Thesis Portfolio

Adaptive Mobile Sensing: Leveraging Machine Learning for Efficient Human Behavior Modeling

(Technical Report)

Building Organizational Learning Cultures in Response to Technology-driven Workforce Shifts

(STS Research Paper)

An Undergraduate Thesis

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Erin Barrett
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Department of Systems and Information Engineering

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Sociotechnical Synthesis

Technology is rapidly transforming all aspects of society: lab-generated meat alternatives are altering fast food menus, cars are driving themselves, and employees are getting trained through virtual reality. Through my analyses, I explored how this rapid development in technology allows unprecedented benefits, but also requires significant changes to avoid severe sacrifices. My capstone project explores possible societal advancements by using cutting-edge smartphone technology. However, rise in technological capabilities may also come at a cost to society. My STS research dives deep into such a scenario (workforce displacement due to technology) and builds actionable solutions to avoid such repercussions.

My capstone project focuses on how smartphone sensor data can be collected, cleaned, stored, and modeled to predict human states effectively. Smartphones can receive millions of data points from each user daily, contributing to a significant change in how the healthcare community approaches health monitoring. To develop robust contextual models, the capstone team performed a three-week study to collect data through a mobile crowdsensing application named Sensus. In this study, participants' smartphones use multiple sensing strategies, ranging from infrequent sampling to continuous sampling, to determine the effect each sensing strategy has on data integrity and battery life. The study concluded with a dynamic data collection strategy that uses a machine learning model trained on existing data collected from 220 participants to forecast when a smartphone will be active and trigger sensor sampling accordingly. The results of this study include the extraction of model features that deliver maximized data quality with minimized battery consumption, implementation of context-driven modeling of user data, and optimized data queries used in metadata visualizations. The adaptive sensing models produced could be used in

future population studies that efficiently examine patterns of behavior in multiple individuals over extended periods to identify disease indicators present in an average user's daily life.

On the other hand, my STS research explores the adverse effects technological growth may have and how to prevent such consequences. Companies are experiencing unprecedented benefits from technologies like machine learning and AI. This growth is creating superhuman standards of productivity and efficiency in America, but this growth is also displacing the people who perform those tasks. Hundreds of millions of people will soon be unemployed due to the rise in technological adaption unless organizations act to institute cultural changes. Organizations must build lifelong learning cultures that foster continual role changes and skill development to assist workers in keeping pace with technological changes. The successful creation of learning cultures is critical to fulfilling future demanded skillsets, avoid dramatic wage polarization, and reap the business benefits technology promises. To discover more about these learning cultures and their environments, Actor-Network Theory is used as a theoretical lens to analyze both the technological and human entities that make up a thriving learning culture. The actors included in this network analysis include, but are not limited to, organizations, individuals, technologies, and learning platforms. This framework and extensive research answer found that an organizational lifelong learning culture should follow a multipronged approach of both cultural traits and individualized learning enablers. Organizations need to build collaboration, active learning, and timely feedback into their culture, while providing personalized learning enablers of learning platforms and role modeling to create a learning culture.

Through these various explorations, I learned that while it is easy to think of the direct benefits you could receive from technological growth, it is crucial to think of how others could also be affected by this technology. With my capstone, it is transparent to see the gains from

smartphone health monitoring: Athlete concussions could be discovered sooner, preventing further injury; soldiers suffering from anxiety could be pulled from duty. However, could such findings also adversely affect individuals? Would smartphones detecting mental health issues lead to discrimination of such individuals when choosing ranks in the military, selecting drafts for sports teams, and scheduling medical staff for procedures? Individuals with mental health issues are just the tip of the iceberg for those who could be adversely affected by the technology my capstone is developing. Hence, it is vital to consider these edge cases while building technology. Without my STS research, I most likely would not have developed this perspective in my Capstone work. My findings in both my STS research and capstone pave the way for society and technology to advance together.