Introduction to Ethical Reasoning and Engineer Ethics

Section 1. Ethics, Values, and Reason

Values and Engineering

What makes a good engineer and good engineering? What values underlie engineering practice today? Which of those values are specifically ethical values? What is the experience of living by those values and working in a society and in organizations that trust you to practice those values? How do these values reflect and affect the person you are and the person you become by practicing them?

This book will help you answer those questions. To answer them requires an understanding of values and value judgments in general and ethical values and ethical judgments in particular.

Societies, especially technologically developed democracies, place trust in professions and the members of professions, such as engineers (including computer professionals). In this book, we will examine what is entrusted to engineers (and computer professionals), together with the factors that created and continue to mold the expectations ingredient in that trust, and what is necessary for engineers and computer scientists to be worthy of that trust. We will consider morally significant problems that arise in engineering and computer fields, and what constitutes fulfilling the trust placed in those professionals. We will also examine the features of work environments that support the fulfillment of that trust.

> The engineering examples chosen for this book reflect *actual engineering experience* so that the discussion of engineering ethics will help introduce engineering students to the realities of the profession for which you are being educated. Therefore, they can help you understand the sort of professional life you will be entering, if you become an engineer.

Most of the readers of this book will be engineers or student engineers. The engineering examples chosen for this book reflect *actual engineering experience* so that the discussion of engineering ethics here will help introduce engineering students to the realities of the profession for which you are being educated. Therefore, they can help you understand the sort of professional life you will be entering, if you become an engineer, and help you find an environment in which you can work with integrity and in an atmosphere of mutual trust (or help you decide at an early date to seek a career elsewhere). An engineering education provides excellent intellectual preparation for many fields in addition to engineering fields, so deciding on a different career, say one in medicine, law, or business, need not mean that you

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should stop studying engineering, and this book will shed some light on ethical issues in other professions, especially the science-based professions.

This introduction examines basic ideas in ethics and draws illustrations from daily life, especially college life, as well as engineering practice and research. Illustrations will sometimes be drawn from other professions, too, especially medicine. Not only will some readers be studying engineering to prepare themselves for a career in the technologically sophisticated world of medicine, but medicine is a profession that engineering students and their families are likely to have experienced from the *client side*. That client experience gives you a second perspective on the importance of trustworthiness of professionals, to complement your perspective as professionals in training. In Chapter 1, we will turn attention to the specific context of engineering practice, the moral problems – by which I mean the ethically significant practical problems – that are likely to arise in that context, and the guidance that the profession offers to new entrants.

Understanding the ethical significance of problems is the first step in responding well to them, so preparing you to both recognize and understand the ethical significance of problems that commonly face engineers is one purpose of this book. Clear concepts and distinctions will aid your understanding and are necessary for the reflective examination of the ethical validity and soundness of conduct, practices, and customs. *The ability to withstand such examination is what distinguishes a* **rationally based ethical conviction** *from a* mere *opinion, an opinion that has no rational basis.* Such opinions with no rational basis may be firmly established in popular culture or a particular subculture even if they are not well supported with reasons and evidence.

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The tendency to avoid ethical language is widespread in today's society, so that even common terms for describing ethical situations may seem unfamiliar. Although, in some circumstances, avoiding ethical language may reduce the defensiveness of those whose actions or policies are being questioned, such avoidance inhibits the understanding of ethical problems that commonly occur and obscures the ethical notions and distinctions that are marked by ethical terms. As was noted in the Foreword to Students, the precise use of concepts is essential for careful reasoning in any field from physics to ethics.

The consistent use of terms, although a separate matter from the clarification of concepts, is also important in engineering and ethics. You may notice that the government's reports on the failings that led to the 2003 explosion of the shuttle *Columbia* highlighted *miscommunication due to vague and inconsistent use of terms*. A consistent use of terms is also important in discussing ethics *so that parties will be able to recognize when they are agreeing, disagreeing, or addressing different subjects*.

The purpose of this introduction is to clarify ethical concepts and distinctions needed to understand many of the widely accepted ethical standards for the practice of engineering and to introduce a model of ethical life (one that centers on the moral evaluation of the acts that people or institutions perform). *Acts* are judged as right and wrong, morally good or bad, according to several sorts of criteria*:

1. The nature of the *acts* and/or whether they respect others' rights or fulfill one's own duties – for example, killing is wrong.
2. The specific *circumstances* surrounding a particular act – for example, Arthur's *unprovoked* assault on Burt was wrong.
3. The *motives* with which the agent committed the act – for example, Cedilla's criticism was *motivated by hostility* rather than a sincere attempt to improve performance and, therefore, wrong.

> In the contemporary United States, adversarial disputes tend to dominate media treatment of ethics and values disputes. Popular culture tends to regard ethical questions and value questions more generally, as a matter of deciding on which of two opposing sides to stand on a variety of controversial questions. The goal of this book is not to argue for any particular side in these two-sided debates, but *to help you think critically about ethics and values questions and those that arise in engineering ethics in particular*.

If discussion of ethical concepts and terms is new to you, you may want to initially read only the main text in this book and skip over the "fine points" that are set off in gray in smaller type. Those "fine points" are primarily philosophical and conceptual points that are not necessary for understanding the principal issues. In the first part of this book, we will consider the moral evaluation of acts and in this introduction examine the concepts needed for that examination. In the second part of this book, we will examine aspects of moral responsibility that go beyond the ethical evaluations of acts, along with related concepts of character. You will find other specialized ethical, legal, and technical notions introduced as needed throughout the book.

What makes a good engineer and good engineering? To which of those characteristics do you aspire and why?

Ethics in Popular Culture and in Reality

Is this book intended to help you choose the right side in ethical struggles?

In the contemporary United States, adversarial disputes tend to dominate media treatment of ethics and values disputes. Popular culture tends to regard ethical questions and value questions more generally, as a matter of deciding on which of two opposing sides to stand on a variety of controversial questions. The goal of this book is not to argue for any particular side in these two-sided debates, but *to help you think critically about ethics and values questions and those that arise in engineering ethics in particular*. Critical thinking skills will often reveal

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*A **criterion** is a standard upon which judgments can be based. (*The plural is* "criteria.") Example: In addition to having driving skills, one criterion for being a *qualified driver of some specific type of automotive vehicle* is that when the driver is sitting in the driver's seat, she can operate all of the controls. If some person could not operate all of the controls when seated in the driver's seat of some specific vehicle, that person would not be a qualified driver for *that* vehicle.

a greater complexity than *either* "side" in the well-known two-sided debates considers. Truth is often complex. Your college education is meant not merely to help you get a good job, but to prepare you to think through all the problems you encounter in life.

Engineers and Obsolescence

When Corey was in college there was a lot of discussion in the Big Tech student newspaper about whether the engineering students were being educated to be more than "tools." Indeed, the engineering students in Corey's living group had taken to using "wedge" (the simplest tool) as a joking insult to one another. Working hard on a problem set had come to be called "tooling." The discussion in the student paper centered around whether the engineers could think about the larger goals that they served by doing their technical work. It also discussed the growing evidence that many engineers at mid-life were finding themselves without jobs because their employers found that to keep abreast of technological advancements, the easiest course was to replace their mid-life engineers with recent graduates, much as one might replace an obsolete tool.

Corey had been too busy to take much part in the discussion but recalled it after being hired after graduation at the Major Widget Company where Corey had worked for several summers. Corey was hired to adapt a new technology to make widgets, and heard that the engineers who had been working with the technology previously used to make widgets had been let go except for the one who had gone into management. Corey was never attracted to management while in school. Indeed Corey had been among the engineering students who snickered that one majored in management if one couldn't hack an engineering major.

What can/should Corey do now?

Getting Started
Reflecting on what you want and expect from your career is a good idea as your career develops. As it does, you will acquire more experience but may find yourself no longer up on the latest technology. How do you expect to grow and benefit from your experience? Does further education appeal to you? Do you like managing people? Are there unusual ways to use your special engineering expertise?

Many ethical problems are discussed in this book. How is this book intended to help you in thinking about them?

The Perspective of This Book
What do you need to understand about:

- Values and ethics,
- Ethical arguments,
- Media stories about government policies,
- Court decisions,
- The alternatives that physicians and other professionals present for you and your family members,
- The questions about your priorities that financial advisors, lawyers, and other advisors ask you,
- How to evaluate the likelihood that a course of action will actually achieve your most important goals?

Why This Book Contains Few, If Any, Coined Terms

For the first half of the twentieth century, it was common in analytic philosophy as well as continental philosophy to coin technical and philosophical terms and to stipulate special senses of familiar words and phrases. This tendency reached an extreme in the work of the Vienna Circle and the school of thought called "logical positivism" and its successor, "logical empiricism."

Logical positivism especially looked upon natural languages as too confused to be useful for clear thinking and, at least in its early stages, often regarded sentences about ethical and other values as simply nonsense and unworthy of attention. Later adherents took the position that what appeared to be ethical statements actually expressed emotion or were recommendations. (C. L. Stevenson provided some of the most nuanced arguments for this view.[a])

Partially in reaction to this trend, a philosophical movement called "ordinary language philosophy" was born and championed by a variety of major philosophical figures from John L. Austin to Ludwig Wittgenstein in his later life. These philosophers renewed respect for and interest in the myriad functions of natural languages and the distinctions they express, although they recognized that language developed for ordinary life may occasionally need to be augmented with new terms, including ethical terms, to capture novel insights or for specialized purposes.

[a] See especially his 1941 essay, the "Nature of Ethical Disagreement," which may be found in his *Facts and Values: Studies in Ethical Analysis* (New Haven, CT: Yale University Press: 1963).

The definitions of ethical terms in this book follow accepted English usage closely. Sometimes, when a word has several senses, I chose one for the sake of clarity. I avoid stipulating *new* technical senses of words, however, for three reasons. First, the ethical distinctions marked in language express many important and subtle distinctions that will often remind readers of distinctions they have been using all their lives even if they have not reflected on that use before. Second, part of my purpose is to prepare readers to discuss ethical problems, concerns, and questions with others who have never read this book, a goal that would be undermined by introducing new jargon. Third, I share the philosophical view that it is pompous and unhelpful to stipulate special senses of terms except when necessary to clearly present major philosophical points.

Therefore, I do not stipulate any distinction between the terms "moral" and "ethical." The latest edition (the eleventh [2005]) of *Merriam-Webster's Eleventh Edition Collegiate Dictionary*[1] lists "ethical" as a synonym for "moral." Many different distinctions have been drawn between the terms "moral" and "ethical." For example, philosophers often reserve the term "ethics" for the *study* of morality. Others, including many engineers, take "moral" to apply to private as contrasted with professional life. To use any one of the distinctions would invite confusion with a host of others. Therefore, I use the terms interchangeably in this book. My goal is to prepare you to understand, discuss, and advance the ethics of engineering and present only as many distinctions as you will need to do that. The ethical concepts and distinctions I discuss are those that are directly applicable to ethical problems in engineering and science. They are usually concepts for which English has adequate terms. These distinctions are not precisely the same as those found in other languages, however. This book does use distinctions expressible in contemporary (American) English. To that extent this book does embody a cultural perspective, although I try to show some ways of expressing a variety of cultural and religious views on ethical matters.

[1] The *Third College Edition of the American Heritage Dictionary* also lists ethical as a synonym for "moral" and presumably the latest edition (fourth) does as well.

"Ethical" and "Moral"

Beginning with H.A. Pritchard in the early 1900s, many distinguished philosophers, especially those philosophizing about moral life rather than "meta-ethics," have referred to their work as "moral philosophy."

Although I make no distinction between "**moral**" and "**ethical**," I follow the common practice of tending to use "moral" for topics that are more concrete and "ethical" for ones that are more abstract. Thus, I usually speak of moral problems and ethical theory.

Some notions carry built-in cultural or political assumptions. "Privacy" is sometimes claimed to be a notion that is used only in relatively individualistic societies. Languages such as Japanese have no term for it. Even if only relatively individualistic societies emphasize the privacy of the individual, actions that many Americans would see as violations of individual privacy may be seen in other cultural settings as rudeness or unwarranted invasions of family or group life. Therefore, discussions of subjects such as the influence of technology on privacy may have relevance for societies that see those influences in other terms than their effects on individual privacy.

This introduction is intended to provide a vocabulary that is rich enough to express ethical problems and make ethical judgments. It is not intended to establish whether some act, motive, or character trait is ethically acceptable. I have tried to choose illustrations of ethical concepts that are relatively noncontroversial. If you disagree – for example, if you think one of my examples of a human right is not a human right at all – understand that *such questions are not supposed to be settled by my discussion*. The examples are simply intended to make the concepts easier to grasp.

> This introduction is about concepts. It is intended to provide a vocabulary that is rich enough to express ethical problems and make ethical judgments. It is not intended to establish whether some act, motive, or character trait is ethically acceptable.

The problems addressed here arise primarily in engineering as it is practiced in technologically developed democracies, especially signatories to the so-called Washington Accord. This accord or agreement specifies the education and proficiency that may be assumed of persons with degrees in engineering. Common expectations are needed for engineering in the global marketplace. Australia, Canada, Hong Kong, Ireland, New Zealand, South Africa, United Kingdom, United States, and more recently, Japan, agree on these common standards for engineering. The point, however, is to understand ethical notions, whether or not English or some other language has ready terms for them. Ethical terminology changes over time. For example, although the notion of an ethical right, especially an ethical right of an individual, arose only with the individualism that marks modern thinking in Western European cultures, the notion of moral rights of individuals, and more specifically of human rights, now finds widespread international acceptance.

The same general conditions of engineering and scientific practice hold for most technologically developed democracies. Some specific conditions of practice vary among them, however, and even vary among signatories to the Washington Accord. For example, although some states in the United States are now moving to require engineers practicing within their borders to become licensed, U.S. engineers employed in industry are currently exempt from the requirement that they be licensed. As a result, the majority of employee engineers in the

United States are not licensed. In Canada, all engineers must become licensed. There the engineering society in each province possesses the legal authority to revoke licenses. In Australia, there is at present no general requirement of licensure for engineers, although engineers must fulfill special requirements to be able to certify drawings. Australia is moving toward licensure, but because government is more centralized in Australia than the United States or Canada, licensure will be administered rather differently from either the United States or Canada, which license professional practice through the states or provinces.

What concepts do you need to understand questions of values and ethics, ethical arguments, media stories about government policies and court decisions, not to mention the alternatives that physicians present for you and your family members, the questions about your priorities that financial advisors, lawyers and your other advisors will ask you, or how to evaluate the likelihood that a course of action will actually achieve your most important goals?

One Model of Ethics

How much of engineering ethics or professional ethics can be expressed in terms of what acts are required, which are forbidden, and which are permitted?

There are a variety of models of moral life and moral learning, some more complicated than others. One of the simplest is the supposition that humanity is divided into heroes ("good guys") and villains ("bad guys"), that moral life is a struggle between them, and that the good guys always win. (The ethical and prudential task is then seen as one of being a hero rather than a villain.) Such a model is too simple to help in thinking about engineering ethics, however.

Because these opening chapters are designed to be accessible to beginning students, this first part starts with a simple model of ethics that can express some important judgments and arguments in professional ethics. This simple model focuses on the ethical evaluation of various *acts* and types of acts. The ethical code and guidelines of engineering societies are mostly written in terms of acts, and in terms of the moral rules and obligations that specify what acts are forbidden or required. (Occasionally they also express rights that specify what acts are permitted to the holder of the right. Therefore, our initial model will allow us to examine those codes and guidelines to see how they view engineering ethics.)

Moral obligations specify acts that are required (must be performed) or forbidden (must not be performed). Rights specify acts that it is permissible for the rights-holder to perform, for example, the moral right to vote or prohibitions of interference with the rights-holder in some general area of life. The rights to be free of interference imply obligations upon others to refrain from interfering. Thus the right to freely exercise religion restrains others from interfering with one's religious practices, *whatever they are*, so long as they do not violate other moral rules. (Human sacrifice might be a religiously significant act but would violate other moral rights.)

Moral rules give an alternative way of specifying the acts that are ethically required, permitted, or prohibited. For example, one such *moral rule* recognized throughout engineering is the rule against offering or accepting bribes. This rule

expresses the *moral obligation* to refrain from two types of acts: offering bribes and accepting bribes. It appears in one form or another in the codes of ethics of most engineering societies.

Noticing what engineering societies choose to include in their codes of ethics and how engineering codes of ethics differ from the codes of ethics of other professions will also draw our attention to some of the special features of professional practice in engineering and the features of the practice to which some of you will devote your lives. In Part 2, we will augment this initial model of ethics that focuses on acts with attention to responsibility for future states of affairs. Other specialized ethical, legal, and technical notions needed to understand special issues will be introduced as necessary throughout the book.

> *How much of what you know of engineering ethics or professional ethics can be expressed in terms of what acts are required, which are forbidden, and which are permitted?*

Moral and Amoral Agents

You have probably heard people say to their dogs: "Bad dog." How do you interpret what they intend to say? For example, do they think that dogs (or at least *their* dogs) are moral agents and that the dogs have done something that is morally bad? If not, do you explain their behavior in some other way? Wherever you draw the line between moral agents and amoral beings, discuss your reasons for counting some beings as moral agents and others as not.

Acts, agents, and the character and motives of agents are all objects of moral evaluation. However, it makes sense to morally evaluate only agents who can act for moral reasons. Such agents are called "***moral* agents**." The statement "the storm was responsible for three deaths and heavy property damage" means that the storm caused these outcomes. Although the storm was the agent of destruction, the actions of the storm are not subject to *moral* evaluation. The storm is not guilty of murder or even manslaughter.

Moral agents are not necessarily morally good individuals. They are just those who can and should take account of ethical considerations. *Moral agents are those of whom one may sensibly say that they are moral or immoral, ethical or unethical*. A competent and reasonably mature human being is the most familiar example of a moral agent. In contrast, most nonhuman animals are generally taken to be **amoral**. Saying they are amoral is to say that they are not capable of acting for moral reasons, and, therefore, questions of morality are not appropriate in evaluating them and their acts. It does not imply that they are not entitled to ethical consideration. We will take up the question of who or what is entitled to moral consideration, the question of "moral standing," in Section 4 of this introduction.

Highly intelligent and social beings such as mammalian dolphins are sometimes argued to qualify as moral agents because of their intelligence and ability to live in a complex social system. Various religious traditions speak of beings, such as angels, whose actions are subject to moral evaluation and thus are moral agents. Examples of nonhuman moral agents are also found in fiction. Boulle's book *The Planet of the Apes* portrays apes as moral agents. Science fiction often describes nonhuman extraterrestrials as persons and moral agents. These

examples show that it is not self-contradictory to think that some nonhumans could be moral agents.

> *You have probably heard people say to their dogs: "Bad dog." How do you interpret what they intend to say? For example, do they think that dogs (or at least* their *dogs) are moral agents and that the dogs have done something that is morally bad? If not, do you explain their behavior in some other way? Wherever you draw the line between moral agents and amoral beings, discuss* your reasons *for counting some beings as moral agents and others as not.*

Section 2. Values and Value Judgments

The Difference between Values and Preferences

In deciding to enter engineering, what value judgments did you make (or others, such as parents and guidance counselors, make for you)? Such value judgments might vary from ones about the material comforts obtainable with a good starting salary to relationships with friends and relatives who are engineers. Have those values changed as you have learned more about engineering?

What makes a good engineer and good engineering? What reasons can you give to support your value judgments about engineers and engineering?

One consideration used in determining the goodness or rightness of an act is the consequences produced by said act. Thus, the invention and dissemination of technologies that benefit humankind are often judged to have been ethically good acts. Examples of such beneficial technologies include the technologies introduced by civil engineering to provide clean water and improve sanitation. These innovations were introduced in many technologically developed countries in the late 1800s and early 1900s. They produced a greater reduction of infant mortality rates than even vaccination and other medical innovations of that period. To evaluate consequences, we will need some understanding of value judgments in general and the relationship of other types of value judgments to those that are specifically *ethical judgments. Ethical judgments are only one type of value judgment*. Furthermore, value judgments are only one type of judgment. Judgments are one type of statement. Sentences express statements, but also many other sorts of things (see Figure I.1).

The question of what is *good or bad*, *better or worse*, *desirable or undesirable* is a question of merit or worth. It calls for a **value judgment**. *A value judgment is any judgment that can be expressed in the form "X is good/superior/ meritorious/worthy/desirable" or "X is bad/inferior/without merit/worthless/ undesirable," at least in some respects*. The judgment that *some knife is a good knife* is a value judgment. Any judgment, including any value judgment, that is to stand up to critical evaluation must be based on relevant criteria, that is, there must be *good reasons* for making that judgment. In the case of a knife, relevant criteria would be having a sharp blade, being well balanced, and having a comfortable grip. Being bright blue would not be a relevant criterion for being a good knife *per se* even if under some *special circumstances* one might want one's knife to be bright blue. Saying that *value judgments are* **objective** *in the sense that*

Sentences may express any of the following:

QUESTIONS—Example: Do you know what time it is?

EXCLAMATIONS—Example: Wow!

. . .

COMMANDS—Example: Stay in line.

STATEMENTS—(Statements have truth value, unlike questions, exclamations, and so on, that is, *they can be true or false*.) Below are three of the many sorts of statements.

 I. Simple descriptions of things and situations. Example: It is twilight.

 II. Statements of preference—are **about the person** or persons whose preferences are stated, rather than **about the thing preferred**. Examples: I detest licorice. She prefers a Macintosh computer.

 III. Judgments—implicitly or explicitly use, or refer to, standards (beyond the meaning of the words in the statement of the judgments). Some but not all judgments are value judgments.

   A. Judgments without value implications. Examples: "The book is 9 inches long." "The book is of medium size." "Diamonds have become cheaper."

   Fine Point: B. Intermediate cases that judge items in relation to human purposes. Examples: "This is a medicinal plant." "That is food." "That pile is just trash."

   C. **Value** judgments—say that something is good or bad in some respect. Examples: "*Monsters Inc.* was a great family movie." "That is a poorly written article." "This song has a beautiful melody." "That would be a good car for you, because it would fit the driving you do most." ["Good" is defined by Aristotle (and many other philosophers) as *what it is rational to want*. John Dewey characterizes the good as the desir*able* as contrasted with what is merely desired.] Value judgments can be of several types depending on the type of value to which they refer.

   • Aesthetic judgments (beauty or ugliness)
   • Epistemic judgments (knowledge value)
   • Religious judgments (sacred and profane)
   • . . .   Aristotle, among others, does not distinguish between
   • Prudential judgments   ethical and (long-range) prudential considerations.
   • **Ethical/moral judgments are judgments of:**
     1 People. Example: "She is a fine person."
     2 Character and character traits. Examples: "Honesty is a central virtue." "Lying shows a cowardly nature."
     3 About motives (emotions) and intentions (plans). Example: "She meant well."
     4 About acts, in which case judgments may focus on:
       a Consequences of the act or kind of act
         (e.g., harms, benefits, damage, improvement, costs)
       b Whether the act is of a kind that is ethically required, permissible, or prohibited

Figure I.1   A Typology of Value Judgments and Their Relationship to Other Judgments and Statements

they are based on relevant reasons and evidence does not guarantee that everyone, or even every reasonable person, will agree on a particular judgment. Disagreements are especially likely when many factors must be weighed in making an evaluation. People are unlikely to disagree for long about whether one board is longer than another, but competent engineering or software designers may disagree on the best approach to fulfilling a design assignment, even when all have made explicit the reasons for their approach. Similarly, competent physicians may disagree on the diagnosis of a particular patient, even when all have articulated the reasons for their diagnostic judgments. Competent research investigators may argue for decades about the correct interpretation of some experiment in a cutting-edge area of research.