Predicting Course Transferability: A Comparative Analysis of Fine-Tuned Embedding Models and Traditional Classifiers Using Public Course Data

A Thesis submitted to the faculty of

San Francisco State University

In partial satisfaction of the

requirements for

the Degree

Master of Science

in

Data Science and Artificial Intelligence

by

Mark S. Kim

San Francisco, California

May 2025

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2025

Certification of Approval

I certify that I have read Predicting Course Transferability: A Comparative Analysis of Fine-Tuned Embedding Models and Traditional Classifiers Using Public Course Data by Mark S. Kim and that in my opinion this work meets the criteria for approving a thesis submitted in partial fulfillment of the requirement for the degree Master of Science at San Francisco State University.

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Professor
Thesis Committee Chair

Arno Puder, Ph.D
Professor

Anagha Kulkarni, Ph.D
Professor

Abstract

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Acknowledgments

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Introduction

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Method

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Chapter 1

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1.1 Chapter 1 Heading 3 (subheading)

Note that every figure present in the document should be referenced from somewhere within the text. This is an example of a reference to a figure in the thesis: see Fig. 1.1.

Figure 1.1: Example of a basic figure title

Cras faucibus condimentum odio. Sed ac ligula. Aliquam at eros. Etiam at ligula et tellus ullamcorper ultrices. In fermentum, lorem non cursus porttitor, diam urna accumsan lacus, sed interdum wisi nibh nec nisl. Ut tincidunt volutpat urna. Mauris eleifend nulla eget mauris. Sed cursus quam id felis. Curabitur posuere quam vel nibh. Cras dapibus dapibus nisl.

Vestibulum quis dolor a felis congue vehicula. Maecenas pede purus, tristique ac, tempus eget, egestas quis, mauris. Curabitur non eros. Nullam hendrerit bibendum justo. Fusce

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Chapter 1 Heading 4 (Sub-heading)

Curabitur varius fringilla nisl. Duis pretium mi euismod erat. Maecenas id augue. Nam vulputate. Duis a quam non neque lobortis malesuada. Praesent euismod. Donec nulla augue, venenatis scelerisque, dapibus a, consequat at, leo. Pellentesque libero lectus, tristique ac, consectetuer sit amet, imperdiet ut, justo. Sed aliquam odio vitae tortor. Proin hendrerit tempus arcu. In hac habitasse platea dictumst. Suspendisse potenti.

Chapter 2

2.1 Sub-heading

Vivamus vitae massa adipiscing est lacinia sodales. Donec metus massa, mollis vel, tempus placerat, vestibulum condimentum, ligula. Nunc lacus metus, posuere eget, lacinia eu, varius quis, libero. Aliquam nonummy adipiscing augue. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Maecenas porttitor congue massa. Fusce posuere, magna sed pulvinar ultricies, purus lectus malesuada libero, sit amet commodo magna eros quis urna. Nunc viverra imperdiet enim.

Every table present in the document should be referenced from somewhere within the text. This is an example of a reference to a table: see Tab. 2.1 and Tab. 2.2.

Fusce est. Vivamus a tellus. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Proin pharetra nonummy pede. Mauris et orci. Aenean nec lorem. In porttitor.

Donec laoreet nonummy augue. Suspendisse dui purus, scelerisque at, vulputate vitae,

Description	yes/no	yes/no
1-2-3	yes	no
Multiplan	yes	yes
Wordstar	no	no

A simple table

Table 2.1: This is an example of a simple table.

Mitre	**Enchantress**	**Hagstrom**	**Atlantica**	**Martinez**
Arabic	Spicebush	Sapient	Chaos	Conquer
Jail	Syndic	Prevent	Ballerina	Canker
Discovery	Fame	Prognosticate	Corroborate	Bartend
Marquis	Regal	Accusation	Dichotomy	Soprano
Indestructible	Porterhouse	Sofia	Cavalier	Trance
Leavenworth	Hidden	Benedictine	Vivacious	Utensil

Table 2.2: This is an example of a slightly more complex table

pretium mattis, nunc. Mauris eget neque at sem venenatis eleifend. Ut nonummy. Fusce aliquet pede non pede. Suspendisse dapibus lorem pellentesque magna. Integer nulla. Donec blandit feugiat ligula.

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Every figure in the document should be referenced somewhere within the text. This is an example reference to a figure: see Fig. 2.1.

Figure 2.1: Example of a basic figure title

Nunc ac magna. Maecenas odio dolor, vulputate vel, auctor ac, accumsan id, felis. Pellentesque cursus sagittis felis. Pellentesque porttitor, velit lacinia egestas auctor, diam eros tempus arcu, nec vulputate augue magna vel risus. Cras non magna vel ante adipiscing rhoncus. Vivamus a mi. Morbi neque. Aliquam erat volutpat. Integer ultrices lobortis eros. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas.

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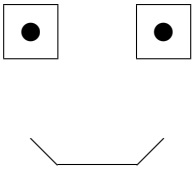

Figure 2.2: Donec eu condimentum.

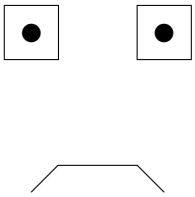

Figure 2.3: Quisque dapibus dignissim.

elit est, consectetuer eget, consequat quis, tempus quis, wisi. In in nunc. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Donec ullamcorper fringilla eros. Fusce in sapien eu purus dapibus commodo.

Nam ac viverra dolor, sed pulvinar justo. Nullam orci est, ultrices non justo vel, euismod aliquet ligula. Cras semper, purus sed pharetra rhoncus, metus mauris ultricies odio, non sodales odio est finibus velit.

> This is an example of a block quote. Donec id mi at nulla tempor tincidunt a sit amet mi. Vivamus pulvinar dolor felis. Mauris in tellus accumsan, pellentesque lacus eu, aliquet lectus. Suspendisse felis nulla, scelerisque at maximus ut, mollis laoreet nisi. Pellentesque pulvinar libero pharetra dolor blandit pulvinar. Proin dapibus sodales velit ac rhoncus.

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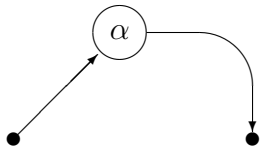

Figure 2.4: Here we see an example of a figure which has been drawn programatically using LaTeX

blandit pulvinar. Proin dapibus sodales velit ac rhoncus. Integer lacinia justo et enim porta porta. Praesent odio velit, ultrices interdum tortor in, consectetur bibendum dolor.

This is an example of a footnote.[1] Pellentesque libero lectus, tristique ac, consectetuer sit amet, imperdiet ut, justo. Sed aliquam odio vitae tortor. Proin hendrerit tempus arcu. In hac habitasse platea dictumst. Suspendisse potenti.

Sample Text 1 *This is an example of how to use the theorem environment.*

- This is an example of a bulleted list.
- Praesent vestibulum mi turpis, vitae ultricies diam porttitor non.
- Morbi sed vulputate nibh, ac iaculis odio.
- Mauris ac risus eget eros ornare.
- Proin quis tellus non velit posuere pulvinar.
- Vestibulum tincidunt tempor hendrerit.

[1] This is the text that will appear in the footnote

Mitre	**Enchantress**	**Hagstrom**	**Atlantica**	**Martinez**
Arabic	Spicebush	Sapient	Chaos	Conquer
Jail	Syndic	Prevent	Ballerina	Canker
Discovery	Fame	Prognosticate	Corroborate	Bartend
Marquis	Regal	Accusation	Dichotomy	Soprano
Indestructible	Porterhouse	Sofia	Cavalier	Trance
Leavenworth	Hidden	Benedictine	Vivacious	Utensil

Table 2.3: Here we have an example of a table that has been set in landscape

- Praesent ornare imperdiet diam, sit amet laoreet.

1. This is an example of a numbered list.
2. Praesent vestibulum mi turpis, vitae ultricies diam porttitor non.
3. Morbi sed vulputate nibh, ac iaculis odio.
4. Mauris ac risus eget eros ornare.
5. Proin quis tellus non velit posuere pulvinar.
6. Vestibulum tincidunt tempor hendrerit.
7. Praesent ornare imperdiet diam, sit amet laoreet.

2.2 Math Examples

Here we see an equation placed within an equation environment

$$cos(2\theta) = \cos^2\theta - \sin^2\theta \tag{2.1}$$

Here we see an equation which has not been placed in an equation environment

$\lim_{x\to\infty} \exp(-x) = 0$

Here we have several more math examples

$k_{n+1} = n^2 + k_n^2 - k_{n-1}$

$f(n) = n^5 + 4n^2 + 2|_{n=17}$

$\frac{n!}{k!(n-k)!} = nk$

$\frac{\frac{1}{x}+\frac{1}{y}}{y-z}$

$$\begin{array}{c} (x_1 x_2) \\ \times (x_1' x_2') \\ \hline (y_1 y_2 y_3 y_4) \end{array} \tag{2.2}$$

$\sqrt{\frac{a}{b}}$

$\sqrt[n]{1 + x + x^2 + x^3 + \cdots + x^n}$

$\sum_{i=1}^{10} t_i$

$$\sum_{i=1}^{10} t_i$$

$$P\left(A = 2 \middle| \frac{A^2}{B} > 4\right)$$

Every equation with a number should be referenced from somewhere within the text. Here's an example reference to an equation: see Eq. 2.3.

$$\begin{aligned} |\psi\rangle &= \alpha |0\rangle + \beta |1\rangle \\ |\psi\rangle &= cos\frac{\theta}{2} |0\rangle + e^{i\phi} sin\frac{\theta}{2} |1\rangle \\ 1 &= \alpha^2 + \beta^2 \end{aligned} \tag{2.3}$$

$$X \otimes H = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} \otimes \begin{pmatrix} 1/\sqrt{2} & 1/\sqrt{2} \\ 1/\sqrt{2} & -1/\sqrt{2} \end{pmatrix} = \begin{pmatrix} 0 & 0 & 1/\sqrt{2} & 1/\sqrt{2} \\ 0 & 0 & 1/\sqrt{2} & -1/\sqrt{2} \\ 1/\sqrt{2} & 1/\sqrt{2} & 0 & 0 \\ 1/\sqrt{2} & -1/\sqrt{2} & 0 & 0 \end{pmatrix}$$

Chapter 3

Implementation

3.1 Sub-heading

When you describe your implementation, you may need to use code or pseudocode to help convey your point.

The lstlisting example shown in 3.1 can be useful.

```
float smoothPixel(Si, Sj, S, R, weights) {
    // compute the weight sum of pixels nearby
    // this code doesn't handle edge conditions
    // and assumes sum of weights[i,j] = 1.0
    float sum = 0.0;
    for (int j=0; j<R; j++)
        for (int i=0; i<R; i++)
            sum += weights[i,j]*S[Si+i,Sj+j]
    return sum; }
```

Listing 3.1: Stencil computation in 2D: performs sum of product of nearby pixels with weights.

Chapter 4

Evaluation and Results

Provide an introductory paragraph that summarizes what's in this section: a list of runs/experiments intended to test your implementation and ideas. Describe each of these experiments in a few words/a sentence.

4.1 Methodology

Describe the procedures you use to test your system.

Performance metrics: describe exactly what metrics you employ to measure performance. It might be elapsed time from instrumentation code you added around the main computational code. Later in the term, it may be something else.

Experimental design: did you run tests over a set of prescribed problem sizes? If so, what were they?

4.2 Computational platform and Software Environment

What machine did you run your tests on? What was the processor, its clock rate (GHz), size of L1/L2/L3 cache, how much memory (DRAM), what OS?

What compiler did you use, what compilation flags?

4.3 Experiment 1

Describe the experiment in a few sentences: what question are you trying to answer, what problem sizes/etc did you use (it's ok to make reference back to Sec. 4.1 so you don't have to repeat a lot of details.

Present the results of your experiment using either tabular forms of information, such as in Table 4.1, or using charts and graphs as in Fig. 4.1.

When creating charts, please think carefully about the information you are trying to present. Also, make use of the best possible tools for generating charts and plots. Some of the best charting tools around are those built into Matplotlib. This thesis template includes a sample Python file that loads a csv file containing data and generates a plot of results, which is shown in Fig. 4.1.

Problem Size (N)	Ideal runtime (sec)	Actual runtime (sec)
1	1	1
2	0.5	0.75
4	0.25	0.56
8	0.12	0.42
16	0.06	0.31

Table 4.1: Comparison of actual and ideal runtimes for different problem sizes. The actual runtime does not equal ideal runtime in this configuration.

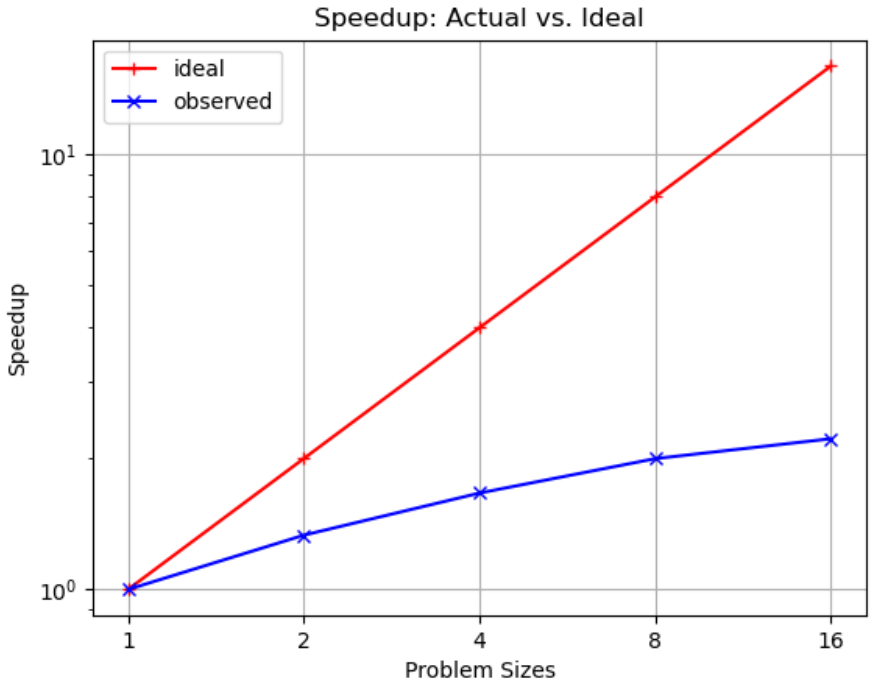

Figure 4.1: Comparison of actual vs. ideal speedup with increasing problem sizes. In this case, we see the observed speedup is quite different than the ideal speedup. Try changing the vertical axis to log-scaling in the Python script that generates the chart. This figure was produced by the sample `plot_speedup.py` file.

4.4 Experiment 2

Repeat the writing motif as in Experiment 1 as needed.

4.5 Findings and Discussion

In this section, please answer the questions posed in the homework assignment writeup on iLearn.

Also, optionally include any additional insights you gained while doing these performance experiments.

If this were an actual tech paper, here is where you would summarize the main findings and observations from the experiments: do the experiment results support your hypothesis? Sometimes the answer is a clear Y. Sometimes, the answer is Y for some circumstances, but not all, and it is important to spell this out.

Sometimes, the experiments turn up unexpected negative results, and it is also important to point out those, as well. Science happens due to both successes and failures, and it is important to document failed experiments so that we can all learn from them.

Bibliography

.1 Appendix A: List of California State University Campuses

- California State University, Bakersfield
- California State University Channel Islands
- California State University, Chico
- California State University, Dominguez Hills
- California State University, East Bay
- California State University, Fresno
- California State University, Fullerton
- Humboldt State University
- California State University, Long Beach
- California State University, Los Angeles
- California State University Maritime Academy
- California State University, Monterey Bay
- California State University, Northridge
- California State Polytechnic University, Pomona

- California State University, Sacramento
- California State University, San Bernardino
- San Diego State University
- San Francisco State University
- San José State University
- California Polytechnic State University, San Luis Obispo
- California State University San Marcos
- Sonoma State University
- California State University, Stanislaus

.2 Appendix B: Abbreviations of California State University Campuses

- CSU Bakersfield
- CSU Channel Islands
- Chico State
- CSU Dominguez Hills

- Cal State East Bay
- Fresno State
- Cal State Fullerton
- Humboldt State
- Cal State Long Beach
- Cal State LA
- Cal Maritime
- CSU Monterey Bay
- CSUN
- Cal Poly Pomona
- Sacramento State
- Cal State San Bernardino
- San Diego State
- San Francisco State
- San José State
- Cal Poly San Luis Obispo

- CSU San Marcos
- Sonoma State
- Stanislaus State

Sub Appendix