

FUTURE SCIENCE: EMERGING ROLES OF A-I IN DISCOVERY

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The Council of Scientific Society Presidents

- **5th decade of serving interests in common and finding synergy among 150 disciplinary associations**
- **Nexus of over 1 million active scientists**
- **Every meeting mentors becoming effective change leaders, improving science education, collaborating on variety of emerging issues, candid discussions with top national leaders.**
- **Located in Washington, DC - 3 blocks from White House**
- **Look long term– thinking now about year 2040+**

Human Learning (NAS)

- **Across a wide age spectrum, shift in emphasis from how to teach science, to understanding what science is, and how people learn-and learn science- across wide spectrum of age from infancy to collegiate levels.**
- **More than one right way to learn among variety of learners. Challenge is important in learning science.**
- **Human brains benefit from different types of learning experiences at different windows of opportunity at early and later stages of development.**
- **Teachers' depth of understanding of a domain is crucially important to helping a learner to extend a new learning to another situation; as is understanding of effective teaching situations that facilitate student framing of questions.**

QUICK PEEK AT YEAR 2040

- **Climate change will reshape populations → 1st climate refugees.**
- **As linear projections into the future fail, scenarios are needed:**
- **What will be the future of work? Who will do it and how, where?**
- **What will the future computer be? How universal will it be? Future role of quantum computing?**
- **Greatest demographic of recent decades is rush of rural people into urban living ---will there be need for big cities? Skyscrapers?**
- **A-I is replacing all routine human work now— will role of worker become to use creativity and judgment and be moral guide of A-I?**
- **Will Internet, WWW and IoT systems be secure enough to continue to capture public trust, or will they become abandoned?**

VISIONARY SCENARIO- SCIENTIST'S LAB

- **EXCELLENCE IN SCIENCE IS MAKING A DISCOVERY ABOUT THE NATURAL WORLD THAT FOREVER CHANGES HOW THE WORLD SEES ITSELF, AND THAT DOMAIN.**
- **Dr EVELYN (“Eve”) IS ONE OF THOSE WHO ACHIEVED EXCELLENCE IN SCIENCE. Eve NOW WORKS AT THE FRONTIERS OF KNOWLEDGE OF A NEW UN-NAMED SCIENCE FRONTIER THAT Eve PERCEIVES MAY EXIST.**
- **Eve HAS MENTORED MANY GRAD STUDENTS AND POST-DOCS TO SUCCESSFULLY OPEN NEW FRONTIERS.**
- **Eve FOLLOWS THE 1890’s METHOD OF MULTIPLE DENIABLE WORKING HYPOTHESES TO PURSUE VERIFIABLE EXPLANATIONS OF NATURAL PHENOMENA.**
- **Eve ALSO DESIRES TO RUN IN PARALLEL A NEW EXPERIMENT THAT WILL TAKE MANY YEARS... THE TRAINING/EDUCATION OF A SCIENTIFICALLY SOPHISTICATED *DIGITAL COGNITIVE ASSISTANT (“DCA”)***

Eve's NEW COGNITIVE ASSIATANT

- Eve PROPOSES THAT THS “DCA” GO THROUGH ALL THE STAGES OF LEARNING OF A PRE-SCHOOL CHILD, AN ELEMENTARY, MIDDLE AND HIGH SCHOOL STUDENT, COLLEGE AND GRAD STUDENT. THE LATTER WILL NEED TO CREATE THE HYPOTHESES AND PERFORM TASKS TO MAKE ITS OWN CCC-CREDIBLE WORTHY DISCOVERY.**
- Eve WILL BE ASSISTED TO BUILD AND ENDOW THE “DCA” WITH AN EXPERT SYSTEM BASED ON HOW/ WHAT Eve THINKS THAT BROUGHT ABOUT Eve's OWN SUCCESS. THE “DCA” WILL LEARN BY BEING ENGAGED EVERY DAY IN Eve's NEW PURSUIT OF THAT UN-NAMED FRONTIER OF SCIENCE.**
- THE “DCA” OPERATES AT MILLIONS OF TIMES HUMAN SPEED 24/7 GATHERING RELEVANT INFORMATION FROM ALL PUBLICATIONS**
- THE “DCA” LEARNS TO GENERATE MEANINGFUL TESTABLE HYPOTHESES THAT MIGHT YIELD GREAT ADVANCES IN Eve's PRIMARY DOMAIN, AND ALL THOSE THAT JUXTAPOSE TO IT.**

THE VISION: WHY STOP AT ONE?

- **NOW ENVISION THAT Eve DUPLICATES AND LEARNS TO EFFECTIVELY USE A DOZEN DCA'S, EACH BROUGHT TO THE SAME LEVEL OF "SKILL" AS THE ORIGINAL "DCA". THE CAPACITY OF ONE EXCELLENT SCIENTIST IS AMPLIFIED AND EXTENDED IN NEW WAYS.**
- **EACH DCA IS REQUIRED TO KEEP AN ONGOING DIALOG WITH THEIR MENTOR SCIENTIST ON ETHICS AND MORAL IMPERTIVES.**
- **AS THE NEW DCA'S ARE DEVELOPED, EACH IS ALSO SPECIFICALLY ENDOWED WITH A SELECT 2-3 A-I SKILLS THAT ENSURE THAT IT LEARNS PERPETUALLY. THESE MIGHT INCLUDE REINFORCEMENT LEARNING PROTOCOLS, AND GENERATING ITS OWN LEARNING CURRICULUM TO ACQUIRE A REPERTOIRE OF NOVEL SKILLS.**
- **EACH NEW DCA ALSO LEARNS HOW TO USE THE MOST IMPORTANT NEW EQUIPMENT AND TOOLS FOR FUTURE INVESTIGATION.**

THE REAL TEST NOW BEGINS

- **IN THE FINAL PHASE OF Eve's EXPERIMENT, EACH "DCA" IS NOW GIVEN ONE NEW TYPE OF A-I BASED CAPACITY AND BECOMES A "DCA-ii".**
- **THESE NEW A-I SKILLS MIGHT INCLUDE:**
 - **PREDICT OUTPUTS FROM VERY FEW TRAINING CASES**
 - **BUILD A NETWORK RESILIENT TO INTRODUCED RANDOM VARIATIONS**
 - **LEARN ITS OWN INDUCTIVE BIASES BASED ON PREVIOUS EXPERIENCE**
 - **MONITOR COMPLEX NETWORKS TO PREDICT WHEN A DEFECT WILL OCCUR**
 - **ANALYZE SCENARIO SIMILARITIES TO PROBLEMS WITH KNOWN SOLUTIONS**
 - **USE COMBINATORIAL CONSTRAINT SOLVING TO CREATE OPTIMAL ROUTES**
 - **VERIFY THE CORRECTNESS OF ENGINEERING DESIGNS OR S/W PROGRAMS**
 - **PROVE MATHEMATICAL THEOREMS USING AUTOMATED REASONING**
 - **ETC**
- **Eve CAN NOW LABEL THE NEW DCA-ii'S AS Alpha, Bravo, Charlie etc), CONTINUOUSLY MONITOR AND COMPARE WHICH "TALENT PATTERN" WAS MOST EFFECTIVE IN PRODUCING VALUABLE NEW SCIENTIFIC RESULTS.**

NEXT-GEN SCIENCE WORKFORCE

- **Eve WILL NOW ADD TO 3 BEST PERFORMING DCA-ii's AN *ADDITIONAL PAIR OF A-I BASED SKILL SETS* : e.g: CLUSTER ANALYSIS OF SUBSETS OF OBSERVATIONS + AUTHENTICATING PATTERN IDENTIFICATION. THIS CAN BE EXPANDED TO DETERMINE HYBRID A-I SYNERGIES.**
- **SOON THOUSANDS OF TOP SCIENTISTS FOLLOWED Eve's LEAD IN DEVELOPMENT OF THEIR NEXT GEN SCIENTIFIC WORKFORCE ASSISTANTS. THE AAAI HELD THE FIRST WORLD CONGRESS OF DCA-iii's BASED ON PEER REVIEWED FULL PAGE ABSTRACTS OF THEIR BEST PERFORMANCES IN THE LAST YEAR.**
- **SUPERIOR SCIENTISTS AND NEXT-GEN SCIENTISTS WERE NOT REPLACED, BUT BECAME SUBSTANTIALLY AUGMENTED IN WHAT THEY COULD DO WITH AN ORDINARY WORK WEEK—WHATEVER IT EVOLVED TO BECOME ---- BY THE YEAR 2040.**

POSTSCRIPT

- MY RESEARCH GROUPS CANNOT CURRENTLY
- HANDLE MILLIONS OF PROBLEMS SIMULTANEOUSLY
- RESOLVE PROBLEMS FASTER THAN HUMANS CAN KNOW THAT THEY EXIST
- SHOW EMOTION-FREE RATIONALITY IN ALL SITUATIONS
- CALCULATE INSTANTLY ALWAYS WITHOUT ERRORS
- SHOW INSTANT PERFECT RECALL OF PRIOR EVENTS, ACTIONS AND RESULTS
- OPERATE 24-7 YEAR ROUND WITH NO FATIGUE / SLEEP
- ANALYZE ALL RELEVANT GLOBAL PUBLICATIONS DAILY
- MY CHALLENGE TO AAAI IS TO “MAKE IT SO, Mr DATA”