Simulation and artificial intelligence assignment

Innovation in Simulation & Artificial Intelligence Virtual Reality Reality has become Science Fiction because the reality most people agree upon to live in isn't the entire picture of what's going on. 2010 Institute of Business Administration Table of Contents Acknowledgement In the name of Allah the most merciful and beneficent.

We are thankful to Allah who has gifted us with such a great, nice and disciplined teacher " Sir Ahmer Zeeshan".

This is because he has provided us with such a great opportunity to work out our in the practical field. Especially this assignment has allowed us to find the latest working on Computer world via simulated technology, during our preparation of this assignment we come to know latest innovative artificial technology which is the future of this world. Thanks to all those who have helped us in making this assignment specially our teacher. Executive Summary Simulation and AI establishes the cultural background against which it has developed.

Different people think of AI differently. Important questions to ask are: Thinking or behavior? Do you want to model humans, or work from an ideal standard? Modern Era of computer technology has made human beings aware of a lot of innovative gadgets. Introduction of Computer Aided Design and Virtual Reality bring a new sense of change into this world reality. Engineered mind can be the most productive for the people related to Innovative new ideas. History of Simulated and Artificial intelligence world leads us to the very beginning of these innovative ideas.

Many new innovators many new innovations many new techniques of communication with computer technology infect bring a sense of feeling into computers. Psychologists strengthened the idea that humans and other animals can be considered information processing machines. Linguists showed that language use fits into this model. Computer engineering provided the artifact that makes AI applications possible. AI programs tend to be large, and they could not work without the great advances in speed and memory that the computer industry has provided.

The history of AI has had cycles of success, misplaced optimism, and resulting cutbacks in enthusiasm and funding. There have also been cycles of introducing new creative approaches and systematically refining the best ones. Recent progress in understanding the theoretical basis for intelligence has gone hand in hand with improvements in the capabilities of real systems. Science of Intelligent Systems: Reality has become Science Fiction because the reality most people agree upon to live in isn't the entire picture of what's going on.

Right in front of our eyes exists a more grand, splendid, incredible world that most of us choose not to observe. Engineering of Mind is what leads us to the creation of every masterpiece in this world. Mind is the most complex part of human body and it is being used in every aspect of daily life. Creation of modern computer and their enhancement till this far is just because of human mind. Mind is the set of processes that run in the Brain such as: * Imagination and Knowledge * Thought and Communication * Reason and Intelligence * Emotion and Intuition Feeling and Awareness * Perception and Consciousness Mind is what Brain does. The mind is a product of the brain which is arguably the most complex structure in the universe. Mind is what separates human from other species. Mind is the essence of who we are. Now can mind be engineered? Yes mind can be engineered and if it can, there can be a huge impact on Science, economic prosperity, military power and Human well being by understanding the technologies in a principle like sensing, perception, representation, decision, control, and system architecture for integration.

The progress after engineering the mind is very rapid that will result in Artificial Intelligence and Robotics, Signal processing, Modeling and Simulation and control theory etc. Results of Engineered Mind: With the engineering of mind human beings are able to achieve this so far and it's an ongoing process because human mind cannot stop working. * Source Code of Man: DNA * DNA vs. Binary * DNA Modification (via RNA or Virus) * The Holy Grail: Eternal Life – Remove DNA that causes aging or reverse aging process and recessive genes. * DNA Printers * Genetic Engineering * Cloning, Stem Cell Research, creating organs for replacement. Creating X-Men Mutant abilities. * Science and Mathematics: * Quantum Theory / Mechanics * PI (1. 6 trillion digits, implications, Einstein's theory) * Energy * The Frequency of Visible Light and the entire range of the electromagnetic spectrum of radiation. * SCI-FI Technology TODAY: * OLEDs Organic Light Emitting Diodes (cloak suit harry potter coat, Aurora, Die another Day) * Wireless Technology * ISS International Space Station * Boba Fett Suit for soldiers * b-2 stealth bomber * Mars pathfinder in '96 landing within 2 miles of destination * Secret projects are 50 years ahead of what we can imagine. Alternate energy. * Rise of the Machines: * Insect Robots that Learn * Business Computer AI that buy and sell. * Artificial Intelligence * Artificial Life * Super Computers * Q-Bit (anti-matter for binary) * Neural Networks * Genetic Algorithms Limitations of Man: Human mind can never be as fast as computer can work calculations. There are some limitations which human mind possesses such as: * Vision frequency. * Hearing Range * Brain calculation limits * Humans currently die via aging. * G-FORCE Grand Challenges in Science and Technology * Understanding the brain * Reasoning, cognition, creativity Creating intelligent machines * Is this possible? * What are the technical and philosophical challenges? * Arguably AI and Simulation poses the most interesting challenges and questions in computer science today. Modern Era Of Computer Technologies: Indeed human is the creator of computer technology but there are things like feelings and emotions which computer when innovated cannot do but with the passage of time human mind will find a way to give computer such ability to feel that will generate a new age of computer technology which is called Artificial Intelligence and Simulation Techniques.

Innovation Starts from Computer Aided Design: Computer Aided design is the use of computer software and systems that assist architects, engineers, artists and other designers in designing, drafting and modeling parts, products or structures. Some products of CAD are AutoCAD, MDT, Inventor, Solid Edge and Solid Works etc. CAD has fundamentally changed the way design is done previously by human beings. History of Computer Aided Design: In the mid-1950s, CAD's basic two-dimensional graphic was developed at the MIT Lincoln Laboratory.

By the end of 1960s, computer-aided three-dimensional modeling was created, by the 1980s, applications were developed for personal computers and by the late 20th century, basic packages for 2D and 3D graphics became standard in design and now in the 21st century more development in CAD is expected from the human engineered mind. CAD capabilities include: * Wireframe geometry creation * 3D parametric feature based modeling, solid modeling * Automated design of assemblies * Create engineering drawings from the solid models Output of design data directly to manufacturing facilities * Calculate mass properties of parts and assemblies * Electrical component packaging * Simulation of designs without building a physical prototype * CAD systems were developed with computer language such as Fortran * Freeform surface systems are built around a number of key, C programming language, modules with their own APIs * Most CAD computer workstations are Windows based PCs, Unix operating systems and Linux * A high end OpenGL based Graphics card is required 2D space: curves and figures * 3D objects: curves, surfaces, or solids * 3D modeling is more accurate than 2D CAD drawings, can save time and money CAD Applications: CAD Impact on the Market: CAD industry continues to grow at a healthy rate (15% for the year 2008) and continues through 2012. CAD industry has been undergoing a remarkable renaissance over the last five years (64-bit computing, multi-core processors, and 3D techniques) Simulation: Simulation is the imitation of some real thing, state of affairs, or process.

The act of simulating something generally entails representing certain key characteristics or behaviors of a selected physical or abstract system. Simulation is used in many contexts, including the modeling of natural systems or human systems in order to gain insight into their functioning. Other contexts include simulation of technology for performance optimization, safety engineering, testing, training and education. Simulation can be used to show the eventual real effects of alternative conditions and courses of action.

Key issues in simulation include acquisition of valid source information about the relevant selection of key characteristics and behaviors, the use of simplifying approximations and assumptions within the simulation, and fidelity and validity of the simulation outcomes. A computer simulation is an attempt to model a real-life or hypothetical situation on a computer so that it can be studied to see how the system works. By changing variables, predictions may be made about the behavior of the system. Computer Simulation:

Computer simulation has become a useful part of modeling many natural systems in physics, chemistry and biology, and human systems in economics and social science (the computational sociology) as well as in engineering to gain insight into the operation of those systems. A good example of the usefulness of using computers to simulate can be found in the field of network traffic simulation. In such simulations, the model behavior will change each simulation according to the set of initial parameters assumed for the environment. Traditionally, the formal modeling of systems has been ia a mathematical model, which attempts to find analytical solutions enabling the prediction of the behavior of the system from a set of parameters and initial conditions. Computer simulation is often used as an adjunct to, or substitution for, modeling systems for which simple closed form analytic solutions are not possible. There are many different types of computer simulation; the common feature they all share is the attempt to generate a sample of representative scenarios for a model in which a complete enumeration of all possible states would be prohibitive or impossible.

Several software packages exist for running computer-based simulation modeling (e. g. Monte Carlo simulation, stochastic modeling, multi method modeling) that makes the modeling almost effortless. Classification and Terminology Historically, simulations used in different fields developed largely independently, but 20th century studies of Systems theory and Cybernetics combined with spreading use of computers across all those fields have led to some unification and a more systematic view of the concept.

Physical simulation refers to simulation in which physical objects are substituted for the real thing (some circles use the term for computer simulations modeling selected laws of physics, but this article doesn't). These physical objects are often chosen because they are smaller or cheaper than the actual object or system. Interactive simulation is a special kind of physical simulation, often referred to as a human in the loop simulation, in which physical simulations include human operators, such as in a flight simulator or a driving simulator. Computer Simulation in Computer Science:

In computer science, simulation has some specialized meanings: Alan Turing used the term " simulation" to refer to what happens when a universal machine executes a state transition table (in modern terminology, a computer runs a program) that describes the state transitions, inputs and outputs of a subject discrete-state machine. The computer simulates the subject machine. Accordingly, in theoretical computer science the term simulation is a relation between state transition systems, useful in the study of operational semantics. Less theoretically, an interesting application of computer simulation is to simulate computers using computers.

In computer architecture, a type of simulator, typically called an emulator, is often used to execute a program that has to run on some inconvenient type of computer (for example, a newly designed computer that has not yet been built or an obsolete computer that is no longer available), or in a tightly controlled testing environment (see Computer architecture simulator and Platform virtualization). For example, simulators have been used to debug a micro program or sometimes commercial application programs, before the program is downloaded to the target machine.

Since the operation of the computer is simulated, all of the information about the computer's operation is directly available to the programmer, and the speed and execution of the simulation can be varied at will. Robotics Simulators: A robotics simulator is used to create embedded applications for a specific (or not) robot without being dependent on the ' real' robot. In some cases, these applications can be transferred to the real robot (or rebuilt) without modifications. Robotics simulators allow reproducing situations that cannot be ' created' in the real world because of cost, time, or the ' uniqueness' of a resource.

A simulator also allows fast robot prototyping. Many robot simulators feature physics engines to simulate a robot's dynamics. Simulation in Education and Training: Simulation is often used in the training of civilian and military personnel. This usually occurs when it is prohibitively expensive or simply too dangerous to allow trainees to use the real equipment in the real world. In such situations they will spend time learning valuable lessons in a " safe" virtual environment. Often the convenience is to permit mistakes during training for a safety-critical system.

Training simulations typically come in one of three categories: * Live simulation (where real people use simulated (or “ dummy”) equipment in the real world); * Virtual simulation (where real people use simulated equipment in a simulated world, or virtual environment) * Constructive simulation (where simulated people use simulated equipment in a simulated environment) Simulations in education are somewhat like training simulations. They focus on specific tasks. The term ‘ micro world’ is used to refer to educational simulations which model some abstract concept rather than simulating a ealistic object or environment, or in some cases model a real world environment in a simplistic way so as to help a learner develop an understanding of the key concepts. Normally, a user can create some sort of construction within the micro world that will behave in a way consistent with the concepts being modeled. Seymour Papert was one of the first to advocate the value of micro worlds, and the Logo (programming language) programming environment developed by Papert is one of the most famous micro worlds.

As another example, the Global Challenge Award online STEM learning web site uses micro world simulations to teach science concepts related to global warming and the future of energy. Other projects for simulations in educations are Open Source Physics and its EJS environment. In recent years, there has been increasing use of social simulations for staff training in aid and development agencies. The Carana simulation, for example, was first developed by the United Nations Development Programme, and is now used in a very revised form by the World Bank for training staff to deal with fragile and conflict-affected countries.

Simulation in entertainment Entertainment simulation is a term that encompasses many large and popular industries such as film, television, video games (including serious games) and rides in theme parks. Although modern simulation is thought to have its roots in training and the military, in the 20th century it also became a conduit for enterprises which were more hedonistic in nature. Advances in technology in the 1980’s and 1990’s caused simulation to become more widely used and it began to appear in movies such as Jurassic Park (1993) and in computer-based games such as Atari’s Battlezone.

Simulation and Manufacturing Manufacturing represents one of the most important applications of Simulation. This technique represents a valuable tool used by engineers when evaluating the effect of capital investment in equipments and physical facilities like factory plants, warehouses, and distribution centers. Simulation can be used to predict the performance of an existing or planned system and to compare alternative solutions for a particular design problem. Another important goal of manufacturing-simulations is to quantify system performance.

Common measures of system performance include the following: * Throughput under average and peak loads; * System cycle time (how long it take to produce one part); * Utilization of resource, labor, and machines; * Bottlenecks and choke points; * Queuing at work locations; * Queuing and delays caused by material-handling devices and systems; * WIP storage needs; * Staffing requirements; * Effectiveness of scheduling systems; * Effectiveness of control systems. Classroom of the future

The “ classroom of the future” will probably contain several kinds of simulators, in addition to textual and visual learning tools. This will allow students to enter the clinical years better prepared, and with a higher skill level. The advanced student or postgraduate will have a more concise and comprehensive method of retraining — or of incorporating new clinical procedures into their skill set — and regulatory bodies and medical institutions will find it easier to assess the proficiency and competency of individuals.

The classroom of the future will also form the basis of a clinical skills unit for continuing education of medical personnel; and in the same way that the use of periodic flight training assists airline pilots, this technology will assist practitioners throughout their career. The simulator will be more than a “ living” textbook; it will become an integral a part of the practice of medicine. The simulator environment will also provide a standard platform for curriculum development in institutions of medical education. Digital Lifecycle Simulation Simulation solutions are being increasingly integrated with CAx (CAD, CAM, CAE…. solutions and processes. The use of simulation throughout the product lifecycle, especially at the earlier concept and design stages, has the potential of providing substantial benefits. These benefits range from direct cost issues such as reduced prototyping and shorter time-to-market, to better performing products and higher margins. However, for some companies, simulation has not provided the expected benefits. The successful use of Simulation, early in the lifecycle, has been largely driven by increased integration of simulation tools with the entire CAD, CAM and PLM solution-set.

Simulation solutions can now function across the extended enterprise in a multi-CAD environment, and include solutions for managing simulation data and processes and ensuring that simulation results are made part of the product lifecycle history. The ability to use simulation across the entire lifecycle has been enhanced through improved user interfaces such as tailorable user interfaces and “ wizards” which allow all appropriate PLM participants to take part in the simulation process. Engineering, Technology or Process Simulation

Simulation is an important feature in engineering systems or any system that involves many processes. For example in electrical engineering, delay lines may be used to simulate propagation delay and phase shift caused by an actual transmission line. Similarly, dummy loads may be used to simulate impedance without simulating propagation, and is used in situations where propagation is unwanted. A simulator may imitate only a few of the operations and functions of the unit it simulates. Contrast with: emulate. Most engineering simulations entail mathematical modeling and computer assisted investigation.

There are many cases, however, where mathematical modeling is not reliable. Simulation of fluid dynamics problems often requires both mathematical and physical simulations. In these cases the physical models require dynamic similitude. Physical and chemical simulations have also direct realistic uses, rather than research uses; in chemical engineering, for example, process simulations are used to give the process parameters immediately used for operating chemical plants, such as oil refineries.

Finance simulation In finance, computer simulations are often used for scenario planning.

Risk-adjusted net present value, for example, is computed from well-defined but not always known (or fixed) inputs. By imitating the performance of the project under evaluation, simulation can provide a distribution of NPV over a range of discount rates and other variables. Virtual Reality and Artificial Intelligence Humankind has given itself the scientific name Homo sapiens–man the wise–because our mental capacities are so important to our everyday lives and our sense of self. Virtual Reality Introduction to Virtual Reality:

If it’s hard to make virtual reality look like a real world, lets make real world look like virtual reality! Virtual Reality is basically providing an interface for the navigation in 3D space that allows interaction with virtual objects and provides illusion of being fully immersed in artificial world. And Non Immersive Virtual Reality is a mouse-controlled navigation through a 3D environment on a graphics monitor and Stereo projection and stereo sound systems. History of Virtual Reality: In the 1560s 360-degree art through panoramic murals were believed to have started the idea of virtual reality.

Than Morton’s Heilig idea of an “ Experience Theatre” in 1950 and its realization as a “ Sensorama” in 1962 proves the existence of Virtual Reality and human engineered mind keep on doing a research on this technology. 1968: Ivan Sutherland, created what is widely considered to be the first virtual reality and augmented reality (AR) head mounted display (HMD) system. Today there’re attempts being currently made to simulate smell and taste: movement of virtual reality into the realm of simulated reality. Gadgets of Virtual Reality:

VR offers new ways for the communication of information, the visualization of processes, and the creative expression of ideas in business and science and with these ideas every now and then the world is having the latest innovative simulated models such as: * HMD “ Eye Phone system”: channels the images from the 2 miniature screens to the eyes, thereby, presenting a stereo view of a virtual world. * BOOM (Binocular Omni-Orientation Monitor): Screens and optical system are housed in a box that is attached to a multi-link arm. CAVE (Cave Automatic Virtual Environment): Provides the illusion of immersion by projecting stereo images on the walls and floor of a room-sized cube. * The Walkman of the 21st century: Attempt to superimpose graphics, audio and other sense enhancements over a real-world environment in real-time. Impact of Virtual Reality on Society: Opportunities| Threats| VR technology can represent the next step in the sociological evolution of humanity. | Techniques will be developed to influence human behavior, interpersonal communication, and cognition (i. . , virtual genetics). | The design of virtual environments may be used to extend basic human rights into virtual space, to promote human freedom and well-being, and to promote social stability as we move from one stage in socio-political development to the next. | As we spend more and more time in virtual space, there will be an gradual “ migration to virtual space,” resulting in big changes in economics, worldview, and culture. | Artificial Intelligence Intelligence itself is the computational part of the ability to achieve goals in the world.

AI is the science and engineering of making intelligent machines, especially intelligent computer programs. Introduction to AI: Artificial Intelligence is basically a combination of searching an innovative idea and bring a knowledgeable part in the respective thought and then to learn how a specific thought be expressed in an artificially intellectual way. The field of artificial intelligence, or AI, attempts to understand intelligent entities. Unlike philosophy and psychology, which are also concerned with intelligence, AI strives to build intelligent entities as well as understand them.

AI is modeling aspects of human cognition by computer, it is the study of ill formed problems, it is a computational models of human reasoning and the things innovated with the help of AI are Models of non-introspective mental processes. AI is that these constructed intelligent entities are interesting and useful in their own right. AI has produced many significant and impressive products even at this early stage in its development. Although no one can predict the future in detail, it is clear that computers with human-level intelligence (or better) would have a huge impact on our everyday lives and on the future course of civilization.

History: AI addresses one of the ultimate puzzles. How is it possible for a slow, tiny brain {brain}, whether biological or electronic, to perceive, understand, predict, and manipulate a world far larger and more complicated than itself? How do we go about making something with those properties? These are hard questions, but unlike the search for faster-than-light travel or an antigravity device, the researcher in AI has solid evidence that the quest is possible. All the researcher has to do is look in the mirror to see an example of an intelligent system.

In late 1940s and 1950s. The first mainframe computers, using firstly vacuum tubes and later transistors in the logic circuits, appeared. In October 1961, the world's first all-electronic desktop calculator, the ANITA (A New Inspiration to Arithmetic/Accounting) was announced. AI is one of the newest disciplines. It was formally initiated in 1956, when the name was coined, although at that point work had been under way for about five years. Along with modern genetics, it is regularly cited as the " field I would most like to be in" by scientists in other disciplines.

A student in physics might reasonably feel that all the good ideas have already been taken by Galileo, Newton, Einstein, and the rest, and that it takes many years of study before one can contribute new ideas. AI, on the other hand, still has openings for a full-time Einstein. In 2005 Honda's ASIMO robot, an artificially intelligent humanoid robot, is able to walk as fast as a human, delivering trays to customers in restaurant settings Recognition of AI: We have now explained why AI is exciting, but we have not said what it is.

We could just say, " Well, it has to do with smart programs, so let's get on and write some. " But the history of science shows that it is helpful to aim at the right goals. Early alchemists, looking for a potion for eternal life and a method to turn lead into gold, were probably off on the wrong foot. Only when the aim changed, to that of finding explicit theories that gave accurate predictions of the terrestrial world, in the same way that early astronomy predicted the apparent motions of the stars and planets, could the scientific method emerge and productive science take place.

In 1990 Loebner Prize established. Grand Prize of $100, 000 and a Gold Medal for the first computer whose responses are indistinguishable from a human. The Origin of AI: In 1950, Turing predicted that in about fifty years " an average interrogator will not have more than a 70 percent chance of making the right identification after five minutes of questioning". In 1957, Newell and Simon predicted that " Within ten years a computer will be the world's chess champion, unless the rules bar it from competition. " This gives us four possible goals to pursue in artificial intelligence: Systems that think like humans. Systems that think rationally. | Systems that act like humans| Systems that act rationally| Importance of AI in the Modern Era: The study of intelligence is also one of the oldest disciplines. For over 2000 years, philosophers have tried to understand how seeing, learning, remembering, and reasoning could, or should, be done. The advent of usable computers in the early 1950s turned the learned but armchair speculation concerning these mental faculties into a real experimental and theoretical discipline.

Many felt that the new " Electronic Super-Brains" had unlimited potential for intelligence. " Faster than Einstein" was a typical headline. But as well as providing a vehicle for creating artificially intelligent entities, the computer provides a tool for testing theories of intelligence, and many theories failed to withstand the test–a case of " out of the armchair, into the fire". AI has turned out to be more difficult than many at first imagined and modern ideas are much richer, more subtle, and more interesting as a result.

AI currently encompasses a huge variety of subfields, from general-purpose areas such as perception and logical reasoning, to specific tasks such as playing chess, proving mathematical theorems, writing poetry, and diagnosing diseases. Often, scientists in other fields move gradually into artificial intelligence, where they find the tools and vocabulary to systematize and automate the intellectual tasks on which they have been working all their lives. Similarly, workers in AI can choose to apply their methods to any area of human intellectual endeavor. In this sense, it is truly a universal field.

Application Areas of AI: AI has its application in almost every field in the world such as: Computer science, Finance, Medicine, Heavy industry, Transportation, Telecommunications, Toys and games, Music and Aviation. Can Computers talk? The modern Innovation of this world is talking computers. The idea generated from the concept of artificial intelligence and this is known as “ speech synthesis” Translate text to phonetic form: * “ fictitious” -> fik-tish-es Use pronunciation rules to map phonemes to actual sound * “ tish” -> sequence of basic audio sounds The difficulties in achieving this innovative idea are: Sounds made by this “ lookup” approach sound unnatural * Sounds are not independent e. g. “ act” and “ action”, modern systems (e. g. , at AT&T) can handle this pretty well * A harder problem is emphasis, emotion such as humans understand what they are saying and machines don’t: so they sound unnatural. * Conclusion: NO, for complete sentences and YES, for individual words. Can we Build Artificial People? The original story, published by Mary Shelley, in 1818, describes the attempt of a true scientist, Victor Frankenstein, to create life. Joseph Faber’s Amazing Talking Machine (1830-40’s).

The Euphonia and other early talking devices are described in detail in a paper by David Lindsay called “ Talking Head”, EUPHONIA “: About this device, Lindsay writes: It is "… a speech synthesizer variously known as the Euphonia and the Amazing Talking Machine. By pumping air with the bellows … and manipulating a series of plates, chambers, and other apparatus (including an artificial tongue …), the operator could make it speak any European language. A German immigrant named Joseph Faber spent seventeen years perfecting the Euphonia, only to find when he was finished that few people cared. Approches Of Artificial Intelligence Historically, all four approaches have been followed. As one might expect, a tension exists between approaches centered on humans and approaches centered on rationality. (We should point out that by distinguishing between human and rational behavior, we are not suggesting that humans are necessarily " irrational" in the sense of " emotionally unstable" or " insane. " One merely need note that we often make mistakes; we are not all chess grandmasters even though we may know all the rules of chess; and unfortunately, not everyone gets an A on the exam.

Some systematic errors in human reasoning are cataloged by Kahneman et al…) Human Centered Approach: A human-centered approach must be an empirical science, involving hypothesis and experimental confirmation. A rationalist approach involves a combination of mathematics and engineering. People in each group sometimes cast aspersions on work done in the other groups, but the truth is that each direction has yielded valuable insights. Let us look at each in more detail. Acting humanly: The Turing Test approach

The Turing Test, proposed by Alan Turing (Turing, 1950), was designed to provide a satisfactory operational definition of intelligence. Turing defined intelligent behavior as the ability to achieve human-level performance in all cognitive tasks, sufficient to fool an interrogator. Roughly speaking, the test he proposed is that the computer should be interrogated by a human via a teletype, and passes the test if the interrogator cannot tell if there is a computer or a human at the other end. Chapter 26 discusses the details of the test, and whether or not a computer is really intelligent if it passes.

For now, programming a computer to pass the test provides plenty to work on. The computer would need to possess the following capabilities: * Natural language processing to enable it to communicate successfully in English (or some other human language); * knowledge representation to store information provided before or during the interrogation; * Automated reasoning to use the stored information to answer questions and to draw new conclusions; * Machine learning to adapt to new circumstances and to detect and extrapolate patterns.

Turing’s test deliberately avoided direct physical interaction between the interrogator and the computer, because physical simulation of a person is unnecessary for intelligence. However, the so-called total Turing Test includes a video signal so that the interrogator can test the subject’s perceptual abilities, as well as the opportunity for the interrogator to pass physical objects “ through the hatch. ” To pass the total Turing Test, the computer will need computer vision to perceive objects, and Robotics to move them about.

Within AI, there has not been a big effort to try to pass the Turing test. The issue of acting like a human comes up primarily when AI programs have to interact with people, as when an expert system explains how it came to its diagnosis, or a natural language processing system has a dialogue with a user. These programs must behave according to certain normal conventions of human interaction in order to make themselves understood. The underlying representation and reasoning in such a system may or may not be based on a human model.

Thinking humanly: The cognitive modeling approach If we are going to say that a given program thinks like a human, we must have some way of determining how humans think. We need to get inside the actual workings of human minds. There are two ways to do this: through introspection–trying to catch our own thoughts as they go by–or through psychological experiments. Once we have a sufficiently precise theory of the mind, it becomes possible to express the theory as a computer program.

If the program’s input/output and timing behavior matches human behavior, that is evidence that some of the program’s mechanisms may also be operating in humans. For example, Newell and Simon, who developed GPS, the “ General Problem Solver” (Newell and Simon, 1961), were not content to have their program correctly solve problems. They were more concerned with comparing the trace of its reasoning steps to traces of human subjects solving the same problems. This is in contrast to other researchers of the same time (such as Wang (1960)), who were concerned with getting the right answers regardless of how humans might do it.

The interdisciplinary field of cognitive science brings together computer models from AI and experimental techniques from psychology to try to construct precise and testable theories of the workings of the human mind.

Although cognitive science is a fascinating field in itself, we are not going to be discussing it all that much in this book. We will occasionally comment on similarities or differences between AI techniques and human cognition. Real cognitive science, however, is necessarily based on experimental investigation of actual humans or animals, and we assume that the reader only has access to a computer for experimentation.

AI and cognitive science continue to fertilize each other, especially in the areas of vision, natural language, and learning. Thinking rationally: The laws of thought approach The Greek philosopher Aristotle was one of the first to attempt to codify " right thinking," that is, irrefutable reasoning processes. His famous syllogisms provided patterns for argument structures that always gave correct conclusions given correct premises. For example, " Socrates is a man; all men are mortal; therefore Socrates is mortal. " These laws of thought were supposed to govern the operation of the mind, and initiated the field of logic.

The development of formal logic in the late nineteenth and early twentieth century's, which we describe in more detail in Chapter 6, provided a precise notation for statements about all kinds of things in the world and the relations between them. (Contrast this with ordinary arithmetic notation, which provides mainly for equality and inequality statements about numbers.) By 1965, programs existed that could, given enough time and memory, take a description of a problem in logical notation and find the solution to the problem, if one exists. (If there is no solution, the program might never stop looking for it. The so-called logicist tradition within artificial intelligence hopes to build on such programs to create intelligent systems.

There are two main obstacles to this approach. First, it is not easy to take informal knowledge and state it in the formal terms required by logical notation, particularly when the knowledge is less than 100% certain. Second, there is a big difference between being able to solve a problem " in principle" and doing so in practice. Even problems with just a few dozen facts can exhaust the computational resources of any computer unless it has some guidance as to which reasoning steps to try first.

Although both of these obstacles apply to any attempt to build computational reasoning systems, they appeared first in the logicist tradition because the power of the representation and reasoning systems are well-defined and fairly well understood. Acting rationally: The rational agent approach Acting rationally means acting so as to achieve one's goals, given one's beliefs. An agent is just something that perceives and acts. (This may be an unusual use of the word, but you will get used to it.) In this approach, AI is viewed as the study and construction of rational agents.

In the " laws of thought" approach to AI, the whole emphasis was on correct inferences. Making correct inferences is sometimes part of being a rational agent, because one way to act rationally is to reason logically to the conclusion that a given action will achieve one's goals, and then to act on that conclusion. On the other hand, correct inference is not all of rationality; because there are often situations where there is no provably correct thing to do, yet something must still be done. There are also ways of acting rationally that cannot be reasonably said to involve inference.

For example, pulling one’s hand off of a hot stove is a reflex action that is more successful than a slower action taken after careful deliberation. All the “ cognitive skills” needed for the Turing Test are there to allow rational actions. Thus, we need the ability to represent knowledge and reason with it because this enables us to reach good decisions in a wide variety of situations. We need to be able to generate comprehensible sentences in natural language because saying those sentences helps us get by in a complex society.

We need learning not just for erudition, but because having a better idea of how the world works enables us to generate more effective strategies for dealing with it. We need visual perception not just because seeing is fun, but in order to get a better idea of what an action might achieve–for example, being able to see a tasty morsel helps one to move toward it. The State of the Art AI Innovations International grandmaster Arnold Denker studies the pieces on the board in front of him. He realizes there is no hope; he must resign the game.

His opponent, Hitech, becomes the first computer program to defeat a grandmaster in a game of chess. “ I want to go from Boston to San Francisco,” the traveler says into the microphone. “ What date will you be travelling on? ” is the reply. The traveler explains she wants to go October 20th, nonstop, on the cheapest available fare, returning on Sunday. A speech understanding program named Pegasus handles the whole transaction, which results in a confirmed reservation that saves the traveler $894 over the regular coach fare.

Even though the speech recognizer gets one out of ten words wrong, it is able to recover from these errors because of its understanding of how dialogs are put together. An analyst in the Mission Operations room of the Jet Propulsion Laboratory suddenly starts paying attention. A red message has flashed onto the screen indicating an “ anomaly” with the Voyager spacecraft, which is somewhere in the vicinity of Neptune. Fortunately, the analyst is able to correct the problem from the ground.

Operations personnel believe the problem might have been overlooked had it not been for Marvel, a real-time expert system that monitors the massive stream of data transmitted by the spacecraft, handling routine tasks and alerting the analysts to more serious problems. Cruising the highway outside of Pittsburgh at a comfortable 55 mph, the man in the driver’s seat seems relaxed. He should be–for the past 90 miles, he has not had to touch the steering wheel. The real driver is a robotic system that gathers input from video cameras, sonar, and laser range finders attached to the van.

It combines these inputs with experience learned from training runs and successfully computes how to steer the vehicle. A leading expert on lymph-node pathology describes a fiendishly difficult case to the expert system, and examines the system’s diagnosis. He scoffs at the system’s response. Only slightly worried, the creators of the system suggest he ask the computer for an explanation of the diagnosis. The machine points out the major factors influencing its decision, and explains the subtle interaction of several of the symptoms in this case.

The expert admits his error, eventually. From a camera perched on a street light above the crossroads, the traffic monitor watches the scene. If any humans were awake to read the main screen, they would see “ Citroen 2CV turning from Place de la Concorde into Champs Elysees,” “ Large truck of unknown make stopped on Place de la Concorde,” and so on into the night. And occasionally, “ Major incident on Place de la Concorde, speeding van collided with motorcyclist,” and an automatic call to the emergency services.

AI Purposes “ AI can have two purposes. One is to use the power of computers to augment human thinking, just as we use motors to augment human or horse power. Robotics and expert systems are major branches of that. The other is to use a computer’s artificial intelligence to understand how humans think. In a humanoid way. If you test your programs not merely by what they can accomplish, but how they accomplish it, they you’re really doing cognitive science; you’re using AI to understand the human mind. “