**Engineering Ethics**

* **What is ethics?**

Ethics is the study of the characteristics of morals, and involves the moral choices made by individuals as they interact with other persons.

The word "ethics" originates from the Greek character ***ethos*** which means habit, custom, or character.

Ethical beliefs shape the way we live – what we do, what we make and the world we create through our choices. Ethical questions explore what Aristotle called 'a life well-lived'.

Ethics isn't just an exercise for philosophers or intellectuals. It is at the core of everyday life.
We ask ethical questions whenever we think about how we should act. Being ethical is a part of what defines us as human beings. We are rational, thinking, choosing creatures. We all have the capacity to make conscious choices – although we often act out of habit or in line with the views of the crowd. We could all make conscious and conscientious ethical choices if we wanted to. There are times when those questions become challenges we just can't resolve alone. Complex ethical problems can be individual and private or widespread and systemic, involving groups, organizations, or whole communities. Ethics provides a framework for answering these questions well. It allows us to be consistent in our judgements, provide reasons for our beliefs and to critically examine opinions. Most importantly, ethics allows us to act in a manner that accords with a set of core values and principles.
Ethical people live what Socrates called ‘an examined life’ – a life particularly associated with being human. Ethical people try to answer the question of how to live by reflecting on difficult situations. They then act in a way that is true to who they are and what they believe.

**Why be ethical?**
Lots of people like to play devil's advocate and ask why they should be ethical. After all, sometimes doing what's ethical comes at a personal cost. If ethics means we can’t exploit other people, tell lies, or steal when these things are in our best interests, why bother?
Ethical questions are an inescapable part of being human. We think and act according to ethical judgements all the time, whether we want to or not. Ethical reflection helps us make responsible judgements that reflect what we care about most.

Ethics is not only for the 'big issues'. Should we execute criminals? Can we destroy embryos for medical research? Lie under oath?

These issues are complex and deserve attention, but ethics covers more than these big things.
 It informs our day-to-day interactions. Should we tell a friend a truth even though we know it will upset them? Is it luxurious to spend my money on an overseas trip when there are people dying of starvation?
Ethics also looks beyond specific actions. It is good to know how to act right now, but we also want to know how to structure our lives as a whole. This is the part of ethics Aristotle called eudaimonia –best translated as 'flourishing'.
Ethics helps us to do the right thing, but it also helps us to live a life worth living.

**Not every ethical question has one right answer. That's ok.**

There is no ethical theory that can resolve every situation perfectly. Lots of things in our lives have moral value - sometimes they come into conflict. Moral dilemmas are inevitable.

Should you tell a lie to protect a family member who has done something wrong? Lots of people would say lying is always wrong. But those same people probably think we have special duties to take care of our families. Our answer in a case like this depends on how much we value certain ideals - truth or family.

What if we value both equally? This is where ethics gets tough. Unfortunately, even when faced with a moral dilemma we still have to make a decision.

In these cases, we need to accept the limits to certainty when trying to decide what we ought to do. Sometimes our range of choice is reduced to picking the least bad alternative. Sometimes we may feel genuinely 'stuck' by a problem. In those cases, we may just have to trust our experience and our conscience. Luckily most decisions aren't moral dilemmas and we can work out what to do with the help of a few ethical tools.

* **Ethics and the Law**

While there is clearly a close relation between ethics and the law – many laws are implemented to enforce the ethical judgments of our society – the two are not identical. A course of action might be legal, but it may still strike the engineer as unethical. Equally, it is clear that thinking through the ethical contours of a situation tells you nothing directly about the laws that apply to that situation in a particular jurisdiction.

Ethics and law differ in that ethics are social guidelines based on moral principles and values while laws are rules and regulations that have specific penalties and consequences when violated. Ethics do not have punishments, fines or associated penalties when people fail to abide by them while laws do. Both set standards of expected societal actions, but laws enforce actions while ethics set forth social guidelines.

Laws and ethics are found in virtually all spheres of society. They govern actions of individuals around the world on a daily basis. Laws and ethics often work hand-in-hand to ensure that citizens act in a certain manner, and likewise coordinate efforts to protect the health, safety and welfare of the public. Although most ethics established at the national level do not set penalties for violations of civil codes, many individual institutions such as corporations, organisations and associations can choose to establish remedial actions for breaches of ethics rules. They have rules that coordinate with a code of ethics, and these institutions may impose penalties for individuals who violate those rules.

 In some instances, laws are established based on ethics, principles or morals. In these instances, morals help to establish a minimal level of safety or expected behavior, which in turn facilitates the act of establishing governing laws. The law also can force people to perform what they believe to be unethical conduct, i.e. physicians who feel that a law forces them to be unethical must work within the legal world to change the law. Of course, a physician who has been exonerated from a criminal charge in the eyes of the law may have still been guilty and been ethically irresponsible.

Yet another example of the difference between laws and ethics can be seen in interpersonal relationships. A parent who is not spending time with his or her children could be considered ethically irresponsible as the children have a right to spend time with their parent. However, unless the lack of times leads to severe neglect, this choice to spend time away from one's children is not illegal.

While both laws and ethics work to establish a moral boundary for all people, ethics is a more personal honor code while the law is a justice-based rulebook. Violating laws will send a person to jail or give a person fines. Violating an ethical code will lead to shame and possibly the scorn of others; however, ethical codes do not carry legal punishments with them.

* **Ethics and the professions**

Why is ethics an integral part of professional life, and in particular the life of an engineering professional? The importance of ethics in the professions can be understood through thinking about what a professional is. The word ‘professional’ is hard to define, even for traditional professions such as medicine, law, accountancy and engineering. However broadly speaking there is agreement on common characteristics shared by all professions. Thus, a professional:

• has specialised skills and knowledge

• has acquired such knowledge and skills through a long period of training and study, and continues to maintain and update them through professional life

• has, as a result of this specialised expertise, significant power to affect individual clients and wider society

• belongs to a professional body which might regulate their practice

• and as part of that self-regulation adheres to ethical principles which the professional body oversees.

The expertise of professionals, and the domains over which they exercise that expertise, give them power to improve people’s wellbeing, or to cause significant harm. This is perhaps most obvious in the case of doctors, whose actions can save lives or cause death, and affect quality of life in many more subtle ways. A patient needs to know that a medical professional is not just technically competent, but will exercise ethically informed judgement in treating them, acting only with consent, maintaining confidentiality, pursuing their best interests, and so on. While the actions of a medical professional typically affect individual patients directly, the decisions of engineering professionals have the potential to impact on the wellbeing of many hundreds or thousands of people.

As a result of the power their skills bring, society places great trust in professionals to exercise those skills wisely. Thus, common to all professions is a commitment to use expertise in pursuit of the public good. This creates a critical role for ethics, as the professional’s adherence to ethical principles is a central part of the exercise of good professional judgement. Through this the professional both earns the trust of the public, and provides good reason for such trust to be continued.

In short, being a professional brings with it significant privileges in terms of effects on others, whether that be access to information about them, or capacity to affect their needs and interests. Those privileges bring with them important responsibilities, so professions and professional bodies need continually to earn the right to be entrusted with such responsibilities by showing that they exercise them in an ethical way.

* **Ethics and engineering**

It is important for engineering students to study engineering ethics so that they will be prepared to make (sometimes difficult) ethical decisions during their professional careers. Personal morality and professional ethics, however, are not always the same. One might have personal objections to working on military projects, but avoiding such work is not required.

Even if every nation has its own culture, its own history and traditions, engineers are nonetheless facing some common ethical issues on the micro-social level (what does it mean to be an ethical engineer?) as well as on the macro-social level (what is the specific responsibility of the engineering profession toward society?) This is even more relevant in our global world.

Engineers need to be aware of ethics as they make choices during their professional practice of engineering. Engineering ethics will be defined as the rules and standards governing the conduct of engineers in their roles as professionals. Engineering has a direct and vital impact on the quality of life for all people. Engineering ethics should be classified as professional ethics because engineers have a special knowledge and influential power as they have a special responsibility to prevent dangerous results caused by their actions.

Engineers work in many disciplines but all of them have the ability to affect societal wellbeing to a very significant extent. The services provided by engineers require honesty, impartiality, fairness, and equity, and must be dedicated to the protection of the public health, safety, and welfare. Engineers must perform under a standard of professional behavior that requires adherence to the highest principles of ethical conduct. They impact on individual and communal welfare in many direct and indirect ways. When a person steps on a bridge they need to know that engineers have wisely balanced the paramount importance of safety against demands for building within cost and achieving a pleasing aesthetic result. The location of a mining project requires good judgement; considering environmental and other impacts as well as adequately meeting technical and commercial requirements. Material and energy resources are used in the production, packaging and distribution of products that engineers design and make, and so the engineer must consider the sustainability of their methods. Responsible engineers should be aware of all these implications and act appropriately in light of them.

Clearly, then, engineering professionals need to be trusted across a vast range of human activity. Wise ethical judgement is as important for engineers as for any other profession. How, though, does ethics differ from basic common sense? There are many concrete examples which show that intelligent people with good common sense can disagree where ethics is concerned. Modern electronic devices that allow surveillance are often claimed to be valuable in countering terrorism, but people disagree as to whether the consequent invasion of privacy is warranted. Some see the production of wind-power as an environmentally sustainable way of meeting needs for electricity, but others claim the impact of the large turbines on the landscape to be environmentally damaging.

Do such difficult cases show that ethical issues are merely subjective, with no right or wrong responses? They show only that it may not always be obvious what the right answer is, as even the most difficult dilemmas have ‘wrong’ answers.

Principles such as honesty, loyalty, integrity, accuracy, impartiality, rigour, confidentiality, respect for life, law and the public good should guide an engineer in achieving the high ideals of professional life. Some of these principles apply to all professions equally; other principles have a stronger role to play in engineering.

Much of the role of an engineer is taken up with making judgments, working with new technologies, and giving advice. So, the need for accuracy and rigour, for maintaining up to date knowledge, and for care in representing the evidence accurately and not making claims that go beyond the evidence, is particularly crucial in engineering. Any inaccuracies may lead to accidents, failures, or even death. Engineers almost always work for and with others – clients, employers, and contractors – and may face conflict between their professional values and the demands made on them by others. Famously in the Challenger Shuttle disaster the engineer concerned with safety critical matters was exhorted by his manager to think like a manager not like an engineer. There may often be similar external pressures to stray from professional obligations, so it is helpful to have clarity on what those obligations are.

* **Fundamental principles**

**Honesty, integrity, confidentiality, professionalism and competence**

Engineers have a duty to ensure that they acquire and use wisely and faithfully the knowledge that is relevant to the engineering skills needed in their work in the service of others. Honesty and integrity are in fact two separate but closely related concepts. While they have different meanings, it is hard to imagine anyone exhibiting one without the other. At least, someone who is dishonest is unlikely to be described as having integrity.

Engineers are likely to work for the benefit of many of different groups of people, and in many cases, will have a duty to keep these people informed of relevant facts. The public trusts professionals to provide information that is as complete and accurate as possible. Honesty is not simply a matter of not lying: an engineer may at times need to disclose information which has not been requested directly, and which in some cases people may not want to hear. In other cases, such as where there is a duty to maintain confidentiality, for example to a client, it may be unethical to disclose information which would jeopardise that confidentiality. In these cases, failure to disclose would not necessarily be dishonest. Integrity is a more difficult concept to define. It has to do with acting ethically, even when there is no personal advantage to doing so. A person of integrity will resist pressure to compromise their ethical values and principles, whether that pressure comes from employers, clients, or anywhere else. They will take steps to avoid conflicts of interest or, where this is not possible, declare these conflicts clearly and do their utmost to avoid improper influence. People with integrity are consistent and reliable, and their actions match up to their words.

For some, integrity may also mean ‘standing for something’, trying to change practices and attitudes that seem less than ethical; it might mean trying to influence for the better the practices of an employer, the engineering profession, or even society at large. According to this approach, an engineer should “take steps to prevent corrupt practices or professional misconduct” in others, and not simply avoid falling into such practices individually. Professionalism also involves being honest about level and areas of competence, and never agreeing to work in areas in which you are not competent or not able to easily achieve competency. The temptation to do this can be generated by commercial considerations, for example a company bidding for a lucrative contract despite not having the correct skills and technical knowledge within its teams. The risk here is that engineers working on the project will make mistakes, as they may not be aware of the key mistakes to avoid, and mistakes in engineering projects have the potential to be catastrophic. Conversely an engineer employing their specialist skills within their area of expertise can make a significant and positive contribution to society. However, it is important to note that many engineering projects are novel, and will require previously untested skills and methods. In these cases, it is an engineer’s duty to ensure that risks are managed and steps taken to allow teams to acquire the appropriate skills – but above all to be honest about unknowns and skills gaps.

Engineers also have a specific duty to maintain up to date knowledge in their fields of expertise because of they have the trust of their clients and the wider public. Engineers should be aware of the value that is given to their ‘professional opinion’, and never give it lightly or on the basis of insufficient evidence. If an engineer’s opinion turns out to be mistaken, they may be held accountable for any negative consequences of actions taken based on it. Although they may have used inaccurate information unwittingly, given their position as a supposed expert they will still be responsible for those actions. Often a manager, even if he/she has engineering experience, is not as up to date on current engineering practices as are the actual practicing engineers. She/he should keep this in mind when making any sort of decision that involves an understanding of technical matters. Conflicts of interest can influence the accuracy of an engineer’s opinion. Engineers should consider whether the opinion they have given is objective, correct to the best of their (up-to-date) knowledge, and based on the available evidence; or whether there might be other considerations influencing their judgment. These might include, for example, commercial considerations, or loyalty to an employer.

**Respect for life, law, and the public good**

**Accuracy and rigour**

Obviously, all of us have general responsibilities for the life, law and the public good, but the engineer also has particular professional responsibilities to protect and uphold these. Many discussions of engineering ethics focus on major accidents where people were killed and injured, and particularly cases in which there seems to have been some level of negligence involved; for example, the Challenger space shuttle disaster and the Piper Alpha offshore rig fire. The set of principles governing the engineering profession is not limited to health and safety, but also covers respect for the law and human life, the protection of the natural environment, and the reputation and dignity of the engineering profession. It encompasses all aspects of engineers’ responsibilities for the people affected by their work and the social and environmental context in which they function. This aspect of an engineer’s responsibility is very sensitive to changing social and political standards and expectations, and the steps engineers are expected to take to protect others have changed over time, and vary across the world. These principles overlap significantly with the previous principles because, for example, failures of accuracy and rigour can put the public at risk, and failures of honesty and integrity can damage the reputation of the profession. Probably the most obvious reason why accuracy and rigour are important to engineers is that accuracy and attention to detail ensures better engineering solutions, just as inaccuracies and carelessness in engineering can mean failure of engineering projects, which can in many cases mean financial failures, accidents, injuries and deaths.

One of the characteristics of engineering decisions is that they can affect the health and safety of very large number of people. This means that the general public expects engineers to consider the ways in which their activities might put people in danger, and to remove or mitigate those dangers. It is easy to say that the health and safety of employees and the public should take priority, but issues arise in identifying an appropriate level of safety. Engineering activities are rarely 100% safe, and what matters is whether an activity is “safe enough”, where this is down to the judgement of individuals, society, politicians, scientists or lawyers.

This issue crops up most often in engineering in the form of managing a balance between safety and financial cost. How much should you spend in order to avoid death or injury to a member of the public? This decision can depend on many factors, and different answers are given in different areas; rail transport and car transport, for instance. Many aspects of this kind of question are settled by legislation and industry standards, but engineers can easily find themselves having to make decisions at the boundaries. In these situations, it is important to be able to think about health, safety, and risk in a rational manner, without either feeling totally constrained by financial pressures, or disregarding the practical implications of implementing safety measures.

* **Conflict of interest**

A “conflict of interest” occurs when an individual is in a position to make decisions which affect at least two opposing interests, usually including the interest of the decision maker. The seriousness of the issue is made much more severe if the decision maker does not reveal the conflict to the opposing interests. If there is a real or potential benefit to the decision maker for a particular decision that would or could potentially harm the other interests, the individual is in a conflict of interest. The personal benefit can be direct through remuneration in some form, or indirect through a positive result for family, friends or colleagues. The result is the same–compromised judgment. There is another principle to apply in conflict of interest situations–full, prompt and complete disclosure of the conflict by the person in the situation to all those who also have a significant interest. This will go a long way toward addressing potential negative perceptions by the other interests. There is a term for this principle – “informed consent.” By making one’s personal interest clear to the others involved, one allows the others to be fully informed and able to decide whether to consent to continue their relationship with you, stop it, or modify it. You, in turn, can respond to their decision. For example, you can decide to find an option that removes your personal conflict, if it is unacceptable to the others involved.

To better understand the responsibility of the engineer, some key elements of the professional responsibilities of an engineer should be examined. This will be done from two perspectives: the implicit social contract between engineers and society, and the guidance of the codes of ethics of professional societies. As engineers test designs for ever-increasing speeds, loads, capacities and the like, they must always be aware of their obligation to society to protect the public welfare.

They might face in their career dilemmas between their loyalty to their company and their responsibility toward society. Engineers have a responsibility to protect the safety and well-being of the public in all their professional efforts. This is part of the implicit social contract all engineers have agreed to. Every major engineering code of ethics reminds engineers of the importance of their responsibility to keep the safety and well-being of the public at the top of their list of priorities. Although company loyalty is important, it must not be allowed to override the engineer's obligation to the public.

A key issue in ethics education for engineers concerns the relationship between the identity of the engineer and the responsibilities of engineering work. This relationship has varied significantly over time and from place to place around the world.

* **Whistleblowing**

Definition: “The raising of a concern, either within the workplace or externally, about a danger, risk, malpractice, or wrongdoing which affects others”. A concern may include something which you may not be directly involved in, but become aware of in the course of your work.

**What are the obligations of an engineer if he/she has such a concern?**

The obligations of an engineer when having a concern can be categorised as ethical, professional and legal.

• An engineer has an ethical responsibility to act when he/she encounters a material and unmanaged risk, danger, malpractice or wrongdoing which adversely affects others.

• He/she also has an obligation as a member of a professional engineering institution to act in line with his/her institution’s Code of Conduct.

 • He/she has a legal obligation to comply with the laws of the country in which he/she operates, and in all countries he/she will have an obligation to carry out his/her duties as an engineer or technician in a competent manner.

Technicians and engineers who cannot easily address a concern on their own should discuss it with, or report the concern to, their immediate employer or manager. If this does not address the concern, you should ensure you are aware of, and make use of, existing company and industry sector regulatory reporting systems. Where there is no whistleblowing policy, you should still try to raise any concern internally. If this approach has not resolved the concern, or your immediate employer or manager is part of the cause, then you are obliged to escalate your concern, which could mean raising it externally. Provided a genuine concern is raised and you have a reasonable belief that you are acting in the public interest. National laws such as the UK law offers individuals protection from action taken by an employer for simply reporting a concern.

* **Codes of Ethics**

Codes of ethics for engineers were developed along with their respective professional societies, which began formal organization in the late 19th century. Initially, codes of ethics involved standard business practices. As the professional societies matured over the years, their codes of ethics were updated and modified. For example, clauses for public safety, public service, and environmental protection are more recent amendments to the various codes of ethics. The first engineering society to adopt a code of ethics was the Institution of Civil Engineers in England in 1910. The American Institute of Consulting Engineers used the British Code to derive their own which they formally adopted the following year.

The first French code of engineering ethics🡺 After ten years’ work that had started in 1987, CNISF produced a code of ethics for engineers. This code - the first one ever written in France - was considered as a step towards a « Code of deontology » whose violation ought to be sanctioned. This code is an adaptation of the « Code of professional duties » adopted a few years earlier by the European Federation of National Engineering Associations (Fédération Européenne des Associations Nationales d’Ingénieurs, FEANI). The FEANI code had been written by a French team of engineers who had studied some codes adopted in English speaking countries: Australia, USA and Canada).

Codes of ethics can be used sometimes to support engineers who are being sanctioned by an employer for uncovering unethical behavior. In the USA, codes have been established by various professional engineering societies, such as the National Society of Professional Engineers (NSPE), the American Society of Mechanical Engineers (ASME), the Institute of Electrical and Electronics Engineers (IEEE), etc. These codes serve as a framework for ethical judgment for a professional engineer. The codes also express the rights, duties, and obligations of the members of the profession. Obviously, the codes of ethics are not comprehensive enough to cover all possible ethical dilemmas that an engineer might encounter in his or her career. The codes serve as starting points for making ethical decisions. It is important to note what a code of ethics does not represent:

· A code of ethics is not a legal document, so a professional cannot be arrested for violating its provisions

 · Although violating the code of ethics may result in expulsion from a professional society (such as NSPE or ASME in the US), expulsion from a society generally will not result in an inability to practice engineering

· A code of ethics does not create new moral and ethical principles; these principles are rooted in centuries of societal and human interactions

Various professional codes of ethics of engineers are interpreted as rules which explicitly determine what engineers should do to fulfill their special professional responsibility.

Finally, it should be noted that many corporations have developed their own codes of ethics for their employees. In many cases, these codes of conduct can be found on the websites of various large corporations. Companies often provide periodic ethical training sessions for their employees to explicitly express their accepted policies on business practices, relationships with vendors and government agencies, compliances with government regulations, health and safety issues, environmental issues, equal employment opportunities, sexual harassment, and diversity in the work place. Corporate codes are often very detailed and explicit, and they hold much more weight than professional society codes, since employment can be terminated if compliance is not met.

* **Computer ethics**

Computer ethics is the study of ethical issues that are associated primarily with computing machines and the computing profession.

Computing professionals perform a variety of tasks: They write specifications for new computer systems, they design instruction pipelines for superscalar processors, they diagnose timing anomalies in embedded systems, they test and validate software systems, they restructure the back-end databases of inventory systems, they analyze packet traffic in local area networks, and they recommend security policies for medical information systems. Computing professionals are obligated to perform these tasks conscientiously because their decisions affect the performance and functionality of computer systems, which in turn affect the welfare of the systems’ users directly and that of other people less directly. For example, the software that controls the automatic transmission of an automobile should minimize gasoline consumption and, more important, ensure the safety of the driver, any passengers, other drivers, and pedestrians. The obligations of computing professionals are similar to the obligations of other technical professionals, such as civil engineers. Taken together, these professional obligations are called professional ethics.

Moral responsibility for recklessness and negligence is not mitigated by the presence of good intentions or by the absence of bad consequences.

Suppose a software tester neglects to sufficiently test a new module for a telephone switching system, and the module fails. Although the subsequent telephone service outages are not intended, the software tester is ethically responsible for the harms caused by the outages. Suppose a hacker installs a keystroke logging program in a deliberate attempt to steal passwords at a public computer. Even if the program fails to work, the hacker is still ethically responsible for attempting to invade the privacy of users. The ethical obligations of computing professionals go beyond complying with laws or regulations; laws often lag behind advances in technology. For example, before the passage of the Electronic Communications Privacy Act of 1986 in the United States, government officials did not require a search warrant to collect personal information transmitted over computer communication networks. Nevertheless, even in the absence of a privacy law before 1986, computing professionals should have been aware of the obligation to protect the privacy of personal information.

* **Responsibilities to Clients and Users**

Whether a computing professional works as a consultant to an individual or as an employee in a large organization, the professional is obligated to perform assigned tasks competently, according to professional standards. These professional standards include not only attention to technical excellence but also concern for the social effects of computers on operators, users, and the public. When assessing the capabilities and risks of computer systems, the professional must be candid: The professional must report all relevant findings honestly and accurately. When designing a new computer system, the professional must consider not only the specifications of the client but also how the system might affect the quality of life of users and others. For example, a computing professional who designs an information system for a hospital and should allow speedy access by physicians and nurses and yet protect patients’ medical records from unauthorized access; the technical requirement to provide fast access may conflict with the social obligation to ensure patients’ privacy.

* **Responsibilities to Employers**

Most computing professionals work for employers. The employment relationship is contractual: The professional promises to work for the employer in return for a salary and benefits. Professionals often have access to the employer’s proprietary information such as trade secrets, and the professional must keep this information confidential. Besides trade secrets, the professional must also honor other forms of intellectual property owned by the employer: The professional does not have the right to profit from independent sale or use of this intellectual property, including software developed with the employer’s resources. Every employee is expected to work loyally on behalf of the employer. In particular, professionals should be aware of potential conflicts of interest, in which loyalty might be owed to other parties besides the employer. A conflict of interest occurs when a professional is asked to render a judgment, but the professional has personal or financial interests that may interfere with the exercise of that judgment. For instance, a computing professional may be responsible for ordering computing equipment, and an equipment vendor owned by the professional’s spouse might submit a bid. In this case, others would perceive that the marriage relationship might bias the professional’s judgment. Even if the spouse’s equipment would be the best choice, the professional’s judgment would not be trustworthy. In a typical conflict of interest situation, the professional should recuse himself/herself: that is, the professional should remove himself/herself and ask another qualified person to make the decision. Many computing professionals have managerial duties, and some are solely managers. Managerial roles complicate the responsibilities of computing professionals because managers have administrative responsibilities and interests within their organizations in addition to their professional responsibilities to clients and the public.

* **Responsibilities to the Public**

According to engineering codes of ethics, the engineer’s most important obligation is to ensure the safety, health, and welfare of the public. Although everyone must avoid endangering others, engineers have a special obligation to ensure the safety of the objects that they produce. Computing professionals share this special obligation to guarantee the safety of the public and to improve the quality of life of those who use computers and information systems. As part of this obligation, computing professionals should enhance the public’s understanding of computing. The responsibility to educate the public is a collective responsibility of the computing profession as a whole; individual professionals might fulfill this responsibility in their own ways. It is particularly important for computing professionals to contribute their technical knowledge to discussions about public policies regarding computing. When a technical professional’s obligation of loyalty to the employer conflicts with the obligation to ensure the safety of the public, the professional may consider whistleblowing, that is, alerting people outside the employer’s organization to a serious, imminent threat to public safety.

* **Avoid harm to others**

‘‘Harm’’ means injury or negative consequences, such as undesirable loss of information, loss of property, property damage, or unwanted environmental impacts. This principle prohibits use of computing technology in ways that result in harm to any of the following: users, the public, employees, employers. Harmful actions include intentional destruction or modification of files and programs leading to serious loss of resources or unnecessary expenditure of human resources such as the time and effort required to purge systems of ‘‘computer viruses.’’ Well-intended actions, including those that accomplish assigned duties, may lead to harm unexpectedly. In such an event the responsible person or persons are obligated to undo or mitigate the negative consequences as much as possible. One way to avoid unintentional harm is to carefully consider potential impacts on all those affected by decisions made during design and implementation. To minimize the possibility of indirectly harming others, computing professionals must minimize malfunctions by following generally accepted standards for system design and testing. Furthermore, it is often necessary to assess the social consequences of systems to project the likelihood of any serious harm to others. If system features are misrepresented to users, coworkers, or supervisors, the individual computing professional is responsible for any resulting injury. In the work environment, the computing professional has the additional obligation to report any signs of system dangers that might result in serious personal or social damage. If one’s superiors do not act to curtail or mitigate such dangers, it may be necessary to ‘‘blow the whistle’’ to help correct the problem or reduce the risk. However, capricious or misguided reporting of violations can, itself, be harmful. Before reporting violations, all relevant aspects of the incident must be thoroughly assessed. In particular, the assessment of risk and responsibility must be credible. It is suggested that advice be sought from other computing professionals. Honor property rights including copyrights and patent as violation of copyrights, patents, trade secrets and the terms of license agreements is prohibited by law in most circumstances. Even when software is not so protected, such violations are contrary to professional behavior. Copies of software should be made only with proper authorization. Unauthorized duplication of materials must not be condoned. Computing professionals are obligated to protect the integrity of intellectual property. Specifically, one must not take credit for other’s ideas or work, even in cases where the work has not been explicitly protected by copyright, patent, etc.

* **Respect the privacy of others**

Computing and communication technology enables the collection and exchange of personal information on a scale unprecedented in the history of civilization. Thus, there is increased potential for violating the privacy of individuals and groups. It is the responsibility of professionals to maintain the privacy and integrity of data describing individuals. This includes taking precautions to ensure the accuracy of data, as well as protecting it from unauthorized access or accidental disclosure to inappropriate individuals.

 Furthermore, procedures must be established to allow individuals to review their records and correct inaccuracies. This imperative implies that only the necessary amount of personal information be collected in a system, that retention and disposal periods for that information be clearly defined and enforced, and that personal information gathered for a specific purpose not be used for other purposes without consent of the individual(s). These principles apply to electronic communications, including electronic mail, and prohibit procedures that capture or monitor electronic user data, including messages, without the permission of users or bona fide authorization related to system operation and maintenance. User data observed during the normal duties of system operation and maintenance must be treated with strictest confidentiality, except in cases where it is evidence for the violation of law or organizational regulations. In these cases, the nature or contents of that information must be disclosed only to proper authorities.