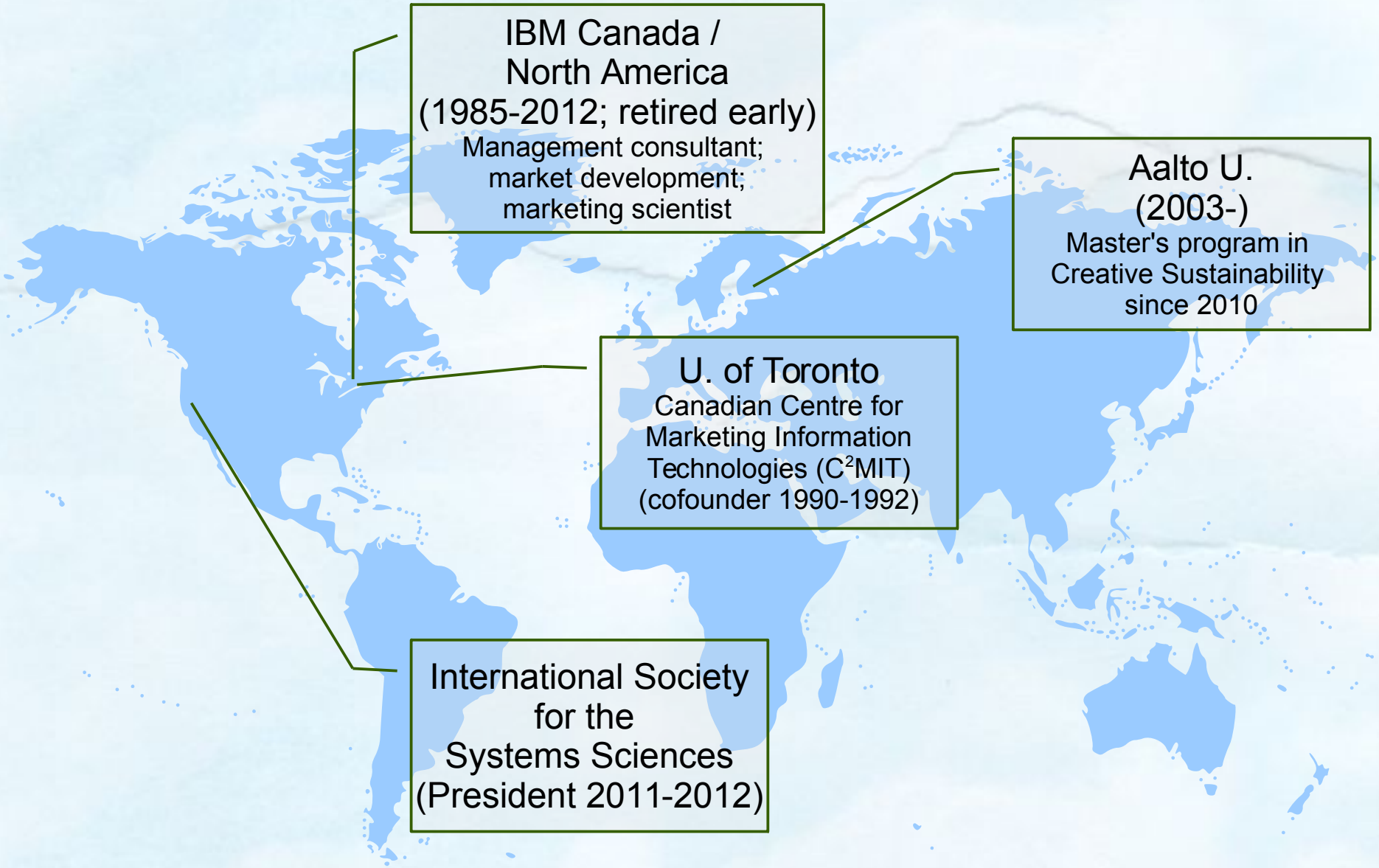
From Smarter Systems towards Cognitive Systems

David Ing
Wuhan University of Technology
March 17, 2016

Agenda

1. Some trends (for service systems)
2. Narratives on “smarter”
3. The cognitive era

David Ing – Professional experience



David Ing 吳禮維 – Family

Home town (-1976):
Gravenhurst, Ontario
Birthplace of 白求恩
Dr. Norman Bethune

樓崗（開平）
Lougang (Kaiping)
Ancestral village

Toronto (1985-)

Agenda

1. Some trends (for service systems)
2. Narratives on “smarter”
3. The cognitive era

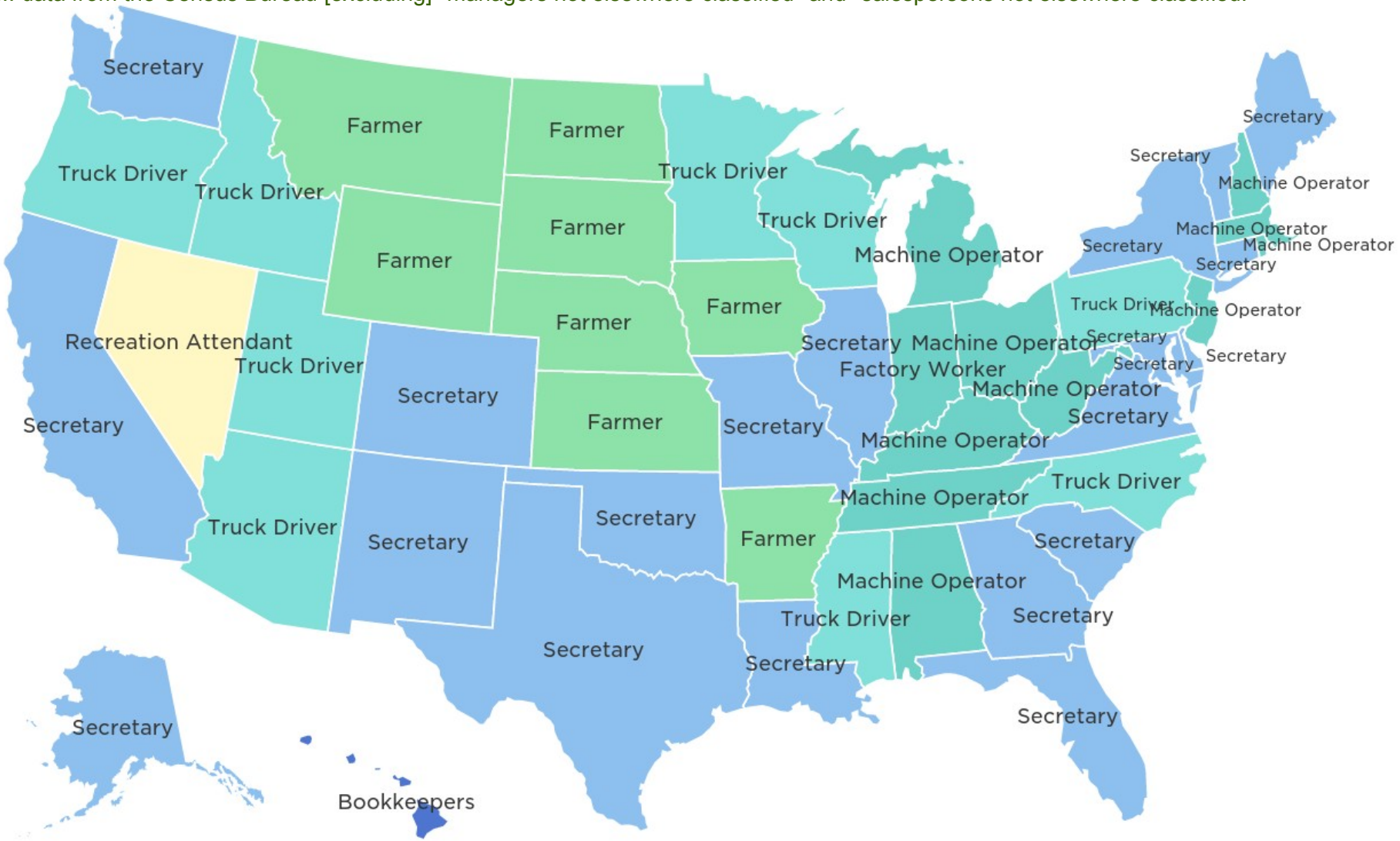
Service systems in our society can be ranked from concrete to abstract, as subjects for schoolchildren

Systems that move, store, harvest, process	• Transportation	K
	• Water and waste management	1
	• Food and global supply chain	2
	• Energy and energy grid	3
	• Information and communications (ICT) infrastructure	4
Systems that enable healthy, wealthy and wise people	• Building and construction	5
	• Banking and finance	6
	• Retail and hospitality	7
	• Healthcare	8
	• Education (including universities)	9
Systems that govern	• Government (cities)	10
	• Government (regions / states)	11
	• Government (nations)	12

Source: Spohrer, James C., and Paul P. Maglio. 2010. “Toward a Science of Service Systems: Value and Symbols.” In Service Science: Research and Innovations in the Service Economy, edited by Paul P. Maglio, Cheryl A. Kieliszewski, and James C. Spohrer, 157–94. 10.1007/978-1-4419-1628-0_9

1978: The most common* job by state

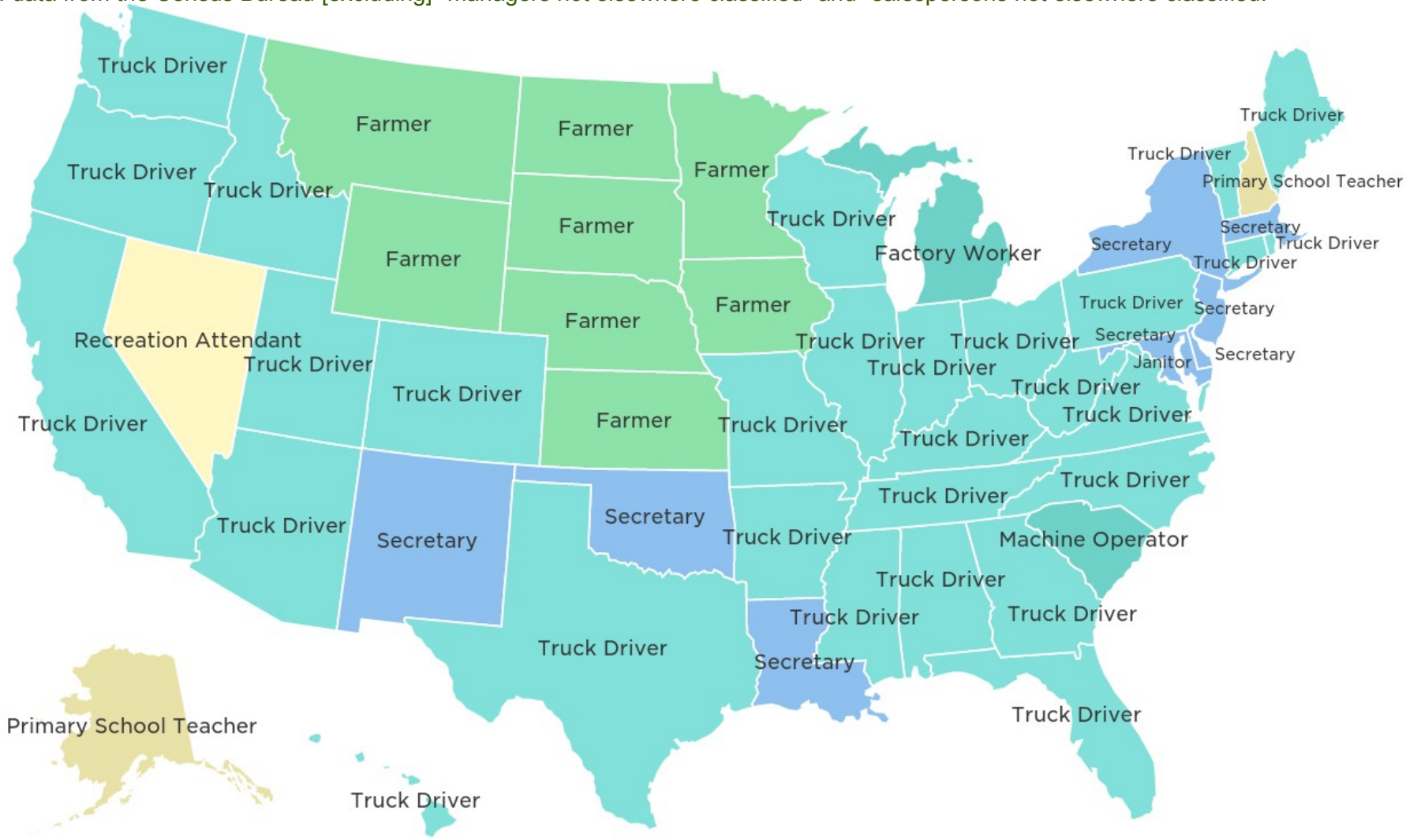
*... data from the Census Bureau [excluding] "managers not elsewhere classified" and "salespersons not elsewhere classified."



Source: Bui, Quoctrung. 2015. “Map: The Most Common* Job In Every State.” *NPR Planet Money*. February 5. http://www.npr.org/sections/money/2015/02/05/382664837/map-the-most-common-job-in-every-state .

1996: The most common* job by state

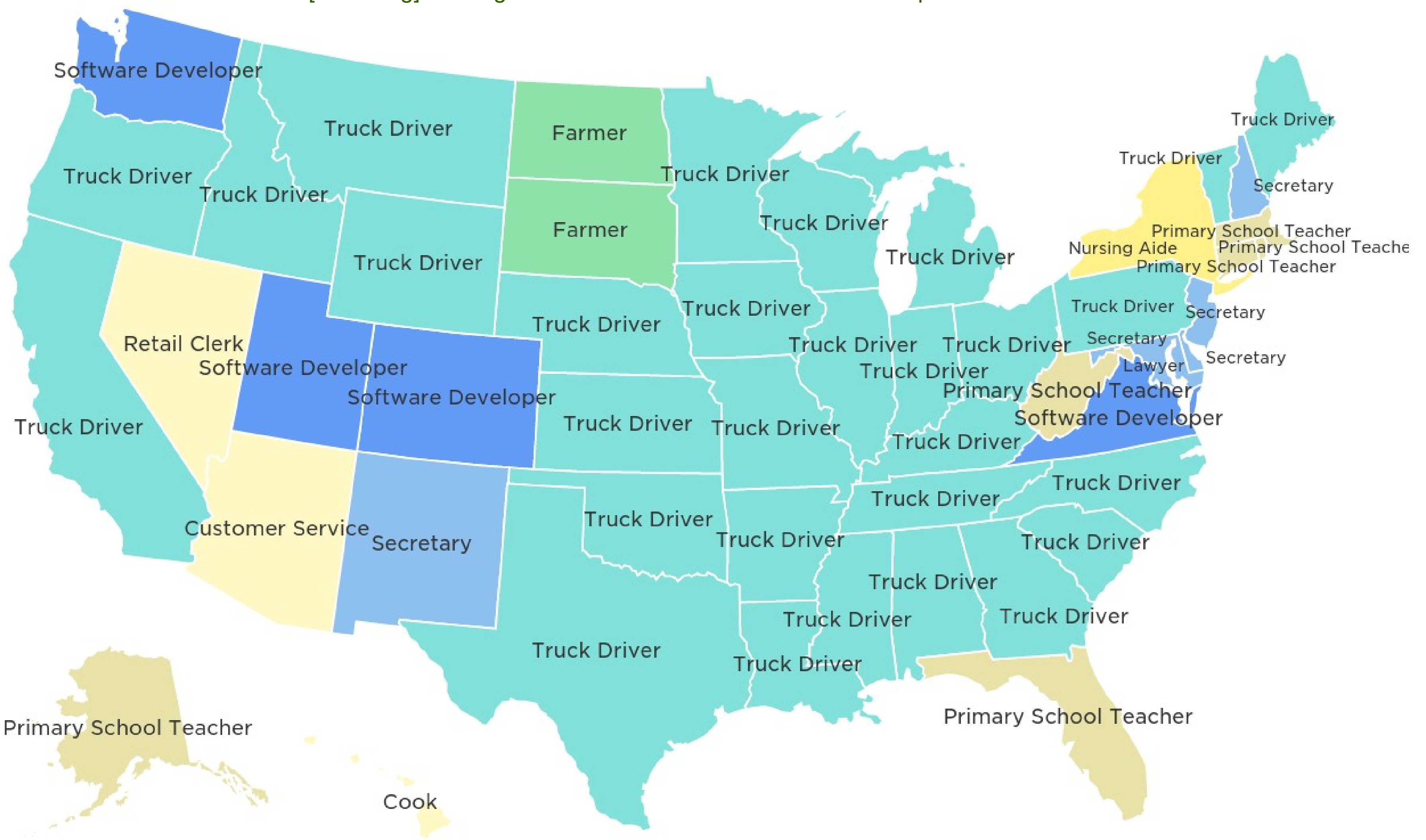
*... data from the Census Bureau [excluding] "managers not elsewhere classified" and "salespersons not elsewhere classified."



Source: Bui, Quoctrung. 2015. "Map: The Most Common* Job In Every State." *NPR Planet Money*. February 5. http://www.npr.org/sections/money/2015/02/05/382664837/map-the-most-common-job-in-every-state .

2014: The most common* job by state

*... data from the Census Bureau [excluding] "managers not elsewhere classified" and "salespersons not elsewhere classified."



Source: Bui, Quoctrung. 2015. “Map: The Most Common* Job In Every State.” *NPR Planet Money*. February 5. http://www.npr.org/sections/money/2015/02/05/382664837/map-the-most-common-job-in-every-state .

May 6, 2015: First Autonomous Semi-Truck Licensed to Drive Itself on Highways

Freightliner's Inspiration truck is able to drive itself **completely autonomously on well maintained highways, in daylight, and in good weather**. A licensed human driver is required to be behind the wheel, and the human will need to take over in some highway situations and whenever the truck is driving on surface streets. But crucially, and this is what's so important about the Inspiration truck, **while the truck is on the highway the driver does not have to be paying attention**. [….]

… **Nevada has granted the Inspiration the first license for an autonomous commercial truck to operate on an open public highway in the United States**. This isn't a provisional or testing permit: it's a license that's just as valid as the one that you probably have, and the Inspiration is allowed to drive itself autonomously on the highway right behind you if it wants to.

Source: Ackerman, Evan. 2015. "Freightliner Unveils First Autonomous Semi-Truck Licensed to Drive Itself on Highways." *IEEE Spectrum*. May 6. http://spectrum.ieee.org/cars-that-think/transportation/self-driving/freightliner-unveils-first-autonomous-semitruck-licensed-to-drive-itself-on-highways.

May 6, 2015: First Autonomous Semi-Truck Licensed to Drive Itself on Highways

These automation levels are defined by the U.S. Department of Transportation's National Highway Traffic Safety Administration (NHTSA), and here's the entire range, from full manual control (Level 0) to full autonomy (Level 4).

No-Automation (Level 0): The driver is in complete and sole control of the primary vehicle controls—brake, steering, throttle, and motive power—at all times.

Function-specific Automation (Level 1): Automation at this level involves one or more specific control functions. Examples include electronic stability control or pre-charged brakes, where the vehicle automatically assists with braking to enable the driver to regain control of the vehicle or stop faster than possible by acting alone.

Combined Function Automation (Level 2): This level involves automation of at least two primary control functions designed to work in unison to relieve the driver of control of those functions. An example a Level 2 system is adaptive cruise control in combination with lane tracking.

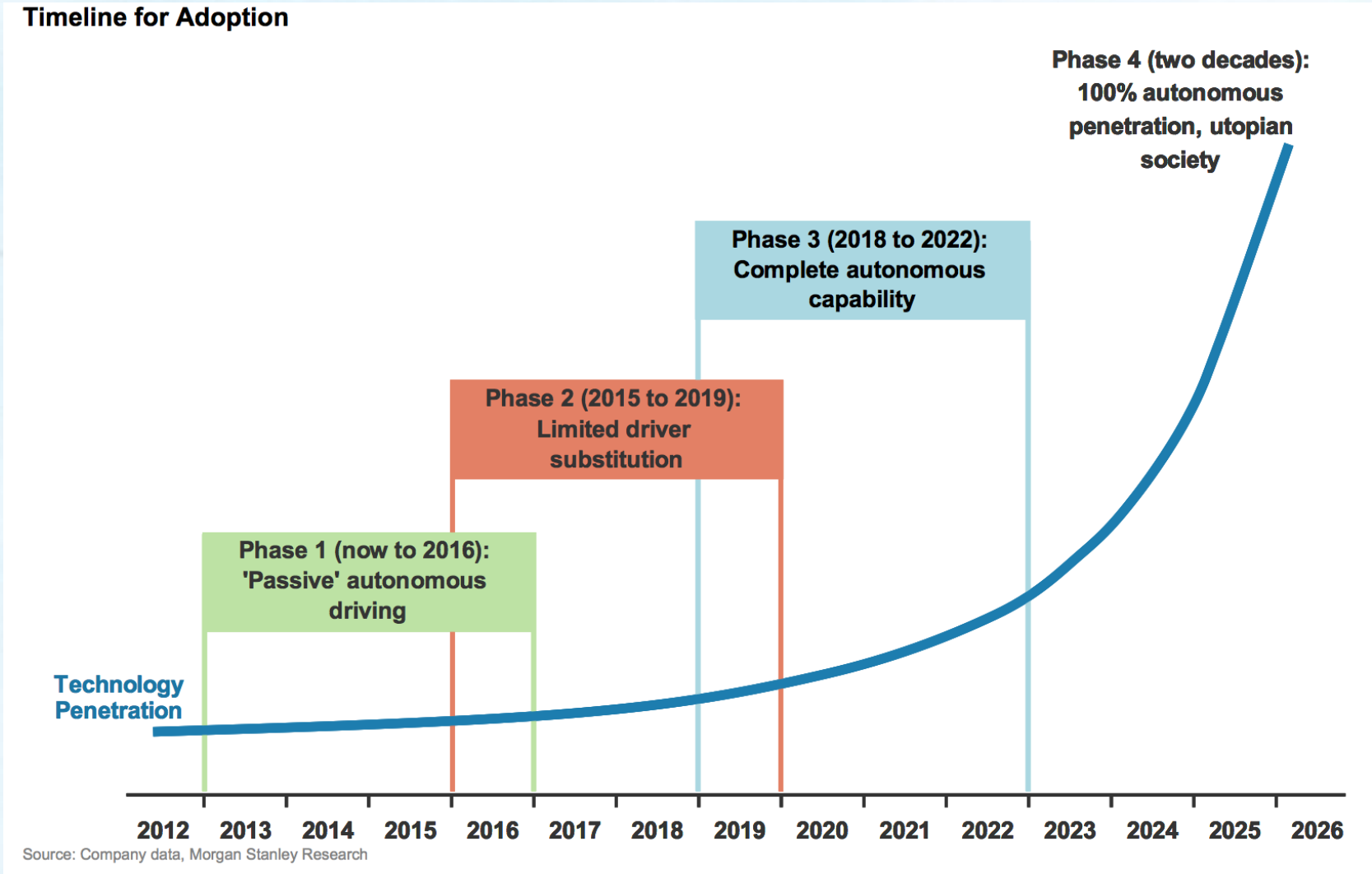
Limited Self-Driving Automation (Level 3): Vehicles at this level of automation enable the driver to cede full control of all safety-critical functions under certain traffic or environmental conditions and in those conditions to rely heavily on the vehicle to watch for changes in those conditions that would require transition back to driver control. The driver is expected to be available for occasional control, but with sufficiently comfortable transition time. The Google car is an example of limited self-driving automation.

Specifically, the Inspiration truck will follow GPS directions, maintaining safe and efficient (and legal) speeds, staying in its lane, and slowing or stopping or speeding up as necessitated by traffic conditions. It won't change lanes to pass, however.

Full Self-Driving Automation (Level 4): The vehicle is designed to perform all safety-critical driving functions and monitor roadway conditions for an entire trip. Such a design anticipates that the driver will provide destination or navigation input, but is not expected to be available for control at any time during the trip. This includes both occupied and unoccupied vehicles.

Source: Ackerman, Evan. 2015. "Freightliner Unveils First Autonomous Semi-Truck Licensed to Drive Itself on Highways." *IEEE Spectrum*. May 6. http://spectrum.ieee.org/cars-that-think/transportation/self-driving/freightliner-unveils-first-autonomous-semitruck-licensed-to-drive-itself-on-highways.

The four phases of self-driving car development suggest autonomous by 2020



Source: Owyang, Jerimiah. 2015. "Self-Driving Cars Disrupt the Crowd." *Web Strategist*. February 19. http://www.web-strategist.com/blog/2015/02/19/self-driving-cars-disrupt-the-crowd/ .

Partial list of who's disrupted by self-driving cars

- **Taxis** compete with Uber, Google, Apple self-driving cars. Ride sharing was just the first blow.
- **Ride sharing drivers** at Uber, Lyft, Sidecar, BlaBlaCar will be disrupted as autonomous cars do a safer job at lower cost.
- **Local couriers**, like TaskRabbit, Instacart and bike messengers will be impacted.
- Mid range and long range **transportation and delivery services** would be impacted as local delivery becomes automated.
- **Retailers** may see a change in foot traffic as people order goods to be delivered to their homes by driverless cars.
- **Auto and life insurance** should be impacted, due to fewer accidents and the introduction of per-mile-based insurance.
- **Paramedics** may be impacted if victims choose self-driving cars to whisk them to ER for less than severe injuries.
- **Car ownership** could dwindle. Self-driving cars means fewer cars will be needed, as they're efficiently routed as needed.
- Airbnb may benefits as urban areas convert **garage spaces into living areas** for short term stays.
- The **parking industry** could suffer, as lots are converted to other uses.
- **Parking fines and local taxes** could dwindle with fewer cars on road and robotic efficiency.
- **Radio and podcasts** could become less popular, as people play video games and watch videos in the self-driving rides.
- **Short distance airlines** could suffer, as people choose to take a relaxing trip in a mobile living room.
- **Communities or attractions not connected by rail** could prosper as people easily travel there for business or pleasure.
- **Auto repair** could be impacted as self-driving cars automatically head for maintenance without the driver or owner present.
- **Hotels and motels** could be affected as families are able to sleep in the comfort of a self-driven vehicle on the way to their destination.

Source: Owyang, Jerimiah. 2015. "Self-Driving Cars Disrupt the Crowd." *Web Strategist*. February 19. http://www.web-strategist.com/blog/2015/02/19/self-driving-cars-disrupt-the-crowd/ .

IBM Watson Oncology Diagnosis and Treatment

PubMed

MEDLINE

Memorial Sloan Kettering Cancer Center

At 2013:
- 605,000 pieces of medical evidence
- 2 million pages of text
- 25,000 training cases
- 14,700 clinician hours

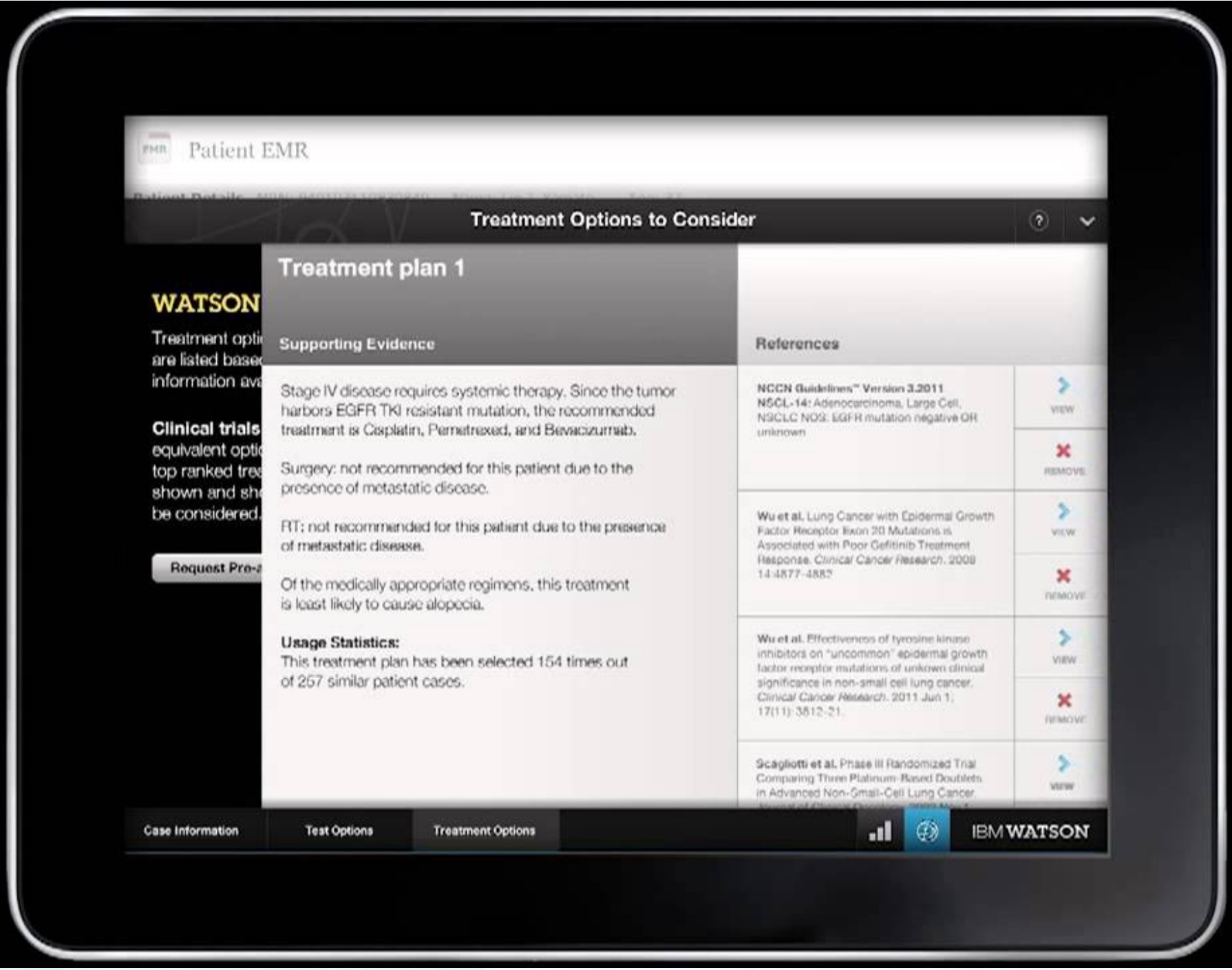
At 2016:
- Over 290 medical journals
- Over 200 textbooks
- 12 million pages of text

Fourteen U.S. and Canadian cancer institutes will use IBM's Watson computer system to choose therapies based on a tumor's genetic fingerprints … toward bringing personalized cancer treatments to more patients.

[1] Upbin, Bruce. 2013. "IBM's Watson Gets Its First Piece Of Business In Healthcare." Forbes Tech. February 8. http://www.forbes.com/sites/bruceupbin/2013/02/08/ibms-watson-gets-its-first-piece-of-business-in-healthcare/

[2] http://www.ibm.com/smarterplanet/us/en/ibmwatson/watson-oncology.html

[3] Begley, Sharon. 2015. "IBM's Watson to Guide Cancer Therapies at 14 Centers." Reuters, May 5. http://www.reuters.com/article/ibm-cancer-idUSL1N0XV26220150506.


Patient EMR
Treatment Options to Consider
WATSON
Treatment opti
are listed base
information ava
Clinical trials
equivalent opti
top ranked tre
shown and sh
be considered.
Request Pre-
Treatment plan 1
Supporting Evidence
Stage IV disease requires systemic therapy. Since the tumor harbors EGFR TKI resistant mutation, the recommended treatment is Cisplatin, Pemetrexed, and Bevacizumab.
Surgery: not recommended for this patient due to the presence of metastatic disease.
RT: not recommended for this patient due to the presence of metastatic disease.
Of the medically appropriate regimens, this treatment is least likely to cause alopecia.
Usage Statistics:
This treatment plan has been selected 154 times out of 257 similar patient cases.
References
NCCN Guidelines™ Version 3.2011 NSCL-14: Adenocarcinoma, Large Cell, NSCLC NOS, EGFR mutation negative OR unknown
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Wu et al. Lung Cancer with Epidermal Growth Factor Receptor Exon 20 Mutations is Associated with Poor Gefitinib Treatment Response. Clinical Cancer Research. 2009 14:4877-4882
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Wu et al. Effectiveness of tyrosine kinase inhibitors on "uncommon" epidermal growth factor receptor mutations of unknown clinical significance in non-small cell lung cancer. Clinical Cancer Research. 2011 Jun 1; 17(11): 3812-21.
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Scagliotti et al. Phase III Randomized Trial Comparing Three Platinum-Based Doublets in Advanced Non-Small-Cell Lung Cancer
VIEW
Case Information
Test Options
Treatment Options
IBM WATSON

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GLOBAL INNOVATION OUTLOOK

IBM's Global Innovation Outlook (GIO)

Over five years ago, IBM launched a unique experiment in exploration, collaboration and innovation: the Global Innovation Outlook (GIO). During its evolution, we've convened hundreds of thought leaders, policymakers, business executives, university researchers and representatives from non-profit organizations. We've explored topics as varied and important as healthcare, energy and the environment, economic development in Africa, and the future of the world's water resources. We've shared the results of our exploration and analysis through reports and studies, brokered new relationships, and launched dozens of collaborative initiatives among GIO participants.

Today the GIO's approach pervades just about all IBM interactions. It is clearly visible in our thinking about building a Smarter Planet, and our implicit invitation for like-minded people around the world to join us in this endeavor.

Engage with IBM at any level today, and you will witness this belief in action, as well as the culture it engenders. Therefore, the GIO itself is no longer necessary as a standalone program, and we will no longer be conducting separate GIO deep dives, roundtables or forums as such. We will, however, continue to support and cultivate the communities essential to the spirit of the GIO, including the GIO Facebook and LinkedIn communities, so that GIO alumni can contact each other and IBM as often as they wish. GIO reports and other collateral material will also remain available. And the GIO blog archives will continue to be hosted at www.gio.typepad.com (link resides outside of ibm.com).

We encourage you to continue to engage with us at IBM, as well as your fellow GIO Alumni. Feel free to share any observations, interests or suggestions about the GIO, innovation, or the quest

Contact us

Questions? E-mail the GIO Team

E-mail us

New GIO report

Read GIO Security, Privacy, and Web 2.0 Report (2.62MB)

IBM

March 2016

Index of insights

Smarter Planet

In the fall of 2008, in the midst of a global economic crisis, IBM began a conversation with the world about the promise of a smarter planet and a new strategic agenda for progress and growth.

System of Systems

CFR Events

November 6, 2008

A Smarter Planet

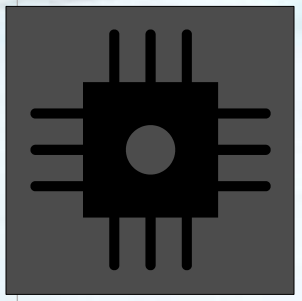
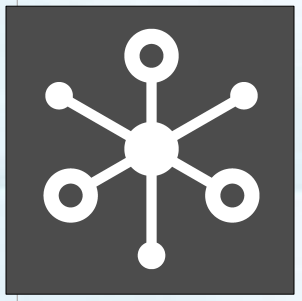
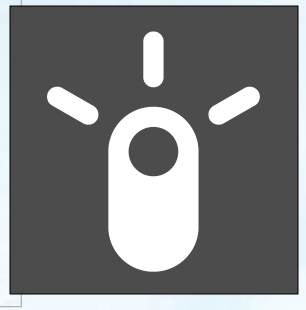
Speaker:

Samuel J. Palmisano
Chairman, President, and Chief Executive Officer, IBM Corporation

Presider:

Robert E. Rubin
Chairman and Senior Counselor, Citigroup

The unobservable becoming observable

Pre-digital physical infrastructure	*Converging physical and digital infrastructure*	
World as invisible or unobserved	Our world is becoming INSTRUMENTED	
Analog / synchronous connections, person-to-person and machine-to-machine	Our world is becoming INTERCONNECTED	
Things as dumb or unresponsive to interaction	Virtually all things, processes and ways of working are becoming INTELLIGENT	

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Welcome to the cognitive era - IBM CEO Ginni Rometty describes a new era in technology and business

IBM

Subscribed 72,245

99,954

Ginni Rometty, Keynote Interview, Gartner Symposium/Itxpo 2015, October 4, republished at https://www.youtube.com/watch?v=bMLYKhiZCVI

Computing, cognition and the future of knowing

How humans and machines are forging a new age of understanding

IBM

Dr. John E. Kelly III
Senior Vice President,
IBM Research and Solutions Portfolio

Cognitive computing refers to systems that learn at scale, reason with purpose and interact with humans naturally. Rather than being explicitly programmed, they learn and reason from their interactions with us and from their experiences with their environment. […]

Those systems have been deterministic; cognitive systems are probabilistic. They generate not just answers to numerical problems, but hypotheses, reasoned arguments and recommendations about more complex — and meaningful — bodies of data.

From the 2015 Cognitive_Colloquium^{SF}, at http://research.ibm.com/cognitive-computing/#sf,

Image 1

The Tabulating Era (1900s–1940s)

- Single purpose mechanical systems
- Essentially calculators

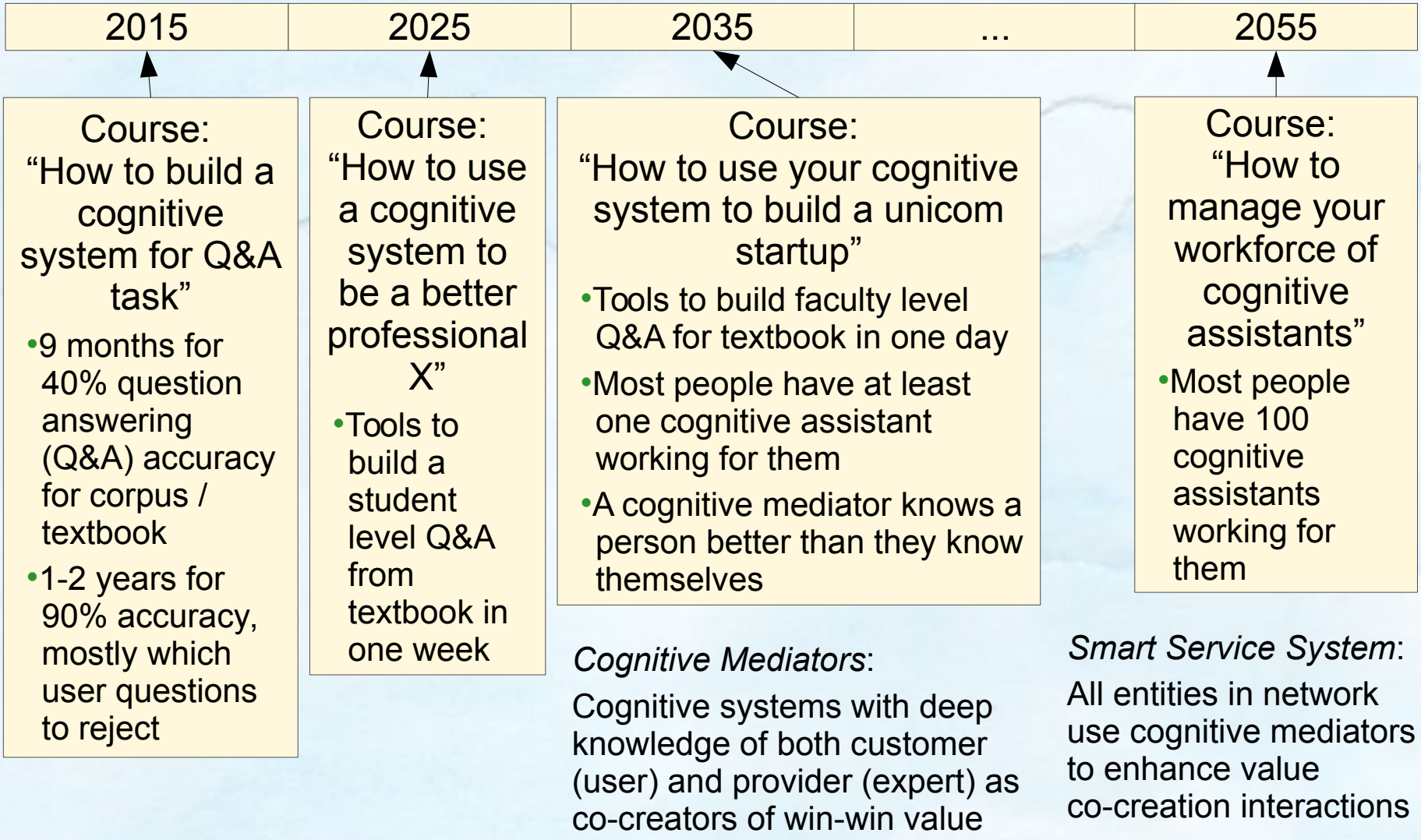
The Programming Era (1950s–present)

- Digital computers
- If / then logic and loops, instructions coded in software

The Cognitive Era (2011–)

- Man-computer symbiosis in cooperative interaction (Licklider)
- (1) let computers facilitate formulative thinking, as they now facilitate the solution of formulated problems; and
- (2) enable men and computers to cooperate in making decisions and controlling complex situations without inflexible dependence on predetermined programs ...

Predictions: Courses & Cognitive (Jim Spohrer, IBM)



Jim Spohrer. 2016. "Open Innovation & Singularity: The Future of Industries & Business Models." Panel discussion presented at HICSS, Kauai, Hawaii, January 5. http://www.slideshare.net/spohrer/spohrer-hicss-20160105-v2.

Open Innovation Leveraging IBM Watson

UGBA 198 - 3 Units: Fall 2014

Class Times: TTH 8:00am – 9:30am. Tuesdays: C-250s Thursdays: I - Lab

Instructors: Solomon Darwin / Donald Wroblewski
E-mail Address: darwin@haas.berkeley.edu / dewroblewski@berkeley.edu

Office Hours: By appointment
Prerequisites: Instructor approval is needed for registration.
Advisors: Ken Singer, Henry Chesbrough, Jim Spohrer and Nanci Knight
Textbooks: 1) IBM resources listed on the back page 2) Open Business Models. Author: Henry Chesbrough

The objective of the course is to offer technical and business students access to the Watson Developer Cloud to learn about the technical aspects of cognitive computing, including ingesting, building and training a corpus, and then in the second half of the semester, using that information to build a cognitive app and developing a business model as a precursor to taking their ideas to market.

The course is intended to help educate and empower the next generation of innovators with an opportunity to 'change the world' with their access to Watson. The students taking this course will be among the first to have hands-on access to the cutting-edge Watson technology, enabling them to develop innovative ideas to solve the most pressing problems of industry and society. And from a skills perspective this course will further enhance the students' marketability. Gartner Inc., a research firm predicts that 4.4 million IT jobs will be created to support Big Data by 2015.

Course Objectives:

1. Understand Watson and its underlying technologies
2. Develop an abstract of a Watson application that solves a real world challenges
3. Formulate a value proposition and identify the target consumers or audiences
4. Develop a corpus of data in a domain with types of text content in format supported by Watson
5. Understand how corpora is ingested and trained for accuracy.
6. Come up with Question/Answer pairs and do some training and scoring
7. Build a Mobile application prototype for use with corpus
8. Develop a business model to take the application to market (to capture the value created)

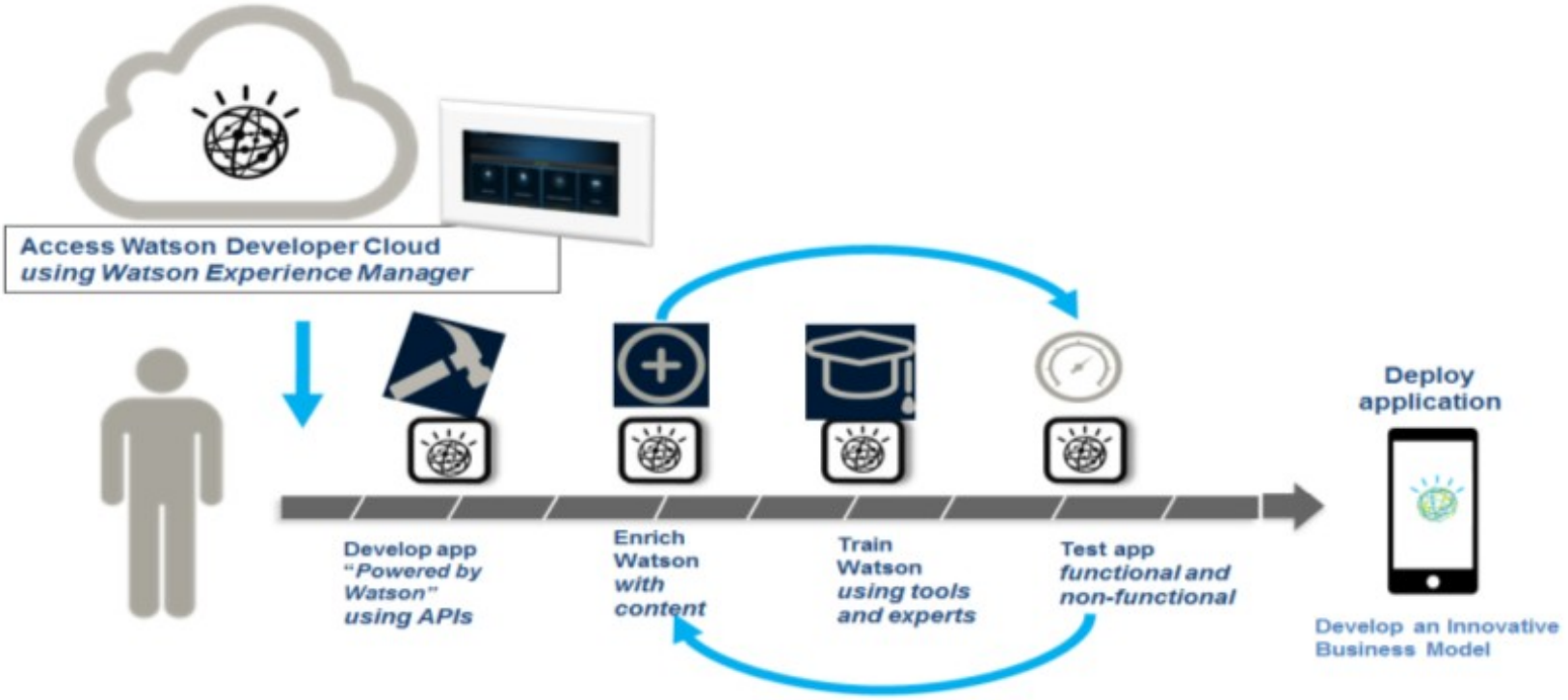
Identify a Real World Challenge ⟹ Develop: Solution that Leverages IBM Watson ⟹ Propose a Business Model

Open Innovation Leveraging IBM Watson

UGBA 198 - 3 Units: Fall 2014

Class Times: TTH 8:00am – 9:30am. Tuesdays: C-250s Thursdays: I - Lab

The process for building your "Powered by Watson" app



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8. Develop a business model to take the application to market (to capture the value created)

Identify a Real World Challenge ⟹ **Develop: Solution that Leverages IBM Watson** ⟹ **Propose a Business Model**

Tentative Schedule

UGBA198 - TTh 8:00-9:30PM meets in C250 on Tusesdays and in I-Lab on Thursdays

Week	Tue	Thur	Topic for Disccussion
1		28-Aug	Introduction to Watson - Speaker from IBM
2	2-Sep	4-Sep	Topics related to Module 1 - guest speaker TBD
3	9-Sep	11-Sep	Topics related to Module 1 - guest speaker TBD
4	16-Sep	18-Sep	Topics related to Module 2 - guest speaker TBD
5	23-Sep	25-Sep	Topics related to Module 2 - guest speaker TBD
6	30-Sep	2-Oct	Topics related to Module 3 - guest speaker TBD
7	7-Oct	9-Oct	Topics related to Module 3 - guest speaker TBD
8	14-Oct	16-Oct	Topics related to Module 4 - guest speaker TBD
9	21-Oct	23-Oct	Topics related to Module 4 - guest speaker TBD
10	28-Oct	30-Oct	Mid-point Review by IBM Executives
11	4-Nov	6-Nov	Meet in Groups - Instructor feedback
12	11-Nov	13-Nov	Groups Meet Outside of Class
13	18-Nov	20-Nov	Pre-Presentation to Selected Executives for input
14	25-Nov	27-Nov	Groups Meet Outside of Class
15	2-Dec	4-Dec	Meet in Groups - Instructors' feedback
16	9-Dec	11-Dec	Reading Week- Instructors will be available for feedback
		12-Dec	Final Presentations to Corporate at I-Lab

Grading: This is a Pass/No Pass Course - Students need to earn 900 points to pass. The grades will not be contingent on whether the Group wins the $100,000 or not.

Undergrads Innovate with Watson Supercomputer for Chance at $100,000

December 28, 2014

L-R: Vincent Tian, Jessie Salas,Vi Tran, Prof. Solomon Darwin, Andrew Koth, David Park, and David Fang.

The U.S. patent system has been called broken. But a team of undergrads at Berkeley-Haas believes a supercomputer named Watson could help fix it.

Team Patent Fox is heading to IBM Watson's new headquarters in New York City's Silicon Alley January 9 to test the mettle of a new patent application it developed in the *Open Innovation, Leveraging IBM Watson* course. The team will vie against nine other teams in the national competition for $100,000.

The winning team includes three business and three engineering majors: Vincent Tian, BS 16, Jessie Salas, BS 16, Vi Tran, BS 15, Andrew Koth, BS 15, David Park, BS 15, and David Fang, BS 16. Patent Fox beat three rival Berkeley-Haas teams Dec. 12 to get the chance to move forward in the IBM competition.

Watson is probably best known for beating the popular Jeopardy quiz show champs. By incorporating three key components—natural language processing, hypothesis generation/evaluation, and dynamic learning—Watson processes information in a way that is more like a human than a computer. It can process over 200 million records per second and learns over time as more information flows into it.

Open Innovation, Leveraging IBM Watson is taught by Solomon Darwin, executive director of the Garwood Center for Corporate Innovation. Berkeley-Haas is one of 10 universities and colleges across North America chosen to offer the course.

Patent Fox designed its app for businesses and law firms. The app relies on Watson's natural language processing abilities and contextual analysis to help organizations search for patent overlaps more quickly and thoroughly.

The team says the app will reduce the excessive cost and time typically associated with filing patent applications and ultimately help companies protect their patents. The average cost of filing a patent ranges between $1,200 to $6,000. Organizations spend $1.2 billion per year in the U.S. on so-called prior art searches required to prove a new patent's originality.

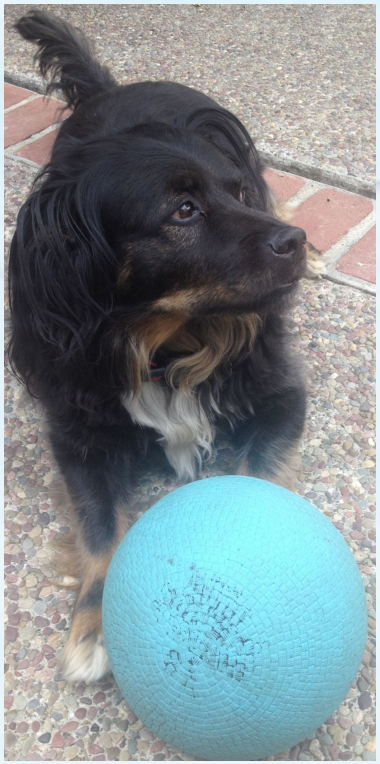
Patent Fox developed its plan with the help of a patent attorney and a patent examiner who were already working at a UC Berkeley patent startup, Park says. "We were connected to (the startup) and had a similar idea," he says. "They were using programmatic computing to solve a problem and we thought if we could use Watson the results would be even better. The way you train Watson is to train it to think and Watson becomes more human in that sense."

Y. Subramanyam, CEO of Apollo Hospitals, Asia's largest healthcare group, called the team's idea "just brilliant," considering the exponential rise in patent filings in Asia.

The runner-up Berkeley-Haas team, Health Note, developed an app that Apollo Hospitals could use to conduct better followup with patients after they leave the hospital. (Health Note will not move on to compete in New York).

The winning team January 9 will receive $50,000 from the IBM Watson Ecosystem group and $50,000 from The Entrepreneur's Fund, a technology venture firm. Students also receive continued access to IBM's Watson Developer Cloud and become part of the Watson Ecosystem partner program.

The difference between a cognitive system and a service system?



My dog is a cognitive system, by the way. I love my dog. But my dog has no rights and responsibilities.

Young children, elderly people with dementia, they're cognitive systems, but they don't have as many rights and responsibilities, as us mature and responsible people.

The way a cognitive system becomes a service system is when it sets up the rights and responsibilities that go along with being a member of a very productive society.

Source: Spohrer, Jim. 2015. Empowering Makers in the Cognitive Era. Web Video. IBM Research - Almaden. https://www.youtube.com/watch?v=FfQbgALI-OE.

ISSIP
International Society of Service Innovation Professionals

About ISSIP

The **International Society of Service Innovation Professionals, ISSIP** (pronounced iZip), is a professional association co-founded by IBM, Cisco, HP and several Universities with a **mission to promote Service Innovation for our interconnected world. Our purpose is to help institutions and individuals to grow and be successful in our global service economy.**

Service innovations improve the quality-of-life of individuals and the wealth of institutions, from businesses to nations that are increasingly dominated by service revenues and economics. Advances in information technology and policy support the rapid scaling of new service innovations in health, education, government, finance, hospitality, retail, communications, transportation, energy, utilities; even in advanced agricultural and manufacturing systems viewed as socio-technical systems, in which community-oriented recycling behaviors improve the economics, sustainability, and resilience of these human-serving systems.

Cognitive Systems Institute Group

TO AUGMENT AND SCALE HUMAN EXPERTISE

Introduction to the Cognitive Systems Institute

The Cognitive Systems Institute Group is a collaborative effort between universities, research institutes, and IBM clients to advance the state-of-the-art in cognitive computing. The institute features resources on this website , a LinkedIn Discussion Group and a weekly Speaker Series . As research collaborators and faculty, we focus on building and evaluating cognitive assistants for every profession. The Cognitive Systems Institute centers on professional cognitive assistants that exhibit the three L's – language, learning, and levels to augment and scale human expertise.

The programs are designed to

- help create linkages between faculty and IBM Researchers to define cognitive system grand challenges
- help faculty and their top graduate students to prepare aligned collaborative

Join us for discussions at the Cognitive Systems Institute LinkedIn Group

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