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-DOS 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 ASSISTANT

- Eve PROPOSES THAT THIS “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 + AUTHENTICICTING 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”