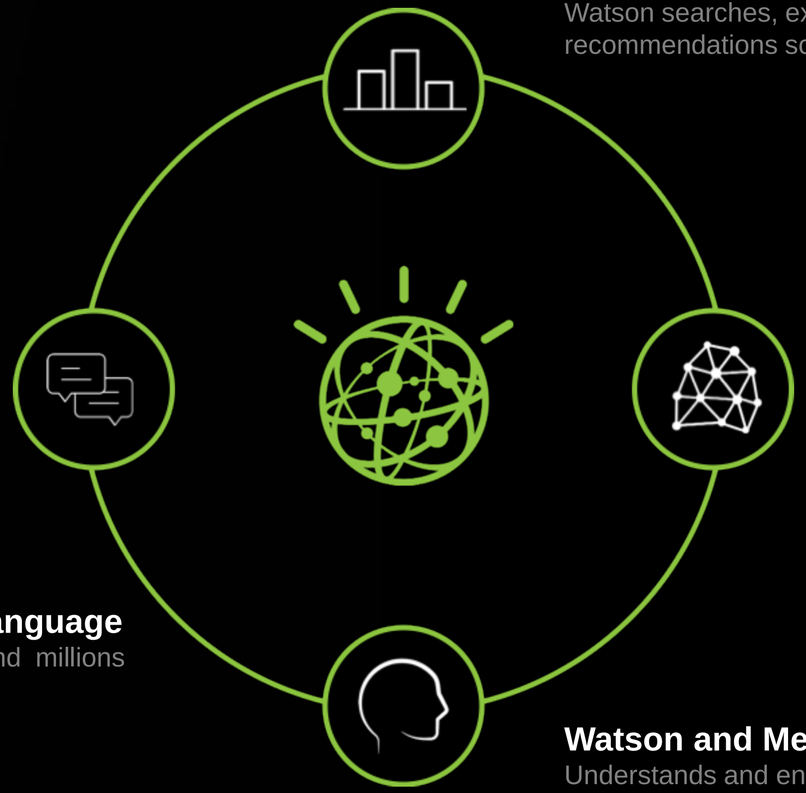
Watson: A Cognitive System



Generates and Evaluates
Watson searches, extracts candidate recommendations scores and ranks decisions

Learns and Adapts
Decisions being made by leading Physicians feed the engine

Understands Natural Language
Watson can read and understand millions and millions of documents.

- Medical Texts
- Evidence-Based Guidelines
- Peer-reviewed Articles
- Clinical records

Watson and Me
Understands and engages me
Learns and improves over time
Helps me discover
Establishes trust
Has endless capacity for insight
Operates in a timely fashion

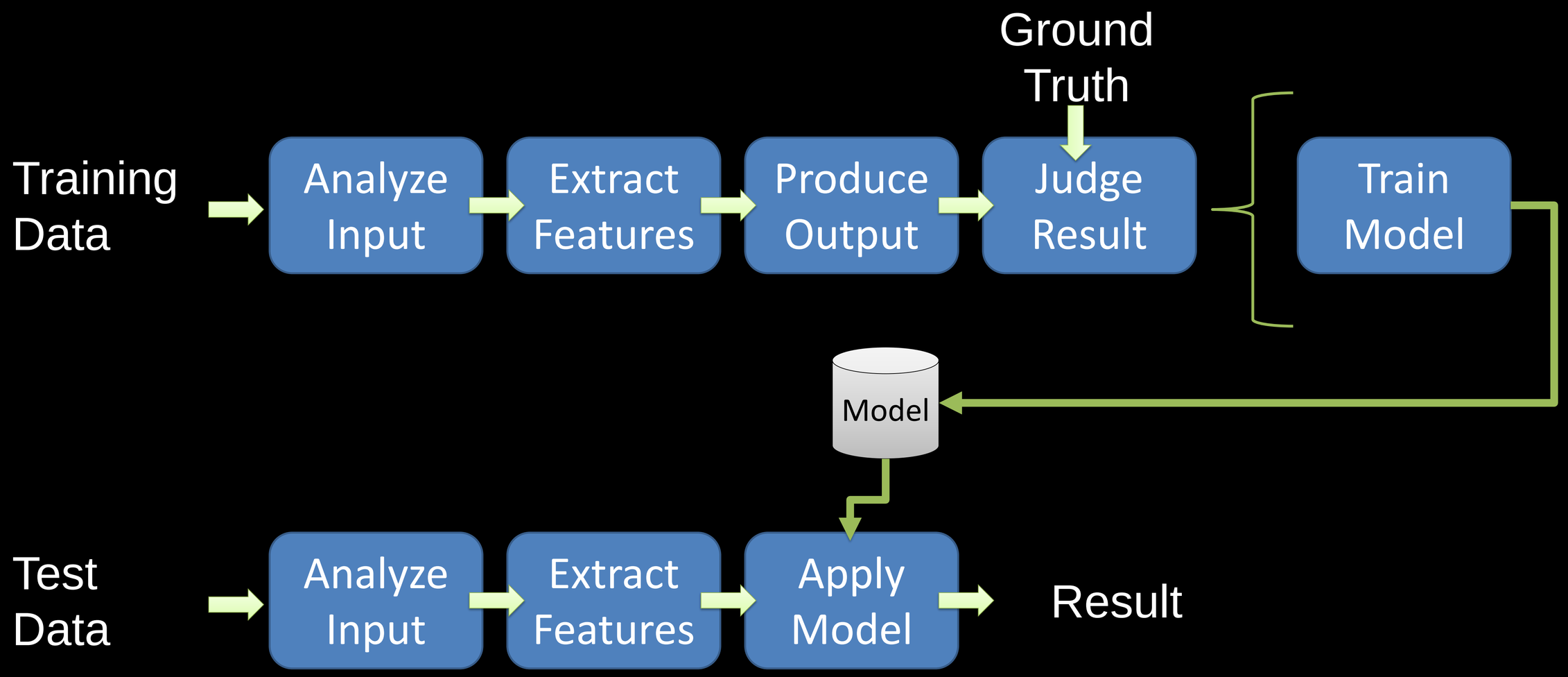
Key Terms - Machine Learning

- **Machine learning** is the subfield of computer science that "gives computers the ability to learn without being explicitly programmed”
- There are roughly three high-level tasks:
  - **Regression** – inputs are converted to an output using a continuous function
  - **Classification** – the inputs are divided into two or more classes
  - **Clustering** – inputs are grouped into clusters of related items

Key Terms - Styles of Learning

- **Supervised** – training examples are given along with the expected output from the machine. This is called “labeled” training data, or training data with “ground truth”
- **Unsupervised** – training examples are given without specifying the expected output. The machine automatically discovers the patterns or signal in the data, e.g., clustering
- **Reinforcement** – the machine is given feedback as it processes inputs and modifies its behavior according to the feedback

High-level Process

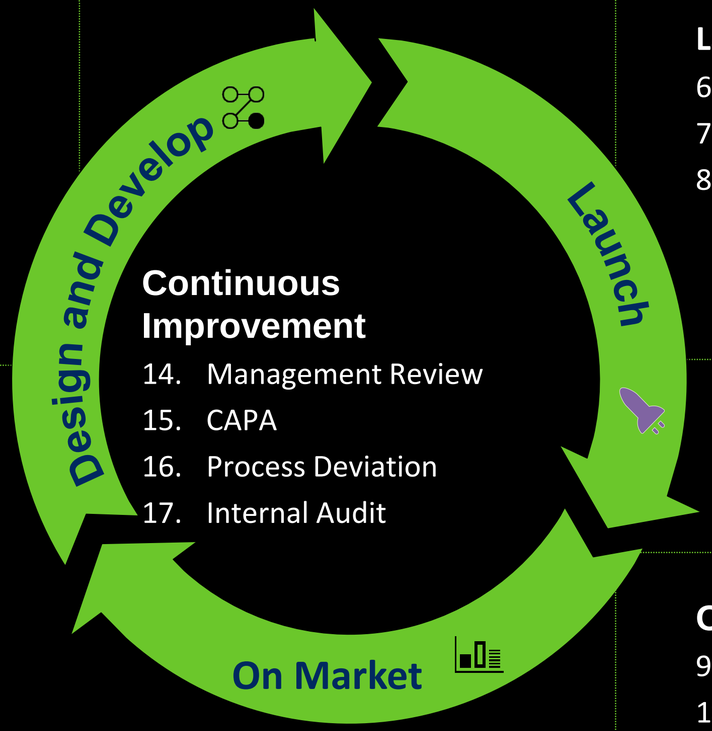


What’s new is old . . .

Design Control and Validation through IBM’s rigorous QMS process

Design and Development

1. Offering GxP Assessment
2. Design Controls
3. Risk Management
4. Supplier Management
5. Label/Labeling and Promotional Material



Continuous Improvement

14. Management Review
15. CAPA
16. Process Deviation
17. Internal Audit

Launch

6. Installation Management
7. Distribution
8. Identification and Traceability

On Market

9. Complaints
10. Nonconforming Offering
11. Recalls Management
12. Servicing
13. Offering Retirement

QMS Control

18. Document Control
19. Records Management
20. Change Management
21. Training
22. MRAP, CSV
23. Statistical Technique

The partnership with human experts is critical to training and managing cognitive systems

- **Imparting expertise via the ”ground truth”**
- **Supervised training (rounds of review and model revision) until expected performance is achieved**
- **Human oversight during production (ability to revise)**
- **Monitoring of solution performance in production**
- **Periodic re-training to accommodate shifts in the data or content**

One Example . . .

Key considerations for cognitive systems in pharmacovigilance

Architecture

- Modularity: Enables discrete tasks, flexible sequencing, faster retraining, flexibility in the workflow
- Logging/Auditing to capture system recommendations and human revision

Training

- Supervised training by safety subject matter experts
- Sufficient machine readable data to train & test
- Quality training data (a validated ground truth)

Transparency and Oversight

- Transparency into the cognitive recommendations and supporting evidence
- Human oversight and the ability to modify
- Performance monitoring and periodic re-training

Considerations for Ground Truth

- Representativeness: training data should be representative enough to cover most typical safety cases being processed recently.
- Diversity: training data should cover as many variations of target entity/attribute as possible, e.g., drugs, adverse event, report type, seriousness.
- Consistency: training data should be consistent across the corpus.
- Accuracy: training data should be accurate. Wrong training data would naturally lead to wrong prediction model.
- Machine readability: training data should be machine readable.
- Completeness: training data should be sufficient to meet all the data requirements that is clearly specified based on the needs of the cog services

Questions?