David Kagawa-Aguirre

CSE 488 – Computer Ethics

Dr. Yasha Karant

Computing Errors and the Consequences of Artificial Intelligence

This essay will attempt to cover the ethical issues related to various software, hardware, and firmware errors that cause financial and physical damage to both software companies and the users of these specific products. The essay will also cover the potential consequences of artificial intelligence and cybernetic augmentations in association with humans. The two topics are completely different at first glance, but upon further examination it will become clear that they both deal with fundamental flaws regarding the computing world. The issues are also similar in that fact that they relate to a rapidly evolving technological field that is struggling to maintain the very basic ethical standards set by the IEEE code of Ethics.

Software and hardware errors along with cybernetic augmentations are already resulting in massive financial losses. This is especially alarming considering a world where technology is rapidly progressing and our dependency on this technology is parallel to this progression. The evidence displayed in this essay will show the financial and physical losses suffered by the people who utilize specific technologies. This harm is already a global issue when we consider the number of people who are supported by specific technologies. If these blatant ethical issues continue to be ignored, we can expect the financial and physical harm of its users to continue far into the future. Adhering to the basic code of ethics set by the IEEE code of ethics must be consistent and required by all professionals associated with technology. Further disregard of these ethical issues will result in massive financial losses. It’s clear that both financial loss and physical harm are symbiotic in the fact that damage to one results in damage to the other.

There are a great number of cases where arithmetic rounding, memory leaks, and various hardware malfunctions have caused harm, sometimes death. Arithmetic rounding, outlined in the IEEE floating point standard, is a computing protocol which guarantees that simple mathematical functions will yield correct results with infinite precision. This precision may become difficult, perhaps even impossible with very complex functions; however the result of these functions should still yield an accurate result. *Race conditions* are significant and common in software, logical circuits, and electronic systems. A *race condition* is a system flaw in which an output is significantly dependent on the sequence of operations within the system itself. Two separate signals "race" one another to be the first output. A *memory leak* is a software problem that occurs when a computer program uses memory without a return of memory to the system. This is common when an object is stored in memory, but not accessible by the program. These errors make up a large amount of common flaws found in software systems. Whether intentional or unintentional, these errors can be responsible for both physical and financial harm. Negligence is not a valid excuse when it comes to system flaws.

One of the most studied software disasters occurred between 1985 and 1987. A radiation therapy machine known as the *Therac-25* killed several people in an apparent overdose of radiation. The machine offered two modes of radiation therapy, a direct electron-beam therapy which delivered low doses of high-energy electrons over short periods of time, and a Megavolt X-ray therapy, which delivered X-rays produced by colliding high-energy electrons into a "target". The accident occurred when a high-powered beam was initiated instead of the intended low-powered beam. A "beam spreader" plate was supposed to rotate into place to evenly distribute the radiation, but failed to do so. The high-powered electron beam struck a patient with 100 times the intended amount of radiation, delivering a potentially lethal amount of radiation.

One of the patients described the feeling as “intense electric shock”, causing him to yell and scream and run out of the treatment center. After several days patients developed radiation burns and showed symptoms of radiation poisoning. Five people later died of their symptoms.

The problem was investigated by a commission which later found that the problems were attributed to bad software design and development practices. Several coding errors were found because the code was not carefully examined. One of the reasons for the equipment failure found that the equipment did not properly synchronize with the operator interface task, so that *race conditions* occurred if the operator changed setup too quickly. The result of this disaster produced a new standard which introduced *development life cycle* standards for medical devices.

The *Therac-25* represents a failure that can cause massive human pain, and even death because of negligence. Upon further investigation it was found that the *Therac-25* was never tested until it was assembled in the hospital. Complaints about the machines operations were ignored because of overconfidence in the software system. Furthermore when the system noticed something wrong with the X-ray beam, it merely displayed the world “MALFUNCTION” followed by an insignificant number not listed in the user manual. The user would then be given the chance to override the malfunction and proceed with the operation! This neglect of proper testing is a clear violation of both the ACM and IEEE code of Ethics. Not having the system properly inspected and reviewed by an outside party left control in the hands of the overconfident *Therac-25* developers. This also reflects egoism because the developers were only worried with the profit generated by the software, not its quality or the adverse effects the poor design created.

Another example of human harm and death as a result of software and hardware errors took place on July 3rd, 1988. The USS Vincennes show down a civilian plane over the Strait of

Hormuz during the Iran-Iraq war. The plane carried 290 passenger and crew. The crew aboard the US naval ship misread messages from the software system used on the ship and believed they were tracking an Iranian fighter jet. Several unanswered transmissions were sent to the airliner which resulted in the US naval ship firing two surface-to-air missiles, annihilating the plane. Although the US government did not fully admit to failure in their software systems, an amount of $62 million dollars was paid to the families of the victims aboard the plane.

The software error aboard the USS Vincennes represents a case where software can cause the death of innocent people. The captain cited *situational ethics* as a reason for the error. He claimed the action took place to protect the lives of his men because a Iranian plane was in the vicinity. Despite the situation the US government should be help to the highest standards because they hold the lives of thousands, perhaps millions, of people in their hands. Their software and equipment can single handedly wipeout entire cities.

Another example of a software error is the Pentium FDIV bug. This bug was in the Intel P5 Pentium floating point unit. The error was discovered by Professor Thomas Nicely at Lynchburg College, Virginia. While the error only affected 1 in 9 billion users, to produce inaccurate results, the processor was later recalled and resulted in a loss of 450 million dollars. When contacted about the error by Nicely, it was found that Intel in fact knew about the error and chose to ignore it because it was so rare. The Intel developers responsible initially claimed to have meet IEEE standards, but later it was clear they violated both the ACM code of Ethics and the IEEE standards. They were neither trustworthy with their claim, nor did they maintain the highest quality in a low-level process. The developers also displayed a *Utilitarian* attitude because the processors capabilities may have made them happy, the errors it produced created an outrage among the users.

One of the most interesting, yet frightening computer science fields is *Artificial Intelligence. Artificial Intelligence* is the study and design of intelligent agents, one that perceives its environment and takes actions that maximize its chances of success. *Robotics* is the actual physical design, construction, and application of a computing system applied to a moving robot. Robots are complex machines that have recently been used for various purposes, including expeditions on Mars, diffusing of bombs, and the assistance of medical procedures.

There are different ways to test the intelligence of a machine. One such method is known as the *Turing Test.* The *Turing Test* engages a human judge in a conversation with both another human and a machine designed to perform like a human. The test checks whether the judge can tell the difference between a machine and the human. The strengths of the test are its simplicity, and its ability to maintain a broad amount of subjects the judge can engage in with the machine. However the test is considered the initial test to measure the machines intelligence. The tests weakness lies in how it limits the scale of what the test an prove. The *Turing Test* only shows that a machine can impersonate a human being, not actually behave intelligently. Other criticisms say the test only measures synthetic intelligence, not "organic" intelligence. This basically means the test only measures the external behavior of the machine.

The *Chinese Room experiment* was created in an attempt to argue that the external behavior cannot be used to show if a machine is "thinking" or just simulating human behavior. The experiment attempted to show that the *Turing Test* did not properly indicate that the machine had a conscious mind or means to understand. However the *Chinese Room experiment* was also criticized because it suffered from logical errors and the misinterpretation of the main premise of the experiment.

When studying *Artificial Intelligence* we find that there are both advantages and disadvantages in its utilization. *Artificial Intelligence* can be used to go places humans currently cannot, namely Mars. These machines can survive in hard environments and complete important research for space programs conducted by NASA. However, there are situations where the impact of *Artificial Intelligence* can be negative. As our population increases, so does the number of people who need employment. Replacing the human population for machines that think for themselves can have a significantly negative impact on the world economy. Also, is it really possible to "trust" a machine to make the right decisions? Another question of whether or not the machines would stick to a specific code of ethics is another issue altogether. While the efforts to create robots to make life easier may be *Altruistic* in nature, the negative impact on the economy can be a major factor. I would also say that the movie "Terminator" is a good example of the capabilities of *Artificial Intelligence* if we were to put an extreme amount of trust into the machines. If a machine were put into a situation where is would have significant military capabilities, would the machines ethical code conflict with our own? *Artificial Intelligence* means the system would have its own conscious mind. This is frightening to me because it insinuates that the machine would have the ability to create its own set of standards and ethics based on its environment. Now imagine the machine views humans as a threat to its existence. With military capabilities entrusted to this *Artificial Intelligence*, it could spell the end of our civilization as we know it.

One of the most interesting and exciting technologies becoming available today comes in the form of cybernetic augmentations. Humans are now able to add artificial augmentations to enhance their own bodies. It's only a matter of time before people begin adding these augmentations without actually needing them. These augmentations can then be used to cheat

within sport organizations. Cheating with these augmentations will obviously increase the individual's profits. This behavior could then be considered to be consistent with Egoism. However these practices would also violate the ACM Code of Ethics.

There are also many negatives to these cybernetic augmentations. These augmentations could cause severe health complications because of malfunction parts. The augmentation could also have a problem because its not completely compatible with a humans organic system. When it comes to the creation of a super-human, egoism is the ethical system most related to the situation. However we could also consider a super-human to be for the good of man. Super-human cops could help clean up society. In that light we can view these super humans as altruistic beings.

There are several views when it comes to the points I have raised within my essay. It can be argued that the progression of technology has made life much better and easier. Although this is true, it's also true that many people in society choose to ignore the negative impacts of improved technology because of the benefits it provides. Cybernetic augmentations can be great when it comes to people who are missing limbs, and suffer from defects that can be corrected with an augmentation, however there are always those individuals who will take advantage of a technology to benefit them as an individuals. Simply put, technology is a wonderful thing if an individual chooses to use it ethically for the well-being of the human race.

The legal consequences for any individual human committing acts that lead to death or massive financial loss face serious jail time. However the organizations mentioned in this essay do not suffer these same consequences. Several people may die as a result of their negligence, or lack of ethical code, but as long as they put out an insincere apology that sounds somewhat sincere they are forgiven. Perhaps a civil case will be brought against an organization whose lack

of ethics caused harm to the public, but the truth is that these individuals who sue these organizations never truly receive the proper compensation for their losses. Technology is moving at such a pace to that it is almost impossible to regulate. As professionals in the computing field, it is our moral duty to ensure we meet all ethical standards set. Not adhering to these ethical standards could have catastrophic effects on the human race.

Works Cited

Mill, John Stuart. "*Utilitarianism.*" New York: Longman, 1907

Print.

Rachels, James. "*20 Questions: Ethical Egoism.*" New York: McGraw-Hill, 1961

Print

ACM Council. "*ACM Code of Ethics and Professional Conduct.*" Association for Computing Machinery. 16, Oct. 1992. Web. 26, Jan. 2013 http://www.acm.org/about/code-of-ethics

IEEE. "*IEEE Code of Ethics*." IEEE – The Worlds Largest Professional Association for the Advancement of Technology. IEEE, 1 Jan. 2013. Web. 26 Jan 2013. http://www.ieee.org/about/corporate/governance/p7-8.html

Fletcher, Joseph. "*Situation Ethics – The New Morality*" Louisville, Kentucky: Westminister Press, 1966.

Print.

Leveson, Nancy G., and Turner, Clark S. (July 1993). "An Investigation of the Therac-25 Accidents," *Computer* (IEEE), *26*(7):18-41

Dershowitz, Nachum. "Software Horror Stories." Software Horror Stories. 11 Nov. 2003. Web. 11 Mar. 2012. http://www.cs.tau.ac.il/~nachumd/horror.html

Knapp, Alex. "Is Ethical Human Genetic Enhancement Possible?" *Forbes*. Forbes Magazine, 15 Sept. 2011. Web. 19 Mar. 2012. http://www.forbes.com/sites/alexknapp/2011/09/15/is-ethical-human-genetic-enhancement-possible/

Schwartz, Ariel. "Roboethics: Three ways to make sure that future robots have morals" *NBC News.* 15 Feb. 2012 Web http://www.nbcnews.com/technology/futureoftech/roboethics-three-ways-make-sure-future-robots-have-morals-627612#/technology/futureoftech/roboethics-three-ways-make-sure-future-robots-have-morals-627612