



ClassifAI

Advancing Teacher-Student Interaction Analysis through
Automated Speech Transcription and Question Classification



View the Portal:
<https://classifai.tcu.edu>

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Project Goals

What:

ClassifAI is an online video/audio analysis tool built to assist teachers and educators in analyzing and understanding how their interaction with students translates into real learning methods. ClassifAI does this by providing transcripts of what was said, measuring how long it takes students to respond to questions, and evaluating the complexity of questions based on Costa's levels of thinking.

Why: Manual methods of analysis are time-consuming and may not be effective in quantifying metrics between teacher and student interactions.

Who:

Instructors who seek more effective and efficient ways to analyze their teaching methodologies.

Previous Iteration:

- Used Assembly AI to transcribe files (costly)
- Question Categorization was based on Bloom's Taxonomy
- No YouTube support or summarization
- Poor User Interface and User Experience (UI/UX)

Project Outcomes

Cost effectiveness- all processing is now done on TCU servers, while maintaining accuracy (100% reduction in month-over-month cost)

Automatic categorization according to Costa's Level of Reasoning.

- We went from approximately 6% of questions categorized via keywords to all questions categorized with a fine-tuned Gemma, resulting in 86% accurate categorization of questions via Gemma.

Automatic summarization of transcripts!

Mobile Optimization

YouTube uploads added

UI Enhanced

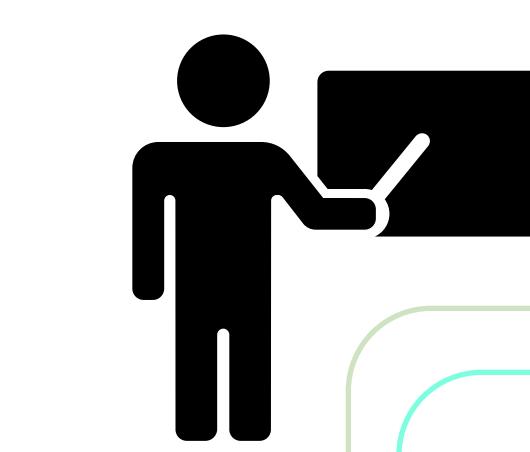
Possible Improvements for Next Iteration

- Develop more accurate models of question categorization and summarization
- Identify heatmap of confusion, and a sentiment analysis of the transcript- identify problematic times.
- Add a student-teacher network graph to identify which people interact with each other most often.

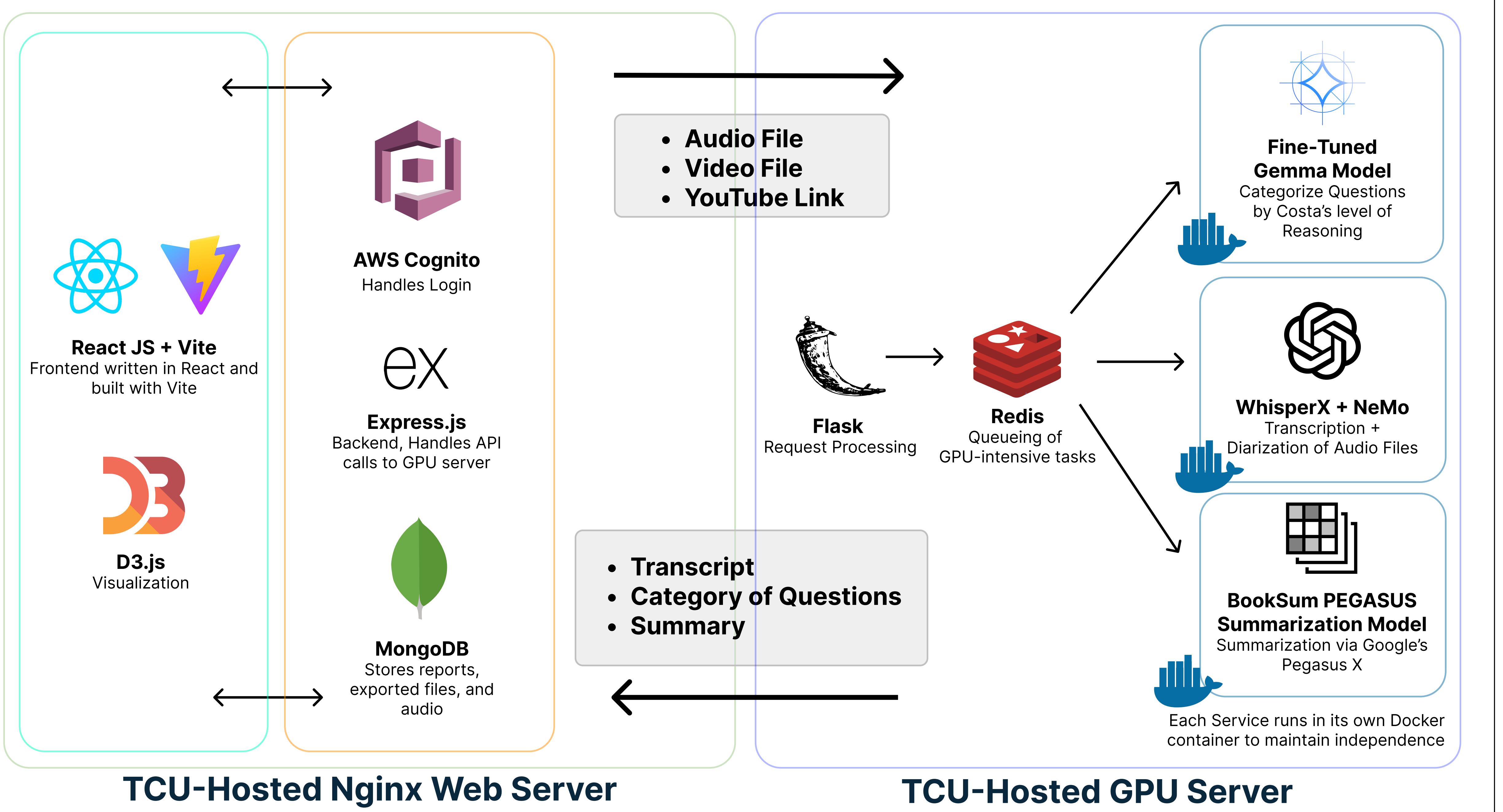
Acknowledgments

- Dr. Binyang Wei, for being our faculty advisor
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 - Dr. Liran Ma
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 - Dr. Michael Faggella-Luby
- Dr. Michael Denkowski, for advising us on our NLP models

ClassifAI is an online video/audio analysis tool that assists educators by quantifying different metrics about their teacher-student interaction. Instructors can view metrics such as the time the teacher talks during a lesson, the timeline of questions asked and their Costa's level of Inquiry, the response time of students to those questions, and other data points such as an automatic summary of the classroom audio.



System Architecture



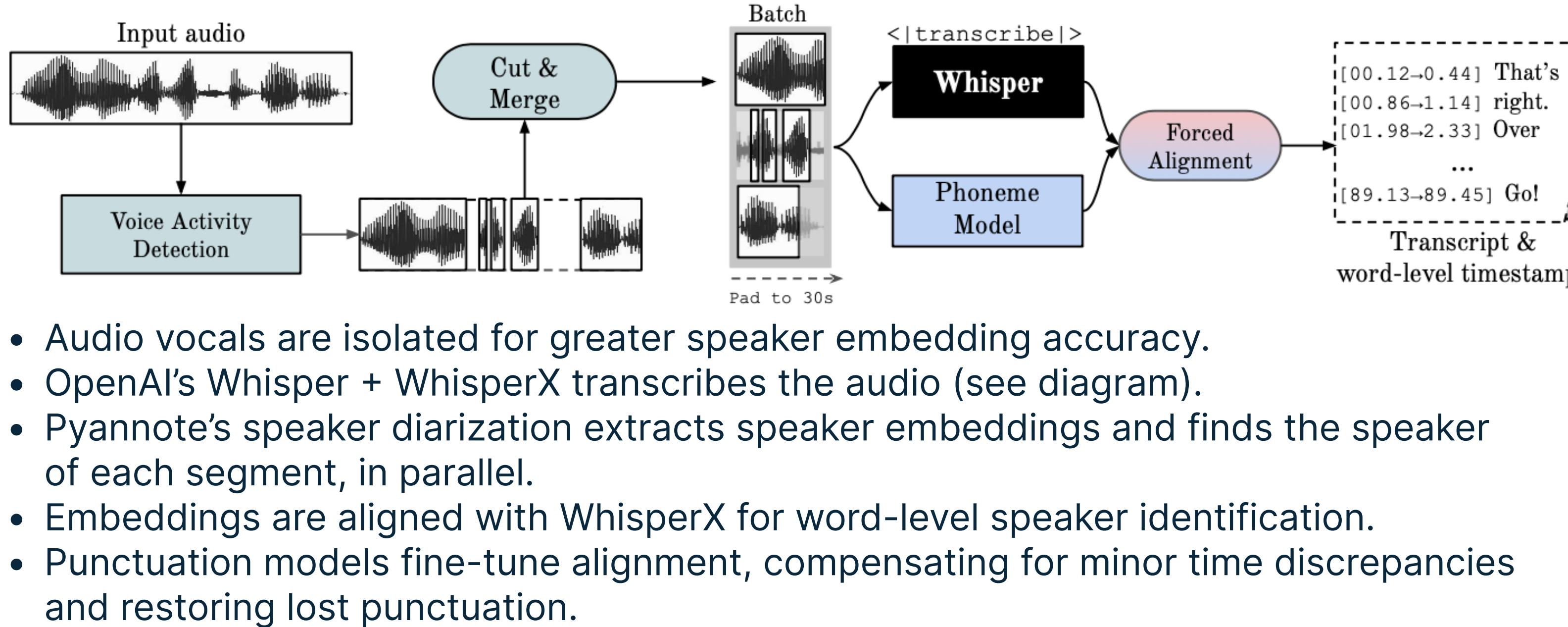
User Interface/Experience

The User Interface/Experience section displays several screenshots of the ClassifAI web application:

- Landing page:** Shows a classroom scene with a teacher at the front and students at their desks. Includes a bar chart comparing the "Old Keyword Model" (6% correct) and the "Gemma Model" (86% correct).
- Transcribing View / Progress bar:** Shows a progress bar indicating the transcription process for a video file.
- Mobile View:** Shows the mobile application interface.
- Word Visualization:** A word cloud visualization of common words in the transcripts.
- Level Distribution:** A bar chart showing the distribution of Costa's levels of inquiry across the transcripts.
- Transcript View:** A detailed view of a transcript with timestamped text and speaker information.
- Report File Management:** A table listing various report files with columns for Report ID, Report Name, Subject, Grade, Audio File, Status, and Edit/Delete/Download options.

Artificial Intelligence

Transcription and Diarization



Categorization- Gemma Fine-Tuning via PEFT and LoRA

- We categorize questions according to their Costa's level of inquiry (1/Gathering, 2/Processing, 3/Applying).
- Categorization is done by fine-tuning the Gemma-7B-Instruct model via Parameter Efficient Fine Tuning (PEFT) on sample questions and their corresponding level.
- The training data is derived from our client's classroom, along with AVID's "Costa's Levels of Thinking and Questioning" resource (which provides question examples for different subjects and different levels).
- We employ the LoRA (Low Rank Adaptation) technique, which modifies only a small subset of the model's weights during fine-tuning and approximates weights. This approach offers efficiency advantages over traditional full-model fine-tuning. The model was trained for 2 epochs.

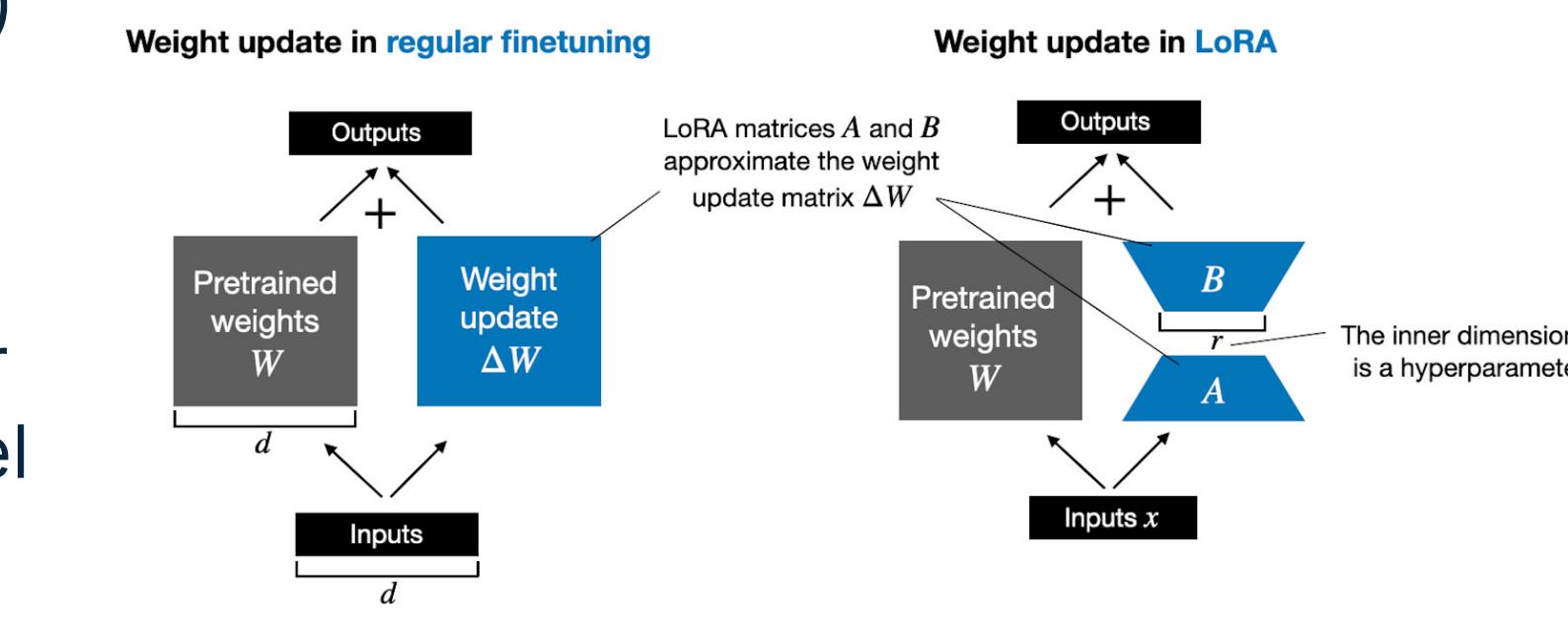


Image Source: <https://www.linkedin.com/pulse/tora-low-rank-adaptation-efficient-fine-tuning-large-language/>

Transcript Summarization

- Summarization is done using Google's pre-trained PEGASUS (Pre-training with Extracted Gap-sentences for Abstractive Summarization) model, specialized in giving a summary of arbitrary topics.
- Created by fine-tuning Google's Pegasus-x-large model on the kmfoda/booksum dataset for eight epochs.

Features

Speech Recognition and Diarization

Extremely fast performance transcription through optimized speech recognition and diarization algorithms (~80 sec for a 45 minute video)

Question Categorization and Analysis

All transcripts undergo a thorough analysis to categorize the questions and evaluate instructional effectiveness. Detailed data visualization is provided.

Exportable and Manageable Data

Easily export transcripts and data visualization models to PDF and CSV.

Transcript Summarization

Transcripts are summarized to extract relevant information for ease of access and note taking.

