Jeopardy! ,
the 2nd Machine Age, 
and the 3rd Offset

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Agenda

- The Start of a new Era: Jeopardy! Challenge
- Where we are going: 2\textsuperscript{nd} Machine Age
- How it pertains to the Navy: 3\textsuperscript{rd} Offset
- Closing Thoughts
Organizations are “dying of thirst in an ocean of data”

- 90% of the world’s data was created in the last two years
- 80% of the world’s data today is unstructured
- 1 in 2 Organization leaders don’t have access to data they need
Data is growing exponentially – How to leverage it?

We are here

44 zettabytes

unstructured data

structured data

2010

2020
Watson answers a grand challenge

Can we design a computing system that rivals a human’s ability to answer questions posed in natural language, interpreting meaning and context and retrieving, analyzing and understanding vast amounts of information in real-time?
IBM Research: The journey to Watson

Question Answering Technology
Machine Learning
Natural Language Processing

Knowledge Representation and Reasoning
High Performance Computing
Unstructured Information Management

Watson interconnected with locations such as Almaden, Austin, Tokyo, Zurich, Haifa, India, Ireland, China, Brazil, Africa, Australia, and Ireland.
Inside Watson

Massively Parallel Probabilistic Evidence-Based Architecture
Watson is ushering in a **new era of computing** . . .

With the goal to create a new partnership that **enhances**, **scales** and **accelerates** human expertise.

cog·ni·tive: of or pertaining to the mental processes of perception, memory, judgment, learning, and reasoning.
Three capabilities differentiate cognitive systems from traditional programmed computing systems...

Understanding
Cognitive systems understand like humans do.

Reasoning
They reason. They understand underlying ideas and concepts. They form hypothesis. They infer and extract concepts.

Learning
They never stop learning getting more valuable with time. Advancing with each new piece of information, interaction, and outcome. They develop “expertise”.

.... allowing them to interact with humans.
“Race with the Machines...” [Not Against them]
Cognitive Systems are everywhere – influencing nearly everything we do

Driverless Delivery for Domino’s

Netflix provides personalized movie recommendations

Waze provides a personalized driving experience for its users
The Cognitive Future for Professionals

- ...We are on the brink of a period of fundamental and irreversible change in the way that expertise of these specialists [professionals] is made available in society....we neither need nor want professionals to work in the way that they did in the 20th century and before.”

The Future of the Professions, How Technology will Transform the Work of Human Experts; Richard and Daniel Susskind, 2015
How might Humans Team with Cognitive Systems?

Freestyle Chess

“Weak human + machine + superior process was greater than a strong computer and, remarkably, greater than a strong human + machine with an inferior process.”

Garry Kasparov
Cognitive systems forge a new partnership between man and machine.

Humans excel at:
- Common Sense
- Morals
- Imagination
- Compassion
- Abstraction
- Dilemmas
- Dreaming
- Generalization

Cognitive Systems excel at:
- Locating Knowledge
- Pattern Identification
- Natural Language
- Machine Learning
- Eliminate Bias
- Endless Capacity

With the goal to create a new partnership that enhances, scales and accelerates human expertise.
Watson Oncology Cognitive Assistant: Helping oncologists treat cancer patients

Attacking the cause of one in four deaths

Business problem:
Need better individualized cancer treatment plans

Solution:
• Suggestions to help inform oncologists’ decisions based on 600K+ pieces of evidence and 2M pages of text from 42 publications
• Analyzes patient data against thousands of historical cases and trained through 5000+ Memorial Sloan-Kettering MD and analyst hours
• Evolves with the fast-changing field
• Cognitive Assistant for Legal Document Analysis
• Automatic Argument Construction (IBM)
• Smart Forms for Citizens
• AI Algorithms for Prior-Art identification for Patent Examiners
• Pro-se Litigant Cognitive Assistant
• Teaching and Learning of Science with Cognitive Assistants
• Watson Conversational online Teaching Assistant
• Cognitive Tutors (CMU)
• Persuasive AI Technologies for the Elderly
• Cybersecurity Cognitive Assistant (IBM)
• Software Assurance Cognitive Assistant (CERT)
• Army – Commander’s Virtual Staff
• NASA Aerospace Innovation Advisor
• NASA Pilot Advisor
• Mitre Digital Co-Pilot
• AFRL Auto-Ground Collision Avoidance System
Auto-GCAS Saves Unconscious F-16 Pilot—Declassified USAF Footage
Reimagining Knowledge-based Organizations: Community of Cognitive Agents helping Humans

- Researcher
- Program Manager
- Cyber Analyst
- Sw Assurance Eng

Community of Cogs

- Orchestrated Collect Cog
- Scheduling Optimization Cog
- Weather Cog
- Environment Analysis
- Risk & Resilience Cog
- Open Source Cog
- CWE Tool
- Personal COG
- Consequence Table
- Tasking Cog
- Sw Component Modelling
- Sensitivity Analysis
- Research Advisor Cog
- Component Modelling
- Researcher
3rd Offset

- Shrinking Capability Gap
- Accelerated Technology Cycles
- Difficulty Absorbing New Technology

“Let me tell you what the big idea really is about.

It's about human-machine collaboration … allowing a machine to help humans make better decisions.”

– Deputy Defense Secretary Bob Work, Nov. 2015
Cognitive Assistance Potential Use Cases

- Intelligence Advisor
- Cyber
- Equipment Advisor
- Mission Handoff
- Crisis Response
- Maintenance
- Supply Chain Risk Management
- Manpower Allocation
- Career Development
- Meeting Acquisition Milestones

*The following use cases are illustrative of potential applications of Watson technology and do not indicate actual engagements.*
Analysts seek capabilities for understanding more than 300 million unstructured intelligence reports available throughout the community.
Watson Intelligence Advisor Solution

Current State of Intelligence Analysis

- Suboptimal search tools
- Current tools focused on structured data
- Non-obvious relationships buried in unstructured data

Watson’s Impact on Intelligence Analysis

- Answers and evidence are returned based on the question
- Growing tool box to analyze entities and concepts in unstructured data
- Follow lines of inquiry to spot patterns, connect dots, and identify threats in a more timely manner

Value Prop

- Evidence-based responses relevant to an analyst’s questions
- Unique ability to analyze unstructured content
- Ability for analysts quickly make sense of large volumes of data
- Ability to open up new sources of insight
- Significant time saved in researching intelligence problems

To succeed, breakthrough insights must come faster than ever before
The standard UI accepts a question and returns hypotheses and evidence passages from unstructured reports.
In addition to QA, Watson can return a knowledge graph of entities.
IBM CyberWatson

What stage is Trojan.kiladisk used for?

Passages that support the ICS Attack Stage

1. “...During the ICS Attack Stage, the adversaries used native software to Deliver themselves into the environment for direct interaction with the ICS components. They achieved this using existing remote administration tools on the operator workstations. The threat actors also continued to use the VPN access into the IT environment. In final preparation for the attack, the adversaries completed the Install/Modify stage by installing malicious software identified as a modified or customized KillDisk across the environment. While it is likely the attackers then ensured their modifications to the UPS were ready for the attack, there was not sufficient forensic evidence available to prove this. ...”

Black Energy Cyber Attack on the Ukrainian Power Grid : Microsoft Word - (01).docx : March 18, 2016 : TLP WHITE :

2. “...However, through publicly available information about the Ukrainian networks, as well as knowledge of similar electric distribution systems, it is likely that there was a diverse hardware and software environment. It is suspected that the administrative and ICS networks contained multiple OS versions such as Windows XP and Windows 7, multiple types of RTUs and gateways, and various industrial switches. During the ICS Attack Stage, the adversaries used native software to Deliver themselves into the environment for direct interaction with the ICS components. ...”

Black Energy Cyber Attack on the Ukrainian Power Grid : Microsoft Word - (01).docx : March 18, 2016 : TLP WHITE :

....Focused on Response & Remediation
**Watson IoT Equipment Advisor**

**What does it do?**

**Connect:** Enables connectivity and data collection from a myriad of devices, sensors and equipment

**Predict:** Provides early warning for operational issues, impending failure / breakage, Time to failure and probable cause, Expected remaining life for components, Process variation resulting in product defects

**Repair:** Mines maintenance logs, equipment manuals, technician unstructured data to assist with diagnostics via an interactive dialog to make repair recommendations with the highest probability of success including parts and tooling

**Optimize:** Using cognitive insights, constantly evaluate its current operating performance looking for alternate settings or operations to improve throughput, quality and availability
Mission Hand-Off

Challenges:

- Short timeframe for handoff while in theater together and no easy way to share information afterward
- Outgoing unit is often exhausted and just wants to go home
- Dynamic operational environment -- what information is/will be relevant?
- Incoming unit may not have same capabilities (e.g. different/no vehicles)
- Key information may not lie with outgoing unit, but with preceding unit(s)
- Information (e.g. AARs, intel reporting) stored on laptops, unstructured

Cognitive Tools:

- IBM Watson\(^2\) for search and discovery

Value Proposition:

- Greater immediate situational awareness
- Counter institutional amnesia
- Incoming units can "stand on the shoulders" of the outgoing unit

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2 Watson Explorer Advanced Edition and/or Watson Discovery Advisor
Mission Handoff Example

As Is

- Incoming army units meet face-to-face with outgoing units
- Handover of a select number of documents deemed relevant and important by outgoing unit
- “Right Seat Ride” (joint patrol, outgoing platoon in the lead)
- “Left Seat Ride” (joint patrol, incoming platoon in the lead)

“When it comes to information, if you don't get it before the Transfer of Authority, chances are you aren't going to get it.”

– Former Army Recon Platoon Leader (Afghanistan ’04, Iraq ’07)

Cognitive Added Value

- During mission handoff, Watson ingests ALL unstructured text generated by the departing unit during its deployment (e.g. After Action Reports, intelligence reports, briefing materials, etc.).
- After Mission Handoff: Tactical commanders and G-staff can ask questions of Watson/the data

“Have there been firefights in the White Gold Neighborhood of West Baghdad?”

- AAR/debrief for firefight on Feb. 17
- Recorded radio traffic for MEDEVAC request Mar. 18

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Getting Started: Watson Cognitive Ecosystem

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
Conversation
Discovery Service
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

Retrieve and Rank

Natural Language Classifier

Tone Analyzer

More @ Bluemix.net
**Watson Data Platform with Machine Learning (new 2017)**

- Watson Data Platform allows employees to work together to gain insight from data.
  - Enables collaboration of Data Scientists, Data Engineers, Business Analysts and Developers
  - Provides data cleansing, visualization and sharing capabilities
  - Support for analytic notebooks
  - Supports R, python, Scala, Rstudio, Shiny, and sparklyr (R interface to Spark), Java

- Watson Machine Learning built on Apache Spark automatically can build models on structured and unstructured information
  - Apache SparkML (also available from Bluemix.net )
  - Cognitive Assistance for Data Science technology scores machine learning algorithms against the data to recommend best match
IBM Academic Initiative

Easy Access to Industry Resources

http://onthehub.com/ibm/
Closing Thoughts

1. The Goal: Augmenting Intelligence (the new AI) – Man + Machine, extending human expertise
2. AI Ecosystem – Agencies, Technology Providers, Data Providers – all linked
3. It’s not about AI – It is about solving problems
4. The value isn’t in doing what we do today just faster/cheaper, but in doing what can’t be done today
5. Bigger, Better Data = Better Outcomes
6. Domain adaptation requires domain expertise
7. Address user anxiety over AI
   - Partnership on AI – established with Microsoft, Amazon, Google and Facebook
     - Will conduct and publish research in such areas as Ethics, Fairness/inclusiveness, transparency, privacy; trustworthiness, reliability, and robustness
Thank You

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