Sabbatical Report
Fall 2022/Spring 2023

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1 Introduction

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 Context

After more than 10 years of experience at Fresno State as a lecturer in Computer Science my 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 to care for my mother with late stage Alzheimer's. 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 STEM Outreach

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. [1] [2] [3] 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.

2.1 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. Students will have same desire with classroom engagement.

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

Figure 2 Code Subtext 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 "Duky". 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.

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

int main() {

   double carLoan1, carLoan2;

   carLoan1 = 25000.00;

   return 0;
}
```

```cpp
#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 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. [4] 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. [5]

3 Data and Artificial Intelligence

My research work quickly moved towards Deep Learning. [6] [7] [8] [9] [10] [11] [12] [13] 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. [9]

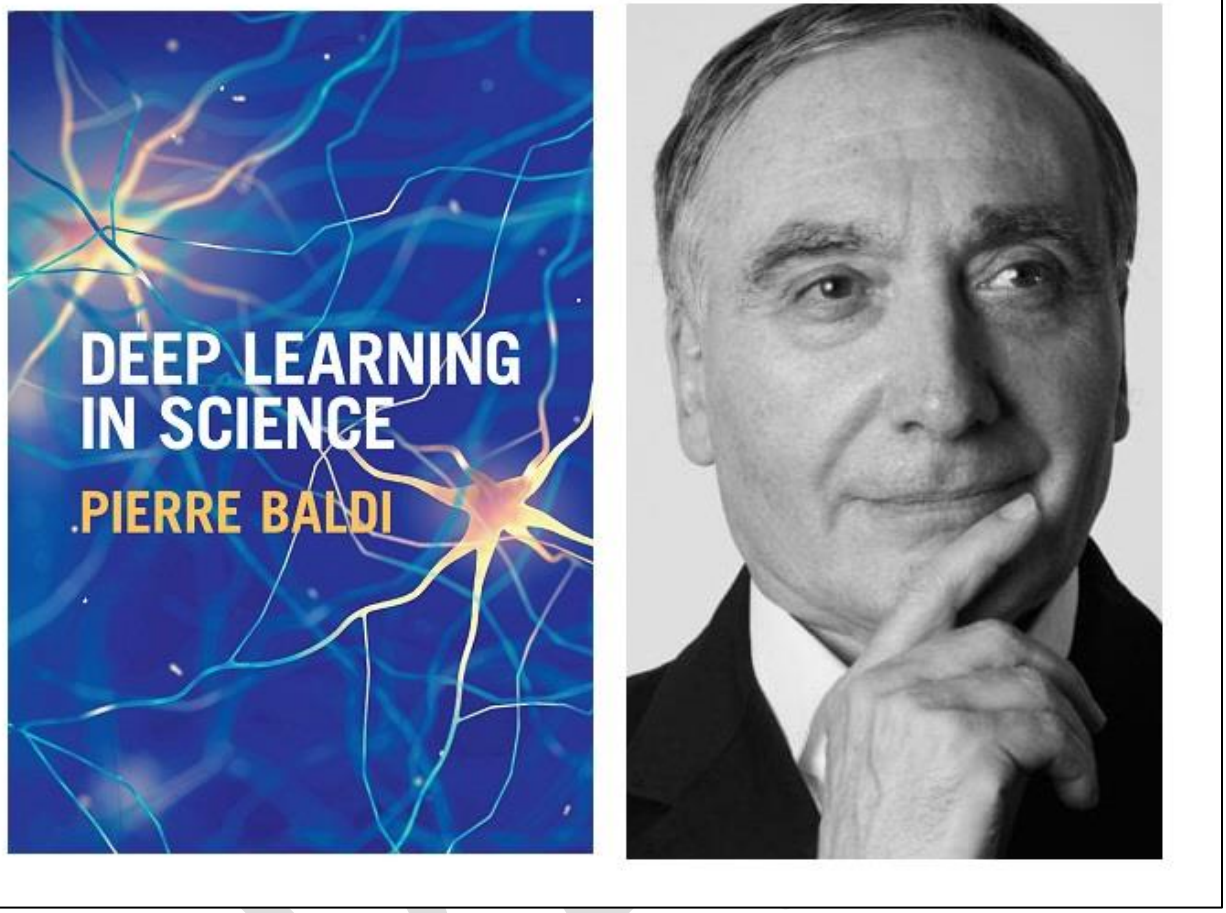

Figure 3 Deep Learning & Neuroscience [7]

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. [7]

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. [13] 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. [14] [15]

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. [16] [17]

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