

# Computers are the world's biggest opportunity

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Humans are not very good at thinking together. Think of debates at the UN: intelligent people discussing important issues, but arguing and disagreeing with each other! We are often adversarial, and have hidden agendas. We get cross, negative and emotional remarkably easily, especially when trying to solve important problems.

In some areas, though, we are remarkably good at doing things together. Consider modern cities: they are amazingly complex, yet houses have water, gas, electricity, waste collection and transport systems. Some parts are organised centrally, some locally. Cities are amazing that they work at all. Or consider the Olympic Games, which, in its modern form, has run since 1896 and brings people together from everywhere in the world. In sport, we can swim together, dance together, or run in competition. These very different examples show that humans can do things very constructively together.

Perhaps we might use computers to make thinking somehow harness the powerful cooperation drivers these examples exhibit, but which group thinking lacks? We need to use technology to expand the range of what we can do successfully together. If we can expand support thinking, this would have a significant impact on solving many important problems.

Computers *are* already completely transforming the way we work and think about everything — and there is no end to the possibilities on offer. We can therefore be optimistic about the future. We have some very pressing problems, such as terrorism, that we all agree need solving. Even the terrorists themselves would argue the causes of their discontent need solving. We will be able to solve such problems by building on clear thinking.

The world wide web was unheard of in 1993, and few but experts knew about email then, but now email and the web affect almost every activity in modern life. The web truly is world wide, with almost every people of the world connected in some way to it.\* Perhaps there are ways to use computers to help us think better together, and hence enable us to work together to solve some of the pressing problems humanity faces? This chapter will explore how we can channel the enormous potential of computers into doing good.

## ***What are computers?***

Computers are not just desktop things for home and office. If you are in a developed nation, there are fifty plus in your new car; and your television, your games, your bank and your washing machine all have them. Once computers were things we use; now they are an unavoidable part of our lives. We cannot be born, go to school, pay tax, or go to hospital without being processed by computer. Some computers are tiny, and some even inside people as implants; on the other hand, the web is the largest and most complex system *ever* built by humans. Just in the last decade it has revolutionised how business is done, and it has revolutionised how people communicate, whether by publishing on the web, chatting with instant messaging, or for spreading political and even subversive information.

Power relationships have been transformed: companies and governments now know far more than they ever did about citizens, and on the other hand, individuals are now more informed and more strongly connected than ever before, or if they wish to be, far more independent, and even as secretive as the cells of terrorist groups.

Sometimes computers work extremely well: the stunning computer graphics of modern films engage us, or medical devices (like pacemakers) keep us alive. Sometimes computers work extremely badly: complex bureaucracy is sustained by ever more complex programs, and many errors are caused by the so-called 'human factor' — a euphemism for the inability for people to work with complex systems, especially under stress.

And thus computers create two extreme opportunities. On the one hand, we can centralise power and have more complex rules to try to control everything from taxes to entertainment

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\* In the rest of this article, I won't bother to make any technical distinction between the internet and the web. I am concerned with what we see, not the technicalities of how it happens. In fact the internet is the infrastructure that supports the web as just one sort of traffic, along with email, podcasts and many other types of communication.

(e.g., censorship); on the other hand, we can communicate more freely and work together across the world to solve pressing problems. In fact, we can often do more than 'solve problems' — we can *dissolve* problems — for computers can often change the ground rules of problems into new opportunities.

Certainly computers have changed modern life more than any other human development; they are changing the arts, the sciences and communication. Unlike transport or electricity, they are not merely making things easier and faster, but transforming how we behave and see ourselves as humans. Possibly medicine and hygiene were more important for our lifespans, but they don't change our way of life while we are healthy. Indeed, computers rewrite rules; they allow bureaucracies of unimaginable sophistication (and obfuscation) to work. Some people have claimed that we invented computers a decade too early: rather than letting modern bureaucracy crumble under its own weight, which might have happened if computers had not rescued it, computers now allow rules and layers of complexity to be added indefinitely. Yet bureaucratic systems (like taxation) still contain people, both to run them and pay them, and *we* are not getting any better at handling complexity — whether *we* are the people paying the taxes, or the employees operating the computer systems!

Computers rewrite boundaries: the internet instantly brings to your screen information generated in any country. You can now trade independently of your country's laws; you can collect banned information; you can distribute — and make a living by doing so — anything from humanitarian information to pornography. The internet can report a story from many angles, or it can distort the truth and ignite terrorism.

While many people today, particularly large organisations and the elderly, are still coming to terms with information and communications technologies (ICT), the developing world is taking advantage of cheap, mass communications, and technology itself is advancing into new uncharted realms. In South Africa, more people own mobile phones than pay taxes; and in Europe we are experimenting with human implants, biometric systems, surveillance and what is called 'incidental interaction' — interaction we neither know nor care anything about but which still makes a difference. (An example is your car interacting with your key so that only you can drive it.)

It turns out that incidental interaction is very seductive. Recently there has been an explosion of games devices, which in a computer sense are utterly trivial, but socially are a huge success (with enormous sales). What will happen when these games, or the ideas behind them, move into the mainstream away from entertainment into general life? Already we might note that every office worker with a personal computer (PC) on their desk has, in fact, an expensive entertainment system able to play CDs and DVDs — provided by their employer! Soon these office machines will have other features to make them more fun and more seductive.

For the right people, even very simple gadgets can have a significant beneficial impact on their lives. Telemedicine, for instance, can use sensors to measure blood pressure or blood sugar levels and monitor them at home. The sort of people who need this support are exactly the sort of people who find travel to doctors or hospitals hard, and their visits are costly and time-consuming. In this case, telemedicine provides a simple filtering mechanism, enabling medics to concentrate on patients who really need help, thus saving everybody else the drudgery of unnecessary visits.

Of course, it isn't all good news.

The 'millennium bug' was the largest and most costly single problem humans have ever faced; it was also a problem entirely caused by humans. We are also familiar with the frustration of not knowing how to use complex computer systems, and with them crashing all too often! Even so, the world wide web has clearly overcome many of these problems: not only is it the largest thing ever made, it has been running continuously, non-stop since the 1990s: and the software and hardware it runs on has been updated and evolved continuously. Technically, its resilience is quite remarkable; so too is its penetration into everybody's lives — it is remarkably easy to use, and it evidently provides something we deeply want.

Many in the advanced nations find life increasingly complex and difficult, with no sign of let-up! As someone said, "I wanted my computer to be as easy to use as my telephone, but now my phone has got as bad as my computer." This sort of frustration sounds like less of a problem than the millennium bug (and certainly cheaper), but in fact when the minutes and hours each person wastes using over-complex and sometimes impossible technology is added up it is not insignificant. If there half of the 3 billion people in the United States use

computers, and half of those waste just one minute a day (a rather modest estimate), then each year wastes about 1,000 working lives in lost time!

And many people who are excited by computers and gadgets today will be in pain tomorrow from their repetitive strain injuries got from pressing buttons too much.

Clearly, along with using computers imaginatively to solve problems, we should put a lot of effort into designing the systems so that they are easy, comfortable and enjoyable to use too.

### *Pigeon thinking*

Once upon a time, people were dreaming about the future and about how people would fly. Birds can fly, and we wanted to fly like them. Perhaps, people thought, you need feathers and flapping wings? Perhaps a beak?

The first powered flight took place in 1903, and the flying machine didn't look like a bird. In fact today, we can easily fly at thousands of feet altitude, and sit back in an armchair, watch a movie, eat a meal. We may be migrating like birds for our holidays in the sun, but nothing else we do is remotely like being like a bird but 'more so.'

*Pigeon thinking* is the name given to the common idea that do better we need only do more of the same thing, or to copy what is being done already. Often it seems that computers can be applied to any task to make it better, because they can do it faster, more cheaply or on a bigger scale. The danger is that this is pigeon thinking; merely using computers to entrench the *status quo*. Instead, the reality is to do better, we need to think differently and try new approaches. Often the different thinking is driven by the technical innovation (in the original case, the development of heavier-than air flying technologies).

The point of this article, then, is to explore how technical innovation, particularly with computers, is entwined with social innovation; how pigeon thinking has, and must, give way to soaring visions of our future.

Pigeon thinking is very seductive. For example, many organisations use computers to reduce paper costs. This is supposed to give a gain based on *dematerialisation*, the replacement of physical things (in this case, paper) with computer images. Unfortunately, when individuals in an organisation print out paper copies of the work sent to them, this is far more costly than it being printed centrally on more efficient printers. Worse, the apparent cheapness of electronic communication compared with paper encourages people to send more messages (often making minor corrections to previous messages), thus creating an increase in information. The original problem was not so much wasting paper, but that was a symptom of having too much to say — getting rid of paper has made the original problem worse! The right use of computers would be to change the organisation's whole approach to information and communication, not merely make it easier to create information.

### *Technical trends*

Modern computing got going when Lyons, a UK catering company, realised around 1947 that computers could be used to make business more efficient.

Gradually, with the decreasing cost and size of computers, computers moved from the centralised operations of finance and inventory, via word processing (which was itself originally a centralised computer replacing typing pools) to the individual's office. Originally, a computer company could expect to sell one computer to a large organisation; with 'office applications' it could expect to sell one to each employee. This increase in scale drove further technical innovation that in turn created new market opportunities, and then opened up the user of computers by the individuals at work and at home: a vastly larger market.

This is, in outline, the driving force behind Moore's Law: that computers are getting smaller and faster and cheaper, and the rate of change is doubling every 18 months or so. Moore's Law is a market law, not a technological law. The exponential growth of computing technology is really because the market has been able to grow exponentially, and the reach of the market has encouraged innovation on the scale of the market's reach. The current area of rapid development is 'ubiquitous computing' which is driven by the vision of putting computers everywhere — not just one or two for each person, but thousands. There will be computers (of sorts) in everything, from shoes, milk cartons, to our houses and bodies. Computers retain all their sophistication, yet are becoming as cheap as dirt and as small as dust. This expansion will create not only new opportunities for computers to be applied to, but will vastly increase the number of creative minds thinking about what to do with them.

Already the benefits of putting computers into everything exceeds their costs. For example, putting chips into clothes reduces in-store theft, helps with distribution, quality control, and allows manufacturers to track fashion trends.

We used to worry about literacy. Now we can worry about computer illiteracy; without understanding how to use computers, jobs are harder to get, social benefits — from education to finance are harder to get. Older people get confused, and more dependent — and the rapid development of computing seems to make their lives impossibly complex rather than simpler. Younger people get disenfranchised and economically inactive: part of the problem called *the digital divide*.

To keep buying into all these technical innovations requires disposing of the obsolete systems. We have an environmental problem on our hands; we are disposing of millions of tonnes of electronics every year, and 'high tech' toxic chemical pollution is a growing concern.

Computers will increasingly be used for entertainment. We all like entertainment, and we are prepared to pay for it, so it is good business — by the term entertainment, we might also include gambling, pornography, or synthetic worlds, which are all examples of 'economic activity' that is booming thanks to the internet. On the other hand, children need education, adults need to work. Entertainment at the levels our society is tending to (it might be useful to call such time-consuming entertainment *diseducation*) is a distraction from being effective; indeed, whether it is economic activity or not, it is not productive (in the sense that farming or manufacturing is) and therefore must ultimately reduce the competitiveness of nations that get it out of proportion.

Increasingly, computers will be used to create new business opportunities that were not there to start with. From a commercial point of view, this makes sense, of course. From an individual's point of view, suddenly what was common practice becomes a costly activity. For example, not long ago there was no 'music industry' but, particularly in the latter part of the twentieth century, the technologies to copy and distribute music created the industry. Then computers allowed people to copy music easily, and briefly there was a period when people did it for free, to the disgust of the industry. Hence the rules were changed so that it was illegal to make copies of music. Now there is an even larger industry, which never could have existed without both the technology and the legislation to keep the industry ahead of the individual. Other examples include regional encryption of DVDs, so that they only work on players bought in approved countries. Again, the technology is used to create markets and profits that could not have been there without it; and the other side of a market is that consumers have to pay for goods. Whether payment is right is an ethical issue that the market as such is ill-equipped to address.

Computers are often used in a pigeon thinking way to control. Managing people is hard work, and the easiest thing to do is to use computers to 'automate' a business so that all employees have to conform to the rules the computer imposes (which might, and often is, an inaccurate model of how the business actually works). This makes an organisation more efficient in some sort of pigeon thinking way, but seriously limits what it can do in terms of innovation, because it has stifled what individuals can contribute to the system.

A worrying development (to my mind) is where business opportunities have been created in the very centre of the machinery of democracy. We might argue that democracy is the foundation of our modern society, but computers have allowed the voting process itself to be commodified. It is now possible to buy computer consoles to replace ballot boxes. On the positive side, this can make fraud harder and it can make vote counting faster and more reliable. On the negative side, the very proprietary nature of the voting machinery has to be secret in order to make a business out of it. In that case, what assurance have the voters that the machines work truthfully? The answer is none at all, and, worse, the evidence so far from countries that have tried the technologies, such as the USA, that e-voting indeed leaves a lot to be desired in terms of reliability and accountability.

Yet if we work out how to do electronic voting properly — rather than automating the old processes (which I am not sure needed automation!) — we could extend it to every issue of concern. Rather than voting for candidates we have to trust, perhaps we could vote on issues? So many governments are reluctant to have referendums, because of the cost and the potential stigma of being voted wrong by the people. But we could change the conventions. Potentially, to do so would shift power from government and organisations back to individuals, where democracy says it should be.

### ***Social impact trends***

The web has already started breaking down national barriers, and international information rules (trade, copyright, qualifications) are becoming more critical to individuals than national citizenship. You are born with inalienable rights of citizenship; but having the appropriate permissions to work have to be acquired (though years of education and skill acquisition), and once work is acquired you can be made unemployed at a whim. It is thought provoking that of the 100 largest economies in the world, the majority are companies, not countries.

Everything that goes into a computer can be commodified. People don't use computers to save work, they use them to create wealth — but not necessarily for us. In as much as personal information will be a core part of computers being useful to us, it will be commodified (credit references being a simple example) and something we have to pay for. Privacy will be undermined, but we will be losing privacy to bureaucracies not to acquaintances who we can reason with.

In the 'old days' you lived next to your neighbour and you had to work out ways of getting on with each other — in some mixture of walls, tolerance or friendship. In times of need, you would support each other because you were neighbours. When you walked down the street or went to a pub or football game, or whatever, you would meet random people, who might or might not agree with you. You had to live with diversity, and learn to tolerate people who held different beliefs. But today, increasingly, it is possible to live within selected communities of people that you choose: there are more people on the web interested in whatever you are interested in (say, building model trains) than you can cope with. You might decide to become a member of a web group of people interested in model steam trains of a particular gauge — and there are still too many to get to know. You thus enter a *tribe*. Tribes are social groups that define their own norms. If a tribe you have joined is based on certain political tenets, then you can easily forget that the tribe was selected for that reason; it appears that all right-minded people — everybody you know, anyway — believes what the tribe believes. If the tribe you have joined is something like the Ku Klux Klan or Al Queda, or even ones supporting paedophilia, then the 'self righteousness' of the tribe causes problems as it conflicts with the preferences of *real* neighbours. (And thanks to international travel, our real neighbours are not just those living adjacent to us, but anywhere in the world.) In short, the notion of *public good* — and of individuals in the community supporting the wider public — is obsolete. Indeed, some early internet commentators pointed out that not only was cyberspace a new 'country with no borders' but it had no taxes — and hence no means to support the weak, vulnerable, or uneducated.

Finally, people who are not connected to the web are invisible to those who are. Increasingly, some people in modern countries — such as immigrants and the poor — are unable to access the web, and they are disenfranchised. But if all those with power are on the web, how can they help them? Fortunately, there are many community initiatives to help people get access to the technologies (such as South Africa's Learn to Earn programme); but how many initiatives are there to widen the knowledge and real-world effectiveness of those *already* on the net?

### ***New uses of computers***

Technologies like blogs, wikis, instant messaging, virals, RSS (Really Simple Syndication, a technique for publishing updates), podcasting ... are completely new uses of computers. You can find out about all of these, and more, by using an internet search engine, such as Google, itself another new technology!

More ideas will come. The web has changed how we think about information, and the democracy of information. It allows anybody to publish ideas, though regardless of their quality. In the 'old days' to publish beyond a small group, you needed resources to pay for printing and distribution; or at least you would need a story to tell that publishers thought would be bought by enough people. This was so-called broadcast. Now we have *narrowcast*, where very specific material is broadcast into small specialist communities — into tribes. Narrowcast comes with twin social problems: it goes into a community of people who agree with it and are not critical of its content, and it is transmitted by people who do not get critical comments from their community over its content. There is no force to make it true or to make it benefit more than the specific tribe it focuses on. Moreover, as narrowcast operations are typically very small, it is easy for them to be infiltrated by not just highly motivated people, but by people who are malicious and wish to pursue their own ends.

Less familiar ideas are massively multi-user games (arguably 'better than reality' for some players), digital libraries, and machinima. These are all computer-based technologies as radical in their impact on styles of thinking and communication as email and the web were in the 1990s. Some people already have implants, and these will soon be integrated in novel ways with both computer systems and with other people. And implants may be a lot smaller than they are today; no lump-like pacemakers that take general anaesthetics to put it (or retrieve when they go wrong), but nanotechnology swimming in our veins, perhaps — which we probably won't ever be able to get out of our systems.

Although these new technologies are in their infancies, they show some remarkable potential. Wikis are collaborative documents that many people can contribute to. The largest wiki is *Wikipedia*, an encyclopaedia with around 900,000 articles in English, and thousands of articles not just in all common languages, but even in Magyar, Ido, Shqip and many other obscure languages. The scale of the *Wikipedia* eclipses conventional encyclopaedias. Conventional encyclopaedias claim to be authoritative, contrasting their editorial policies with the 'free for all' approach of wikis. Yet wikis are surprisingly successful; although the web is the largest single thing ever made by humans, wikis are the largest collaborative things ever made. When somebody makes a mistake (or puts up something misleading) these errors are rapidly corrected. Very little moderation is required. One wonders whether the ideas of wikis can be generalised to help make organisations like the UN work better when writing large documents, or for governments creating legislation?

Digital libraries are like real libraries but on the web. Unlike wikis, the material is often created in conventional ways, and therefore they add authority and consistent style to web material. Many digital libraries can be copied onto CDs and hence used without access to the internet. The New Zealand digital library is one of the largest digital library projects, and it has high quality material used for disaster relief (such as libraries of first aid, farming, and so on) that can be used in remote areas more easily than the tonnes of paper it replaces. Interestingly, the technology of the New Zealand digital library is freely available, and thus it brings to anyone with a computer the ability to make their own libraries.

The scientific community is concerned with truth, and over centuries has developed procedures for ensuring information is correct and constructive. Indeed, the world wide web sprang out of a physics laboratory precisely to handle scientific papers. Scientists want, like everybody else, to distribute their ideas, but they also want the ideas to be correct. There is therefore a habitual distinction between a draft, which a few people see; a preprint, which is more-or-less finished but might have errors in it; and a refereed paper, which is about as high quality as it can be, having passed the close scrutiny of peers. It would be interesting to merge or otherwise combine the web, digital libraries, and wikis with these sorts of quality control ideas so that one gets the best of all worlds.

More ideas will come. They change the digital divide into a digital opportunity. None of the ideas above are technically difficult to achieve; most of them merely require the creativity and ability to assemble new tools. Fortunately, there are plenty of people willing to do that.

### ***What sort of technology do we need?***

There was a cartoon of a dog using the internet, and the caption was 'on the internet, nobody knows you are a dog.' Then, people could participate in on-line discussions and nobody knew what sort of person you were, even if you were a dog. There was an almost Utopian vision of people participating fully in cyberspace, without regard to their real life position — whether they were rich or poor, athletic or disabled, regardless of race, creed, or whatever. This could have led, the hope was, to a new democracy without borders and without prejudices.

The original idea of the web was to allow individuals to create content, but the earliest browsers made creating material very difficult (in fact, they did not allow it, and other tools had to be used).

Unfortunately, then, the web developed into a disproportionately passive medium of consumption, and the market forces driven by e-commerce created rules and regulations that reinforced the concept of the individual as a consumer. Thus empowering initiatives like Napster, which undermined 'real world' market conventions were themselves undermined by real world legislation.

The web to a great extent ignores location and neighbourhood. We could use variations of search engines to find problems we want to solve and communities of people who want to solve them. Many problems that affect people are geographically local. It would not be difficult to use metadata to find people who are in the same region who already share the

problems. By learning how to help people solve problems they really want to solve, typically ones affecting their real neighbourhood, we will learn how to help people solve problems that are harder and which, often, don't start with any sort of identifiable consensus.

Location and identity awareness is even more important than these few sentences suggest: social cooperation arises because people know they will meet again. (People who won't meet again tend to exploit each other: anonymous vandals being an extreme example, in contrast to family relationships.) In other words, the right sort of identity and permanence of identity, and location is part of this, will encourage a constructive approach to cooperation. This is something the web does not yet provide.

It is encouraging that developments like blogs and wikis are returning to the web's original goal, by making the creation of content much easier for individuals. Neither sort of technology, though, creates a space for conversation or dialogue. Neither brings people together. The only tools that do this are synthetic worlds, which create the means to live in fantasy worlds. Synthetic worlds have millions of users, so they are very successful. Could these ideas be directed into problem solving for the real world? After all, synthetic worlds originated in war gaming technologies, which the military used to solve their problems.

Can we foresee using technologies only a little more advanced than wikis and blogs in the UN Security Council, the World Trade Organisation, scientific meetings (like climate change and sustainable fishing conferences — just two of many examples of politico-scientific and very sensitive issues), or in our national and local governments? Can such technologies be integrated with interactive voting, so we can have full participatory democracy? The answer is obviously *yes*.

Perhaps it is too ambitious to try to change the world at this level, indeed it is rather risky in case it fails and makes things worse!

Instead, a more realistic goal is to develop the same technologies but develop them in schools for children to work together. Here, the children can learn all the issues, and can appreciate their diversity and learn to listen and contribute. Later, the children will grow up and take what they have learnt works with computers into the future, whether they move into government, business, health, entertainment or education. Some might go into international projects, whether they relocate to other countries or use the technologies to stay where they are, but nevertheless contribute to international development.

This way, it will just take a generation longer — though as something like 60% of the world's population are children or young people anyway, this is not a bad deal.

### ***What are the opportunities? Rhetoric for the future...***

There are many opportunities, many obvious; given our space restrictions, I have therefore chosen a few ideas that are unusual and unfamiliar — even provocative.

Abraham Lincoln said, "Give me six hours to chop down a tree, and I will use the first four sharpening the axe." This is usually taken as moral or 'meta-principle' about how to be more effective: the converse moral is, "I'm so busy chopping down this tree, I don't have time to sharpen my axe." The real principle is not to sharpen your axe ("Give me four hours to sharpen my axe, and I will use the first hour to find a good sharpening tool") but to *think*. When we pause to think, we can solve real problems faster than by just plunging in.

Real problems, such as the one this article opened with, do not wait passively like trees. We do not have six hours to solve poverty; it is tempting to start solving the problem immediately — with inadequate preparation and thought to being more strategic. Worse, there are some people who do not wait but already just know *the* solution to the problem; they rush in where angels fear to tread.

So to solve problems, we need to find ways to suspend action while we think. For big problems, we need to find ways to suspend action while we think cooperatively. Unfortunately, group thinking is itself an action — like sharpening axes — and itself needs suspending. People working in groups often interrupt with pre-prepared ideas, they don't listen, they have private interests they camouflage as principles, and so on. Worse, recent communication technologies like email exacerbate the speed of action against the suspension of action. *Flames* are the email symptom of acting without thinking. Flames are extraordinarily damaging to cooperative thinking.

An opportunity, then, is to exploit new technologies is to find ways to suspend, delay, slow down, increase reflection in preparation for group thinking. We mention this idea first because it seems ironic, even counter-productive: technology always seems to be speeding up things. But if we speed up *the right* things, surely we will have more time to reflect?

Next, we should ask why are computer technologies so successful and popular? Why did the web take off so quickly, whereas some of the popular predictions of the future, involving things like monorails and space travel, still seem as remote as ever? What's the difference?

The difference is that the web lets us tell and listen to stories; to communicate with each other. We have been telling each other stories for thousands of years, and we like it. (Before the web, printing was probably the fastest-ever spreading invention, for precisely the same reason.) Technologies like wikis work well when the goal is to define facts (as in an encyclopaedia), but they do not work so well for creating stories — where people can be opinionated. Synthetic worlds work very well because they are stories people can literally get into, and become players within.

A second opportunity is to find ways of creating and telling stories that help constructively solve real problems. Synthetic worlds are often set in historic or mythic terms (that is, playing either with restricted or magically unrestricted rules); can they be developed to address present day issues, and still be as seductive? Some systems, such as SimCity suggest there are ways, and many converge fun and education.

A third opportunity is to distinguish between different sorts of thinking. The stories example and experience of wikis suggests that imaginative and factual thinking are very different, and moreover that the difference has an important impact on the success of using computer tools to achieve certain goals. Our current technologies, such as email and the web, make no distinctions between different sorts of thinking. *Emoticons* were introduced to allow the otherwise unemotional text of emails to allow explicit slips into humour and other emotions. Without emoticons, emails were often wildly misunderstood.

Normally we think differently, but never notice. One of us may be thinking imaginatively, one judgementally, one about today, one about 'sometime.' We may be thinking differently ourselves, never reflecting on our changes of style. Can we then focus our thinking, either in tools appropriate and perfected for particular styles of thinking, or can we better separate out our modes of thinking. Certainly, if we can think at the meta-level of which style of thinking we choose, we will be more likely to understand each other. Surely we can invent bigger ideas than emoticons.

One of the different styles of thinking that is pivotal for the future of the world is religious thinking. It is clear that both much good and much bad in the world is motivated by religious principles. Apart from the use of technologies we have already mentioned, mainly for broadcast, I am unaware of any specific approaches to supporting constructive religious debate. There is clearly some urgency in developing approaches, say variations on wikis or synthetic worlds, that appeal to 'fundamentalists' and supportively open up dialogue.

Lastly, notice that many technologies are popular because they save us doing work. Cars remove the need for walking. Writing saves us remembering. We may worry (as Socrates did) that technologies lose essential parts of our humanity, such as using our own memories — but in fact, we can travel more safely and remember more reliably than ever before. The danger is that we become habitually passive. Rather than becoming involved in stories, we can lie back and watch TV and *do* nothing. It is easier to be entertained than to be engaged. Entertainment is the 'opium of the people.' So, the fourth opportunity is to find a way to distinguish or balance entertainment and engagement. Is there a line between play and education; is there a distinction between wasting time and developing skills? What is the difference between education and diseducation? Finding the principles behind these questions will enable us to develop new technologies that are not only more successful in terms of who and how many like them, but are more successful in terms of how effective humanity is in the long run.

### ***What are the priorities?***

The priority for humans is to find ways to use computers to help us think more clearly, and hence find solutions or ways around our besetting problems. There are some very positive signs, such as the success of wikis, but more generally the creativity and diversity of the technologies being created. Certainly some of these new ideas will transform the way we think, particularly how groups of people think together, and hence how we address — and *agree to address* — the world's besetting problems. Hopefully these technologies will be taken up by organisations like governments, the UN and at strategic levels in non-governmental organisations (NGOs) such as the Red Cross. Perhaps they will be taken up by individuals arguing their own causes, such as regenerating their local neighbourhoods. The world of the future can be a better place, and we can make it so provided we use computers to help us think clearly together.

Hopefully computers will help us turn our thinking into a new sort of doing. Not only will the technology help because of its intrinsic power (as it does in managing a wiki, say) but it will also help by getting our thinking out of our interior worlds in our brains into the real physical world. Perhaps we can try to gain the advantages of the Olympics, but for doing thinking rather than athletic competitions?

We solved incredible technical problems to put man on the moon, but at the same time it was not possible to walk from one side of Berlin to the other. Now we have taken down the Berlin wall, and that particular divisive period is behind us — we landed on the moon in July 1969 and broke the wall down in November 1989, twenty years later.

The Berlin wall came down because enough people wanted it down and enough people got organised to achieve what they wanted. In fact, exactly as happened with solving the immense problems of landing on the moon. Solving problems, such as the overwhelming problems like the energy crisis and poverty, requires the innovative will to escape pigeon thinking and the traps of rigid computerisation.

One of the best uses of computers will be to put them to use to help us re-organise ourselves in tackling, and tackling effectively together in dialogue, the most urgent and important of problems facing humanity, both globally and in our own neighbourhoods.



Technology has a key role in society. For recent examples, one only has to recall the role of the fax in Tiananmen Square, the usenet in the fall of communism, the web for the Mexican Zapatistas, or mobile phones for rescue or even for the Madrid bombings. And centuries earlier, the transforming role of the then new technology of printing precipitated the European Reformation. I started to write an essay about the future of computers, but I found myself exploring social issues and the entanglement of computers with social issues. This experience is not unusual: when the ACM (the largest computer society in the world) celebrated its fiftieth anniversary in 1997, social impact was its main concern, not the technical advances in computing. Indeed, computers are the future's agent of social change.

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