

2c.) If the absolute value of the pole angle,  $\theta$ , is more than .175 radians, or about 10 degrees, and the max Force is equal to 6N then the pole can not recover.

7b.) One logical application of this tool could be an autonomous caretaker robot that would respond to various human emotions differently. Another application could be an autonomous robot that tracks how a suspect reacts during an interrogation. One ethical consequence could be unwanted mass surveillance of customer service employees. Employers could create a system that keeps track of how their employees are feeling throughout the day and fire ones that they deemed too unhappy.

4b.)  $l_1 = 60\text{cm}$ ,  $l_2 = 40\text{cm}$

Joints	linkage length $d_i$	joint length $a_i$	torsion angle $\alpha_i$	joint angle $\theta_i$
1	$d_1$	$l_1$	0	$\theta_1$
2	0	$l_2$	0	$\theta_2$
3	$-d_3$	0	180	0
4	0	0	0	$\theta_4$

10a.) I believe that robotics can not be classified as purely a technical development field because it creates entities that should be, to some extent, accountable to the law. The problem with classifying robotics as solely a developmental field ignores that any entity that can make decisions, can cause problems. Already we have the problem of autonomous vehicles crashing and killing humans and the legal ramifications that causes. Now most companies will use the defense that their autopilot systems are still in a testing phase, and they require a human to have

their hands on the wheel and be paying attention. However, what happens when companies eventually release complete autonomous vehicles? The autonomous vehicles will need to make decisions and will likely cause some car accidents. Treating the field as only educational or theoretical overlooks the real-world consequences of creating systems that make decisions. Cloning causes similar ethical quandaries because both fields can create entities that some can make decisions, and cloning is so beset with ethical questions that it is illegal even though the field could lead to advances in medical technology.

10b.) Even if we only consider the first law, creating an algorithm that knows when a human is going to get hurt if a robot does something to stop it seems incredibly complex. Imagine a robot in the workplace sees a human on a ladder and the ladder being to topple. It would need to be able to recognize both the human and the ladder, understand that the human is about to fall, and act quickly enough to prevent the accident. There are many unforeseen scenarios where a human can get hurt and creating an algorithm that stops a robot from being in any of those scenarios would be incredibly difficult. These laws seem to assume that a robot system will have an almost complete understanding of the environment around it, and how decisions the robot makes will influence that environment. Making a robot capable of taking orders, or collision avoidance so the robot doesn't damage itself are completely possible in terms of complexity, but it seems to me that a robot would have predict the future to stop it from ever causing harm.

10c.) Currently since autonomous vehicles require a human pilot, companies will be able to blame the individual who should have corrected the machine. However, when car become completely autonomous, I think car accidents will be pretty similar to ones today. Assuming not everyone could afford a self-driving vehicle, there will be a mixture of autonomous vehicles and human driven ones which will likely cause accidents. I believe that investigation will happen to

see which part is the most at fault for the accident and blame will be assigned that way. What if there was a hiring algorithm that would automatically not consider certain candidates based on gender, race, or sexual orientation. Although the system is behaving in an unethical manner how would you prove that this was the company or individual's intent when they created the algorithm. I believe that most cases in which an autonomous system causes harm no one will be held responsible legally because proving someone's intention is incredibly difficult without ample evidence.

10d.) Laws that require companies to hire programmers to check autonomous systems for possible ethical violations would be a good start. One drawback would be that even if you had employees specifically looking for ethical violations, it would be practically impossible for them to foresee every way a system could cause harm. There could be laws regulating autonomous systems that could potentially be used for extreme harm. Having a risk analysis on systems would also help programmers look out for potential ethical problems as they work. However, this could lead to missing out on beneficial technologies because they are deemed too dangerous. There could also be laws that hold companies responsible to a degree when a system they created causes harm. The drawback to this is it might stop companies from wanting to develop autonomous systems because the sanctions are too expensive if they make a mistake. Another drawback to each of these laws is a general pushback from autonomous system companies against laws that increase the cost of running their companies.