

# Looking Forward by Looking Backward

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Visions Lecture

- Things I have tried – 1956-2009
  - Computational Chemistry and Physics, Operating Systems, Performance Evaluation, Symbolic Mathematics, Computer Architecture, Data Bases, AI, Parallel Computation, Embedded Control Systems, Formal Verification, Software Engineering
- What I have learned?

All of these areas have a common foundation.

# Visions

- Great Visions - There are great visions of computer science and the world it will help create.
  - Books - Kurtzweil, Christensen, Gardner, Hall, Milner
  - Turing Lectures – Hopcroft especially.
- Small Vision– Stimulate thought about a vision for UTCS and its partners in computing-based research.

# Parental Warning

- **This is an R-Rated Presentation – This presentation contains broad generalizations and platitudes which may offend almost anyone.**
- **Neither are the opinions expressed graven in stone.**

# Questions

- **Is there a commonly accepted and meaningful one sentence definition of computer sciences? If so, does it provide useful guidance for CS?**

# Central Concept of Computer Science

**Automation** - *“Efficient automation of complex processes”*

Algorithm – Specification for an **automatable process** starting from some initial state and arriving at **a** desired state

Heuristic – Specification for an **automatable process** starting from some initial state and arriving at **some** desired state.

Programming – Executable representations of automatable processes.

Systems – Effective execution of complex interacting processes

Verification/Security – Will the automated process actually work as specified and implemented?

# Implications

- **Assume** automation is the unique domain of computer science
  - Does this suggest additional directions of research in your sub-discipline?
  - Does this suggest additional collaborations across computer science disciplines?
  - What would this suggest for future generations of curricula?

# What is Computer Science's Contribution of Computer Science to the Advancement of Science and Engineering?

- Mathematics contributes the ability to build evaluatable models of physical and logical systems.
- Computer Science contributes .....  
.....??



# Computer Science - Integration with Other Disciplines

- Several generations
  - First Generation:
    - Computational experiments
    - Logical decision system – (Expert Systems)
    - Automation on a local scale
  - Second Generation
    - Complex physical and process management
      - Chemical plant control
      - Robotics
      - Etc.
    - Automation on a system scale
  - Third Generation
    - ??

# Questions

- **What is the next stage of development for computer sciences?**
- **What should UTCS be doing to lead into the next stage of computer science?**

# Maturation of A Science

- Sciences typically develop in phases
  - Sparked by new technologies and unexplained data
  - Partition and specialize – multiple applicable knowledge domains
  - Interaction among local sub-disciplines and across scientific disciplines
  - Which generates contact with more new technologies and new unexplained data **leading to**
    - New disciplines and sub-disciplines based on synergistic merging of knowledge and technologies
  - Engineering disciplines based on applicable knowledge domains emerge.
  - **Emergence of commonality among sub-disciplines**

# Maturity of Computer Science?

- Partitioned/Specialized – Created many applicable knowledge bases
- Interactions with other disciplines are legion – including creation of new disciplines and sub-disciplines
- Computer engineering disciplines abound and overlap computer sciences
- **Common conceptual foundations are just emerging.**

# How is a Common Conceptual Foundation Useful?

- Enables understanding and thus collaboration across sub-disciplines.
- Enables development of applicable knowledge and broader application of computer science.
- Establishes a foundation for teaching undergraduate computer science.

# What should UTCS to take lead in the future generations of computer science?

- Focus collective wisdom on development of the common foundations
- Each researcher or group defines the conceptual foundations of her/his sub-discipline
- Share these views of conceptual foundations
- Merge into operational representation

# What should UTCS to take lead in the future generations of computer science?

- Create an **operational** vision and goals
- Collectively explore broad research opportunities
- Generate Computing Community Consortium and/or

NSF Expedition proposals and projects for these goals

CCC-><http://www.cra.org/ccc/>