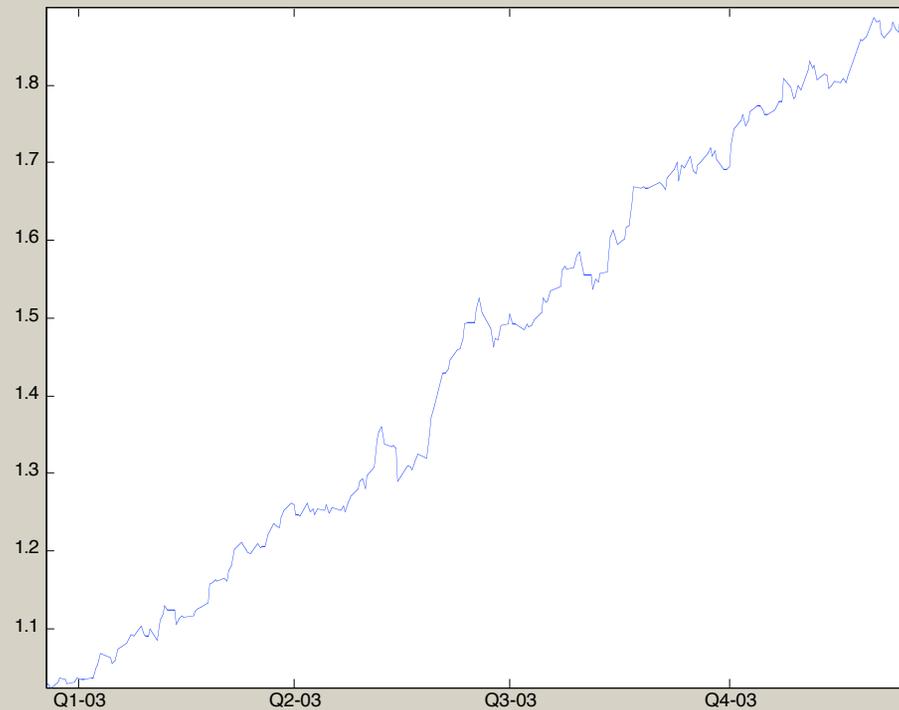


FatKat (*Financial Accelerating Transactions from Kurzweil Adaptive Technologies*): applying pattern recognition with thousands of variables to short-term stock movements

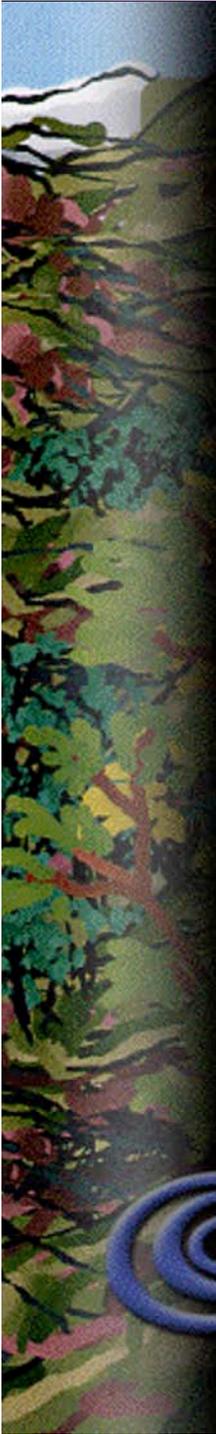
FatKat (*Financial Accelerating Transactions from Kurzweil Adaptive Technologies*): applying pattern recognition with thousands of variables to short-term stock movements





2010: Computers disappear

- Images written directly to our retinas
- Ubiquitous high bandwidth connection to the Internet at all times
- Electronics so tiny it's embedded in the environment, our clothing, our eyeglasses
- Full immersion visual-auditory virtual reality
- Augmented real reality
- Interaction with virtual personalities as a primary interface
- Effective language technologies



2029: An intimate merger

- \$1,000 of computation = 1,000 times the human brain
- Reverse engineering of the human brain completed
- Computers pass the Turing test
- Nonbiological intelligence combines
 - the subtlety and pattern recognition strength of human intelligence, with
 - the speed, memory, and knowledge sharing of machine intelligence
- Nonbiological intelligence will continue to grow exponentially whereas biological intelligence is effectively fixed



Nanobots provide...

- Neural implants that are:
 - Noninvasive, surgery-free
 - Distributed to millions or billions of points in the brain
- Full-immersion virtual reality incorporating all of the senses
 - You can be someone else
 - “Experience Beamers”
- Expansion of human intelligence
 - Multiply our 100 trillion connections many fold
 - Intimate connection to diverse forms of nonbiological intelligence



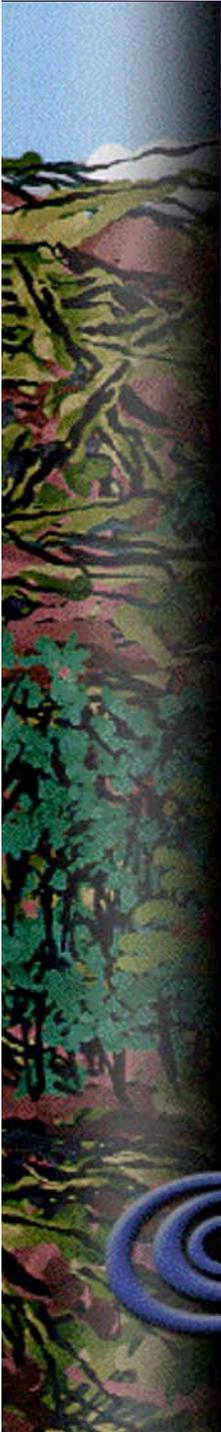
Innovation as Surfing

- Catch the wave at the right time
- Most modern technologies are interdisciplinary
- Create devoted, passionate teams
- Organize project milestones around demos
- IP: Patents growing in importance with the acceleration of time



Creative Problem Solving

1. Write the advertising brochure (harder than it may seem)
2. Recruit the beneficiaries (to help invent the technology)
3. Fantasize you're giving a speech on how you solved the problem
 - What would you have to be saying?



The Challenge from Malthus:

“Exponential trends eventually run out of resources”

However...

- The resources needed for computation and communication are close to zero.
- Based on current understanding, there are sufficient resources on Earth for these trends to continue through the 21st Century:
 - During which time nonbiological intelligence will become trillions of times more powerful than biological human intelligence
 - Beyond that: yet lower thresholds, and expansion beyond Earth

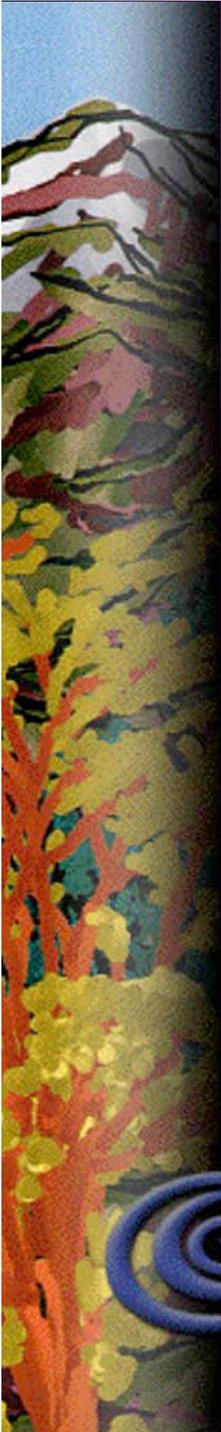
- 
- Specific Paradigms do hit limits
 - e.g., the flat IC's of Moore's Law will hit atomic limits within 15 years
 - But then yield to other paradigms
 - Moore's Law is the fifth paradigm, not the first, to provide exponential growth for computing
 - The Sixth paradigm will be 3D molecular computing
 - The brain achieves its power because it computes in 3 dimensions despite an extremely bulky and slow information processing method (10 million times slower than today's electronic circuits)
 - Even Moore's Law by itself will be sufficient to exceed human intelligence



The Challenge from Software:

*“We’re making exponential gains in hardware,
but not software”*

- However, we are making exponential gains in software, although the doubling time is indeed longer.



Software Price-Performance has also Improved at an Exponential Rate *Example: Automatic Speech Recognition Software*

	1985	1995	2000
Price	\$5,000	\$500	\$50
Vocabulary Size (# Words)	1,000	10,000	100,000
Continuous Speech?	No	No	Yes
User Training Required (Minutes)	180	60	5
Accuracy	Poor	Fair	Good

- 
- There has been increased productivity from new languages, class libraries, software development tools:
 - Doubling time is about 6 years
 - Software complexity required to emulate the human brain is manageable:
 - Compressed genome data that describes the human brain is 12 million bytes
 - 6 billion bits X compression factor of 30 X 50% devoted to the brain

- 
- We have a specific game plan to reverse engineer the human brain
 - Knowledge of the human brain at all levels is growing exponentially
 - We will not program human-level intelligence link by link (e.g., the expert system “cyc”)
 - But rather as an elaborate architecture of parallel self-organizing systems
 - Educating such a system will be the hardest part of the software task



The Challenge from Ethics

- There is far less ethical resistance to the development of nonbiological intelligence (including intimate connection with our bodies and brains) than to biological tinkering
- In any event, ethical concerns end up as stones in a stream: the economic and moral imperatives are too strong
- There ultimately will be grave dangers, but the biological downsides are more apparent today

Bostrom's Categorization of Risks

Intensity

Scope

	Endurable	Terminal
Global	Ozone Thinning	<u><i>Existential Risks</i></u> to human civilization
Local	Recession	Genocide
Persona	Stolen Car	Death

The Already delivered Promise of Technology

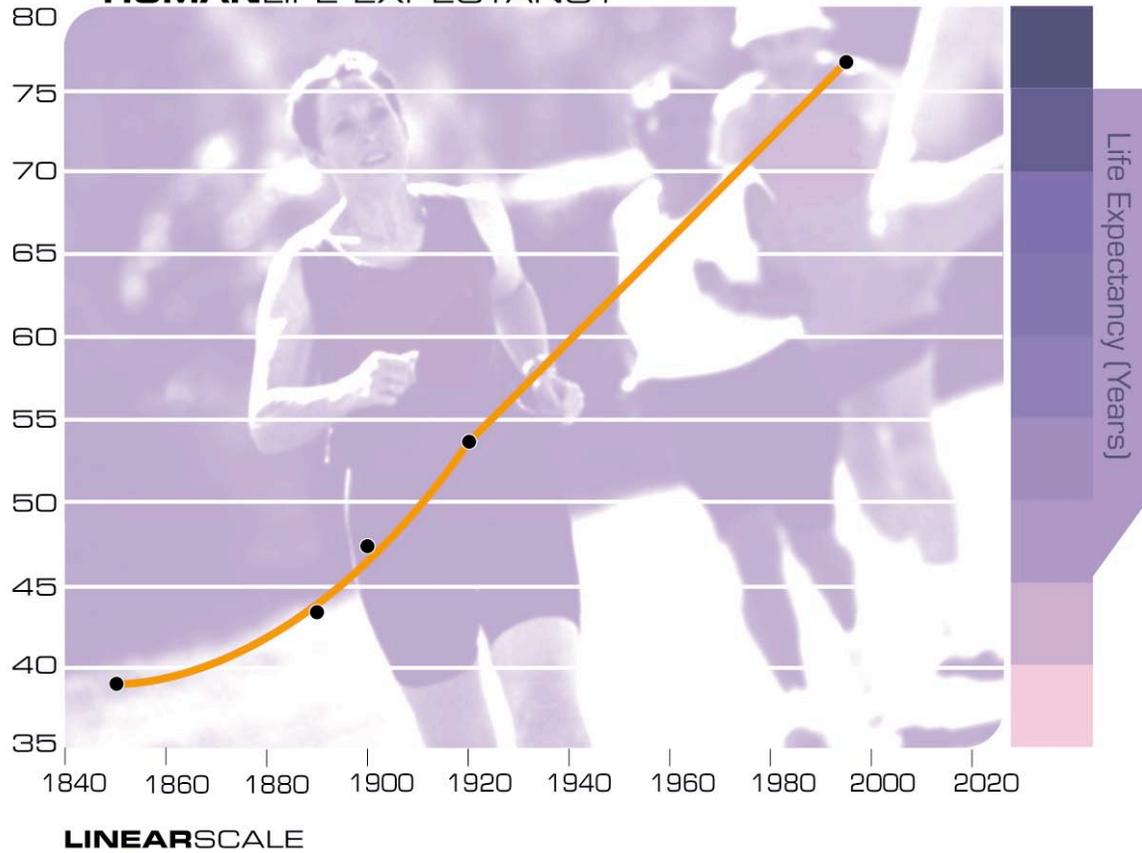
*Greatly improved health and
Longevity*

Average Life Expectancy (Years)

Cro Magnon	18
Ancient Egypt	25
1400 Europe	30
1800 Europe & U.S.	37
1900 U.S.	48
2002 U.S.	78



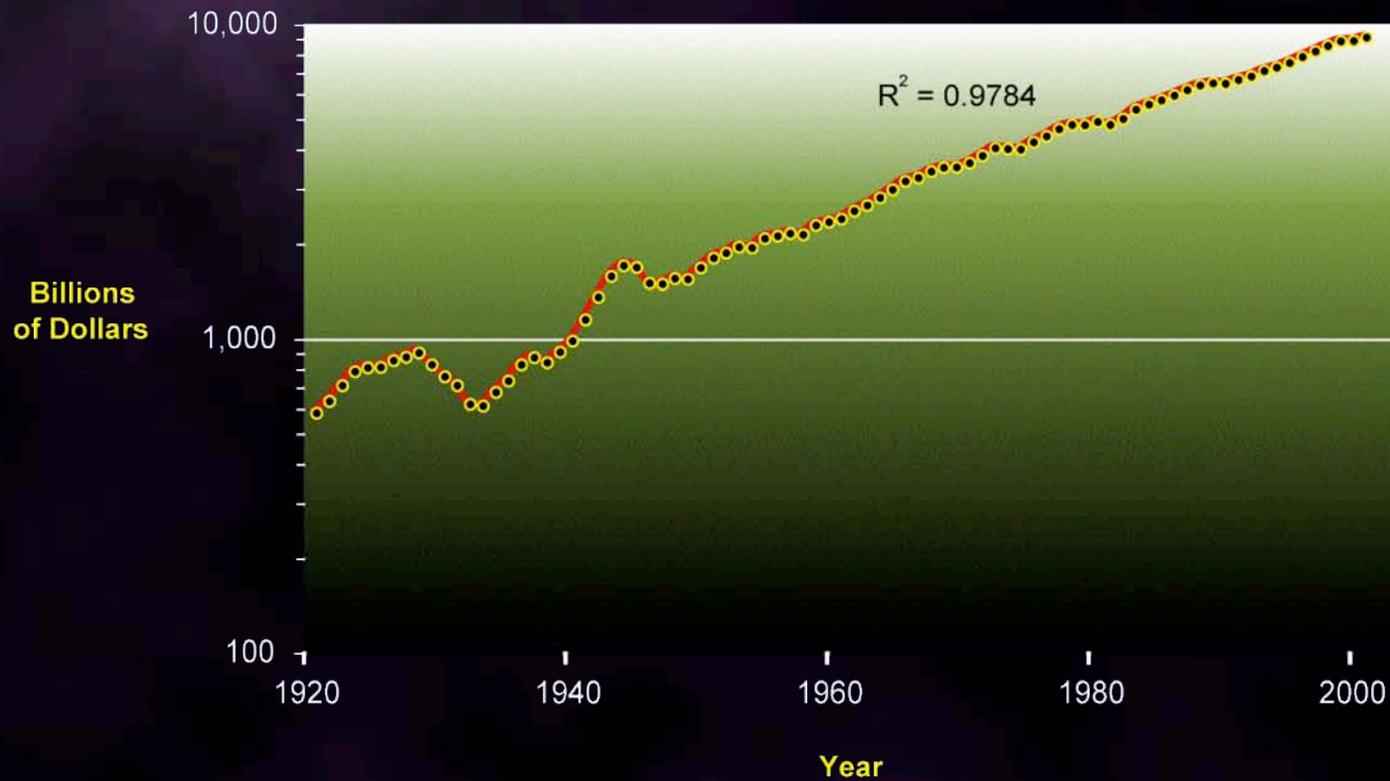
HUMAN LIFE EXPECTANCY



Wealth

- 12-fold increase in U.S. GDP in past 74 years (in constant 2000 dollars)
 - \$865B in 1929
 - \$10,398B in 2003

Real Gross Domestic Product

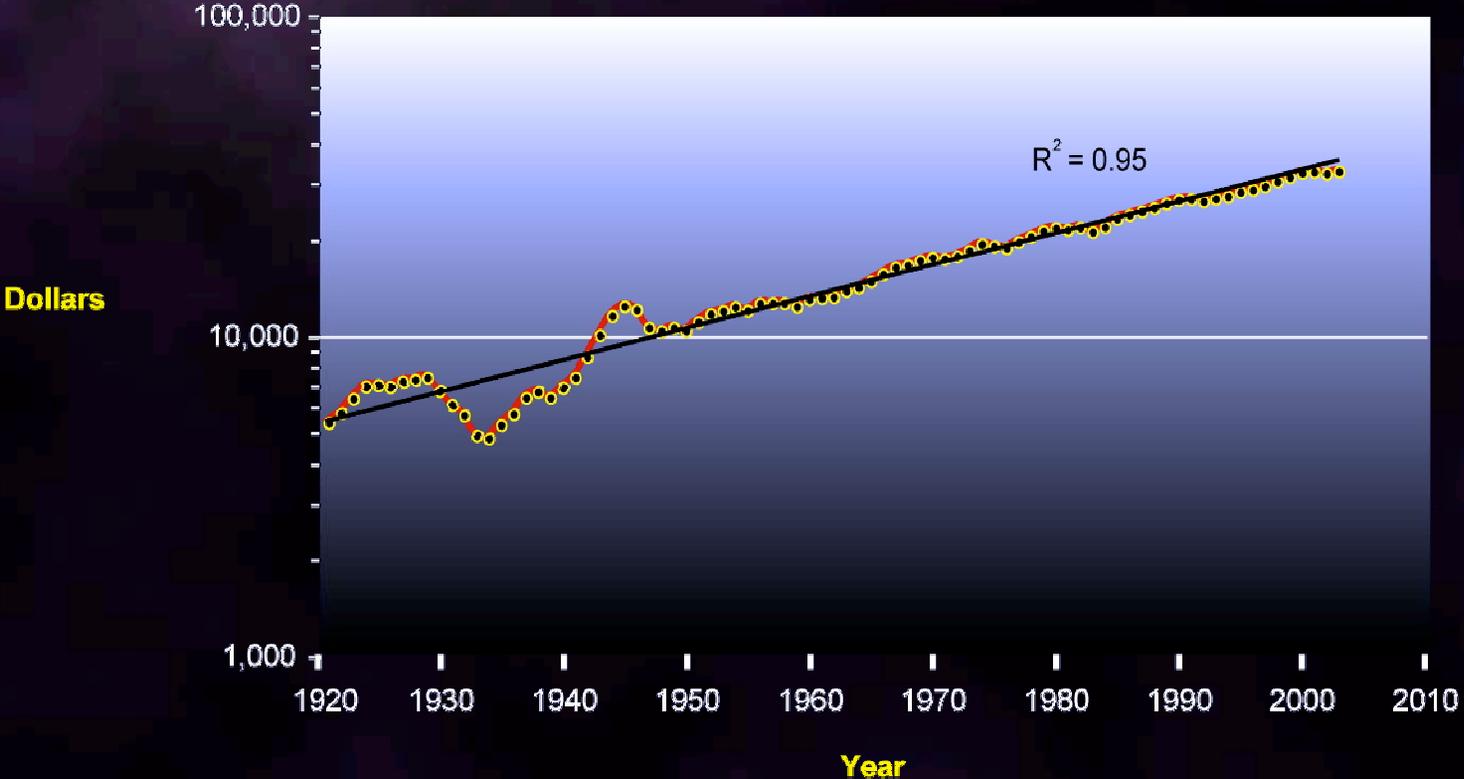


Logarithmic Plot

Data from: Bureau of Economic Analysis

Per Capita GDP

Logarithmic Plot



Data from: U.S. Census Bureau

Doubling time: 30 years

Vast improvements in:

- Computation
- Communications
- Knowledge

Life Two Centuries Ago was:

- Short (life expectancy 37 years)
- Filled with hard labor
- Subject to rampant disease
(no antibiotics)
- Disaster prone (no social safety nets)

Contemporary Perils

- **Nuclear**
- **Biological**
- **Chemical**

Nuclear Risk

Intensity

Scope

	Endurable	Terminal
Global	Fallout (under control from agreements)	<u>All Out Nuclear War</u> (still possible, but improved political climate between nuclear superpowers)
Local	Radioactive Contamination (dirty bombs likely)	Nuclear Attack on City (Likely terrorist goal. This is the #1 terror concern)

(Conventional) Biological and Chemical Weapon Risk

Intensity

Scope

	Endurable	Terminal
Global	Conventional biological attack spreads via travel	Conceivable existential risk from smallpox, but existential damage unlikely with conventional biological weapons
Local	B/C attack causes local sickness	Effective B/C attack causes large-scale local deaths

The intertwined promise and peril of

- **G**enetic technology (biotechnology)
- **N**anotechnology
- **R**obotics (“Strong” AI)

The **Promise** of Genetic technology (biotechnology)

Reprogramming biochemical pathways to block disease

- Dramatic new therapies already in pipeline for heart disease, cancer, type II diabetes, stroke.....
 - One example of many: Heart disease therapies in testing (ApoA-I Milano, HDL boosting medications, new anti-inflammatories, and others) likely to reverse atherosclerosis
- Blocking gene expression through RNA interference
- Designer baby boomers through gene therapy
 - Fourth generation viral vectors to insert new genes

Somatic Cell Engineering: therapeutic cloning

- Transdifferentiation: turn your skin cells into other types of cells
 - Already skin cells turned into immune system cells, nerve cells
 - Learning to manipulate gene expression molecules (peptides, short RNA)
 - With extended telomeres
 - Without DNA errors
- Regrow your own (youthful) heart (& other organs) in place....no surgery

“Grow” meat in factories through therapeutic cloning of muscle tissue

- Very low cost (subject to law of accelerating returns)
- Desirable nutritional profile
- No animals: no animal suffering

Stop and reverse aging

- We evolved in an era of scarcity when short live spans were in the interest of the species
 - In an age of abundance, we can all contribute to the ongoing expansion of knowledge
- We have the strategies to reverse each aging process, Examples:
 - DNA errors:
 - Gene therapy
 - Therapeutic cloning of selected cells with intact DNA
 - Later: repair through nanobots
 - Control of telomerase
 - Turn off to block cancer
 - Turn on to extend healthy cell longevity
 - Mitochondrial mutations
 - Move mitochondrial DNA into nucleus
- Mouse that doesn't age will be demonstrated within ten years
 - Translation to human therapies within another ten years

The **Peril** of Genetic technology (biotechnology)

Wandering Transgenes (from GMO)?

- Yes, it's a problem
 - But manageable
 - And worth the significant environmental, health, and economic benefits of GMO

Designer Viruses: the urgent **GNR** problem we face **NOW**

Intensity

Scope

	Endurable	Terminal
Global	Attack spreads via travel	<u>Conceivable existential risk</u> from rapid spread of deadly engineered virus
Local	Attack causes local sickness	Effective viral attack causes large-scale local deaths

The Possible Existential Risk from Designer Genes (viruses)

- The SARS Experience was encouraging
 - Compared to HIV: SARS more deadly, spreads more easily

SARS tools

- New tools
 - Sequenced in weeks (versus years for HIV)
 - Information spread rapidly by Internet
- Ancient tool
 - Quarantine

SARS is not the worst type of virus

- Deadlier, more communicable viruses are possible
- Worst scenario: stealth spread through long, silent incubation

Future anti-viral technologies

- Gene arrays / sensors for instant identification of disease carriers
- More powerful anti-viral medications
- Effective means to halt viral spread

Urgently Needed: Anti-Viral Medications and Technologies

- We are at war
 - We need to bypass regulatory obstacles
 - Would DOD wait for endless phases of trials before deploying weapons?
 - Need to balance risks: regulation today does not adequately consider the risk & damage of delay
 - Bioterrorists do not need to put their “inventions” through FDA

Because viruses use evolution effectively:

- RNAi is one effective tool
- Gene therapy will also be effective
- We need “cocktail” approaches
- But these are discouraged by FDA regulations
 - Almost impossible to test within regulations

Propose that we spend 1%
of GDP (\$100B today)

- aimed at civilization's #1 threat
 - Viruses today
 - Later on: self-replicating nanotech
- Relinquishment is untenable
- Therefore, it is a race
 - Effective technologies are close at hand

The Promise of Nanotechnology

- Radical Life Extension
 - Finish the job started by biotech
- Radical Life Expansion
 - Human Body Version 2.0
 - Already 4 major conferences on BioMEMS / BioNEMS
 - Age of Neural Implants underway (Parkinson's, retinal, others)
 - Full immersion virtual reality from within the nervous system
- Reverse environmental damage from industrial era technologies
- Radical wealth creation
 - Manufacture of virtually any physical product from information & inexpensive raw materials

The Peril of Nanotechnology

- Environmental danger of nanoparticles
 - Legitimate issue, but existing regulatory systems for new materials are the right approach

The Gray Goo Problem is Real

- Nanotech has the same scaling problem as biology
 - So solution is the same: self-replication at some stage is needed
 - Where there is self-replication, there is the danger of unwanted replication
 - Most biological diseases involve self-replication of pathogens or once healthy cells (cancer)

A defensive strategy: the broadcast architecture

- Reproduction codes are not contained within the entity
- Obtained from secure server
- So unwanted replication can be stopped
- Effective against inadvertent release
- But can be circumvented for intentional abuse
 - By modifying the design to include the codes

We can apply the broadcast Architecture to biology

- Replace the nucleus and Ribosome machinery with a nanocomputer and nanobot
- The nanobot assembles the amino acid strings.
- The computer follows the broadcast architecture
- This approach would eliminate cancer and biologic viral disease

Nanotech development guidelines

- Some of the Foresight Institute guidelines:
 - “Artificial replicators must not be capable of replication in a natural, uncontrolled environment.”
 - “Evolution within the context of a self-replicating manufacturing system is discouraged.”
 - “MNT (molecular nanotechnology) designs should specifically limit proliferation and provide traceability of any replicating systems.”
- Effective against accidents, but terrorists will ignore the guidelines

Time estimate for nanobot destruction of Earth's biomass

- Biomass = 10^{45} carbon atoms
- Nanobot $\sim 10^6$ carbon atoms
- \rightarrow Need 10^{39} replications \rightarrow 130 replications
- Estimate replication time of 100 seconds
 \rightarrow 3.6 hours
- However gating factor would be the moving front of destruction
 - Nanobots travel slowly because of their small size
 - Likely to take weeks to circle the globe

More insidious threat: two-phased stealth attack

- Nanobots takes weeks to spread throughout biomass
 - But use up insignificant portion of the carbon atoms¹⁵
 - Say, 1 per 10 carbon atoms
- Phase 2: each seed nanobot replicates in place
 - Thousand trillion fold requires only 50 replications (90 minutes)
 - Travel no longer a limiting factor

What is the answer to the stealth scenario?

- An Immune System
- Same solution that biology came up with
- Is a nanotech immune system itself dangerous?
 - Yes: putting it in place looks just like the dispersal stage of the stealth gray goo scenario
 - But there is no choice
 - We need it for the same reason that biological systems need one
 - To guard against unwanted replication
 - There are auto-immune diseases in biology also
 - But we could not survive without an immune system

Relinquishment is not the answer

- The dangerous technologies are the same as the beneficial ones
- G, N, and R are all inevitable result of repeated incremental advances
- The only way to relinquish them would be a “Brave New World” totalitarian system
 - Inconsistent with all of our values of liberty, democracy, etc.
 - Ultimately doesn't even work
 - Dangerous development continues “underground”
 - Responsible practitioners are deprived of the tools to create defenses, so the race is likely to be lost
 - And there is an even more important reason: see “R” below
- Battle against software pathogens is a good example of the race
 - Thus far, the damage has been modest

A Program for GNR Defense

- Greatly increase our investment in defensive technologies
 - Today: antiviral medications and technologies
- Streamline regulatory process for genetic & medical technologies
- Continued development of safety & ethical guidelines for nanotech
- Improved public education to avoid reflexive anti-technology backlash
- Raise public awareness of both promise & peril
- International cooperation: these are not local problems
- Strengthen intelligence agencies (including Int'l. cooperation)

The Promise of Robotics (Strong AI)

- Vast Expansion of human . . .
 - Intelligence
 - Knowledge
 - Experience
 - Wealth
- Can protect us from pathological **G** and **N**
- It is our Destiny

The **Peril** of (unfriendly) **Robotics** (Strong AI)

- None of these strategies for G and N will work for pathological R
 - Broadcast architecture
 - Immune systems
 - Safety and ethical standards
- Superior intelligence trumps them all

*So what is the answer to
provide protection from
unfriendly AI?*

The Only Answer:

Foster the values of liberty, openness, democracy, tolerance of diversity, respect for knowledge

- Strong AI is emerging from our society
- Will be an extension of our civilization
 - and of ourselves
 - It will be our civilization
- Likely to reflect the values of its predecessor society
- So best approach is to maintain & strengthen the values we cherish
- Not foolproof, but that is the only conceivable strategy
- This is the most important reason to avoid relinquishment of GNR
 - Broad relinquishment requires a totalitarian system, exactly the opposite of this strategy



You can live forever now

I intend to live forever. So far, so good.

- *Stephen Wright*

I don't want to achieve immortality through my work.

I want to achieve immortality through not dying.

- *Woody Allen*



Average Life Expectancy (Years)

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2002 U.S.	78



(Biological) Evolution is NOT on our Side

- Not after child rearing age, that is
- Older generations are just using up limited (material) resources
- Biological evolution took place in an era of scarcity
 - So it favored a limited life span
- But technological evolution is taking place in an era of abundance
 - So we can override this vestige of our biological evolutionary heritage
 - And allow all generations to continue to contribute (intellectual) resources

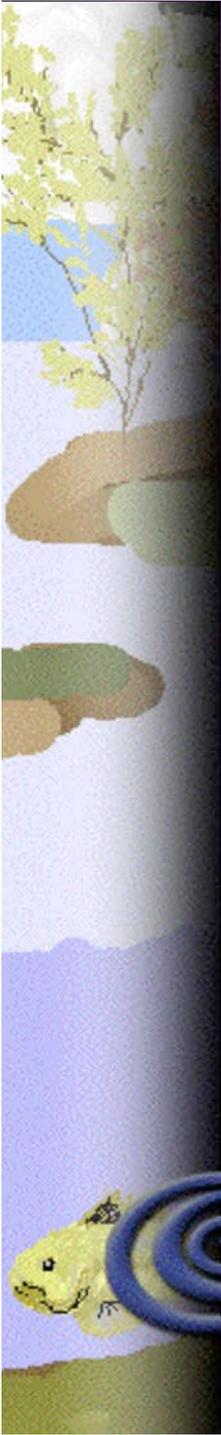
A Decades Long March to Disease or Health

- The leading causes of death (heart disease, cancer, stroke, diabetes, kidney disease, liver disease) do not appear out of the blue.
- They are the end result of decades-long processes.
- You can assess where you are personally in the progression of these processes
- And end (and even reverse) the lethal march towards these diseases.



A Bridge to a Bridge to a Bridge

- Today's optimal program: an amalgam of
 - Ancient wisdom
 - Contemporary medicine
 - Alternative practices
 - Emerging biotech breakthroughs
- A bridge to the full blossoming of the biotech revolution
- Which will be a bridge to the Nanotech-AI revolution



Combating Disease Processes as War

- Our ultimate health goal:
 - Serenity, balance, fulfillment, self-actualization
- But the path is often a struggle
- The vast majority of adults (particularly middle-aged or older) suffer from chronic degenerative disease even if not yet manifest in clinical symptoms
- Not easy to reverse, but doable
 - And much easier now than later



Most degenerative diseases have NO symptoms until. . . .

- 2/3 of cardiac patients receive their first warning by suffering a heart attack
- 1/3 of all first heart attacks are fatal
- Another 1/3 cause permanent heart damage
- Strokes typically cause permanent brain damage without warning
- Cancer is usually not detected until after it has metastasized
- But it doesn't have to be this way



Death and Taxes

Neither is inevitable in
the 21st century.





The Pillars of Ray & Terry's Longevity Program

- Nutrition & Digestion: You are what you digest
- The problem with sugar (and insulin)
- The role of inflammation
- The Methylation cycle
- Cleaning up the mess (toxins and detoxification)
- Living invaders
- Coronary artery disease: the cause of most coronary heart disease
- Prevention of cancer
- Hormones and hormone replacement
- Your brain: the power of thinking. . .and of ideas
- Aggressive supplementation
- Know thyself: the personal genomics revolution
- Keep moving: the power of exercise
- Stress and balance



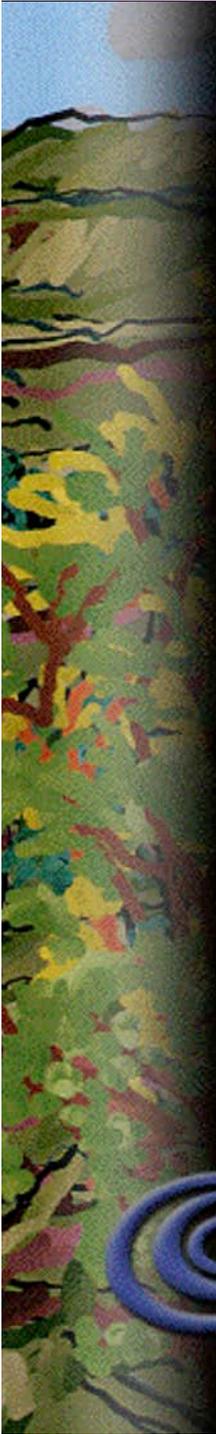
My Personal Story

- Father died of heart disease at 58
- I was diagnosed with type 2 diabetes at age 35 (1983)
- Developed “The 10% Solution”
- Met Terry Grossman, M.D. at 1999 Foresight Conference
- Developed “Ray & Terry’s Longevity Program” with Dr. Grossman
- Today:
 - Diabetes fully controlled
 - Ideal blood levels
 - Aggressively reprogramming my biochemistry
 - Biological age advanced only 2 years in 16 years

My Personal Story - TERRY

- Became disenchanted with conventional medicine in the 1990s
- Researched and wrote “The Baby Boomers’ Guide to Living Forever” in 1999
- Developed “Ray & Terry’s Longevity Program” with Ray
- “So far, so good” at age 57, but ...
- Genomics testing revealed many potentially harmful genes
- Goals:
 - Block the expression of potentially deleterious genes
 - Improve from excellent to optimal health
 - Avoid age-related disability
 - Follow in (or improve upon) my grandfather’s footsteps (he lived to 104)





What's Coming

- Designer Baby Boomers
 - Many emerging means to change gene expression
 - RNA interference to turn off genes
 - Somatic Gene therapy to insert new genes
- Tissue engineering (including extended telomeres)
 - Therapeutic cloning
- Rational drug design and biological simulation
- Strategies for DNA mutations, cell senescence, mitochondrial mutations, cell loss and atrophy,
- BioMEMS and BioNEMS
- We will demonstrate a mouse that doesn't age by 2014, translation to human therapies by 2024
- Human Body Version 2.0

¹ Hunt has calculated that there are 1.55×10^{22} kilograms (10^{22} grams) of organic carbon on Earth. Based on this figure, and assuming that all “organic carbon” is contained in the biomass (note that the biomass is not clearly defined, so we are taking a conservatively broad approach), we can compute the approximate number of carbon atoms as follows:

- Average atomic weight of carbon (adjusting for isotope ratios) = 12.011.

- Carbon in the biomass = 1.55×10^{22} grams / 12.011 = 1.3×10^{21} mols.

- $1.3 \times 10^{21} \times 6.02 \times 10^{23}$ (Avogadro’s number) = 7.8×10^{44} carbon atoms.

² Hunt, J.M., *Petroleum Geochemistry and Geology*, W.H. Freeman (1979, 1996).

Freitas, Robert A. *Nanomedicine*.

Reference

URLs:

Graphs available at:

www.KurzweilAI.net/pps/foresight/

Kurzweil Technologies (links to all Kurzweil companies)

www.KurzweilTech.com

Home of the Big Thinkers:

www.KurzweilAI.net

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