



Introducing a new way to explore the evolution of human technology, cognition and organizations

A Fugue on the Theory of Knowledge

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Introducing a new way to explore the evolution of human knowledge and technology

- *This Meetup is an experiment!*
 - to road test the draft content of a hypertext book
 - to introduce the theory of knowledge and cognitive revolutions
 - to explore the history and philosophy of knowledge and technology
 - to learn/demonstrate how technology made us human and how we became what we are, and
 - to see if I can guide you through a vast and exciting cognitive landscape and hope that you will think it is as exciting as I do
 - **I hope it will be entertaining and make you think**

Tonight's Meetup

- What resources are on offer in this exercise?
- Introduce ourselves
 - Who I am, what do I offer, and what do I hope to gain?
 - I'll do this more thoroughly in Session 2 when I talk about how the book came to be written.
 - Who are you?
 - What would you like to get from this intellectual exploration (answer later)
- What is a hypertext fugue?
- What are the key threads and how are they interwoven to turn a book into a fugue?
- Project outline

Project resources

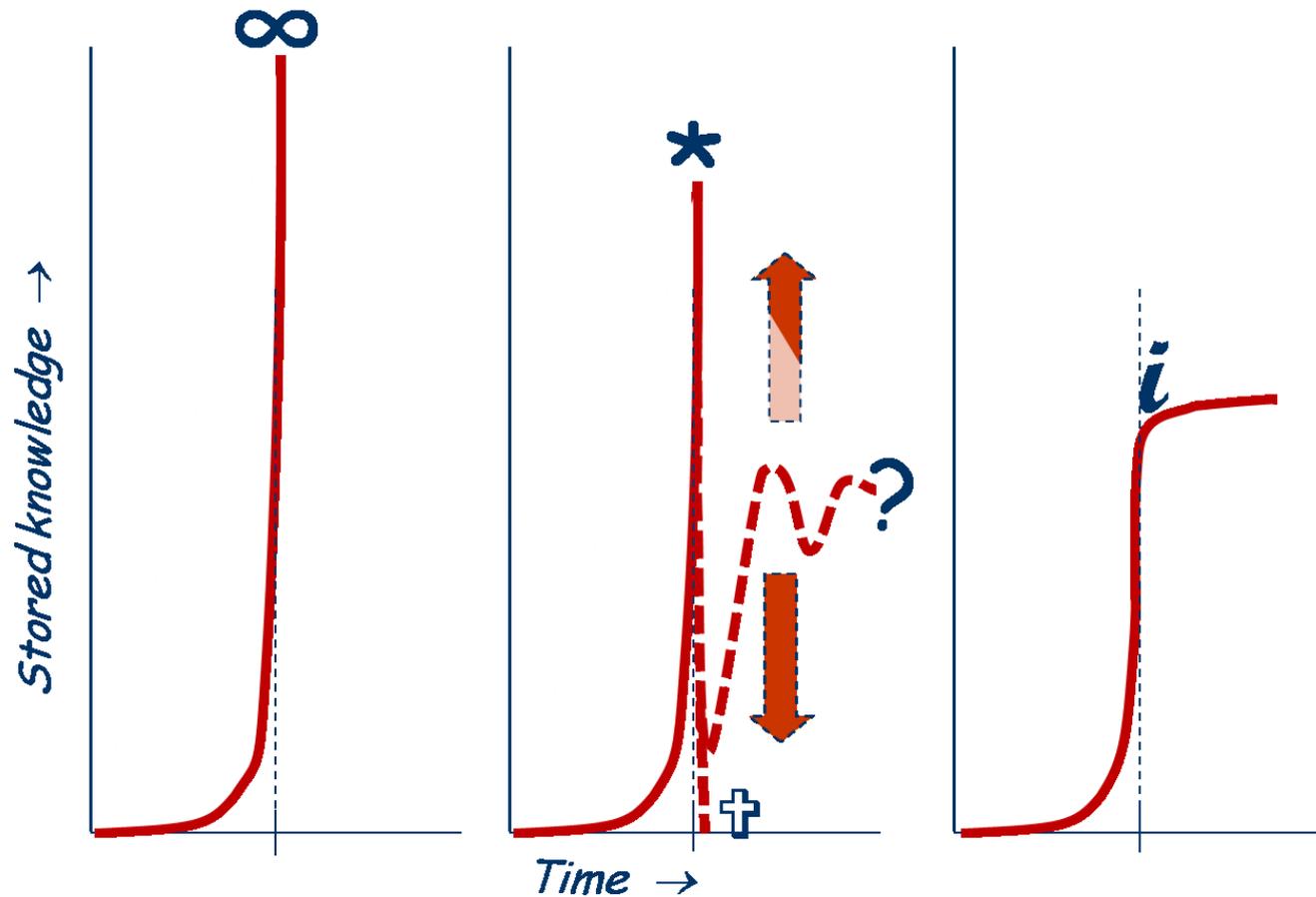
- Me and my living knowledge
- You and your living knowledge
- Our social networks
- Our cognitive tools and connections to network infrastructure
- The “university” and its connections to network infrastructure
- The book and its connections to the Web
- The World Wide Web and everything that is in it

Application Holy Wars or a New Reformation - A Fugue on the Theory of Knowledge

- Based on 70+ years observing nature, studying & teaching science, working in a variety of organizations and managing knowledge for them
- I began writing in 2001 and after several interruptions it is now close to being finished
 - Combines theories of life, knowledge and evolution
 - Explores the history of cognitive technologies
 - Provides an evolutionary hypothesis explaining how some tool-using apes became us and how we formed knowledge-based organizations that transcend the sum of people forming the organization
 - Considers our possible futures as our knowledge grows hyperexponentially
- Designed as a hypertext that is intended to allow its huge scope to be browsed and read in many ways from many different interests

A question to ponder

Will knowledge growth end in a singularity, spike or inflected S curve?



Explaining the title

- "Application"
 - computer software designed to solve a class of problems
- "Holy wars" (~ "flame war")
 - conflicts over competing knowledge paradigms or technologies that become heatedly emotional when protagonists do not focus on implicit aspects of world views associated with their different paradigms; often associated with scientific or technological revolution
- "Reformation"
 - *improvement or transformation of existing institutions or practices etc; intended to make a revolutionary change for the better*
 - the revolutionary invention of printing technology facilitated the Protestant Reformation of the 16th century
- "Fugue" (illustrated by J. S. Bach's "Little" fugue in G minor, BWV578)
 - a compositional technique in two or more voices, built on a subject (theme) and possibly a counter subject (secondary theme) that are introduced at the beginning and recur frequently in the course of the composition
 - the logical development in the book is modelled after a fugue
- "Knowledge"
 - solutions to problems of life
 - what the book is all about
- "Theory of knowledge"
 - branch of philosophy concerned with the nature and scope (limitations) of knowledge, addressing the questions: What is knowledge? How is it constructed? How well does knowledge reflect external reality?

Background for the project

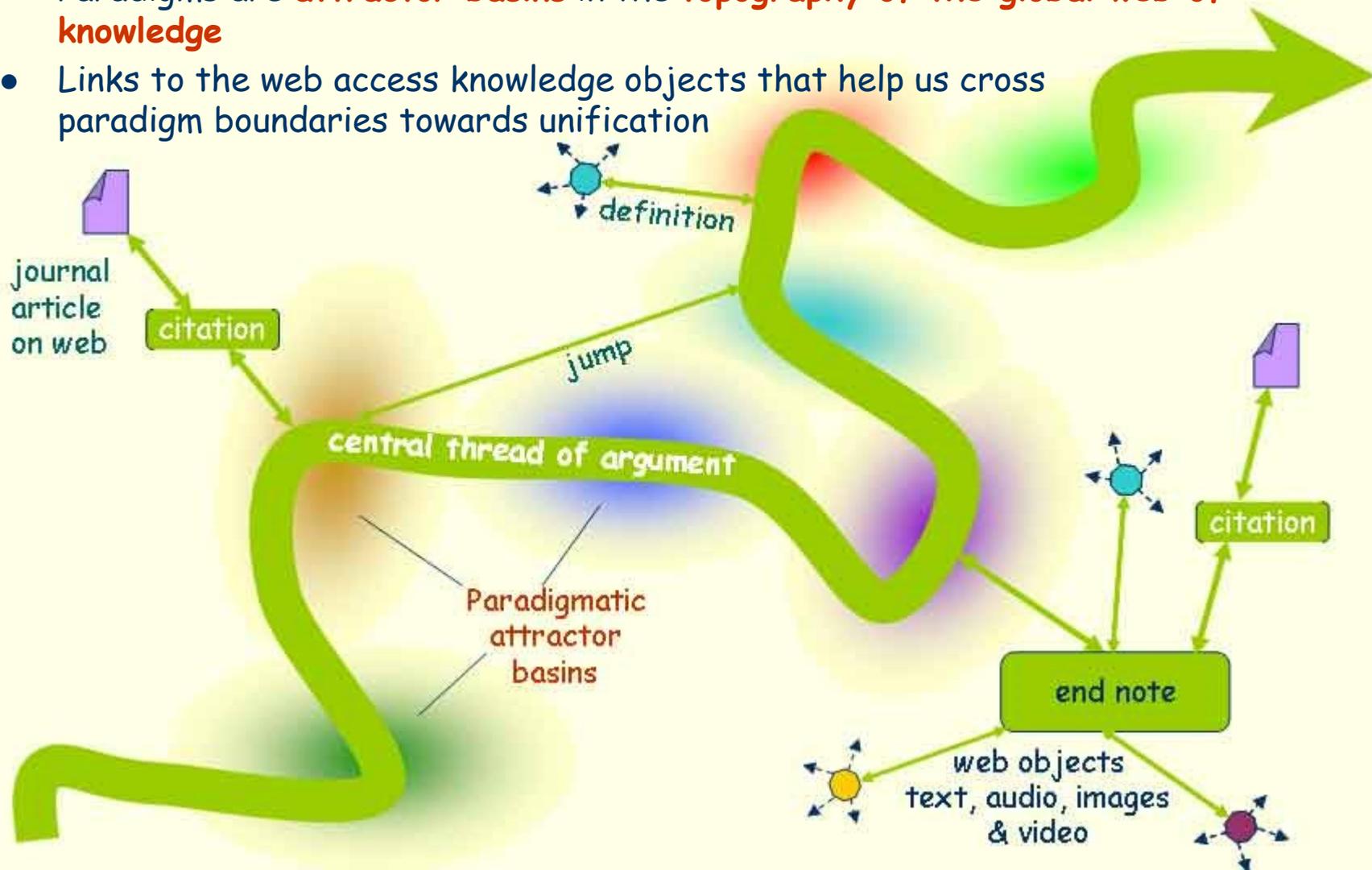
- Combines threads from many disciplines in my background
 - immersed in the ocean from the age of 5 when family moved aboard a boat
 - studied physics for $2\frac{1}{2}$ years from 1957 (failed because of maths dyslexia)
 - started over in zoology (my life-long marine biology/natural history hobby)
 - hands on first & second generation computers (analysis, flow-charting, etc.)
 - neurophysiology research assistant for 3 years (intro to cognitive science)
 - **studying & teaching biology**
 - vertebrate & marine invertebrate biology, cytogenetics, genetics
 - sophisticated user of library science products
 - evolutionary biology (PhD Harvard, 1973), research & teaching to 1980
 - theory of knowledge and history and philosophy of science (UoM 1977-79)
 - **organizational knowledge management**
 - technical communication and computer literacy training from 1981 (UoM)
 - analysis and design of computerized authoring and content management systems from 1990 to 2007 with a key role designing systems to manage ANZAC Ship Project engineering technical data and documentation
 - ANZAC Ship maintenance doco problems solved by 2000
- Book writing - Holiday break 2000-2001
 - time on my hands to think about difficulties in organizational knowledge management
 - **Result: started writing a hypertext book on *co-evolution and revolutions in human cognition and cognitive tools humans use***

“Application Holy Wars” is a fugal hypertext: a revolutionary format for sharing knowledge

- Text displayed on a screen including clickable hyperlinks to other text or other objects that can be instantly accessed by a pointing action (mouse click)
 - besides texts, hyperlinks may access tables, images, audio, video, and other presentational formats
 - links may be other parts of the same document, or
 - may be located anywhere in the World Wide Web
- Hypertext is the underlying concept defining the structure of the World Wide Web.
- The book is constructed as a hypertext living in the Web
 - top layer of text is a fugally structured sequential argument providing a guided tour through many disciplinary paradigms
 - direct links from the text to the Web mostly define and discuss the linked terms
 - hyperlinked notes in the document offer additional information, explanations, arguments and web links
 - text citations link to extensive bibliography where most references then link directly to the complete work being cited
- The result is knowledge built from and directly connected to knowledge and wisdom held in the World Wide Web

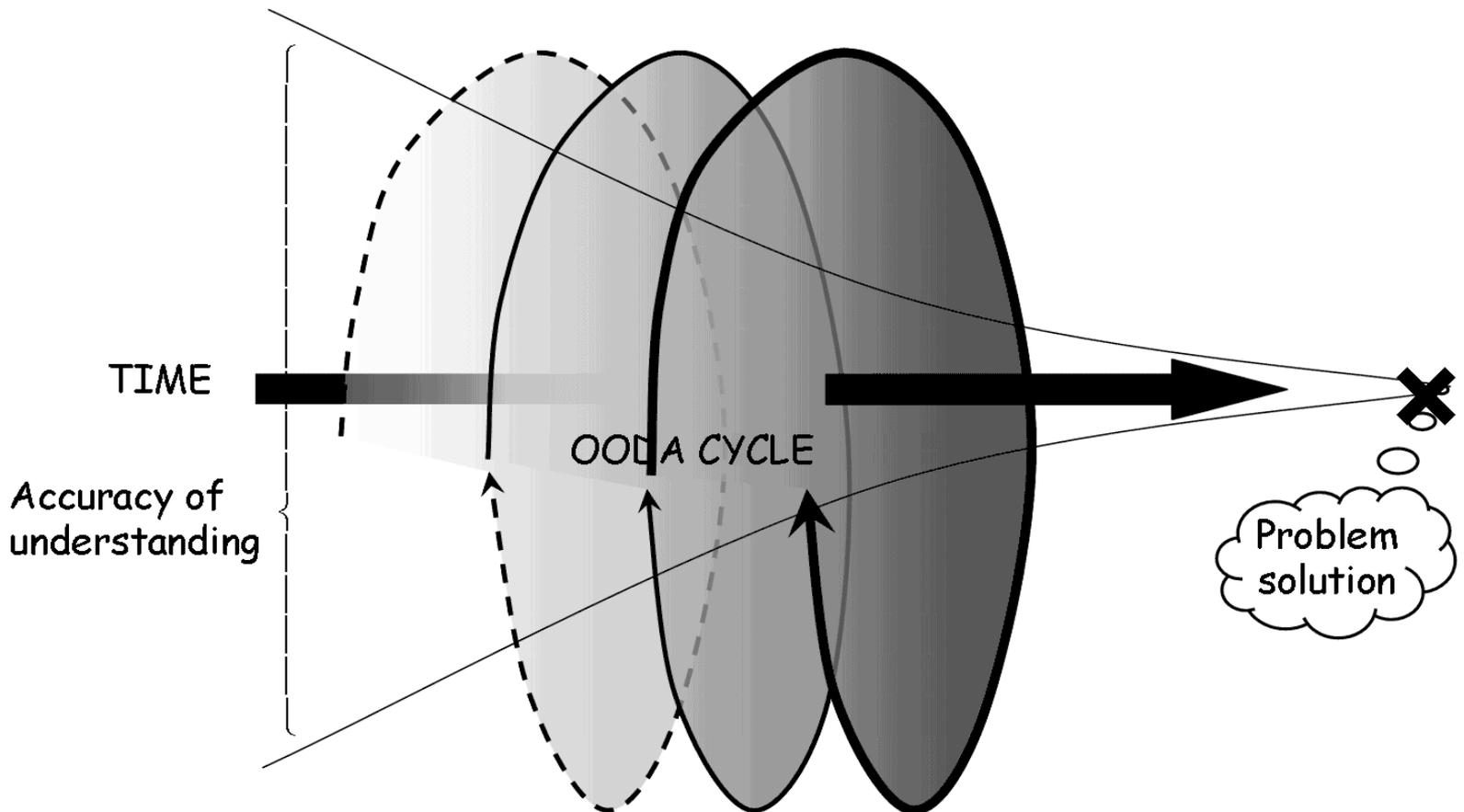
Hypertextually navigating the landscape of the web of knowledge

- Paradigms are **attractor basins** in the **topography of the global web of knowledge**
- Links to the web access knowledge objects that help us cross paradigm boundaries towards unification



The central thread of the fugue is semi-recursive forming a knowledge spiral

- The figure is explained in the topic on *autopoiesis* in the book [Contents: Interlude / What is life / Autopoiesis]

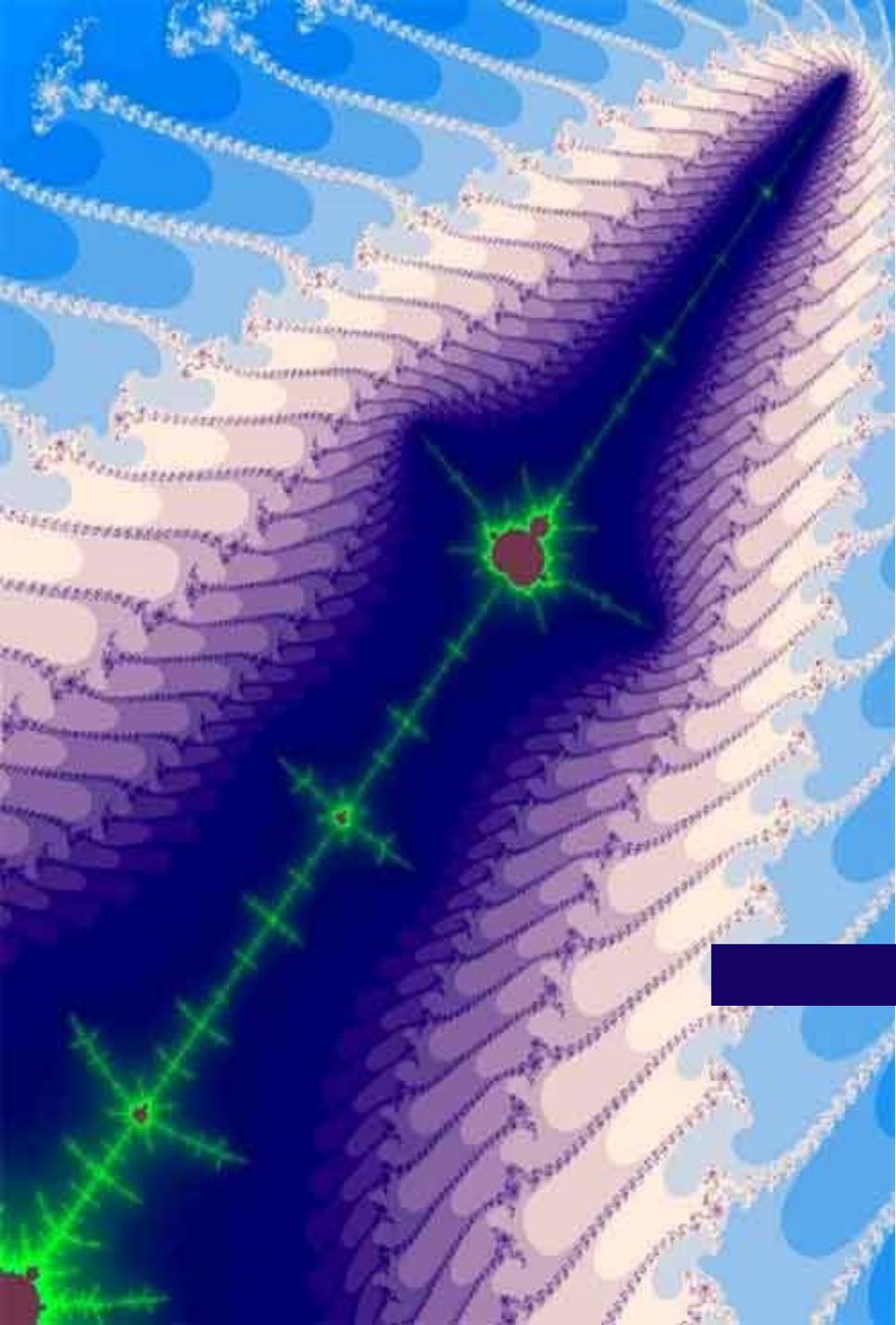


History of the writing

- Started serious work at Tenix Defence ~ Jan. 2001
 - stimulated by a holy war in the technical writing community over the use of conventional paper-based word processing applications versus the newer semantically structured authoring environments based on SGML and XML
- Working in industry I had no practical access to an academic library
 - A structure of Subject, Counter Subject and 4 Episodes established early
 - Concept was to link and distill freely available knowledge on the Web
 - Worked very well for first three Episodes
 - Took extended leave 2001-2002 for heavy-duty writing
 - First three episodes flowed easily
 - In Episode 4 I could not reconcile my understanding of Tenix with web-accessible literature on knowledge management or organization theory
 - I could not resolve this without access to academic thinking and research libraries
- Hon fellowships
 - Research to develop a unified theory of organizational knowledge
 - Monash 2002-2005 (1 day/week at Monash in 2003 on Tenix time)
 - UoM 2005- (helped establish TOMOK, Melbourne Emergence, KIPSA)
 - Retired Tenix mid 2007
 - Many publications as I explored the theory and practice of organizational knowledge
- By 2009 I understood the theory well enough to return to working on the book directly

Book organization

- Fugal development around knowledge growth (learning) cycles
 - **SUBJECT:** epistemology, learning cycles construct new knowledge, and revolutionary cycles of technology and knowledge growth
 - **COUNTER SUBJECT:** knowledge and its value
 - **EPISODE 1:** (historical) counting, writing, books, printing
 - **EPISODE 2:** (historical) automating cognitive processes
 - **EPISODE 3:** (historical) cognitive tools for individuals
 - **INTERLUDE (theory):** systems, theory of living knowledge, hierarchically complex autopoietic systems/organizations
 - **EPISODE 4:** (history and theory informed observation) social computing: moving posthumans into the cloud
 - **EPISODE 5:** (history and theory informed observation) individuals forming societies and socio-technical organizations
 - **CADENZA:** liberating knowledge, knowledge explosion and the "global brain", organizational knowledge management
 - **CODA:** is the singularity a spike or a point of inflection?



Outline of the Meetup Project



About the book and its central themes

- Today: Introducing a new way to explore the evolution of human knowledge and technology
- 19 February: Preface: Application Holy Wars theme and why the book was written
 - How evolutionary biology (PhD Harvard 1973) and 20 years managing knowledge led to this new kind of "book". I'll introduce some key ideas from my life history that resonate throughout the book.
- 3: Reading and writing a massive online hypertext
 - What is hypertext? How does it work to connect you with the world of knowledge about how people and technologies interacted to build the dynamically evolving world we live in.
- 4: Epistemology, technology and knowledge growth
 - The fugal Subject is knowledge, building on Karl Popper's evolutionary epistemology and Thomas Kuhn's scientific revolutions
- 5: Understanding the adaptive value of knowledge
 - The Counter Subject of the fugue explores the relationships of data, information, knowledge, wisdom and how these are transformed into strategic power over life's problems.

The rise and rise of tools extending human cognition

- 6: Episode 1 - Early technologies for making living memory explicit
 - Emergence of technologies for transcribing ephemeral thought onto semi-permanent physical objects and some human impacts of these technologies.
 - Ephemeral and fallible living memory versus changing the physical world
 - Counting things to participate in society and commerce
 - Tokens, words, alphabets, writing and emergence of clerical/scribal society
 - Paper, printing, and typesetting revolutions make clerical knowledge public
 - Accumulating explicit knowledge: books, journals, libraries and catalogs
- 7: Episode 2(1) - Mechanical automation and calculating
 - How mechanical computation and automation in the ancient *Greek* world contributed to the rise of mechanical computation in the first half of the 20th Century.
 - Extending human capabilities with automation and automated replication
 - *Greek* automation contributed to 18th Century androids and automatons and escapements, clocks, and mechanical digital computation through the mid 20th Century
- 8: Episode 2(2) - Electronic automation & computation
 - Adding electrons to the automation equation in the 1940's fueled the hyper-exponential evolution of technology that during my lifetime has radically changed and today and tomorrow continues to change the nature of humans and humanity.

Cognitive tools for the individual

- 9: Episode 3(1) - Cognitive tools help people share what they know
 - Personal computers give individuals cognitive tools to convert thoughts into explicit electronically realized objects that can be independently stored, copied, communicated, retrieved, shared and even processed semantically.
- 10: Episode 3(2) - Automation to store, manage & retrieve knowledge
 - Preserving knowledge electronically extends cognition beyond individuals to social systems. Information science covers the dissemination, indexing, management and retrieval of scholarly, scientific and technical knowledge.
- 11: Episode 3(3) - Birth and explosion of the World Wide Web
 - A universally accessible library for the body of human knowledge emerged from what started as a defense project to harden digital communications against nuclear warfare.
- 12: Episode 3(4) - Emerging cognition in the Web itself
 - As knowledge in the Web grows exponentially and processing tools become more sophisticated the web is developing its own kinds of cognitive capacities to help manage and retrieve relevant content.

Theoretical Interlude - unifying knowledge and life

- 13: Interlude (1) - Autopoiesis & physics of life, cognition, & knowledge
 - Unifying theories of life and knowledge helps to understand what follows
 - Life is self-regulating & self-producing thermodynamic dissipation driven by the transport of energy
 - Knowledge and life are inseparable
 - Importance of and mechanisms for sharing knowledge in evolution
 - Physical differences and relationships between living and explicit knowledge
 - Culture and the sharing of knowledge at higher levels of organization
- 14: Interlude (2) - Life and knowledge at higher levels of organization
 - Unifying of knowledge and life explains the emergence of living systems at levels of organization above living cells. Multicellular living systems arose from "social" interactions of cells. Social interactions of multicellular organisms like people eventually led to the emergence of knowledge-based social entities.
- 15: Episode 4 - 21st Century global brains and humano-technical cyborgs
 - Increasingly frequent technological revolutions are fundamentally changing our biological nature and what it means to be human.

Human origins and history - the "facts"

- 16: Episode 5(1) - Human evolution, social cognition & socio-technical organization
 - The last, largest and most complex episode in my fugue explores the biology of our emergence and evolution from tool-using apes to evolve the cultural capacity to share hyper-exponentially growing knowledge about tools and the world and explains how modern humans came to be and how cultural transmission of knowledge among groups led to the emergence of modern social and economic organizations.
- 17: Episode 5(2) - Primate genomics, our African genesis & family tree
 - Paleontology, paleoarcheology and detailed genomic evidence provide an increasingly detailed understanding of our ancestry and genealogy.
- 18: Episode 5(3) - Where and how we started our path to now
 - Our ancestors were the unfortunate apes who were stranded on the African savanna when climate change destroyed the primeval forests of their Garden of Eden like our monkey cousins have been more recently. This session reviews some of the comparative evidence showing how tool-using apes (and monkeys) can adapt with technological solutions when climatic change turns their forests into dry thorn forests and savannas and forces them to work for their livings.

How and why did it happen this way? an evolutionary hypothesis

- 19: Episode 5(4) - Apes become human with fire and language
 - Mastering fire greatly expanded the ecological niche occupied by the carnivorous apes that became us. Proto-humans had to remember and share more and more complex knowledge. Culture and language were needed to transmit details of complex technologies required for making things like effective hunting bows and arrows with hafted heads.
- 20: Episode 5(5) - Mnemonics & the rise of social complexity
 - The rise of agricultural and industrial economies required revolutions in the social capacity to accumulate, manage & transmit "working" knowledge. Many thousands of years before writing, cultural systems using mnemonic technologies enabled societies to store, manage, and accurately propagate the orders of magnitude more knowledge than required to support hunting and gathering.
- 21: Episode 5(6) - Rise of socio-technical organizations & cyborgs
 - Some key technologies impacted by Moore's law supporting modern organizations are considered, raising questions: What does it mean to be human? Are we still human or are we becoming something quite different even within our own lifetimes? At the same time we are becoming ever more interconnected in ways that are happening faster see and understand.

Summing up

- 22: Cadenza - knowledge in the life & death of a large engineering co.
 - *A cadenza is a virtuosic section for the performer, usually near the end of the composition reflecting and elaborating on some key themes of the overall composition. Here I reflect on observations of the management of knowledge I made during my active involvement over 17½ years in Tenix Defence with the successful & profitable completion of 10 ANZAC Frigates that was immediately followed immediately by the company's death because it forgot how to effectively complete a much simpler and smaller project.*
- 23: Coda - The sting in the tail
 - *A coda is a generally short and more or less independent passage added to the end of a composition so as to reinforce the sense of conclusion. Here I consider the question raised in the title of this Meetup series - what does the understanding of the roles of cognitive technologies developed in this book tell us about the future of humanity? I see three possible scenarios, only one of which is moderately benign. Which of these will come to pass depends critically on how successful we are at understanding who we are and applying the tremendous body of knowledge we have assembled over our history to bring Moore's Law under control.*

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