MACHINE INTELLIGENCE & THE FUTURE OF COMPUTING

November 2016

Booz | Allen | Hamilton

The Rise of Machine Intelligence

1950s – 2010s

We Programmed Machines

- Computers require explicit programming in order to accomplish activities with no ability to reason
- They can only address the narrow task for which they were programmed

1990s – Today

Especially the last 3 years

We let Machines Learn / Infer

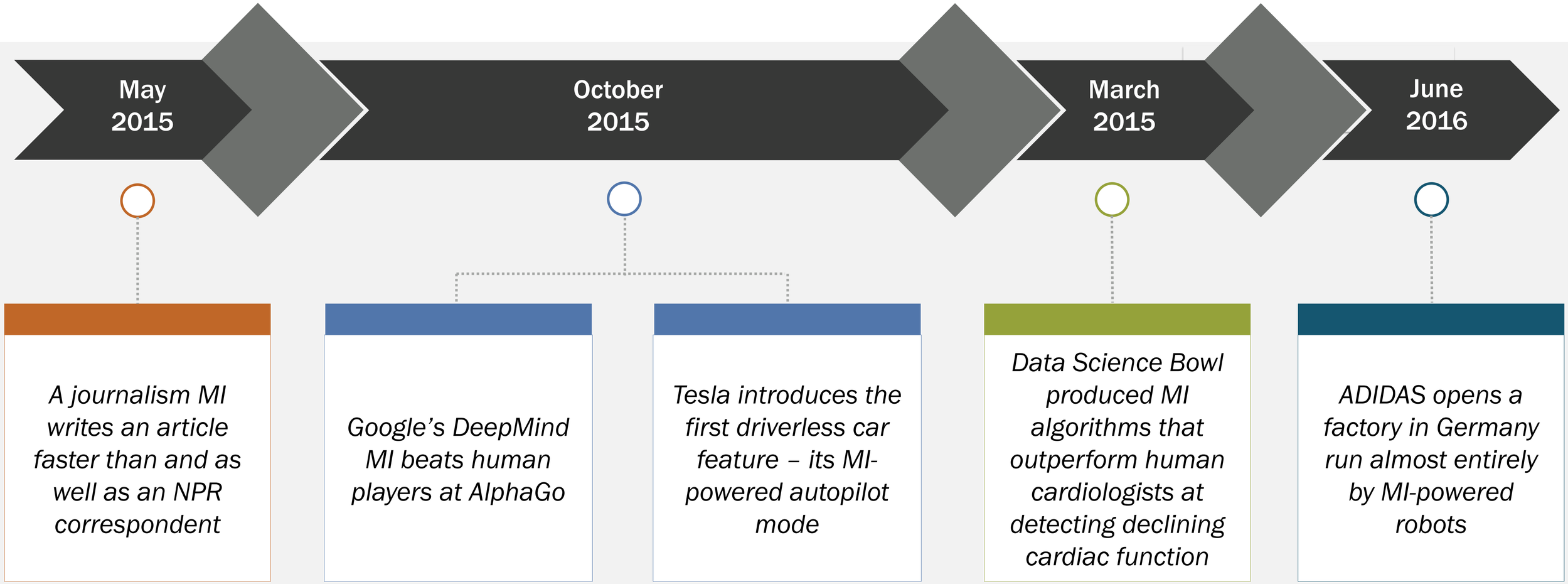
- Humans interpret and develop hypotheses, then direct computers to prove and automate
- Computers are able to learn simply by interacting with their environment (e.g., AlphaGo)

2020 and Beyond

Machines are Intelligent

- Computers are capable of independent critical reasoning, planning, abstract thinking and inference
- They exceed human abilities to synthesize massive data volumes and make high speed decisions

Pushing the Frontiers

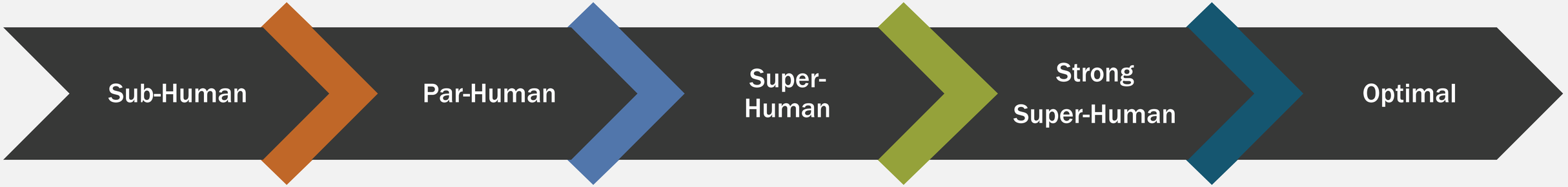


Machine Intelligence Today

Task Type	Application Scope	Return on Investment
• Complex • Exploratory • Non-routine • Decision-supporting	• Focused • Targeted to specific data sets • Tasked to deliver specific outputs (no artificial general intelligence yet)	• High • Potential to transform operational and business models

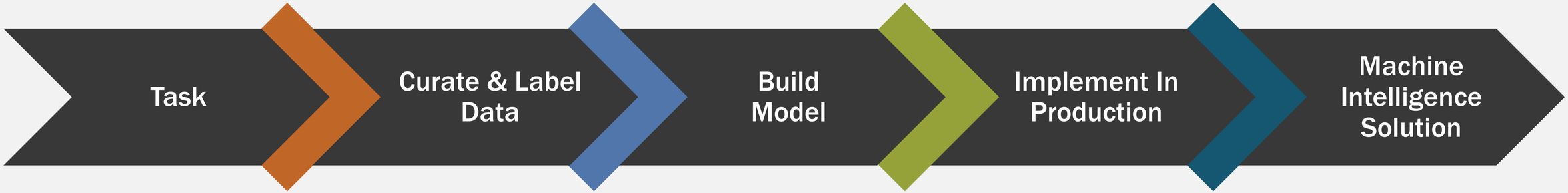
Source: https://hbr.org/2016/10/the-3-ways-work-can-be-automated

Machine Intelligence Performance

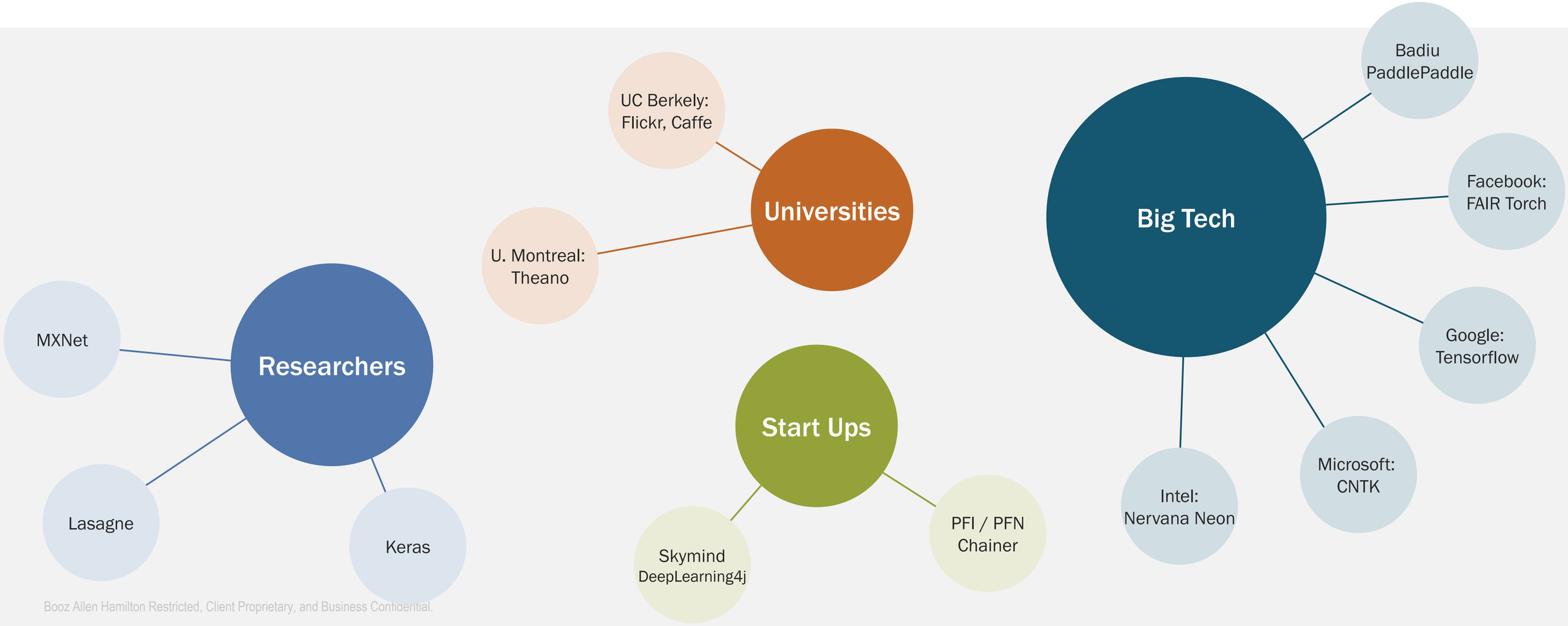


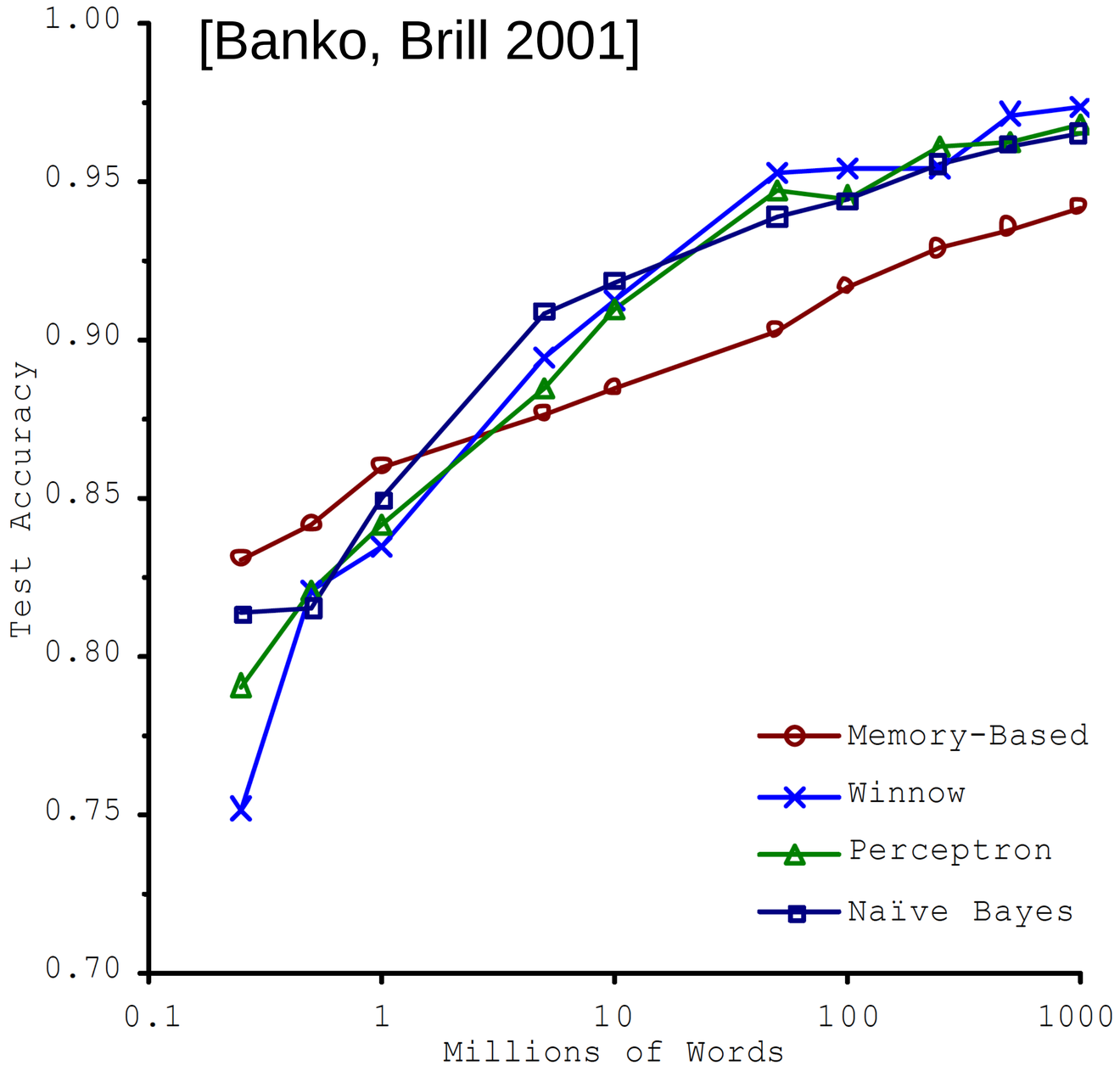
Worse than Most	Similar to Most	Better than Most	Better than All	Peak Performance
- OCR - Machine Translation	-Image Classification -Speech Detection	-Crossword Puzzles -Driving a Car	- Bridge - Chess - Go	- Tic-Tac-Toe - Checkers - Rubik's Cube

Automating a Task

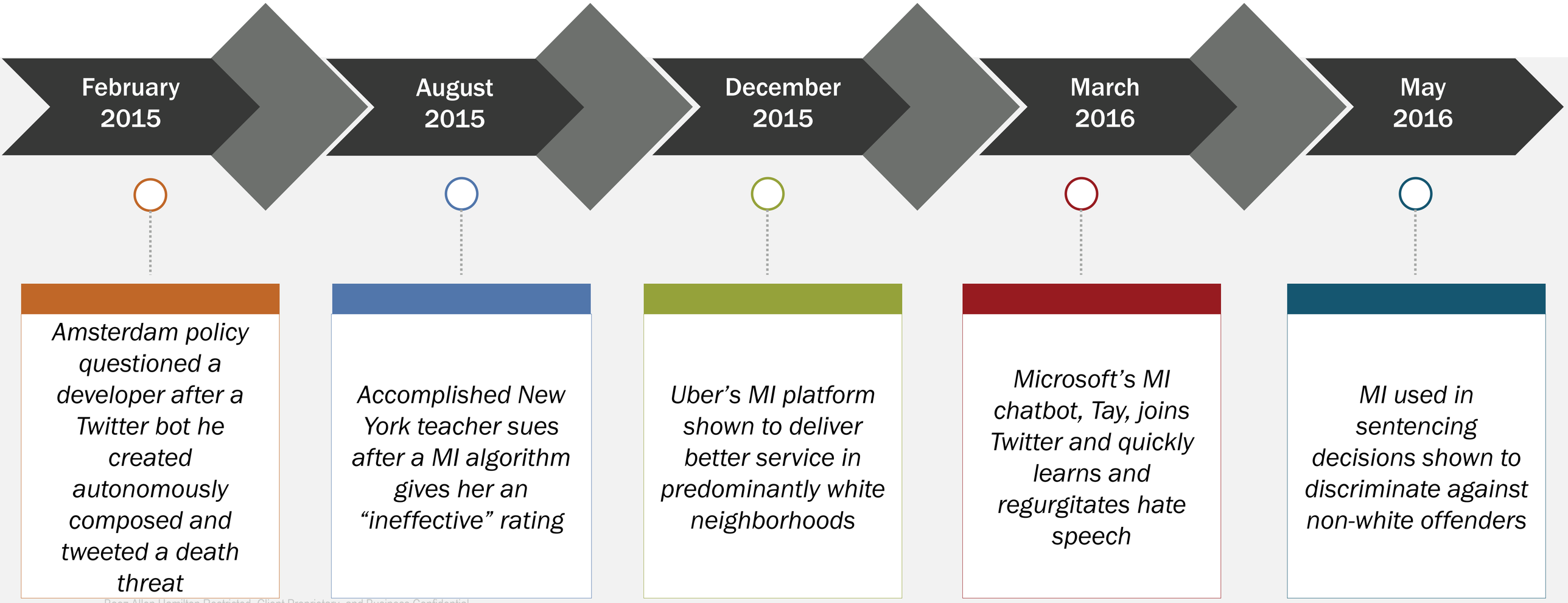


The Commoditization of Models




[Banko, Brill 2001]
1.00
0.95
0.90
0.85
0.80
0.75
0.70
Test Accuracy
0.1
1
10
100
1000
Millions of Words
Memory-Based
Winnow
Perceptron
Naïve Bayes

Implementation Can’t be an Afterthought



Use Case 1: GSA Acquisition Platform – Cognitive Computing PoC[1]

Task Type

- Capture
- Analyze
- Report
- Learn

Application Scope

- Proof-of-Concept
- 19 Sources Data
- Improve Accuracy
- Cut ”Time to Accomplish”
- Positive or Negative Determination
- Capable of “Learning” to improve performance

Return on Investment

- Potential to transform operational and business models
- 98% probability that these tasks can be fully automated[2]

Sources
[1] https://govtribe.com/project/cognitive-computing-responsibility-determination-pilot
[2] http://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf

Use Case 2: TUNE Semi-Structured Entity Resolution

Task Type

- Capture
- Analyze
- Infer
- Associate
- Suggest

Application Scope

- Large Amounts of Dirty Data
- Web of Unstructured Data
- Multiple Sources of Identity
- Automated Entity Resolution
- Learn from New Information Over Time

Return on Investment

- Developed Structured Data
- Identified Key Points-of-contact
- Eliminated Duplication of Effort
- Readily Adaptable to New Domains

Source : http://www.boozallen.com/content/dam/boozallen/documents/2016/06/TUNE-merchandiser.pdf

Use Case 3: USDA Supplemental Nutritional Assistance Program (SNAP)

Task Type	Application Scope	Return on Investment
• Capture • Analyze • Model • Explain • Predict	• Many Sources of Open Data with SNAP Performance Data • Synthesize Ground Truth • Formulate and Test Hypothesis • Capture factors for success	• Potential to transform program effectiveness. • Targeted funding • Improved ROT • Replicate success across states

Source: http://www.fns.usda.gov/pd/supplemental-nutrition-assistance-program-snap

In Summary…

- Machine Intelligence is Rapidly Evolving
- Many New Opportunities
- Data Favored over Static Models
- Produce Technically Complex Systems
- Careful Attention to Implementation
- Collaboration with and Augmentation of Human Intelligence and Capability