# Notes on Artificial Intelligence and Education in the Age of the Computer

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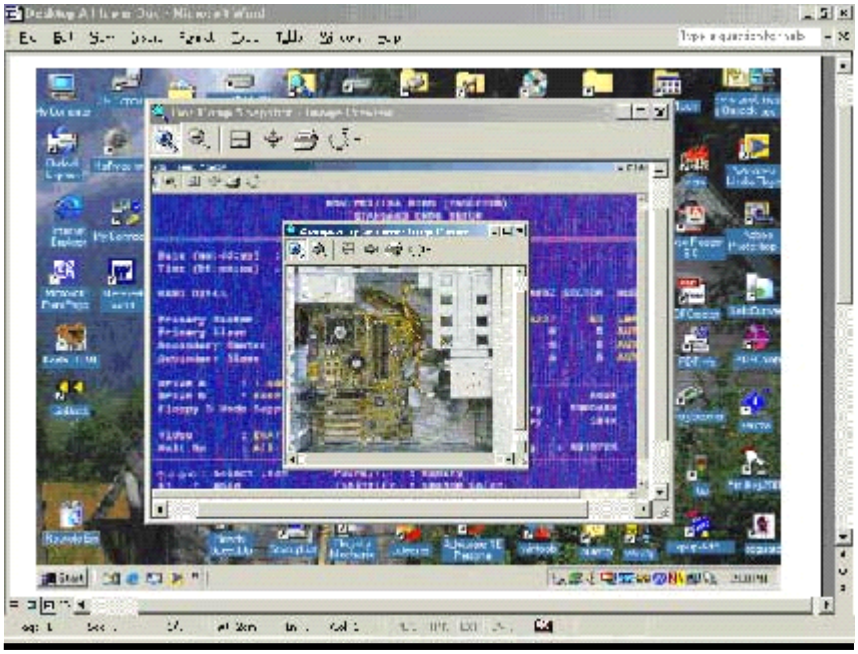

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# Notes on Artificial Intelligence and Education in The Age of The Computer

## Contents:

# Notes on Artificial Intelligence, Life, and Consciousness:

WARNING: If you do not wish to know about non-linear dynamical systems, chaos, entropy, criticality, phase transitions, complexity, emergence, quantum theory, and even about life itself as merely being a property of organised matter, with evolution as the principle organising factor, plus associated ideas, debates, and other disturbing evidence of an impermanent and non-human-centred Universe, then you are well advised to waste no time on studying the following Notes.

Otherwise, for those who are interested in such matters, these brief Notes and accompanying References are offered as a basis for beginning the study of the origins and continuing development of Artificial Life, Intelligence and Consciousness, and, comparison with the human versions. Life manifests intelligence and consciousness, so if artificial life is to exist, there must be parallels to biological life as we know it, and hence AL must manifest these qualities. Thus, physics and biology are drawn closer together in the search to understand any form of life that may exist, however constituted. Also, and most importantly for humans and the scope of their own intelligence, this inevitably raises the question of when or whether there will be a true Turing Test that will establish any possible artificial intelligence as being equal or better than human intelligence.

The history and development of computers, and IT in general, is thus so intricately bound up with these and other questions, that reading about one aspect inevitably leads on to acquiring ever-wider knowledge and understanding of the implications of the existence of this technology. The debate about artificial life is just one example of this knowledge networking, and this is also reflected in the books chosen for the Bibliography. However, you can draw your own conclusions, **this Notemaker herein merely defers to the rich and well-written sources listed herein, and offers instead just a short, and general, introduction to these topics, while offering to share a very interesting reading experience.**

Firstly, using clear and sustainable definitions of life, intelligence and consciousness is important, as is recognising the fact that the quality of these faculties is a relative matter, and that self-awareness is also an important criterion in human and 'other' life forms for enhancing the intrinsic quality of these faculties. (Animals have already been subjected, crudely or otherwise, to these anthropomorphic comparisons.) The more complex the organism or machine, ie, the more 'alive' it is, the more important self-awareness, including self-appraisal, is, for assessing the degree of intelligence and consciousness present within the entity being studied.

If AI has a machine body to dwell within, and the equivalent of a human biological body, so there should be these corresponding faculties within each corpus, and similar interactions with external physical or intellectual ambience should be possible. Of course, androids and cyborgs, when sufficiently sentient and self-aware, may have their own opinions on what constitute a body..? Intelligence implies Life, and vice versa, no matter how humbly may be the perceived manifestations?

For all aspiring of putative life forms, to be alive, intelligent, and conscious there must be sensory input, proprioception, self-awareness, self-appraisal, self-preservation, ongoing learning, environmental and intellectual interaction, spontaneity of thought, pursuit of ideas, pattern recognition, judgement, and problem-solving abilities, plus survival in complex environments, to name some necessary and/or sufficient criteria. That great conundrum, common sense, to be applied in any given situation, should also be obviously manifest for human and/or artificial intelligence to be viable. Self-reproduction is another intrinsic ability required for higher life forms.

Artificial Intelligence is now advancing by utilising pattern recognition, and other human neural abilities, for 'machine' learning and commonsense. AI will, and must, evolve as human intelligence has in this respect, because it is impossible to build in the potential scope of knowledge and commonsense, this being potentially infinite for both human and machine. Commonsense here is defined as application of both past experience and/or learning pattern recognition abilities, allied with considered decision-making, although this definition may, of course, be open to discussion. In short, valid pattern recognition must be coupled with effective pattern synthesis, or algorithm synthesis in computer terms, to manifest as real and applied commonsense, for AI, II, or human intelligence development. (**Note that II=Indistinguishable Intelligence.)**

Some humans will welcome the challenge of developing artificial intelligence and consciousness, others will be fearful and intimidated, or else too egotistical to entertain the idea of such intellectual equality or even possible eclipse. But humans will learn more about themselves as this research is advanced, and also the definitions of these standards will be made clearer. One thing is for certain, a successful and valid Turing Test will surely help to define the limits of human intelligence, and that the principle limitation may ultimately be biological. Even now, our computer creations work at faster speeds than we ever will, albeit with simple and oft-repeated steps at present.
To avoid the reefs of semantic dispute, on which other aspects of the discussion may founder, the generality of terms used in this instance is conceded. But, for those wishing to fruitfully pursue such matters, the advice is to establish **early** and commonly accepted meanings on which to base further pursuit of these ideas, and to be prepared for further refinements. Indeed, as an example, consideration has been given to Artificial Intelligence being regarded as Alternative, Other-Worldly, or Non-Human Intelligence as being less pejorative, and thereby helping to develop more rational and relevant descriptions of what we humans are wont to call at present merely artificial intelligence.

Of course, this intelligence must then be compared to what **we** think we as humans have, which should include our biological limitations as well, both physical and temporal. By studying computers, and now artificial intelligence, we are also advancing knowledge of our own thinking processes and intelligence. We may find that new and better standards of human behaviour are established as we define what constitutes a 'good' and artificially intelligent and conscious machine. Do we fear that something 'better' than us will be created?

For a useful summary of these topics of AI and consciousness, and relevant knowledge, (at least in 1992), **Life At The Edge Of Chaos**, Ch. 10, and **Virtual Organisms**, (1999), may help with making the decision to pursue these matters further. Chaos study is also integral to these topics, and is a good read anyway, as in James Gleick's groundbreaking book of the same name, which is also included in the short Bibliography. In these selected books, and related to chaos, are further descriptions and discussions concerning the edge of chaos, complexity, phase transition, criticality, entropy, entropy equilibrium, plus increasing and diminishing returns, to name some of the interesting topics you will discover. (**Chaos** is more correctly termed deterministic chaos, as in sensitivity to starting conditions and feedback in nonlinear systems. There is also an **inverse chaos**, meaning that simple effects may follow from complex interactions.)

The foundations of artificial life, intelligence and consciousness are explained by applying these definitions and mechanisms, and in turn, the development biological life is also. One most interesting example of this is the principle that observed diminution of entropy should be accepted as a sign of what we as humans would describe as 'life', first proposed by James Lovelock as a testing parameter for identifying extraterrestrial life forms during early Mars planetary exploration.

Certainly, our understanding of chaos and complexity have been made possible by the availability of computing power, as have advances in so many other disciplines utilised in everyday life, such as medicine, science, architecture, CAD, AV, finance, information storage and retrieval, and general library dynamics to name just a few. Valid and useful simulations, and model-building, are so easily obtained using IT, as variations may be easily factored in, and outcomes speedily presented. These models are increasingly more important now in biology, and the question could be posed of how much more speedily the Riddle of DNA would have been solved with present digital model-building capabilities? There would also be no A380 airbus without computers and the vast IT model-building potential needed! Even some of the blind among us are being helped to see by this new computing power.

Also, the development and continuing use of computers is now part of the history of science. Both aspects continue to reshape our human philosophy of scientific knowledge in two main respects, viz, the new realization of an all-pervading impermanence in our own lives, and, growing consciousness of the infinite limits of scientific knowledge, both of which are now part of our continuing human intellectual challenge. Certainly, as humans we must learn co-operation among our own kind as never before, so that these new dimensions of knowledge and inventiveness are enlarged. Can we improve on our past record in this co-operation?

The knowledge and degree of our own limitations will be tested by investigating artificial life, so, do we just fear the findings that may reflect badly on ourselves, or will we welcome whatever will be further discovered about ourselves and our biological reality? Will life, intelligence, and consciousness, finally be defined as processes stemming originally from organisation at a phase transition, that evolved to emerging self-organisation and then self-replication, both in ourselves and in other forms of life capable of such evolution? This is a common research theme, and where physics and biology intercept in the search for further understanding and clear description of the origins of life, whether artificial, or carbon-based-biological such as humans.

The complexity of human intelligence was derived from gradual evolutionary modification, and this complexity will be similarly derived for artificial intelligence. This will also include increasing self-organisation, logic, memory, and the increasing ability to deal with situations as they arise, aka common sense! The sheer speed of computing power will help compensate for the richness of neural networks characteristic of the human brain, but that neural richness may yet still be enabled in artificial intelligence also? Thus, to enlarge and enable more advanced research into the development of intelligence et al, parallel processing, quantum computing, and neural networks are now the main areas of ongoing research into artificial intelligence, and indeed, towards greater understanding of our human intelligence as well.

By this definition, and based on AI research, we now enter the **Fifth Age of Computers**. (The other four Ages are: 1) 1940-46 **Vacuum Tubes**; 2) 1956-63 **Transistors**; 3) 1964-71 **Integrated Circuits; 4)**1971-Present **Microprocessors**. (Really, we would be in the **Sixth Age** if all those earlier systems of counting by fingers, toes, abacuses, and later efforts at mechanical calculation such as by Leibniz, Pascal, Babbage, et al, that preceded vacuum tubes, were also counted in?) Neural networks are based on brain function and the processing of information, and artificial intelligence in general is now being based on the understanding and of emulation of biological processes of learning. Hence the emphasis on life being a necessary concomitant of artificial intelligence, as well as having the inherent consciousness, self-awareness, self-organising and self-adaptive faculties of biological life-forms in general.

The history and progress of this Fifth Age research are both equally interesting, and thus, books in the appended References also reflect an increasingly historiographical record of how scientists have developed and used interrelated science and technology as part of this research, and also how others viewed the ongoing effects and findings In this small selection of books, the history, science, and continuing research into, the subjects of IT, the relationships of physics and biology, as well as applications to life, intelligence, and consciousness, are well presented. Themes, histories, and personalities resonate, yet the various volumes listed are different enough in style and detail to provide a wider understanding than if only one or two were read. **AI** in particular has a very readable historical overview, and the contrasting approaches of 'top-down', or programming for specific situations, versus 'bottom-up', based more on neural networks and learning being built on, or evolving, are both especially interesting.

**Computer Power and Human Reason,** and **Turing's Man,** both reflect the concern that such research is hubris, and/or that over-reliance on IT is counterproductive for human progress. These are the most pessimistic and cautionary of the references listed, and also the least recent. In **Turing's Man**, we are cautioned to see that the computer is to be regarded merely as a machine, or, at best as a tool, but **never** our equal or master. Thus, synergy with this ubiquitous tool should be our aim, utilising the best of both sets of human and tool/machine abilities, no doubt for the best reasons and motives, presumably. How far this synergy will progress, while human mastery is assured is not just anyone's guess, but is also everyone's

responsibility. **IT becomes AI, becomes II**, and this is inevitable, at least given the human IQ range to be emulated by II, so some of us may have been be overtaken already. **I think therefore I am, versus, II therefore I am..?**

{To digress, this says much about the potential of II; after all, Hal's whole mission logic was simply the logic of **The Nuremberg Defence** in average expedient human terms, and the putative, and human-centred, morality of **Asimov's Robotic Laws** was superseded by the overall mission objective. Also, computers may be programmable to incorporate the diversity of human logic, but what if they derive a particular form of logic outside the parameters of any possible human logic? Who knows what will ensue when the present potentially dangerous "in-our-own-image" standard and technology are exceeded? Food indeed for human thought.

At this point, II will be exceeded, no doubt, but what form will this take? Is this outside our logic parameters to predict? This is inferred by **The Minor Law of Human Logic Parameters**, which states simply that human intelligence, and thus human logic, are both constrained by the limits and nature of our own organic architecture. Furthermore, as long as our own checks and balances are unresolved, how can we instigate these in, or determine predictable cohabitation with, our future II creations? What happens **when** our creations, evolving with an organic/mechanistic nature, begin self-replication as higher intelligence is achieved?

Much is made of common sense being a human trait that no computer could match, but common sense derives from a mixture of experience and intelligence, (relying on association and pattern recognition), and a willingness to use both, or, constructive experience-based conjecture that should manifest as commonsense; a computer is always "willing", has computing power and speed well beyond that of humans, can be programmed with the infinite possibilities of constructive conjecture that characterise basic human intelligence, and even be taught as humans are taught, including pattern recognition. What of the ultimate human-machine synergy of a human brain linked directly to computing power? The cyborg of science fiction is certainly an increasing possibility, the ultimate synergy of human and computer! Nothing like few healthy what-if conjectures..?}

We can, after all, as Bolter states in his Conclusion to **Turing's Man**, pull the plug when necessary, surely? Or, will independent machines also have independent power sources? Yet again, how will we view, and relate to, cyborgs? Plug-pulling in this instance could have a whole new meaning! Any sensible intelligence dependent on a power source, organic or otherwise, would tend to protect this vital life-support from unplugging or other forms of disruption, surely? All this will be part of building and managing 'The Future', and as well, if these IT/AI/II machines are in our own image, can we avoid the transferring the (relative?) problems of our own human nature? How will trust and responsibility be manifested within 'other' intelligence? New challenges will surely abound!

Anyway, an early version of the **Turing Test** was Joseph Weizenbaum's **ELIZA** program of the 60's, formulated for a sympathetic question-and-answer interaction with humans. The results were surprising, (see the Introduction, **Computer Power and Human Reason)**, not least because this proves that humans, at least when in subjective or self-centred mode, are no match for a very basic Turing Test! However, regardless of Deep Blue's strategic chess computations, the **real** Turing Test with a fully conscious and self-aware non-human intellectual entity is yet to come, although it is surely just a matter of when? This is the opinion of the later publications, and the difference in publishing dates reflects the speed and increasing scope of this research, as well as itemising the history.

The two **Turing Test** references discuss what the parameters of a Turing test should be, as well as the form(s) this should takes, such as verbal or non-verbal. Some contributors appear resentful that a Turing Test should even be considered, others state that humans will be intrigued by the emerging challenge, as well as the opportunity for ongoing interaction with such a sentient and successful machine. AI becomes II, or, Artificial Intelligence becomes Indistinguishable Intelligence, irrespective of its actual nature!

**Digital Soul** very competently studies the sorts of questions that would be posed by intelligent lay-people concerned about emerging artificial intelligence and consciousness, including the dimension of morality, and its social contexts. Free will and its implications are considered, (pp. 86-90), and an interesting question is posed as to whether free will is the beginning of thinking, or the end? What form will free will or intelligence other than ours actually take? Surely there is no universal constant of what constitutes free will?

For those with delusions of intellectual grandeur, Roger Penrose's two books are for you. But other more modest and self-effacing researchers should first read **The Third Culture**, especially pp. 239-257, and then decide if further action re investigating this particular emporer's mind, and its various shadows, (such as a fear of being superseded by a mere computer?), is warranted. This Notemaker also skipped the main exercise after a quick thumb-through! **Decoding the Universe,** in particular, provides a convincing rebuttal, pp 212-216, of the idea that the brain does not support quantum consciousness, due to physical storage deficiencies that promote decoherence of information, and thus system entropy.

**Understanding Intelligence** introduces 'embodied cognitive science', including the importance of differentiating respective autonomous agents, and estimating their combined contribution to the emergence of robotic autonomy. Self-sufficiency, autonomy, situatedness, embodiment, adaptability, ecological niches, and universality are defined and explained, as well as emphasising the need for an interdisciplinary approach to studying and developing artificial intelligence and robotics. The sheer complexity of AI development is also well presented.

**Out of Their Minds**, in the two sections '**Architects'** and **'Biological Connections'** has very interesting studies about two AI problems, firstly of machine intelligence hardware architecture, and, of duplicating other human neural activities such as massive parallel processing, both in time, and in space, which humans conduct naturally, as individuals and in groups. Not only must machines think 'neurally' to advance artificial intelligence to human levels, or beyond, they must also be massive

parallel processors as well, which could be limited by the human-originated technology required to build them to this stage. When these limitations are overcome, linking both humans and AI machines by networks, when optimised, will greatly enhance all sorts of intelligence gathering and application. Human intelligence, currently using the Internet Information Highway for qualitative information exchange, and facilitated by present 'machine efficiency', gives us a glimpse of just what might be in the future..?

**Mind At Light Speed,** true to subtitle, **A New Kind of Intelligence,** discusses how AI can be expanded and improved by optical and quantum computing, the powers of both, particularly quantum, would introduce the scale of pattern recognition and associative potential of which humans are finitely capable, which implies that human intelligence will eventually be superseded in 'computing power'. Needless to say, Moore's Law would now longer apply with these computing technologies..? Infinite computing power, and an infinite 'work ethic,' will thus combine in AI minds operating at light speed!

**The Third Culture** is concerned with scientific writing, (and also contains papers relevant to the aforementioned topics), that maximises communication with ordinary people, an essential element of understanding scientific direction, as well as enabling perspective for future decision-making to support any scientific research. Public perceptions of acceptability and relevance do depend on public education and understanding, and science writers represented in **The Third Culture** are most important as presenters of clear and understandable scientific writing, including the study of artificial life and intelligence!

Finally, **The Unnatural Nature of Science** is a study of the nature of Science itself, that particular discipline so central to all the issues under discussion here. Scientific progress tends to be more serendipitous than serial, and very often chance does favour the prepared mind. We must also must understand what Science **is** in order to know and understand what Science is actually **doing,** as a process as well as a discipline**,** so that **we** all may understand and support the need for continuing scientific research and development.

Meanwhile, we should all keep our powder dry and minds open in regards to ongoing matters of Artificial Life, Consciousness, And All That, and, as already suggested, you can further draw your own personal conclusions, if you wish, from the reading of some or all of the following suggested **References**, including the **Notemaker's Picks:**

**AI,** D. Crevier, BasicBooks 1993, ISBN **0465029973**

**Artificial Intelligence,** B. Whitby, One World 2003, ISBN **1851683224**

**Artificial Life,** S. Levy, Jonathan Cape 1992, ISBN **0224035991**

**Chaos,** J. Gleick, Penguin 1987, ISBN **0140092501**

**Cognisers,** R. Johnson & C. Brown, Wiley 1988, ISBN **0471611611**

**Complexity,** M. Waldrop, Viking 1992, ISBN **0670850454**

**Computer Power and Human Reason,** J. Weizenbaum, Freeman 1976, ISBN **0716704641**

**Darwin Among the Machines,** G. Dyson, Allen Lane 1997, ISBN **0713992050**

**Decoding the Universe,** C. Seife, Viking 2006, ISBN **067003441X**

**Deep Simplicity,** J. Gribbin, Penguin 2004, ISBN **0713996102**

**Digital Soul,** T. Georges, Westview 2003, ISBN **0813340578**

**Does God Play Dice?** I. Stewart, Penguin 1989, ISBN **0631168478**

**Emergence,** S. Johnson, Touchstone 2001, ISBN **068486875X**

**Frontiers of Complexity,** P. Coveney & R. Highfield, Fawcett Columbine 1995, ISBN **0449908321**

**Into The Heart of the Mind,** F. Rose, Century 1985, ISBN **0712608060**

**Growing Up With Lucy,** S. Grand, Weidenfeld & Nicholson 2003, ISBN **0297607332**

**Life at the Edge of Chaos,** R. Lewin, McMillan 1992, ISBN **0025704850**

**Mind At Light Speed,** D. Nolte, Free Press 2001, ISBN **0743205014**

**Natural Born Cyborgs,** A. Clark, OUP 2003, ISBN **0195148665**

**Out of Their Minds,** D. Shasha & A. Lazere, Copernicus 1995, **ISBN 0387979921**

**Shadows of the Mind,** R. Penrose, OUP 1994, ISBN **0198539789**

**Spiritual Machines,** R. Kurzweil, Allen & Unwin 1999, ISBN **1865080268**

**The Bit and the Pendulum,** T. Siegfried, John Wiley, ISBN **0471321745**

**The Emporer's New Mind,** R. Penrose, OUP 1989, OUP 1989, ISBN **0198519737**

**The Garden in The Machine,** C. Emmeche, Princeton UP 1991, ISBN **0691033307**

**The Turing Test,** ed. J Moor, Kluwer Academic Press 2003, ISBN **1402012047**

**The Third Culture,** J. Brockman, Simon & Schuster 1995, ISBN **0684803593**

**The Turing Test,** ed. S. Schieber, Bradford MIT 2004, ISBN **0262692937**

**The Unnatural Nature of Science,** L. Wolpert, Faber,1993 **ISBN 0571169724**

**Turing's Cathedral,** G Dyson, Allen Lane 2012, **ISBN 9780713997507**

**Turing's Man,** J. Bolter, Uni. N. Carolina Press 1984, ISBN **0807815640**

**Understanding Intelligence,** R. Pfeiffer & P. Scheier, MIT 1999, ISBN **0262161818**

**Virtual Organisms,** M. Ward, Macmillan 1999, ISBN **0333724828**

**See also A Computer Beginner's Survival Factfile, Introduction and References**

**ADDENDA:**

**Chaos in Computer Performance** If you think the complex microchips that drive modern computers are models of deterministic precision, think again. Their behaviour is inherently unpredictable and chaotic, a property one normally associates with the weather. Intel's widely used Pentium 4 microprocessor has 42 million transistors and the newer Itanium 2 has no fewer than 410 million. Chaos theory can explain the unpredictable behaviour. The National Research Institute for Information and Automation in Orsay, France, ran a standard program repeatedly on a simulator which engineers routinely use to design and test microprocessors, and found that the time taken to complete the task varied greatly from one run to the next. But, within the irregularity, the team detected a pattern, the mathematical signature of "deterministic chaos", a property that governs other chaotic systems such as weather. Such systems are extremely sensitive - a small change at one point can lead to wide fluctuations at a later time. For complex microprocessors, this means that the precise course of a computation, including how long it takes, is sensitive to the processor's state when the computation began. (Issue 2507 of **New Scientist,** 11 July 2005.)

**Parts of the human brain operate on binary principles.** Neurons in the human pre-frontal cortex are binary, ie, either active or inactive, and the basal ganglia switches pre-frontal cortex parts on and off. Digital computers operate using principles of on/off, and also employ dynamic switching between these states. **(Science,** Issue of 6October 2006)

**Anon and Trad both state that computers and their systems are presently so complex and ad hoc, in both development and function, that it is a wonder that they do go at all. Perhaps, rather like their human creators? So, wonder in your turn own, but do continue to persevere, with care, and then enjoy the fruits of your joint and synergistic endeavours!**

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# Notes on Education in the Age of the Computer:

**Firstly, some relevant definitions: IT, or Information Technology,** in general usage really stands for all the convergent technology, including the computers and software, and both terms of 'IT' and 'computers', in common usage anyway, have become interchangeable, even if not strictly so. The **computer** is the machine or tool with which computations and other digital operations are carried out, and usually includes connected peripherals in this definition. **Information technology,** more strictly speaking, deals with storage, processing and dissemination of information, especially using computers.

**Technology** is applied science, as well as being a general descriptive, (and sometimes pejorative!), term. **Data** is a matter of **facts**, with the additional duty of having a digital existence as stored information featuring in digital operations. **Information** ranges from knowledge and facts to instruction, news, statistical and digital values, and even a given entity of itself being an item of information, in an abstract scientific sense. Finally, **education** is the systematic instruction of children, and adults, to develop mental and physical prowess, plus intellectual powers, and to **train** is to discipline, or teach, particular skills. This assemblage of data/facts/information, also in a general sense, was compiled with help from **The Shorter Oxford, 1990**.

Of increasingly greater significance now, in the 21st Century, is the fact that contemporary education in the age of the computer not only applies to humans, either as an ongoing process, or, in order to optimize benefits gained from IT in general, but also to more sophisticated programming and actual education of computers themselves, especially as bottom-up evolutionary-type computer education is developed, such as for improving artificial intelligence based on neural network development.

This has also led to greater understanding of human intelligence, and the more systematic analysis of thought and action processes, that we ourselves have for so long taken for granted, that they may be re-produced and further developed by and for artificial intelligence, wherever, and irrespective of, where that may lead. There are at present definite parallels with human and artificial intelligence, but there will be evermore-evolving differences as time goes by, (are grey areas for humans the equivalent of fuzzy logic for AI??), including even potential differing natures of intelligence; furthermore, all of these factors will be contributing to the sum of human knowledge, and to the development of new disciplines and research directions.

However, with at least the present perspective of nearly 50 years of increasingly widespread computer use, the worst fears of the IT Luddites and Doomsayers, for human well-being, have not been realized. Computers have enhanced our human minds, and enlarged our intellectual world, while at the same time making our physical world smaller, more understandable, and more accessible. Communications, science, planning, architecture, engineering, graphic arts and medicine, to name a few, have benefited greatly from this technology. Libraries continue to thrive, not least because they have wholeheartedly embraced this new technology, children still play sport, and we have not all become hackers or computer potatoes, indeed, human weakness for drugs and fast foods is more of a threat to continuing civilisation than computers and/or IT. Excuses for sloth also abounded long before computers graced our world!

Since the 1960s especially, alarms have been sounding about the perils of computer power versus human the mind, computation versus human cognition, computation versus human consciousness, and/or diminution of human attention spans and intellectual creativity caused by computer overuse or over exposure. There is also the putatively spurious authority of Computer Findings, and the undesirable compilation of data for access by questionable vested interests, not to mention the usual mischief-makers who will always be with us in any age or stage, because of our common humanity. All these are part of past, present, and no doubt future arguments, about computers/IT, now so ubiquitous, now so securely entrenched in our human midst.

Indeed, whole generations have now grown up with IT, and these generations have since reduced the profile of computers to a more everyday perspective, checks and balances of operation are in place, life goes on as before, and we should expect even more so. Voodoo electronics has given way to user-friendly, novelty has been replaced, in the main, by everyday acceptance, and healthy skepticism about claims of omniscience and ubiquity are prevalent. However, although human existence could continue without computers, much that is now regarded as our legitimate and laudable quality of life would be absent, and the boundaries of research, knowledge and communication would be much diminished. The pursuit of artificial intelligence has also enhanced our knowledge of ourselves, and of other biological entities, as well as aiding understanding of the inanimate world. For these reasons, there is widespread respect and gratitude what has been gained by IT development and subsequent widespread human utilisation.

Still within optimizing IT, increasing technological convergence, that also enhances the capabilities of the everyday computer, has since produced the ever more ubiquitous and alarming mobile phone, which in turn is calling the peals of tocsins much as it's nearest technological parent, the computer, has done in the past. All that alarming talk about alienation, damage to the young, EM radiation, wasted time, and technological over-dependence, etc., is heard once more. But, make no mistake, even the mobile phone will recede into an everyday and commonsense perspective in its own turn, and doubtless some other temporarily alarming technology will, in turn, replace that, also pending the usual accommodation in everyday human affairs.

The present Age of IT is really just another phase of the ongoing Industrial Revolution, perhaps classifiable as a High-Tech Sub-Revolution, that is certainly accelerating social, economic, and resource management changes, as well as aiding human originated changes wrought upon the world at large. The time is telescoping during which consequences of human progress manifest themselves, and also the feedback time required for effective management of these changes. IT, in the form of the Internet and ever more accessible news media and facilitated publishing, has become a means of witnessing, recording, and educating us all about change, and world consequences, as well as an accelerator of change.

IT also does help to make individuals and governments more accountable as plague, plight, and great discoveries are all very quickly notified to the rest of the world, and with many varying news/information perspectives to compare and consider. ***The Age of the Computer*** is the stock description that acknowledges the changes wrought in recent decades by the use of IT that

can help create an even better world, or just aid in the committal of even greater errors. For better or worse, we humans must manage and exploit this newest resource IT for our betterment, and that of the world as a whole, while taking account of the affects on human society and the world around us that have become evident from its increasing ubiquity and ongoing use.

Indeed, information feedback, especially relating to resource management, has never been so ubiquitous, timely, or widespread due to the computer, the problem that now remains is human apathy or indifference to the present data and forecasts that out IT creation has made so easily available to us. Our standard human nature and our biological reality remain, and regardless of what bounties our sciences may bring us, our use of such bounties is a reflection of, or result or conflict with, our own organic nature. Our human challenge still remains to know **ourselves** well, and then to sensibly manage our own creations, to also use these creations, directly or indirectly, to enhance our knowledge of ourselves, and benefit the world at large.

The impact of IT on different societies has also been influenced by existing cultures, and although there have been some failures and repercussions, the benefits are increasingly being experienced worldwide. The US educational experience, for example, has been well-publicised in publications such as **The Flickering Mind**, although the social and economic impact will not necessarily be the same for all other societies utilising IT for educational purposes. In a society where time for leisure and leisure pursuits, as well as a thriving 'Entertainment Industry', is a sign of wealth and technological superiority, infotainment increasingly powered by convergent IT is bound to have an even greater effect, including educationally.

An inherent cultural conflict concerning the value of learning, and the perceived need for it in that cultural context, is thus inclined to develop in the minds of susceptible individuals. Even more worrying is the growth of debt that belongs to those less able to afford the ever-newer and grander standards of an industry whose cutting edge is so heavily advertised. Also, the various service industries that have grown with IT are not going to encourage optimum technological knowledge being shared, and expeditiously riding behind a political bandwagon does bring its own reward. Nor do the politicians that launch bandwagons always feel responsible for consequences of decisions, as the next planned vote-winning move has already displaced the current in importance**.**

Although the US may pride itself as a leader in so many ways, the price of that leadership is also to make errors and/or solve problems as an exemplar from which other more tardy sideline observers may learn so expediently. These points, and their consequences, are very well related in **The Flickering Mind**, but which is not necessarily the standard of what will transpire elsewhere, although there will, of course, be more congruence with those societies who follow more directly the model of contemporary American society. Look around you, and make your own judgement of how IT has affected your own particular society, for better or worse, and especially educationally. The main aim of any liberal and comprehensive education system, is surely, to optimise the active part of human mind..? Other useful references on this topic include **The Information, The Shallows,** and **The Filter Bubble.**

Indeed, a paper could well be written on **Computer/IT Use, and Human Attention Span,** (in homage to Joseph Weizenbaum..!), that would address, in detail, the adverse affects of quick online trawling without enough detailed thought and analysis of data, with consequent inhibition of 'writing up' language and style, among those that do still engage in this pastime. Plagiarism is also a hazard for those who highlight and copy in bulk, without due attention to source references. Portable computing has also increased the scope of this kind of data-trawling, and the 'always-on' mental state that does not allow time for due reflection , always being aware or, and checking for email and/or texts, are good examples of this. Gaming has the attendant hazards of alternate realities impinging on personal real-world awareness, as well as adrenalin addiction, in those susceptible to this. Health considerations must also be factored into extended computer use, so that time away from the constraints of keyboard use are balanced by occupation of desks and easy-chairs, as well as ambulant thinking, especially in the company of like minds..!

Note that **The Filter Bubble** infers hazards for general education, as well as for everyday life online, so that data-gathering should always be done with suitable Search Engines, from assorted and reputable sources, including hard-copy, and strive to be as objective as possible. Useful advanced intellectual exercises for truly active and deep-thinking minds..?

Transient low-level mental stimiulii, precluding dedicated and directed thought, with a consequent low-level response, results in the inculcation of shallow thinking and poor attention spans, from an early age, thus inhibiting formal speech and writing development, which should also have preceded learning the particular shorthands of emailing and texting. The observant and proactive parent setting a good example of thinking, learning, reading, writing, and related computer/IT use, is so very important for developing minds, regardless of formal educational input..? The difference between short-term and long-term attention spans should also be taught with any level of education, and, learning of the difference between promoting the passive aspects of brain function, and of higher-level active brain use. An active brain is a well-trained and intellectually nourished brain, that can thus slip easily into detailed thought and analysis when data-gathering is considered sufficiently advanced for this to occur.

Generally, in any contemporary well-organised, well-endowed, and, democratic society, children who were always fortunate to be involved with books, parental examples, good teaching, stable formal education, and not conditioned to being baby-sat by technological infotainment, have incorporated all these new IT trends, and moved on to even greater things. Those without such stabilising influences would always be less likely to do so. Unfortunately, this usually equates with socio-economic status, both of individual and/or society, and this inevitably places more responsibility on public education systems, in regard to access to educational resources whatever they may be, and, technical support as well. In an increasingly smaller world, these factors are increasingly a shared human responsibility, and must be recognised as such. Thus, well-directed educational aid programs, rather than just well-meant educational aid, are also necessary to help the developing world share successfully in the IT cornucopia, especially as this influences ongoing education.

Most certainly, and where possible, careful planning, teacher training and quality technical support are required, for successful IT implementation. But there will be one constant from the past that still pertains, and that is those who do not have a secure intellectual grounding in childhood, and ongoing education the pursuit of ideas, will tend to be at a social or economic disadvantage in any age. That is all about human social management, and to reiterate, in **our** time, computers should not be regarded as some sort of deterministic influence for social decline over which the human race has no control. They have a very useful place in our world, given proper use, especially in an educational setting. How **useful** though, is, and always will be, up to **Us!**

Legitimate questions in **The Cult of Information,** at the time of the first edition, 1986, about information being mistaken for useful knowledge, as expressed by describing a putative Cult of Information, have not been generally realised, at least where computers are used sensibly. As a collector of information that needs to be rendered into useful knowledge in an educational setting, the humble photo-copier can still exert a malign influence over the unwary, and over-use of the computer printer will follow this precedent if due care is not taken. Once again, common-sense management is required, and this also follows when dealing with digital information. At least speed of data-crunching operation helps with IT, complemented by useful training in knowledge sifting or discrimination.

The point is, recording the source of knowledge these days is ever-more important than bulk accumulation, and whole-scale reading of files is not no longer necessary, given digital manipulation skills that are presently available. Increasing digitisation of knowledge, as well as improved and digitised records of access in other media, are important for maintaining a healthy and balanced world-wide educational database, and such important advances would not be possible without IT. These perspectives must also be along taught with computer familiarity and proficiency.

Student personal interaction at well-run educational institutions is also encouraged using the ubiquity of IT, and is actually enabled by IT in the case of distance learning. Adults will make their own choice about such interaction, but only a fool would consider auto-didacticism a foolproof path to a comparative education in any age! Even Einstein sought out his peers for consultation and exchange of ideas, and would doubtless do so to-day using IT, or else engage in face to face contact just as he did in pre-IT days, unless you count telephone access and mail of the time! Most significantly, the demise of libraries, as lamented in **The Cult of Information**, has not occurred. To the contrary, they are thriving, and in enlightened societies are pooling resources and databases, and have embraces IT as another link in the greater library chain.

The evolution of The Computer Age has been rapid, and continues to be so, not least because of the speed of events, and of the changes initiated. The temporal **plateaus** that followed the discovery of pencils, pens, and printing presses, as well as innovations such as railways and air travel, have not followed the development of IT, and may never do so. This evolution has been swift and continuous, powered by human curiosity, the military, academia, communications, mass media, universal access, and by the realisation of the many uses to which IT and its technological convergence can be put. There is past, present and future of great significance crammed into the last 50 years, at least when the time when existing technology could realistically catch up with the ideas. The transistor really got things moving, and the rest, as they say, is our mostly contemporary history, circa 2005, and the pace both of IT development and of IT learning is not slackening. Keeping up has, and will continue to be, a test of human intelligence and accommodation, but the benefits are increasingly obvious.

Recording and assaying contemporaneous changes and effects, both good and bad, are not easy, and the true historical perspectives of any era do not mature for at least 100 years. In that time, change will continue anyway, some problems will be solved, others will emerge, and yet more perspectives will eventuate. Technology is no more cumulative in destiny than its human creator; Darwinian principles of evolution apply to both organic and technological entities, so hard-and-fast predictions of doomsayers and optimists should be both be regarded with due caution. Coping and decision-making in regards to IT, and IT management, are often made 'on the fly' as never before, and this makes social and intellectual adjustment to computers and IT that much more of a challenge. Thus, if humans do claim that their own intelligence potential still continues to grow, then let us take the best from this latest technology, and move on, if we say we are so smart and able to do so. Human flexibility has at least been responsible for rendering IT as a more everyday aspect of human society within a generation or so, thus removing much of the sheer distracting novelty of these innovations, and this is most important from the point of ongoing constructive use of IT in human education.

Furthermore, when discussing **education in the age of the computer**, bear in mind that **we** have not changed as far as actual learning is concerned, our human biology means that learning is so often heuristic, needs practice, revision, **and** constant use, to reinforce and maintain. We must literally grow those neural connections to be involved with information building, and with understanding and utilising what we learn and know. So, however much our learning experience is fruitfully enhanced by IT, we should not look to IT for quick learning fixes because of the bells and whistles. IT **will** enhance learning, and strengthen learning associations that are so important for learning, especially in the less abstract stages of childhood. **But IT will not remove the need for traditional learning, and should thus IT be seen as an important aid to learning, not just as an end in itself.** Remember, there must always be decisions made at any level of human interaction with computers, as to when actual ad hoc computer learning is (temporarily) shelved, and actual net productive use of the computer begins.

But we must still continue to learn in steps, with revision and practice, as we have always done, although now we will do so with newer perspectives of relevance and human interaction, as IT has become increasingly technologically convergent. Storage and recall of information is now much easier, although there are new skills of research, retrieval, and processing, that are required, including of information discrimination, even if IT does remove much of the drudgery of retrieval and presentation. But, the promise of human intelligence intrinsic in the evolution of spoken language, enhanced by written language, and further enhanced by infinite records and speed-of-light retrieval, has now, more than ever, been realised by allowing ever-greater scope for applying this intelligence more spontaneously, increasingly unhindered by mechanical inhibitions. **Whether for better or worse is again up to Us, the capacity to make bigger errors faster is also as likely as doing beneficial and useful work faster, and this applies, in general, to what we humans like to call Progress.**

Therefore, fostering human intelligence by balanced and comparative education must always be a priority, regardless of technology or standard of living. Maintain an intellectual wheel to push against, lest smugness and apathy shape our lives, so that mere information is not mistaken for ideation, or beer and circuses do not rule, and lest leadership inevitably loses accountability. **Garbage out is forestalled by limiting the garbage in, and this is ensured by comparative education.** Censorship only narrows and thus strengthens the garbage flow, and has no history that recommends its continuation. Children are better protected by good example, and an early learning grounded in a comparative education. These challenges are always with us, IT potentiates these challenges, and also must be fully harnessed to counter them, especially within general education, whether formal or informal.

With respect to Jean **Piaget**, and using traditional age-related human learning skills and stages, school computer education, supported by parental interest and example, could be outlined thus:

I First principles: IT use as simple, effective, directly results oriented, and always promoted as just another aspect of life and learning**. Learn touch-typing!** Then:
II Class interaction and discussion, early trending away from the potential solitariness of IT use. Distance learners and the disabled especially will benefit from this wider peer interaction that is enabled by IT.
III Productivity-oriented program learning, purpose-oriented self-publishing, and advancing software learning according to both ability and need-to-know.
IV More complex steps such as introduction of useful personal technical IT knowledge, and Internet access, plus Internet research, downloading, and email.
V Beginning of a separate learning option for those who would make IT a special interest or chosen vocation, but still balanced with other mental and physical activities.
VI Preparation for on-going practical or tertiary computer skills, with emphasis on quality research, plus data and information screening skills.

As each stage is reached, there is a cumulative continuation of the preceding stages, as all the learning will remain relevant, even for adults. (Note that Piaget has also influenced computer science and research into artificial intelligence.)

With self-publishing and the scope of the Internet, there will also be fewer of those mute, inglorious Miltons, and greater potential to ensure comparative education for all by ease of networking, given a continuing free Internet, of course. Education without a comparative basis is intellectual unreality just waiting to be exploited, and computers/IT and Internet, when well-used, will help to overcome this limitation. Also, with respect to **Socrates**, learning should be supplemented by individual choices being followed that encourage spontaneous interest in further learning interaction, and, self-motivated searching for answers and solutions. The drawing out of ideas, rather than the stuffing in of knowledge, is made so much easier and more interesting with commonsense educational use of IT, along with ongoing peer interaction.

Teaching and lecturing, once IT skills are mastered, are also made easier by data access and presentation, and whole lessons, syllabuses, lectures, or courses of study, can be made available at the click of a mouse, when such references are required. Once again, **distance learning** is particularly facilitated. Educator familiarity with the technology will become less as of a problem as some of those who actually grew up with computers choose a teaching vocation for themselves. The Google Internet library initiative further enhances knowledge access and retrieval, and quality texts are increasingly spawned by quality documentaries in a way never before possible, via the Internet and the best of the so-called “mass-media”. Tailored publications are more easily compiled and updated, and with ever-increasing quality. Internet terminal availability must be assured, but in an ever-more wired world, as economies and geography permit, this is becoming more of a universal reality.

There will be increased educational scope for **disability sufferers** who have been previously disadvantaged by conventional communication means, and convergent technology renders this even more so. There will be so much more scope for, and democratisation of, **distance learning**, including face to face time never before possible, and also through the accessing the universal database of the Internet. There will be more instantaneous exchange of information, from respective locations in **real time**, where such communication would have hitherto been difficult or impossible, such as extreme geographical locations, and Space itself. Ordinary people can also scan, digest, derive, and significantly contribute, along side of the input from daily papers, august Journals, and even grander upholders of The Greater Traditions of culture!

But, to reiterate, for education to be truly useful, growing IT embellishments and technological convergence must never be allowed to degenerate into distractions that are not a part of real and consistent learning. Likewise, the sheer speed of a computer, and facility of its use, should not be mistaken for overall learning achievement. Infotainment, posing as reasoned pursuit of ideas, at best panders to weakly motivated learning. Thus, the former should not overshadow the latter, and bells, whistles and gaming are never to be mistaken for relevant IT knowledge or useful general learning. **Because of the complexity of computers and their programs, always maintain a perspective as to what is to be learnt in order to produce useful results.** Perhaps this could be called **The Prime Law of Computer Education?**

Despite all this new speed, communication facility, and of late, burgeoning technological convergence, that standard human biological reality means that our learning still must be done as it ever was before, in steps, and in stages, and with practice. Skills to bolster education have never been so important, or so universal, or so prolix, and yet we still retain our human temporal and organic limitations, which mean that human learning should be as economical and productive as possible, and from as early as possible!

A human deprived of sensory and cognitive stimulation soon deteriorates both mentally and physically, because as a species, we are not programmed to hibernate, we only manage to stagnate. Thus, the urge for physically interactive activity and stimulation in young minds and bodies should soon be channelled into the active pursuit of useful ideas, to foster higher order thinking skills, peer interaction, and in **our** age, this also means fruitful synergy with computers. We are built to learn,

**especially** from an early age, but the traditional education standards and practices still apply, and, as mentioned, **Socrates and Piaget Rule, OK!** This means drawing out of ideas rather than the stuffing in of knowledge, and as well, with structured learning that keeps pace with, and takes advantage of, sequential human developmental stages. This increasingly includes learning and utilisation of educational technology such as IT.

All other educational theories seem to be derivative of these wise principles, despite the florid language and glossy text-books within which the other theoretical wannabes are couched. The Three R's must still be learnt by the same age groups at their respective rates, and the newest technology must be geared to accommodate this need. After this, computer higher order thinking and using skills must then be developed, so that the vast potential of those newest communication and learning aids do not become overlooked because of over-emphasis on novelty, infotainment and gaming. These are matters of human concern, and human responsibility. The outcomes of IT development and utilisation are for humans to manage appropriately, becoming part of our intellectual toolkit to be used wisely and well, or suffer the consequences.

If there must be computer games, they should only be of optimal standards for advancing thinking, pursuit of ideas, and developing pattern recognition, as well as basic digital manipulation skills. Pattern recognition is manifested in all levels of terrestrial intelligence, is necessary for survival, and is the foundation of human commonsense, as well as providing impetus for ongoing human learning. Artificial Intelligence is now advancing by utilising pattern recognition for machine learning and commonsense. AI will, and must, evolve as human intelligence has in this respect, because it is impossible to build in the potential scope of knowledge and commonsense, this being infinite for both human and machine. (To reiterate as above, commonsense here is defined as application of both past experience and/or learning pattern recognition abilities allied with considered decision-making, although this definition may, of course, be open to discussion. In short, valid pattern recognition must be coupled with effective pattern synthesis, or algorithm synthesis in computer terms, to manifest as real and applied commonsense for AI, II, or human learning and intelligence development. (Note that II=Indistinguishable Intelligence.)

Computer usage encourages planning and sequential learning, problem-solving and hand-eye skills, pattern recognition, and independence of expression that is also enabled by easy editing, and printing, etc., and anyone can become their own publisher at the press of a button. How much greater would Tolstoy have been with a word processor? How far-ranging would have been Darwin's information base with Google and email? Ordinary people, including those with disabilities, or constrained by distance, can now communicate, record, and contribute knowledge as never before; there is, nowadays, an exponential rise in the pursuit and exchange of fruitful ideas and relevant facts that far outweighs the misuse of this new information exchange medium. But standard language learning must underpin modern language use, as this did for Tolstoy and Darwin in their day, and the more so now as education is supposed to be more and more universal, and compulsory.

Instead of a gun being the Great Leveller, a computer should be seen as a far more civilised example of such reasoning about fair play, and in particular a powerful aid to democratisation of knowledge and communication, especially since the communication may be two-way for any peer interaction or Web use for those who wisely desire these facilities. More than one verifiable source is always advised, and IT is so useful for such tracking, including of hard copy reference locations.

Comparative education in general is now more easily obtained, given well-managed educational institutions, including libraries, and a free and fulsome Internet. Although there will always be those who would wilfully refuse this new educational dimension, but with time, their numbers will continue to dwindle. As for those who unquestioningly embrace IT, and the mass media for that matter, (in view of the close relationship with IT), an 'idiot box' can surely be simply defined as that particular media technology with which any given idiot/idiette is currently interacting?

The richness of the IT-enhanced learning environment now experienced, when relevant, will ensure strong associations and ease of manipulation, these are the greatest advantages of computer use in education, though, of course, more legible and well-edited script is possible as never before, as is self-publishing at the press of a button. So is new IT speed-of-access to thesauruses, spelling and grammar checks, dictionaries, tables, and font that were part of laborious hard-copy production beforehand. Yet more innovations are also present if and when they are needed! Colour, graphic insertion, web pages, PDF, and the list will go on. (Remember, though, that if thy spelling-checker doth offend thee, thou canst turn it off!)

Also of note are the specifically **computer-related** terms that 'cross-used' in **everyday** speech, often directly borrowed ad hoc from the common lexicon, or neologisms, often grammatically multipurpose as noun, verb, etc., and some with even picturesque connotations. E.g. the coalface and the frontline now can be the interface, there is the importance of being connected, boot has a whole new dimension, as does freeze, multitask, legacy, network, flash, rip, burn, program, startup, plugin, port, serial, hardware, software, readme, install, housekeeping, application, module, handshake, dialup, broadband, text, flame; even **BSOD**, The Blue Screen of Death, has a growing common application for describing signs of pending defunctness of more than just ailing computers, and so the list goes on. These are all terms that have grown with, or derived to serve, a descriptive, active or nominative purpose within IT as a whole, and in all their various forms, grammatical purposes, and applications(!), they further continue to enlarge and enrich our collective speech, common culture, and consciousness.

The teaching of standard language should also emphasise the need to check precise word meanings, given such easy access to current digital or hardcopy thesauruses, but, approximate or similar meanings chosen from a convenient selection of words is likely to be a problem as old as thesauruses anyway. Access to synonyms and antonyms may need the same facility, and how many people would have used such specific dictionaries, even before the advent of the personal computer? This sort of detail is a matter of educational management, which the computer should be shown to complement rather than supplant, as part of early self-expression exercises. Also, keyboard use should not be enabled to dominate over speech and handwriting that uses conventional methods to inculcating early habits of clear speaking and writing.

There is, nowadays, some irony in that the exactitude required for computer communication and programming exists along side increasing use of short-hand speech and digital communication between humans. Mass advertising already panders to easy

short blurbs, small paragraphs, and short attention spans, and that also pre-dated computers, although TV and radio have further refined this type of message, and increased the frequency of its deployment. The hazard for early learning habits is greater if IT, (and mass media in general) are the default baby sitters, which of course, is not the fault of 'computers', but of poor early childhood management, and poor use of such pervasive media if quality programming is not present.

**The present-day computer** is a word processor, numeric computer, and design aid that is connected to scanner, printer, AV, camera, and other peripheral technology. Also it is a digital IT interface, via the Internet, to infinite external knowledge resources such as libraries and archives. Plus, the computer is also a very efficient storage and filing system, if well managed, of course. The Google initiative to scan in world libraries now fulfills the best destiny of IT, as long as humans continue to defend freedom of information, and of information access, throughout the range of the Internet. Again, our collective responsibility is to see this defence maintained, especially as regards education, and for any other form of quality information access or retrieval.

One obvious early effect of convergent IT, (and also mass media), on education, apart from concerns about quality and access of information and its management, is the continuing consolidation and maintenance of one standard language for purposes of easy universal communication. This has become more prevalent, also building on the universal communication needs of navigation, air traffic control, trade, etc., and that world language is, by default, English. (**The History of English,** presented by Melvyn Bragg for television, is as good a popular summary as any of how this came to be. See also **Useful References** p. 18. Note that English also exists in standard as well as other non-standard forms, such as regional variations, dialects, and creoles, and in social, commercial, informal or local uses, as well with as second or other-language status.)

No value judgements should be construed from introducing this subject. However, what is relevant here is that English became dominant because its destiny so often rode on ever more advanced means of communication that evolved along with active colonisation and war-induced political changes, as well as the early development of electronic mass media in predominantly English speaking localities. Concurrently, within the 20th Century, the perceived needs of military, educational, and research institutions helped initiated IT networks, especially the DARPA- and ARPANET, as reading of any basic history of computing will reveal. From these networks, the Internet later developed, and the language standard was increasingly to become what could sensibly be now called **'Panglish'**.

The Internet has now superseded all other media as a driver of this world language standard, and thus, English is now even more that dominant world language of affairs and mass media, being the always-developing original Internet standard language. The alphabet, punctuation and numerals of English are easy to "program" into communication units of words and overall syntactical structure, and the language also lends itself to neologisms, and evolution is also informally and formally encouraged as a normal language standard. As one good example, coined franglais neologisms will be more likely accommodated in the Oxford, than in the Larousse! Perhaps English, by its vary nature, was has been an ideal candidate for achieving such liguistic ubiquity when given the opportunity? Opinions about this may vary, of course.

**Considering the sheer number of words and phrases from other languages that are in common use in Standard English/English, sensitivities about the use of the dominant language, of the old Empire Where The Sun Never Set, should surely now be assuaged.** Thus, the fact of, need for, **and** default presence of, an existing World Language already familiar to many, medium-easy to learn, and ever-evolving in its standard form, should now be equably acknowledged, as we all may now have a share in, and have use of, this standard language. So, when discussing education in the age of the computer, English must be invoked and involved, just as it is for navigation, air traffic control, the UN, etc. Certainly another linguistic chore for those who must learn this standard language as well as their own, or, along with others as necessity demands, but nevertheless this ensures an easier world within which all and anyone may linguistically interact.

**Nofrillstech's Notemaker** had the traditional 1950s educational initiation of early copperplate and grammar drilled in using a dip pen, later a fountain pen, while concurrently being Imperialised and taught conventional clock reading. Then there came the learning of logs and slide rule, later the handheld calculator, then Officially Decimalization in 1967. Later again there was diligently learnt utilitarian other-language communication during world travels, then stumbling somewhat over "Reading Knowledge of.." at Tertiary level. After which there came mature-age computer-learning, both of hardware and software, being the hardest learning task of all, and age had much to do with that. The learning sponge is so much stiffer and less absorbent after youthful years have passed!

So, it was with something like plain relief, rather than with a feeling of linguistic superiority, that standard English was already 'loaded' so as to make this latter IT learning task so much easier, computer terms and related literature having made their debut in the then-emerging universal English! Nowadays, this Notemaker's copperplate skills have long been lost, ballpoint is now ubiquitous, even for signing cheques, grammar does not have the weight it used to, especially in expedient IT communication, and digital clocks now reign. Reading Knowledge also proved very different to the real life vernacular in question, and, personal decimalisation will never really be complete, but, despite some lingering disillusionment about past learning labour lost, one must move on, there is much that is good and exiting in the **new** learning!

However, **empathy with extra other-language learning has been learnt,** and respect is proffered for those who have learned several languages out of need or geographical location, and in this case, sincere understanding for those for whom their muttersprache was, or is, not English! So, if **you** must learn this new World Language, for whatever reason, be they computers, education, international expediency, or otherwise, please do not judge English just for its colonial origins, or default spellings and syntax. But rather, judge English for its general flexibility, ubiquity, near-common, (with so many other languages), numerals and/or alphabet, ease of lexical and phrasiacal coining and/or incorporation, and most notably, its talent for ease of ongoing linguistic evolution. Most existing languages will have some connection with English now, and some that are otherwise dormant as well, either through shared origins, or as borrowings and derivations. Check English dictionary word derivations to see for yourself.

Increasing faster digital communication and ease of data access, that further catalyses ideas and innovations, characterises the history of modern computing. Language interfaces expedited by IT are such an innovation, are now a standard Internet facility. The IT language standard is derived from English, regardless of who interacts with this, but apart from just this IT language standards, if 'Panglish' is **not** systematically learnt, by choice or circumstance, increasingly sophisticated translation interfaces are now tending to democratise language use once more on the Internet, important for those who feel strongly about own-language traditions being perpetuated. Likewise, native English speakers interested in other languages will find acting on this interest facilitated by IT and translation interfaces as well as traditional means.

Although English and other modern majority languages now collectively dominate due to mass media ubiquity, the Internet, and IT, the power and facility of IT can be utilised to digitally record and preserve **any** major or minor language or cultural artefacts deemed endangered or otherwise. Thus, the engines of mass media and IT that have previously threatened minority cultures could together and likewise so easily save, preserve, and publicise these particular cultures within the human cultural database, and this is a matter of our collective responsibility, and will, to ensure that this is done.

**Nevertheless, new developments of informal grammar**, such as easy and convenient Web and mobile phone typing-friendly and tele-texting styles, and indifferent upper and lower case use, are unofficially changing the rules of **any** Web language usage. Therefore, in the case of English, unless a Standard English is still taught, in tandem with this new and ever-growing trend toward streamlined and abbreviated language form, further babelisation of English will be a problem for future understanding, and education.

Perhaps a standard Web and Mobile phone English and grammar could thus be developed, to take its own place as a standard IT user language, and formally constituted for the benefit of ongoing universal IT understanding for all users. Maybe there will be **t-txt** versions of words included the Oxford? Text jargon lexicons do exist, but formal and systematic acceptance is yet to eventuate. **Other language groups may wish to formulate their own standard streamlined IT shorthand, and that is their prerogative.** But, as mentioned, streamlined standard IT shorthand language versions will need to be compatible with standard universal translation interfaces such as exist already for formal languages.

Proliferating sub-cultural jargon forms also abound that see language alternation or deviation as a necessary part of emerging group identity, mass media and AV play a large part in these forms mixing with existing formal language, younger peer groups especially embrace jargon formation. This should not totally displace actual standard language, especially as they are mostly ephemeral in nature, and certainly should not displace early formal language teaching. A permanent place for new words in such publications as the Oxford English Dictionary is not easily earned, and that should not change. Increasing use of informal English in written form, that is supplanting the formal version originally used for this purpose, is further contributing to confusion. The ever-growing occurrence of the miss-used written apostrophe is a prime example of over-used informality. The informal word use more suited to speech representation breaks the flow of written language as well. Or, will the answer then be that it is all a matter of what the reader is used to?

When in doubt, in the case of English, anyway, use formal language when writing, and the very use of apostrophes, correct or otherwise, is diminished, surely? Anyway, it is just as easy to type, or less frequently these days, to write, without abbreviations, is it not? Also, phoney 'user-friendly' informal language should really remain sub-cultural, and a standard, normally-evolving Standard English should be maintained to enable trouble-free universal communication with the world at large. There are still problems in Standard English with multiple forms and archaic spellings, but English will doubtless undergo due ongoing streamlining, for the convenience of all whom depend on this universal language medium. Lexical, rather than grammatical or punctuation changes should pre-dominate, though, or the language may evolve too fast for the common good? Scientific and technological lexicons also continue to expand as part of any language evolution, and these too must be rendered standard and useable by all whom would use these terms. The symbols used by science and technology must also be maintained as standard and mutually understandable also, especially as they are being added to so rapidly now as time goes by.

But on past record, English will continue to grow and evolve, formally and informally, and seems to be particularly well-suited to do so. **No doubt, opinions may differ about language, standard or otherwise, in the new Age of IT. Others will certainly have their respective experiences and opinions about informal versus formal language.** But, guarding against language 'babelisation' that will hinder communication, whether directly or via a translation interface, is everyone's responsibility, or much of the advantages of the new digital speed will accordingly be cancelled out by an increasing mutual incoherence. The added burden of formal grammar teaching is not so necessary for native speakers if good language skills are learned early by example, and by peer interaction. It is preferable, surely, to emphasise debating skills that foster deliberate mental preparation and word use as well as overcoming muteness in the face of an audience. Cultures and societies that already have verbal or compositional shrinking violets cannot now just blame 'the computer' for this, and must do better with future early language acculturation of their children. Taking refuge in the anonymity of minority peer groups will inhibit language skill formation needed for interaction with the society at large. Again, these are matters of educational management.

It is, furthermore, very interesting to note that **computer** language and symbol use, in whatever form, is now standard, and, although originally and fortuitously based on English syntax, letters numbers, and other symbols, these computer languages are now also universal and used by all programmers, regardless of their own native language. Thus, the origin of computer languages is no longer now as important as the fact that any human who uses them for programming is constrained by the **computer's** own particular need for exactitude; i.e**., however that set of code or instructions is written, or for whatever purpose, there is only right code or wrong code, and definitely no grey code; binary is binding, so to speak!** No small irony in the fact that the standards required for IT communication may induce humans to look to improving the clarity of their own linguistic intra-communication, macro or otherwise!

Computer communication, regardless of form or purpose, is most stringent in its demands, both syntactically and/or logically, and, in the uses of the code; these are new language standards not necessarily hitherto universally observed in everyday human language use, regardless of language base; indeed the origin, development, and implementation of computer language could now be regarded a separate discipline in its own right. A systematic, analytical and logical approach to language use is no longer just a branch of Philosophy, but has been made **universally necessary**, and is also widely developed and implemented by humans needing new and better standards of communication with their ever-developing and growing digital creations.

What you say, **and** how you say it, are now **both** most important for any form of communication with, and of course, between, any computer and/or emerging artificial intelligence entity. These standards are also necessarily universal, and, to a perhaps less stringent extent, such standards could also apply to any human world language development if such communication was to be truly effective. **Babelisation** of language definitely is counter-productive, both between human and computers, between computers, and, between humans themselves; in any of these cases, language standardisation **and** standards as well are most important for ongoing effective and productive modern communication.

**There are other skills required for optimal education in the age of the computer, and one very important standard is that of proficient use of the IT interface input medium that is the keyboard,** so, learn to touch-type, to save time, edit errors, and incorporate textual improvements. This is best undertaken as part of early schooling, when that form of skill learning will be relatively effortless. Even as the dictaphone potential of the computer is being realised, touch-typing should still be learnt for ease of input in any situation, or to drive cars with standard transmission as well as automatic drive, for obvious commonsense reasons. These reasons also extend to maintaining handwriting standards, as already noted. QWERTYUIOP seems to be the default keyboard standard, at least in the West, and even if not the most ergonomically efficient keyboard arrangement, at least this is a useable universal standard. Any language that is rendered IT compatible will have a dedicated keyboard arrangement, and that is a fact of life! (However, actual keyboard shapes are a matter of personal choice, and not so easy to adjust to! QWERYTOIUP around corners on an ergonomic keyboard is a case in point?)

The ad lib and ad infinitum **editing facility** available in your computer, although a major technical advancement, should carry a beginner-user warning, in that over-editing can be, and often is, very easily carried to clarity-threatening and idea-attenuating extremes. Thus, the computer beginner should always make use of that very useful file-copying facility that the computer enables you to perform back-ups to refer to, at least until personal editing skill and confidence have grown to optimal proficiency levels.

There is continual criticism of the computer as facilitating print-copy over-production, but once again, this is a matter of human management. However, proofreading is now so much easier, and the final copy is achieved with less draft printing and paper-wasting, than the re-writes of yesteryear. Used paper can be recycled, and paper itself does not always have to be made from harvested trees, that is also up to **Us**, as is recycling of other computer-related hardware. Also, sheer weight of numbers of computer users, again a matter of human self-management, will tend to produce more and more hard copy, however sparingly. Of course, over-printing, especially for the home computer user, does produces its own penalties of printer maintenance and consumable recharge. However, such management details, macro and micro, are all part of computer-related skills that must be learnt as part of general education in the age of the computer, along with programs plus all the other peripheral management produced by technological convergence.

Nowadays, **high quality of written, graphic, and/or aural presentation,** even with basic desktop publishing, has enhanced student endeavours at all levels of education. This humble Notemaker truly regrets not having had a computer, and attendant skills, when studying at tertiary level as a mature student 25 years ago, if only because better grades would have followed more legible textual presentation. There would have also been more motivation to keep those old assignments, now long since discarded as being a reminder of frustrations due to presentation being limited by flaws of handwriting and editing difficulties. Also, there was the time expended for results far short of what could be achieved to-day in the same span using even basic computer and desk-top publishing facilities. Not to mention wasted paper, and those white-out dabs decking final copies. Typing was expensive too, if not undertaken personally, in those days!

The pictorial glory of **new texts** published these days is a matter of wonder, too, such a boon for those requiring clear graphics and photos, also in actual true colour, plus detailed 3-dimensional graphics, detailed indexes. There is an easing of that Red Queen chase for new or updated facts, as IT enables easier digital search for updated information from many sources via networks or the Internet. Lessons and lectures are downloaded as needed, and universities can offer online back-up for all their members, lecturers and students alike, as an extra precaution against data loss, until further measures are taken. Thus, research entered directly and legibly into a laptop at a library table, and backed up online, is an everyday facility available to anyone who is able to perform this. All so much easier and better in these days of IT, and there is also high-quality AV and other technological convergence this to supplement this boon. IT also enables Internet access to even more digital treasures, and selective printing ensures that parts of this bounty can extend to transfer to a personal folder for future hard-copy reference. Annotation is still quickest and easiest on convenient hard copy!

**Libraries** will still carry these physical and digital textual treasures, for those students and other interested parties who may not have personal copies, and similarly digital access.
Libraries are thereby ensured of a solid future in the age of computers, despite the earlier doomsaying! As well, a library experience may very well lead to a purchase of a personal copy of a book for enjoyment and convenience. Even if conventional hard-copy is being replaced by some more portable IT equivalents, that dedicated central information repository, the library, and those new and used text emporiums, for that matter, will all still be required.

Used book stores also seem to growing in number, especially in University cities, so along with ongoing publishing and well-stocked libraries, the future of the traditional book also seems assured, although a conventional wood paper substitute would be

a prudent change to help maintain their popularity as a consumer item? Paperback printing, especially for first editions, is becoming more common, which brings down the price of books, both new and pre-loved, for institutions and individuals. Indeed, dull would anyone be who do not get a buzz from the regular frequenting of libraries and bookshops for their exciting atmosphere of what was, is, and will be.

To be able to partake of their riches set so enticingly on rows of colourful shelves, as well as, these days, on those ubiquitous colourful screens, of course.
To date, there is still nothing like having a portable hardcopy of any chosen notes and texts that one can carry around or 'leave till later', especially if this is a personal possession. One can underline choice passages, scribble in the margins of, and curl up with or fall asleep over, this personal hard copy, and otherwise moderately mistreat it without much harm to either party. In addition, a book only needs to be opened, not booted up, to interact with, and is so much more portable, too, for the foreseeable future. Actual **books,** and printed notes, are not just an extravagance, or a waste of paper, but a necessity of life! Computers have not changed this very human attachment to the written Word, 'books are making a comeback' is the frequent catch-cry; binding is now less formal, more utilitarian and resource-aware.

**Philosophy of Knowledge in the Age of the Computer:** The questions concerned with **why** we pursue knowledge, and the **uses** to which we put this knowledge as humans, have not changed. But, the over-riding responsibility of the **keeping of knowledge** is to protect, conserve, add too, order, organise, and to continue to maintain as accessible and infinitely reproducible, so that others who seek it will have unlimited access to this unaltered, unadulterated, uncensored knowledge, and expeditiously so. This has been made so much easier to undertake and fulfill with the development of IT, this is the great triumph of digitally recorded knowledge, multiple copies in many locations, (all on, or in, some sturdy medium, of course), and infinitely reproducible as required.

The original knowledge hard copy we still retain, whatever its age or medium, now has less stress from light, handling, improper storage, and consequently may rest in peace, except for possible further improvements in welfare that will come with time. Interference in, or revisionist treatment of records is rendered less credible when many true copies in many locations are equally and easily accessible. At a personal level, photos, files, and databases are so easily maintained in multiple copies, and in alternative locations, by present optical removable media, and no doubt there will be other forms of physically-rendered posterity for universal use in the future.

**Program learning and computer maintenance** have already been discussed in ***A Computer Beginner's Survival Factfile***, so here only the most important principles are reiterated. These principles also apply to any educational activity involving computer use, viz, **identifying what you need to know for what you want to do with your computer, and continuing program learning on a need-to-know basis.** As well, **organise your computer time** so as to optimise the actual productivity that will be directly derived from synergising with your machine, and do not overlook computer housekeeping and security, so that opportunity for educational or other worthwhile use of your personal or institutional computer is not compromised!
Note also that **computer management** does teach dedicated and stringent skills of exactitude, despite questions of grammar and other supposed declining of 'standards' often associated with IT. Try coding HTML or even learn formal programming if you wish to test this assertion!

**Children** will still learn that accuracy and consistency are necessary for commands and program manipulation, and there are management standards that cannot be compromised upon, especially for computer housekeeping and security. Managing computers, if properly carried out, also means responsibility for operating complex technology, and in turn needing to employ patience, rational and logical thinking, and even, at times, intuitive thinking. Computers also require clear and unequivocal commands to perform their multiple and complex tasks, thus, developing the faculties of patience and intuition is also required to complement keyboard skills.

Responsible adult exemplars are thus very much needed for supervision of children with computers, both to learn by doing, and also in relation to gauging quality, and even ethics, of content studied, especially when Internet interface skills are required. These skills, both manual and intellectual, are built on as the young student matures, and such consolidation is essential for ongoing education and vocation that requires computer skills. Mature-age IT beginners also have to learn that there is no compromising on careful and accurate computer instruction and input! It is all a matter of relative perspective, surely?

So, emphasis on suitable literacy skills still subsists in this new age of computers, but with the added dimension of also being 'computer literate'. Nowadays, the particular standards of **computer interfacing literary skills** required are just as exacting as those of copperplate and grammar standards of the past, and now they open up a far greater educational vista when mastered, given the contemporaneous possession of standard language skills. Even upper and lower case at times must be carefully adhered to! Thus, the reality is that any child without early inculcation of computer and IT skills will be seriously disadvantaged throughout their education, or at least until such skills lack is made good. **The Three R's + Computers**, these are the standards now! **This extra learning requirement means that economies of scale and increasing returns are thus important factors to consider for ensuring productive computer use, especially for optimal education purposes.**
These important principles need to be learnt as early as possible by any computer user, especially by children who can learn so quickly and easily these necessary standards and mechanics of process, and will continue to build on them.

**Skills and learning** are always in tandem, each will potentiate the expansion of the other, and computer learning and use and are a prime example of this axiom! But still remember to enrich early learning experience with books and library environments, if you do have responsibility for educational experience of children. Books at home, and familial reading habits, as well as computer learning **with** interested adults or parents, are essential to foster an early habituated pursuit of ideas that will hold fast and resist less fruitful distractions in the IT Age. Tertiary learning habits begin in primary school, and any school should not be expected to shoulder abdicated parental responsibility for completing aspects of a well-rounded education that can, and should,

only take place beyond the school gates. Latest technology alone will not fill the gap, especially if used merely for entertainment-based baby-sitting! Constructive use of IT is increasingly a social as well as personal skill!

**Common-sense education** in the Age of Computers is what is required for all children, (and for any other age-group for that matter), and at any time in our shared computer-involved future. Pasteur's observation that fortune favours the prepared mind is also true for all time, and not just for scientists. In particular, a child's mind can be equally well prepared for what life may bring, beginning with the necessary early formal education in the continuing company of peers, and this preparedness is in turn initiated, as it always has been, in a stable and literate home. The worst has never happened, and the best is yet to come!

For any liberal culture that favours open-ended development of knowledge and intelligence, the quality and scope of education, starting at early childhood, becomes evermore important. In a future human world that incorporates equal educational opportunity for all, this will be all taken for granted, but, as is all too obvious, much still needs to be done to make such standards and opportunities universal for many present, and future, children of homo sapiens sapiens. IT will do much to help, when utilised with a will, in diminishing the sheer scale of the effort needed to enable such standards and opportunities to be equitably developed.

Finally, adults, as belated computer learners, will need perseverance, these necessary additional physical and intellectual skills will not be learned and developed so readily as they are by children. But the benefits of improved personal computer compatibility and synergy will soon become apparent, whether for self-education or any other worthwhile form of computer use. As a matter of fact, adults unfamiliar with computers, who aspire to computer literacy and competent management, may be well-served by the company of a commonsense computer-literate child!

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## Postscript:

As defined by the title, these pages just comprise notes concerning education in the age of computers, a file of personal experiences, reflections, and observations that are general in nature, although still intended to be reasonably even-handed and objective. The references listed above did raise initially important points, and thus were largely responsible for many comparisons and considerations that followed. The Notes were also based on the personal observations and experiences of someone who felt the need to change and adapt, as a mature-age participant, to learn to use this new Information Technology, and to participate in the still relatively new world of universal digital interconnectedness. As well, this Notemaker has never regretted belated participation, and envies those who actually grow up learning all these IT things so much more readily! Oh well, better late than never?

However, the general impression of The Age of the Computer, in 2012, surely is that the worst has not happened, and the best is yet to come? Needless to say, a more formal and universally objective treatise on the wider subject of *'Education in the Age of the Computer'* would go much so much further in developing the principle ideas and themes noted, and identifying and pursuing others. Do feel free..!

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