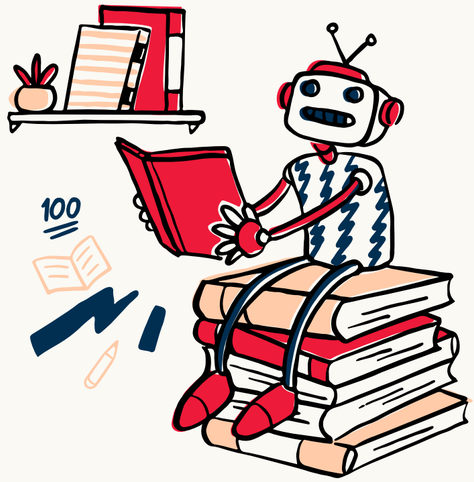
APPLIED DATA SCIENCE PROJECT

Patient Preference Studies
Classification System



Cesar Augusto Seminario Yrigoyen
Francesco Giuseppe Gillio

UNIVERSITÀ DI TORINO

Politecnico di Torino

APPLIED DATA SCIENCE PROJECT

Checkpoint

UNIVERSITÀ DI TORINO

Politecnico di Torino

Part 1

Table of Contents

The
Data

Patient Preference Studies

Patient Preference Studies evaluate what treatment attributes patients value, their importance, and the trade-offs patients choose to inform healthcare decisions

PubMed

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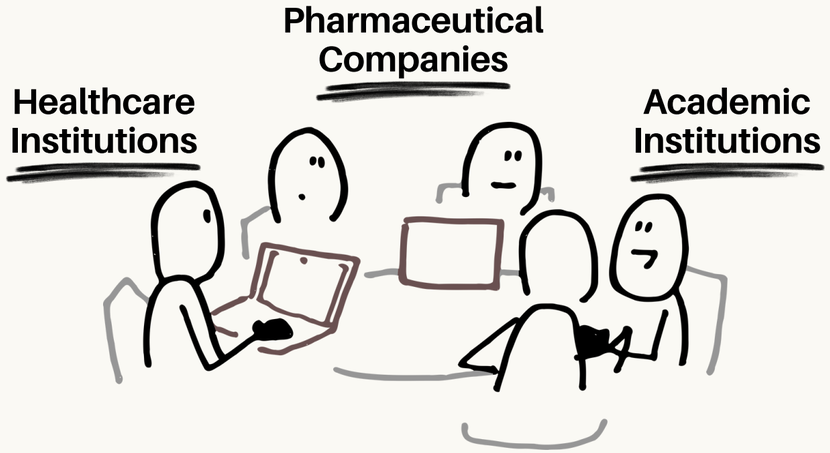
The Stakeholders

Medical Researchers

CORE

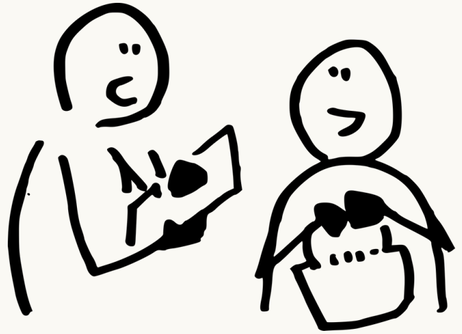
valuable insights to



Healthcare Ecosystem

DIRECT

valuable services to



Patient Communities

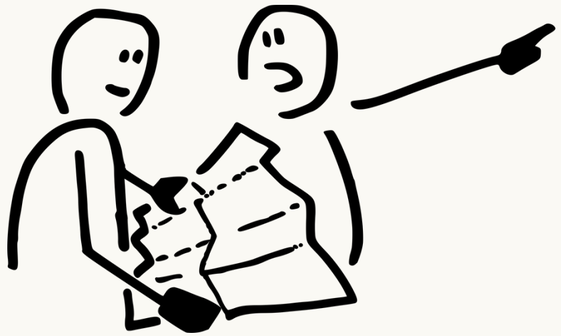
INDIRECT

The Challenges

Large Volume

of Scientific Literature

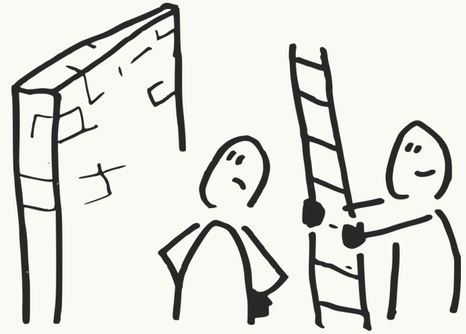
search strings in citation databases (**PubMed**) return a large amount of content, often irrelevant



Broad Scope

of Scientific Areas

PPS cover a wide range of clinical areas and accurate searches require manual supervision



Adaptation to Scale

of Scientific Databases

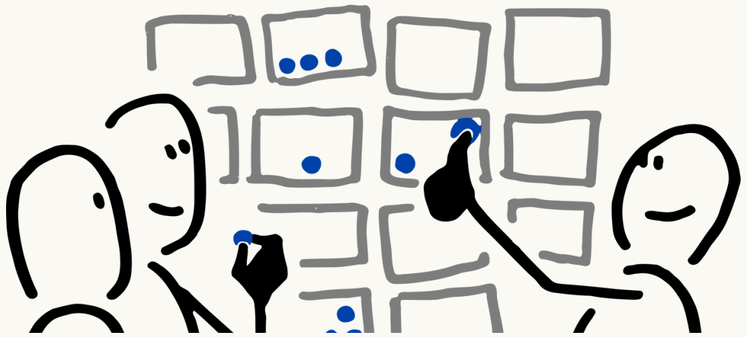
manual supervision struggles to cope with the publication scale of scientific literature

The Project Values

Improve Relevance

by Classification System

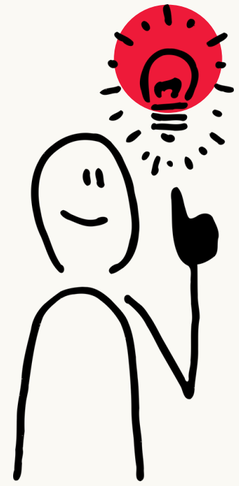
to bypass irrelevant content and return high-value literature



Improve Retrieval

by Categorization System

to categorize search results and improve area-specific retrieval



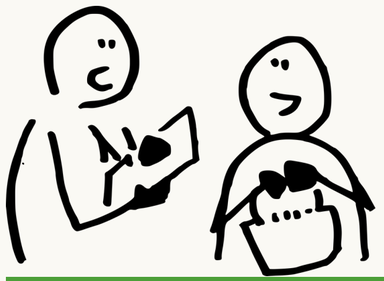
Improve Efficiency

by System Automation

to reduce manual effort and improve access to up-to-date research

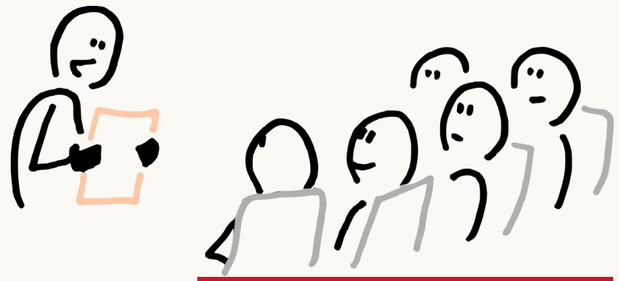
The Values

Sustainable Development Goals
2030



3 GOOD HEALTH AND WELL-BEING

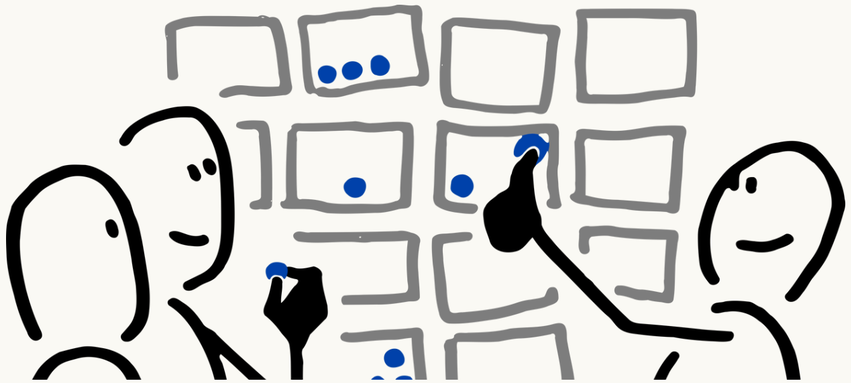
Support the advancement of
patient care systems and processes



4 QUALITY EDUCATION

Support the advancement of
information retrieval in medical research

The Objective



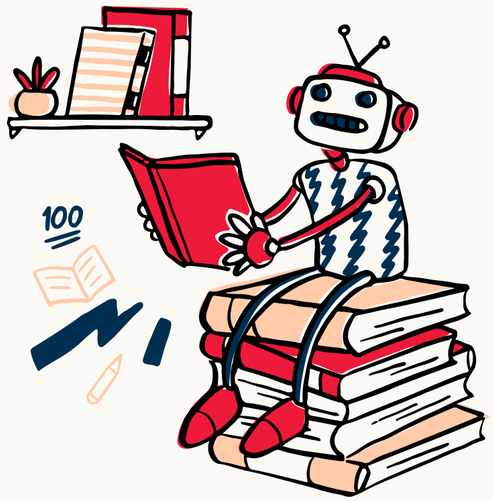
Classifier Model for Medical Research Papers

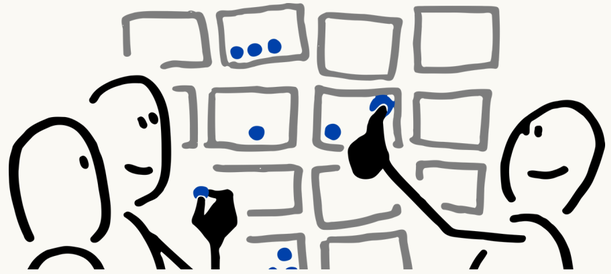
- Papers classification by relevance to Patient Preference Studies (PPS)
- Papers classification by relevance to Clinical Areas

The
Project Objective

Supervised
Binary
Classifier Model

to classify
search string outputs
by relevance to **PPS**

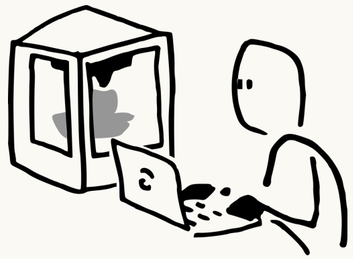




Self-Supervised
Multi-Label
Classifier Model

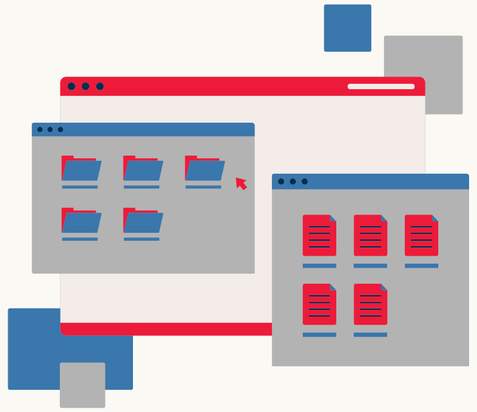
to categorize
PPS-relevant content
into **Clinical Areas**

The
Project Design



Medical Researcher

Large Search String on
Patient Preference Studies



PPS-relevant and irrelevant
content across clinical areas

High-quality PPS-relevant literature

Self-Supervised
Multi-Label
Classifier Model

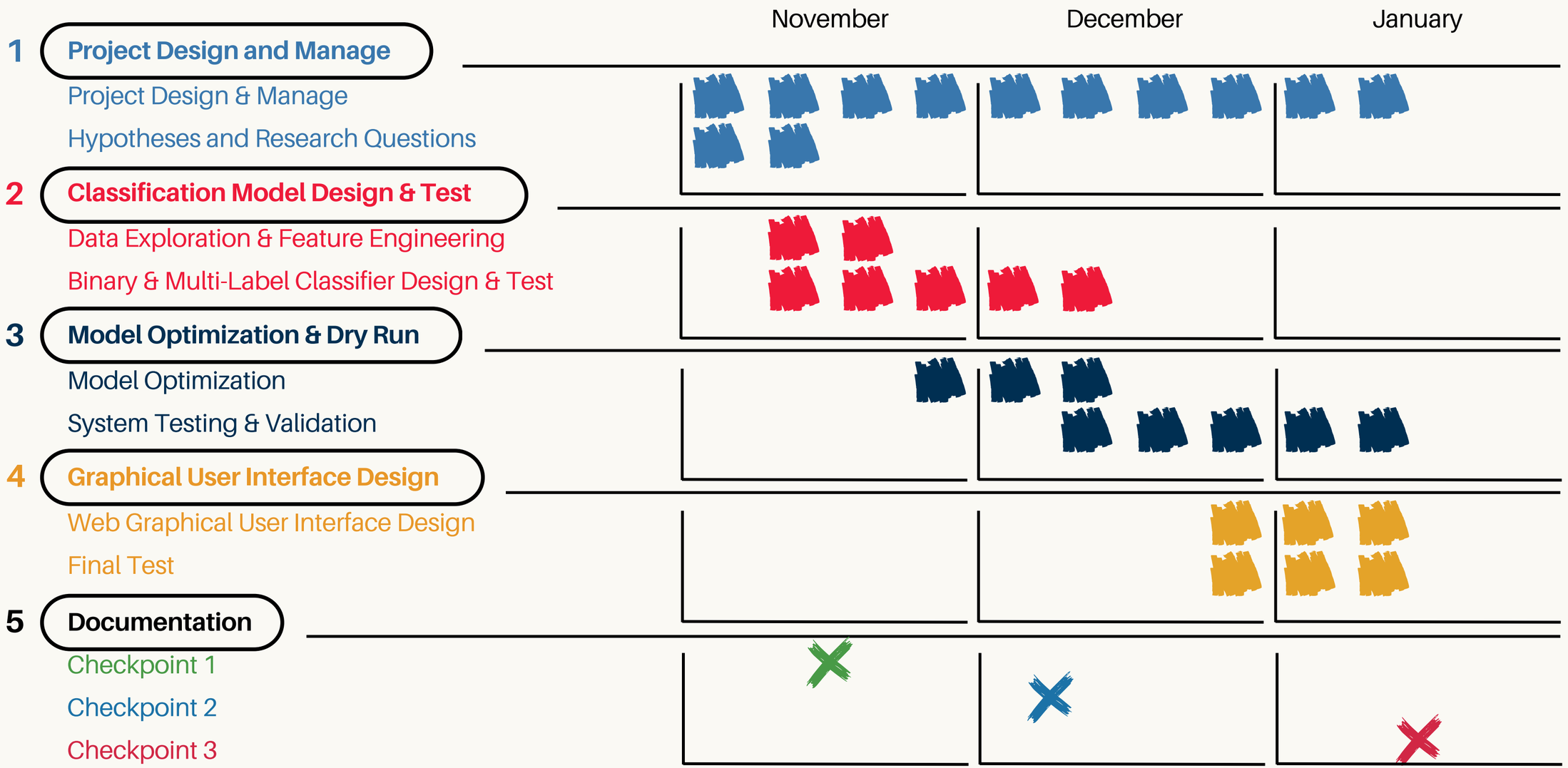
to categorize PPS-relevant
content into Clinical Areas

Supervised
Binary
Classifier Model

to classify search string outputs
by relevance to PPS

Project

Work Breakdown Structure



Part 2

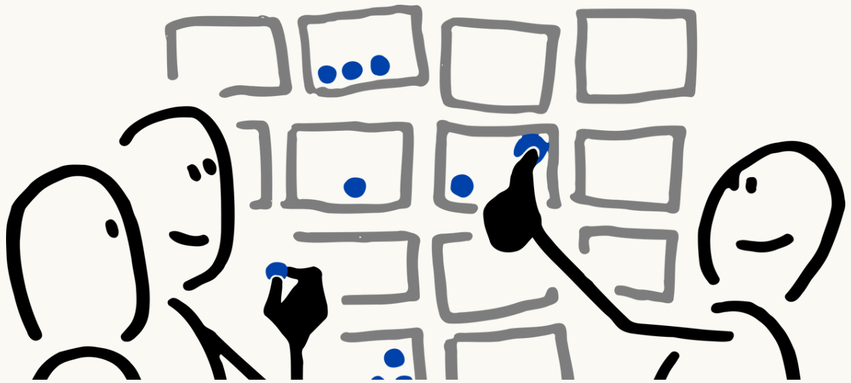
Table of Contents

The
Picture

"The **urgent crave for tools** that support efficient access, integration, and **analysis of health data** to derive actionable insights from **patient-reported outcomes** and real-world evidence"

- EU Commission

The Objective



Classifier Model for Medical Research Papers

- Papers classification by relevance to Patient Preference Studies (PPS)
- Papers classification by relevance to Clinical Areas

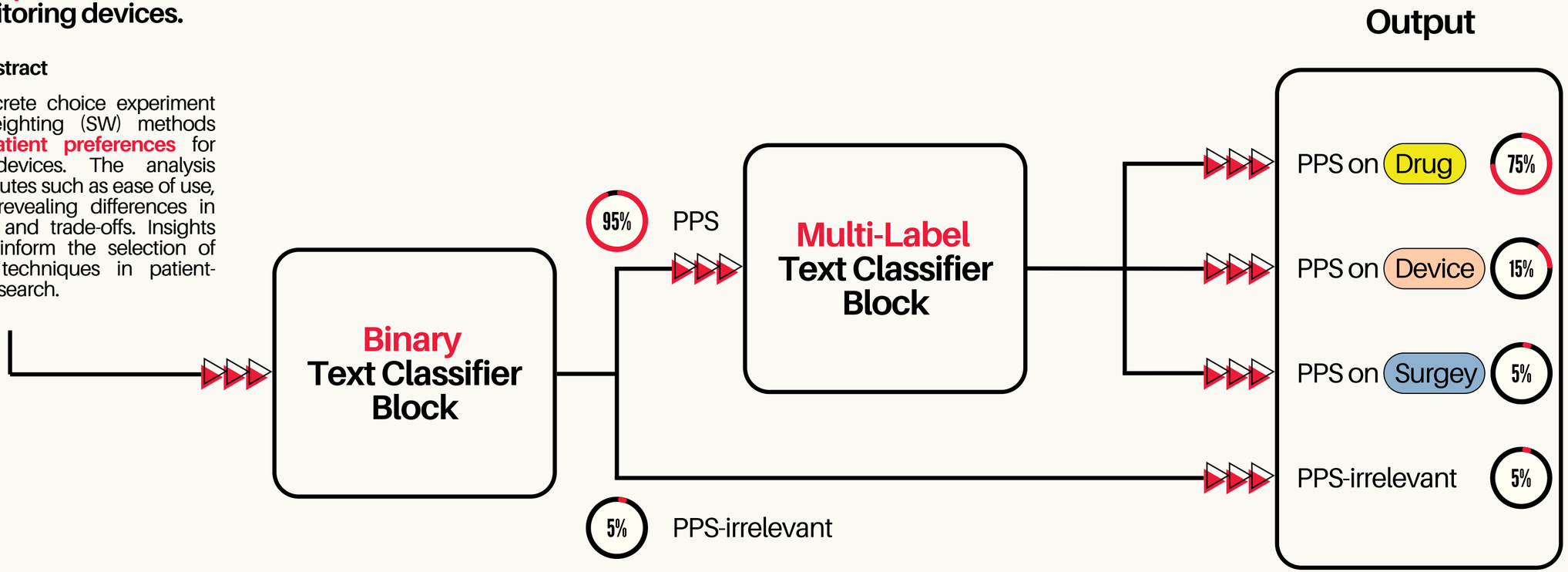
The Task

The head-to-head comparison of diabetic patient preferences for glucose-monitoring devices.

Abstract

A comparison of discrete choice experiment (DCE) and swing-weighting (SW) methods assesses diabetic patient preferences for glucose-monitoring devices. The analysis highlights critical attributes such as ease of use, accuracy, and cost, revealing differences in attribute prioritization and trade-offs. Insights from this evaluation inform the selection of preference-elicitation techniques in patient-centered healthcare research.

Two-Stage Text Classification



The **Binary** Text Classifier

Classification by relevance to Patient Preference Studies

The head-to-head comparison of diabetic patient preferences for glucose-monitoring devices.

Abstract

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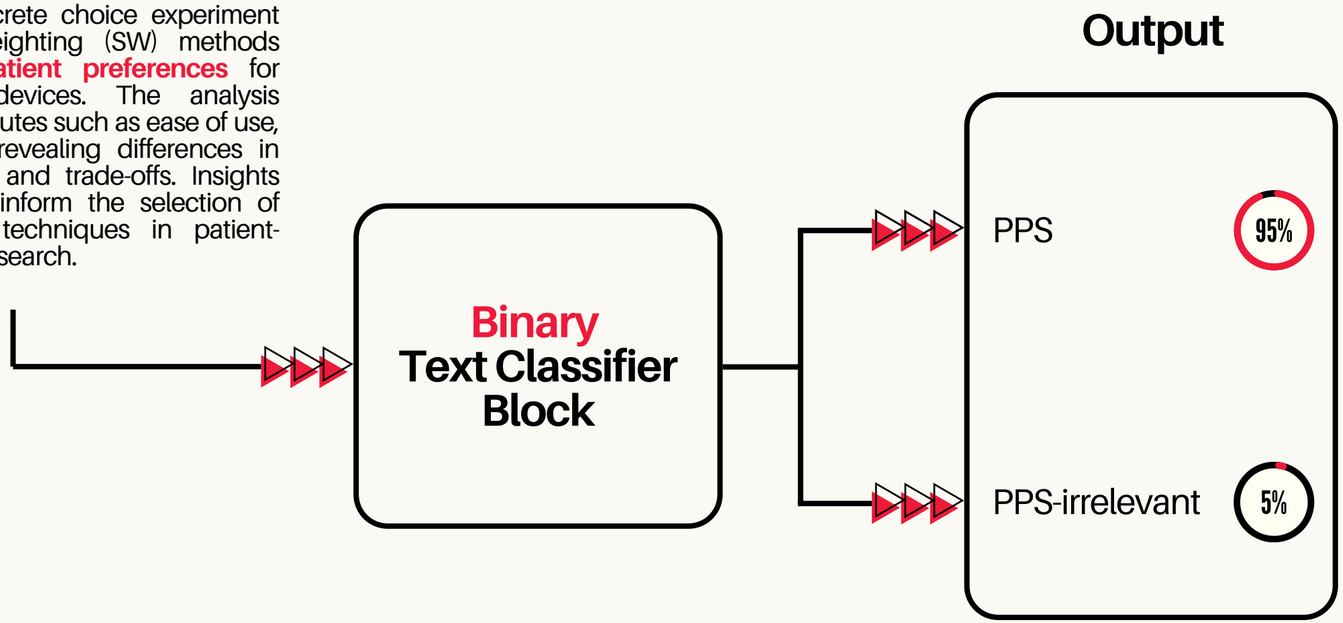
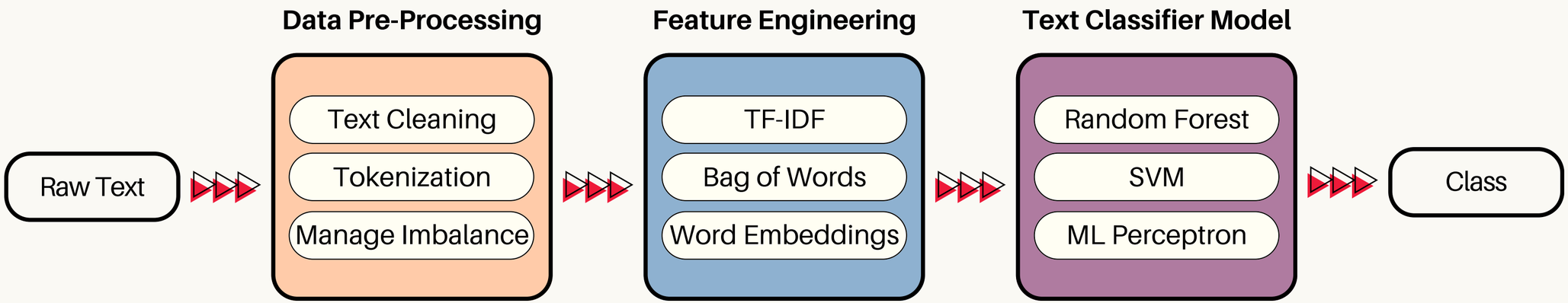


The **Binary** Classifier Methods

Binary
Text Classifier Model

Machine Learning Methods

Low-performance, but deployment requires simple training on a small amount of data via **CPU**

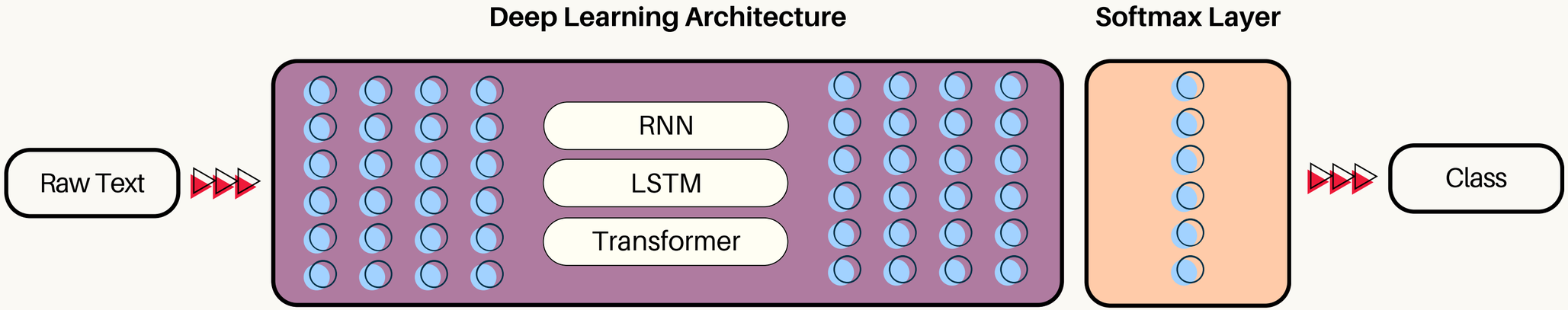


The **Binary** Classifier Methods

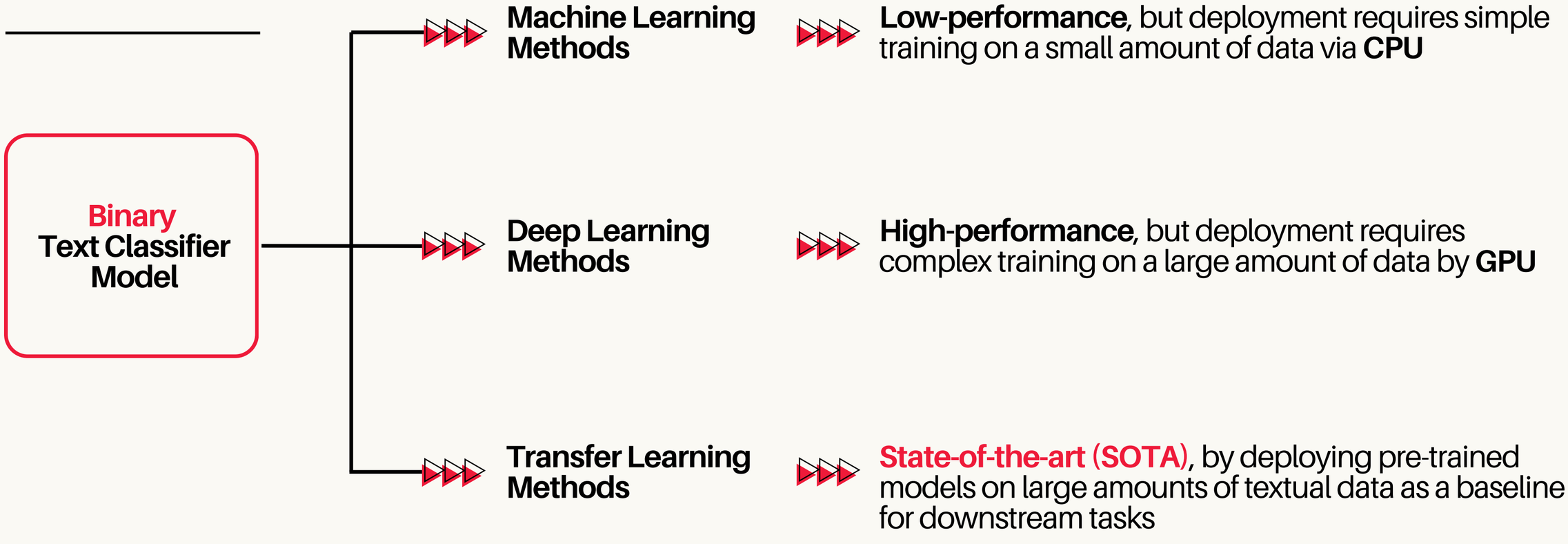
Binary
Text Classifier Model

Machine Learning Methods → **Low-performance**, but deployment requires simple training on a small amount of data via **CPU**

Deep Learning Methods → **High-performance**, but deployment requires complex training on a large amount of data by **GPU**

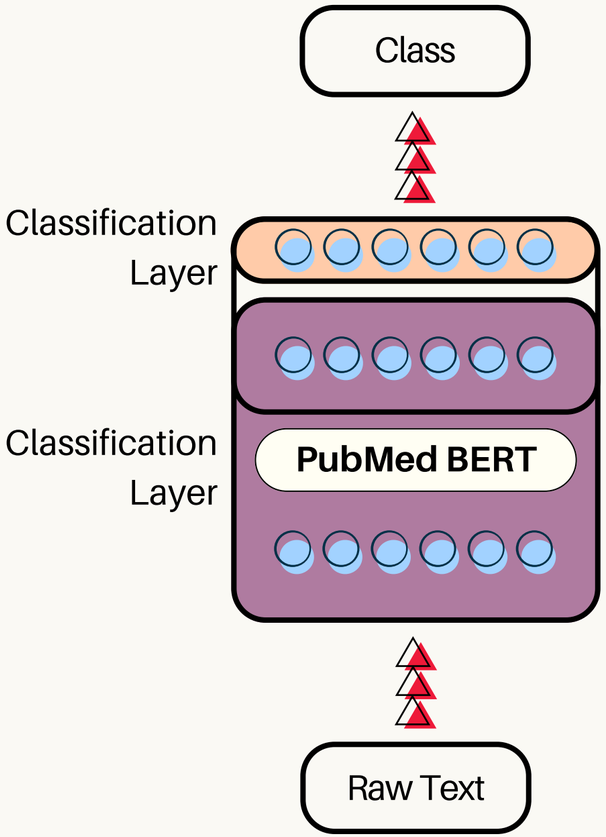


The **Binary** Classifier Methods

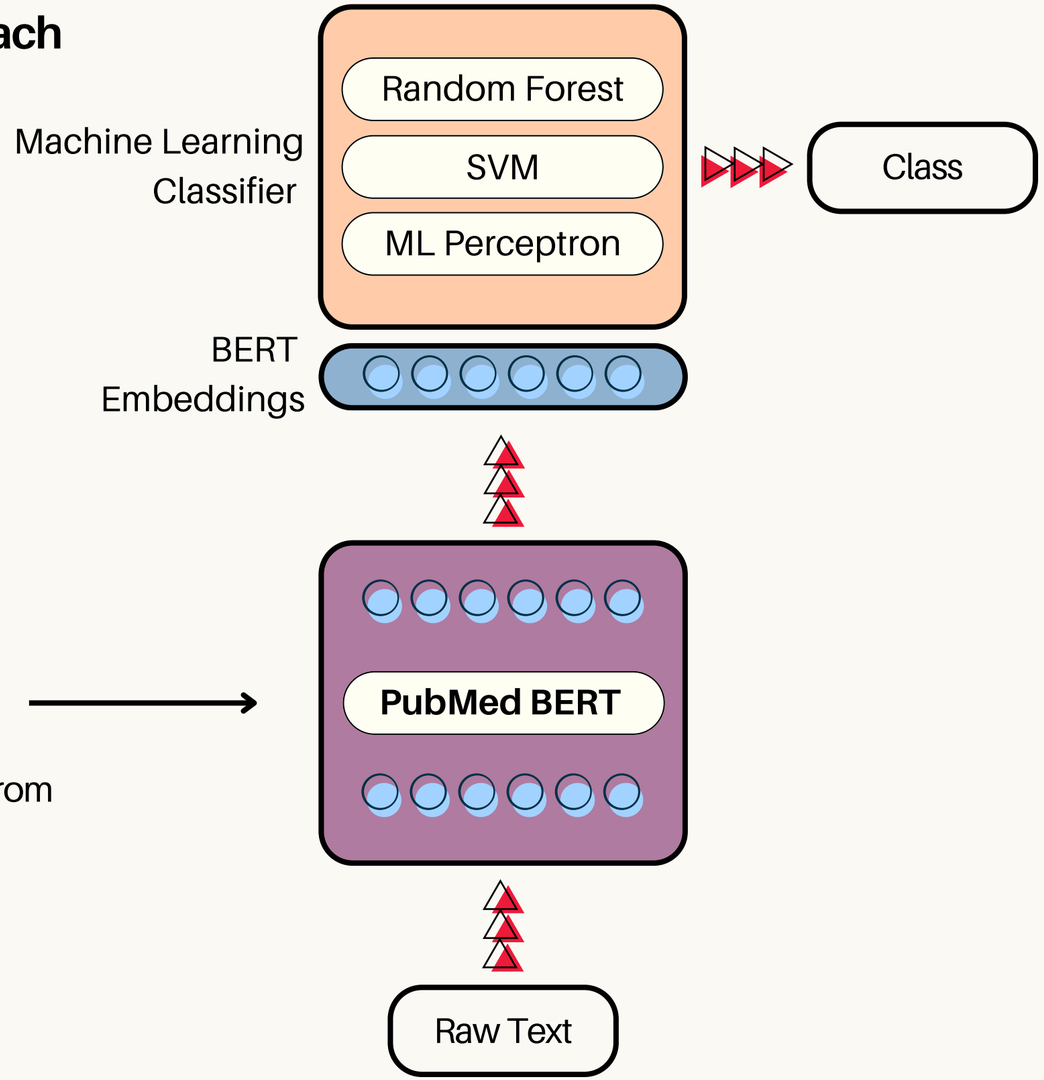


The Choices

The Standard Approach



The Hybrid Approach



Pre-Trained BERT Model

from scratch on abstract from PubMed

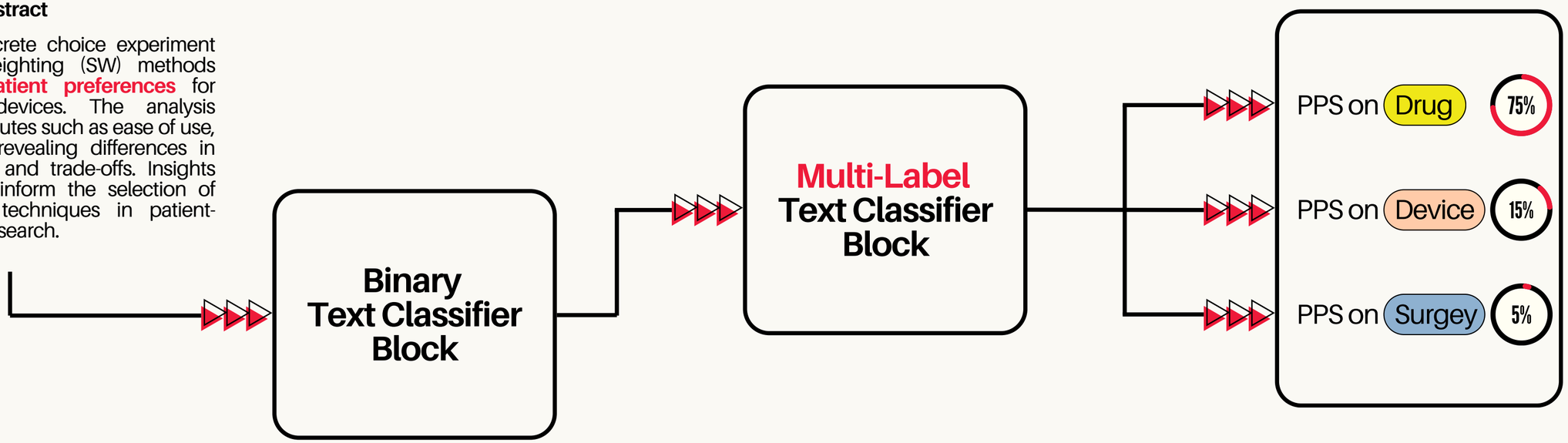
The **Multi-Label** Text Classifier

Classification by relevance to Clinical Areas

The head-to-head comparison of diabetic patient preferences for glucose-monitoring devices.

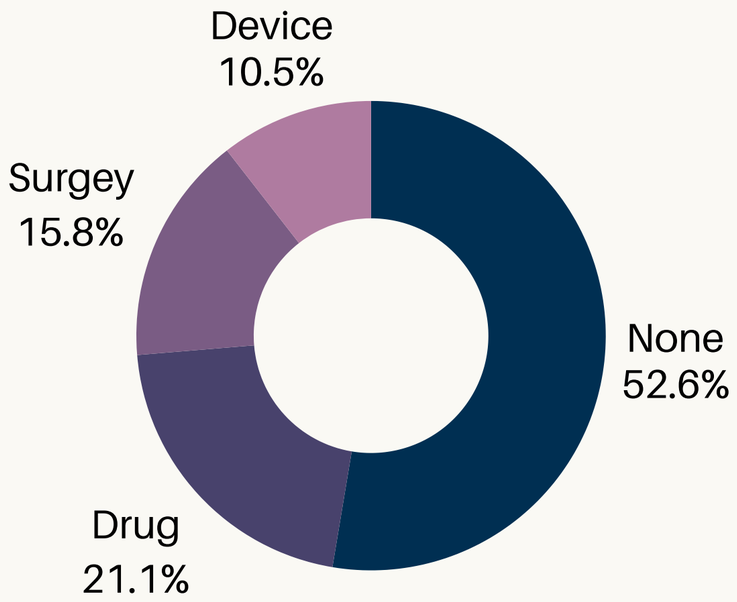
Abstract

A comparison of discrete choice experiment (DCE) and swing-weighting (SW) methods assesses diabetic **patient preferences** for glucose-monitoring devices. The analysis highlights critical attributes such as ease of use, accuracy, and cost, revealing differences in attribute prioritization and trade-offs. Insights from this evaluation inform the selection of preference-elicitation techniques in patient-centered healthcare research.



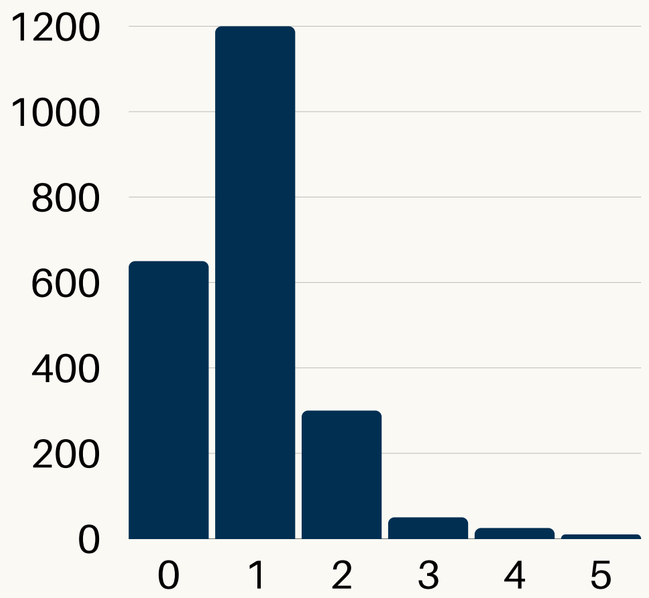
The **Multi-Label** Classifier Problem

Class Distribution



Data Imbalance

Multi-Label Distribution



Research Questions

"What are the most effective techniques for **building a multi-label classification model** to categorize scientific articles while addressing data imbalance?"

"How **can topic modeling** be used to determine if the identified **areas are sufficient, discover new areas** of interest and can the same model be leveraged for **classification**?"

The **Multi-Labels** Classifier Models

Multi-Label
Text Classification Problem

BERTopic

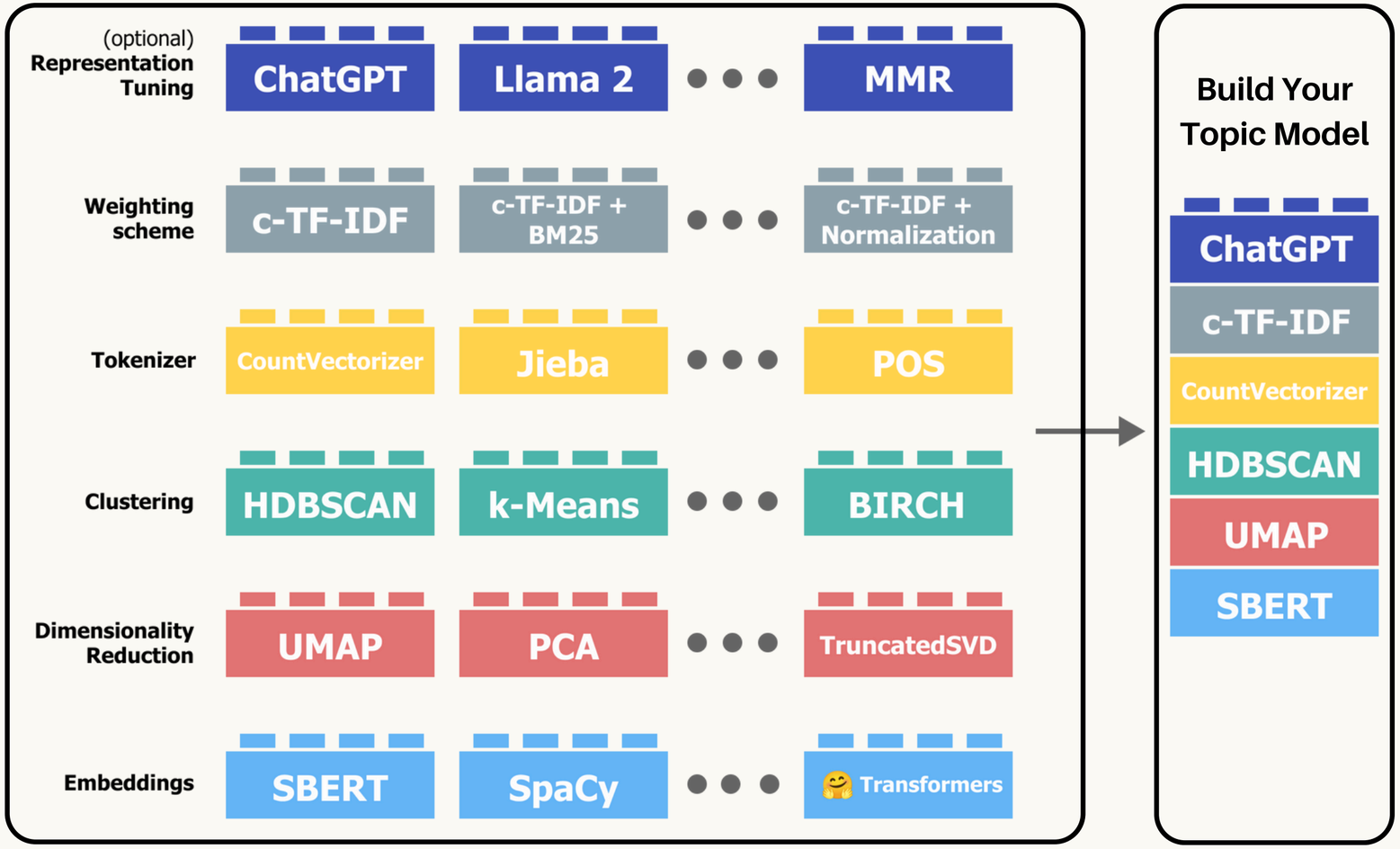
Problem Adaptation

Algorithm Adaptation

- Multi-Label k-NN
- Multi-Class MLP
- Ranking SVM

Topic Modelling

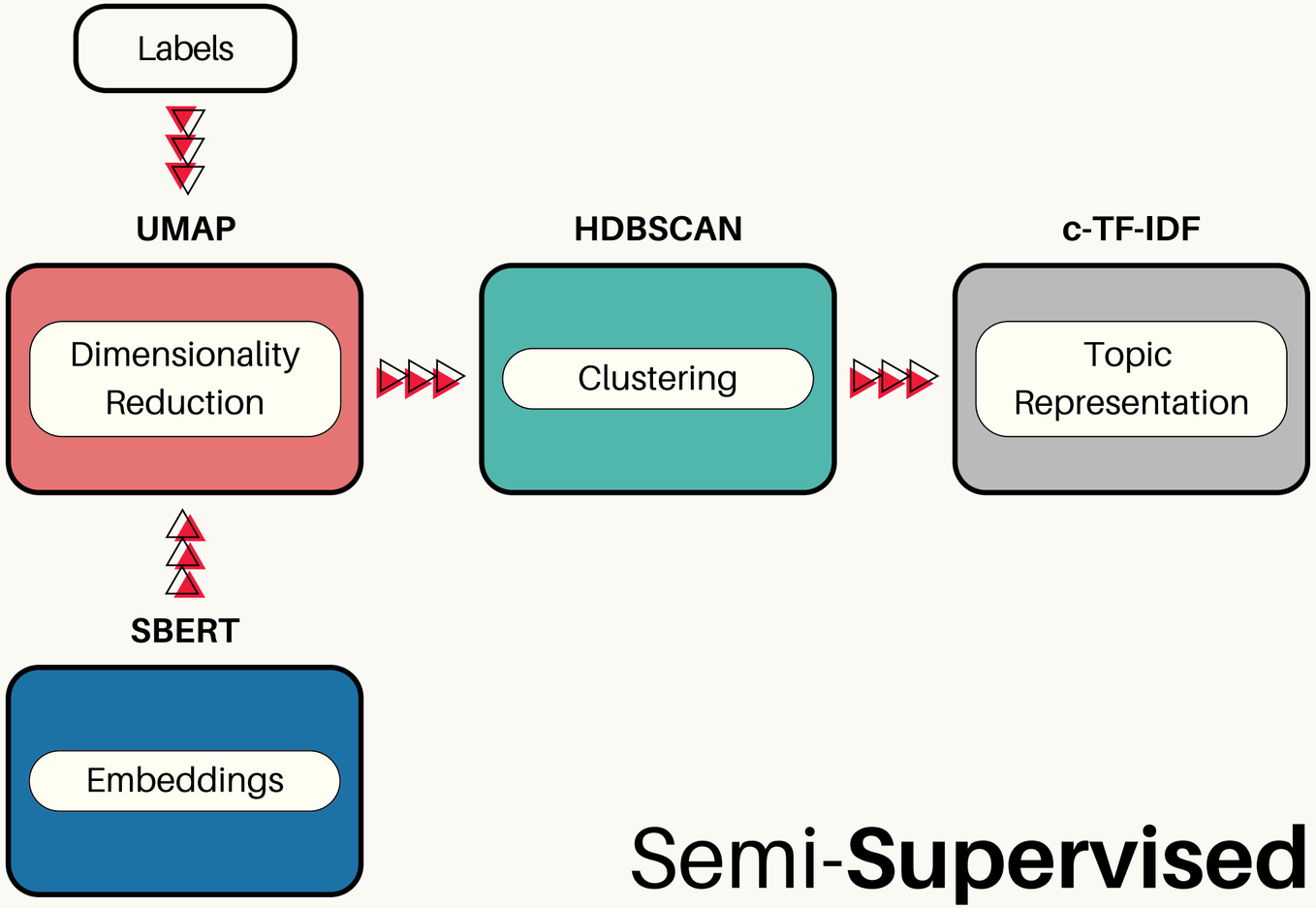
- LDA
- NMF
- Top2Vec
- Bertopic



Multi-Label
Text Classification Problem

BERTopic
Project Benefits

- **Topic Exploration**
- **Categories Not Fixed**
- **Improve & Speed Up Manual Labeling**
  - Binary Classifier
  - Multi-Label Classifier
- **Classification Approaches:**
  - Unsupervised
  - Semi-Supervised
  - Supervised: Classification



Semi-**Supervised**

Multi-Label
Text Classification Problem

BERTopic
Project Benefits

- **Topic Exploration**
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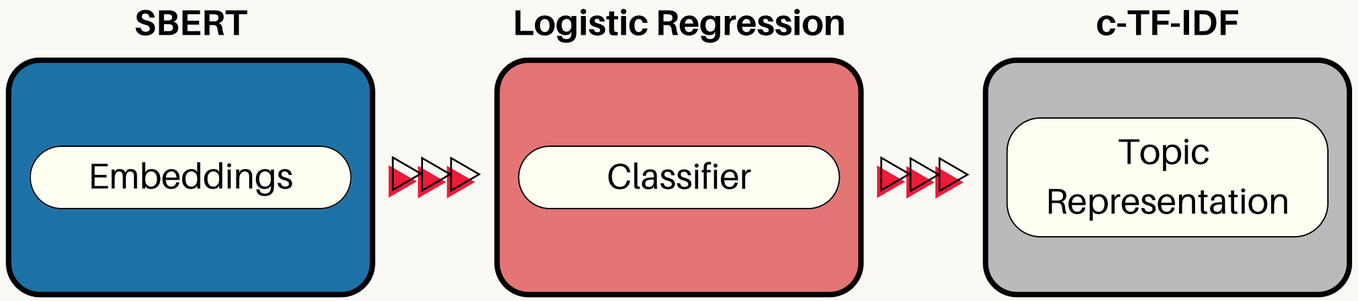


Supervised

The Evaluation Metrics

Classification Models

Example-Based

- F1-Score
- Recall
- Precision
- Subset Accuracy
- Hamming Loss

Ranking-Based

- Coverage
- One Error
- Ranking Loss

Label-Based

- Micro Average
- Macro Average

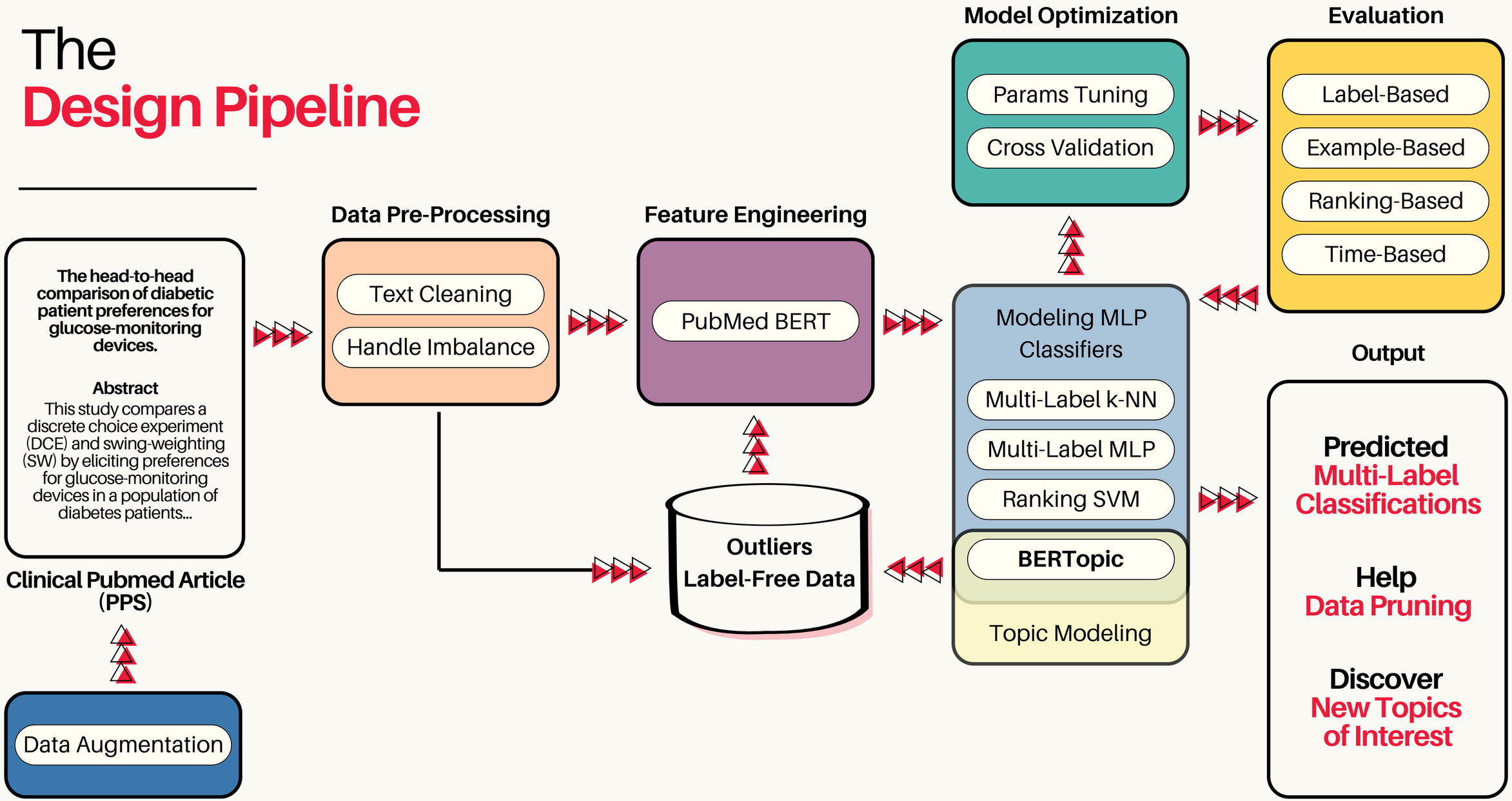
Topic Modelling

- Diversity
- Coherence

System Time

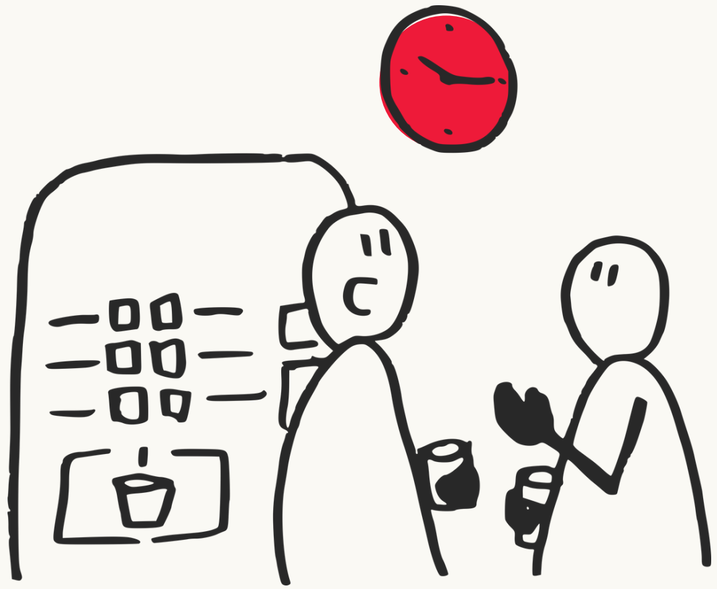
- Train Time
- Inference Time
- Latency
- Throughput
- Scalability

The Design Pipeline



APPLIED DATA SCIENCE PROJECT

Thank You



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