

## Fluency with Information Technology

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### Computer Research Association

- ∇ CRA -- Professional “lobbying organization” for computing
- ∇ Membership -- “all” universities with PhD pgms, many universities/colleges, orgs (ACM, IEEE-CS, SIAM ...), industry (MS, IBM, Sun...)
- ∇ Goals: further interests of “computer research”
  - Funding, policy, diversity health of field, technology trends, education, ...

Find CRA at: [cra.org](http://cra.org)

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## A Question of Substance...

- ∇ In 1997 the National Science Foundation
  - which is responsible for the stewardship of science and technical education in the US
- ∇ Asked the National Research Council
  - which is chartered by Congress to conduct research in the public interest

*“What should everyone know about Information Technology?”*

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## For What Purpose?

- ∇ Reasons motivating NSF to ask for the study...
  - **More informed citizens:** Complex issues concern the public ... Communications Decency Act, strong encryption, monopoly in SW industry, privacy
  - **Better prepared workforce:** Knowledgeable employees are more productive, versatile, competitive
  - **Pursue personally relevant goals:** Though many use IT now, most believe they can benefit more from the technology

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## CSTB Formed A Committee ...

NRC's computing department (CSTB) formed a committee ...

- Alfred Aho AT&T Bell Labs
- Marcia Linn UC Berkeley
- Arnold Packer Johns Hopkins University
- Lawrence Snyder, Chair, UW (Chair)
- Allen Tucker Bowdoin College
- Jeffrey Ullman Stanford University
- Andries van Dam Brown University

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## The WESKAIT\* Committee

- ∨ Committee started August, '97
- ∨ Report published June '99
- ∨ Testimony was requested from many sources
  - Business
  - Computer Science
  - Education
  - Library Science
  - Societies
  - Standards
  - Training



\* What Everyone Should Know About Information Technology

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## But Is Learning IT Really An Issue?

- ∇ We use technology everyday without knowing anything about it ...
  - Telephones
  - Digital cameras
  - *“Driving does not require knowledge of how a car works ... computing shouldn’t either.”*
- ∇ Technology is “trade knowledge” not suitable for “formal” education ... students don’t all learn the details of X-ray machines despite the benefits of radiology

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## Distinguish Among Tools ...

- ∇ “Physical devices” moving or transforming matter/energy perform a single fixed function
- ∇ Devices specialized to a single application can be operated without knowing the “internals”
  - Cars, CDs, digital cameras -- apply or not
  - “Perfectly” customized user interface
- ∇ Happily, new functionality in the kitchen or shop requires **new tools**

**... but not so in information processing**

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## Computers Are Universal Info Processors

- ∇ A new IT task doesn't require a new computer
  - Install new software on existing computer
  - 1 device solves all information processing tasks
  - Computers are universal information processors
- ∇ Compare a digital camera and a laptop
- ∇ Universality ...
  - Limits the extent of specialization to any 1 task
  - Implies users play a major role in set-up and use

Conclusion: computing ≠ driving ... knowledge is needed

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## What Should "Everyone" Know?

Should everyone know ...

- How to find accurate information on the WWW?
- How to perform Mail Merge in MS Word?
- How to program?
- What makes a Pentium go fast?
- What makes a Pentium possible?
- What "Pentium" means?
- The principles of database design?
- The principles of debugging & troubleshooting?
- Why there is a "y" in byte?

... some topics simple, some deep, some merely useful

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## Committee Concerns

- ∇ Primary focus was on *content* ...
  - List the essential topics
  - Ignore implementation
- ∇ As a practical matter, consider college setting
- ∇ Target audience is the **population at large**
  
- ∇ Committee's primary worry -- rate of change

*No fixed list of topics can last...*

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## Fluency

- ∇ Traditional computer literacy does not suffice
- ∇ The committee adopted the term “fluency” at the suggestion of Yasmin Kafai, UCLA
  - “Literacy” means only basic knowledge, skills
  - “Computer literacy” is in wide use: “skills-based”
  - “Fluency” implies expertise, the ability to use IT effectively
- ∇ **Fluency with Information Technology** describes the objective, **FITness** is the term the committee adopted for it

*Goal: Teach the IT needed to today  
and how to learn more IT in the future*

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## A Tripartite Solution

- ∇ Fluency with Information Technology requires the acquisition of three kinds of knowledge
  - Fundamental Concepts
  - Contemporary Skills
  - Intellectual Capabilities
- ∇ Concepts, Skills and Capabilities are different parts of IT knowledge
  - Interdependent
  - Co-equal

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## Skills

- ∇ To know contemporary applications
- ∇ Approximately the same as “computer literacy”
- ∇ Essential for
  - Job preparedness
  - Education, as a tool making a student productive
  - Learning the other parts of FITness
- ∇ A moving target, relies on the state-of-the-art

Example: Use a word processor

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## Concepts

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- ∇ The foundations of Information Technology
- ∇ Concepts refer to material that might be called the “book learning” part of FITness
- ∇ Concepts explain ...
  - How and why IT works as it does
  - Constraints and limitations on applications
  - Principles on which to build new understanding
  - Ideas that can be used to make IT more personally useful

Example: Organization of computer networks: TCP/IP

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## Capabilities

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- ∇ Higher level thinking
- ∇ “Life skills” applied to Information Technology
- ∇ Learning Capabilities requires ...
  - Abstract thinking
  - Learning by analogies
  - Analysis
  - Judgment
- ∇ The raw material for life-long learning

Example: Engage in sustained reasoning

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## Selecting The Key Knowledge

- ∇ Committee goal: Avoid “over-prescription” trap
  - Top 10 items in each type
    - 10 top skills
    - 10 top concepts
    - 10 top capabilities
  - Keep to the plan -- no adds, just replacements
- ∇ FITness is not an end state -- it is a process of life-long learning ... so the goal is a sufficient level of introduction

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## Ten Skills

### NRC Recommended Skills

- Setting up a personal computer
- Using basic operating system features
- Using a word processor
- Using a graphics/artwork/presentation tool
- Connecting a PC to a network
- Searching via Internet to locate information
- Using a computer for email
- Using a spreadsheet
- Querying a database
- Using online tutorial information (help)

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## Ten Concepts

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### NRC Recommended Concepts

- Principles of computer operation
- Enterprise information systems
- Networks
- Digital representation of information
- Information structure and assessment
- Modeling with computers
- Algorithmic thinking and programming
- Universality
- Limitations
- Information in society

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## Ten Capabilities

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### NRC Recommended Capabilities

- Engage in sustained reasoning
- Manage complexity
- Test a solution
- Locate bugs in a faulty use of IT
- Organize and navigate information structures
- Collaborate with others using technology
- Communicate IT to other audiences
- Expect the unexpected
- Anticipate technological change
- Think technologically

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## Projects Touch Many Ideas

Construct an information system to run a small business and explain its use to the employees

### Skills

Organize Database  
Use Spread-Sheet  
Use On-line Tutorial  
Presentation Tools  
Communicate  
With Others

### Concepts

Information Systems  
Information Structure  
Algorithmic Thinking  
Information & Society  
Limitations

### Capabilities

Sustained Reasoning  
Manage Complexity  
Test a Solution  
Communicate IT  
Locate Bugs  
Expect the Unexpected

Projects allow students to put knowledge to use and to integrate the skills, concepts and capabilities

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## Coverage?

### Original List

- How to find accurate information on the WWW?
- How to perform Mail Merge in MS Word?
- How to program?
- What makes a Pentium go fast?
- What makes a Pentium possible?
- What "Pentium" means?
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## Who Should Be Taught Fluency?

- ∨ Everyone!?
- ∨ Colleges teach Fluency now -- today it's a "post-condition;" should be a "pre-condition"
- ∨ K-12 is ideal ...
  - Learn basics as children build "model of world"
  - Skills with tools in middle years + fundamentals
  - High school treats capabilities
- ∨ How do people "past school" become FIT?

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## Fluency at High School

- ∨ Several forms are appropriate ,,,
  - 1/2 yr, for college-bound; a science class for non-techies; prep for techies for Java
  - 1 yr with applications for non-college-bound
  - 1 yr, after hours for "computer club"
- ∨ Good class to de-geek tech
- ∨ Requires "adequate" keyboard time, some SW

A really fun class to teach!

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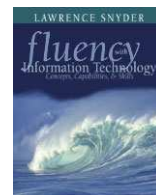
## Fluency Since The Report ...

- ∇ *Being Fluent* was published in June 1999
- ∇ Excellent press, *Chronicle of Higher Education*
- ∇ States (Wash. and Mass.) are assessing FIT
- ∇ Int'l interest: Australia, Chile, Swiss, Canada
- ∇ At **UW** a course FIT100 has been developed
  - First taught Spring Quarter 1999
  - Challenging curriculum -- formally evaluated
  - Offered every quarter to 150 students
  - FIT100 is being taught at other universities
  - First textbook published in 2002
- ∇ **BeneFIT**, a free self-study FITness course

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## FITness For Free

- ∇ **UW** has developed a self-taught Web based version of the FIT100 class, **BeneFIT100**
  - Designed to teach teachers
    - NSF Funding -- free to anyone
    - High "production values," text, video, animations,...
    - <http://www.fit.washington.edu>
    - Help, college credit available from **UW** for \$\$
  - How can **BeneFIT100** be used?
    - Uses AW: Fluency with IT
    - Many materials online
    - Brief Edition of FIT?



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## Summary

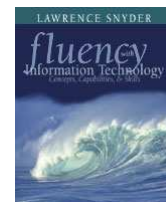
- ∨ FITness sets a higher standard than literacy
- ∨ The key to FITness is life-long learning
- ∨ Components of FITness are essential:
  - Skills -- are valuable immediately
  - Concepts -- foundation of life-long learning
  - Capabilities -- better thinking for any subject
- ∨ Projects integrate skills, concepts, capabilities
- ∨ FIT100 is an example FITness curriculum
- ∨ BeneFIT100 free course for anyone

Just Do IT

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## Links ...

- ∨ NRC report, *Being Fluent with Information Technology*: [www.cstb.org](http://www.cstb.org)
- ∨ University of Washington's FIT100  
[www.cs.washington.edu/100](http://www.cs.washington.edu/100)  
[www.washington.edu/oea/9915.htm](http://www.washington.edu/oea/9915.htm)
- ∨ BeneFIT100  
[www.fit.washington.edu](http://www.fit.washington.edu)
- ∨ *Fluency with Information Technology*  
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[www.aw.com/snyder/](http://www.aw.com/snyder/)



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