Thesis Project Portfolio

Convolutional Neural Network for Automatic Cobb Angle Detection

(Technical Report)

Reskilling Programs: Giving Lower-Income Adults the Opportunity to Thrive in an Ever-Increasing Digital Skills Labor Market

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

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Sociotechnical Synthesis

Throughout the past decade, humans have seen technology accomplish things that our grandparents could never have dreamed of. Computational modeling, robotics, and artificial intelligence have allowed industries to revolutionize the way they perform day-to-day tasks. Technological automation is used extensively in the modern healthcare field to improve patient outcomes within hospitals. My technical thesis focuses on the development of a machine learning algorithm to automate spinal Cobb angle detection for potential Adolescent Idiopathic Scoliosis (AIS) patients. My STS research investigates a negative consequence of technological advancement: the displacement of laborers from the modern workforce. In my thesis, I discuss the social implications of technology's ever-increasing presence in the workforce, and how society can adapt to retrain workers so that they may remain relevant in today's digitalized job market.

My technical thesis focuses on automating the current process of measuring a child's spinal Cobb angle during diagnosis of AIS. Current diagnosis for AIS involves measuring the Cobb angle (degree of lateral curvature) of a patient's spinal X-ray by hand – a time-consuming and error-prone process for orthopedic surgeons. By iteratively training a convolutional neural network with a dataset of real patient spinal X-ray images, my capstone team has created a deep learning algorithm to automate this Cobb angle detection. Our technology is able to significantly reduce measurement error and ultimately save orthopedic surgeons valuable time during AIS diagnosis.

My technical thesis emphasizes how digital automation can be used for good; my STS thesis, alternatively, explores how technology can consequently displace laborers from the workforce on a macro level. Focusing on Boston, Massachusetts as a case study, I set out to

research how organizations currently retrain workers who were displaced due to efficient modern technology. I discovered that corporations, education systems, and government bodies each have their own versions of job retraining programs that serve Boston's citizens. However, while these reskilling programs exist, they are woefully disjointed, and often inaccessible to lower-income citizens. As a result, I propose a way that these three entities can unify to create a streamlined job retraining pipeline that will adequately serve those who need it the most. By adopting this model, Boston's labor workforce will be able to adapt to keep up with today's rapidly-evolving technological labor market.

Overall, I was able to automate an outdated medical diagnostic practice, while understanding the implications that such automation can have on the modern labor force. Building off of my work, I hope that engineers continue to explore new and innovative ways to improve diagnostic technology in the healthcare field. However, while doing so, I hope that they can be cognizant of potential social ramifications, and ensure that their technology can coexist with a concurrently evolving labor workforce.

I would like to thank Alexander Singh and Eric Teleghani who have guided my team throughout our technical capstone project. I would also like to thank Sean Ferguson who helped me pinpoint my research methods in order accomplish my STS thesis.