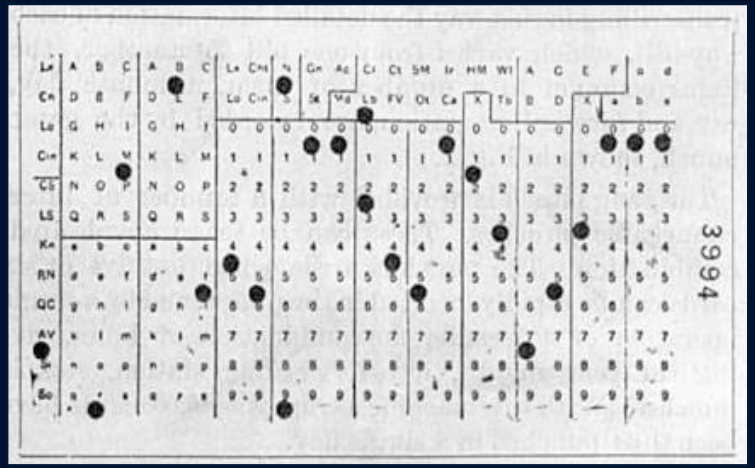
Machine Learning in Industry

Dr. Zhong Su 苏中
IBM Research - China



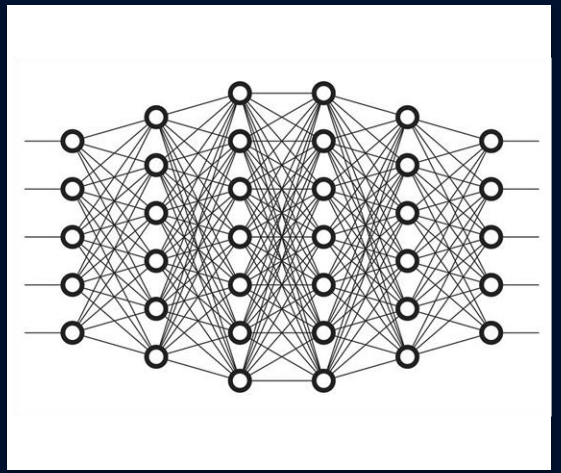
Building Computing Systems (1900 – Present)



Build Hardware

```
000100 IDENTIFICATION DIVISION.
000200 PROGRAM-ID.     HELLOWORLD.
000300
000400*
000500 ENVIRONMENT DIVISION.
000600 CONFIGURATION SECTION.
000700 SOURCE-COMPUTER. RM-COBOL.
000800 OBJECT-COMPUTER. RM-COBOL.
000900
001000 DATA DIVISION.
001100 FILE SECTION.
001200
100000 PROCEDURE DIVISION.
100100
100200 MAIN-LOGIC SECTION.
100300 BEGIN.
100400     DISPLAY " " LINE 1 POSITION 1 ERASE EOS.
100500     DISPLAY "Hello world!" LINE 15 POSITION 10.
100600     STOP RUN.
100700 MAIN-LOGIC-EXIT.
100800     EXIT.
```

Write a Program

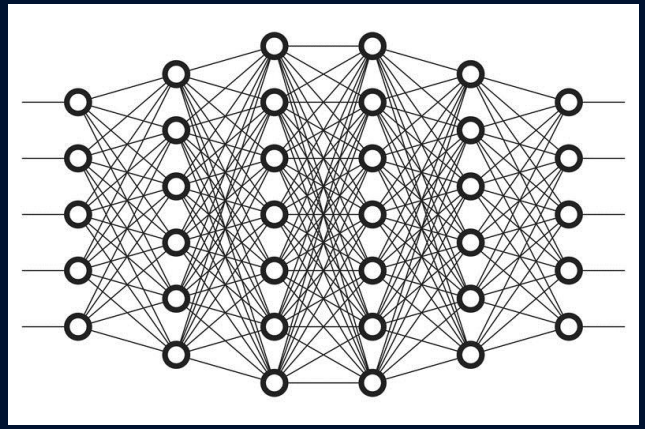


Train a Data Model

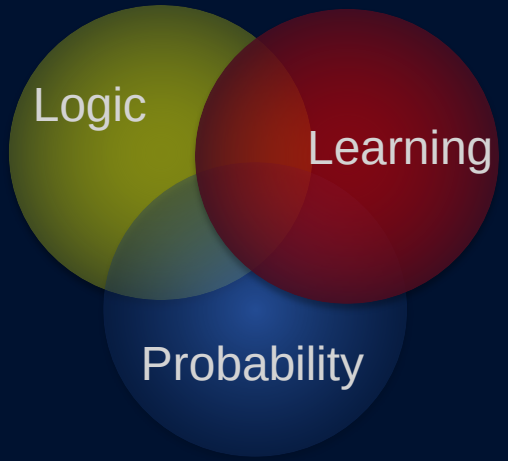
An AI Renaissance



Cloud



Deep Learning

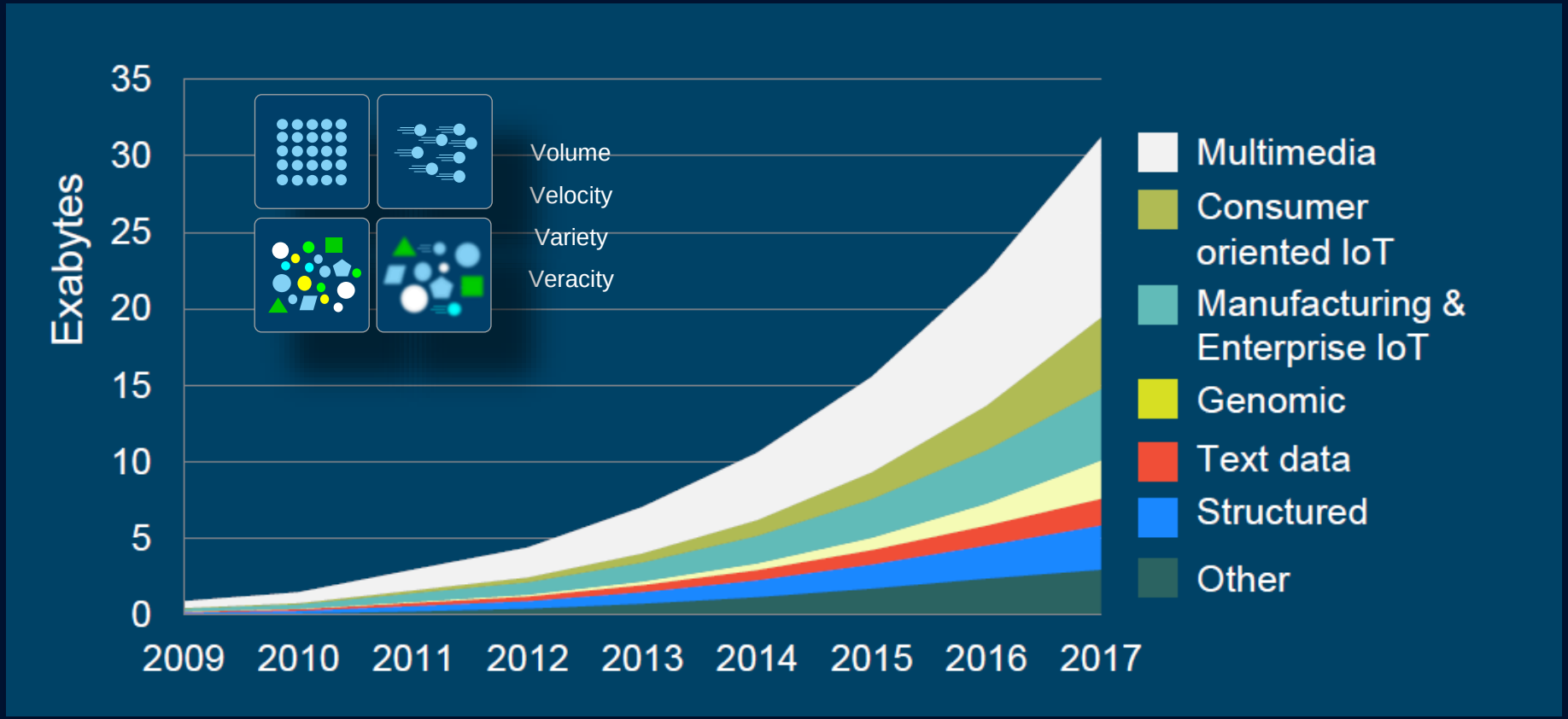


Probabilistic Reasoning

Be Afraid Of the Robots? … They Fall Over

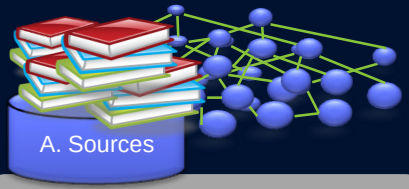


Machine Learning in Big Data Era



Jeopardy Watson: Massively Parallel Probabilistic Architecture









Question

Question/ Topic Analysis

Query Decomposition

Primary Search

Candidate Answer Generation

Hypothesis Generation

Answer Scoring

Supporting Evidence Retrieval

Deep Evidence Scoring

Hypothesis & Evidence Scoring

Evidence Retrieval

Deep Evidence Scoring

Synthesis

Final Merging & Ranking

Trained Models

Answer, Confidence

Hypothesis Generation

Soft Filtering

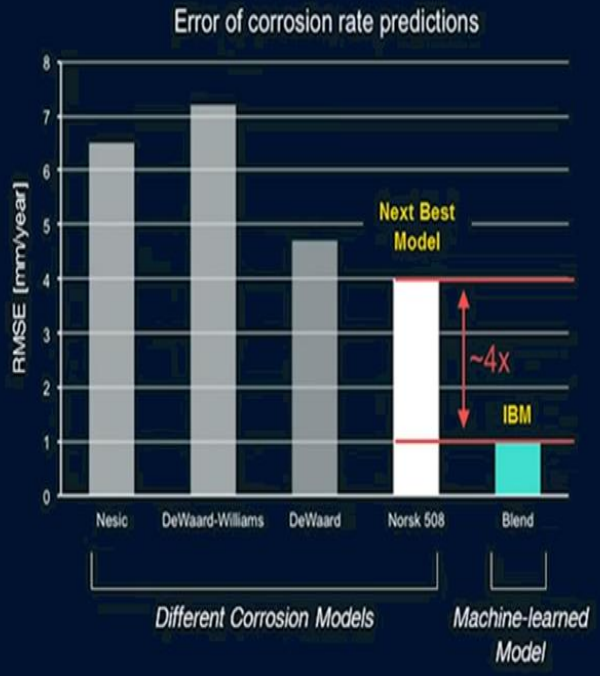
Hypothesis & Evidence Scoring

Hypothesis Generation

Soft Filtering

Hypothesis & Evidence Scoring

Generalization and similarities to Watson Jeopardy! system



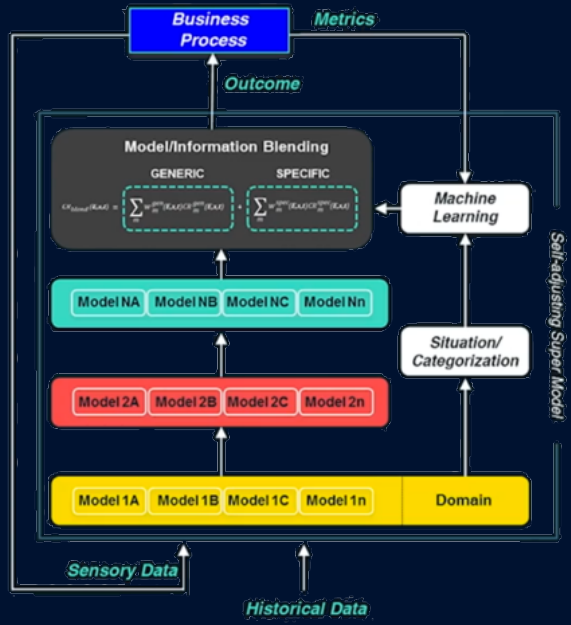
Machine learning reduces error of pipeline corrosion predictions by 4x

Approach

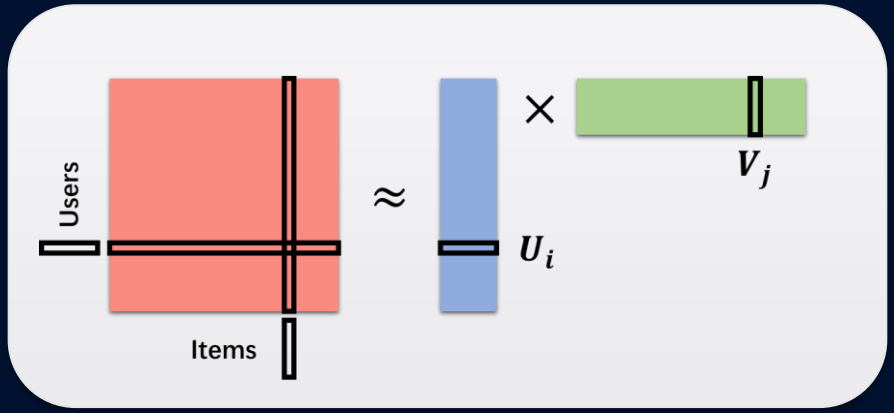
- Situation-dependent, machine-learned information blending of different models to create a self-adjusting super model
- Blending coefficients are learned from historical and operational data

Similarities to the Watson Jeopardy! system

- Classification required depending on the type of question (here category/applications)
- Various models/engines have different strengths/ weaknesses depending on situation
- Big data and deep learning approach



Mixture-Rank Matrix Approximation for Collaborative Filtering



Optimization: $\boldsymbol{U,V} = \text{argmin} \sum_{i,j} \left(\boldsymbol{R_{i,j}} - \boldsymbol{U_i V_j^T}\right)^2 + \boldsymbol{\lambda}\left(|\boldsymbol{U}|_{\boldsymbol{F}}^2 + |\boldsymbol{V}|_{\boldsymbol{F}}^2\right)$

Prediction: $\widehat{\boldsymbol{R}}_{\boldsymbol{i,j}} = \boldsymbol{U_i V_j^T}$

- Targeted Problem
  - Fixed rank is adopted to described all users/items
  - May not be optimal for users/items with different number of ratings

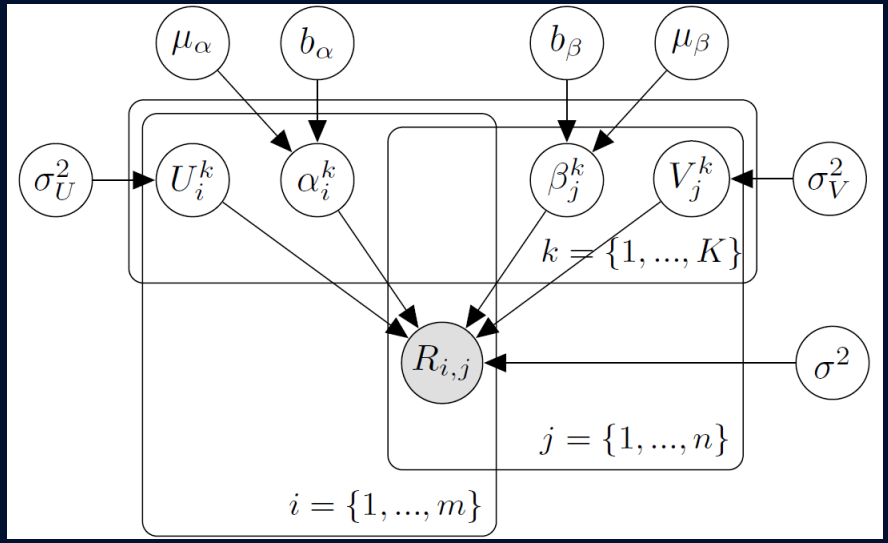
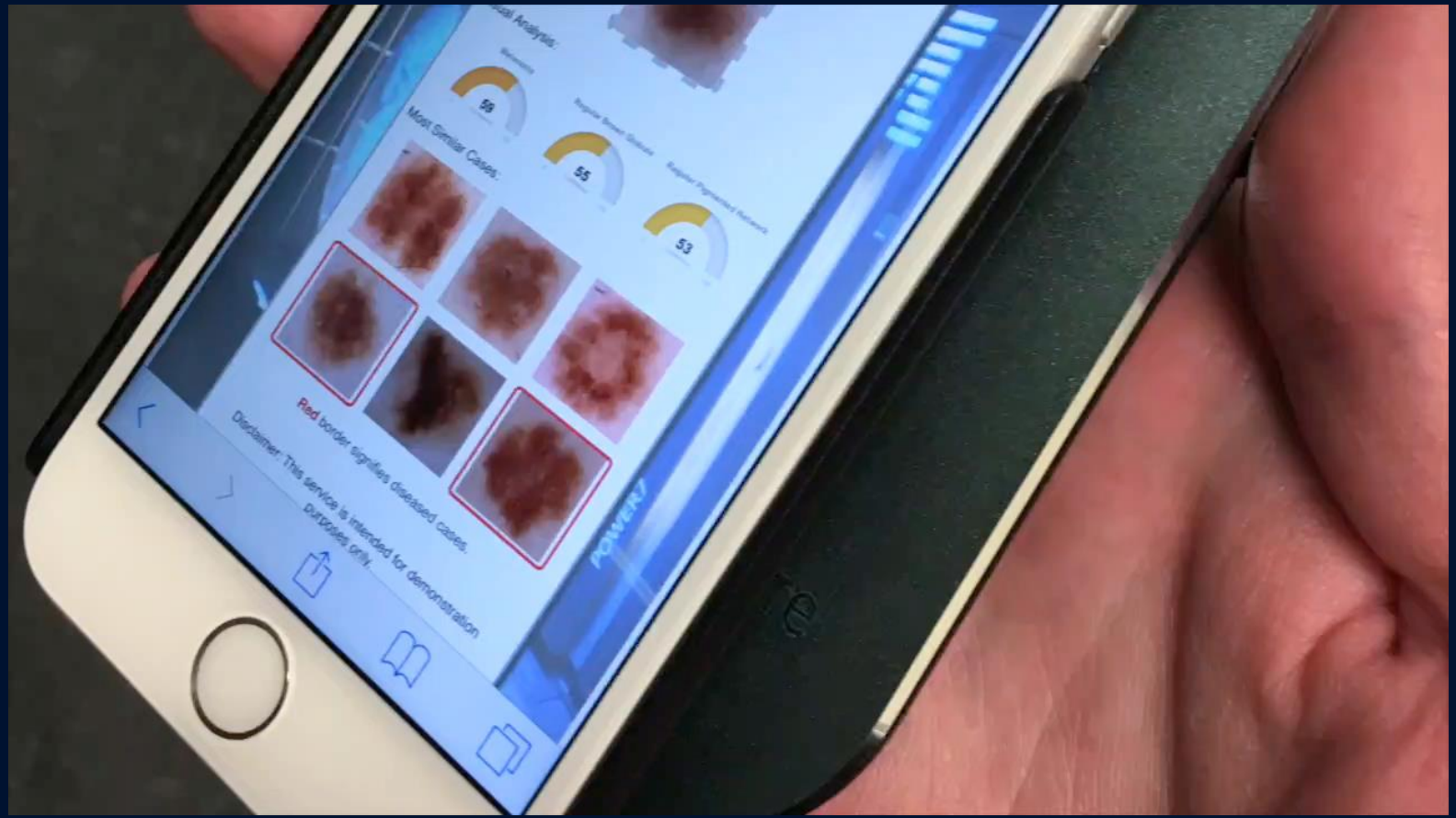


Fig: The graphical model for the proposed mixture-rank matrix approximation (MRMA).

Dongsheng Li, et al. Mixture-Rank Matrix Approximation for Collaborative Filtering. **NIPS 2017**

IBM Research Melanoma Image Analysis



Mapping Obligations to Topics, Controls



Regulatory Documents

O1: Banks should have in place contingency plans to ensure their ability to operate in the event of severe business disruption…"

O2: The bank's internal assessment process must identify gradations of risk. Internal assessments must correspond to the external ratings …

O3: Banks must document in writing their rating systems design and operational details. The documentation must evidence compliance …

Deep Natural Language Understanding + Learning Models

O1 ↔ C1, C2
O2 ↔ C2



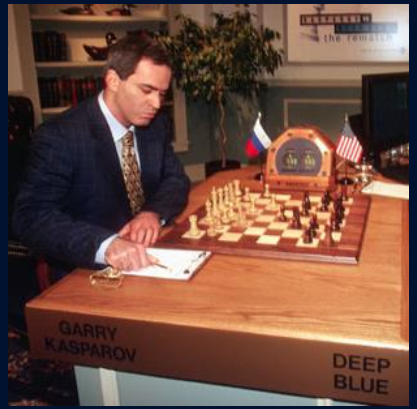
Internal Control Documents

C1: Establish and maintain a risk assessment program to manage internal threats and external threats.

C2: Establish and maintain system continuity plan strategies for all in scope systems.

C3: Include business security requirements in access classification schemes.

From Games to Real World



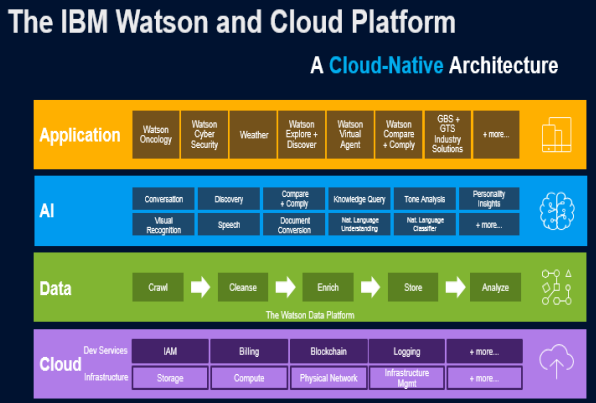
1996



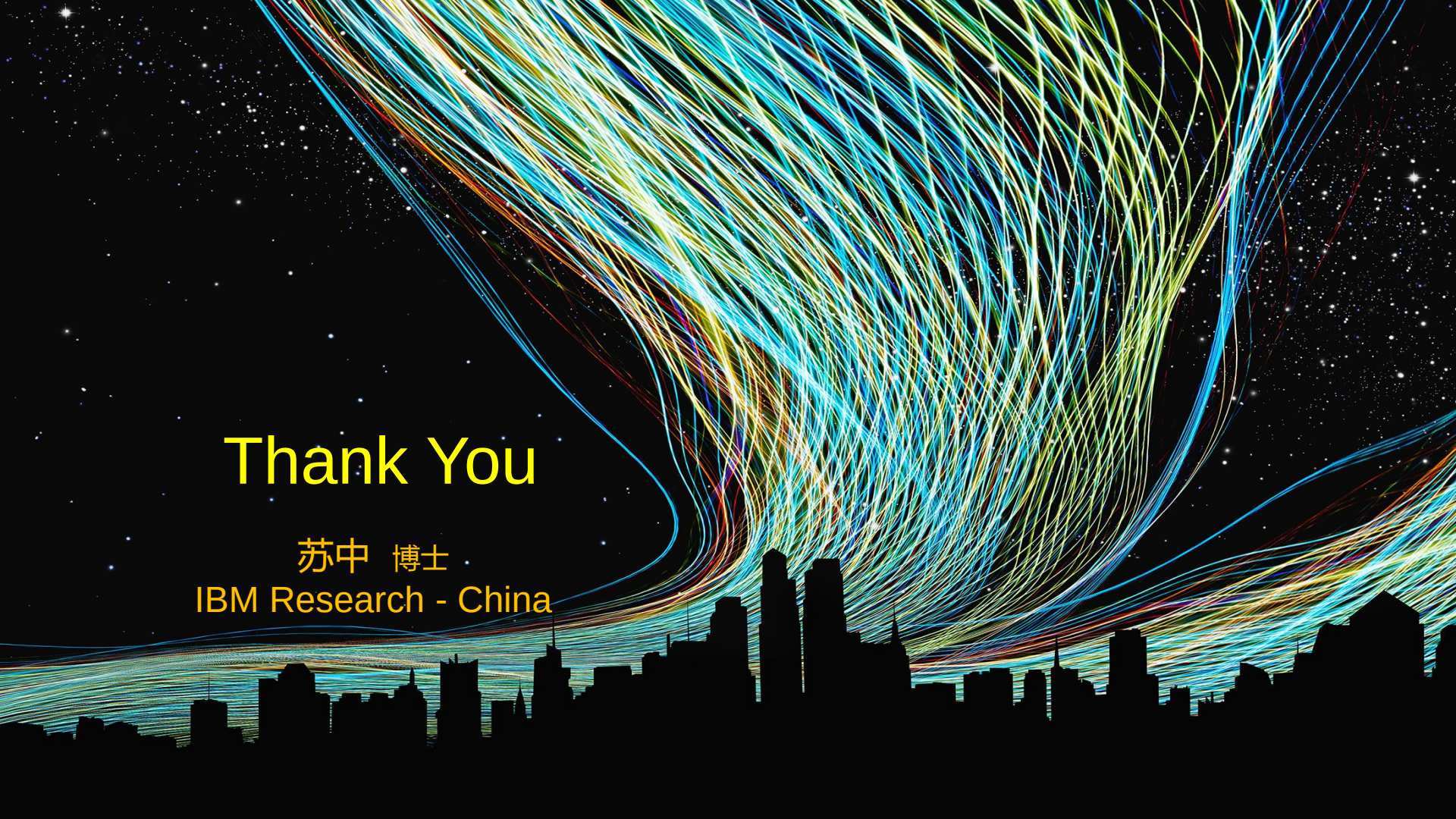
2011



2015



2017


Thank You
苏中 博士
IBM Research - China