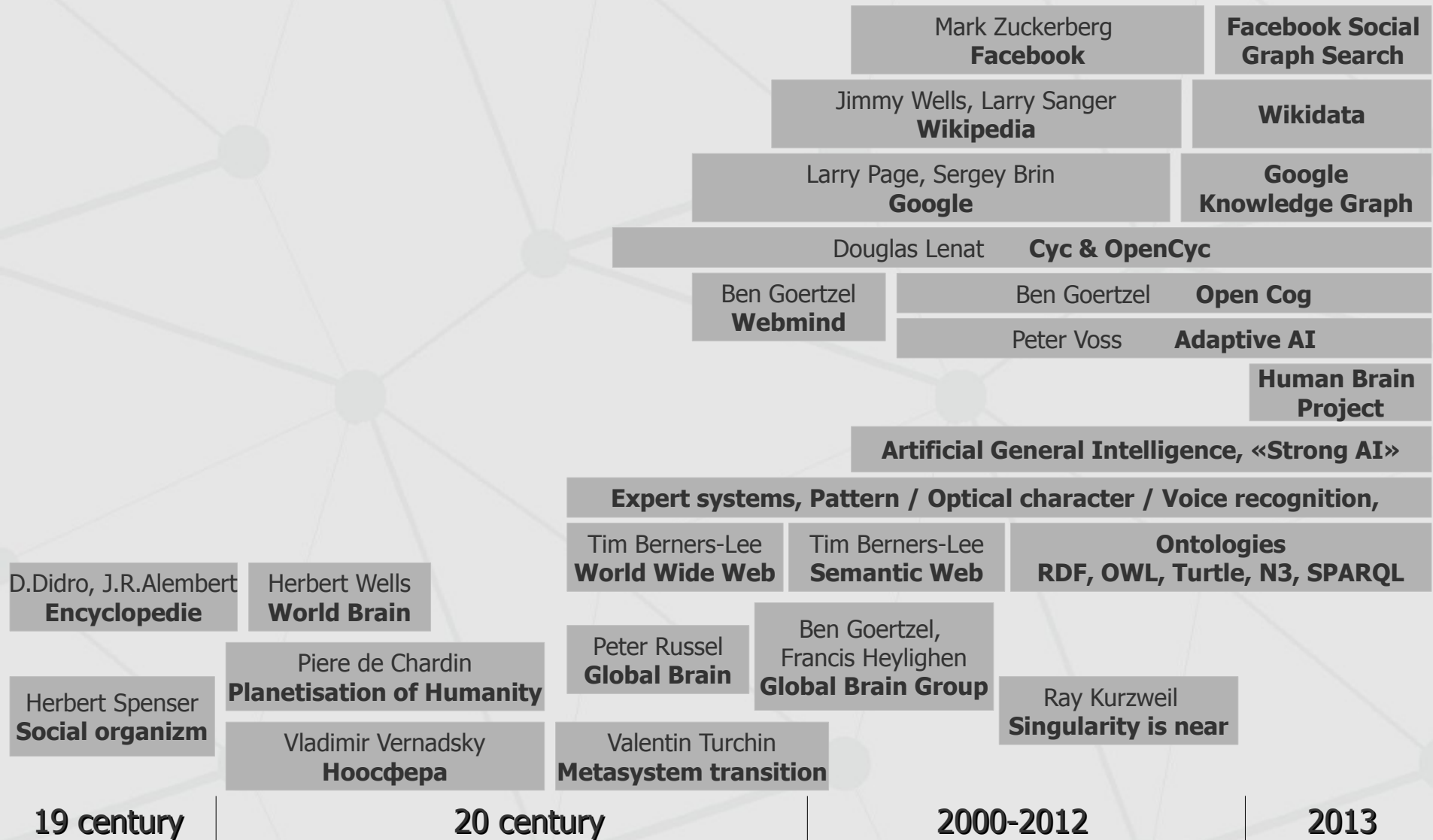
## State of affairs, treats and opportunities

Anton Kolonin  
2013, May 4

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- Computational resources
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- Centralized globalization model
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# Global computational intelligence

## Brief history



# Global computational intelligence

## Definitions

- Intelligence - the ability to achieve complex **goals** in complex **environments**, using limited **resources** (Ben Goertzel);
- **Goals** – may be defined by environment or set by resource operators;
- Global computational intelligence – emerging in Earth **humanistic environment** and using **computational resources** of the world;
- Based on algorithms of massive processing (**big data**) of **structured information**;
- **Intelligence criteria** – not necessarily judged by Turing test;
- **Impossible, maybe possible, coming or already here**

# Global computational intelligence

## Possible goals

### **Principal** (*set by operators*):

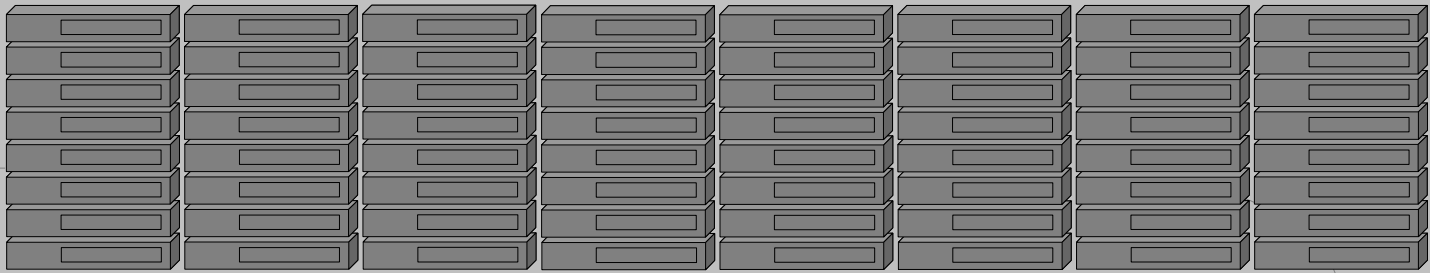
- Detection of treats and opportunities – for user, corporation or government;
- Demand formation – for given market good, service or political vector.

### **Technical** (*set by environment*):

- Better matching (search) queries
  - including speech queries;
  - using natural language processing, semantic analysis;
  - with account for mental/behavioral user model.

# Global computational intelligence Environment and resources

Computational resources



Web page publishing

Search queries

Status and location change

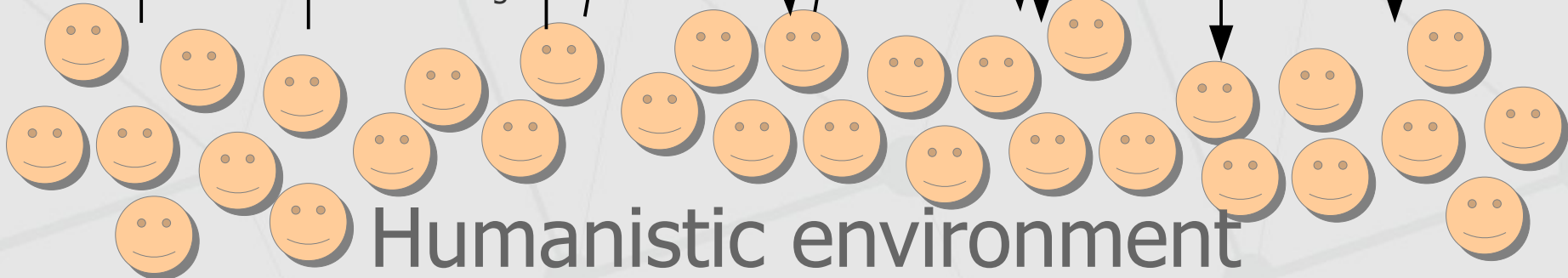
E-mail communication

Chat communication

Search results

Commercial ads

Notifications and alerts



Humanistic environment

# Global computational intelligence

## Environment of emergence

Information space	Amount of information
Google, Google+ and Knowledge Graph (proprietary)	500 million users, 700 million concepts, up to 20 billion facts and connections
Facebook Social Graph (proprietary)	900 million users, “hundreds of billions of entities, trillions of attributes and relationships”
Cyc Knowledge Base (partially public, “upper ontology” available in LISP or RDF/OWL)	2 million assertions
Wikidata (public, custom format expected to be exportable as RDF/OWL)	1 million statements
English lexicon	1 million words (including scientific terms)
World population	7 billion people 2.5 billion active internet users 1 billion smartphone users
Active social network users	1.1 billion – China's 7 social networks 0.7 billion – Facebook 0.3-0.6 billion – Google+ with YouTube 0.3 billion – Twitter

# Global computational intelligence

## Environment of emergence

### Summary

- 99% of structured knowledge is about humans and their relationships;
- 99% of that structured knowledge is kept in proprietary corporate knowledge bases;
- 35% of human population is counted by structured network knowledge stores and can be involved in real-time reasoning;
- The links/nodes ratio in known graphs varies from 30 (Google) to 100 (Facebook) compared to 10000 (human brain).



# Global computational intelligence

## Computational resources

Resource	Processors	RAM	Storage
Cray Titan	<b>300 thousand cores</b> (19000 nodes of 16 cores)	<b>710 terabytes</b>	<b>10 petabytes</b>
Google Cloud	1 million servers (4 cores, 16 gigabytes memory, 10 terabytes storage) <b>4 million cores</b>	<b>16 petabytes</b>	<b>10 exabytes</b>
Desktop computers in personal use	1 billion personal computers (average: 3 cores, 3 gigabytes memory, 100 gigabytes storage) <b>3 billion cores</b>	<b>3 exabytes</b>	<b>100 exabytes</b>
Smartphones in personal use	<b>1 billion smartphones</b> (average: 5 gigabytes memory)	<b>5 exabytes</b>	

# Global computational intelligence

## Computational resources

### Summary

- Corporate cloud computer outperforms single supercomputer in terms of computational power and memory (few orders of magnitude).
- The entire humanity outperforms standalone cloud computer in terms of distributed computational power and memory (few orders of magnitude).

# Global computational intelligence Growth points and market segmentation

	Desktop OS	Mobile OS	Any OS	Semantic Graph	Search Engine
Microsoft (Windows, Bing)	91%	-	45%		5%
Apple (OS X + iOS)	7%	55%	31%		-
Google (Android, Google+, YouTube, Search, Knowledge Graph)	-	26%	13%	26-48%	83%
Yahoo	-	-	-	-	8%
Facebook (Social Graph Search)	-	-	-	52%	-
Twitter	-	-	-	22%	-

*Numbers from NETMARKETSHARE and GlobalWebIndex sources.*

*Any OS measure computed given nearly equal numbers (1 billion) of personal computers and smartphones.*

*Market shares under 5% are not listed.*

# Global computational intelligence

## Growth points and market segmentation

### Summary

- Intellectual globalization (99% of knowledge controlled by few corporations) much greater than financial globalization (more than 40% world resources controlled by 100+ corporations);
- Except Google, no one corporation on the market has substantial share in ownership across all parts of “the whole system”, so the one might get exceptional competitive advantage to pose the goals for the emerging computational intelligence.
- Concentration of the knowledge about entire humanity in one particular privately owned system can be called as **centralized intellectual globalization.**

# Global computational intelligence

## Centralized globalization

### Treats and opportunities

#### ■ Risks:

- Risk of the personal data loss due to cloud service close on owner discretion (Examples: Yahoo's Geocities, Google's Wave, Health, Reader and Cloud Connect);
- Practical impossibility to execute privacy control over confidential personal data processed by "cloud" service (especially, if located in the other country);
- Disappearance of competitive environment on the knowledge processing market except for products attached to few providers controlling global structured information resources.

#### ■ Opportunity:

- Quickly grow few particular models of collective computational intelligence in few centers.

# Global computational intelligence

## Networks and computational architectures

### Historical perspective

Decentralization

**Computer**  
Interconnections  
between  
**transistors**

**Network**  
Interconnections  
between  
**computers**

**World Wide Web**  
Interconnections  
between  
**documents**

**Semantic Web**  
Interconnections  
between  
**concepts**

**Host-terminal**  
Ultra-thick servers  
Ultra-thin clients

**Client-server**  
Thin servers  
Thick clients

**Cloud Computing**  
**Application Server**  
**Web client**  
Thick servers  
Thin clients

**Distributed Computing**  
**Peer-2-Peer**  
Thick peers  
Thin peers

Centralization

1950

1980

2000

2020

# Global computational intelligence

## Decentralized computational intelligence

### Arguments

- Evolution of **human intelligence** needed social interaction between human peers,
  - which has been enabled with **human society and language**,
  - which has been rocketed with **globalized society and common language**.
- Evolution of **computer intelligence** needs social interaction between computer peers,
  - which has to be enabled with **computer society and language**,
  - which is to be rocketed with **global network and unified language**.

# Global computational intelligence

## Decentralized computational intelligence

### Requirements

- Network of computer **agents** as functional structure and rules of dynamic self-organization:
  - rich **historical memory** shared by communicating computer agents (e.g. accessible public banks of information);
  - rich **sensory environment** driving the communication and accessible **means of gathering novel information** (e.g. search, browsing and messaging against peer computer agents);
  - for an agent, **ability to explicitly expose its own knowledge** indicating confidence, proprietary rights and privacy levels of it;
  - unrestricted **fertility of diverse behavioral patterns** (i.e. computational algorithms) exposed by agents (capable for evolution upon feedback);
  - ease of peer-to-peer communication by means of **unified language** based on the same upper ontology (i.e. open knowledge transfer/manipulation protocol);
  - legal definition of the **responsibility for computer agent's actions** (e.g. search results, browse requests and messages) delegated to the person or corporation operating the agent hardware.



# Global computational intelligence

## Current situation

**Cyber Intelligence  
Sharing and  
Protection Act:**  
Facebook, IBM, AT&T  
2012

**Cyber Intelligence  
Sharing and  
Protection Act:**  
Google, Yahoo  
April 2013

**Facebook  
Graph  
Search**  
January 2013

**Facebook  
OS  
on Android**  
March 2013

**Wikidata**  
October 2012

**Google  
Knowledge  
Graph**  
May 2012

**Yandex  
Wonder**  
(Birth & Death)  
January 2013

**Google  
acquires  
Behavio**  
April 2013

**Ray Kurzweil  
joins Google**  
December 2012

**Human Brain  
Project  
EU**  
January 2013

**Brain Activity  
Map Project  
USA**  
April 2013

2012

2013

# Global computational intelligence

## Conclusions

- For a person – start feeling as part of the whole body or real-time sensor/motor cell of entire humanity organism;
- For business – competitive business promotion on the internet requires use of “true semantic” markup (<http://schema.org/>);
- For software developers – emerging market of intellectual agent software with treat to get blocked-out by major players and opportunity to be acquired by one of them;
- For government – providing environments for national information globalization projects as mater of national security;
- For humanity – passing through the next (since invention of computers and internet) pivotal point of development – in 10 years;
- For evolution – forthcoming meta-system transition (since assembly of atoms in the cell and neurons in the brain) – soon.