

Hamming: Learning to Learn
Art of Doing Science and Engineering
Graduate Research Course, MV4000 (4-0)

Synopsis	Turing Award winner Richard W. Hamming's original course "Learning to Learn: Art of Doing Science and Engineering" has been fully digitized and placed online. This course presents distilled career insights of a preeminent thinker, spread across a complete range of topics in modern science. <i>Learning how to pursue novel research</i> is presented by example.		
Instructor	Don Brutzman Office Watkins 270	brutzman@nps.edu https://faculty.nps.edu/brutzman	1.831.656.2149 work 1.831.402. ____ cell
	Office hours are by request. Usually I am available as shown in Outlook/Teams schedule, otherwise please just stop by if I am in my office. Make an appointment if you want to be sure to see me. If necessary, please may call me.		
Schedule	Watch 1-2 videos per week whenever you want, online group discussion Friday 1300-1400. Grading is based on papers, projects, or presentations. Announcements are in Teams. We are proceeding at "half pace" given the busy schedule followed by NPS PhD students. This course is testing the full restoration of all online assets. Your feedback is valuable and appreciated. We are using newly encoded videos and slides matching the textbook.		
Online sites	NPS Sakai Course Page (https://cle.nps.edu/portal/site/hamming) and NPS Calhoun videos Hamming Learning to Learn videos and MV4000 Course videos archive on YouTube		
Sessions	Weekly sessions are coordinated via nps.edu Microsoft Teams and calendar invitations.		
Textbook	Hamming, Richard W., <i>The Art of Doing SCIENCE and Engineering: Learning to Learn</i> , Gordon and Breach Science Publishers, Amsterdam B.V, The Netherlands, 1997. Textbook is available online and recently back in print at Stripe Press , also listed at #9 of 20 in " The Best Books We Read in 2020 ," New Yorker Magazine, 1 December 2020.		
Guidelines	<ol style="list-style-type: none"> 1. You must devote time to reading and watching video to succeed in this course. Each week you should read 1-2 chapters and view the corresponding videos. 2. Friday afternoon is topic discussion – please join prepared to participate. We meet then in order to honor Hamming’s routine of dedicating 10% of each week to think big thoughts. 3. We are considering many important questions. The answers are not always the same. 4. The breadth of material covered by Dr. Hamming is quite broad. This is intentional. 5. This course is designed to help you work on significant dissertation research. Improvements continue. Your comments, questions and suggestions are always welcome. 6. Reporting, tracking and fixing archive bugs and issues is important. When you send mail, please add “MV4000” or “hamming” in the subject line so that email filters work. 		

Course Objectives

Richard W. Hamming's original capstone course "Learning to Learn: Future of Science and Engineering" has been fully digitized and placed online. This course presents the distilled career insights of a preeminent thinker. In 1968, Dr. Hamming was the recipient of the Turing Award, the highest honor in computer science, for his work on numerical methods, automatic coding systems, and error-detecting and error-correcting codes. This course is intended to instill a "style of thinking" that will enhance one's ability to function as a problem solver of complex technical issues.

With respect, students sometimes called the course "Hamming on Hamming" because he relates many research collaborations, discoveries, inventions, and achievements of his own. This collection of stories and carefully distilled insights relates how those discoveries came about. Most importantly, these presentations provide objective analysis of the thought processes and reasoning that took place as Dr. Hamming, his associates, and other major thinkers in computer science and electronics progressed through the grand challenges of science and engineering in the twentieth century.

Class Policy and Study Recommendations

1. You are learning new ideas and – in some ways - a new language. Thinking and writing in a new language requires fluency. Don't be reluctant to think new thoughts or work hard. Persistence pays.
2. You will get a LOT more out of class by reading assigned material beforehand. Keep ahead of me in your reading. Read each section, review the slidesets and slide notes, and use the videos as backup learning material. This is a challenging, ambitious course that is worth your while.
3. Discussion and dialog can help make class concepts a lot more relevant to your own work. Typically each student presents 1-2 topics during the course and leads discussion via a presentation.
4. Projects make up your entire grade, just like the real world. Exams are boring.
5. Grading is based on merit and performance. I expect everyone to work hard and get an A.
6. Your guiding theme throughout this journey is the rule of thumb "How does this help my research?" Please use that guideline as inspiration each week by meeting or exceeding expectations. Your course project or presentation should ask and answer that central question as well.
7. Student participants from outside of NPS are welcome and receive a letter of recognition upon completing the course. Faculty participation is also welcome.
8. All feedback and suggestions for improvement are welcome. Good luck with your research work!