1999 Medical Informatics
A Course for Health Professionals

Sponsored by the National Library of Medicine and the Marine Biology Laboratory, Woods Hole Massachusetts

Course Directors:

Spring course: Daniel R. Masys, M.D.
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1999 Spring Course Session Education Objectives and Outlines

Day 1 - Monday, May 31, 1999

Session 1: 8:30 - 10:00 AM

HPCC, NII, current issues in medical informatics

Faculty

[Donald A.B. Lindberg, M.D.](#)

Educational Objectives

This lecture will summarize the federal interagency High Performance Computing and Communications program accomplishments in non-medical and health related aspects and will enumerate some past, current, and future research funding sources.

At the completion of the session, participants will:

1. Understand the "interagency model" and the government-industry-university approach to the HPCC work.
2. Understand the initial opportunities in biomedical applications of the NII.
3. Have a beginning set of funding contacts.

Session Outline

1. High Performance Computing and Communications federal program
    - Background and Legislation

- Objectives and Organization
- Phase 1

  Accomplishments - Grand Challenges

  Progress on Grand Challenge Problems

- Phase 2
  - National Information Infrastructure
  - National Challenge Applications
    - Non-medical
    - Medical

2. NLM Role in the NII
   - Intramural Research

     UMLS

     Visible Human

   - Extramural Research

     NII medical testbed

     Telemedicine

     Computer-based patient record

3. Public Policy Issues
   - Medical Data Privacy
   - National Security
   - Intellectual Property Rights

     Traditional Copyright Demands

     Today's Revolution in Electronic Publishing

4. Federal Research Funding Sources for Medical Informatics
   - NLM Programs
   - Other HHS Programs
   - Other federal agency support

Session 2: 10:30 - 12:00 N

Principles of Database design

Faculty

[Daniel R. Masys, M.D.](#)

Educational Objectives

This lecture and lab session will introduce basic principles of organization of data in computerized systems. At the completion of the session, participants will:

1. Understand the historical evolution of computerized data handling methods
2. Know the relative strengths and weaknesses of hierarchical, relational, information network, and object-oriented database systems
3. Understand the process of development of a set-theory-based relational data model, including entity-relationship definitions, principles of fully normalized relational models, state transitions and data flow diagrams.
4. Understand the design principles involved in the transformation of a flat file record structure to a normalized relational structure (lab exercise).

Session Outline

1. Database definitions and paradigms
   - What is a Database?
   - Historical Evolution of data management techniques
   - General benefits of Database Management Systems (DBMSs)
   - DBMS types

     Heirarchical

     Information Network (linked lists and pointers)

     Relational

     Object-oriented

2. Principles of Relational database design
   - Representation of real world objects and their attributes
   - Relationships between objects
   - Table notation formalisms
   - Relationships: one-to-one, one-to-many, many-to-many
3. System design and building methods
   - Entity-relationship diagrams
   - State Transition Models
   - Data Flow Diagram
4. Transforming flat files to tables
5. A sample problem in database design

Session 3: 1:30 - 3:00 PM

Medical Uses of Spatial and Geographic Data

Faculty

TBD

Educational Objectives

Session Outline

Session 4: 3:30 - 5:00 PM

Unified Medical Language System

Internet Grateful Med

Faculty

Lawrence C. Kingsland, Ph.D.

Educational Objectives

This lecture and lab session will introduce the National Library of Medicine's Unified Medical Language System (UMLS) and a major new application which uses it: Internet Grateful Med. At the completion of the session, participants will:

1. Understand the problem addressed by the Unified Medical Language System initiative
2. Know the major components of the Unified Medical Language System
3. Have been exposed to the breadth of content of the UMLS Metathesaurus
4. Receive an introduction to and concentrated lab time with NLM's new Internet Grateful Med program, using the UMLS Metathesaurus and other resources to provide assisted searching in MEDLINE and other NLM databases

Session Outline

1. Problem addressed by the Unified Medical Language System

   Multiplicity of vocabularies, classifications, naming systems

2. Major components of the Unified Medical Language System
     - Metathesaurus
     - Semantic Network
     - Information Sources Map
     - Lexicon, Lexical Tools
3. Breadth of the Unified Medical Language System Metathesaurus

   UMLS Knowledge Source Server

4. Internet Grateful Med
     - The problem addressed by Internet Grateful Med
     - The NLM Access Model
     - Assisted searching with an intelligent gateway system
     - Active use of the UMLS Metathesaurus
     - Search formulation; retrieval
     - Search refinement
     - Guided lab time (tutorial)
     - Independent lab time; tutors on hand

Evening Personal Skills Workstop, Monday May 31, 1999

Digital Multimedia using PowerPoint

Faculty

[Adrian Smith, MBL staff](#)

Educational Objectives

Multimedia is becoming vital to the success of education and online presentations and new tools allowing the simple integration and display of multimedia files are now common on desktop computers. Using Microsoft PowerPoint 97, the class will explore the audio, image, and video file formats available for multimedia presentations. The class will begin with of a short talk on analog vs. digital files, audio, video, and image file types, sizes, and quality, and the appropriate techniques for acquiring and presenting these materials, both from the Internet and from digital still and videocameras. This will be followed by a hands-on tutorial where students will be able to obtain representative multimedia files from the World Wide Web and incorporate them into a PowerPoint presentation, using the multimedia features of the application to present the materials to their best advantage.

At the completion of the session, participants will:

1. Understand the document model used by PowerPoint.
2. Be comfortable building presentations using PowerPoint's built-in "Wizards".
3. Have a better understanding of the processes involved in creating a multimedia presentation.

Session Outline

1. Why use computer-generated presentations?
2. What is PowerPoint?

   - Concepts

3. Wizards

   - Presentation Wizard

   - Auto-Content Wizard

   - Help Wizard

4. Creating a Presentation

   - Choosing a Wizard

   - Adding Information

   - Previewing the Presentation

5. Views

- Slide View

- Slide Sorter View

- Outline View

- Notes

6. Design Considerations

   - Color

   - Layout

   - Effects

7. Multimedia elements

   - Graphics

   - Video

   - Audio

Day 2 - Tuesday, June 1, 1999

Session 1: 8:30 - 10:00 AM

Molecular biology information resources

Faculty

[David Landsman, Ph.D.](#)

Educational Objectives

In this lecture and the accompanying lab session, Dr. Landsman will discuss methods developed at the National Center for Biotechnology Information, to extract information about chromosomes, genomes, molecular sequences and structures, and the associated information in the biomedical research literature. Students will get hands on experience of these tools.

Session Outline

1. Molecular biology data objects
   - Building blocks
   - Sequences
   - Folding
2. Databases of molecular objects
   - GenBank and its international collaborators
   - Molecular Modelling Database (MMDB) and Protein Data Base (PDB)

- The Genomes Division of GenBank
  3. Extracting data from these databases
       - Entrez
       - Network Entrez

Session 2: 10:30 - 12:00 N

Encryption and Public Policy Issues

Faculty

[Donald A.B. Lindberg, M.D.](#)

Educational Objectives

This lecture and discussion will present the theoretical and practical bases for recommendations concerning medical data privacy, data encryption technology, and some of the national security considerations.

At the completion of the session, participants will:

1. Know the issues facing the US regarding copyright and database protection world-wide
2. Know if they support or do not support federal privacy legislation, and its features
3. Understand the basis for current data encryption methods.
4. Will have tested at least two Security Token Authentication devices.
5. Know if they prefer to operate Challenge Response or Time Synchronous security devices.

Session Outline

1. Intellectual Property Rights
       - WIPO Treaty proposals
       - Pub Med Plans
2. Encryption
       - Basic concepts
       - DES
       - Public-Private Key
       - Implementation and Devices

   a) Data Encryption Technology

       - Private Key Encryption
            - Digital Encryption Standard
            - Kerberos
       - Public-Private Key Encryption

   b) System Considerations

       - Length of Cipher Keys
       - Security
       - Token Authentication

    c) Devices

- Challenge - Response
- Time Synchronous

3. Medical Data Privacy
    - Requirements
    - Legislation
        - Overview
        - Status of Federal Privacy Legislation
        - Contentious Issues
    - Initial Practical Experience with Medical Data Privacy Assurance

Session 3: 1:30 - 3:00 PM

- *Database Design Laboratory exercise*

Session 4: 3:30 - 5:00 PM

Principles of Web Page Design

Faculty

[David Remson, MBL staff](#)

Educational Objectives

At the completion of this session, participants will have an understanding of Hypertext Markup Language (HTML) and its application in the creation of World Wide Web pages.

Evening Personal Skills Workstop, Tuesday June 1, 1999

Class of '98 Personal Web pages

Faculty

[Daniel R. Masys, M.D.](#)

Educational Objectives

During this workshop, the HTML principles discussed in the afternoon session will be applied to creating personal web pages, and uploading those pages to a Web server.

Day 3 - Wednesday, June 2, 1997

Sessions 1-4

Evaluation Methods in Medical Informatics

Faculty

Charles P. Friedman, Ph.D.

Educational Objectives/Session Outline

This section of the course examines medical informatics as an empirical science. As such, the section will focus on formal studies of applications of information technology in medicine. We refer to these applications generically as information resources. Studies can be conducted while information resources are under development as well as after they are in routine service. Studies typically address questions such as: Is the resource functioning as anticipated? How can it be improved? Does it make a difference? Are the differences it makes beneficial?

Within medical informatics, there is increasing interest in evaluation and empirical studies. From an administrative perspective, as institutions invest in new technology, it is critical for them to know how these systems can contribute to health care, education, and research so they can set develop plans and set priorities. From a more academic perspective, research projects in informatics, including doctoral dissertations and masters theses, now often include an evaluation or empirical study component. Much of the funded research in informatics is required to have such a component.

This day-long session on evaluation will provide participants with an understanding of the range of evaluation methods that are used in informatics and will address how studies are designed as well as how data for these studies are collected, analyzed, and reported. We will address during the day many of the challenges that make evaluation difficult, emphasizing those challenges that are particular to medical informatics, and we will discuss methods that have been developed for addressing many of these challenges.

Session 1: 8:30-10:00

The Panorama and Challenges of Evaluation

Learning Objectives:

At the completion of the session, participants will be able to:

1. Describe the purposes of evaluation in medical informatics.
2. List several factors that can make it difficult to do evaluation in medical informatics effectively, as well as strategies that can be employed to address these difficulties.
3. Distinguish objectivist (quantitative) and subjectivist (qualitative) approaches, describe the assumptions that underlie them, and explain why both methods are used.
4. Identify the major steps in the process of conducting objectivist and subjectivist studies.
5. Identify the individuals or groups comprising the ìaudienceî for an evaluation study.
6. Describe how the methods and purposes of a study can be matched the level of maturity of an information resource.

Session 2: 10:30-Noon

Objectivist Studies: Issues of Study Design

Learning Objectives:

At the completion of the session, participants will be able to:

1. Distinguish between measurement and demonstration aspects of objectvist studies.
2. Distinguish between descriptive, correlational and comparative study designs and the purposes served by each.
3. Identify the features comprising a complete study design.
4. Identify major threats to inference and validity.
5. Name, define, and identify major biases and other factors that threaten the internal and external validity of study designs.
6. Describe the benefits and weaknesses of various control strategies in comparative studies.
7. Identify data analysis strategies that are appropriate to descriptive, correlational and comparative study designs.

Session 3: 1:30-3:00

Objectivist Studies: Issues of Measurement

Learning Objectives:

At the completion of the session, participants will be able to:

1. Frame many of the recurring difficulties of evaluation in medical informatics as problems of measurement.
2. Distinguish between measurement errors that are issues of reliability from those that are issues of validity. Distinguish between different types of validity.
3. Explain how ìmeasurement studiesî can be conducted to identify the sources of error in any measurement process, and to estimate the magnitude of these errors.
4. Explain what is meant by a ìgold standardî in the framework of a measurement study.
5. Identify measurement methods and features of measurement instruments that can be employed to reduce measurement errors.

Session 4: 3:30-5:00

Subjectivist Studies

Learning Objectives:

At the completion of the session, participants will be able to:

1. Identify some specific evaluation questions or issues that lend themselves particularly well to subjectivist approaches.
2. Explain how the questions and key issues of a study arise through the process of immersion.
3. Describe the major data collection strategies in subjectivist research, how these are used in a complementary way within a study, and how the data generated by each are analyzed.
4. Explain the steps a researcher can take to ensure the veracity of the findings of a subjectivist study.

5. Describe some of the barriers to combining objectivist and subjectivist methods within a single study.

Evening Personal Skills Workstop, Wednesday June 2, 1999

Building Web Intefaces to Databases

Faculty

[David Remsen, MBL staff](#)

Educational Objectives

This workshop will give participants hands-on experience in serving databases to the web. In this session they will learn the different necessary components of a database web server. They will create their own interface to a database and learn how to conditionally format the results in HTML. They will get an understanding how HTML form elements translate to database calls, how an HTML form translates to a database query, and how a query is processed and the results are returned.

Session Outline

1. Present an overview of a generic database web serving system. This overview will consist of identifying and defining the function of the the different elements that compose a database server.
2. A brief introduction to a few of the different database solutions to show how different vendors address the model described in 1.
3. Create an interactive web database using Filemaker Pro 4.0 with a sample database which will address the following: Querying the database using FORM and embedded URLS
4. Editing a Record via the web
5. Adding/Deleting Records
6. Processing results with format files.
7. Understanding how HTML and database meta tags can interact by:

     a. Listing multiple records
     b. Formatting a single record
     c. Using conditionals to selectively format records
     d. Using color and graphics with numeric content

   8. Creating embedded links to Entrez, PubMed, others

Day 4- Thursday, June 3, 1999 and Day 5 - Friday, June 4, 1999

Sessions 1-4: 8:30 AM - 5:00 PM

Clinical Information Systems

This series of lectures and lab sessions will cover the design principles of large-scale clinical information systems that meet the needs of academic medical centers.

Faculty

James J. Cimino, M.D.

George Hripcsak, M.D.

Soumitra Sengupta, Ph.D.

Educational Objectives

At the completion of the session, participants will:

1. Understand the success factors in building and managing large-scale information systems in an academic medical center.
2. Know the design principles of clinical information systems, and understand the function of each component: patient database, controlled vocabulary, event monitor, and user interfaces.
3. Understand the cost/benefit issues involving health care information systems, in particular, the role of automated care plans and practice guidelines.

Session Outline

1. IAIMS (Integrated Academic Information Management System)
    - IAIMS goals

        Success factors

        Institutional Commitment

        Leadership

        Network

        People

        Architecture

        Applications

        Demonstration

2. Clinical information system architecture
    - Architectural issues

        Scale: from desktop to nation

        Heterogeneity: network, applications, users

        Centralization: quality control vs. flexibility

        Case study: large-scale, heterogeneous, system with centralized control

3. Data interchange standards
    - Goals
    - Seven layer ISO model

- Medical standards organizations
- Health Level Seven (HL7)
- Limitations
4. Medical databases and vocabularies
    - What is special about medical data?

      Large number of entities

      Complex naming

      Degrees of granularity

      Temporal nature

      Perspectives for classification

      Nesting of modifiers

      Medical databases

      Content: medical events

      Views: patient care, research, department

      Design issues: performance, availability, extensibility, ease of access

    - Clinical vocabularies

      Goals: coding, translation, decision support

      Methods

      Maintenance issues

      Established vocabularies

5. Clinical data acquisition and review
    - Types of clinical applications
    - Types of clinical users and working styles
    - Data acquisition
        - Input modalities (text, voice, pen, touch)
        - Design principles
    - Data review
        - Display modalities (graphics, text, sound, video)
        - Design principles
6. Decision analysis
    - Purpose
    - Judgment under uncertainty
    - Baysian approach
    - Decision trees
    - Assessing probabilities and utilities
    - Sensitivity analysis

7. Decision-support systems
    - Goals
    - Approaches to decision support
    - Types of decision-support systems
    - Knowledge representation and sharing
    - Architecture of an event monitor
    - Care plans and practice guidelines
8. Costs and benefits
    - Costs of building systems
    - Conclusions drawn from usage
    - The role of information systems

Evening Personal Skills Workstop, Thursday June 3, 1999

Java, JavaScript, and Database Access

Faculty

Adrian Smith, MBL staff

Educational Objectives & Outline

This session is intended to provide an introduction to Object Oriented concepts using Java. The lecture component of the class will consist of an overview of classes, objects, methods and variables as they are implemented in Java, followed by examples of Java and JavaScript in action. In the hands-on segment of the class the students will build and compile a simple Java applet using Symantec Visual Cafe. In addition, a demonstration will be given of using Visual Cafe and the associated dbAnywhere middleware tool to connect a Java applet to an SQL database residing on a remote server.

Day 6 - Saturday, June 5, 1998

Session 1: 8:30 - 10:00 AM

Introduction to Telemedicine

Faculty

Charles Safran, M.D.

Educational Objectives

This lecture will review the historical evolution and the technical underpinnings of Telemedicine. In addition, the current policy and regulatory issues will be explored.

Session Outline

1. Historical Background
2. Evolution of Care at a Distance
3. Technical Infrastructure

4. Policy and Regulatory Issues

Session 2: 10:30 - 12:00 PM

Telemedicine Applications

Faculty

Charles Safran, M.D.
Peter Macaulay

Educational Objectives

This lecture will review current telemedicine applications. Specific emphasis will be placed upon how these systems have been evaluated, what are the associated costs, what are the benefits, and what factors are associated with successful applications.

Session Outline

- Review of Current Applications
- Human factors and Workflow
- Costs of Telemedicine
- Measuring the Benefits of Telemedicine

Session 3: 1:30 - 3:00 PM

Case Study of the Baby CareLink Project

Faculty

Charles Safran, M.D.
Jim Gray, MD

Educational Objectives

This lecture will review one current home telehealth project in detail. The Baby CareLink Project uses telemedicine to provide educational and emotional support to families of high risk newborns both during their hospitalization and following discharge. This innovative use of this emerging technology will hopefully lead to shorter hospital stays and will also increase parental understanding and comfort, overall parental satisfaction with their baby's NICU care, improve the childís overall health status, improve clinician satisfaction, and provide a clear cost savings.

Session Outline

- From Concept to Application
- Organizing the Team
- Developing the Application
- Practical Choices
- Delivering Telemedicine in the Home
- Evaluation Strategies
- Live Demonstration

Session 4: 3:30 - 5:00 PM

Designing a Medical Informatics Curriculum

Faculty

Educational Objectives

At the completion of this session, participants should have an understanding of issues attendant to the development and implementation of a medical informatics curriculum at the fellows' home institutions.

Session Outline

This session will be an interactive discussion among faculty and fellows. It will review the topics covered at the MBL course and promote discussion regarding future changes.

5:00 PM

Course Wrap-Up and Farewell

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