Thesis Project Portfolio

Synthesis of the Path-Planning of Autonomous Vehicles and Reinforcement Learning in University of Virginia Computer Science Curriculum

(Technical Report)

A Virtue Ethics Analysis of the Development and Testing of the Airbus A400M Atlas Aircraft

(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

My technical and STS research projects are primarily connected through the potential consequences of inadequate software development and testing of vehicles. With increasing usage of software to control various types of vehicles, those who produce software in such fields must implement high-quality programming with sufficient testing to reduce the potential for dangerous accidents. My technical work examines ways to improve the current CS curriculum at the University of Virginia School to better prepare students for future work in the autonomous vehicles industry, while my STS research focuses on an example of a failure in software development and testing which resulted in the crash of an Airbus A400M aircraft. Although my technical and STS research projects differ in the application of software, both works investigate the need for proper software practices to be implemented in their respective fields.

My technical work proposes a new design with two potential methods to improve the teaching of autonomous vehicles software and artificial intelligence in the UVA CS curriculum by providing different avenues for students to apply their knowledge. The first proposed method is to have students apply a reinforcement learning algorithm to their F1Tenth car to replace the Pure Pursuit algorithm currently taught in the Autonomous Vehicles course. The second proposed method is to have the professor for the Autonomous Vehicles course provide a guest lecture to demonstrate various artificial intelligence algorithms applied to a F1Tenth car. This proposed design will hopefully produce more dedicated and experienced engineers who will positively contribute to successful software development beyond the classroom.

My STS research also explores software development and testing, but concentrates on an example of software failure that resulted in a crash of one of Airbus' A400M aircraft. My research uses the normative ethical framework of virtue ethics as developed by Aristotle to judge the morality of Airbus' actions leading up to the crash of its plane and subsequent loss of life. I

claim that Airbus can be held ethically responsible for the event due to its lack of two character traits deemed necessary for morally responsible engineers by Michael Pritchard: commitment to quality and cooperativeness. The lack of these two qualities throughout Airbus' work and relationship with its engine supplier resulted in insufficient implementation and testing of software needed to control the aircraft's engines. My research paper examines this claim with the ultimate goal being to add to the broader discourse on responsible engineering practices in software and aerospace engineering.

Working on these projects simultaneously has added immense value to both, where my technical work allowed me to explore what makes a successful engineer and how to properly implement software engineering before investigating what Airbus did wrong with their development of the A400M aircraft. My STS research allowed me to consider the potential harm to society caused by inadequate software design and testing, which in turn made me more motivated to improve the curriculum of the CS department at UVA to produce more experienced engineers. Overall, working on both my technical and STS research projects over the past year has allowed me to examine what successful software engineering entails with each project increasing the quality of the other.