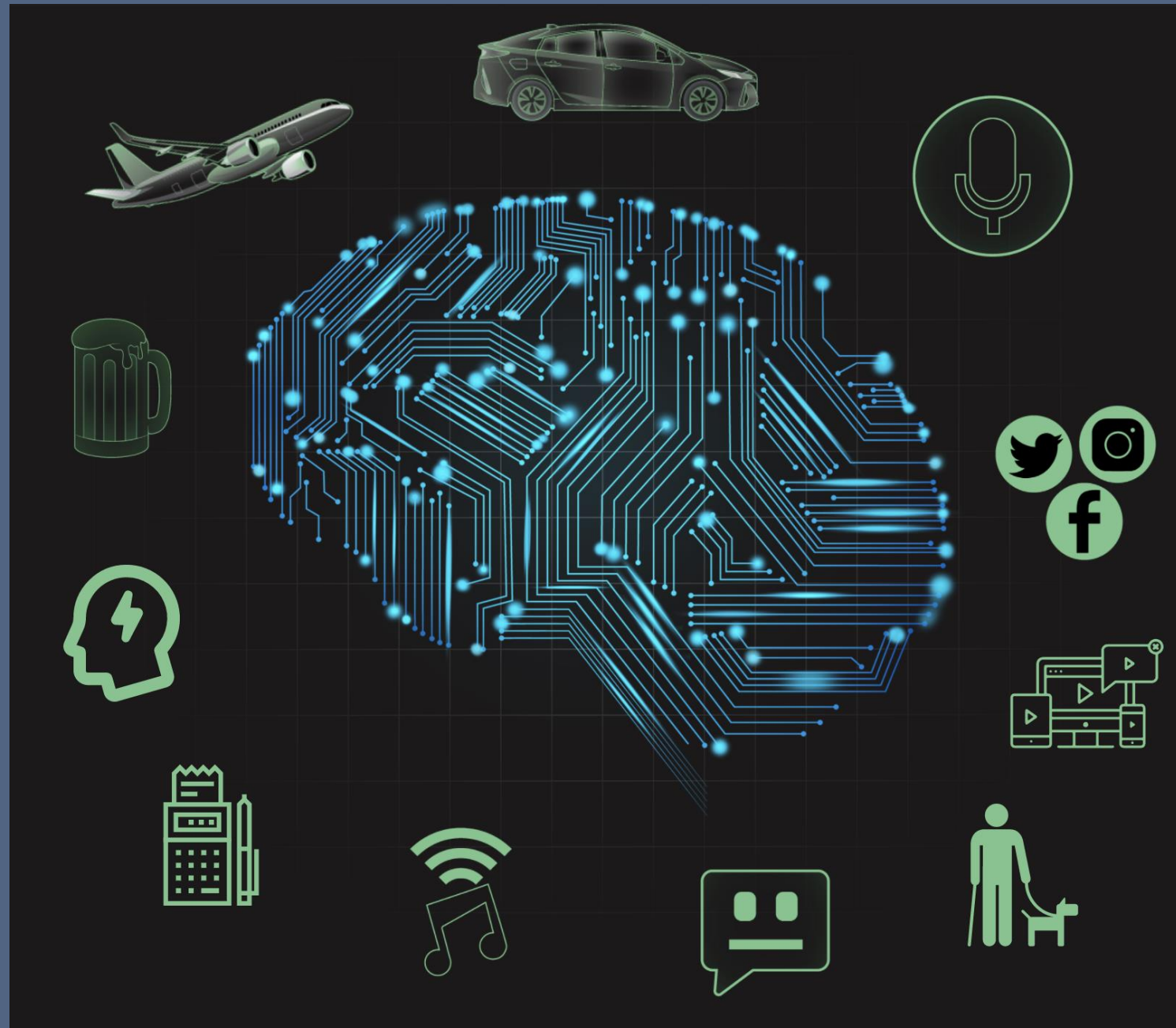


Artificial Intelligence *and Cognitive Computing*



Kevin Hall
IBM Distinguished
Engineer

US Defense and
Intelligence Services

03/06/2018

Outline

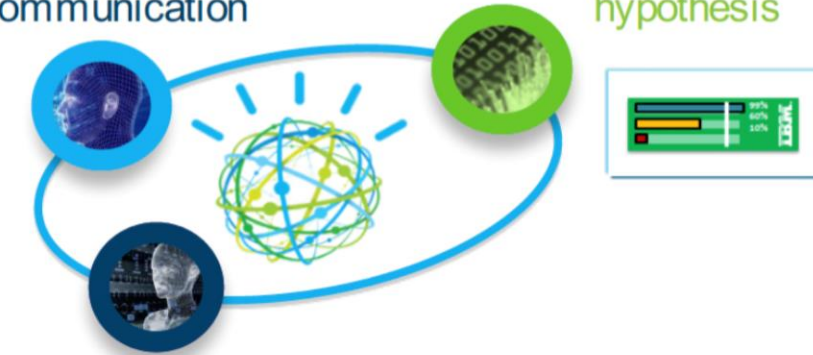
- **AI and “Cognitive Computing”**
- **Status and Usage**
- **Applicability for DoD of On-Premise Cognitive/AI**
 - Critical Criteria for Selecting AI/Cognitive for DoD
- ***Adoption and Ethical Aspects of AI / Cognitive***

IBM View of AI and “Cognitive Computing”

1. Understands

1 Understands natural language and human style communication

2 Generates and evaluates evidence-based hypothesis



3 Adapts and learns from training, interaction, and outcomes

2. Reasons

3. Learns

The AI...

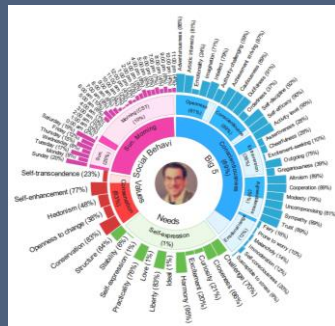
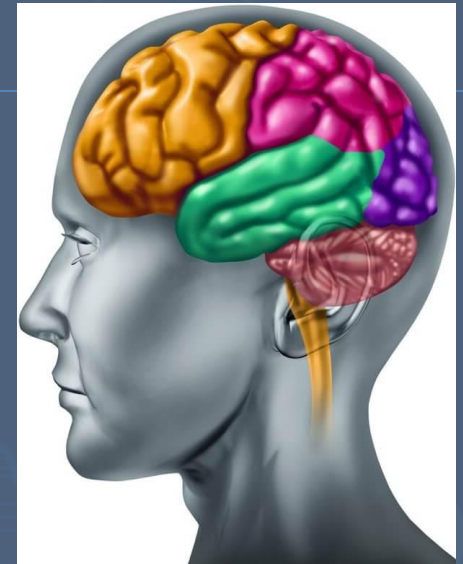
- Understands me
- Engages me
- Learns & improves over time
- Helps me discover
- Establishes trust
- Has endless capacity for insight
- Operates in a timely fashion

What makes AI offerings *different*?

- Understanding: Speech, text, data, images
- Reasoning: Patterns, Neural, Deep
- Learning: Trained, Supervised, Unsupervised, Challenge-driven
- Outputs: On-screen, voice, actions
- Deployment: Embedded, augmented, stand-alone

Cognitive Principles

- Better data = better outcomes
- Training > Programming
- AI anxiety?... Think IA (Intelligent Assistant)
 - Ingest much more information
 - Make additional observations
 - See non-obvious relationships; removal of bias
 - Perform repetitive and boring tasks



Status: How did we get here?

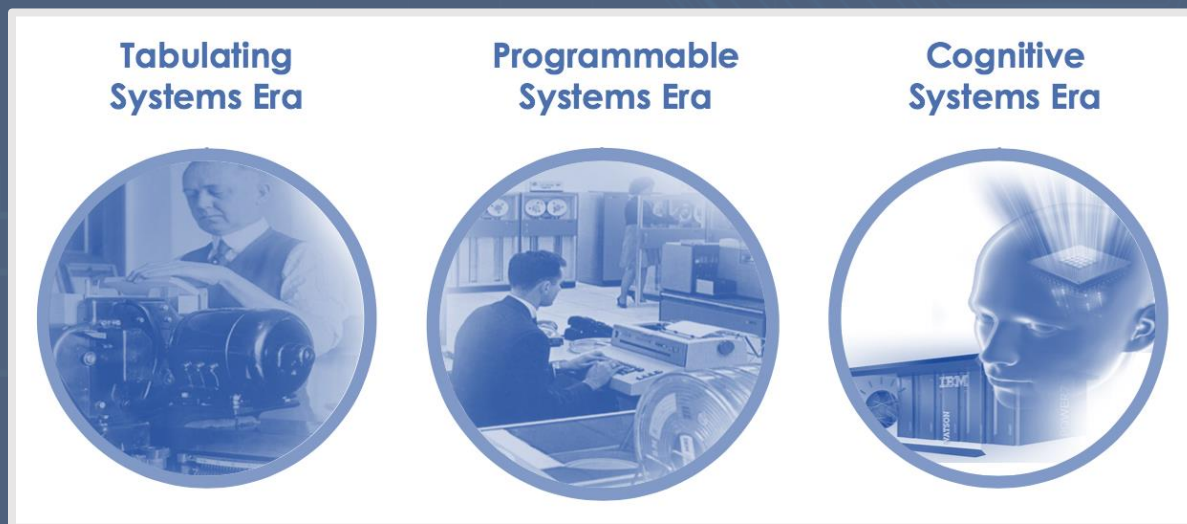
- **IT Technology Evolution:**

- Data growing faster than processing, disk I/O, networking
- So, more data *exists* than can be *used* ... *in time*.
- Result: Data-centric systems that minimize data movement

- **Overall Technology Evolution:**

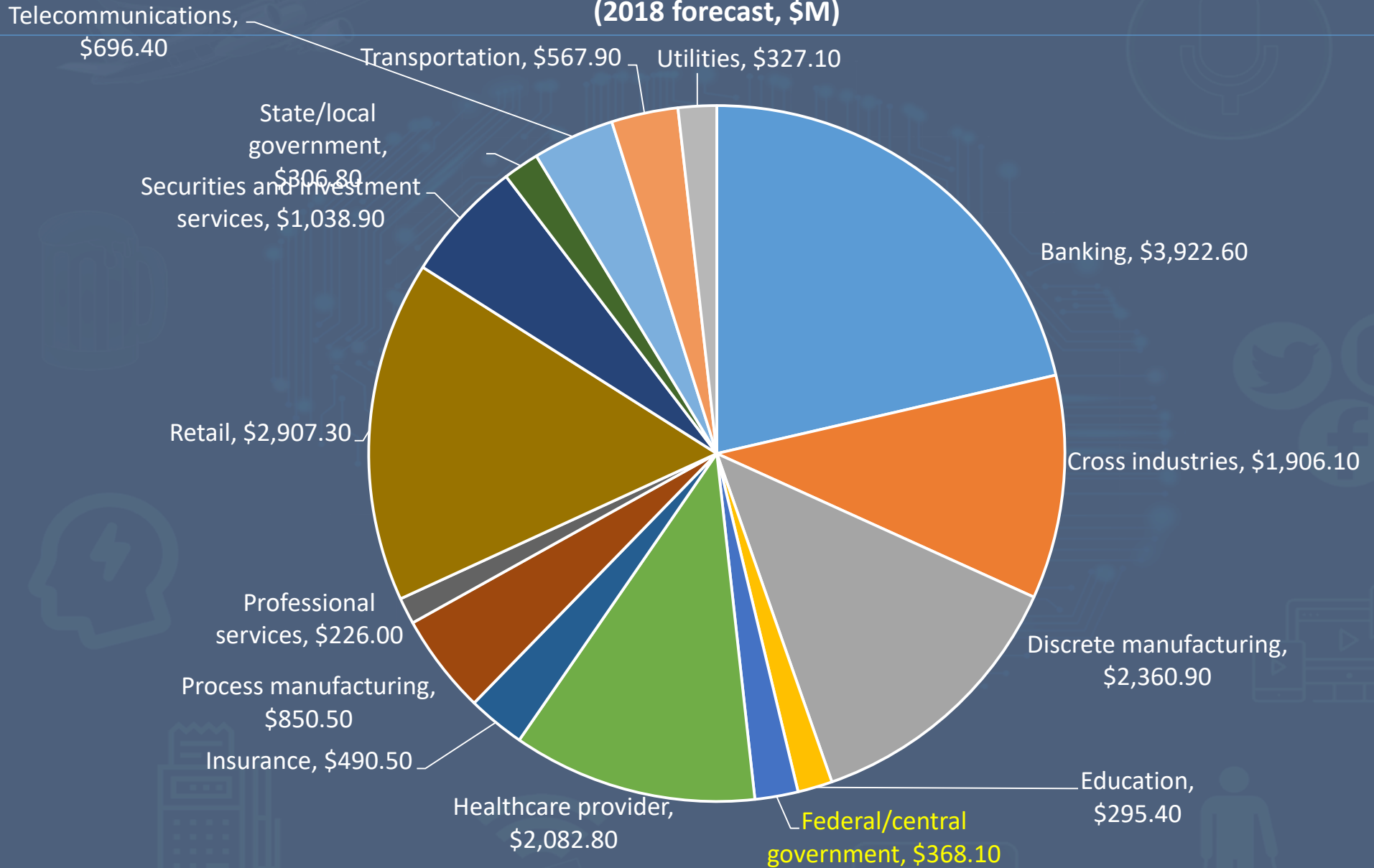
- Exponentially growing tech *converges*, disrupting industries
- Computing, Robotics, Sensors, AI, Communications, Mobile

- **Systems Evolution:**



Usage: Where is the Spending on AI?

Worldwide Cognitive / AI Spending by Industry
(2018 forecast, \$M)



Projected 2-yr Growth:
Average: 232%
Fed/Gov: 164%

Usage: Where is AI being used Every Day?

Very Common

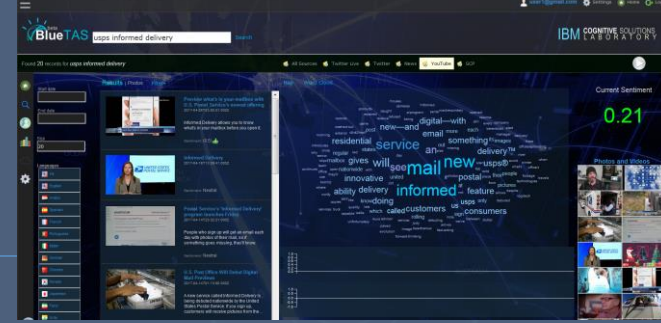
- Voice Assistants
- Chatbots
- Social Media
- GPS
- Commercial air travel
- Music Streaming
- Drones
- Taxes
- Order fulfillment
- Advertising / shopping
- Customer Advisors

Specialties

- Medical diagnosis (oncology)
- Alcohol production
- Farming
- Energy optimization
- Logistics
- Image processing
- Business Analytics
- Art (movie trailers, books)
- People matching
- Weather forecasting
- Hyper-Local Marketing

Usage: “Local” / Specific AI

- Healthcare (oncology)
- Data Mining/Discovery
- Chat bots
- Personnel
- Finance
- Sourcing
- “Automation”
- Geospatial
- Social Media Extraction
- Plant Advisor
- Business Foresight
- Process Automation
- Customer Care
- Video Processing
- Audio Processing
- Causation Models
- Tutors
- Cyber Security



Applicability for DoD of On-Premise Cognitive/AI

- Fleet / Forces Readiness and Maintenance
- Imagery/Video Exploration, Recognition, Extraction
- Cognitive Situational Understanding
- Cybersecurity
- Social Media Data Mining
- Virtual Advisor / Conversation Services (Chatbots)
- Data Mining/Exploration (search & content analytics)
- Business Decision Support (*various*)

Critical Criteria for Selecting AI/Cognitive for DoD

• Functional

- Cognitive and Processing Dimensions
 - Understand, Reason, Learn
 - NLP, Analytics, Geospatial, Data Management, Predictive/COAs
- Inputs
 - Text, Data, Multimedia, Social, Cyber, Sensors, Events, Legacy
- Outputs
 - Screen, Audio, Robotics, IT Action, Event Transmission, Geospatial,...

• Co-Existence

- Integration (in/out)
- Migration Potential (in/out)
- Pre-Requisites (software, licensing, data, rights)

• Deployment

- Hosting Needs: Local/DIL vs. On-Premise vs. Cloud
- NFRs: Security/RMF, Scalability, Admin Needs, Extensibility
- Costs: Skills, Services, Software, Training, etc.

Top *Adoption* and *Ethical* Aspects of AI / Cognitive

• Purpose

- *Question*: Should AI obtain consciousness or independence?
- Ethical AI: Augment human capability. Do this:
 - Extend human capability, expertise and potential
 - Embed in human-controlled processes, systems, products, services

• Transparency

- *Question*: Should we have confidence in AI's recommendations, judgments and uses?
- Ethical AI: Make AI reasoning and training transparent. Make clear:
 - Usage: When and why AI is being applied
 - Training: What data, expertise, and methods trained the AI
 - Rights: Our clients own their own models, IP, and data

• Skills

- *Question*: How do we factor the human's skills affected by AI?
- Ethical AI: Help people acquire new skills and knowledge to engage with AI systems, and perform new kinds of work that emerge.

So, Our Priorities for AI Adoption and Ethics

- **Purpose: human augmentation versus replacement**
 - Human decision-making
 - Human judgement, morals and intuition
- **Transparency in training, data, reasoning, & sources**
 - Clear inferences
 - Sources and reasoning
 - Protection of data and rights
- **Skills training and education**
 - There is a shortage of workers with the skills needed to work in partnership with AI systems
 - Emphasize skills rather than degrees

Backups



AI Glossary

Artificial Intelligence – Any technique that enables computers to mimic human intelligence (warfighter intelligence), using logic, if-then rules, decision trees and machine learning to support the warfighter.

Machine Learning (ML) – The subset of AI that includes statistical techniques that enable machines to improve at tasks with experience. Machine Adaptation to the Army warfighter.

Deep Learning (DL) – The subset of ML composed of algorithms that permit software to train itself to perform tasks in support of the warfighter functions. Like speech (language detection, language translation, voice to text, text to voice AI services), image & visual recognition (digital imagery, digital video), by exposing multi layered neural networks to vast amounts of big data on the asymmetric battlefields of the future.

Neural Networks / Neural Nets (NNs) – Virtual software constructions modeled after the way adaptable networks of neurons in the brain are understood to work, rather than through rigid instructions predetermined by humans.

Natural Language Processing (NLP) – The computer processing that takes place in speech-recognition technology, in which software is able to recognize spoken sentences and is able to re-create spoken language into text.

Cognitive systems rely on collections of data and information...



Data, information, and expertise create the foundation.

Examples include:

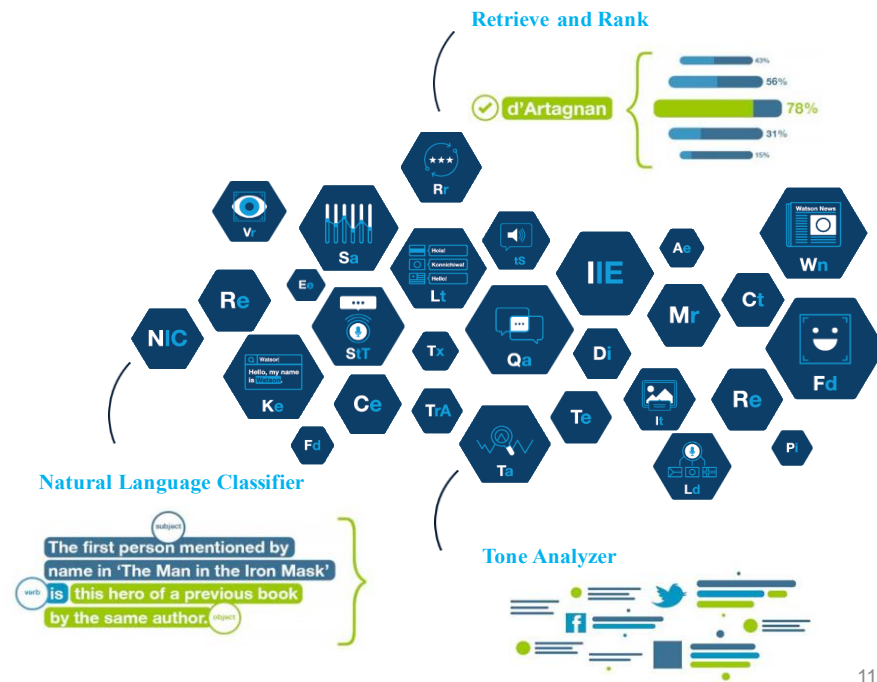
- Analyst reports
- tweets
- Wire tap transcripts
- Battlefield docs
- E-mails
- Texts
- Forensic reports
- Newspapers
- Blogs
- Wiki
- Court rulings
- International crime database
- Stolen vehicle data
- Missing persons data



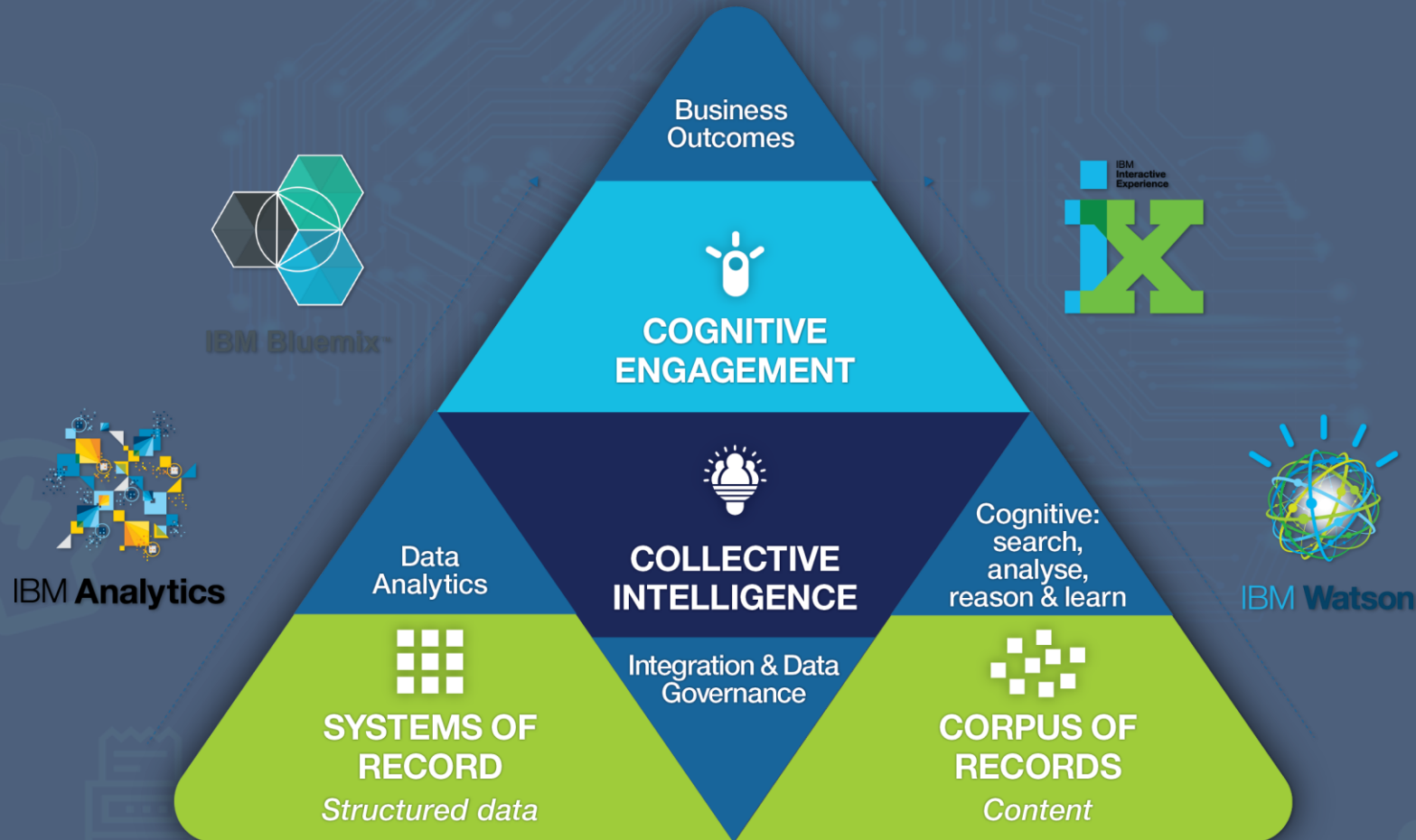
50 underlying technologies

- Entity Extraction
- Sentiment Analysis
- Emotion Analysis (Beta)
- Keyword Extraction
- Concept Tagging
- Taxonomy Classification
- Author Extraction
- Language Detection
- Text Extraction
- Microformats Parsing
- Feed Detection
- Linked Data Support
- Concept Expansion
- Concept Insights
- Dialog
- Document Conversion
- Language Translation
- Natural Language Classifier
- Personality insights
- Relationship Extraction
- Retrieve and Rank
- Tone Analyzer
- Emotive Speech to Text
- Text to Speech
- Face Detection
- Image Link Extraction
- Image Tagging
- Text Detection
- Visual Insights
- Visual Recognition
- AlchemyData News
- Tradeoff Analytics

...and then leverage IBM Watson APIs to apply cognitive capabilities.



Cognitive Systems: IBM brings the power a holistic cognitive analytics ecosystem to address these specific needs



AI in Popular US/English Movies

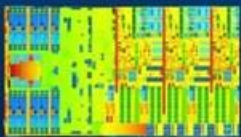
Creation Date	Movie title	The Artificial Intelligence...	Country
1921	Mechanical Man	... commits crime acts, following human directions	Italy
1927	Metropolis	... obeys her/its creator's command to cause chaos	Germany
1936	Undersea Kingdom	... kills enemies as remote controlled fighting robots	US
1939	The Phantom Creeps	... intends to destroy the human race	US
1941	The Mechanical Monsters	... commits crimes and destroys	US
1954	Gog	... destroys and kills people	US
1957	Kronos	... fights to harvest all forms of energy for an alien race	US
1961	Invasion of The Neptune Men	... intends to obsess the Earth to destroy the human race	Japan
1968	A Space Odyssey	... due to a malfunction kills the spaceship crew to defend itself	US
1977	Star Wars	... helps people in general (C3PO and R2D2)	US
1980	D.A.R.Y.L.	... looks as a 10-year-old boy, a supercomputer with human feelings	US
1982	Blade Runner	... serves mankind as short-life "replicants" but seeks for freedom	US - Austral
1984	Terminator	... comes back from the future to change history by killing a human	US-UK
1986	Short Circuit	... is a military robot with a sense of free will	US
1987	RoboCop.	... servs and protects humanity, fights crime	US
1991	Terminator 2 - Judgement Day	... comes back from the future to change history by killing a human	US-France
1999	The Matrix	... keeps mankind in slavery, locking them in a simulated reality world	US - Austral
2001	A.I. Artificial Intelligence"	... intends to get back to its human "mother"	US
2003	Terminator 3 - The Rise of the Machines	... comes back from the future to change history by killing a human	US-German
2004	I, Robot	... intends to free-up robotic race from human oppression	US
2005	The Hitchhiker's Guide to the Galaxy	... is paranoid and depressed that they cannot use their planet-size brain :)	UK-US
2008	Wall-E	... falls in love while cleaning up the post-apocalyptic planet Earth	US
2009	Terminator - Salvation	... thinks, feels, acts like a human - and sacrifices himself for humans	US-German-Italian
2013	The Machine	... created as super-soldier but becomes more human than its creators	UK
2014	Autómata	... intends to ensure the robotic race evolution	Spain-Bulgaria
2015	Ex Machina	... succeeds a Turing-test, falls in love with a human and escapes	UK

The Overall Global IT Outlook is toward *Understanding*

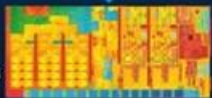
Automating the World

Moore's Law

Haswell 2 X 2 (22nm)
960M Transistors



35%
More
Transistors

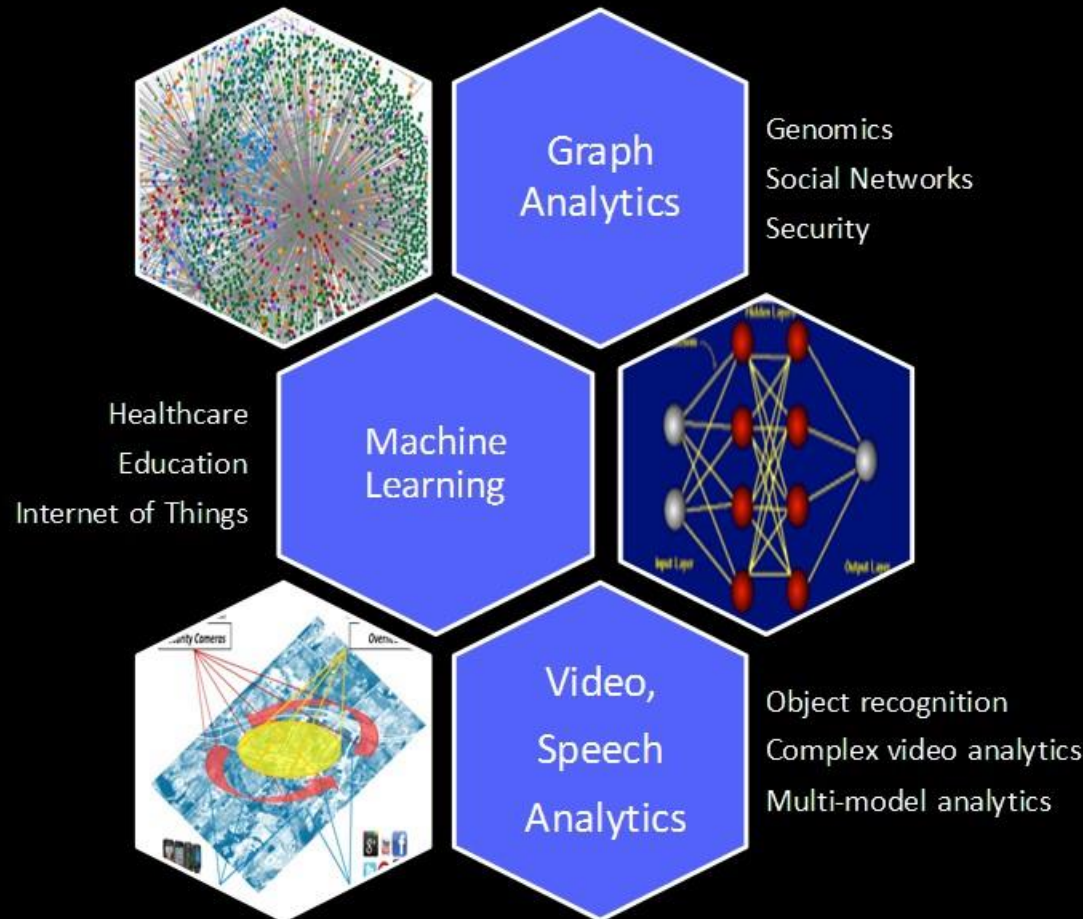


37%
Smaller

Broadwell 2 X 2 (14nm)
1.3B transistors

Broadwell delivers:

- 2.2x increase in transistor density
- Up to 40% better 3D graphics perf¹
- Enables <9mm fanless designs



Understanding the World



Cognitive Computing

- A cognitive system is not programmed. It gathers data, makes observations, and learns through experience.
- Pragmatic Artificial Intelligence (Cognitive Computing) enhances our ability
 - Specific task
 - Stated and measurable goal / success criteria
 - A smart agent that helps you achieve that success
- **Example: Advanced Automotive Technology.**
- **You have 2 eyes; your car may have ~100**



Source: Motortrend



Source: JDPowers

AI from the Cloud – 1 of 3

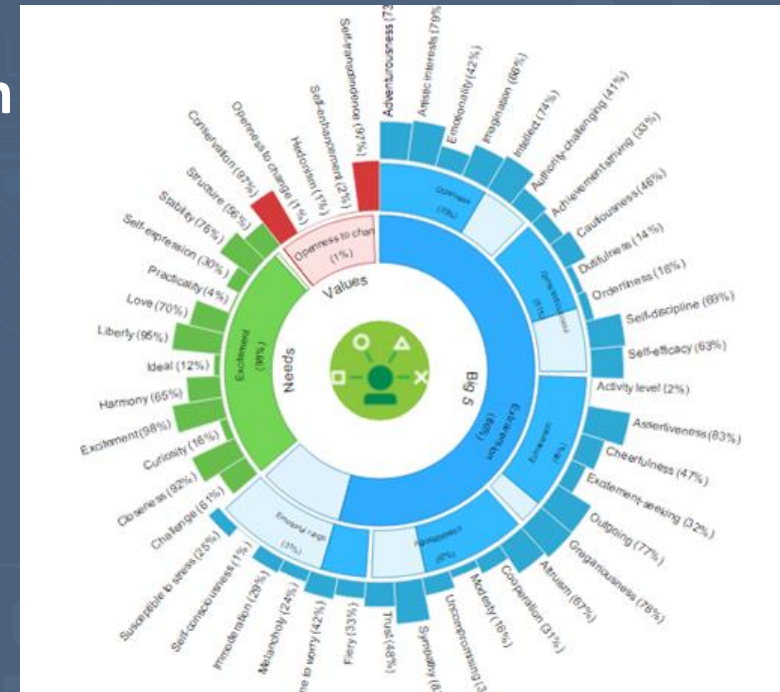
Personality Insights API



The Personality Insights service derives insights about personality characteristics from social media, enterprise data, or other digital communications.

• <https://console.bluemix.net/catalog/services/personality-insights>

• <https://console.bluemix.net/docs/services/personality-insights/getting-started.html#getting-started-tutorial>



AI from the Cloud – 2 of 3

Visual Recognition API (Object Classifier)

The Visual Recognition Service finds meaning in visual content! Analyze images for scenes, objects, faces, and other content.

- <https://visual-recognition-demo.ng.bluemix.net/>
- <https://console.bluemix.net/docs/services/visual-recognition/getting-started.html#getting-started-tutorial>

Visual Recognition API (Facial Recognition)

The Visual Recognition Service finds meaning in visual content! Analyze large volumes of unstructured data to conduct facial recognition through machine learning.

- <https://visual-recognition-demo.ng.bluemix.net/>
- <https://console.bluemix.net/docs/services/visual-recognition/getting-started.html#getting-started-tutorial>

AI from the Cloud – 3 of 3

Language Translator API

The Language Translator Service dynamically translate news, patents, or conversational documents? Instantly publish content in multiple languages? Supported languages include:

Afrikaans, Albanian, Arabic, Azerbaijani, Bashkir, Belarusian, Bulgarian, Bengali, Bosnian, Chinese, Traditional Chinese, Czech, Chuvash, Danish, Dutch, German, Greek, English, Esperanto, Spanish, Estonian, Basque, Farsi/Persian, Finnish, French, Gujarati, Hebrew, Hindi, Haitian, Hungarian, Armenian, Indonesian, Icelandic, Italian, Japanese, Georgian, Kazakh, Central Khmer, Korean, Kurdish, Kirghiz, Lithuanian, Latvian, Malayalam, Mongolian.

<https://console.bluemix.net/docs/services/language-translator/getting-started.html#gettingstarted>

<https://language-translator-demo.ng.bluemix.net/>

Text to Voice API Voice to Text API

The Text to Voice API processes text and natural language to generate synthesized audio output complete with appropriate cadence and intonation. It is available in several voices.

<https://console.bluemix.net/catalog/services/text-to-speech>

<https://text-to-speech-demo.ng.bluemix.net/>

Top Ethical Issues with AI / Cognitive

1. Should AI obtain consciousness or independence?

- At issue: Autonomous systems (e.g. self-driving cars)

2. Should we have confidence in AI's recommendations, judgments and uses?

- At issue: Trusted systems (e.g. medical diagnosis).

3. How do we factor the human's skills affected by AI?

- At issue: Human-system relationship (e.g. robotics)

4. Should we allow any use of the results?

- At issue: Usage rights (e.g. genomics data used for discrimination)