

NLP: FINAL PROJECT REPORT

MATHPLOT VQA

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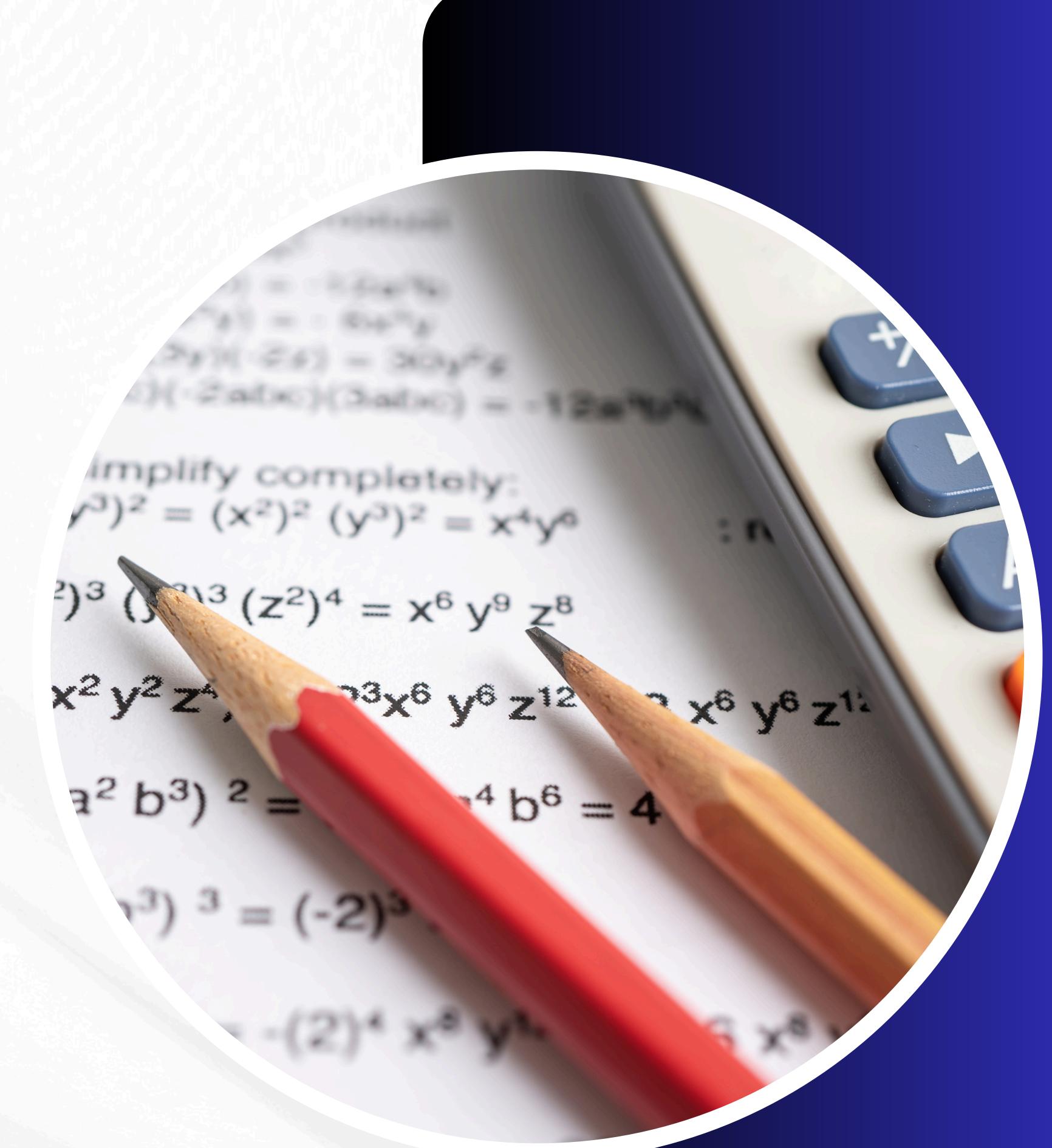


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PROJECT RECAP



- Improving current question-answering systems by creating a new system that can **understand and answer questions about graphs in math problems**.
- This new system allows users to input photos of graphs, **making math easier to understand for everyone**, especially those who find graphs difficult.

Proposed: MATHPLOT VQA

Solution Requirements:

- Graph Image Submission
- Question Input
- Math Question-solving (from graph)
- Graph Interpretation

Dataset:

- ChartQA
- AutoChart

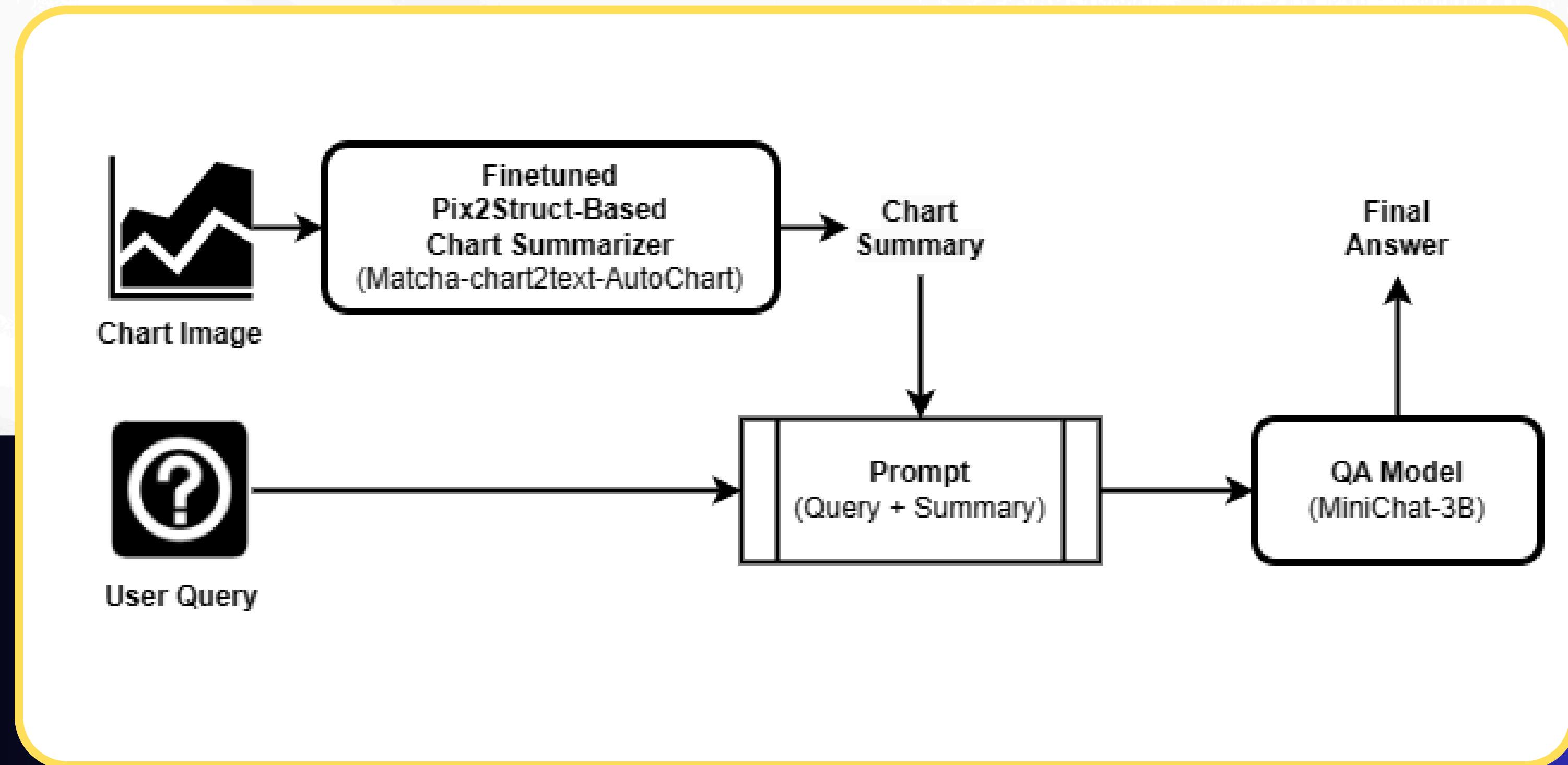
Pretrained Models:

- Matcha
- MiniChat

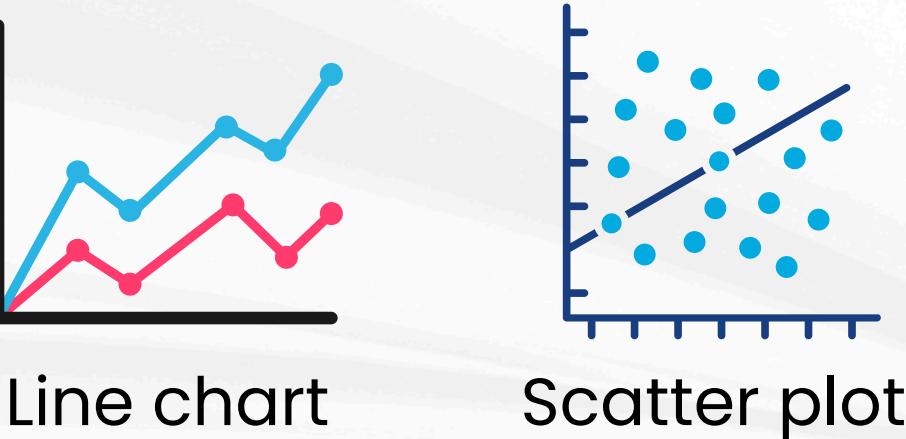
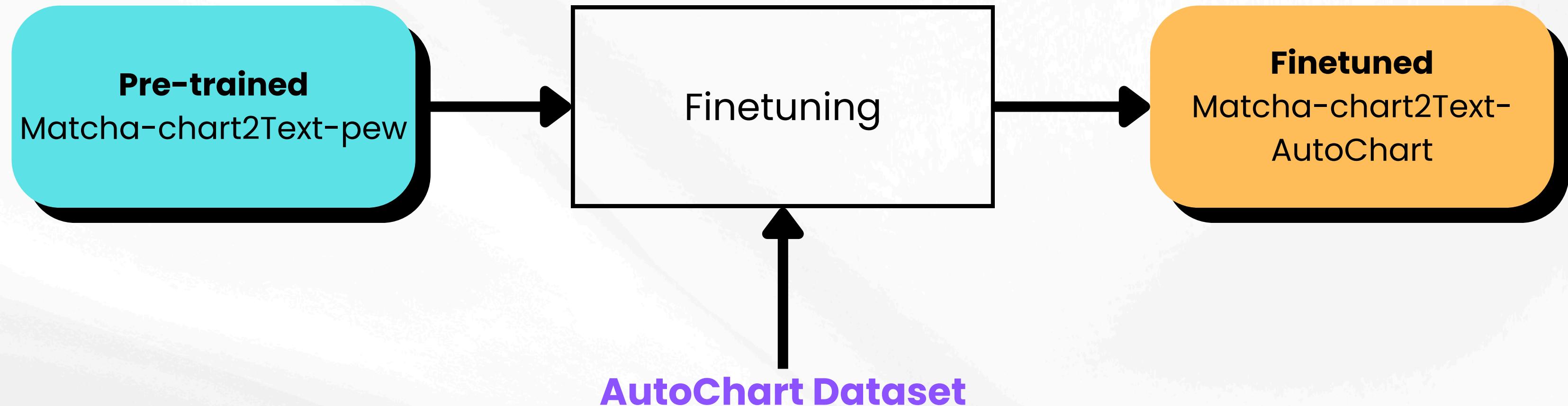
FINAL REPORT MATHPLOT VQA



ACTUAL CONDUCTED EXPERIMENTS



FINETUNING PROCESS



Bar chart

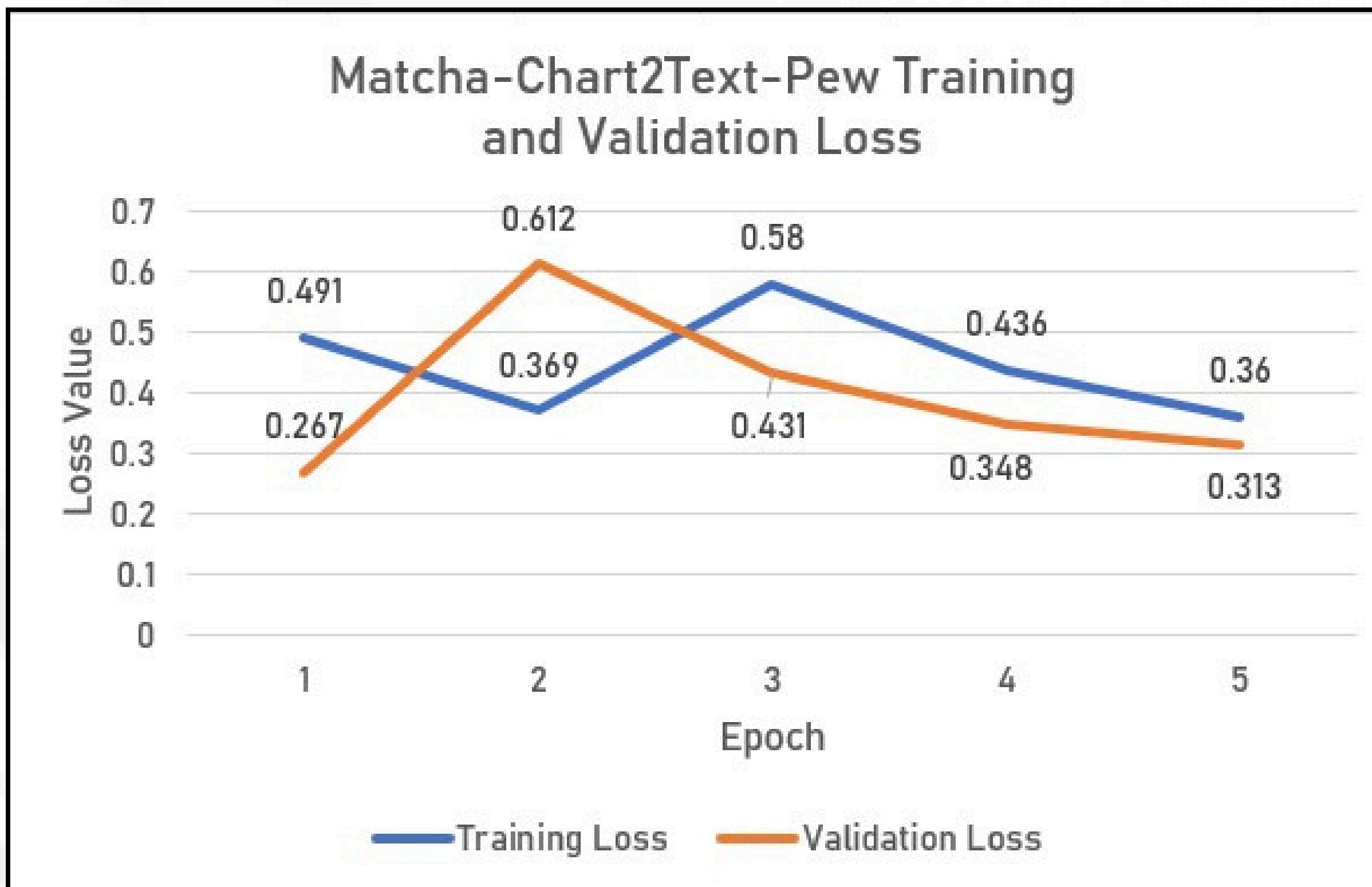
Line chart

Scatter plot

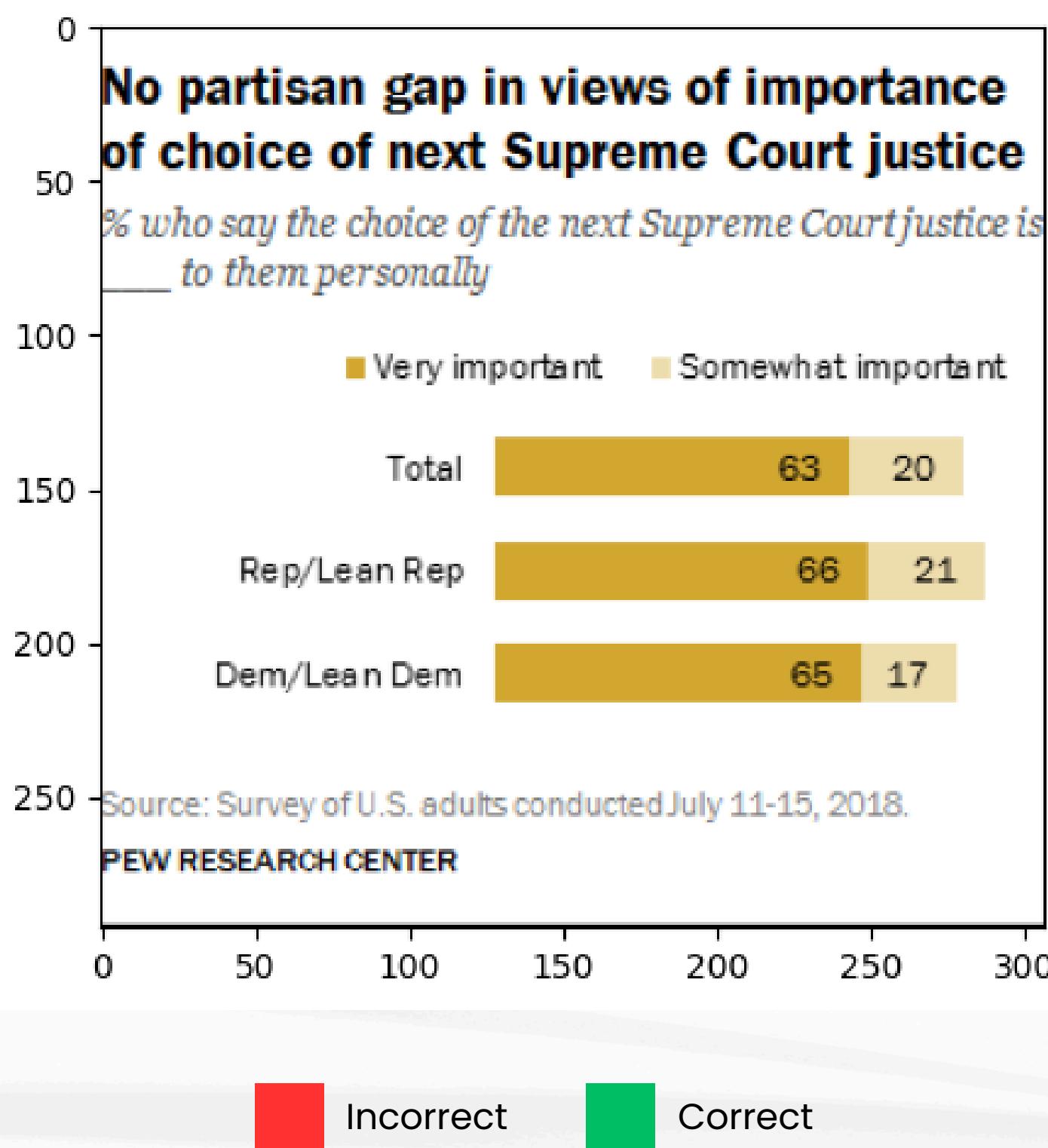
dataset for chart-to-text generation

- Comprised of chart image-description pairs
- Split into 3000/300/300 for training/validation/testing

FINETUNING AND RESULT



FINETUNING AND RESULT



Pre-trained

Chart summary: The public is divided over the importance of the choice of the next Supreme Court justice: 63% say it is very important, while 20% say it is somewhat important. About half of Republicans and Republican leaners (66%) say the choice of the next Supreme Court justice is very important to them personally, with 21% saying it is somewhat important. Democrats and Democratic leaners are far more likely than Republicans and GOP leaners to say the choice of the next Supreme Court justice is very important to them personally (65% vs. 17%).

Finetuned

COMBINE WITH THE QA MODEL

Chart Summary

"The public is divided over the importance of the choice of the next Supreme Court justice: 63% say...."

User Query

"What is the trend of the graph? "

Prompt

Below is a summary that describes a chart, paired with a question the user has about the chart. Write a response that appropriately answer the question.

Summary:
{Chart Summary}

Question:
{User Query}

Response:

QA Model
MiniChat-3B

Final Answer

FINAL ANSWER FROM FINETUNING

User Query:

Is the choice of next supreme court justice important for the democrats?

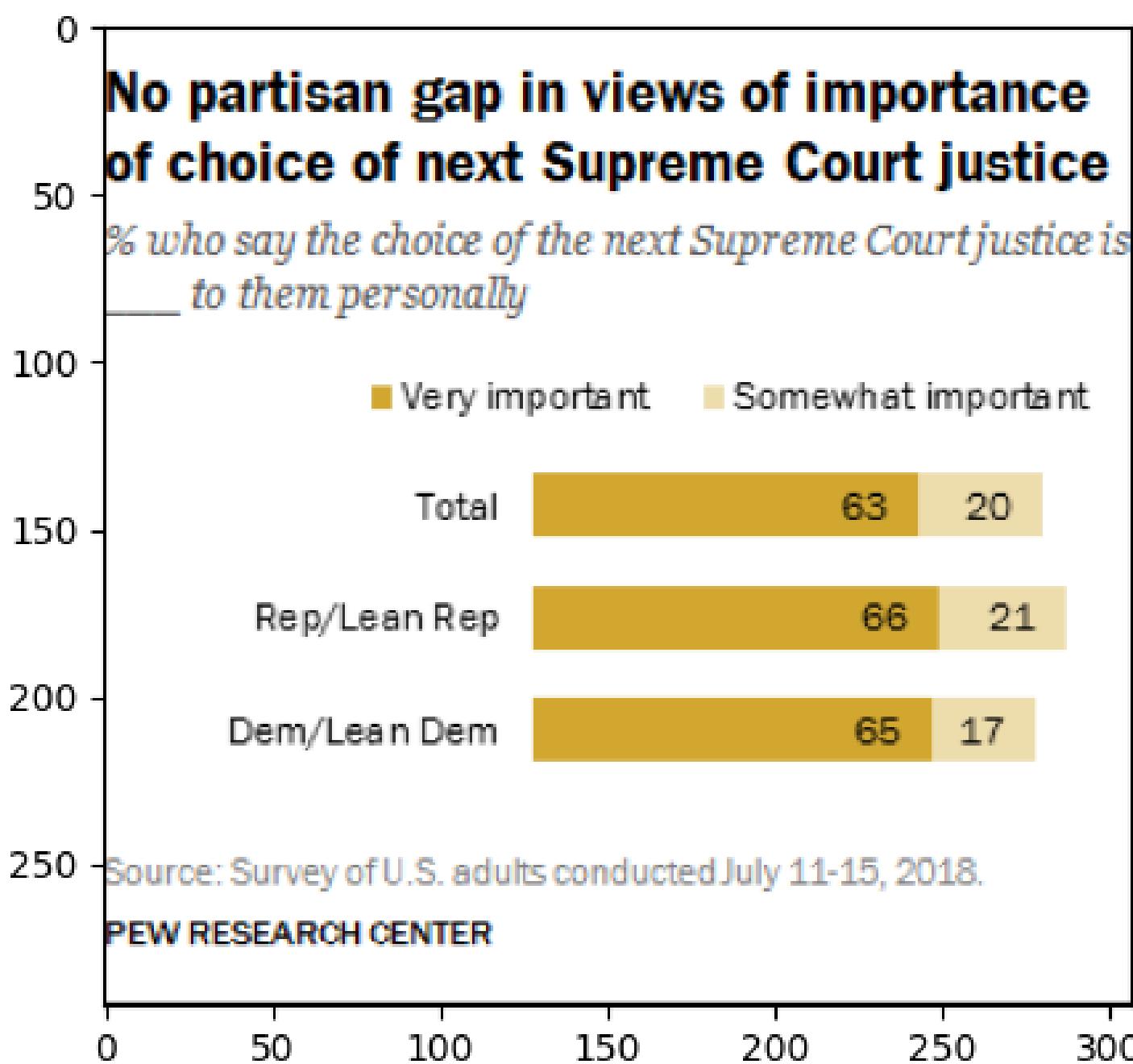


Chart summary: This linechart shows the number of annual population growth of 2000 through 2000 through 2000. The unit of measurement in this graph is Population growth (in %) as shown on the y-axis. It is clear that the number have a go up and down trend. The highest number is found in 2000 and the lowest in

Answer: The choice of the next Supreme Court justice is a critical decision for the democrats. The ideology and experience of the next Supreme Court justice will have a significant impact on the future direction of the country, particularly in issues such as healthcare, civil rights, and the environment. The democrats will need to carefully consider the nominee's views and experience to ensure that they align with their values and will serve to protect the rights of all Americans. Ultimately, the democrats' decision on the next Supreme Court justice will shape the future of the country for years to come.

PRE-TRAINED VS FINETUNED

User Query

“Is the choice of next supreme court justice important for the democrats?”

Pre-trained Chart summary: The public is divided over the importance of the choice of the next Supreme Court justice: 63% say it is very important, while 20% say it is somewhat important. About half of Republicans and Republican leaners (66%) say the choice of the next Supreme Court justice is very important to them personally, with 21% saying it is somewhat important. Democrats and Democratic leaners are far more likely than Republicans and GOP leaners to say the choice of the next Supreme Court justice is very important to them personally (65% vs. 17%).

Pre-trained Answer: Yes, the choice of the next Supreme Court justice is important for Democrats. The survey shows that 65% of Democrats and Democratic leaners consider it very important, while only 17% of Republicans and GOP leaners say the same. This difference is statistically significant, suggesting that Democrats place a greater personal weight on the appointment of the next Supreme Court justice compared to Republicans.

Incorrect

Correct

Irrelevant

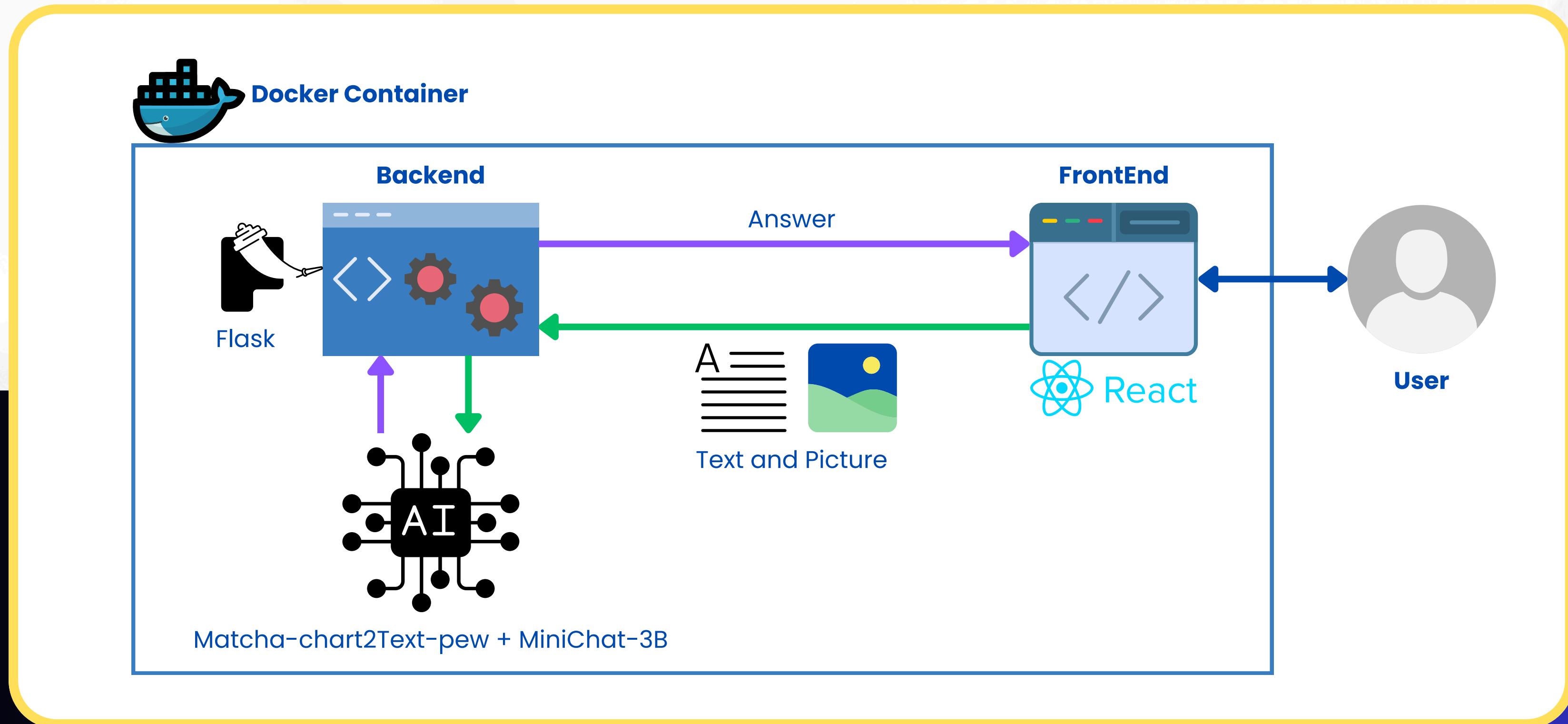
Finetuned Answer: The choice of the next Supreme Court justice is a critical decision for the democrats. The ideology and experience of the next Supreme Court justice will have a significant impact on the future direction of the country, particularly in issues such as healthcare, civil rights, and the environment. The democrats will need to carefully consider the nominee's views and experience to ensure that they align with their values and will serve to protect the rights of all Americans. Ultimately, the democrats' decision on the next Supreme Court justice will shape the future of the country for years to come.

EVALUATION SCORES

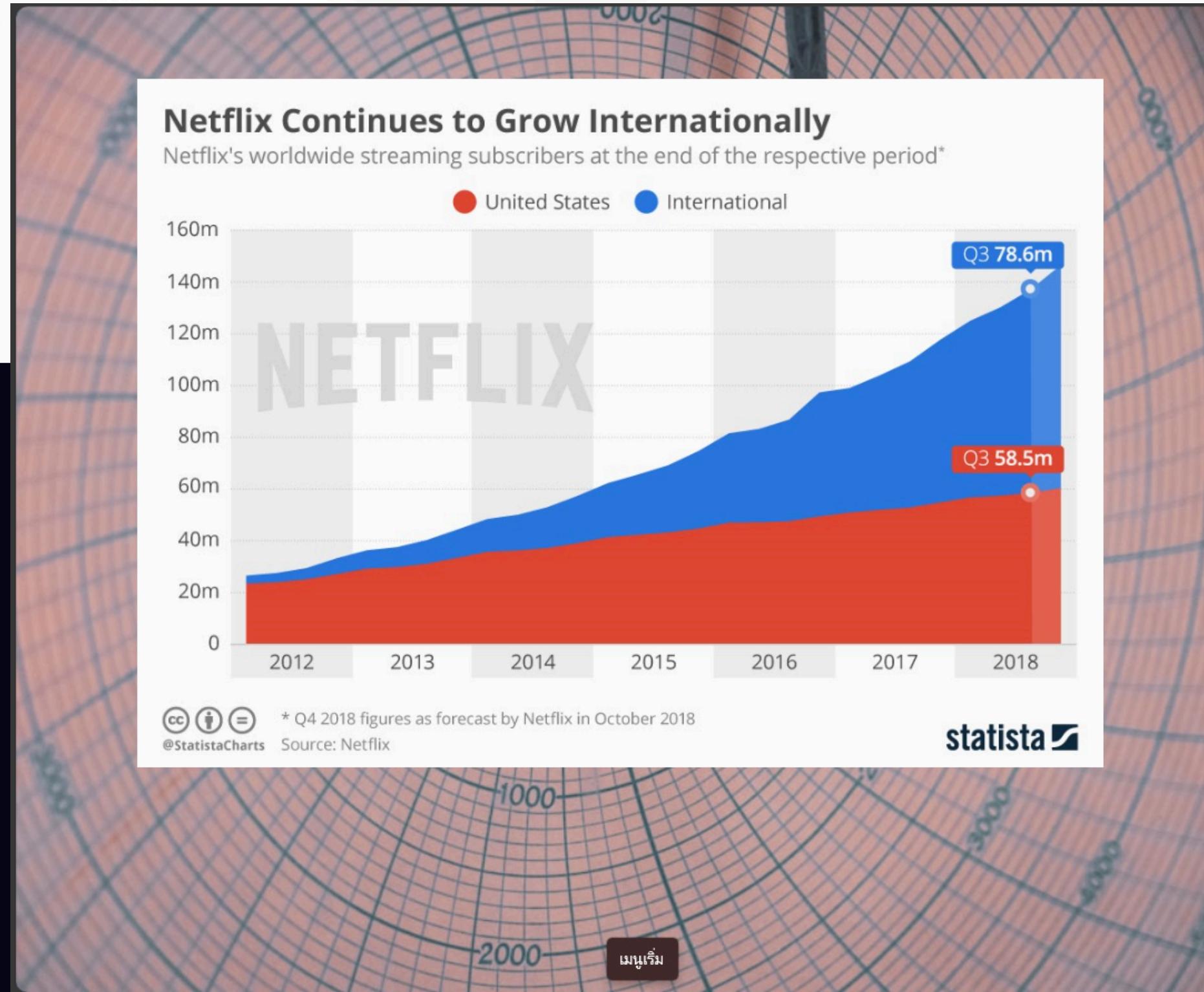
Model	Pre-trained Matcha-chart2Text-pew	Finetuned Matcha-chart2Text-AutoChart
rouge1	0.2464	0.4561
rouge2	0.0562	0.2286
rougeL	0.1757	0.3609
rougeLsum	0.1757	0.3606
BertScore	0.7929	0.8598

* Both models were evaluated on AutoChart testing set

WEB APPLICATION DEVELOPMENT



WEB APPLICATION



 MATHPLOT VQA

User-Query *
What is the trend of this graph?

Choose File Stats-on-Netflix's-subscriber-growth-after-2016-pric-hike.jpg

PROCESS

OUTPUT

The trend of the graph is that the share of Americans who say they are following news about the 80s and 100s very closely has increased. Currently, 75% of Americans say they are following the news about the 80s and 100s very closely, which is an increase from 57% in October.

Visit us on [MATHPLOT-VQA github repository](#) 2024.



MATHPLOT VQA

User Query *

Choose File No file chosen

PROCESS

OUTPUT

Visit us on [MATHPLOT-VQA github repository](#). 2024.



DISCUSSIONS

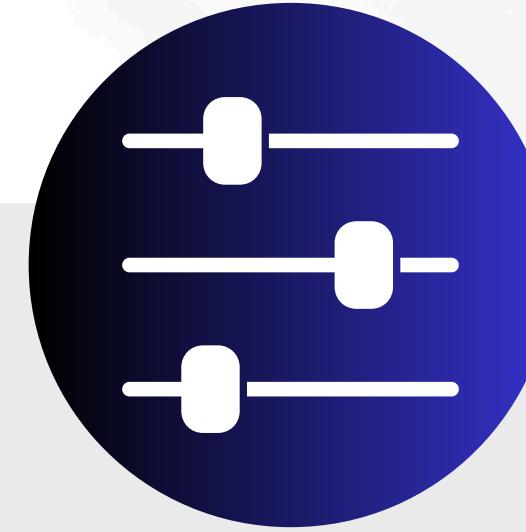
- **Result:**

- The scoring results of the finetuned model appear better than the pre-trained model, but the actual interpretation suggests otherwise. This discrepancy indicates that the scoring method may not be effective. Since we only trained the model for five epochs, it might be insufficient for the model to reach optimal efficiency.
- The web application meets all requirements, but it still takes a long time to generate answers.

- **Insights & Limitations:**

- The finetuning process was a failure since the finetuned model performed much worse than the original
- The finetuned model generates the same sentence regardless of inputs, indicating that the model is under fitted
- Unsure whether underfitting is due to a small training set or training epochs
- Evaluation metrics such as ROUGE and BERTScore could not capture the model's performance well since the worse model actually obtained a higher score
- Since the models are complex and large, the time to generate the answer is too long. Generated time depends on the local host's hardware, suggesting creating the model endpoints.

FUTUREWORKS



FINETUNED THE MODEL

Finetune model using better techniques such as LoRA or QLoRA and increase number of epochs to allow model convergence



DEPLOYING AN AI MODEL ENDPOINT

Deploy the finetuned model to HuggingFace/AWS Sagemaker to allow other users to experiment or integrate with their web application without concern about the hardware specification and hardware infrastructure.

THANK YOU

Question and Answer section