Professional Leave Report Cover Sheet

Name: David Ruby

Department: Computer Science

College: Science & Mathematics

Leave taken: ◉ Sabbatical ○ Difference in Pay ○ Professional Leave without Pay

Time Period: ○ Fall

○ Spring

◉ Academic Year 2022-2023

○ Other

Your report will be sent to your Dean for your PAF and to the Library Archives.

Sabbatical Report
Fall 2022/Spring 2023

David Ruby

12/12/2023

1 Executive Summary

The opportunity to take an extended period to reflect and grow is special benefit of working in academia. My sabbatical has been a unique experience that has combined many years of work experience, with a returning home. The opportunity has opened as many new questions as ideas, but has certainly been a period appreciated.

1.1 STEM Engagement

Engagement focus turned to social engagement to facilitate class engagement. Importance of social engagement for health and student engagement has been shown. [1] [2] My own experience as a student at Fresno included struggles with social connections even as I excelled with content. My course refresh focus is on increased engagement through increased discussions both online and in-person, with an intent to share results in future workshops/conferences.

1.2 Data-Centric AI and Deep Learning

My research efforts with AI and Data-Centric AI quickly turned towards Deep Learning. Increased focus on Deep Learning both in Machine Learning and Artificial Intelligence will better help students under changes from new technology in this area, and understand how industry can apply it successfully.

1.3 Final Thoughts

Fresno State, the College of Science and Math, and the department of Computer Science are in a great position to support our nation's goals to grow interest and understanding in STEM, but just as important, if not more so, we can also improve the health of our community by increasing social engagement. Increasing understanding of content areas is an important goal of our university, but promoting the healthy growth of our students is our true mandate. Only by encouraging healthy student growth will our students be able to achieve their true potential and enable society to reap those benefits.

2 Sabbatical Success

2.1 Context

After more than 10 years of experience at Fresno State as a lecturer in Computer Science my 1 year sabbatical was combined with a move back to the home where I grew up and lived when attending Fresno State as a student. Unfortunately, the move was motivated by the need to care for my mother, Shirley Ruby, with late stage Alzheimer's, passing peacefully June 13th 2023 [3]. Being back home in the old neighborhood was expected to help understand STEM outreach, being so close to the community I branched out from, but really raised more questions than answers.

2.2 Course Refresh

Course refresh focus was on improving engagement. Understanding student engagement across the varied social background for central valley students is a complex issue, but certain points stand out. For example, an important part of the college experience is social engagement. [4] [5] [2] This social engagement involves meeting students, as well as sharing something about themselves. Facilitating social engagement by ensuring students are able to share some elements of themselves with their classmates is an important part of my class engagement strategy. One way I include for this is the use of interesting online discussions combined with in class ones.

This ability for classes to provide mechanisms for students to explore interactions with each other, is an important part of the academic experience. It will also help promote the idea of interleaving personal components of life with work life, and important step towards understanding how to manage work/life balancing. The assignments need to include both content required elements, but also one that allow for the personal expressiveness.

2.2.1 Abstract Thinking

In looking to connect STEM to old neighborhood, I considered where symbols were being utilized. Neighbors expended much energy and thought into their home presentation, utilizing a variety of abstractions. Figure 1 is an image of my street from Google Street View, and illustrates a variety of common elements across many homes. Students will have same desire with classroom engagement.

Figure 1 Neighborhood Symbols: Cars, Fences, Plants, etc.

Figure 2 illustrates two code snippets that contain personalized elements. The left one indicates two car loans, while the right one shows a grate fence and a dog named “Dooky”. These types of shared elements not only allow students to connect with each other, but help them understand that code is read by humans and includes subtext.

```
#include <iostream>
using namespace std;

int main() {

   double carLoan1, carLoan2;

   carLoan1 = 25000.00;

   return 0;
}
```

```
#include <iostream>
#include <string>
using namespace std;

int main() {

   double fenceGratingCost;
   string dogName1 = "Dooky";

   fenceGrating = 10000.00;

   return 0;
}
```

Figure 2 Code Subtext

2.2.2 Teaching w/ Performance Art

When beginning to teach Advanced ‘C’ programming at UCLA extension in 1992, I decided I needed to develop a more relaxed and engaging teaching style. I looked to another UCLA extension course in Performance Art to help develop my public engagement style.

The course taken was offered by two Los Angeles based artists, Ms. Jackie Apple [6] and Ms. Rachel Rosenthal [7], as seen in Figure 3. This training emphasized awareness during teaching, and an understanding of how engagement between audience and instructor occurs. Consistent with the educational literature on engagement, social engagement important for communicating ideas.

Figure 3 Ms. Apple & Ms. Rosenthal

Understanding how events in our lives generalize with others is an important part of social engagement. In my course on Database systems I used a dataset generated from my own transcript as a student here at Fresno State, see Figure 5. The idea that this dataset told a story of my time here at Fresno State would happen organically. Seeing how this dataset forms part of my story leading to teaching opportunities, facilitates student understanding they can write their stories to include research contributions, and this realization is as important as the technical skills required to make it a reality.

Figure 4 Lauren Lee McCarthy Performance Artist and Computer Scientist, Artist in Residence @ Stanford HAI

Lauren Lee McCarthy, Figure 4, artist in residence at Stanford's Institute for Human-Centered Artificial Intelligence [8], further explored issues such as how Artificial Intelligence technology will affect human relationships stemming from this rapidly developing area. Her explorations from an artist perspective using performance art further illustrates how such tools facilitate deeper connections with technology.

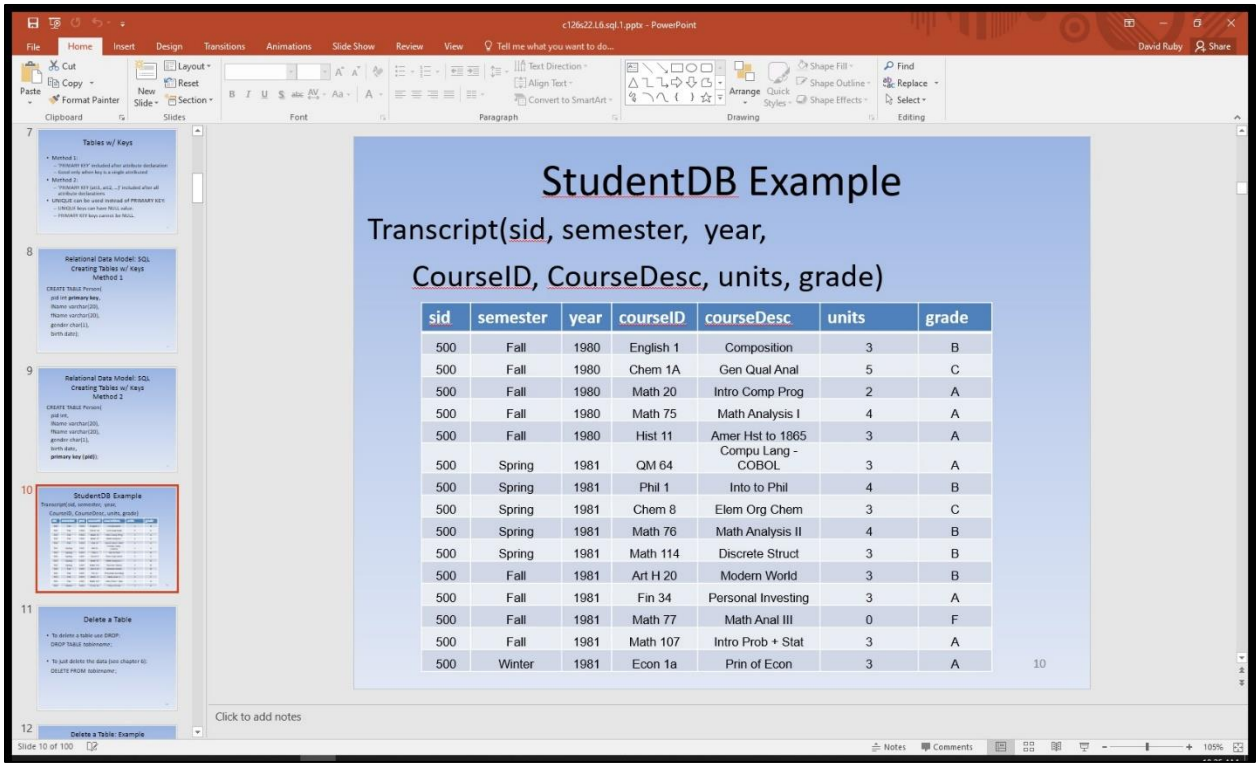

Figure 5 D. Ruby CSUF Transcript Snippet

2.2.3 STEM Education

Ms. Arati Prabhakar, the director of the White House Office of Science and Technology Policy, assistant to the president for Science and Technology, and a member of President Biden's Cabinet, Washington, DC, has written of the critical importance of improving the vibrancy of American research and development. [9] Vice President Kamala Harris has written of the importance of the influence from her experience with her grandfather on his diplomatic mission to Africa when she was young, see Figure 6. [10] We here at Fresno State are in a unique opportunity to facilitate this goal by enriching our own local community, by building on important tools available through emerging areas such as Data-Centric Artificial Intelligence. The 2023 AI Index highlights the rise in demand for those trained in areas of AI. [11]

Figure 6 Vice President Kamala Harris w/ Grandfather

2.2.4 Student Engagement w/ Discussions (Online/In-Person)

Research has shown that instructor student engagement is important for class engagement. [12] Reflecting on my course over the past 10 years, student engagement in class has definitely responded to personal student engagement. To better facilitate this, a key add to classes will be more discussions, both online via Canvas and in-class. These discussions will be organized to facilitate sharing ideas around both content, and personal details. This will facilitate both student teacher engagement by providing better sharing of information, but will also facilitate connections between students. These discussions will be used to calculate the participation grade.

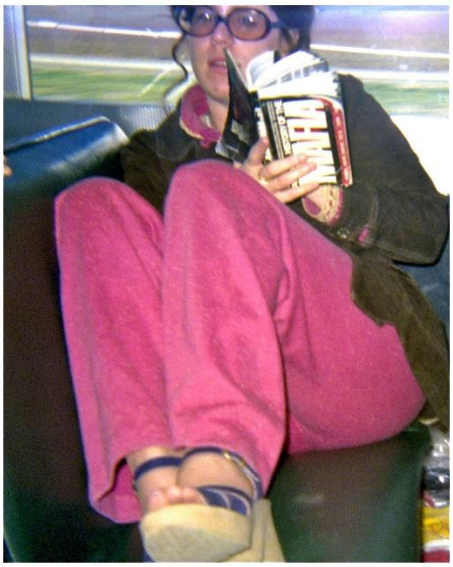

Figure 7 Mrs. Heifetz, 1974-1977 Favorite Teacher

My personal favorite teacher of all time was from my 9th grade English class at Sequoia Junior High. English was never my favorite subject, but Mrs. Heifetz's ability to connect personally with all her students, made class come alive. I actually first met Mrs. Heifetz my first year at Sequoia because her class was adjacent to one I was in, and her presence on campus was quickly felt. Figure 7 displays a few photos of Mrs. Heifetz on a memorable trip to Berkeley and San Francisco in 1977. Not only was she able to inspire me to love literature, she was also able to connect with my father who later worked at Sequoia as a custodian, enabling a continued relationship with this beloved instructor. Maybe not completely surprising, Mrs. Heifetz lifelong husband was a professional musician. Figure 8 shows a recent photo of Mr. Heifetz with the then president's daughter, Ivanka Trump, from a professional piano player opportunity.

Figure 8 Mr. Heifetz w/ Ivanka Trump

US Surgeon General report on Loneliness in US [1] highlights the importance of connections. A critical component of successful program is facilitating growth in our students. Our ability to facilitate connections can play in key role in improving upon this issue of loneliness while at the same time improving engagement. I too suffered from social disconnection while a student at Fresno State. This led first to taking advantage of a therapy group offered by the student health center. When registering for the group, student health explained the group membership benefits are greatest when coupled with individual therapy, so I was encouraged to take advantage of this as well. I was convinced to take advantage of both group and individual therapy as a student at Fresno State and believe it helped facility greater growth than I would otherwise achieved.

Reflecting upon the experience of interacting with Fresno State therapy community, much growth was gained from sharing my experiences as a student with different therapists, and then listening to their response as another human being. Once I checked-in to the system, I ended up working with many different therapist from the Fresno State community, and felt like it was great way of interacting with helpful professionals about basic social issues of a Fresno State student. I still remember one interaction with a Fresno State therapist where I was sharing concern with being disconnected as a student. Their words of encouragement followed with a comment about how, “many students experience issues of disconnectedness and some is attributed to our ‘Commuter School’ property where students driven-in and leave.” Encouraging this friendly sharing of life experiences and listening to the perspective of others really has a strong growth influence, and has shaped my approach to relationships in general.

With my course refresh focus on increased engagement through increased discussions both online and in-person, my intent is to share results in future workshops/conferences. Encouraging increased engagement as a way to improve learning, while also facilitating improvement in student growth and mental health is an exciting area. Through the semesters I will look for both metrics and case studies for highlighting results.

2.3 From Data-Centric AI to Deep Learning

My research work quickly moved towards Deep Learning. [13] [14] [15] [16] [17] [18] [19] [20] As a breakthrough area generating headline grabbing results, it is clear that this is an area where our departments can help students understand the technology.

Until the late 2000's deep neural nets were not able to shine against other machine learning methods. This changed in the late 2009-2010 with several simple but important algorithmic improvements: activation functions, weight initialization schemes, optimization schemes. With these improvements nets of 10 or more layers, allowing deep learning to start to shine. In 2014, 2015, 2016, further improvements introduced with batch normalization, residual networks, and depthwise separable convolutions. Now arbitrarily complex networks are possible. [16] When these arbitrarily large networks are combined with the processing power of modern data-centers, the results have been earth shaking. ChatGPT is an example of one such result, that has truly shaken the global consciousness around Artificial Intelligence.

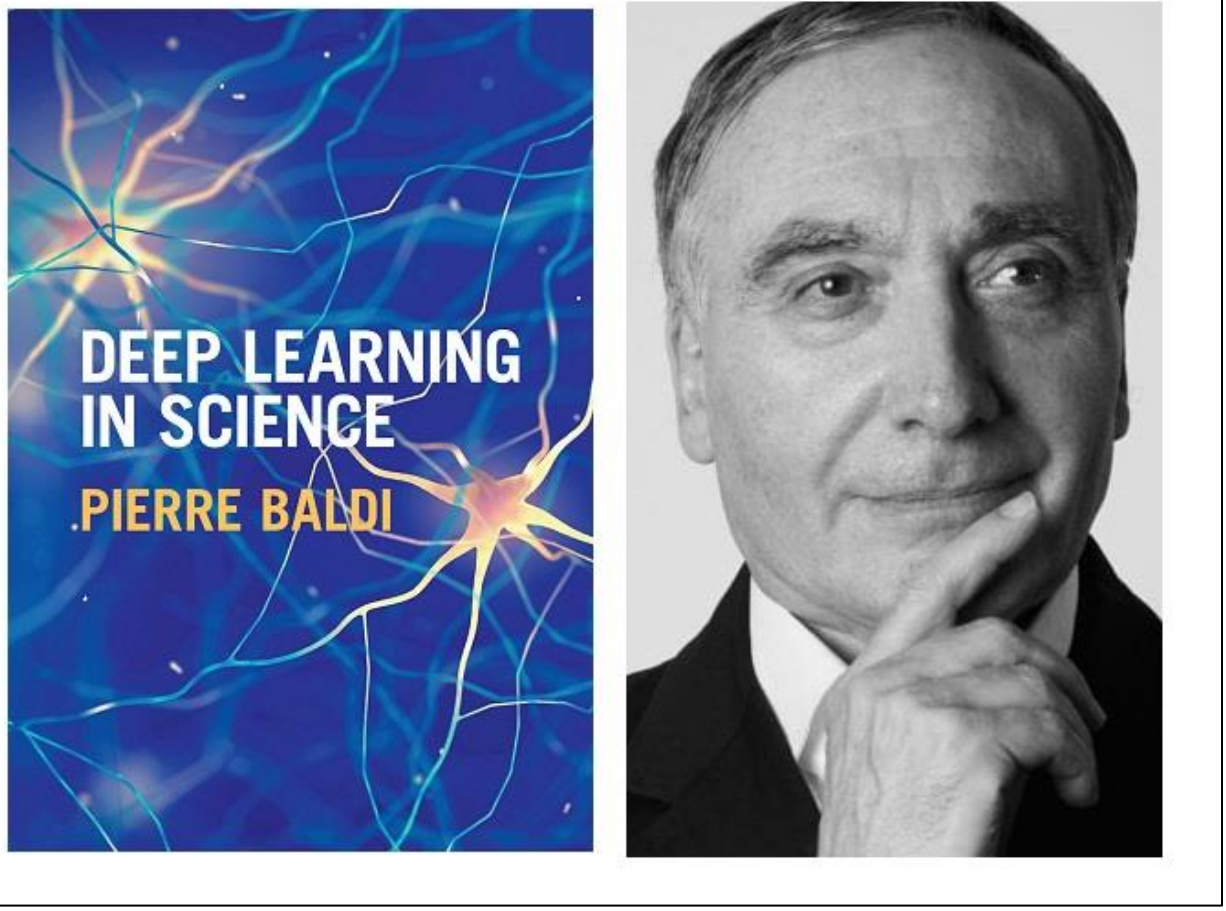

Figure 9 Deep Learning & Neuroscience [14]

Although many researchers approach Deep Learning purely from an algorithmic perspective, some researchers do emphasize the connection to biological neurological systems. Dr. Pierre Baldi with his Deep Learning text encourages researchers to understand these ties. [14]

2.3.1 Neurons and Deep Learning

Deep learning has its root in traditional machine learning, which in turn has multiple roots. One root definitely includes the work from neurobiology in understanding brain functioning, and the basic unit the neuron. The perceptron, and its perceptron learning algorithm has always been an important part of machine learning history. [20] Later Yann LeCun took inspiration from animal visual cortex architecture such as the early work of Hubel & Wiesel with cats to with his work with hand-written character recognition. [21] [22]

2.3.2 Data-Centric AI

Within the context of Deep Learning, the data suddenly can take on much more profound roles. Problems with the learned models can frequently be traced to issues with the training data. Work with engineering the data used to train models can suddenly become much more

important that the particulars of the model. This work in understanding learning with a focus on the data becomes is suddenly an important research topic. [23] [24]

2.3.3 Large Language Models

Large Language Models started raising waves in November of 2023 with ChatGPT. [25]

2.3.4 Course Proposal: Introduction to Deep Learning

Sabbatical work with deep learning lead to realization that my current Machine Learning course really needed a modification to provide a better lean into deep learning. My proposal was:

> *The Department of Computer Science is currently offering a Machine Learning undergraduate topics course. The demand from students for the course has been strong since its first offering in Spring of 2013. That first semester the enrollment was 17. When offered the second time, in Fall of 2016, enrollment was 40. Our third offering was Spring 2018 when enrollment was 27. Our fourth offering was in Spring 2019 with an enrollment of 42. Our last offering was Fall of 2021 with 22 students. Our proposal now is to convert this topics course to a regular course, but with a slight rebranding as Introduction to Deep Learning.*
>
> *Machine Learning is a fundamental area in computer science, with a wide range of applications such as the data classification (images, signals), with Deep Learning being extensions of core machine algorithms. Student interest is high to learn about this technology from its fundamentals as it can be applied on various problems, biomedical signals, neuroimaging,... . The maturity of many of the tools for Deep Learning is making its application potential continue to grow. Interestingly these tools build upon many classical mathematical frameworks such as linear regression and gradient descent, making them well suited for curriculum course.*
>
> *This proposal to convert the Machine Learning topics course to a regular course is well justified at this time, and supports department goals. Placing the focus for course on Deep Learning allows for an early entry into this area, providing opportunity to establish strength in this area for the College and University. Once converted we will be able to continue to develop the content and educational tools to best meet the needs of our students and the community these students will serve once they graduate.*

While the response to the proposal was positive, the request was to further the focus on Deep Learning, and modify title to “Introduction to Deep Learning”, which the department approved as CSci 167, with new course description:

> *This introductory course on deep learning will give an overview of many concepts, techniques, and algorithms in machine learning with special*

attention to concepts underlying modern deep learning. This course will cover fundamental concepts, techniques, and algorithms, including logistic regression, backpropagation, diminishing gradients issue, batch normalization, residual networks, convolutional networks, recurrent networks, and hyperparameter tuning. Hands-on experience through machine learning experiments using popular learning frameworks.

As a resource within the University for Deep Learning, we would look forward to facilitating the use of this technology with many projects. For example, Dr. Chris Miller from the Psychology Department here in the College of Science and Mathematics has used fMRI scans for predictive tasks, achieving prominent recent results. [26] Earlier work has also shown illustrated great expertise with domain features. [27] Such expertise would provide excellent opportunities for exploring data and datasets through a variety of learning architectures.

3 Personal Benefits

My sabbatical has strengthened my resolve to continue to work to contribute to the community for as long as I am able. My mother saw steady decline throughout the sabbatical year, passing June 13th 2023 [3], leaving me feeling fortunate for the additional available time I was able to spend together and the care and support I was able to provide my mother.

My refresh of course has shown that engagement is facilitated by personal engagements with students. As a student my focus was always on content, so as I worked on teaching my focus moved more towards content, missing the key element of personal engagement. My sabbatical has reinforced my commitment to share with student my own background in the valley, and allow them to share elements of their story. This process facilitate community building, and is critical to improving STEM engagement.

4 University Benefits

University benefits from my sabbatical fall into two categories: student engagement, and Deep Learning.

4.1 Student Engagement

My sabbatical has provided me with an interesting perspective on the relationship between the Fresno State faculty (Computer Science, in particular) and the local community at large. Moving between both communities has been illuminating. My goal is to support improved engagement with the students and community. Promoting personal and professional ties between faculty, students, and community is critical for both improved engagement and improved community health and well-being. This is not a one-shot solution. Only by adopting approaches to

facilitate continued growth with our community engagement will we achieve our goals. I intend to push this using my own understanding of the community, together with course curriculum activities to allow students to share community ties with instructor and classmates. This continued process will be beneficial to department and university.

Understanding our diverse community is difficult, but each of us offers unique blends of valuable ties. My own ties begin with growing up in the community with two parents that also grew up in the community. Having gone to school in Fresno, including Fresno State, meeting my wife at Fresno state, then having two children graduate from Fresno State creates many community ties. Having first had the chance to move back into my home to care for my father through hospice in 2012, and then this past year with the sabbatical having the chance to again move back into my childhood home to care for my mother through hospice allows for another set of community ties. Combining these with teaching here at Fresno State and all the student interactions, and faculty and staff interactions creates another set of ties. My plan now is to use these ties to improve engagement to facilitate STEM education and community health, which benefits the university in its goals.

4.2 Deep Learning

Recognizing the significance of the new tools from Artificial Intelligence was highlighted during my sabbatical with new applications like ChatGPT. My sabbatical provided the opportunity to tie my understanding of these new breakthroughs to concepts I have been working with for years. My goals is to support these deeper understanding of these new technologies within our department and the university.

My transition from more traditional tools within Machine Learning and Artificial Intelligence provides a complementary perspective on this field and will support nicely an organic approach to growing understanding of these tools within the department. This growth in deep understanding will provide a resource to the other departments for the use of these powerful new tools.

5 Original Proposal

5.1 Overview

Since leaving industry and beginning my time here as a lecturer I have benefitted from many experiences influencing my educational pedagogy. From an academic perspective, I have been able to teach classes ranging from first class students take when learning computer science (CSci 40), to advanced undergraduate courses in Artificial Intelligence, Machine Learning, and Database Systems, to graduate courses in Artificial Intelligence and Database systems. I have also been able to advise a number of graduate and undergraduate students. This has all helped prepare me for this opportunity for a sabbatical period.

I have had the opportunity to take advantage of several educational opportunities to facilitate teaching activities. I participated in DISCOVERe and Course Redesign training, along with several additional training opportunities. These programs combined with the teaching experience has sparked my interest in having time to synthesize and apply this knowledge.

On a personal level, I have watched my own son and daughter start and finish their undergraduate studies here at Fresno state, with both now working in the education sector. My son is now a high school math teacher at Berkeley High School, and my daughter an administrator at Seattle Central College. This after having graduated myself from Fresno State growing up here in Fresno with my father working as a custodian for the Fresno Unified School District, and my mother never working outside the home. These combined experiences have shaped my perspective on teaching, and now I would like to utilize this sabbatical to synthesize this experience into improving my own teaching and research activities.

I am proposing a 2 semester sabbatical providing enough time for: (a) revision of class materials for several of courses currently teaching, (b) improved understanding of current research and industrial applications for my research area.

The Computer Science department here at Fresno State is well positioned to provide a strong influence on our central valley to facilitate technical innovation and growth. It is also well positioned to facilitate improved social equity and inclusivity by embracing tools and technology brining new skillsets, understanding and perspective to many underserved communities of the central valley. My sabbatical will provide me with tools and time to help our department, college, and university make these opportunities a reality.

5.2 Proposed Activities

5.2.1 Course Refinement

5.2.1.1 Course Learning Objectives:

Refining course learning objectives and insuring that all activities are aligned with these goals is needed for many of my courses. I propose developing new syllabi for courses to teach the year following my sabbatical.

5.2.1.2 Active learning:

Active learning has been a challenging change to adopt. Several peer reviews have suggested more in class activities, but I have struggled to develop these. Taking time to develop sets of seed activities aligned with learning goals with greatly help with this process. I propose the development of a set of active learning activities to incorporate into several classes, and incorporating these into course syllabi.

5.2.1.3 Teaching Technology:

Learning to take advantage of the latest teaching tools requires time, and this sabbatical will provide that time. I propose incorporating several new tools into course, incorporating descriptions of their use into course syllabi.

5.2.2 Research

Having spent most of my career in industry, understanding the role of research for our students of the central valley has been a challenge, especially in the light of high teaching loads. This sabbatical will give me time to revisit a few active research areas in Machine Learning/Artificial Intelligence and the new area of Data-Centric AI. I propose to write a Survey from the research into these areas.

5.3 Timeline

5.3.1 Summer 2022:

I intend to start the sabbatical year by taking advantage of summer courses usually offered through Center for Faculty Excellence. This will provide good fodder to course improvement activity.

5.3.2 September, October, November 2022

- Revise CSci 40 course objectives/evaluations/feedback/activities.
- Develop research Survey of new area of Data-Centric AI:
    - See for example: https://github.com/hazyresearch/data-centric-ai

5.3.3 December 2022

- Updated Syllabi for CSci 40 shared with department.
- Improved activities and other course materials for CSci 40 shared with department.
- Data-Centric AI Survey shared with department.

5.3.4 January, February, March, April 2023

- Develop AI/ML revision to course objectives/evaluations/feedback/activities.
- Develop Database revision to course objectives/evaluations/feedback/activities.
- Develop proposal to convert Machine Learning topics course.
- Develop proposal/evaluation for possible Data-Centric AI Course for consideration.

5.3.5 May 2023

- Newly developed AI/ML/Database course objectives/evaluations/feedback/activities shared with department.
- Proposal for Machine Learning Topics course conversion provided to department.
- New course proposal/evaluation for Data-Centric AI provided to department.

5.3.6 June 2023

- Final Report provided to department.

5.4 Resources

Resources required will include continued office space, desktop computer, and Microsoft Surface tablet and keyboard.

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Sabbatical Proposal

Dr. David Ruby

9/17/2021

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I have had the opportunity to take advantage of several educational opportunities to facilitate teaching activities. I participated in DISCOVERe and Course Redesign training, along with several additional training opportunities. These programs combined with the teaching experience has sparked my interest in having time to synthesize and apply this knowledge.

On a personal level, I have watched my own son and daughter start and finish their undergraduate studies here at Fresno state, with both now working in the education sector. My son is now a high school math teacher at Berkeley High School, and my daughter an administrator at Seattle Central College. This after having graduated myself from Fresno State growing up here in Fresno with my father working as a custodian for the Fresno Unified School District, and my mother never working outside the home. These combined experiences have shaped my perspective on teaching, and now I would like to utilize this sabbatical to synthesize this experience into improving my own teaching and research activities.

I am proposing a 2 semester sabbatical providing enough time for: (a) revision of class materials for several of courses currently teaching, (b) improved understanding of current research and industrial applications for my research area.

The Computer Science department here at Fresno State is well positioned to provide a strong influence on our central valley to facilitate technical innovation and growth. It is also well positioned to facilitate improved social equity and inclusivity by embracing tools and technology brining new skillsets, understanding and perspective to many underserved communities of the central valley. My sabbatical will provide me with tools and time to help our department, college, and university make these opportunities a reality.

II Proposed Activities

Course Refinement

Course Learning Objectives:

Refining course learning objectives and insuring that all activities are aligned with these goals is needed for many of my courses. I propose developing new syllabi for courses to teach the year following my sabbatical.

Active learning:

Active learning has been a challenging change to adopt. Several peer reviews have suggested more in class activities, but I have struggled to develop these. Taking time to develop sets of seed activities aligned with learning goals with greatly help with this process. I propose the development of a set of active learning activities to incorporate into several classes, and incorporating these into course syllabi.

Teaching Technology:

Learning to take advantage of the latest teaching tools requires time, and this sabbatical will provide that time. I propose incorporating several new tools into course, incorporating descriptions of their use into course syllabi.

Research

Having spent most of my career in industry, understanding the role of research for our students of the central valley has been a challenge, especially in the light of high teaching loads. This sabbatical will give me time to revisit a few active research areas in Machine Learning/Artificial Intelligence and the new area of Data-Centric AI. I propose to write a Survey from the research into these areas.

III Timeline

Summer 2022:

I intend to start the sabbatical year by taking advantage of summer courses usually offered through Center for Faculty Excellence. This will provide good fodder to course improvement activity.

September, October, November 2022

- Revise CSci 40 course objectives/evaluations/feedback/activities.
- Develop research Survey of new area of Data-Centric AI:
    - See for example: https://github.com/hazyresearch/data-centric-ai

December 2022

- Updated Syllabi for CSci 40 shared with department.
- Improved activities and other course materials for CSci 40 shared with department.
- Data-Centric AI Survey shared with department.

January, February, March, April 2023

- Develop AI/ML revision to course objectives/evaluations/feedback/activities.
- Develop Database revision to course objectives/evaluations/feedback/activities.
- Develop proposal to convert Machine Learning topics course.
- Develop proposal/evaluation for possible Data-Centric AI Course for consideration.

May 2023

- Newly developed AI/ML/Database course objectives/evaluations/feedback/activities shared with department.
- Proposal for Machine Learning Topics course conversion provided to department.
- New course proposal/evaluation for Data-Centric AI provided to department.

June 2023

- Final Report provided to department.

Resources

Resources required will include continued office space, desktop computer, and Microsoft Surface tablet and keyboard.