Optimized Processes for Customs Compliance

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Agenda

- Introduction
- Project Scope
- Impact of Research
- Value to Industry
- Current Results
- Future Directions

Introduction: Project Team

KALYANMOY DEB (MSU), PI

ERIK GOODMAN (MSU), Co-PI

DAVID CLOSS (MSU), Co-PI

CHUN WANG (The Dow Chemical Company), Co-PI

YASHESH DHEBAR (MSU), Doctoral student

JOHN WASSICK (The Dow Chemical Company), Project Champion

VICKI ROTHHAAR, Global Trade Compliance Analyst, Dow Corning

ERIKA SY, Supply Chain Expertise Specialist, The Dow Chemical Company

Project Scope

The Dow Chemical Company: **$49 billion** worth of sales involving

179	6,000	45,000	600,000
manufacturing sites in 35 countries	**product families**	**customers worldwide** across 180 countries	**border transactions** annually

- Automate the HS (Harmonized Schedule) code classification process
- Total 99 chapters of which 40 chapters are of interest to Dow
- Fast and efficient classifier - from approximately 30 man-hours to several seconds
- Existing patents and publications

Impact of Research

- About 30-50% of all customs entries are misclassified (from patent search)
- Affected sectors

Agriculture/Live Animals/Animal Products 24 Chapters	**Chemical Industries** 16 Chapters	**Domestic Appliances** 10 Chapters	**Forestry** 6 Chapters	**Textiles** 14 Chapters
Machinery 14 Chapters	**Electrical/ Electronics** 4 Chapters	**Media/ Entertainment/ Sports** 4 Chapters	**Medicine** 3 Chapters	**Military** 1 Chapter
	Transportation 4 Chapters	**Antiques, Luxury, Jewelry** 2 Chapters	**Miscellaneous** 2 Chapters	

Value to Industry

- Every product requires a tariff classification code for a better trade
  - A misclassification can result in delay at ports, misinterpretation of product, loss of time and money
- Consumer product industries are interested
  - Dow is interested in 40 chapters of products
  - Amazon is interested in all 99 chapters of products
  - Amber Road showed interest
- HS classification methodology can be used for other industries having their own coding systems
  - IKEA and Walmart, for example
- Potential for a commercial software
- HS classification code for a product is one of several types of automated information a product can be assigned
  - A more generic value creation

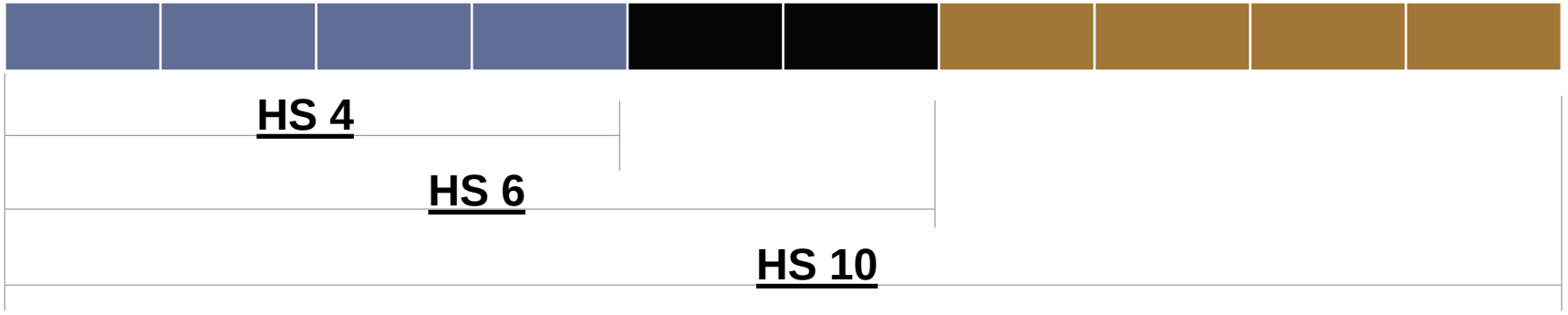
Technology

HS Code Classification Breakdown

Employed Hierarchical Scheme

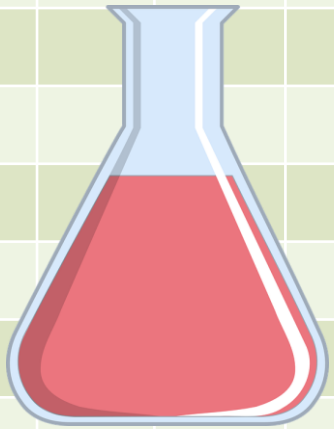
1. First, determine first 4 digits of the HS code
   - Machine-learning based on random forest classifier
   - Natural language processing for feature extraction
2. 6-digit and 10-digit HS code (HS6 and HS10) determined after predicting HS4 code

3. Expert System (ES) used for HS6 and HS10 code prediction



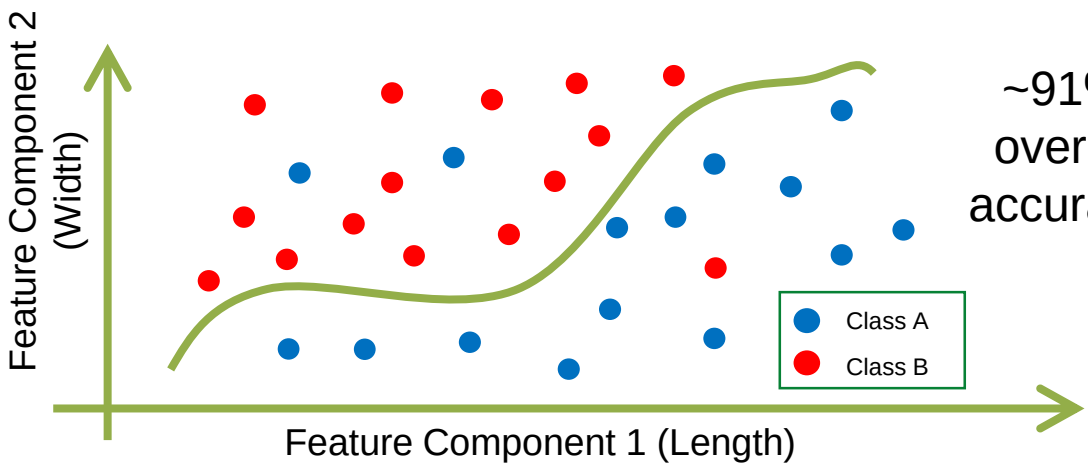
Database as Viewed by an ML-Based Classifier

Product	…	….	HS Code

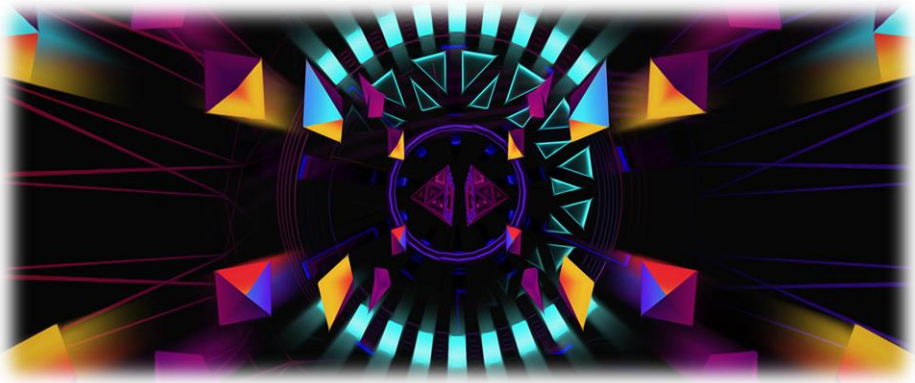


product

=



~91% overall accuracy



a high-dimensional coordinate system

Categorization of Outliers

Incorrectly predicted by **Machine but** correctly classified **in the database**

Correctly predicted by **Machine but** incorrectly classified **in the database**

Incorrectly predicted by **Machine and** incorrectly classified **in the database**

Missing Information

Handling Missing Information with Synthetic Data

1 Propene, ethene copolymer

- Monomer ratio? …… (missing information)
- Propene dominant ➔ 3902
- Ethene dominant ➔ 3901

1 Propene, ethene copolymer: Synthetic Input

1-Propene	Ethene
90%	7%

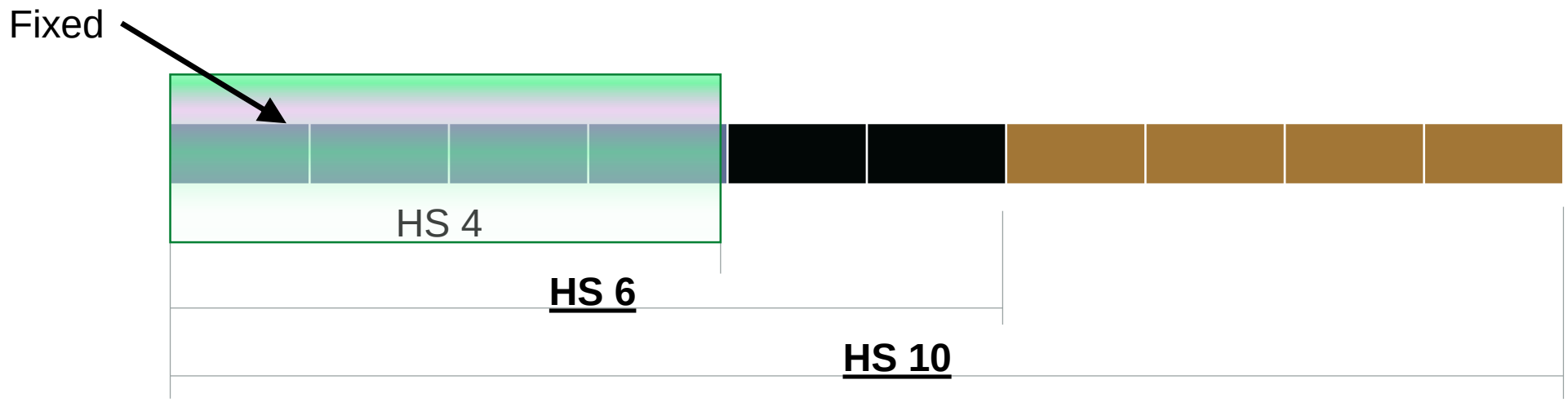
Things Done to Improvise HS4 Accuracy

1. Analyzed outliers
   - By product: machine was able to spot errors in the database
2. Introduced “RegEx”-based features
3. Handled missing information with a synthetic data

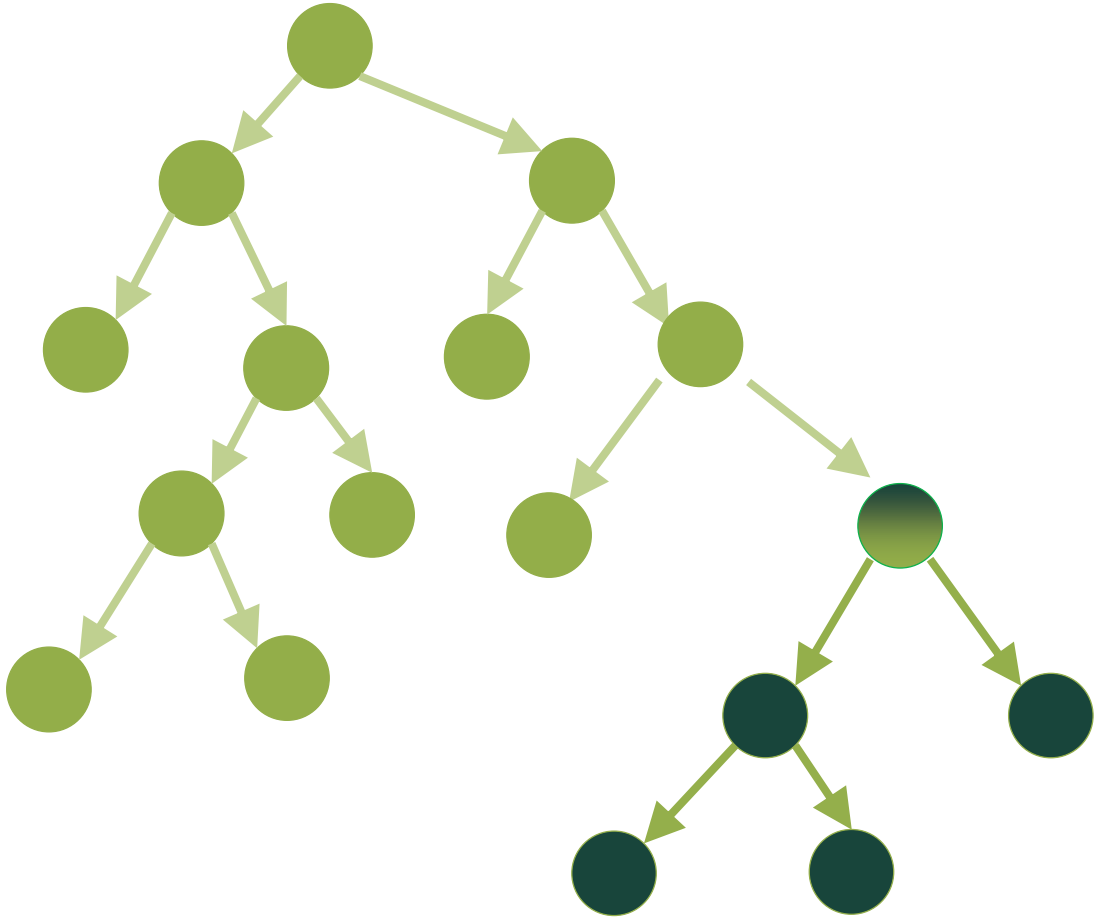
Final HS4 accuracy = 95.3%

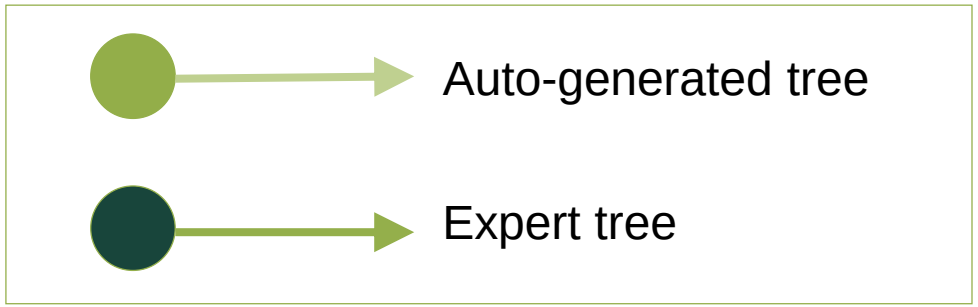
Next Target

HS 6 and HS 10 Classification



Auto-Generated Tree and an Expert Tree





Expert Tree

- A custom-coded decision tree
- Simpler structure
- Integration of complex rules
- Potential: 100% accuracy
- Not Data Driven
- Modifiable

Current Results

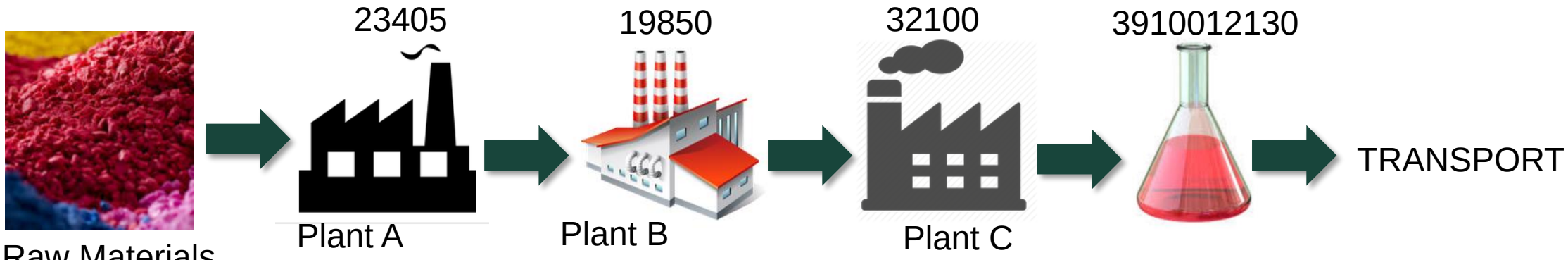
95.3% accuracy in predicting HS codes of products from 14 headings of Chapter 39 (from 3901 to 3914)

100% sublevel (HS6 and HS10) accuracy

- High potential to be applied to other products
- Patent search indicates uniqueness of our approach
- Opportunity for a commercial software

Future Directions

- A comparative study with other existing classification methods based on HS classification accuracy for above products
- Extend the idea to remaining 25 chapters of interest to Dow
- Explore possible commercial venture opportunities as a value-added contribution from Axia Institute
- Explore future projects for utilizing the ideas of the HS classification procedure to make a more efficient order-to-cash system within Dow



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Thank you