BOOK REVIEW

The Singularity is Near, by R. Kurzweil.
(hbk). Pp. xvii + 652. ISBN 0-670-03384-7 (New York: Viking Press, 2005) $29.95.

This book is a tour de force of the current status, progress and future of genetics, nanotechnology and robotics. The book is a mixture of Eric Drexler's grey goo, Arthur C. Clark and Star Trek.

The title is tainted by the now familiar cosmological singularity as in the centre of a black hole. It is perhaps unfortunate that the singularity at the centre of the black hole is all-destroying and that no living organism can survive the passage to the point where physics breaks down. The analogy, more appropriately, is that technology and ourselves will pass through the event horizon and emerge into a universe dramatically different from that which we know today. The starting premise is that various significant technologies have progressed over the last century according to an exponential curve, and it is only in the last decades that the slope of this curve has become apparent.

There is a good review of the rapid progress that has been made in computing-related technology, genetics and nanotechnology, which all appear to fit a law similar to Moore's law for the growth in capability. Areas covered include computer hardware and software, learning algorithms like neural nets and genetic algorithms, optical and quantum computing, and neuroscience. New technology is reviewed in terms of developments in instrumentation showing promise to resolve texture at sub-nanometre atomic level, in new nano-engineered materials and medicines, and in nanomachines ultimately leading to Drexler's nanobots (nanometre scale robots). The brain and neuroscience is reviewed with particular emphasis on the processing power of the brain, which at the lowest estimate may be only an order of magnitude more powerful than the next generation of supercomputers. Estimates of brain power are quoted covering upper and lower limits based upon extrapolation of the computing power required for visual pattern and speech recognition, and by neuron count (assuming a typical neuron is capable of 10^4 computations per second) and by parallel processing at a few hundred hertz.

Extrapolating this progress based upon a Moore's law-like growth rate, Kurzweil maps out six epochs starting from now. At the fifth epoch is the singularity, when computing power will be equivalent to the human brain and nanobots will be a reality, capable of circulating in human blood performing tasks and mapping the human brain. Genetic understanding will have

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reached the point where food can be assembled like the replicator in Star Trek, while old age will be a thing of the past as genetic engineering will eliminate the slow breakdown of DNA with time.

Following the singularity, in epoch six, the human race expands into a new world where non-biological machines will answer the more difficult questions that to current science are impossible, build better machines and further outstrip their human counterparts. At this stage a number of further more philosophical imponderables begins to emerge. Who controls the machines, is it humans or another machine? If computer modelling is now able to simulate the human brain, then the possibility arises of a human being in terms of personality existing in a computer. Who then is the real me; is it me or is it the simulation? Given that this level of computing power would certainly appear intelligent, is it conscious?

The discussion of these questions constitutes the second half of the book. The singularity is estimated to occur in 2045, so that the future beyond that point is described in the realms of science fiction. The ultimate state arises from the observation that, potentially, each subatomic particle in the universe could operate as a single bit computer. This would imply that a massive object such as a black hole would, if properly manipulated, form the ultimate computer, possibly 50 orders of magnitude more powerful than anything we know today.

The progress projected is breathtaking, but predicated by the view that Moore's law will persist. There is some discussion as to why this might not be the case, but historical causes of a temporary slowdown are in general dismissed on the basis that previous decelerations in the progress of computing power have been overcome by new technologies, for example, transistors replaced valves and integrated circuits replaced transistors. That conventional computing progress will be halted by size, as the semiconductor thickness approaches a few nanometres where quantum effects will dominate, is also dismissed on the premise that new optical or quantum techniques will replace them. There is no discussion of the economic factors that have essentially culminated in Moore's law. In the 1960s, as computer power began to accelerate, the law was primarily driven by the defence market. This is no longer true and for the past decade at least the drive for ever more powerful computers has been from the commercial market in response to the increase in spending and leisure power of the Western nations. Thus the games and more recently the mobile phone industry have forced the pace of progress. In the author's view, by 2045 there will be more internet servers than people in the world. Certainly this makes for an impressive world computing capability, but is it realistic? Will the demand of the leisure industry saturate and break Moore's law as demand reaches a plateau and the finances available for research reduce?

Most of the critical questions are discussed in some depth in a sometimes annoying dialectic style. That the author displays incredible optimism regarding the progress of technology is not denied, and perhaps the most interesting discussion in the latter part of the book concerns human consciousness. In fairness, the author answers all of his critics but in many ways fails to give a definitive answer. On the question of consciousness, he asserts that he is a pattern of thoughts and logical steps and not just a particular set of biological cells. This circumvents the argument that a human being is just a collection of biological building blocks by asserting that all of our cells are replaced at one time or another, and therefore that consciousness must be something more. Thus it will be possible to simulate a human personality. The Penrose assertion that the microtubule of a neuron in some way operates as a quantum computer, and therefore, since it is impossible to capture a quantum state at a precise point of time, it will be impossible to simulate human personality and consciousness, is examined. The author's view is that the quantum state of his brain is always changing and therefore it is not necessary to capture the state at any given precise epoch, merely the processes and memory of the assembly of neurons. Inevitably, the author must view these future computing engines as also being conscious.

This is a big book, 652 pages, full of facts and projections with good reviews of the state-of-the-art in genetics, nanotechnology and robotics. The unanswered questions are food for thought, predicated by an incredibly optimistic view of the progress of human technology.

G.C. HOLT