REVA Academy for Corporate Excellence (RACE)

AI-Enabled Automation Solution for Utilization Management in Healthcare Insurance

Name of the Presenter
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M.Tech in Artificial Intelligence

Capstone Project Presentation
Year: I

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Agenda

Utilization Management (UM)

Evaluation of medical treatment based on Evidence-based criteria and Insurer requirements.

Prior Authorization (PA)

Administrative process, type of UM, where Insurer require providers to obtain preapproval to supply a service or medication.
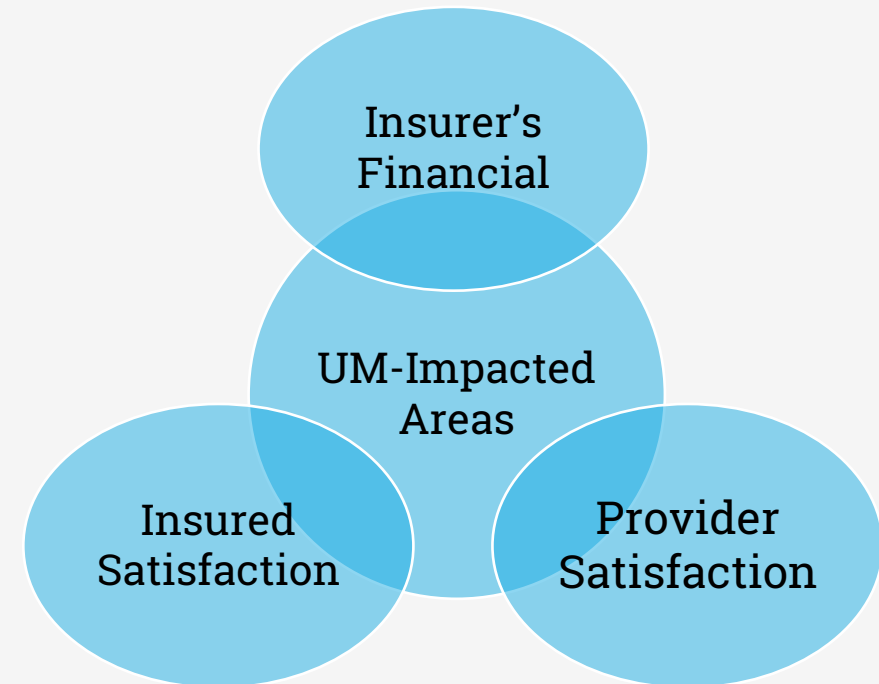
UM-Impacted Areas

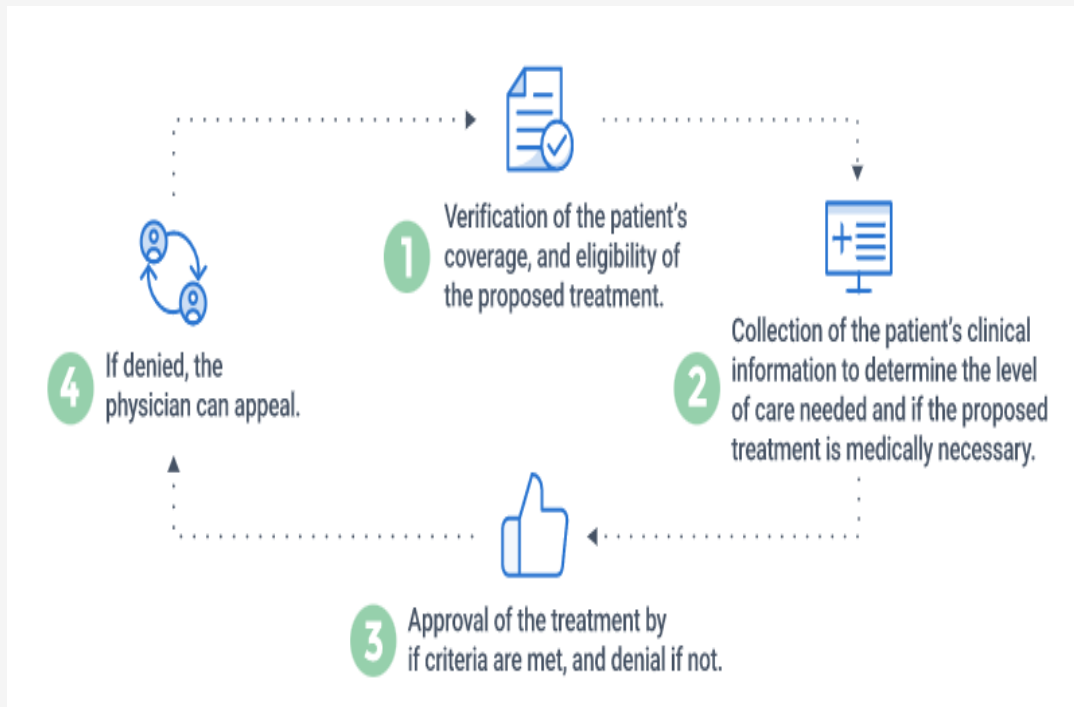Figure: UM-impacted areas on Healthcare Insurance

PA Manual Workflow

1. Verification of the patient's coverage, and eligibility of the proposed treatment.

2. Collection of the patient's clinical information to determine the level of care needed and if the proposed treatment is medically necessary.

3. Approval of the treatment by if criteria are met, and denial if not.

4. If denied, the physician can appeal.

Figure: Steps in UM for PA Process

Source: https://www.smartsheet.com/content/utilization-management

Challenges with UM for PA

- Care Delays
- Increased operating expenses for the health insurer
- Human error

Reason

- Manual Process

Opportunity

- Insurers have the opportunity to transform their UM processes by leveraging automation through Artificial Intelligence (AI).

Literature Review

Title	Author & Year	Journal/Source	Major Insights	Research Gap
Measuring progress in improving prior authorization	American Medical Association | 2021	https://www.ama-assn.org/system/files/prior-authorization-reform-progress-update.pdf	• 84% of physicians say the prior authorization burden is "high" or "extremely high".	Streamlining PA Process
CAQH Index Report	The Council for Affordable Quality Healthcare | 2020	https://www.caqh.org/sites/default/files/explorations/index/2020-caqh-index.pdf	• Physicians do 40 PAs every week on average. • PA takes 20 minutes to accomplish manually. • Automating PA might save $417 million yearly.	Use of Automation

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Title	Author & Year	Journal/Source	Major Insights	Research Gap
Data mining to predict and prevent errors in health insurance claims processing	M. Kumar, R. Ghani, and Z. S. Mei | 2010	Proceedings of the ACM SIGKDD International Conference on Knowledge Discovery and Data Mining	• Used Binary Classification on claims data • Widely used TF-IDF method for text-encoding	To detect False claims
Rule-based prediction of medical claims	J. Wojtusiak, C. Ngufor, J. Shiver, and R. Ewald | 2011	Proceedings - 10th International Conference on Machine Learning and Applications, ICMLA 2011	• Attributional techniques can predict claim discrepancies.	Fraud detection differs from claims rework review.
A text similarity approach for precedence retrieval from legal documents	Thenmozhi, D Kannan, C Aravindan | 2022	ceur-ws.org	• Word embedding such as word2vec captures document semantics.	Semantics information at sentence level

Technical

- To find text similarity in the patient's clinical history with the insurer's guidelines to approve a PA claim.

Functional

- To streamline the PA process to prevent delays in patient treatment and decrease costs for insurers and providers.

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Objective

- To develop an AI-enabled solution, consisting of a text similarity model based on NLP and decisions based on semantic analysis, to make utilization management a streamlined and collaborative process.
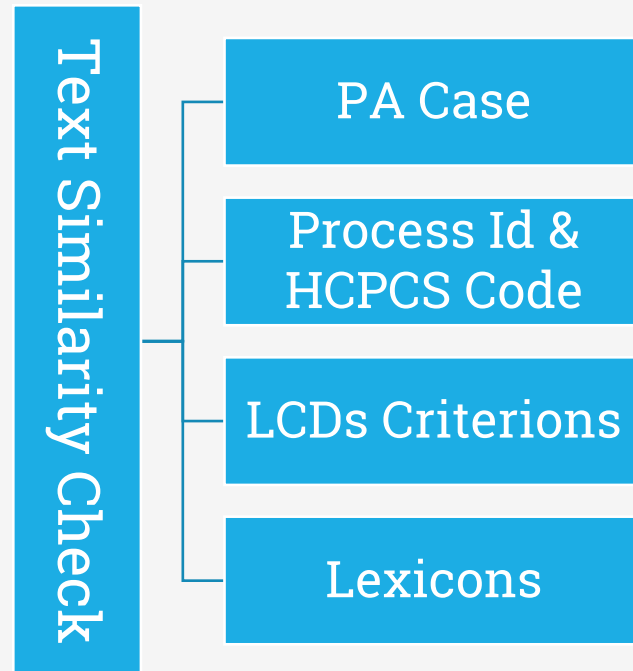
Sub-Objective

- Automate PA to improve auto-decisions and prioritize clinical evaluations.

- To expedite patient care while increasing member satisfaction.

- Unlocking unstructured data to contextualize permission requests can improve insurers' administrative efficiency and provider experience.
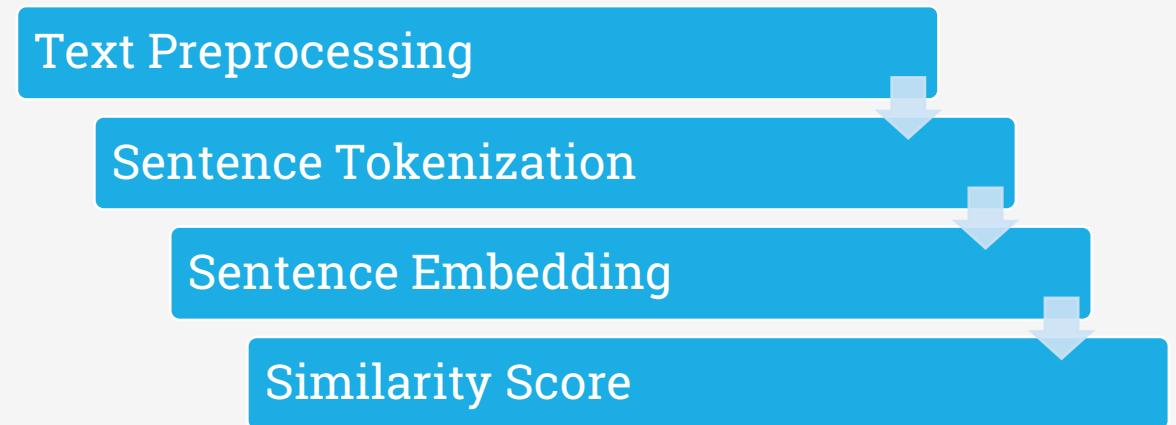
Conceptual Framework

Text Similarity Check

- PA Case
- Process Id & HCPCS Code
- LCDs Criterions
- Lexicons

Text Analysis Workflow

- Text Preprocessing
- Sentence Tokenization
- Sentence Embedding
- Similarity Score

Data Resources

- **Process**
    Powered Mobility Devices

- **Guidelines**
    Local Coverage Determination, which are decisions made by a Medicare Administrative Contractor (MAC).
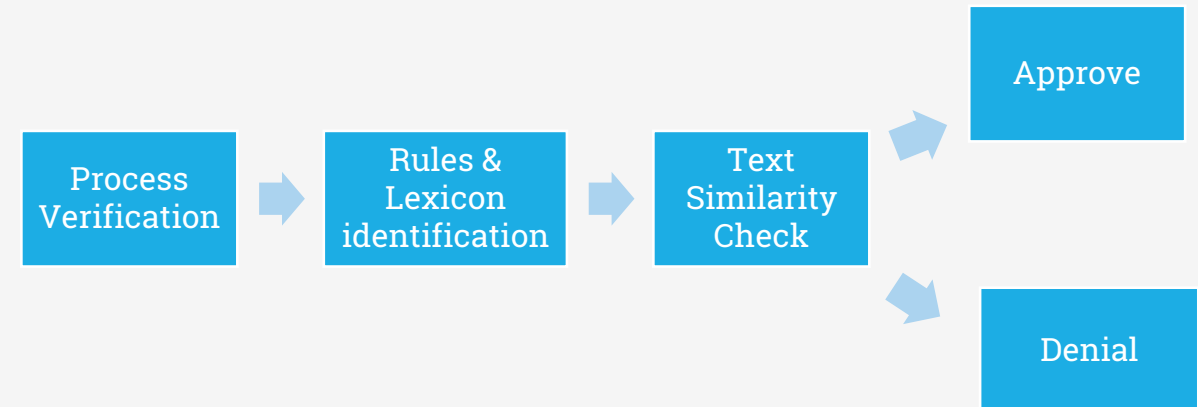
- **PA Case**
    Powered Mobility Devices

Technical Resources

- Python environment with required libraries like NLTK, Pandas, Tensorflow, Scipy etc.

- Semantic Textual Similarity (STS) benchmark data for evaluation.

- Pre-trained model - Universal Sentence Encoder

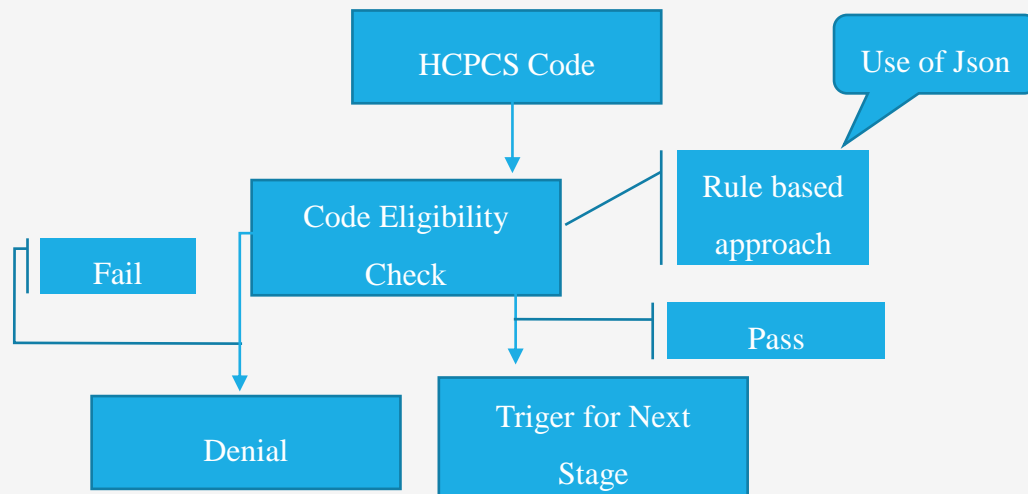## Proposed AI-Enabled PA Process
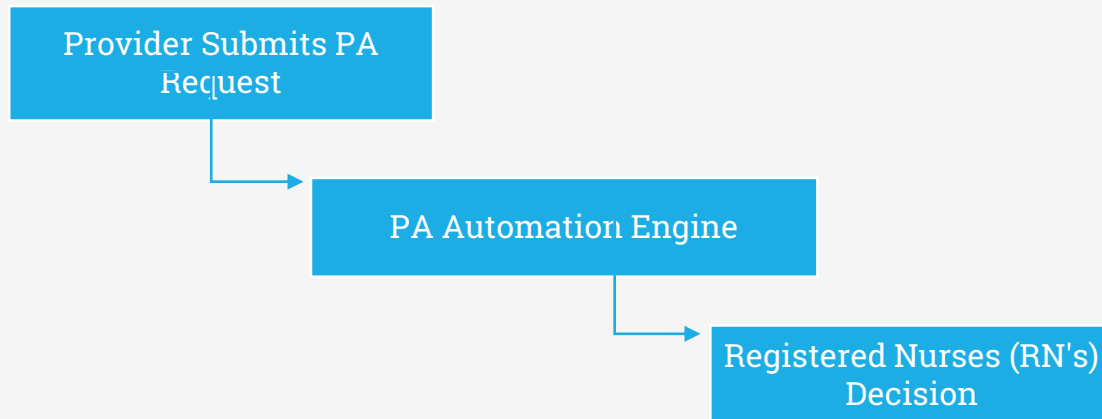
Automation Engine Process

Provider Submits PA Request

PA Automation Engine

Registered Nurses (RN's) Decision

Process Verification → Rules & Lexicon identification → Text Similarity Check → Approve / Denial
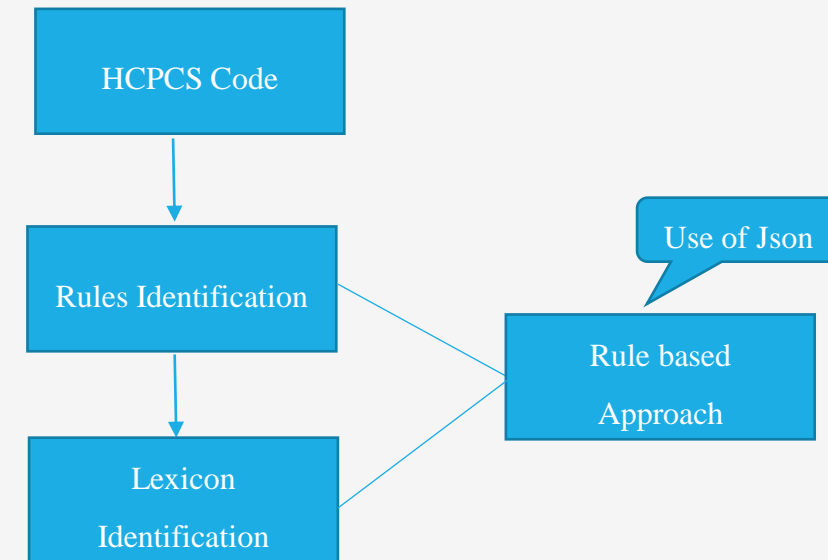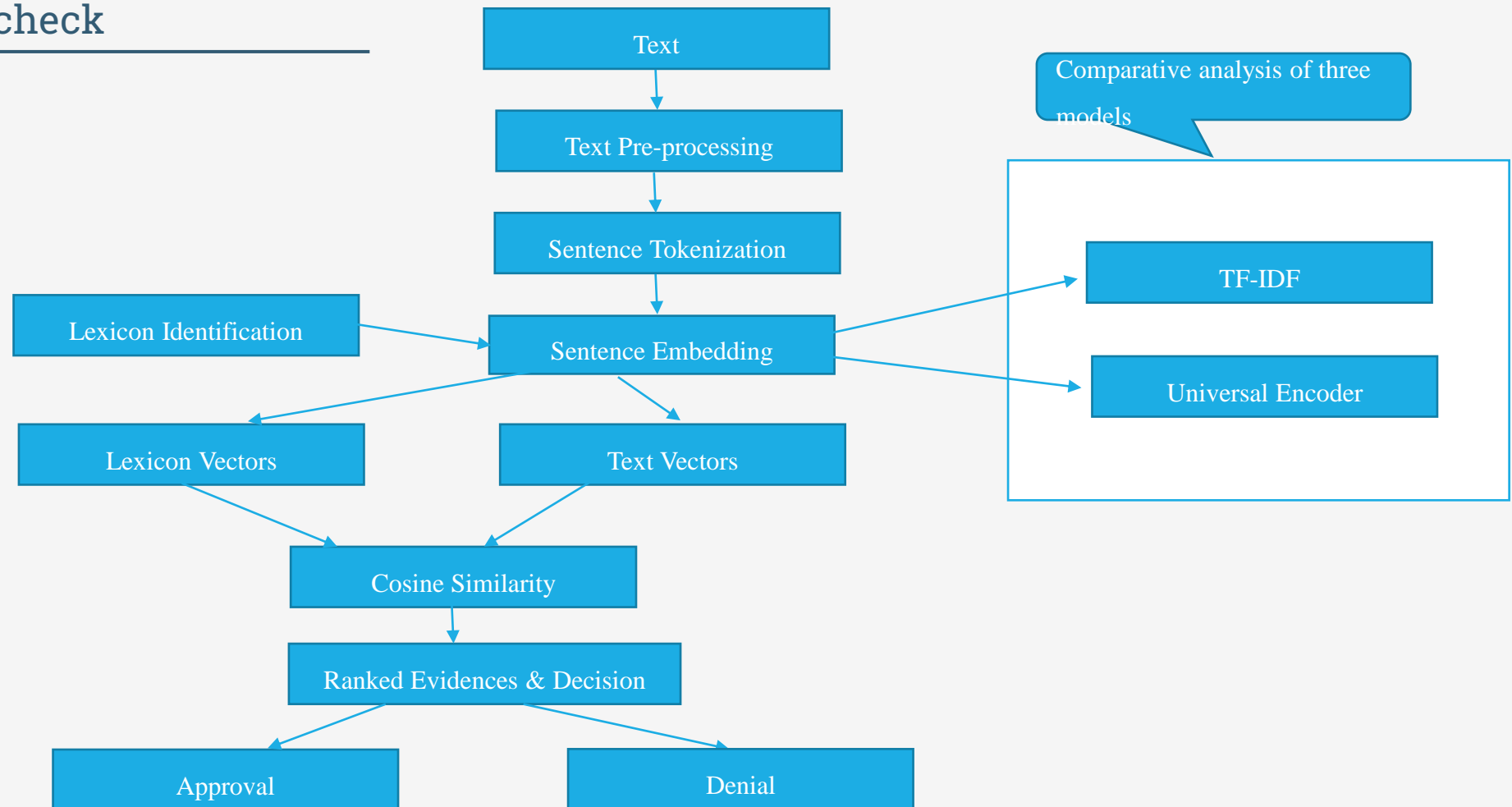
Text Similarity check

Text

↓

Text Pre-processing

↓

Sentence Tokenization

↓

Sentence Embedding

Lexicon Identification →

Comparative analysis of three models

TF-IDF

Universal Encoder

Lexicon Vectors

Text Vectors

↓

Cosine Similarity

↓

Ranked Evidences & Decision

Approval   Denial

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DEMO

Testing and Validation

Test Results | Learnings

Testing for TF_IDF Technique

| Rule name	Total no. of Matches	Top matching sentence from PA text	Highest score
A	5	he limited in his ability to participate in all mobility related activities of daily living in the home setting	0.491431
B	6	he la unable to safely or effectively use cane or walker for the distance needed in the home due to fatigue joint pain and numbness	0.2933
C	9	he is unable to self-propel an optimally configures manual wheelchair due to upper extremity weakness and arthritic hand pain	0.3841

Testing for Universal Sentence Encoder Technique

Rule name	Total no. of Matches	Top matching sentence from PA text	Highest score
A	7	he limited in his ability to participate in all mobility related activities of daily living in the home setting	0.72
B	5	he la unable to safely or effectively use cane or walker for the distance needed in the home due to fatigue joint pain and numbness in rle	0.70
C	8	he is unable to self-propel an optimally configures manual wheelchair due to upper extremity weakness and arthritic hand pain	0.71

Results for TF_IDF Technique

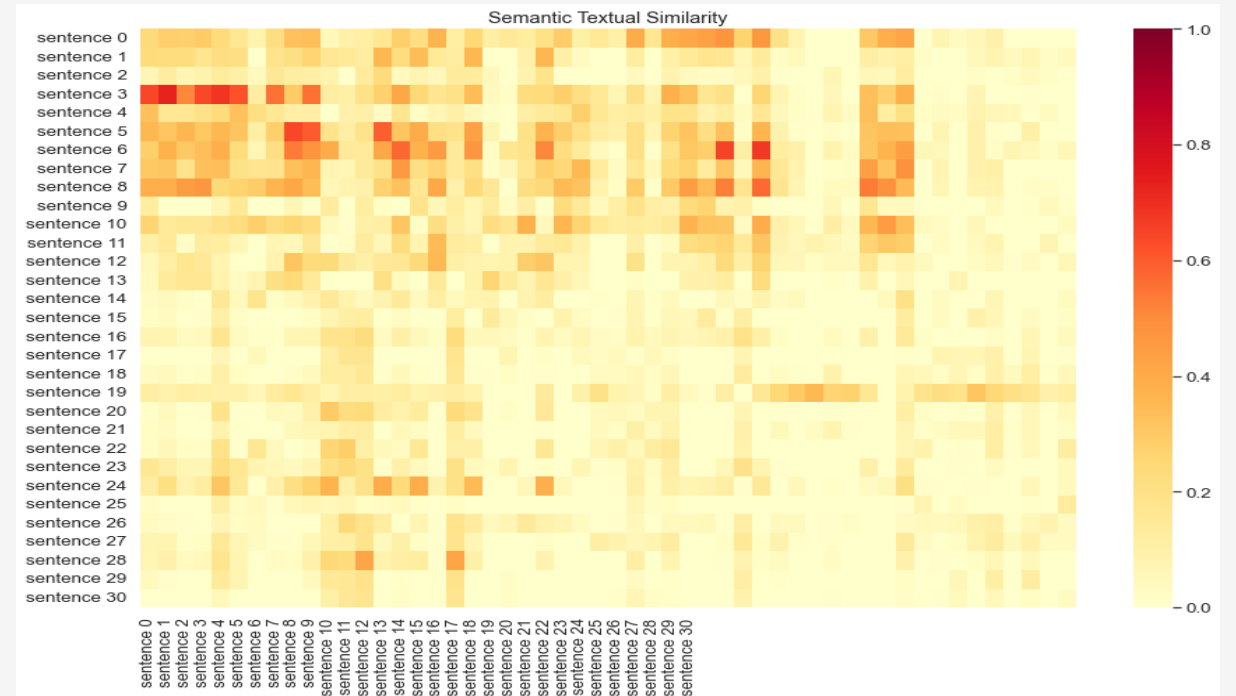**Pearson correlation coefficient** = 0.2340
p-value = $1.015e^{-19}$

Semantic Textual Similarity
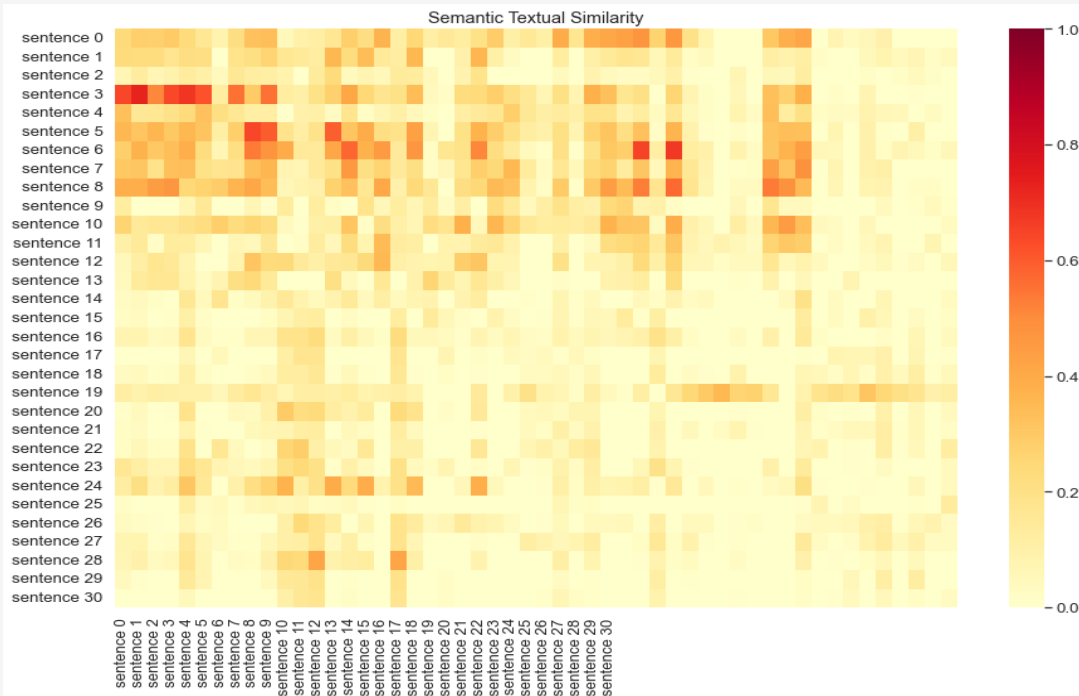
Testing for Universal Sentence Encoder Technique

Pearson correlation coefficient = 0.83
p-value = 0

Semantic Textual Similarity

Insights

- The previous section shows that USE's techniques are superior to TF IDF's.

- Sentence embedding approaches represent whole sentences as vectors. This helps the machine recognize context, intention, and other complexities.

- Fewer denied claims, lower costs, more effective treatments, real information, and more efficient resource use benefit the healthcare business.

Next Step

- As this study only examines a powered wheel chair process, it is necessary to validate this method with a more intricate procedure.

- The second step for insurers is to ask employees about their prior authorization experiences.

Future Scope

- This study motivates us to solve this problem by approaching it as a classification problem.

[1]   T. M. Wickizer and D. Lessler, "Utilization management: Issues, effects, and future prospects," *Annu. Rev. Public Health*, vol. 23, pp. 233–254, 2002, doi: 10.1146/ANNUREV.PUBLHEALTH.23.100901.140529.

[3]   A. Medical Association, "Prior Authorization Physician Survey Update | AMA," 2022, Accessed: Aug. 10, 2022. [Online]. Available: https://www.ama-assn.org/system/files/prior-.

[4]   "Most physicians had little relief from prior authorization as COVID cases soared | American Medical Association." https://www.ama-assn.org/press-center/press-releases/most-physicians-had-little-relief-prior-authorization-covid-cases (accessed Aug. 10, 2022).

[5]   "Electronic Prior Authorizations Impact Quality, Provider Burden." https://healthpayerintelligence.com/news/electronic-prior-authorizations-impact-quality-provider-burden (accessed Aug. 10, 2022).

[6]   M. Kumar, R. Ghani, and Z. S. Mei, "Data mining to predict and prevent errors in health insurance claims processing," *Proc. ACM SIGKDD Int. Conf. Knowl. Discov. Data Min.*, pp. 65–73, 2010, doi: 10.1145/1835804.1835816.

[7]   J. Wojtusiak, C. Ngufor, J. Shiver, and R. Ewald, "Rule-based prediction of medical claims' payments: A method and initial application to medicaid data," *Proc. - 10th Int. Conf. Mach. Learn. Appl. ICMLA 2011*, vol. 2, pp. 162–167, 2011, doi: 10.1109/ICMLA.2011.126.

[8]   D. Thenmozhi, K. Kannan, C. A.-F. (Working Notes), and undefined 2017, "A text similarity approach for precedence retrieval from legal documents.," *ceur-ws.org*, Accessed: Aug. 10, 2022. [Online]. Available: http://ceur-ws.org/Vol-2036/T3-9.pdf.

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