



Calhoun: The NPS Institutional Archive
DSpace Repository

Instructional Content

Course Descriptions

2000-09

**The Art of Doing SCIENCE and Engineering:
Learning to Learn, Richard W. Hamming (1915-1998)**

Brutzman, Don

Monterey, California : U.S. Naval Postgraduate School

<https://hdl.handle.net/10945/62468>

This publication is a work of the U.S. Government as defined in Title 17, United States Code, Section 101. Copyright protection is not available for this work in the United States.

Downloaded from NPS Archive: Calhoun



Calhoun is the Naval Postgraduate School's public access digital repository for research materials and institutional publications created by the NPS community. Calhoun is named for Professor of Mathematics Guy K. Calhoun, NPS's first appointed -- and published -- scholarly author.

Dudley Knox Library / Naval Postgraduate School
411 Dyer Road / 1 University Circle
Monterey, California USA 93943

<http://www.nps.edu/library>

The *Art* of Doing SCIENCE and Engineering: Learning to Learn

Richard W. Hamming (1915-1998)

Overview

The late Richard W. Hamming made numerous fundamental contributions to mathematics and computer science. He passed away suddenly on January 7, 1998. For many years he taught a capstone course on the future of science and engineering at the Naval Postgraduate School (NPS).

This course is extremely stimulating. Many people think it is the most important course they have ever taken. Dr. Hamming's observations on learning and the conduct of scientific inquiry are profound, far-reaching and practical. Because he discusses a large number of subjects which he helped develop first-hand, this course has sometimes been called "Hamming on Hamming." However, Dr. Hamming was always insistent that he only used first-person examples because they best achieved his true goal: showing people how they might learn to learn.

In 1995, Tracey Emswiler and R. Jon Bigelow recorded the full lecture series and transmitted the live audio and video streams over the Internet's Multicast Backbone (MBone). This was the first complete global multicast of a full-quarter academic class. About thirty students attended the class locally, while Internet attendance ranged from five to forty. Mike Tiddy and Mark Glover wrote follow-on theses about this course which showed how multicast distribution of this video material might best be accomplished to support distance learning.

In 1998 Simon Goerger, Rob Jezek, Mark Evans and Steve Murley succeeded in recording all 30 lectures for on-demand playback using Wieland Hofhelder's MBone VCR On Demand (MVoD) software. We are now ready for the final steps in preparing this thought-provoking material for use as a viable distance-learning course.

If you are interested in taking the class, please send mail to Don Brutzman at brutzman@nps.navy.mil.

Textbook

Hamming, Richard W., *The Art of Doing SCIENCE and Engineering: Learning to Learn*, Gordon and Breach Science Publishers, Amsterdam B.V, The Netherlands, 1997.

From the cover:

This book is intended to instill in the reader a *style of thinking* that will enhance his ability to function as a problem solver of complex technical issues. A collection of stories about the author's participation in significant discoveries, it relates how those discoveries came about and, most importantly, provides analysis about the thought processes and reasoning that took place as the author and his associates progressed through engineering problems.

Dr. Hamming believes that highly effective thinking is an *art* that engineers and scientists can be taught to develop. By presenting actual experiences and analyzing them as they are described, he conveys the developmental thought processes employed and shows that a style of thinking that leads to successful results is something that can be learned. Along with spectacular successes, the author also shows how failures contributed to shaping the thought process.

For several years this material has been taught to graduate students at the U.S. Naval Postgraduate School in Monterey, California in preparation for their military careers. The volume is written in a very informal conversational style and can be read in whole or in part. Although mathematics are used to illustrate clearly how discoveries were made and problems solved, the book can be read and its benefit derived *without* the mathematics.

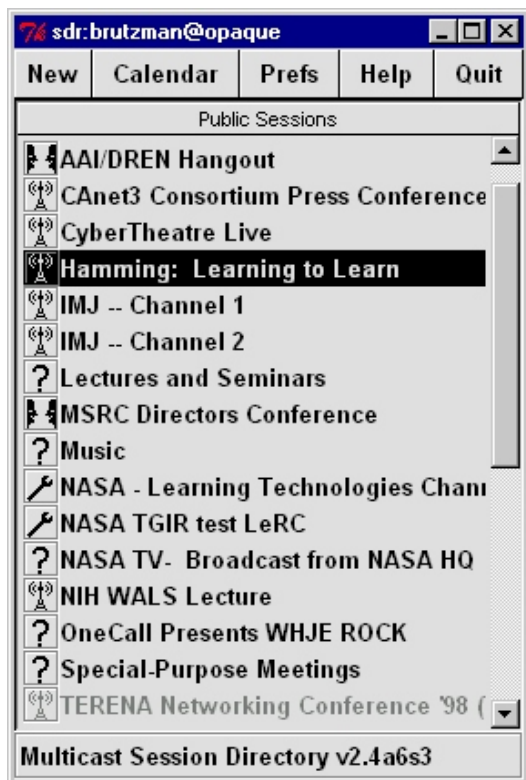
About the author. Richard W. Hamming spent the majority of his career at AT&T Bell Laboratories in Murray Hill, New Jersey, where he built his reputation with discoveries in coding and information theory, digital filtering, and numerical methods. Every year the Institute of Electrical and Electronic Engineers (IEEE) presents the Richard W. Hamming Medal, an award for "exceptional contributions to information sciences and systems."

Course Objectives

We will view all 30 lectures via the campus MBone individually over the network, at a rate of three per week. We will also meet weekly to discuss the material and upgrade the website. There is approximately one hour of reading from the textbook per hour of video lecture.

NPS-Wide MBone Announcement

[Here is our original announcement.]

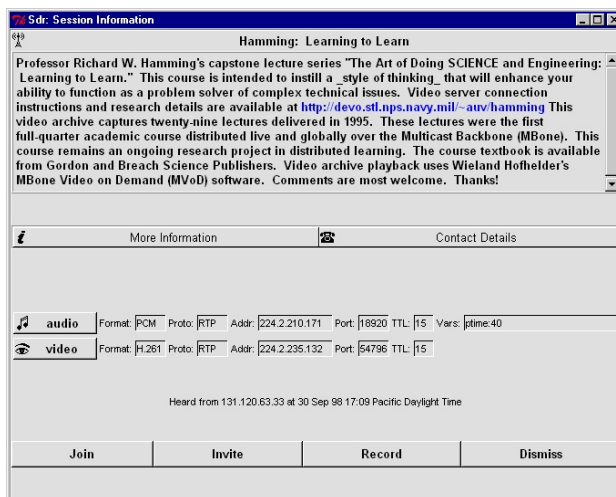


On the left is a picture of typical program listings available via the *sdr* session directory reporting tool.

Click on the right image to see the full-size **Hamming: Learning to Learn** session description.

A [copy of the session announcement file](#) illustrates how the [Session Description Protocol \(SDP\)](#) is used to convey to receivers the packetization scheme used, the media data encoding format and parameters for the media encoding format. The SDP RFC is written by Mark Handley & Van Jacobson and is available at <ftp://ftp.isi.edu/in-notes/rfc2327.txt>

The time-to-live (ttl) value for this session announcement will be adjusted from NPS-wide to global (i.e. worldwide) distribution after this quarter's beta test of course



content is
complete.

References

Hofhelder, Wieland, *MBone VCR on Demand (MVoD) Website*, September 1998. Video-on-demand support using Java applet client and Java server software. Available at www.informatik.uni-mannheim.de/informatik/pi4/projects/MVoD/

Finlayson, Ross, LiveNetwork's Windows/Unix Mbone software [Multikit](http://www.lvn.com/multikit) at www.lvn.com/multikit

Almeroth, Kevin, *The Interactive Multimedia Jukebox (IMJ) Website*, September 1998. Video-on-demand support using HTML client and cgi-bin server software. Available at imj.gatech.edu

Glover, Mark P., *Internetworking: Distance Learning "To Sea" via Desktop Videoconferencing Tools and IP Multicast Protocols*, Master's Thesis, Naval Postgraduate School, Monterey California, March 1998. Primary advisor Rex Buddenberg. Available at web.nps.navy.mil/~seanet/Distlearn/cover.htm

Tiddy, Michael E., *Internetworking: Economical Storage and Retrieval of Digital Audio and Video for Distance Learning*, Master's Thesis, Monterey California, June 1996. Available at www.stl.nps.navy.mil/~iurg/tiddy/

Emswiler, Tracey, *Internetworking: Using the Multicast Backbone (MBone) for Distance Learning*, Master's Thesis, Naval Postgraduate School, Monterey California, September 1995.

Bigelow, Randall J., *Internetworking: Planning and Implementing a Wide-Area Network (WAN) for K-12 Schools*, Master's Thesis, Naval Postgraduate School, Monterey California, June 95. Describes in detail how local-area networks (LANs) and WANs were implemented to connect two dozen K-12 schools to the Internet. Available at <http://www.stl.nps.navy.mil/~rjbigelo>

Macedonia, Michael R. and Brutzman, Donald P., "MBone Provides Audio and Video Across the Internet," *IEEE COMPUTER*, vol. 27 no. 4, April 1994, pp. 30-36. Available at [ftp://taurus.cs.nps.navy.mil/pub/i3la/mbone.html](http://taurus.cs.nps.navy.mil/pub/i3la/mbone.html) or [mbone.pdf](#)

Uniform Resource Locator (URL) for this page is <http://web.nps.navy.mil/~brutzman/hamming/hamming.html> (14 September 2000) ([official disclaimer](#))