Intelligence Advanced Research Projects Activity (IARPA)

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Why IARPA?

The IC needs a way to sponsor high-risk/high-payoff research that has the potential to provide the U.S. with an overwhelming intelligence advantage over our future adversaries

- This is about taking real risk.
  - This is NOT about "quick wins", "low-hanging fruit", "sure things", etc.
- Failure is completely acceptable as long as …
  - It is not due to failure to maintain technical and programmatic integrity
  - Results are fully documented
- Best and brightest.
  - Competitive awards and world-class PMs.
  - Every IARPA program will start with a good idea <u>and</u> a good person to lead it. Without both, IARPA will not start a program.
- Cross-community focus.
  - Address cross-agency challenges
  - Leverage agency expertise (both operational and R&D)
  - Work transition strategies and plans
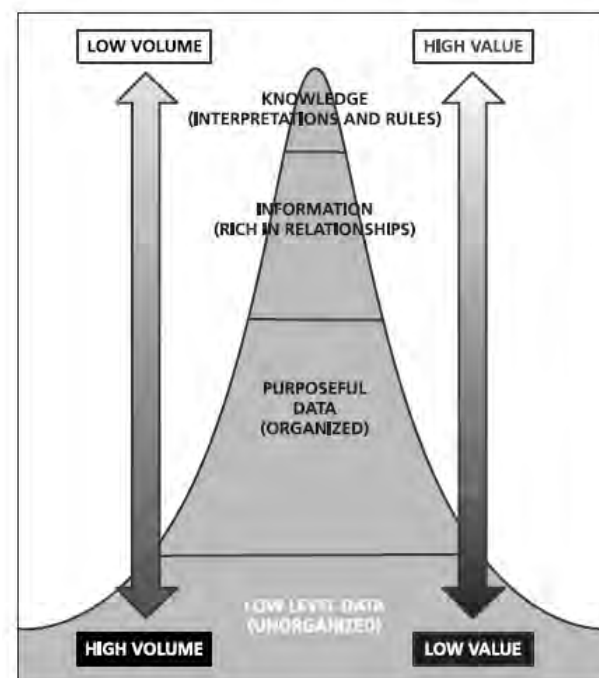
The "Heilmeier Questions"

1. What are you trying to do?

2. How does this get done at present? Who does it? What are the limitations of the present approaches?

    – Are you aware of the state-of-the-art and have you thoroughly thought through all the options?

3. What is new about your approach? Why do you think you can be successful at this time?

    – Given that you've provided clear answers to 1 & 2, have you created a compelling option?

    – What does first-order analysis of your approach reveal?

4. If you succeed, what difference will it make?

    – Why should we care?

5. How long will it take? How much will it cost? What are your mid-term and final exams?

    – What is your program plan? How will you measure progress? What are your milestones/metrics? What is your transition strategy?

The Three Strategic Thrusts (Offices)

- **Smart Collection**: dramatically improve the <u>value</u> of collected data
  - Innovative modeling and analysis approaches to identify where to look and what to collect
  - Novel approaches to access
- **Incisive Analysis**: maximizing insight from the information we collect, in a <u>timely</u> fashion
  - Advanced tools and techniques that can handle large volumes of multiple and disparate sources of information
  - Innovative approaches (e.g., using virtual worlds, shared workspaces) that dramatically improve the productivity of analysts
  - Methods that incorporate socio-cultural and linguistic factors into the analytic process
- **Safe and Secure Operations**: countering new capabilities of our adversaries that could threaten our ability to operate effectively in a <u>networked</u> world
  - Assure the confidentiality, integrity and availability of our cyber systems
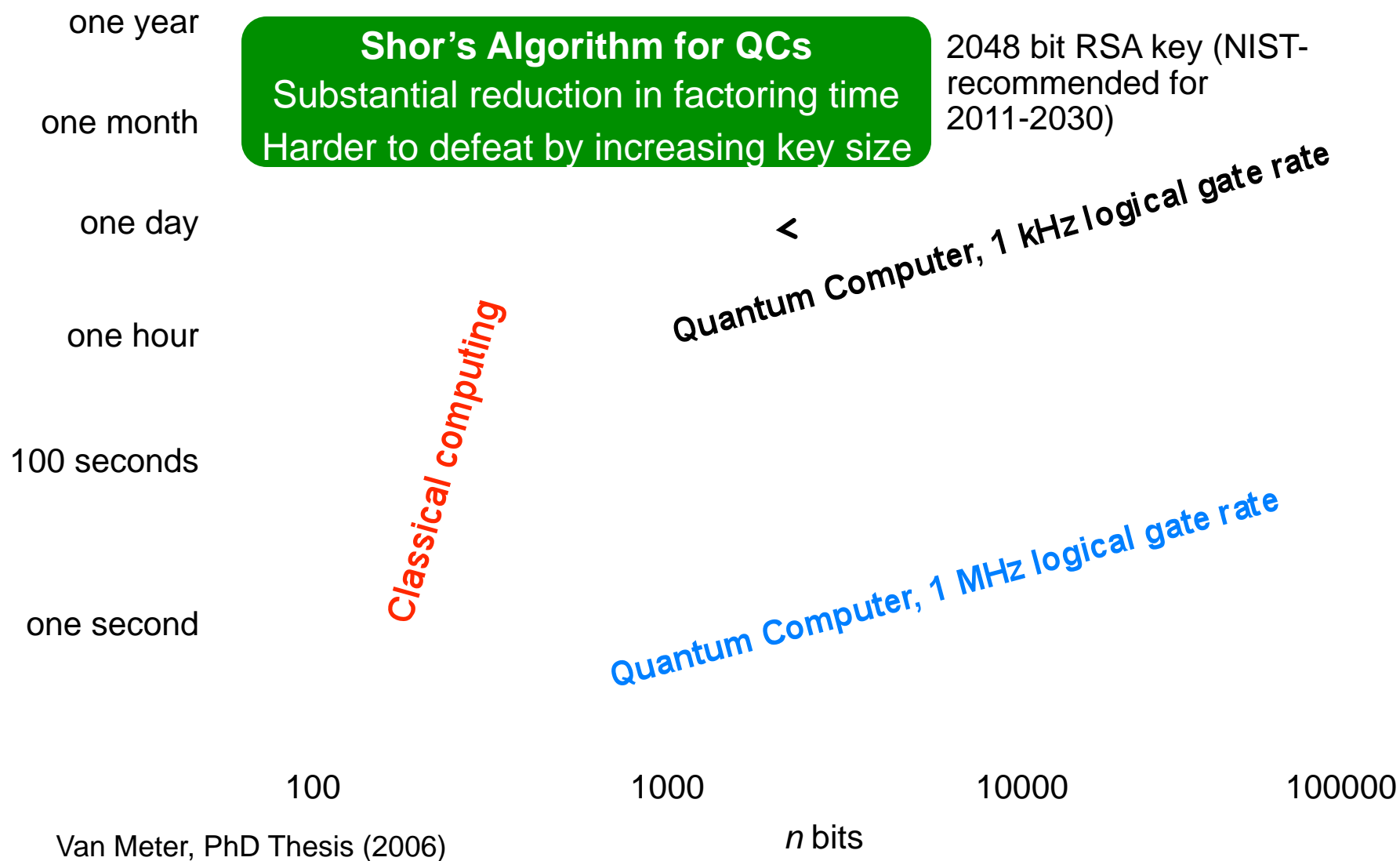 - Quantum information science and technology

Examples

Quantum Computation

one year

Shor's Algorithm for QCs
Substantial reduction in factoring time
Harder to defeat by increasing key size

2048 bit RSA key (NIST-recommended for 2011-2030)

one month

one day

<

Quantum Computer, 1 kHz logical gate rate

one hour

Classical computing

100 seconds

Quantum Computer, 1 MHz logical gate rate

one second

| 100 | 1000 | 10000 | 100000 |

n bits

Van Meter, PhD Thesis (2006)

Quantum Information Science & Technology

- **Major milestones:**
  - Demonstrate interacting logical qubits
  - Execute quantum circuits with thousands of operations
  - Optimize error correction codes for different qubit types
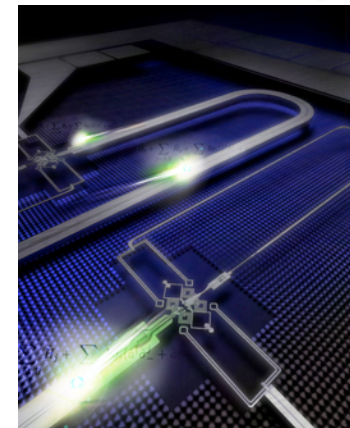- **A scientific-scale quantum computer**
  - Has several logical qubits & sustains several thousands of operations
  - Will let us ask and answer fundamental questions about quantum computing
  - Should inspire new quantum applications
- **Investment areas:**
  - Development of robust qubit technology
    - Trapped ions, neutral atoms, photons, Josephson junctions, quantum dots, etc.
    - Faster and more accurate qubit initialization, measurement & manipulation, and qubit-qubit interactions
  - Supporting technologies
    - Better materials, device fabrication, detectors, etc.

Cover and illustration show two SC qubits coupled by a serpentine waveguide resonant cavity.

First demonstration of quantum bus and basic quantum memory using SC phase qubits …aka … *A Flying Qubit*
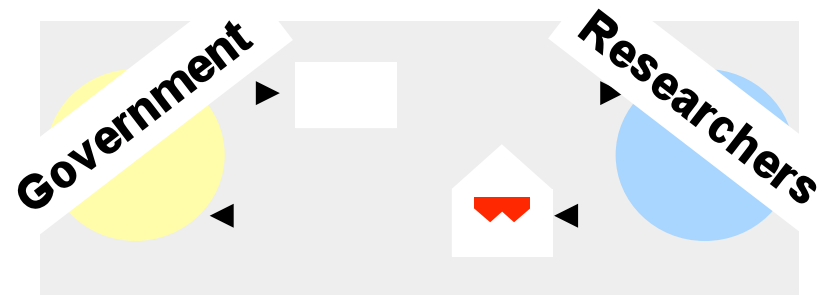
Socio-cultural Content In Language (SCIL)

- Language is a mirror of social and cultural norms, contexts, and expectations

- Current human language technologies show little ability to "understand" or capture social dimensions of language

- Can we characterize the nature of social groups (e.g., motivation, intent, member characteristics, member roles, etc.) by examining the use of language in the group (e.g., terms of address, honorifics, syntax, taboo topics, stylistics, etc.)?

- Can we generalize across languages and cultures? Can we apply insights regarding linguistic indicators from one culture to a new language and culture?

- Can we automate the insights to provide analysts with the means to identify subtle indicators of socio-cultural phenomena and emerging events?

Knowledge Discovery and Dissemination (KDD)

- The KDD Program is interested in new ideas for collaboratively analyzing data from multiple, massive data sets and streams

- BLACKBOOK provides Researchers with an infrastructure that supports development and allows testing on IC problems

- BLACKBOOK is a software framework that allows research algorithms and vendor tools to be easily integrated and tested.

  - New tools become plug-in components that are automatically compatible with other tools in the framework.

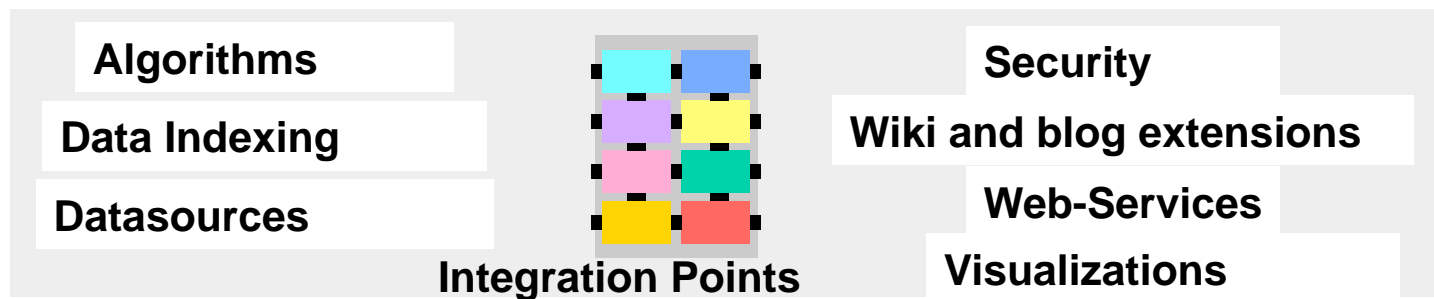- KDD/BLACKBOOK provides a new "self-addressed envelope" process.

blackbook**2**

BLACKBOOK

- BLACKBOOK is a framework based on Semantic Web technologies and open standards.
- It provides Researchers with support code such as Database interfaces, Visualizations, Algorithms, and integration points for new work.
- The framework is provided as a "self addressed envelope" to software developers, who deliver the framework back with their software tools embedded.
  - Software that is interfaced to one of BLACKBOOK's integration points automatically becomes compatible with other software elements in the framework.

Access to BLACKBOOK Wiki to download software:
Buster Fields 240-373-5309

Algorithms

Data Indexing

Datasources

Integration Points

Security

Wiki and blog extensions

Web-Services

Visualizations

Concluding Thoughts

- **Technical Excellence & Technical Truth**
  - Scientific Method

  - Peer/independent review

  - Full and open competition

- **We're looking for outstanding PMs**

- **How to find out more about IARPA:**

  www.iarpa.gov