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Two of my favorite movies are Terminator and Wall-E. One tells the story of a killer robot attempting to rid the world of humans for good, while the other envisions a lone robot who is desperately trying to give humans another chance of life on Earth. While at first glance, the premises of these movies seem to directly oppose each other, both plots are driven by the capabilities of artificial intelligence. Indeed, the idea of autonomous or intelligent robots has intrigued human minds for ages. However, it is only now, in the 21st century, where robots like Terminator and Wall-E may no longer be science-fiction and soon may become a reality.

For any expanding field of science, it is imperative that the Navy and the Marine Corps are at the forefront, actively seeking out ways to incorporate new scientific ideas into their work; autonomy is no different. Naval research program officer Dr. Bob Brizzolara summarizes that autonomous ships can allow for more expendable ships, ensure that humans are not placed in risky environments, and open the door for new innovative designs for watercraft. For example, new bio-inspired designs may be crafted, such as a ship that mimics the rhythmic fan of a dolphin's tail fin. This could possibly create new ships that are much faster and hydrodynamic than old ones. An invention like this is only possible if the ship is autonomous and doesn't require a person on board; imagine riding a ship that constantly goes up and down like a dolphin! Furthermore, Aamir Qaiyumi, technology lead for autonomous systems, discusses how autonomy will allow us to discover and collect data from difficult destinations, many of which may be too dangerous for humans to travel to. For the Navy, this includes the deep seafloor and discovering what lies there, including new organisms, shipwrecks, or even old sea mines that must be disabled. Finally, what's extraordinary about naval research in autonomy is that their research can propagate to other sectors of science. In fact, Qaiyumi admits NASA is attempting to use very similar technology to power robots that can investigate hostile locations on other planets.

Autonomy is interesting to me because it exemplifies how humans are able to create something that can inevitably become smarter than ourselves. Just as how our ancestors utilized simple machines to multiply the force and work that they could achieve, autonomous robots truly shatter the limits of what we think is possible in the 21st century. I'm fascinated by this topic because the power and usability of autonomy is unprecedented and unparalleled. After doing more research concerning how autonomy is shaping the future, I have become even more interested in the field. The Navy alone has increased their spending on unmanned vehicles from $50 million in 2019 to $450 million in 2020, and this money is being spent on a variety of applications. For example, a body of research surrounding autonomous weapons is growing rapidly, and is important for every sector of the US military. This research is filtering into the design of weapons that are more precise and effective at defeating enemies. In fact, professor Steven Umbrello at the University of Turin argues that autonomous weapons are already far more accurate than human-driven weapons. Sociology professor Amitai Etzioni further finds that humans are worse than robots at performing objectives on the battlefield, because emotions such as fear or hysteria can cloud human judgement and problem-solving; autonomous robots have no such weakness. On the other hand, lots of research surrounding autonomy actually goes into discussing the morals and ethics of utilizing autonomous machines. For instance, Dr. Brizzolara speaks of how self-driving cars are a great example of the power of autonomous machines. However, what he doesn't discuss is the ethics behind self-driving cars. How should a self-driving car act if it must collide into one of two vehicles? I find

autonomy fascinating because not only are the potential applications endless, but each potential new application forces us to ensure that it is ethical.

Dr. Brizzolara and Qaiyumi's talks, as well as my additional research have inspired me to further dive into this field in the future. I've always been interested in computer science, but it's always been a broad interest. However, after learning so much about autonomy, I now hope that I can take a track in college specifically related to intelligent systems. Classes pertaining to artificial intelligence and machine learning will prepare me to tackle careers focused on autonomy. Furthermore, just as Dr. Brizzolara and Qaiyumi both have other interests outside of autonomy, I know that my future doesn't have to solely be focused on studying autonomous robots. In fact, studying biology, physics, chemistry, and other sciences may allow me to cross-apply ideas that can actually improve autonomous robot design. As a whole, I know that autonomy is inherently an interdisciplinary subject. I understand that my future career can specialize in a wide array of scientific fields, yet still incorporate ideas from autonomy. Ultimately, the interdisciplinary nature of autonomy just makes me all the more excited to further learn about robot intelligence.

I believe that autonomy will achieve new heights in 20 years. New inventions will most certainly affect our day-to-day lives more, and there's a possibility that autonomous robots may even replace jobs currently performed by humans. Perhaps in the future, we may build a robot that can independently diagnose patients for their health problems, replicating the job of a nurse or a doctor. We could have a self-driving vehicle that can automatically analyze what is in your pantry or fridge, understand foods you don't currently have, and subsequently drive to the supermarket to buy that food. We could design an autonomous rover that drives across Mars and finds the optimal location of a human base, based on climate, resources, elevation, and more. Alternatively, we could develop an "R2-D2" style robot that can help astronauts repair spaceships and space stations; this would ensure that astronauts do not have to do spacewalks themselves and remain safe inside space stations.

A plethora of ideas come to my mind that specifically pertain to the Navy and the Marine Corps. Perhaps the Navy can utilize small, autonomous robots to analyze and collect data on delicate underwater ecosystems, such as coral reefs, without disturbing the ecosystem. Similar robots could brave through tropical storms or hurricanes and collect vital info on how the hurricanes formed, how long they will last, and predict the destruction the storm will cause. The Navy may also have a robot that not only independently finds old WW2 sea mines, but has the capabilities to dismantle and disarm them. I also believe the Navy and the Marine Corps may be able to use autonomous robots to track weather patterns across the sea, which may affect shipping routes and ensure that ships are always taking the safest route possible. If natural disasters destroy houses or flood towns, the Marine Corps may be able to use intelligent robots equipped with IR sensors, laser scanners, radar, and other necessary equipment to find survivors in an area. The Navy could possibly use powerful human recognition software to send robots into enemy territory and find hostages among enemy troops; this would allow the robot to effectively neutralize hostile situations and save victims. Scientists may even be able to develop a way

for these robots to be self-sufficient; if solar panels were installed on underwater robots, the robot could automatically return to the sea surface when it detects that it needs to recharge its battery.

Autonomous robots are already here. The videos on the naval researchers have made me realize just how amazing it is to see what scientists can already do. Our inventions range from Boston Dynamics coding their robots to dance to the beat of music, to seeing little self-driving rovers deliver food to student dorms on college campuses. However, despite the fascinating work that scientists have done today, there are many more incredible ideas that have yet to come to life. I just hope that in the future, I can be a part of this developing field.