



**Snowbird 2006**

# The State of Computing

## The State of CRA



**Snowbird 2006**



**Dan Reed, CRA Board Chair**  
**Andy Bernat, CRA Executive Director**

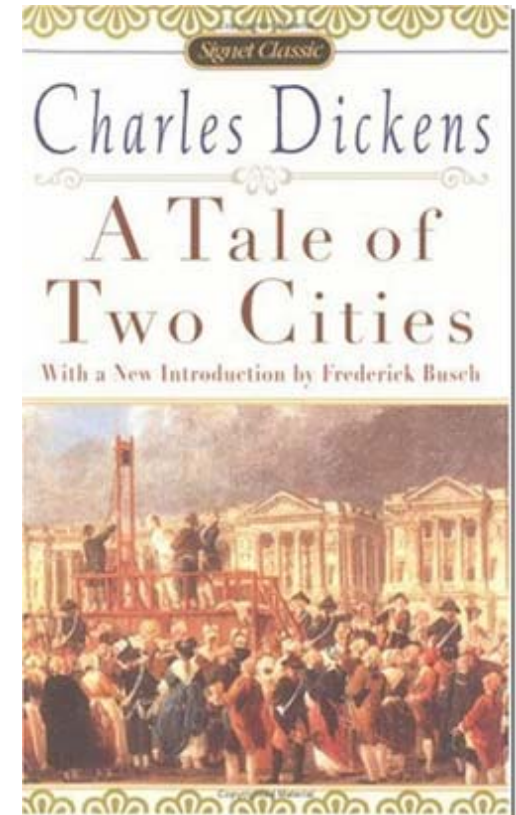
# Takeaway Themes

- **Education and image**
  - Changing opportunities dictate new responses
- **Community building and futures**
  - We can and should define the future
- **Research funding and policy**
  - CRA is an ever more powerful voice

# A Bit of Poetic License

IT was the best of times, it was the worst of times, it was the age of wisdom, it was the age of foolishness, it was the epoch of belief, it was the epoch of incredulity, it was the season of Light, it was the season of Darkness, it was the spring of hope, it was the winter of despair, we had everything before us, we had nothing before us, we were all going direct to Heaven, we were all going direct the other way ...

*Charles Dickens*



# Ten Years: Past and Future

- **Looking back, in the public mind**
  - there were few or no experiences with ...
    - web sites, email, spam, phishing, computer viruses
    - e-commerce, digital photography or telephony
    - digital job offshoring, electronic globalization
  - cell phones were rare and expensive
  - a Sony Walkman was state of the art
  - CDs were still pretty cool
  - wireless networks were unknown
  - 16 MHz processors were fast
- **What will the future bring?**



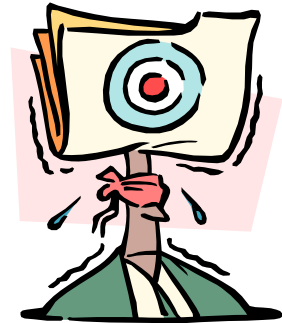
# The Public Perception ...



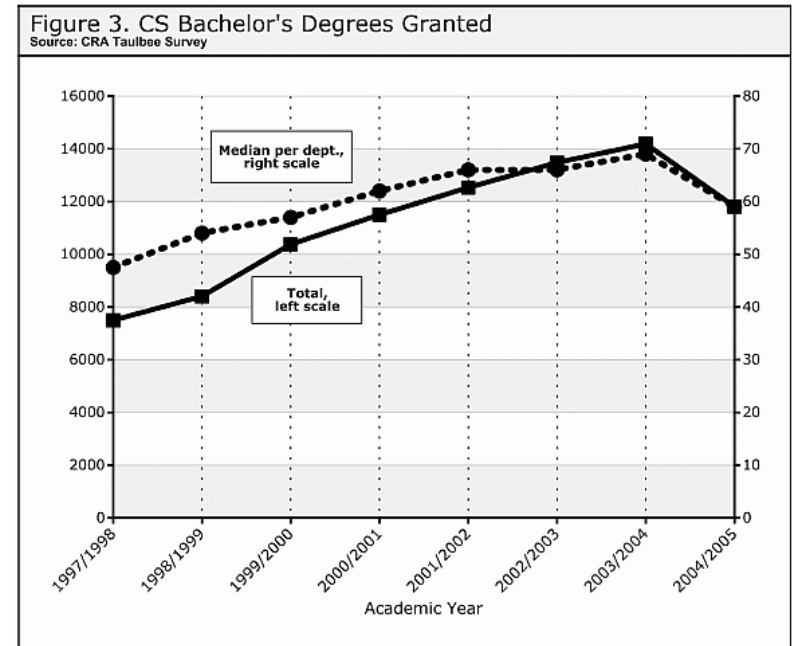
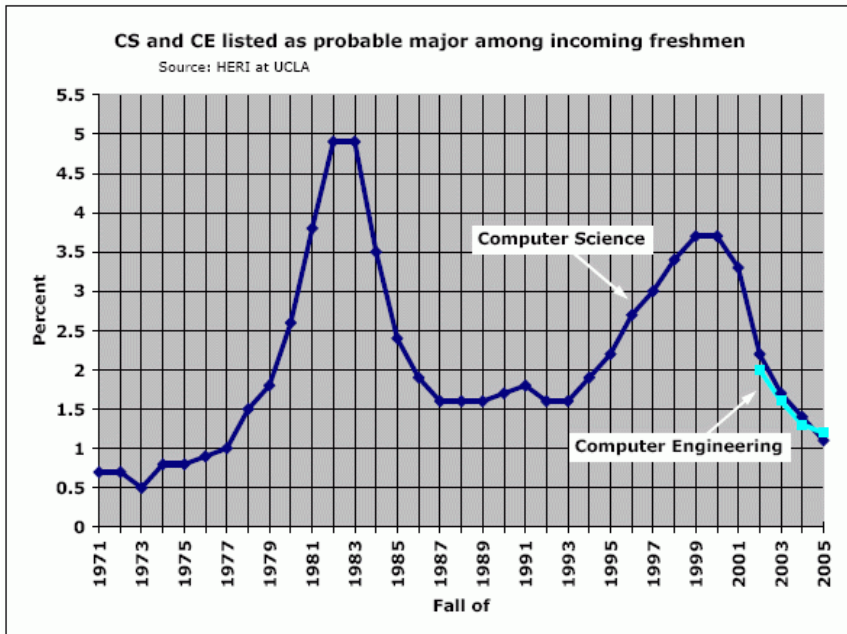


# The Public Perception and Fear ...

- **Your every physical movement is tracked/logged**
  - ... by embedded sensors on all human artifacts
- **Your neighbors know all the books you read**
  - ... because your electronic financial identity was stolen
- **Your every call is monitored for content**
  - ... by deep semantic analysis and logging
- **Your utilities fail due to a virus attack**
  - ... because security was penetrated by a 10 year old
- **Your DNA sample/lifestyle determine health cost**
  - ... because you are targeted as a high risk genotype/lifestyle
- **Cyberwar destroys our financial institutions**
  - ...because we lack the ability to construct IT infrastructure



# Perception vs. Reality

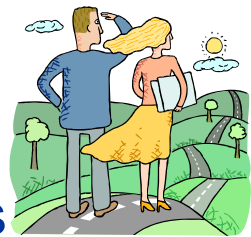


- **Bureau of Labor Statistics estimates (2004-2014)**
  - *IT will grow at >2X the rate of the overall workforce*
    - *1 in 19 new jobs*
  - *over 1 million new jobs, a 30% increase*



# Imagine a Future Where ...

- **Your car finds a parking space for you**
  - ... and parks the car (already a 2008 Lexus feature)
- **The radio only plays music you love**
  - ... because it knows every song you've ever heard
- **Your phone only rings when you want to answer**
  - ... because it knows your emotional state
- **Your body calls an ambulance when you are ill**
  - ... via implanted, biologically powered diagnostic sensors
- **Your DNA sample determines personalized treatment**
  - ... because genotype-phenotype models are specific
- **Your research exploits multidisciplinary models**
  - ... that are easy-to-use, composable and scalable



# The Story *Does* Matter

Sashimi

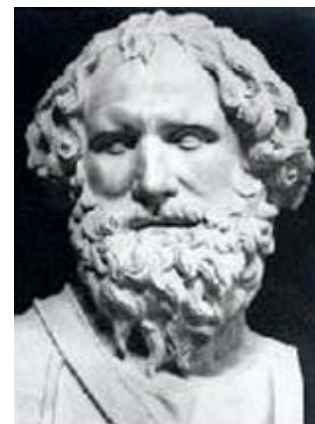


**See Rick Rashid's Talk**

Dead Tuna

# Computing Reality

- **The 21<sup>st</sup> century is about knowledge economies**
  - managing information for competitive and intellectual advantage
- **We are in the knowledge business!**
  - creation, preservation, transmission and application
- **Globalization is a challenge and opportunity**
  - we made it possible; we should capitalize on it
- ***Blurry computing definitions***
  - *blurry is good; computing is ubiquitous*
  - *we have not fully internalized this fact*

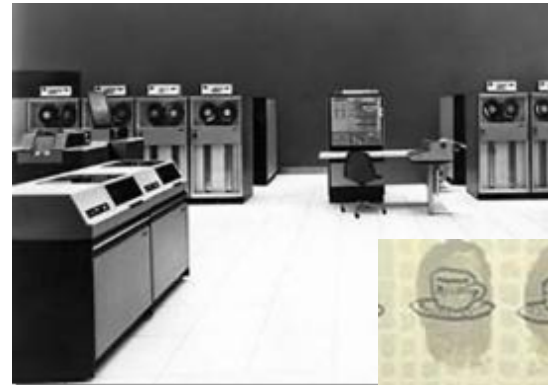


**“Give me a place to stand and a lever long enough, and I will move the world.”**  
***Archimedes, 287-212 BC***

# Changing Opportunities

- **Then (1960s-1970s)**

- tens of thousands of users
- field repair of design errors
  - extra revenue ☺



- **And now**

- billions of users
- critical international infrastructure
- massive product recall of design errors
  - life and death issue ☹



- **We are more important than ever**

- new foundational technologies
- disruptive product niches
- critical international infrastructure
- seminal research discovery

***and we are now in adulthood***





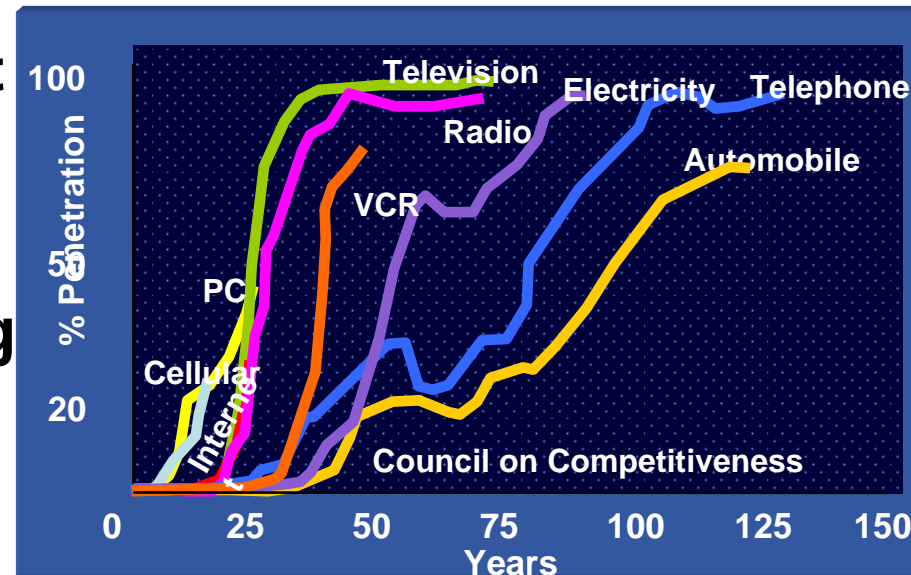
# Onboard Medicine and Demographics



- **Changing demographics**
  - aging baby boomers (us)
  - remote medicine, independence and health costs
- **Your car has on-board diagnostics**
  - What about you?

# Faster, Faster, Faster, ...

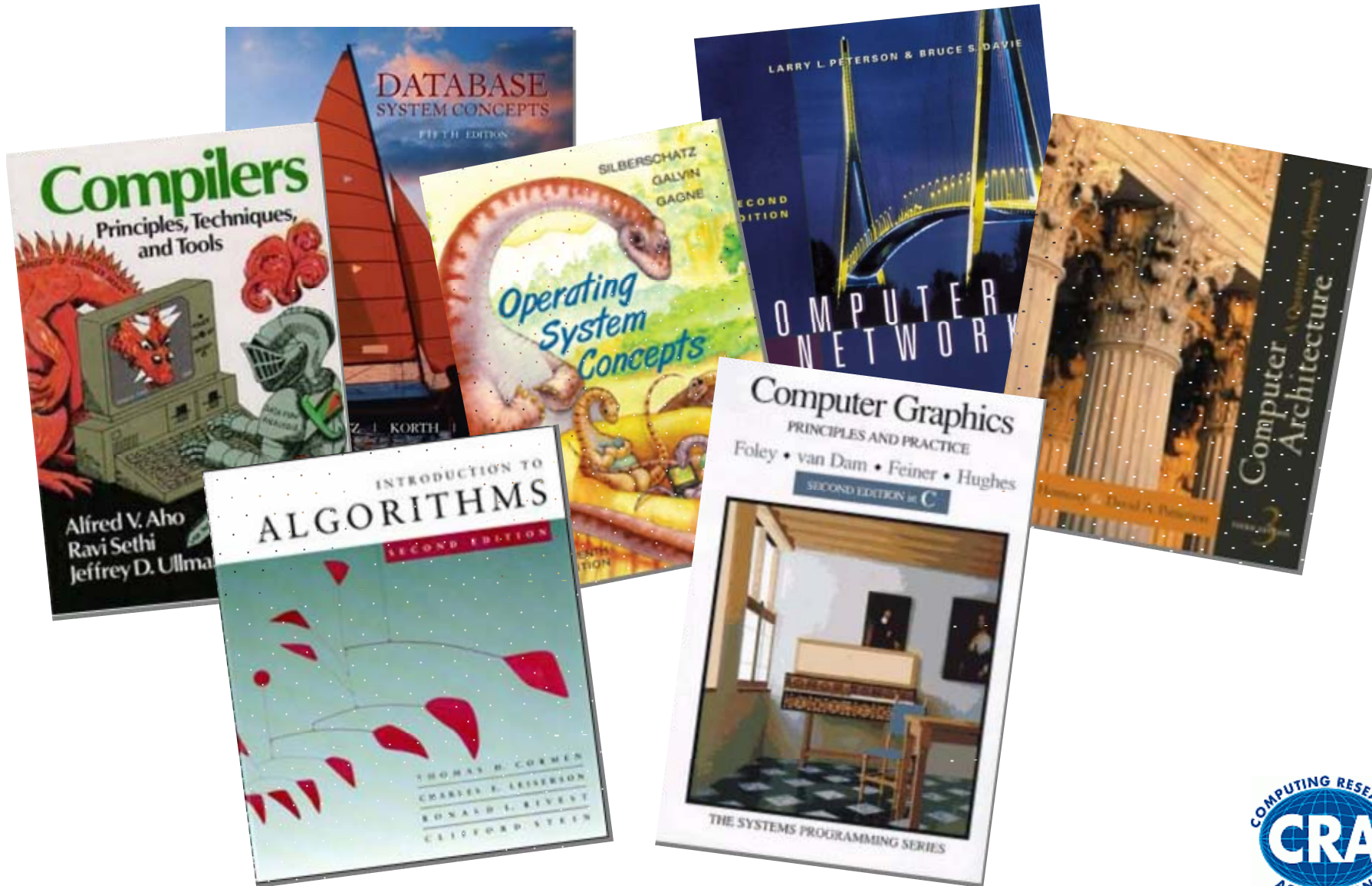
- “Real world” change is accelerating
  - five years is an eternity
  - information friction is declining
- **University adaptation is not**
  - some hysteresis is good ...
    - there are verities
  - but, we risk cultural dissonance
- **Frame debate by innovating**
  - approaches, applications
  - collaborations, benefits



“He was so learned that he could name a horse in nine languages; so ignorant that he bought a cow to ride on.”  
Ben Franklin



# The Standard Computing Syllabus



# Looking Forward ...



**Our 2016 undergraduate is 8-12 years old now**

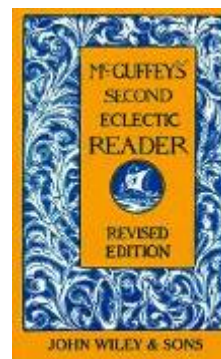
# Education: Past and Future

- **Today's students have**
  - 10,000 hours of video games
  - 250,000 email messages
  - 10,000 hours on cell phones
  - 20,000 hours of television
  - 500,000 commercials
  - *less than 5000 hours reading books*



Asthma

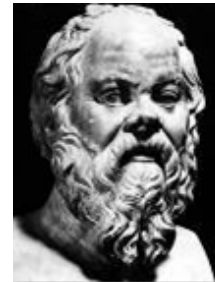
[www.socialimpactgames.com](http://www.socialimpactgames.com)





# Computing Education and Futures

- **Classical education**
  - *trivium*
    - grammar, logic and rhetoric
  - *quadrivium*
    - arithmetic and geometry
    - music and astronomy
  - fluency in Latin and Greek
- **Natural philosophy emerged ...**
  - Boyle, Bacon, and Newton
  - *disciplinary decomposition*
- **Planned CRA education summit**
  - *improving computing education*
    - *graduate and undergraduate*
    - *interdisciplinary*
  - *not focused narrowly on curriculum*
- **State of the art skills**
  - no substitute for competence
- **Teaming and collaboration**
  - real problems are solved in teams
- **Oral/written communication**
  - sharing/marketing ideas is critical
- **Multidisciplinary knowledge**
  - *domain skill plus other discipline(s)*
- **Social engagement skills**
  - empathy, understanding & patience
- **Learning skills**
  - the technical constant is change



# Leadership Summit: Task Forces

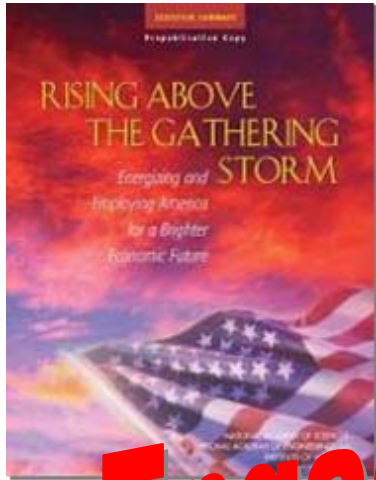
- **The Image of Computing**
  - Rich Rashid, Microsoft Research
- **American Competitiveness Initiative**
  - Doug Comer, Intel
- **Experimental Computing Infrastructure**
  - Peter Freeman, NSF CISE
- **Computing Research Funding**
  - Ed Lazowska, U. Washington





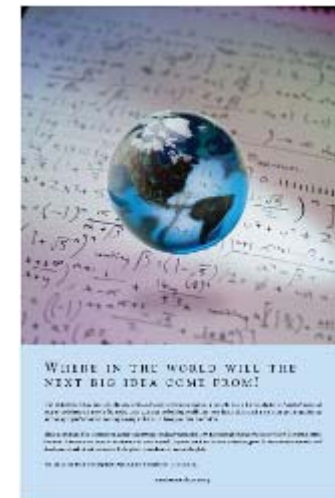
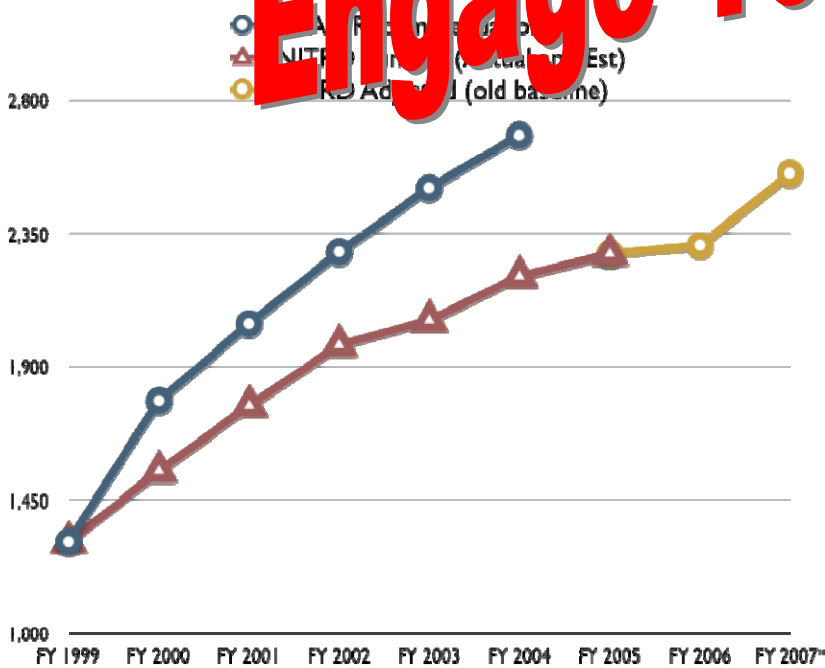


# American Competitiveness Initiative



**Engage Your Delegation**

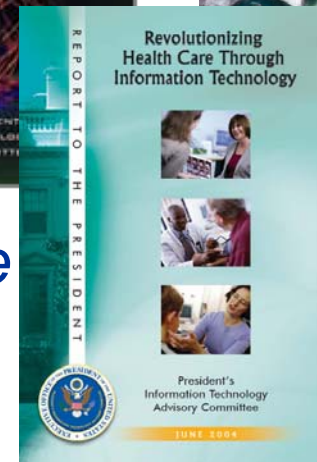
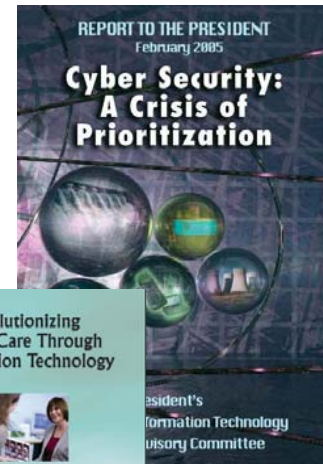
- **Innovation**
  - double NSF, DOE SC and NIST
  - make permanent the R&E tax credit
- **Education**
  - 70,000 new teachers
- **Workforce/Immigration**
  - expand worker training programs
  - flexible H-1B caps, reform visa issues



# PITAC/PCAST Activities



- **Cybersecurity**
  - IT systems are the control loop for critical infrastructure
    - electricity, air traffic control, finance, communications, ...
- **Computational science**
  - the third pillar of science
    - theory, experiment and computing
- **Health care and records**
  - reduced costs and quality care
- **PCAST**
  - *subsumed PITAC NITRD evaluation role*
  - *networking and IT committee*
    - *George Scalise and Dan Reed, co-chairs*



# Community Computing Consortium

- **CCC vision**
  - community building and vision setting
  - research agenda and funding advocacy
- **Seek complementary funding**
  - infrastructure and facilities
- **Other disciplinary examples**
  - astronomy leadership
  - physics faculty lists

***“The challenge to the Computing Community Consortium (CCC) is to catalyze the computing research community to debate longer range, more audacious research challenges; to build consensus around research visions; to articulate those research visions; to evolve the most promising visions toward clearly defined initiatives; and to work with funding organizations to move the challenges and visions toward funding initiatives.”***

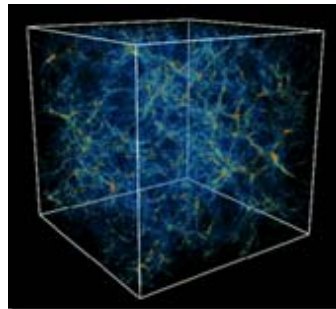
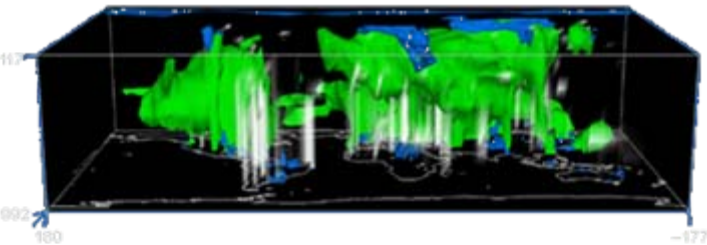
- **CRA leadership**
  - \$6M NSF proposal
  - submitted June 8, 2000
- **Proposal leaders**
  - Ian Rice, Harvard Chair
  - Andy Herzog, MIT
  - Eric Eyal, CMU
  - Susan Graham, UC Berkeley
  - Ed Lazowska, Washington
  - Dick Karp, UC Berkeley
  - Ken Kennedy, Rice
  - Peter Lee, CMU
  - Wim Sweldens, Lucent
  - Jeff Vitter, Purdue

**Thank You for Your Support**



# Compelling Visions Are Common

- **Multilevel biological modeling**
  - from molecules and structures to organisms and ecologies
- **Distributed, virtual astronomy**
  - real-time data analysis and multi-modal data fusion from distributed archives
- **Personalized, *in situ* medicine**
  - drug design tailored to individual DNA with embedded micro-transfusers
- **High-energy physics/cosmology fusion**
  - dark matter, the standard model, and the theory of everything
- **Integrated climate change and urban/social planning**
  - multidisciplinary data fusion, modeling, and analysis



# Community Computing Consortium

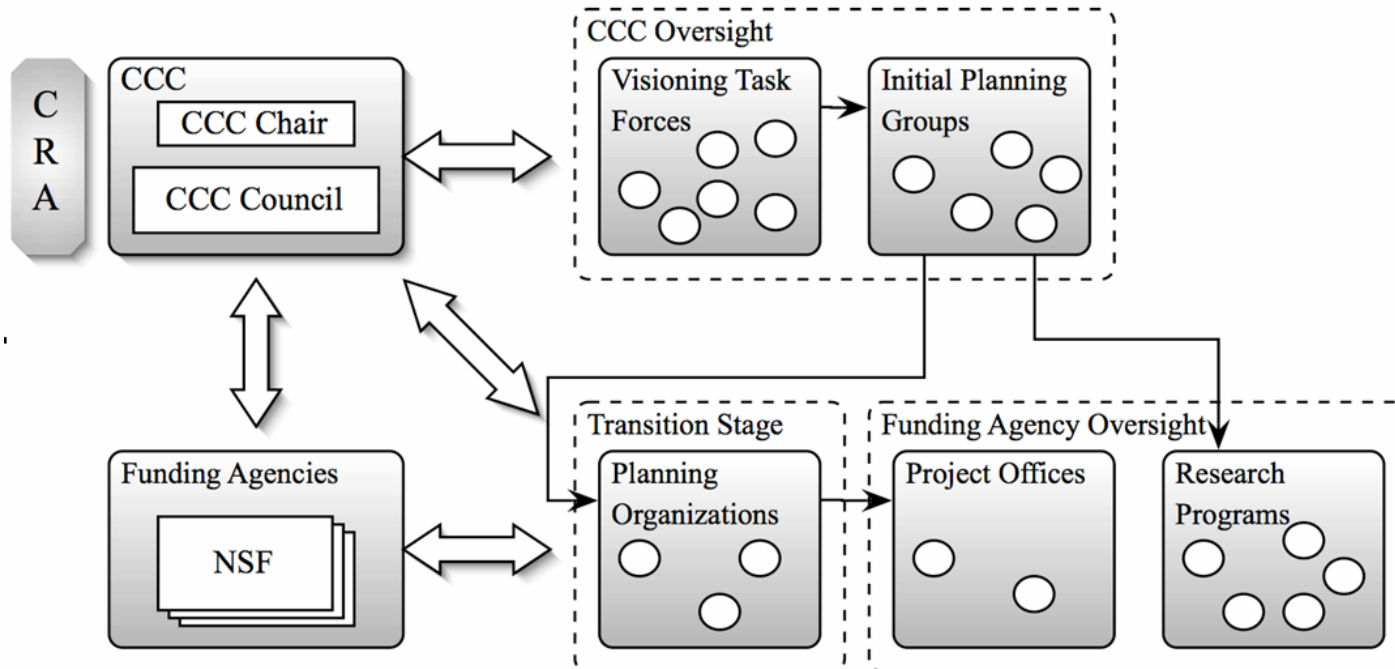
- **Organization**

- CCC council
  - 12-15 people (rotating terms)
- CCC chair (30%-50% time)

- **Multistage pipeline**

- visioning and planning
- transition/oversight

- **Multiple outcomes**





# CRA/NIH Workshop

- **Computing research engagement**
  - multidisciplinary collaborations
  - elaborating the NIH Roadmap
- **Jointly organized by NIH and CRA**
  - NIH researchers/leaders
  - computing researchers/leaders
  - keynote presentations
    - Lee Hood, Jill Mesirov, Chris Johnson and Dan Reed
- **Recommended outcomes**
  - enhance communication process and dialog
    - basic science and clinical medicine/disease
  - study and support broader undergraduate education
  - major outreach to computing and biology communities
  - fund 2x2 engagement partners (single and multiple agency)
  - fund large, transformational centers (“expeditions to the future”)





# Takeaway Themes

- **Education and image**
  - Changing opportunities dictate new responses
- **Community building and futures**
  - We can and should define the future
- **Research funding and policy**
  - CRA is an ever more powerful voice
- ***We need your ideas ...***
  - *education, research, policy, investment*
- ***Talk to the CRA Board at lunch Tuesday***



# Dream, Strategize, Realize

**“Twenty years from now, you will be more disappointed by the things you didn't do than by the ones you did. So throw off the bow lines. Sail away from the safe harbor. Catch the trade winds in your sails. Explore. Dream.”**

***Mark Twain***

