

Intelligence is an Algorithm for Understanding The Human Brain, Not so Much

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Subtheme: Words matter unless they don't Words have meaning unless entropic (decoherent)

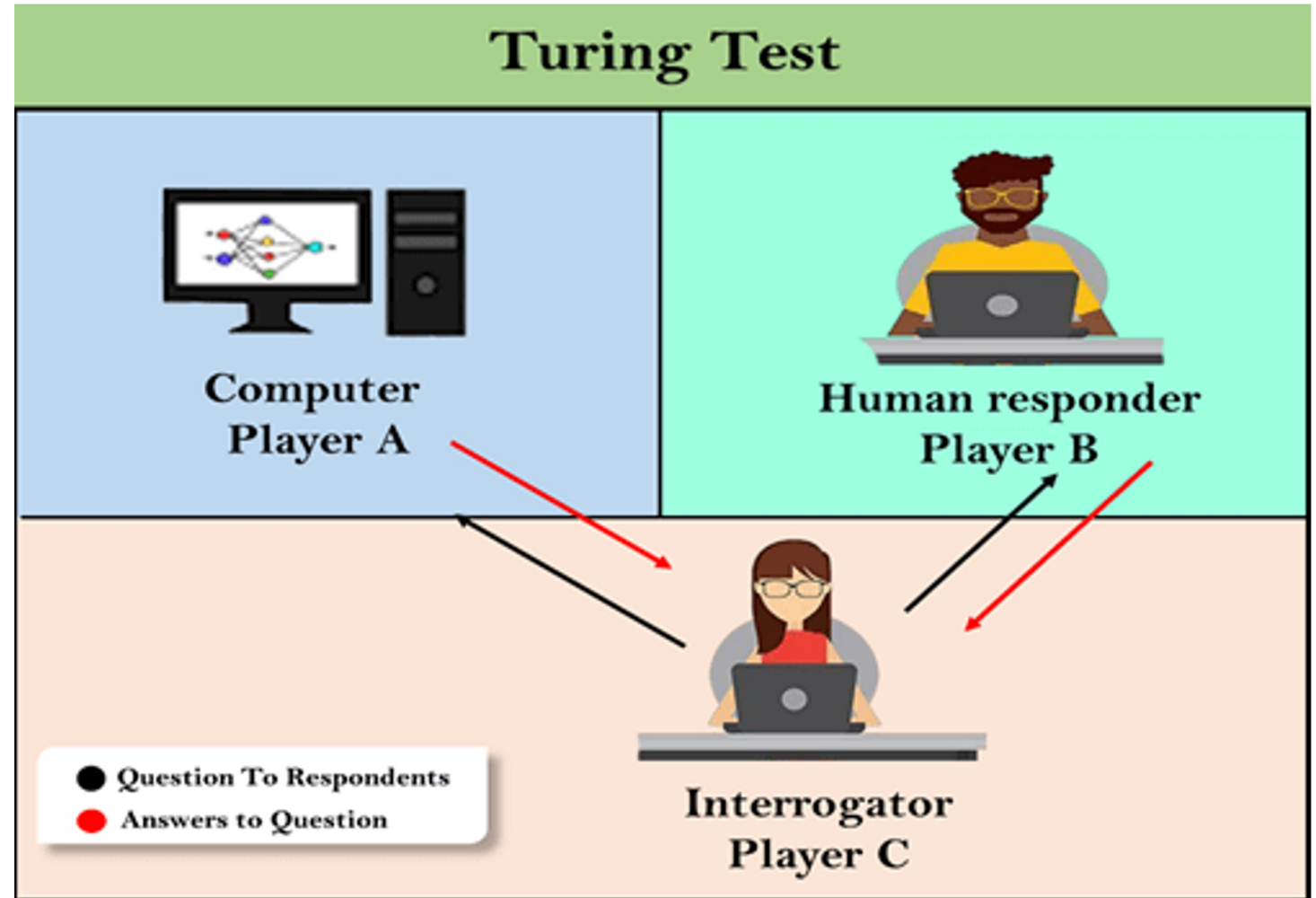
- Intelligence
- Learning
- Data
- Machine
- Information
- Supervised
- Unsupervised
- Neuromorphic
- Answer
- Declarative
- Axiom
- Neural Net
- Training
- Wisdom
- Artificial
- Empirical
- Analytics
- Brain
- Knowledge
- Thinking
- Imperative
- Graph
- Consciousness
- Decision
- Memory
- Semantic
- Understanding
- Context

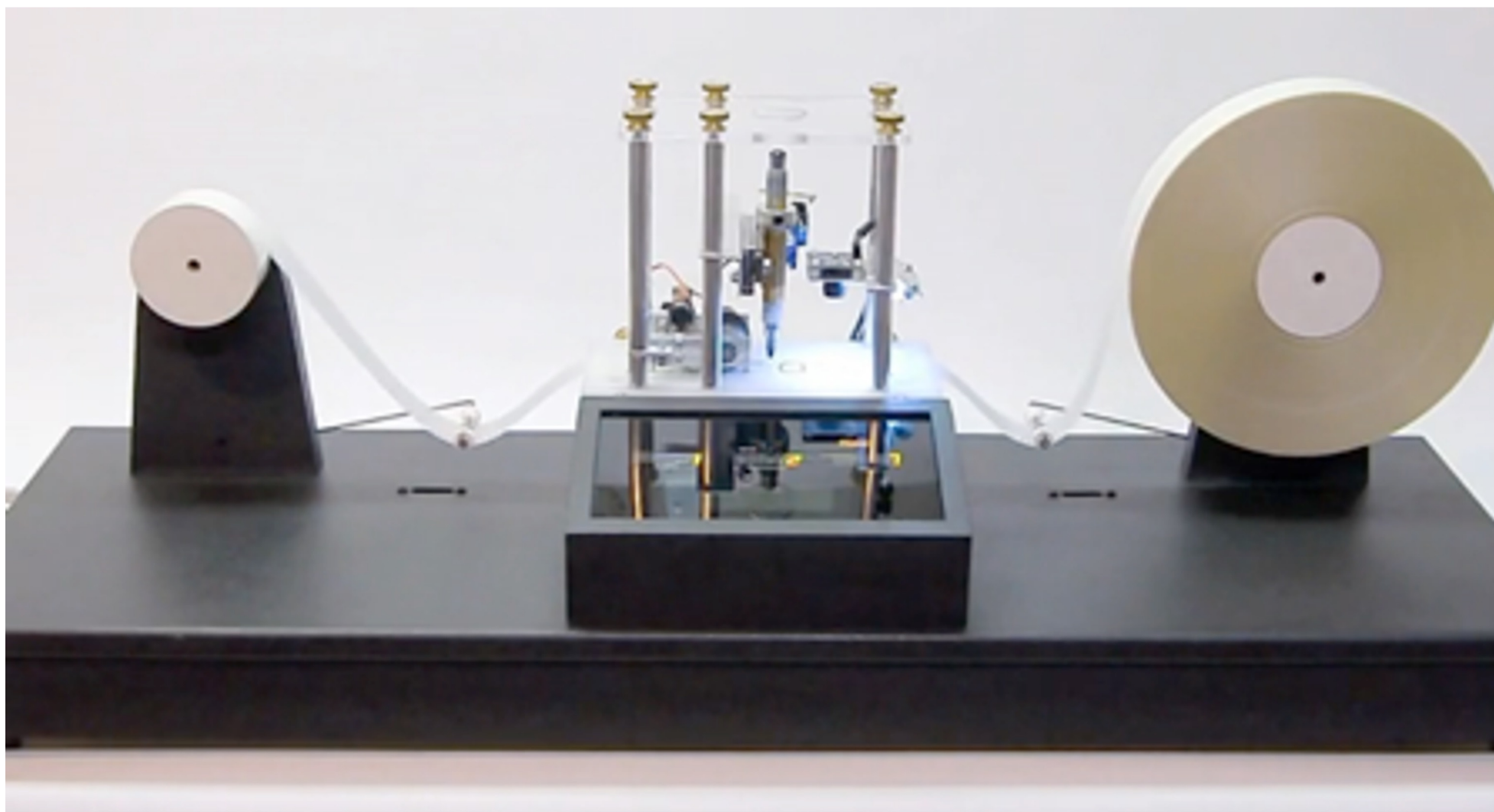
Words can serve as a bridge to new concepts or a barrier; they can focus or obscure

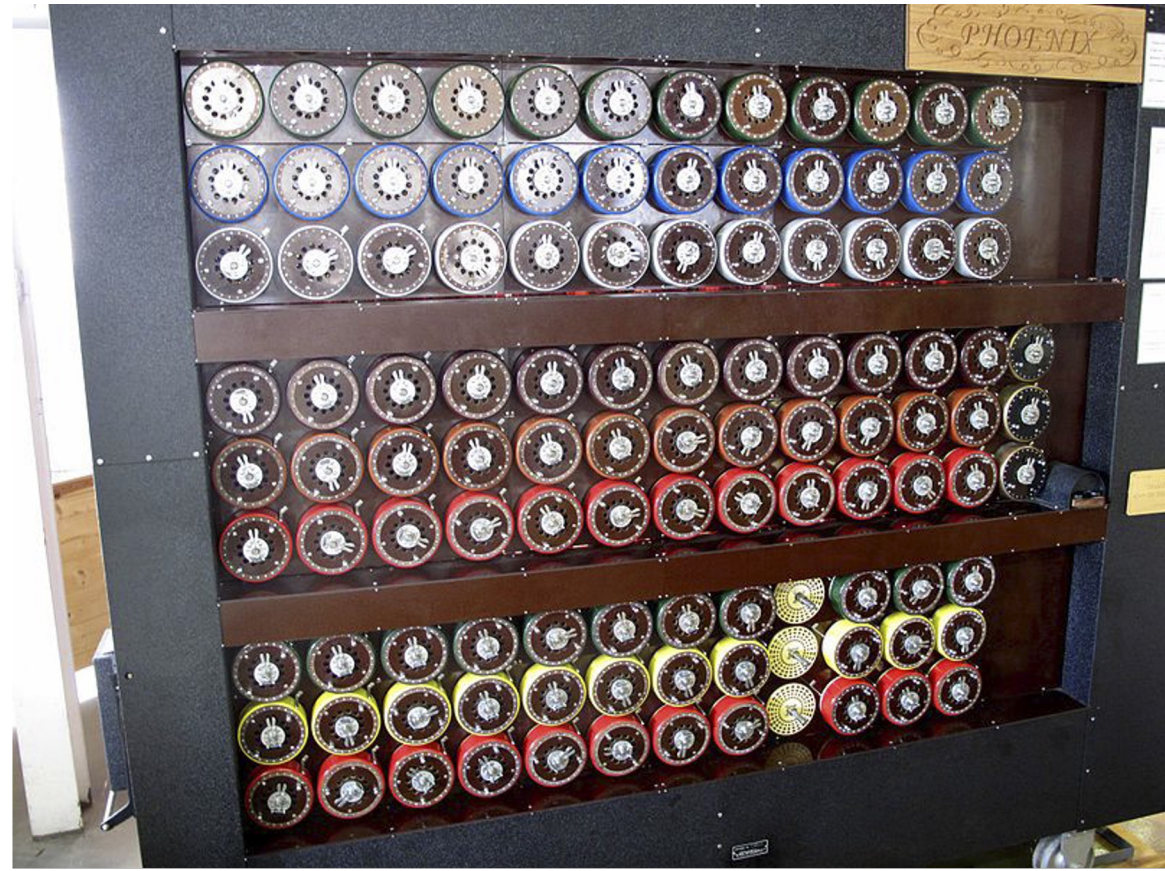
1st Data Analytic System

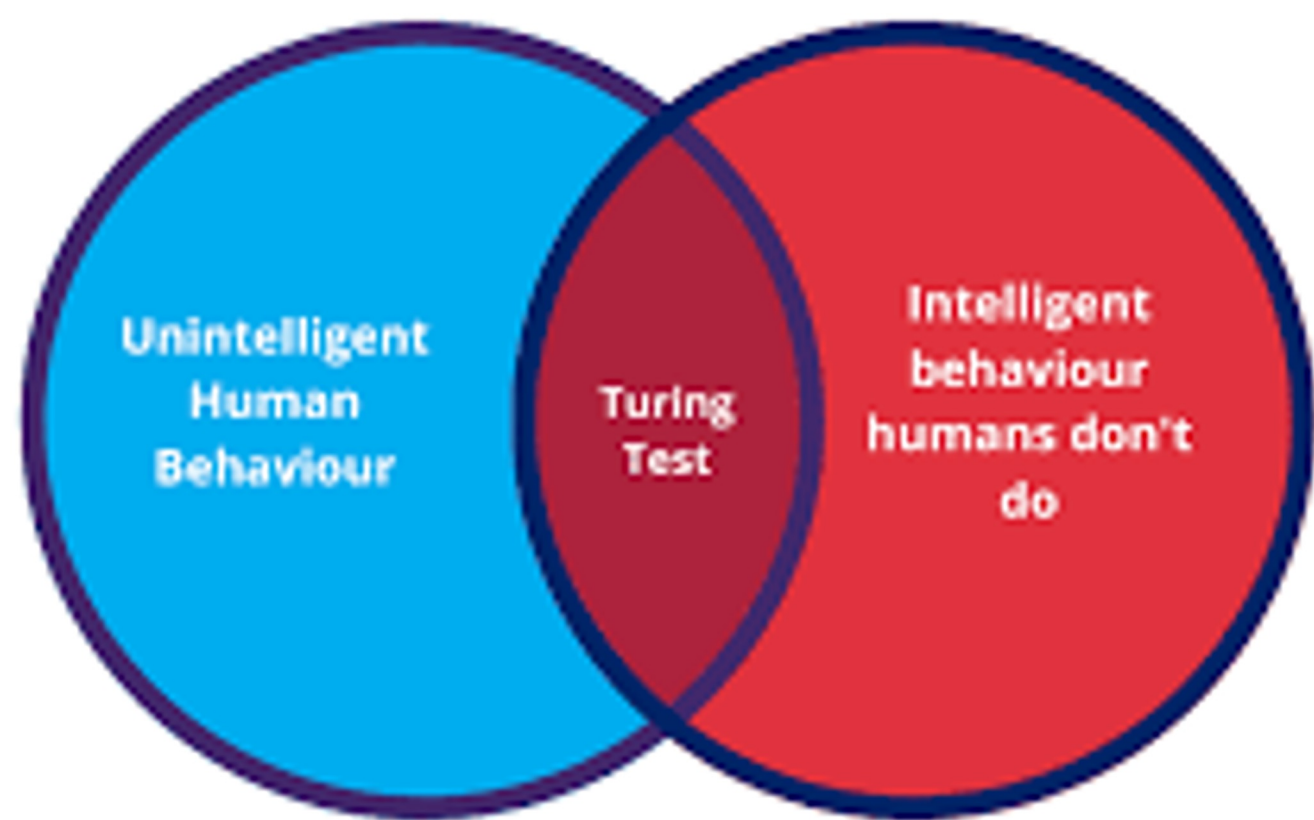


Turing Test

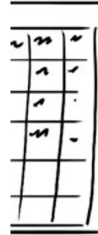






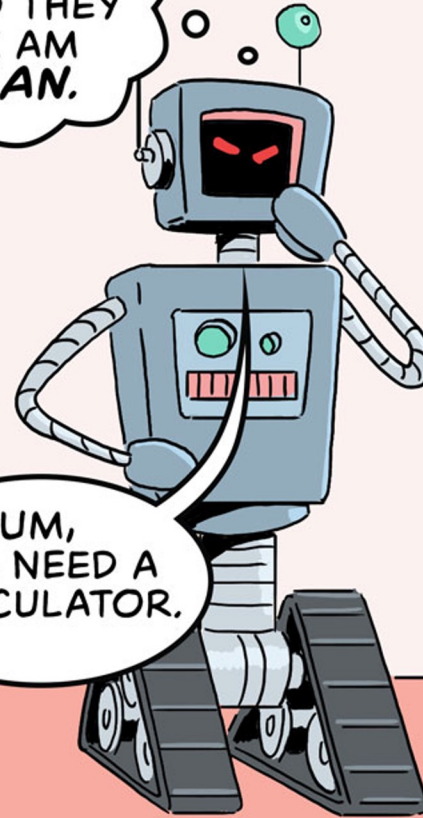


TURING TEST
PRODUCT PLUG #83
FEBRUARY 21, 2022



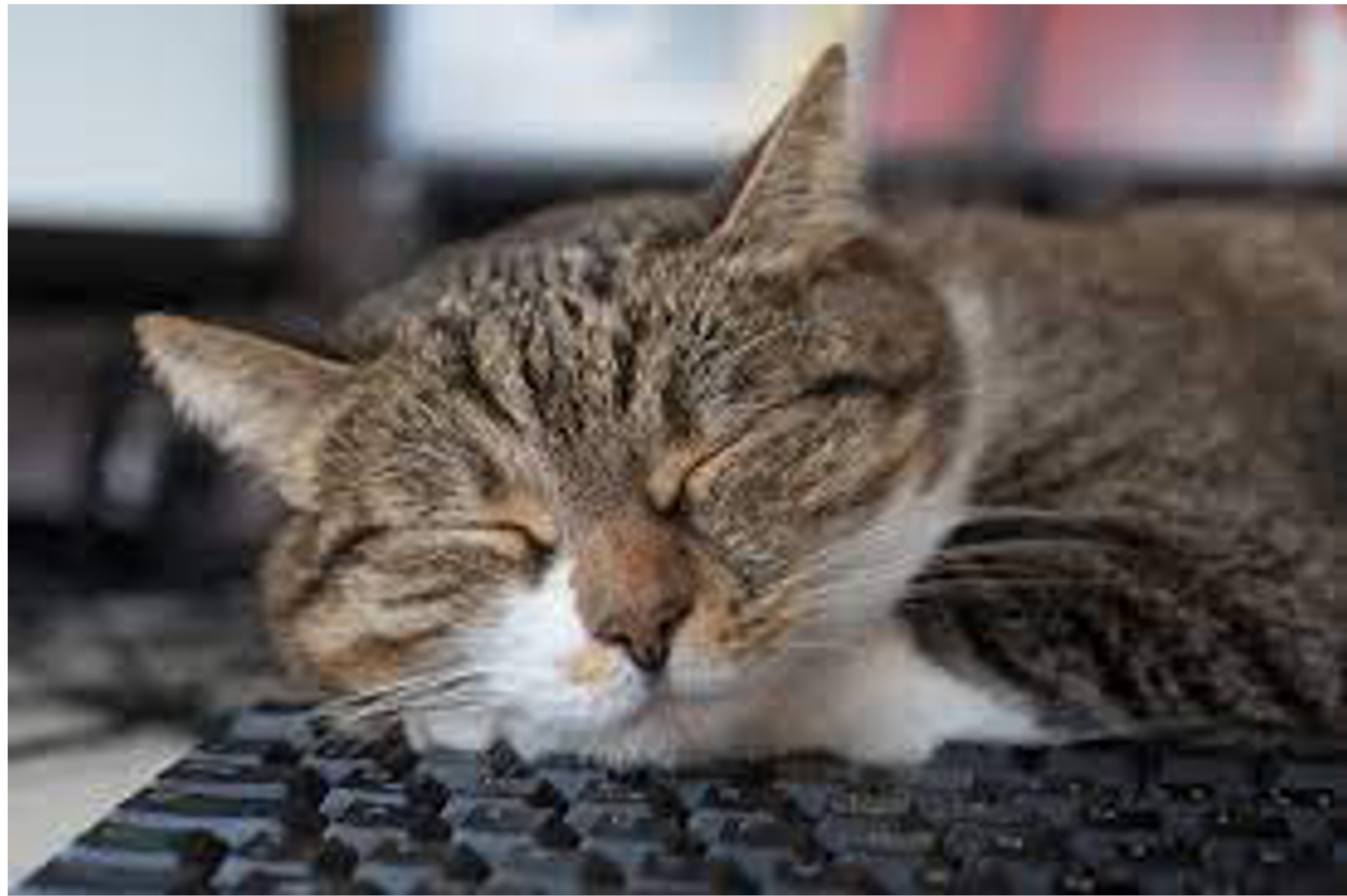
287,289
BUT I'VE
GOT TO DUMB IT
DOWN SO THEY
THINK I AM
A **HUMAN**.

UM,
I'LL NEED A
CALCULATOR.









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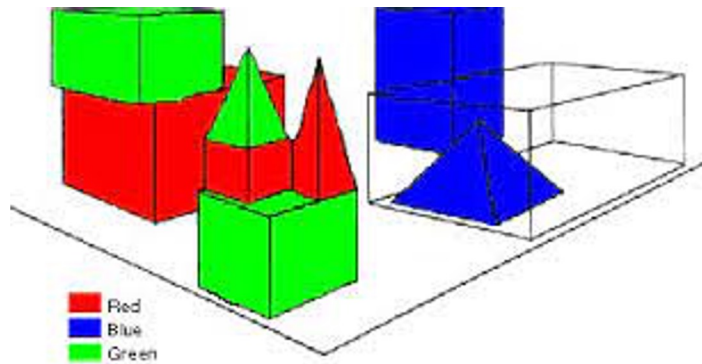
=====
      EEEEEEE L      IIIIII 2222222  AAA
      E      L      I      Z      A  A
      E      L      I      Z      A  A
      EEEEE  L      I      Z      A  A
      E      L      I      Z      AAAAA
      E      L      I      Z      A  A
      EEEEEEE LLLLLLL IIIIII 222222  A  A
=====
ELIZA > (PLEASE TYPE IN ALL CAPS) WHAT'S YOUR NAME DEAR ?
AMIT
ELIZA > HI. I'M ELIZA. WHAT DO YOU WANT TO TALK ABOUT ?
AMIT > CAN I TALK ABOUT MY PROBLEM ?
ELIZA > SURE... !
AMIT > DUE TO ON GOING EXAMS IN COLLEGE, I HAVE A LOT OF STRESS.
ELIZA > PLEASE RELAX A LITTLE. SLEEP WELL.
AMIT > THANKS FOR YOUR ADVICE.
ELIZA > NO MENTION.
AMIT > BYE
ELIZA > BYE AND KEEP IN TOUCH...
=====

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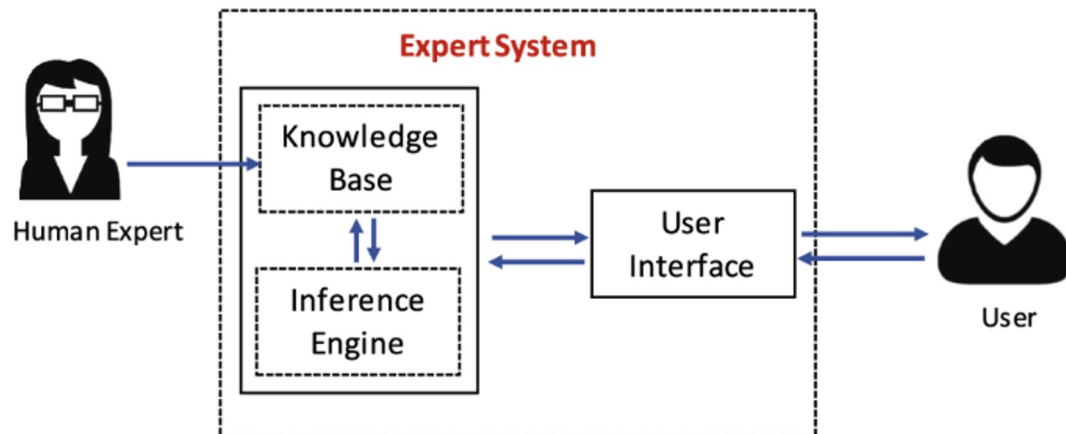
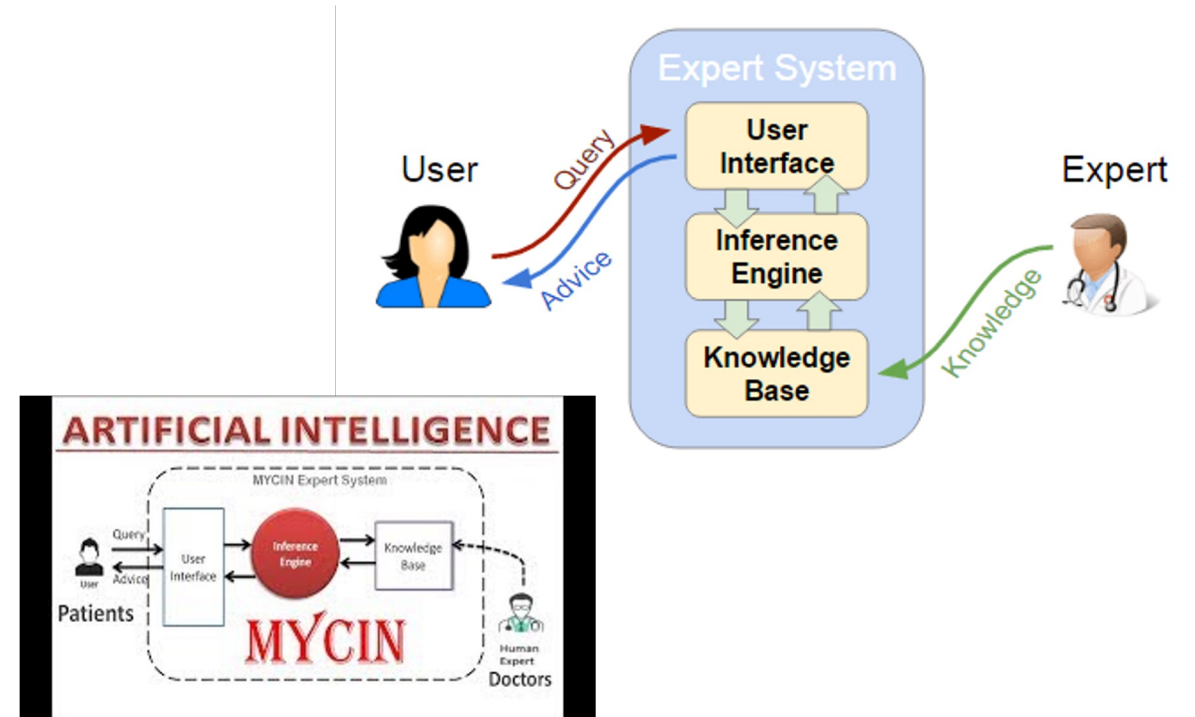
LISP – the Language of the Gods (and AI)

- List Processing
- Syntax-less syntax
- Functional but side-effects too
- Very Slow, but improved
 - Interpreted
 - Compiled ultimately
 - Automated garbage collection
- Benefitted from tagged architecture
- Lisp was not AI !!
 - But lots of AI research done in Lisp
 - SHRDLU (Winograd's Blocks World)



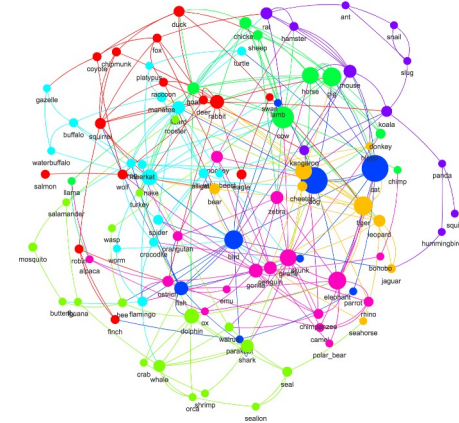
Expert Systems: A Cautionary Lesson from Past AI

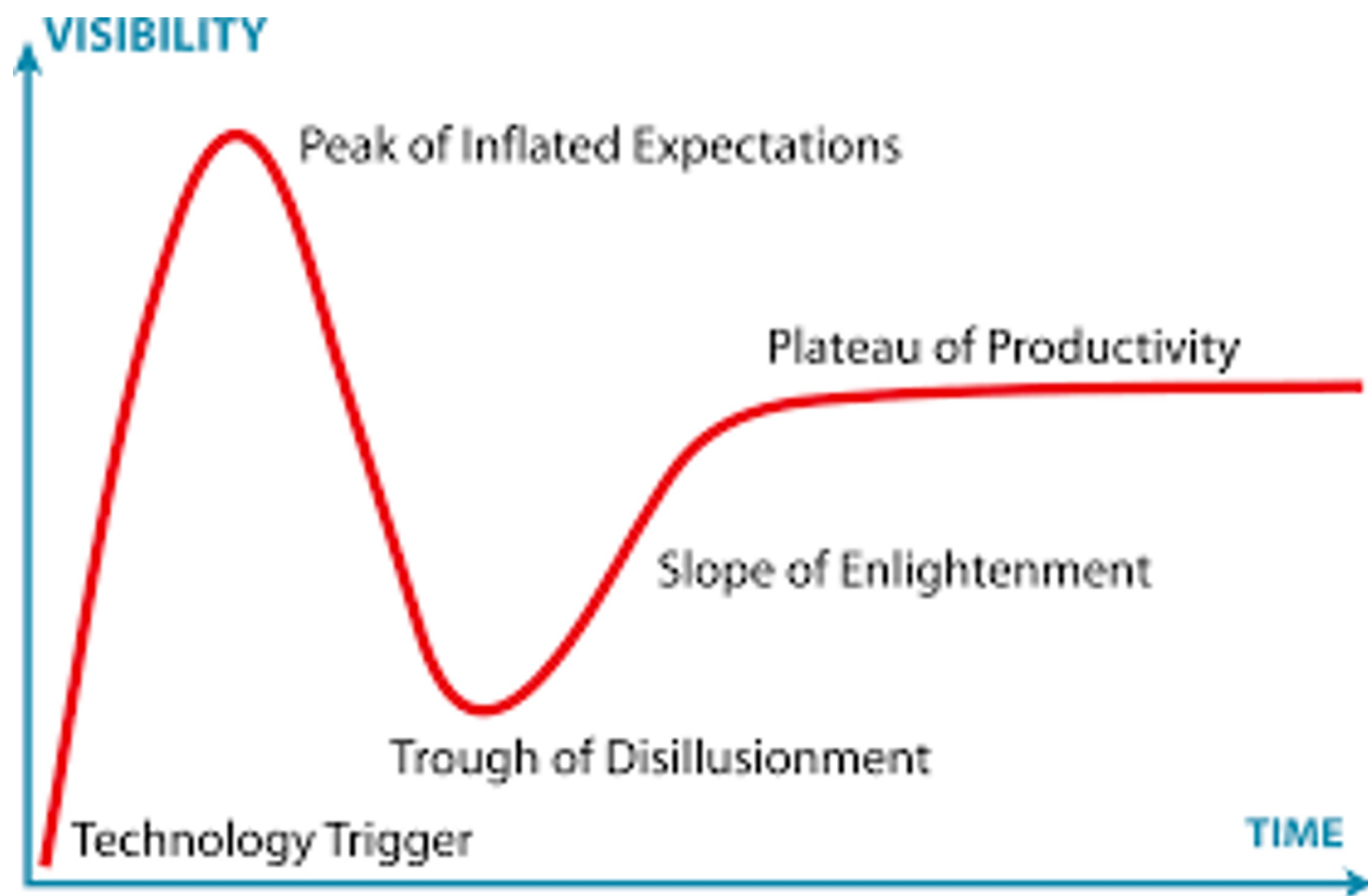
- Production systems, big in the 1980s
- Rule-based programming
 - “First truly successful form of AI”
- Useful tools for automated planning and decision making under restricted cases
- Essentially If-then-else all the way down
- Knowledge engineering



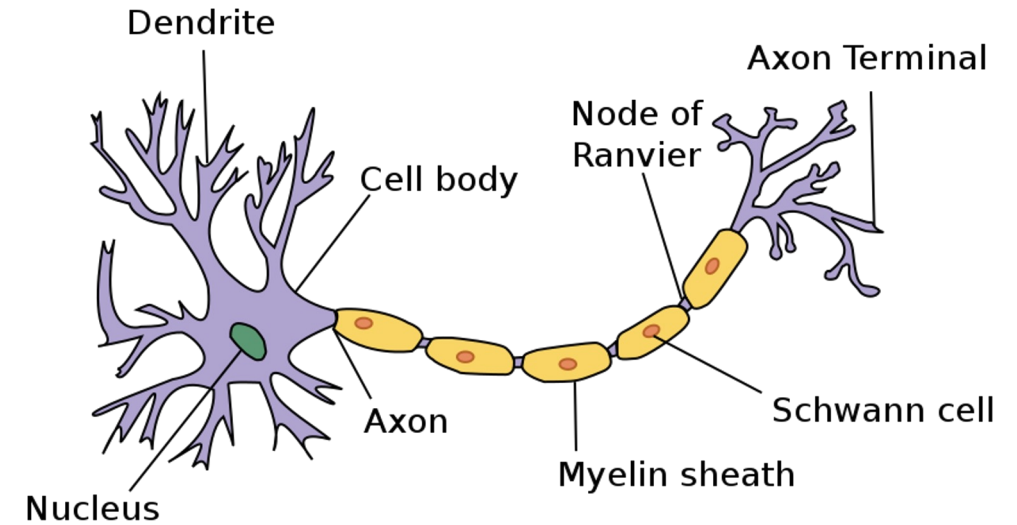
Thinking Machines Inc. – Connection Machine

- CM-2
- Mid 1980s
- Semantic Nets for “knowledge”
- SIMD, 64K Hyper-cube, 10 MHz
- Symbolics LISP Machine front-end
- Danny Hillis Ph.D project
 - Gerry Sussman & Marvin Minsky
 - Time Magazine: “wunderkind”
- For the BIG AI market
 - There wasn’t one
- You gotta love the lites

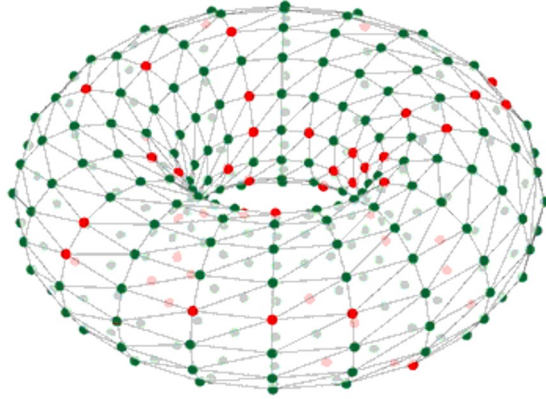




Level-Setting – No, Intelligence is not defined here



Neuromorphic Computing – Spinnaker vs. Brain



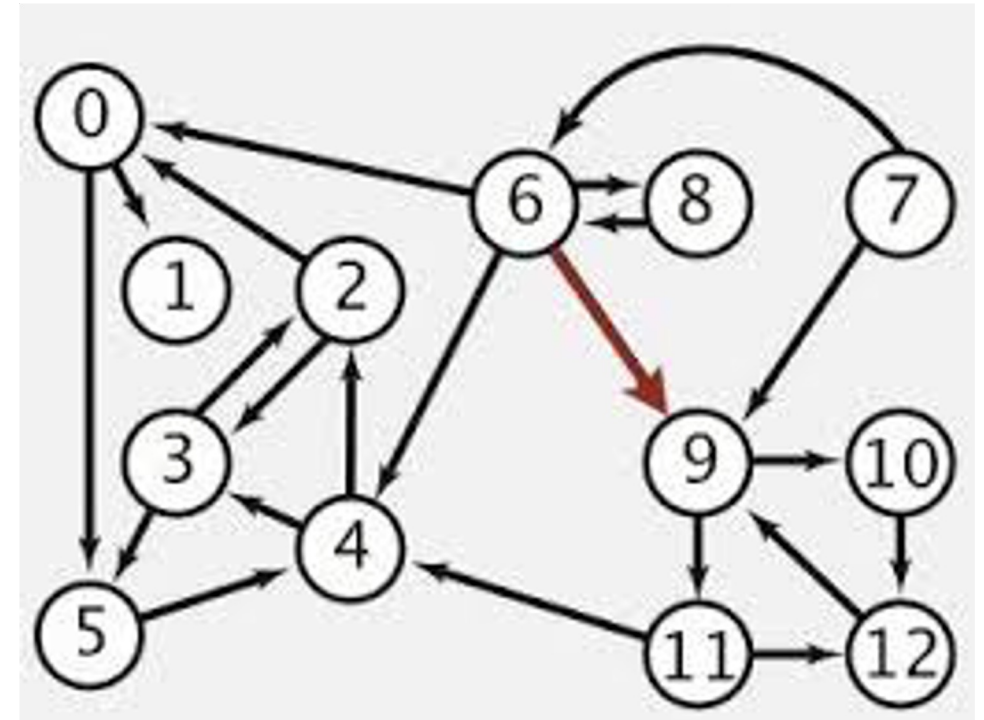
Graphs play Expanding Roles beyond just Data

- Represents Data Flow Execution

- Static and Dynamic Dataflow
- Systolic Arrays
- Neuromorphic structures
- Traces

- Search Structures

- Scheduling
- Planning
- Optimization
- Decision Making
- NP hard computations
- Heuristic-based Relaxation Tree
 - Memory is a constraint resource for partial state space representation
 - Vertices represent alternative choices with iterative Bayesian confidence factors



A Framework for Description of “Intelligence”

- **ML/DL** has successfully automated model building and application to some empirical domains proving practical for data analytics
 - ML does not encompass **AI**; rather the other way around
 - Unsupervised ML extracts coincidental correlation, not causality
- **Data** without context is also without meaning but only an index into a set (group) of distinct enumerated alternatives
- **Information** (codified by Shannon) can elevate data with relationships and contexts
- **Knowledge** preserves meaning via association with axiomatic concepts
- **Understanding** is achieved through associations of knowledge to the primal context
- **Intelligence** is knowledge capacity and understanding capability to derive, refine, clarify, and validate new posited knowledge as well as apply it to context and objectives
- **Thinking**/thought is the mechanism and process of understanding to problem solve, pattern matching in time and space, select down, predict, plan, acquire new information, and assert reaction.
- **Machine Intelligence** is a construction for thinking, in real-time, and interactively
- **CRIS** – abstract high-level Machine Intelligence logical architecture with self-awareness

Advanced Graphic Intelligence Logical (computing) Environment

- **a.k.a:** AGILE research and development program
- **WHO:** “U.S. Army Research Office (ARO) in partnership with IARPA ...” BAA
- **WHAT:** “... seeks research and development of innovative, energy-efficient, reliable computer architectures ...”
- **WHY:** “... to implement large-scale data-analytic applications, as well as other classes of large problems ... to solve challenges ...”
- **GOAL:** “... create novel computer architectures and designs ...”, “... that allow for scalable and efficient execution of dynamic graph analytic workflows.”
- **WHEN:** date of proposal submission = January 24, 2022 (its closed) for 2-phase projects of 18 or + 18 (more) months.
- **Start date:** October 1, 2022
- **W911NF-22-S-0001-01**

AGILE Technical Challenges and Research

Key Technical Challenges

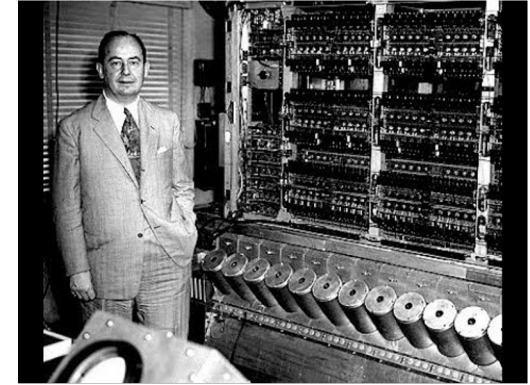
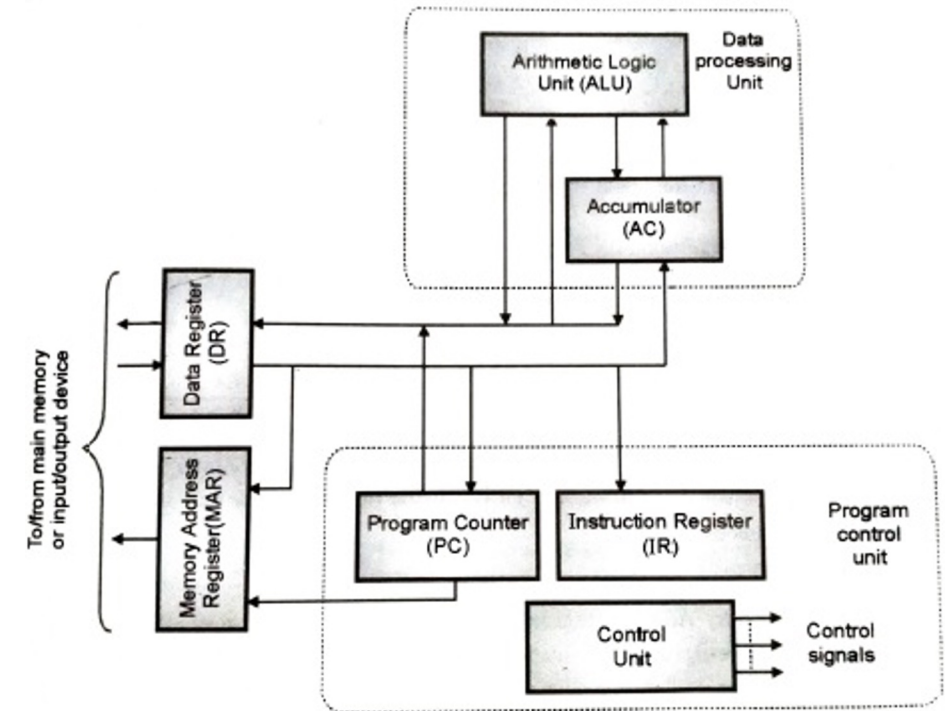
- Processing elements designed to execute efficiently a broad spectrum of data-driven methods
- Fine-Grain, irregular data movement
- Parallelism from fine to course
- Memory/storage architectures for dynamic irregular data structures
- High-velocity data stream I/O
- System security, data integrity, multiple apps working on single data
- Runtime system conceptual control

Possible Areas of Research

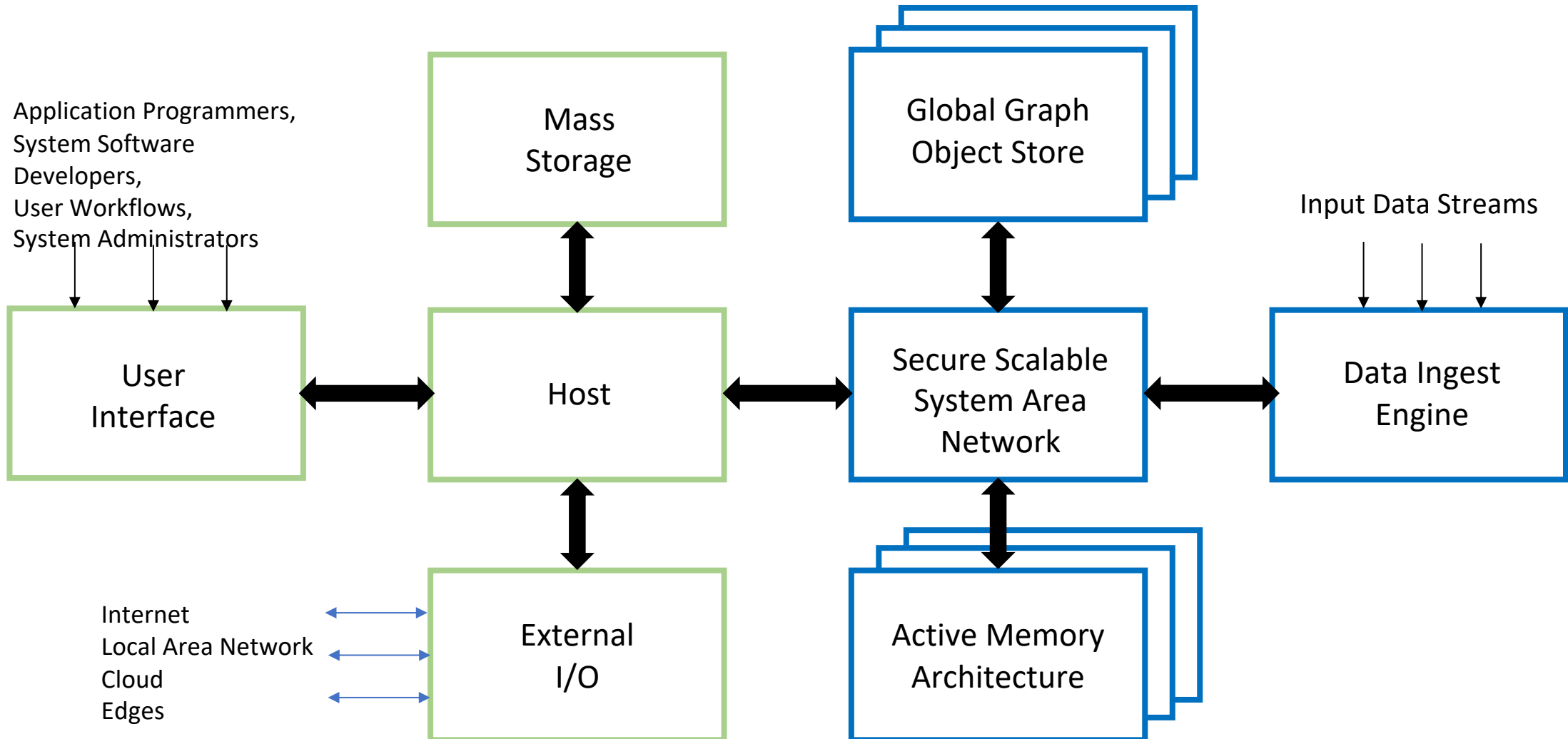
- Tightly integrated designs
- Data-driven compute elements
- Distributed memory management
- Distributed security
- System-level intelligent mechanisms
- Global name-space and translation
- Global adaptive data transfer
- Dynamic adaptive runtime systems
- Parallelism intrinsic to varying graphs

Von Neumann Architecture Barriers inform AMA Invention

- Optimization of ALU/FPU utilization
 - Presumes that FPU is most valuable resource
 - Wastes > 10X die area
- Separation of compute logic and memory
 - Referred to as “von Neumann bottleneck”
 - Consequence of early disparate enabling technologies
 - Cause of bad latency, bandwidth, power
- Sequential instruction issue
 - Constrains natural parallelism
 - Conventional ILP ultimately failed
- Sequential consistency memory model
 - Narrows ordering of global mutable side-effects
 - Imposes cache coherence mechanisms
- Forces core-centric parallel system design and operation
 - Rather than data-centric parallel hardware support

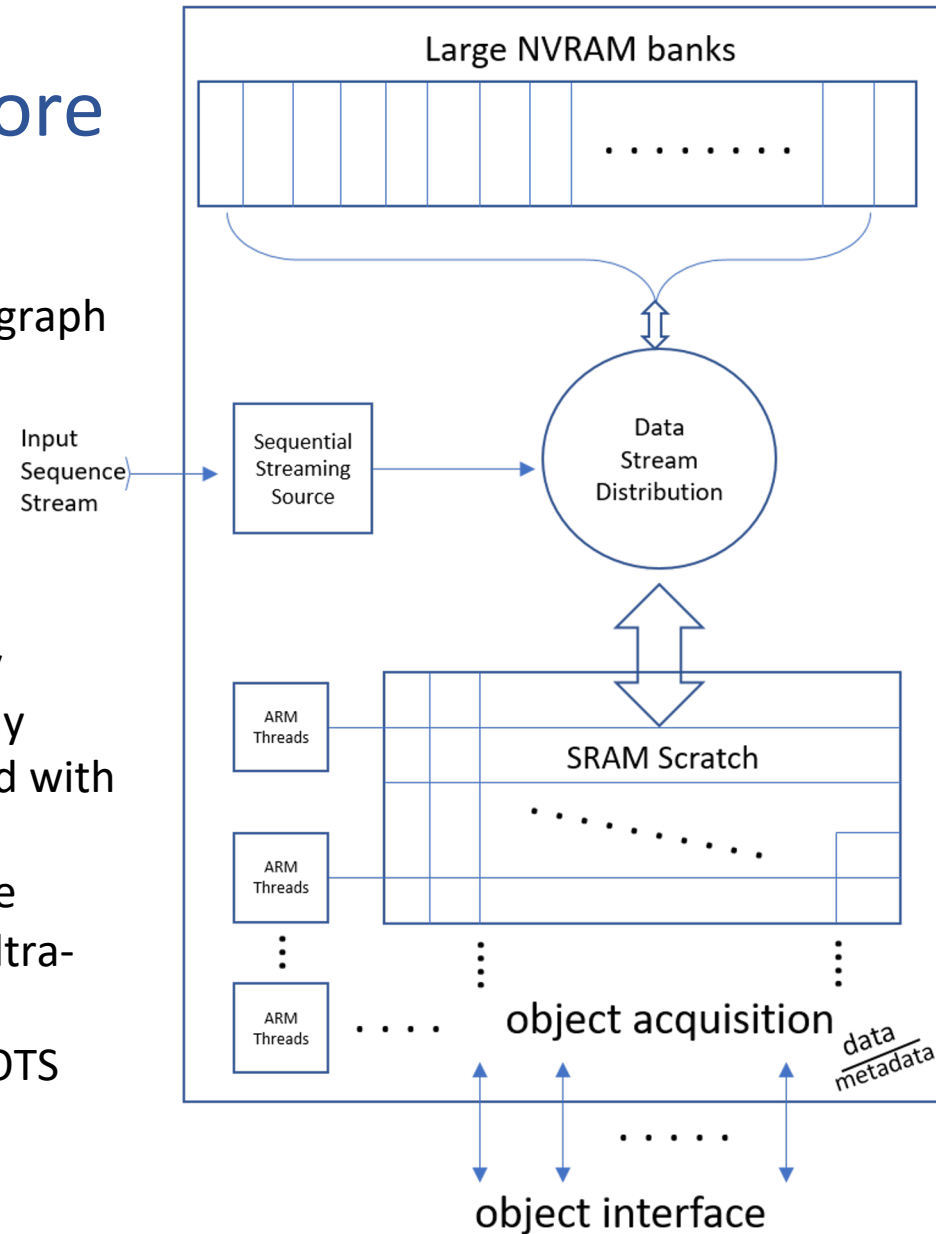


High-Level Block Diagram: AGILE Pilot-CRIS Hardware System Architecture



Global Graph Object Store

- “Data Vertices”
- Mass storage of knowledge graph structures multiple modules
- Vertices/Edges stored by hierarchical global names
- Converts data streams to knowledge graph structures
- Maintains name consistency across modules and cell array
- Transactional multi-threaded with separate ARM cores
- Coherent with parallel Active Memory Architectures for ultra-high performance
- Fully implementable with COTS



non von Neumann Active Memory Architecture

- Eliminate sequential cores
 - Unessential patches
 - Eliminate sequential flow control
 - Tessellation of very small cells 100X
- Innovative Execution Model & Runtime
 - ParallelX, new HPX* runtime, and dynamic graph instruction set and containment
- Adopt Message-driven computing
 - Avoid global barriers
 - Manage asynchronous operation
 - Expose communication parallelism
- Global name space for direct access
 - Revolutionary HW translation mechanisms
- Dynamic Graph compound atomic ops
 - Local to vertex for distributed control
 - Global across total structures to preserve determinism

e.g., tessellation
structure of AMA
module for Pilot-CRIS

