Biomedical Informatics: Computer Applications in Health Care and Biomedicine

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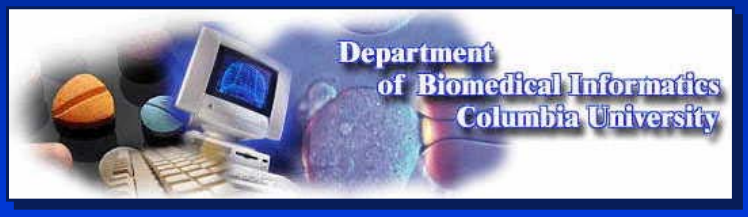
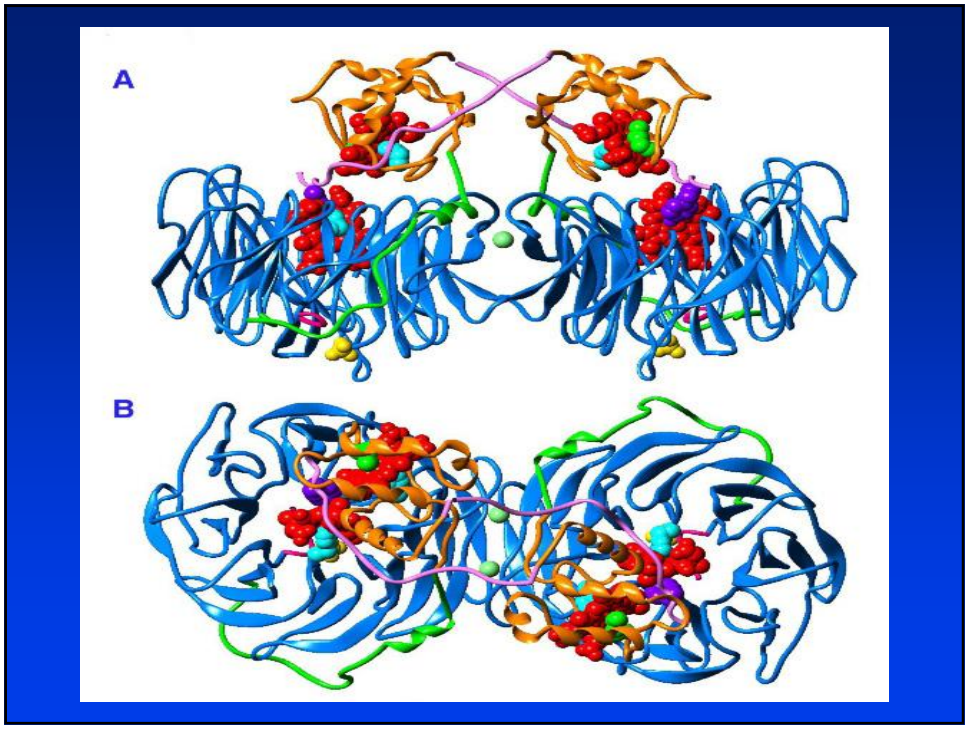


Asian Pacific Association for Medical Informatics
Symposium 2006
Taipei, Taiwan
October 27, 2006


A
B

Today's Topic

Academic Biomedical Informatics

- Definitions and scope
- Terminology
- Textbook of Biomedical Informatics
- Education of Biomedical Informatics professionals
- Education of Biomedical Informatics researchers
  - Scientific papers
  - Doctoral dissertations
- Education of health professionals about informatics
- Creation of new academic units
  - Graduate training and recruitment of faculty
- Anticipating the future

What is Biomedical Informatics?

- Is it a "real" academic discipline?
  - Scientific base?
  - Here to stay?
- Is it needed both in universities and in the world beyond?
  - Job opportunities?
  - Are people filling those roles now?
  - Are there enough of them?
- How does it relate to other disciplines?
  - Duplicative?
  - Interdisciplinary?

Historical Perspective

- Computers in medicine emerged as a young discipline in the 1960s
  - Most applications dealt with clinical issues
- No consistency in naming the field for many years
  - "Computer applications in medicine"
  - "Medical information sciences"
  - "Medical computer science"
- Emergence in the 1980s of a single, consistent name, derived from the European (French) term for computer science: *informatique*
  - Medical Informatics

The Last 25 Years

- US Govt-supported medical informatics training programs at several universities (now 18 programs)
  - Application areas broadened in recent years to include biological sciences, imaging, and other biomedical domains
- Creation of professional societies, degree programs, quality scientific meetings, journals, and other indicators of a maturing scientific discipline
- Broadening of applications base, but with a growing tension between the field's service role and its fundamental research goals

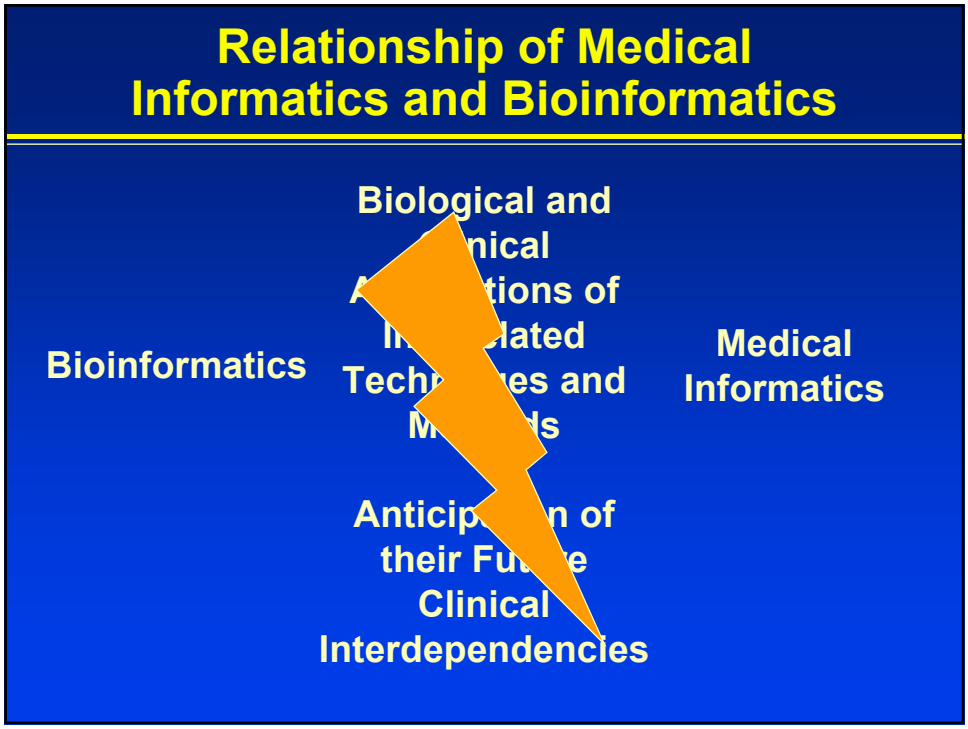
Issues For Academic Informatics

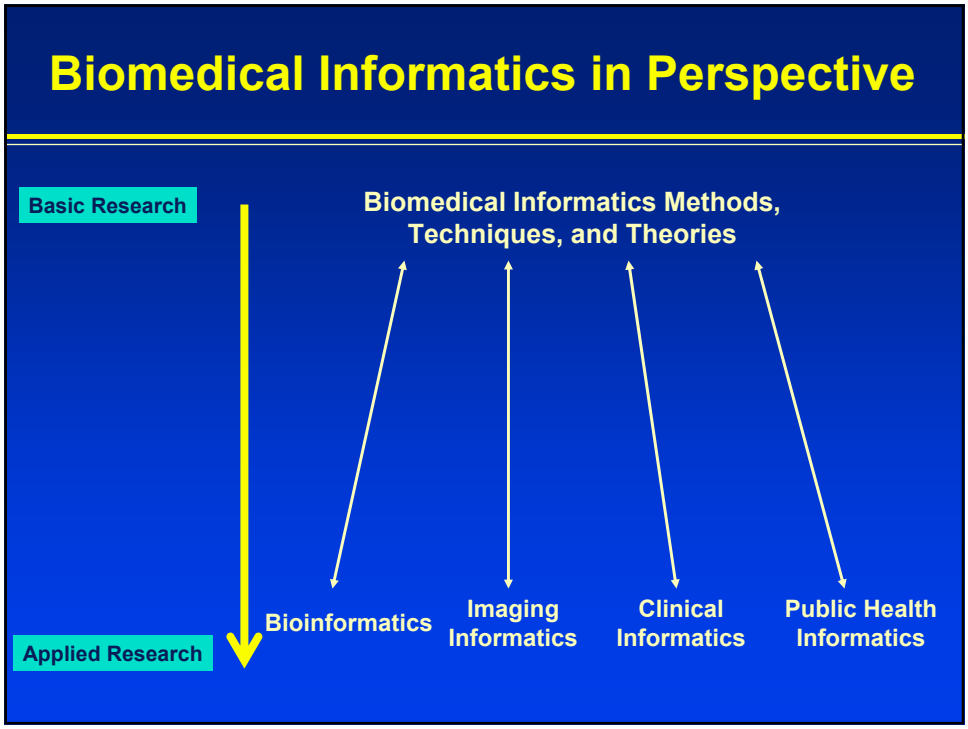
- Conveying the fundamental issues in the field to colleagues who equate "true science" with life-science discoveries, typically in the wet-bench laboratory
- Finding the right mix between research/training and service requirements
- Dealing with the challenges of an interdisciplinary field that demands peer relationships with individuals in the computer science and biomedical fields as well as in biomedical informatics itself

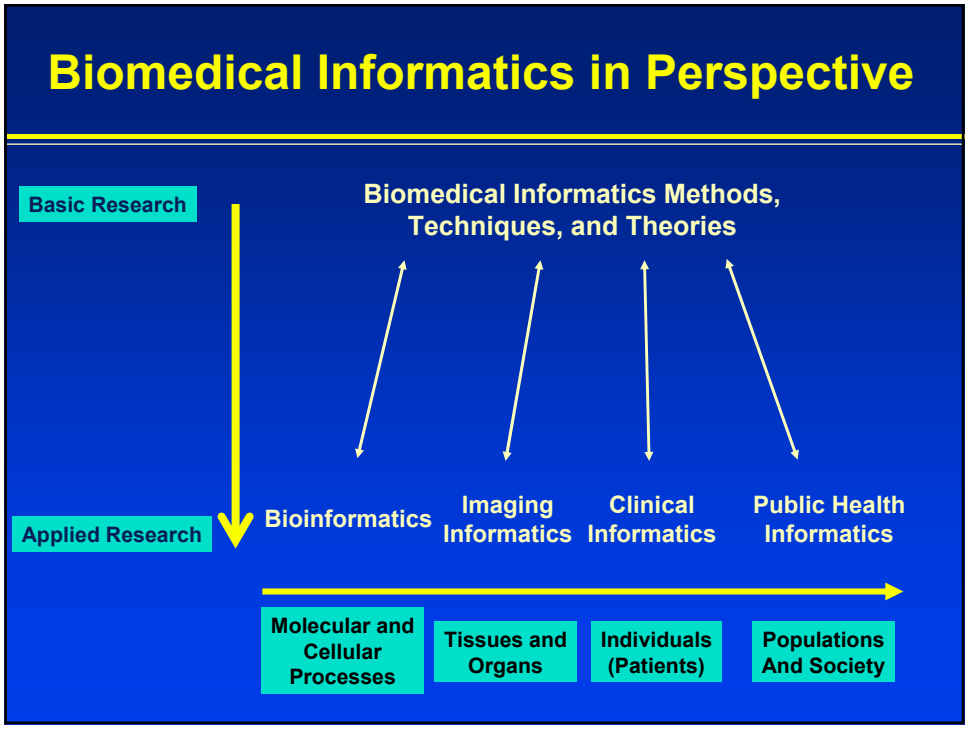
Biomedical Informatics

Biomedical informatics is the scientific field that deals with the storage, retrieval, sharing, and optimal use of biomedical information, data, and knowledge for problem solving and decision making.

Biomedical informatics touches on all basic and applied fields in biomedical science and is closely tied to modern information technologies, notably in the areas of computing and communication.


Relationship of Medical Informatics and Bioinformatics
Bioinformatics
Medical Informatics
Anticip n of their Fu e Clinical Interdependencies


Biomedical Informatics in Perspective
Basic Research
Applied Research
Biomedical Informatics Methods, Techniques, and Theories
Bioinformatics
Imaging Informatics
Clinical Informatics
Public Health Informatics


Biomedical Informatics in Perspective
Basic Research
Biomedical Informatics Methods, Techniques, and Theories
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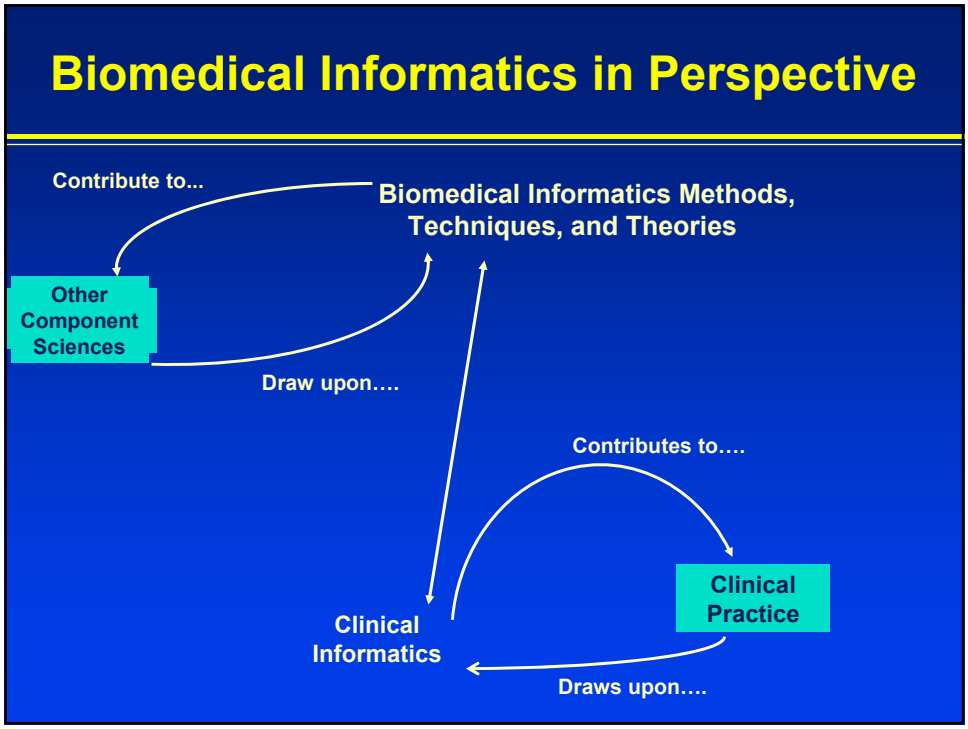
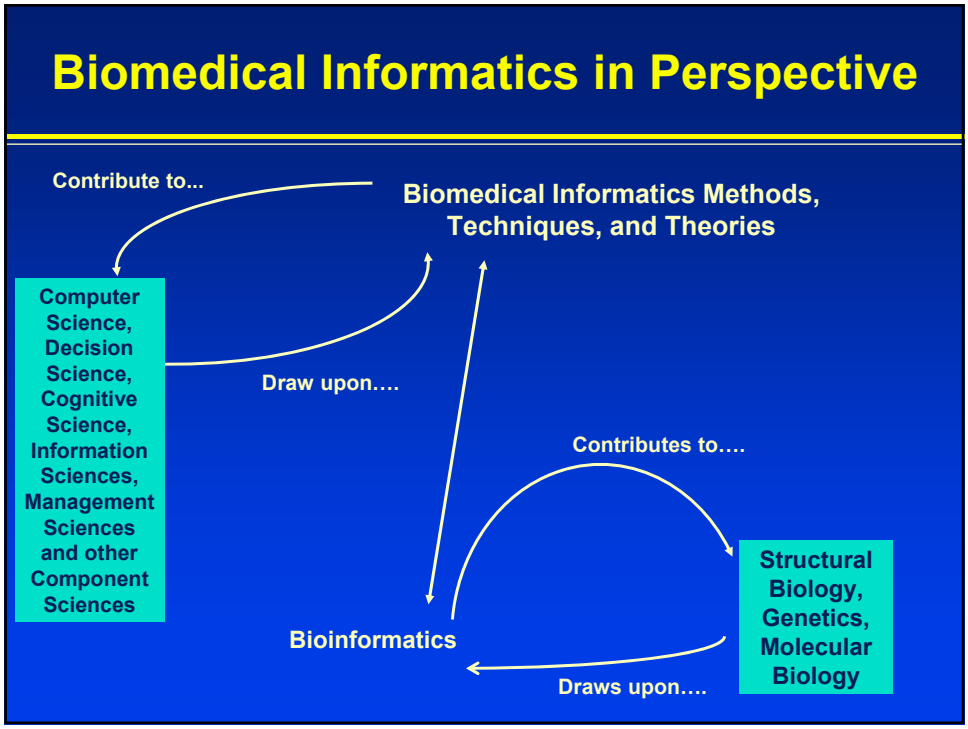
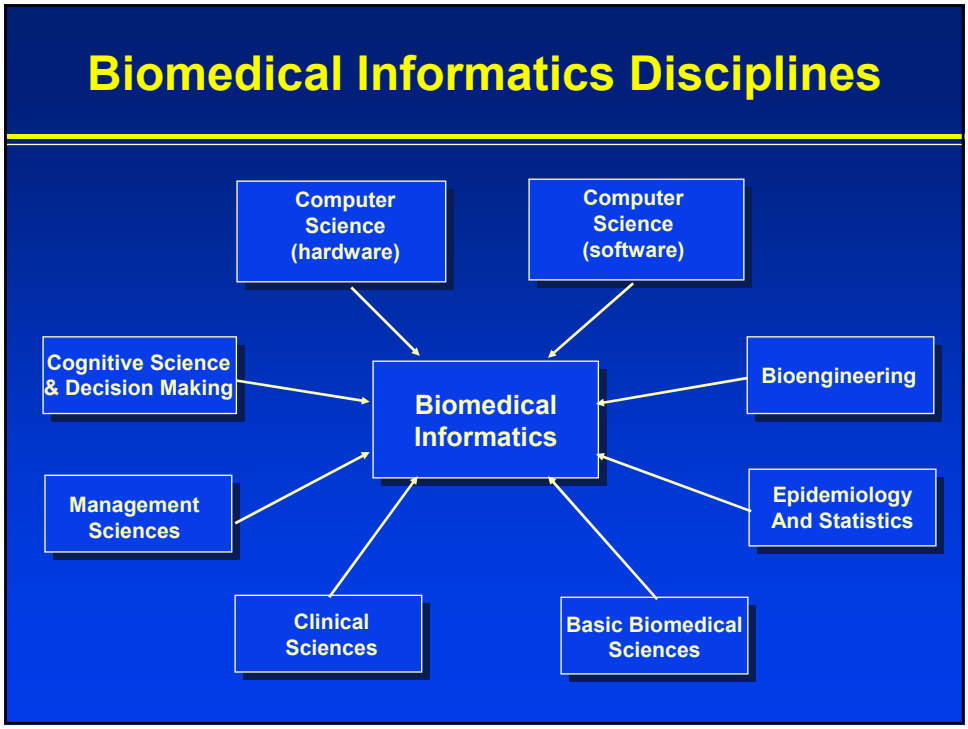
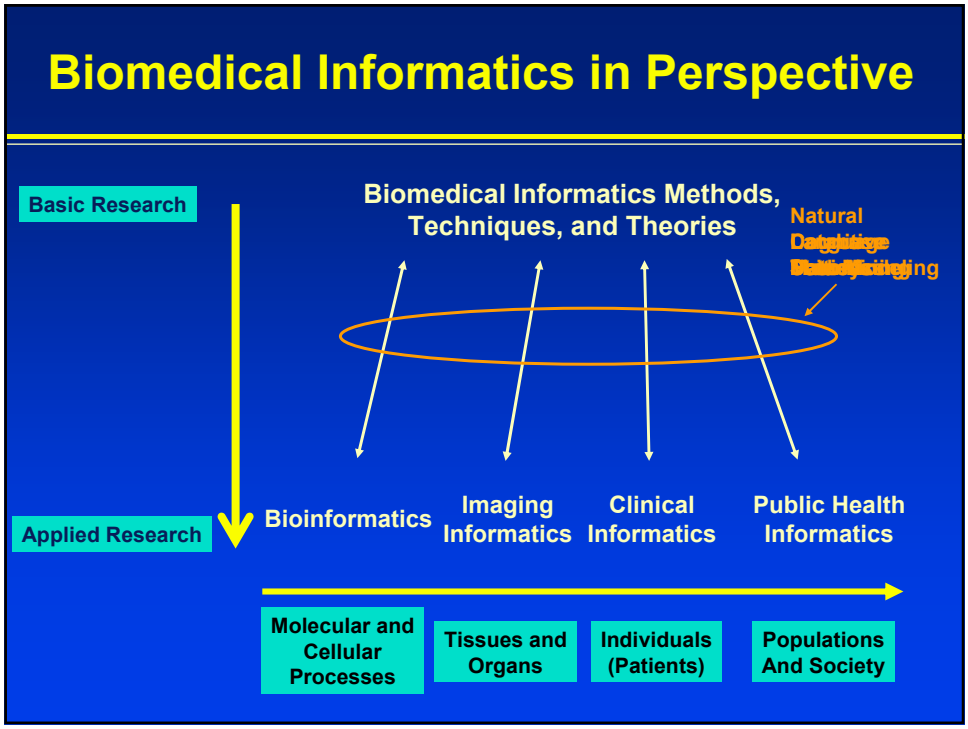
Bioinformatics
Imaging Informatics
Clinical Informatics
Public Health Informatics
Molecular and Cellular Processes
Tissues and Organs
Individuals (Patients)
Populations And Society


Biomedical Informatics in Perspective
Contribute to...
Biomedical Informatics Methods, Techniques, and Theories
Other Component Sciences
Draw upon....
Contributes to....
Clinical Practice
Clinical Informatics
Draws upon....


Biomedical Informatics in Perspective
Contribute to...
Biomedical Informatics Methods, Techniques, and Theories
Computer Science, Decision Science, Cognitive Science, Information Sciences, Management Sciences and other Component Sciences
Draw upon....
Contributes to....
Structural Biology, Genetics, Molecular Biology
Bioinformatics
Draws upon....


Biomedical Informatics Disciplines
Computer Science (hardware)
Computer Science (software)
Cognitive Science & Decision Making
Biomedical Informatics
Bioengineering
Management Sciences
Epidemiology And Statistics
Clinical Sciences
Basic Biomedical Sciences


Biomedical Informatics in Perspective
Basic Research
Biomedical Informatics Methods,
Techniques, and Theories
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Applied Research
Bioinformatics
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Informatics
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Informatics
Public Health
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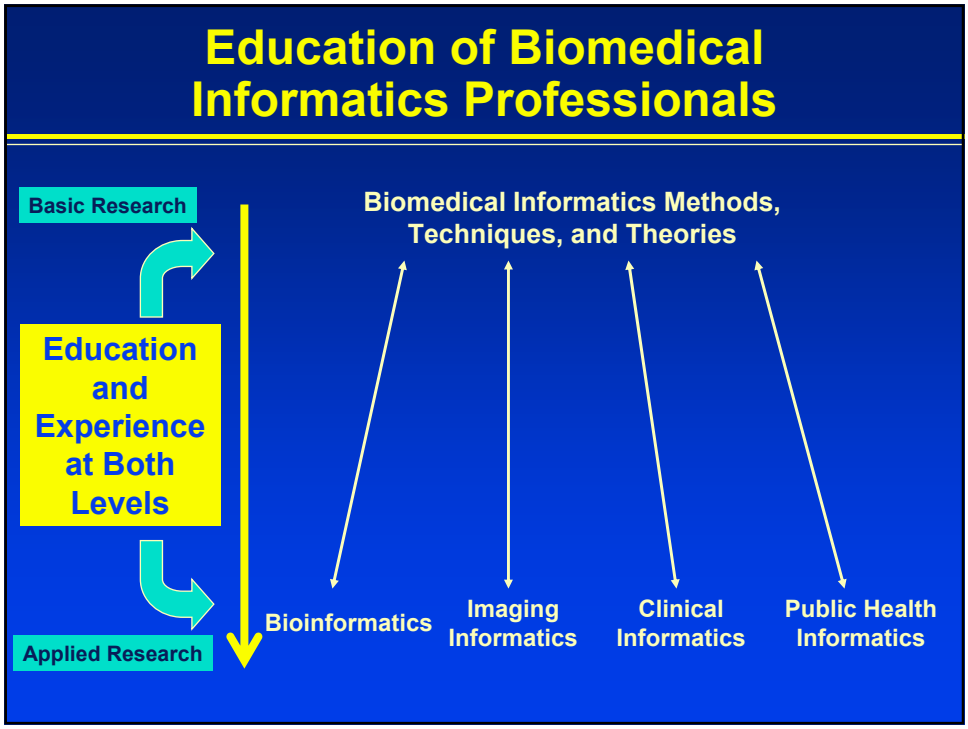
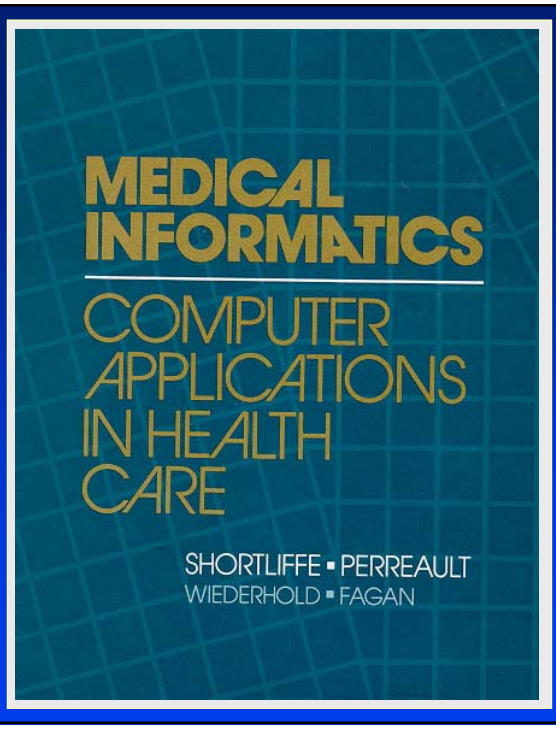
Molecular and
Cellular
Processes
Tissues and
Organs
Individuals
(Patients)
Populations
And Society


Education of Biomedical
Informatics Professionals
Basic Research
Biomedical Informatics Methods,
Techniques, and Theories
Education
and
Experience
at Both
Levels
Applied Research
Bioinformatics
Imaging
Informatics
Clinical
Informatics
Public Health
Informatics

Medical Informatics Textbook

(1st Edition)

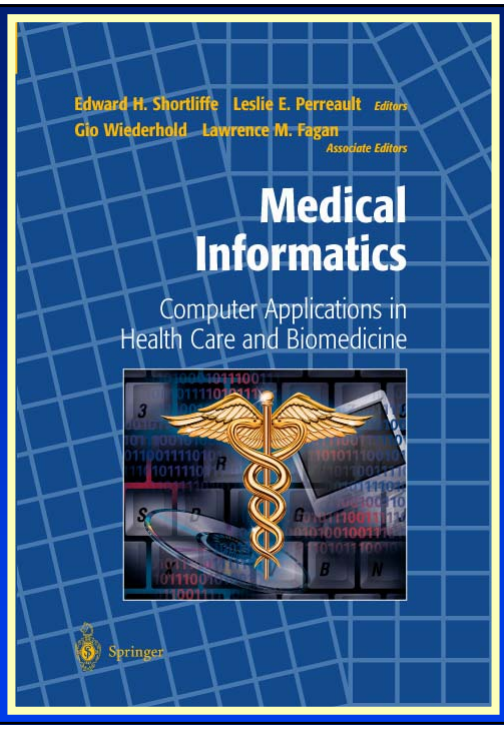
Addison-Wesley 1990



Medical Informatics Textbook

(2nd edition)

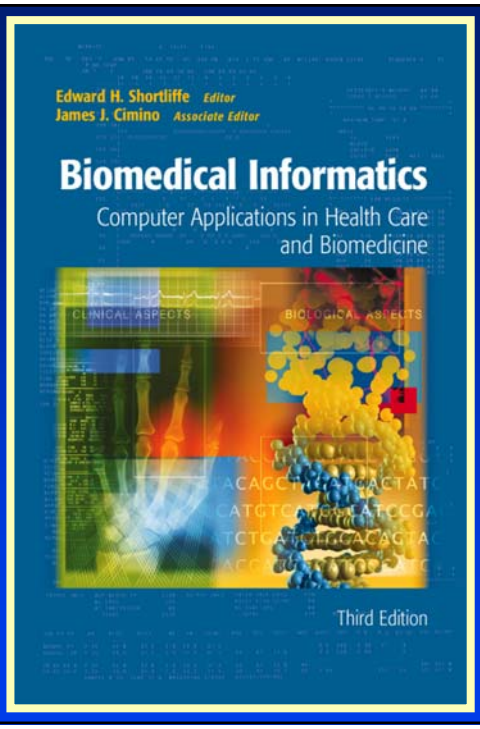
Springer Verlag - 2000



Biomedical Informatics Textbook

(3rd edition)

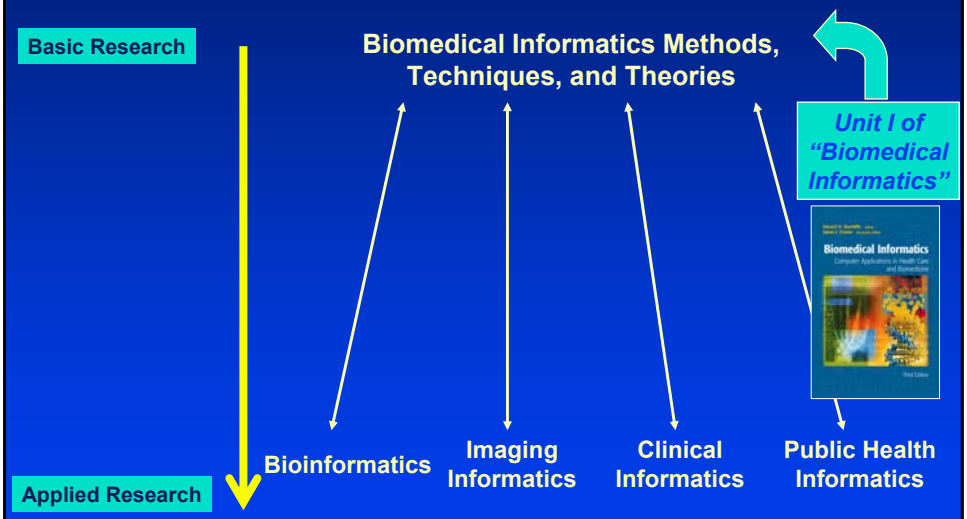
Springer - 2006



Unit I: Recurrent Themes in Biomedical Informatics

1. The Computer Meets Medicine and Biology: Emergence of a Discipline
2. Biomedical Data: Their Acquisition, Storage, and Use
3. Biomedical Decision Making: Probabilistic Reasoning
4. Cognitive Science in Support of Biomedical Informatics
5. Essential Concepts for Biomedical Computing
6. System Design and Engineering
7. Standards in Biomedical Informatics
8. Natural Language and Text Processing in Biomedicine
9. Imaging Informatics
10. Ethics and Health Informatics: Users, Standards, and Outcomes
11. Evaluation and Technology Assessment

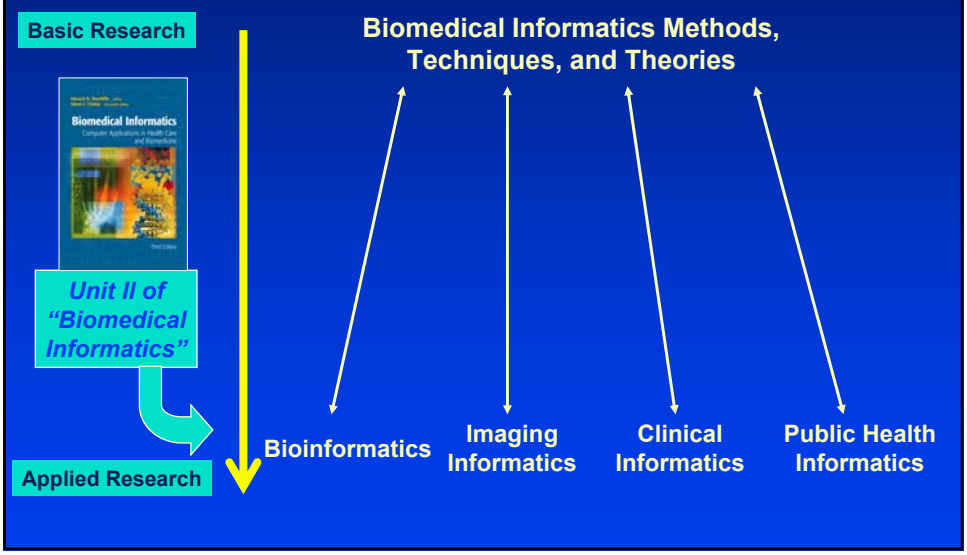
Biomedical Informatics



Unit II: Biomedical Informatics Applications

12. Electronic Health Record Systems
13. Management of Information in Healthcare Organizations
14. Consumer Health Informatics and Telehealth
15. Public Health Informatics and the Health Information Infrastructure
16. Patient-Care Systems
17. Patient Monitoring Systems
18. Radiology Systems
19. Information Retrieval and Digital Libraries
20. Clinical Decision-Support Systems
21. Computers in Health Science Education
22. Bioinformatics

Biomedical Informatics



Unit III: Biomedical Informatics in the Years Ahead

23. Healthcare Financing and Information Technology: A Historical Perspective
24. The Future of Computer Applications in Biomedicine

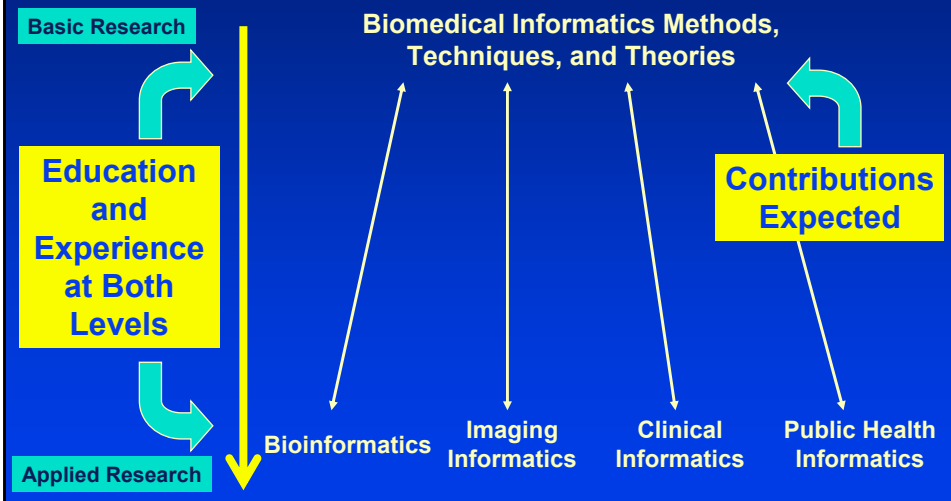
Glossary

References

Name Index

Subject Index

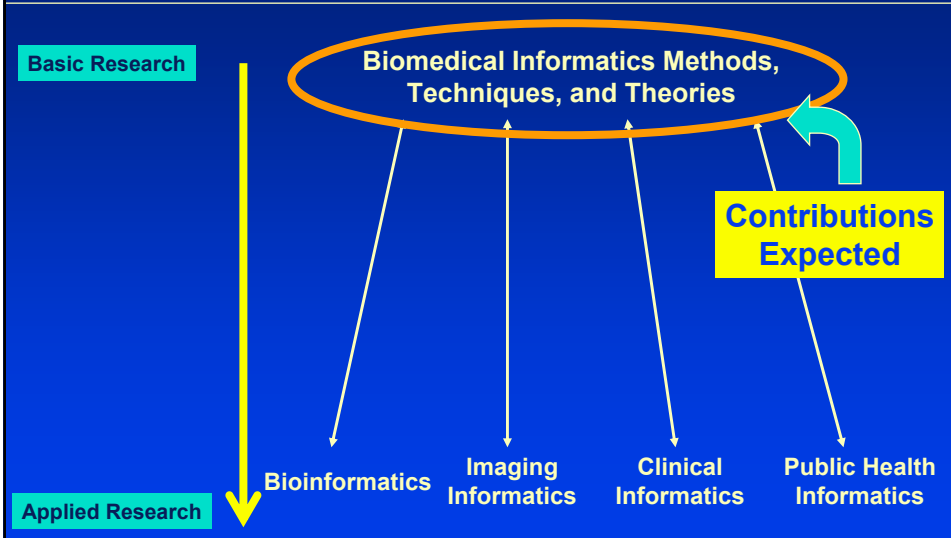
Education of Biomedical Informatics Researchers



Fundamental Research in Informatics

- Although projects are inspired by biomedical application goals, basic research in biomedical informatics typically:
  - offers methodological innovation, not simply interesting programming artifacts
  - generalizes to other domains, within or outside biomedicine
- Inherently interdisciplinary, biomedical informatics provides bridging expertise and opportunities for collaboration between computer scientists and biomedical researchers and practitioners

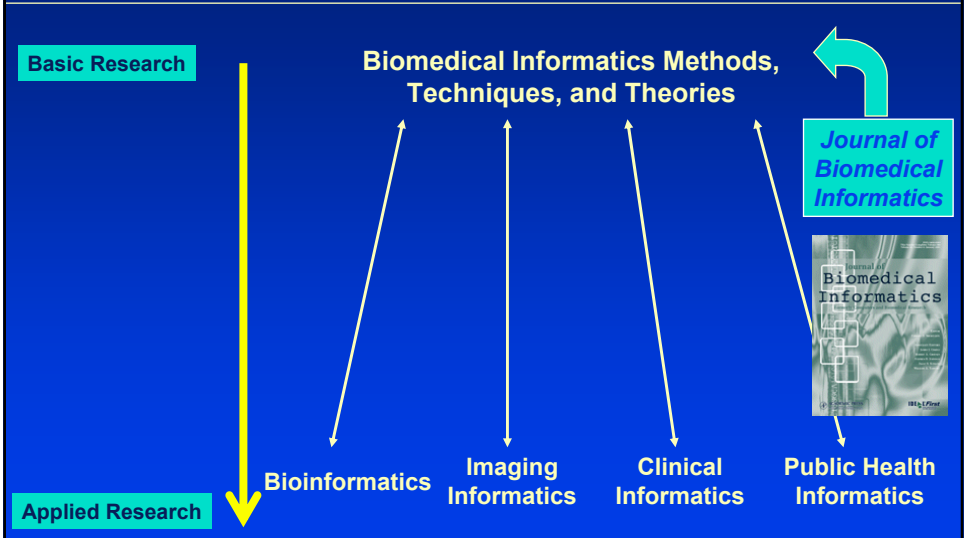
Biomedical Informatics Basic Research



Messages to Students

- Individual projects will always be applications-motivated
- Solutions often require informatics innovation rather than "off-the-shelf" software or tools
- Researchers must ask what general lessons can be derived from the work that they do
  - Of what class of applications is the project an example?
  - What is the range of applicability of the methods developed?
  - How can the work be described generically, independently of the application that motivated it
- There is a role for applications papers and evaluations, but the *science* of informatics requires that we identify and describe the generalizability and reusable lessons of a piece of work

Biomedical Informatics Research

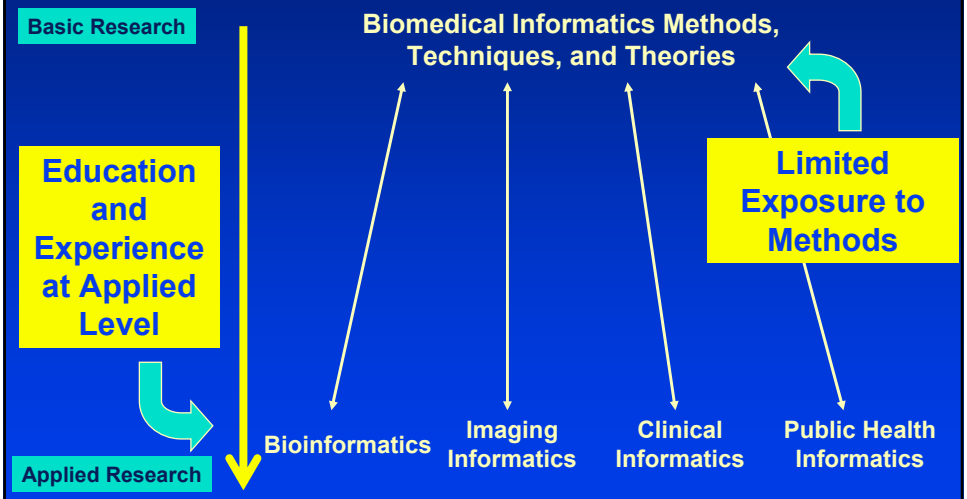


Doctoral Dissertations

Chapter 1:	Introduction and Overview
Chapter 2:	Literature Review
Chapter 3:	Overview of Methodological Innovation
Chapter 4:	System Component #1
.	
.	
Chapter 4+K:	System Component #K
Chapter N-2:	Examples of Total System's Operation
Chapter N-1:	Formal Evaluation of Method in the Context of the Application
Chapter N:	Summary of Contributions and Future Work

Typically N = 8 or 9

Education of Health Professionals



Issues in Teaching Medical Students About Biomedical Informatics

- Columbia experience starting in Autumn 2005
- How to make the topic seem relevant?
- Learning climate: students need to *want* to learn about the topic
- Lack of role models in clinical training settings
- Curriculum design: How to integrate informatics topics throughout training?
- Emphasize teaching by physicians who are cross-trained in informatics

Student Reactions

- Mixed and bimodal
- Extreme example of negative:

  "I still don't think informatics is relevant to my becoming a surgeon. I will have nothing to do with any of the stuff taught. I don't want to. I am 100% against computerized medicine, and I don't want doctors to turn into robots. I don't want to use a computer to make decisions. And nobody should. If you need a computer to become a competent doctor, then you shouldn't become one because you're not cut out for it."

Student Reactions

- Example of positive:

  "Content of presentations was strong. Demonstrated the relevance of informatics to everyday clinical decisions. The presentations were definitely worthwhile preparing for and listening to."

To-Do List for a New Program

- Attract faculty who understand biomedical informatics as science, not just as means to reach pragmatic ends
  - Joint (secondary) appointments for faculty from other units
  - Primary appointments only for informaticians
- Attract faculty committed to education as well as research, well-trained in informatics, and who embrace the notion that BMI spans applied disciplines across all of biomedicine
- Include graduate education as soon as possible, and do not wait to include doctoral training as well as masters
- Build diversified financial base: institutional, government, industrial, and foundations

To-Do List for a New Program - 2

- Link the department to transformation of modern knowledge dissemination in universities (i.e., to the library of the future)
- Seek diversity across the areas of application so that training does not become too narrow, even though students may be specializing in one of the application areas
- Seek to build and maintain visibility within the institution:
  - Collaborations
  - Some (limited) service activities
  - Presentations that educate others about the field and its relevance to modern biomedicine

Trends In The USA (and beyond?)

- Creation of several new biomedical informatics departments or independent academic units
- Strong job market for graduates of informatics degree programs
- Government investment in training and research is reasonably strong, especially for applications and demonstrations
- Increasing acceptance of biomedical informatics as a subspecialty area by biomedical professional societies
- Increasing recognition that biomedical problems can drive the development of basic theory and capabilities in information technology research