PROGRAM PROPOSAL

MASTER OF SCIENCE IN BIOMEDICAL & HEALTH INFORMATICS

STATE UNIVERSITY OF NEW YORK
COMPUTER SCIENCE DEPARTMENT
OSWEGO, NY 13126-3599
315.312.2683

PROVOST AND VP FOR ACADEMIC AFFAIRS: Dr. LORRIE CLEMO
DEAN: Dr. RICHARD BACK

(Revision Date: 9/24/2014)

9/12/2014
(Date Approved by Priorities and Planning Council)

5/9/2014
(Date Approved by Graduate Council)

11/22/2013
(Date Approved by Computer Science Department)
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Appendix I – Definition of Biomedical Informatics and Specification of Core Competencies for
Graduate Education in the Discipline

Appendix II – CAHIIM’s Requirements for Accreditation for Graduate Programs in Health
Informatics

Appendix III – CAHIIM’s Requirements for Accreditation for Graduate Programs in Health
Information Management

Appendix IV -- Syllabi

Appendix V – CS Faculty CV’s (in progress)

Appendix VI – Letters of support (in progress)
A. Name of institution: State University of New York at Oswego

Specify campus where program will be offered, if other than the main campus: This program will be delivered primarily online with selected coursework and other activities, such as recruitment and advisement, available at the Metro Center in Syracuse and at the Oswego Campus.

B. Campus President or Chief Academic Officer

Name and title: Deborah F. Stanley, President
Signature and date:

C. Contact person, if different

Name and title: Richard Back, Dean College of Liberal Arts and Sciences
Telephone: 315-312-2285
Fax: 315-312-3577
E-mail: Richard.Back@oswego.edu

D. Proposed program title: Biomedical and Health Informatics

E. Proposed degree or other award: Master of Biomedical and Health Informatics

F. Proposed HEGIS code: ***

G. Total Program Credit: 33-36

H. If the program will be offered jointly with another institution, name and address of the institution/branch below: n/a

I. If the program will lead to teacher certification as other than a classroom teacher, list the intended: n/a
Certification title(s) and type(s):
(e.g., English 7-12, Professional; Childhood 1-6, Initial/Professional)

J. If specialized accreditation will be sought indicate:

The Program will be housed within the Computer Science department, currently under Association for Computing and Machinery (ACM) accreditation review.
Accreditation by the Commission on Accreditation for Health Informatics and Information Management Education (CAHIIM) will be explored. An application for CAHIIM accreditation cannot begin until specifically defined candidacy requirements are met as outlined in the CAHIIM Handbook of Policies.¹

Accrediting group(s): CAHIIM (proposed)

Expected date of accreditation: A date for CAHIIM accreditation is yet to be determined. Student need to be enrolled in the program before the CAHIIM application process can begin.

K. Anticipated enrollment: (headcount)

Initial: 12  
Maximum within first five years: 40

L. If this program will be offered in a special format, please specify (See Appendix H for definitions.): Distance Education

M. If this program will be offered in an atypical schedule that may affect program financial aid eligibility, please describe: n/a

N. Brief Program Summary (300 words), describing academic content, structure and duration.

The proposed Master’s in Biomedical & Health Informatics (BHI) combines SUNY Oswego’s existing Computer Science programs with specialized health informatics and health information management coursework. The framework for the program’s curriculum is guided by CAHIIM², the preeminent accrediting body for graduate health informatics and information management education.

The proposed program will address the revolutionary shifts the healthcare system is currently undergoing. According to recent trends, the projected landscape of healthcare and wellness involves the following tech-enhanced facets: the coming of globally connected digital health networks and the advance of ubiquitous intelligent agents (BHI Health Informatics Track), and the harnessing of Big Data and decision analytics (BHI Health Information Management Track). The synergistic effect of tech-enabled globally connected health networks, ubiquitous intelligent agents, and Big Data and decision analytics will dramatically improve health outcomes through patient engagement, prevention, and education.

The resulting curriculum of 33-36 semester hours includes:

- BHI Foundation* (0 - 3 Semester Hours)
  - BHI 552 Biomedical and Health Terminologies

*Foundation courses are prerequisites to selected BHI Core courses and may be waived based on prior academic or professional experience.

¹ CAHIIM Requirements for Accreditation: Retrieved from:
http://www.cahiim.org/files/CAHIIM%202012%20MHI%20Curriculum%20Requirements_Revised_2013.doc
and from
http://www.cahiim.org/files/CAHIIM%202012%20MHIM%20Curriculum%20Requirements_Revised_2013.doc

² Commission on Accreditation for Health Informatics and Information Management Education (CAHIIM)
• BHI Core (12 Semester Hours)
  o BHI 501 Introduction to Biomedical Information Systems
  o BHI 502 Health Informatics Methods
  o BHI 503 eHealth Systems
  o BHI 504 Systems Design, Integration, Safety & Security

• BHI Health Informatics / Intelligent Health Systems track Core (9 Semester Hours)
  o BHI 505 Digital Health
  o BHI 506 Decision Support & Intelligent Systems
  o BHI 507 Quality Assurance Informatics

• BHI Health Information Management / Health Data Science Track Core (9 Semester Hours)
  o BHI 508 Database Applications
  o BHI 509 Data Analytics
  o BHI 510 Geospatial, Temporal & Text Analytics

• BHI Health Informatics Professional Track Core (9 Semester Hours)
  o MBA 517 Organizational Management: A Global Perspective
  o BHI 506 Decision Support & Intelligent Systems or another advisor approved graduate BHI course
  o BHI 507 Quality Assurance Informatics

• BHI Project, Thesis, or Internship Course (6 Semester Hours)

• BHI Electives (6 Semester Hours)

The duration of study depends on foundation requirements and prior academic or professional experience. A full-time student, taking 9 Credits each academic semester, will be able to complete their studies in no more than 2 years.

All courses will be delivered online but with the possibility of hyflex class participation either at SUNY Oswego or at the Metro Center. Courses delivered online will use asynchronous and synchronous formats as required.
PROPOSED MASTER IN HEALTH INFORMATICS

Whether it’s improving our health or harnessing clean energy, protecting our security or succeeding in the global economy, our future depends on reaffirming America’s role as the world’s engine of scientific discovery and technological innovations. - Quoted from President Barack Obama, Office of Science and Technology

1. Program Description & Curriculum

Recently, the American Medical Informatics Association\(^2\) (2013) has defined biomedical informatics as “the interdisciplinary field that studies and pursues the effective uses of biomedical data, information, and knowledge for scientific inquiry, problem solving and decision making, motivated by efforts to improve human health”. The proposed Master’s in Biomedical & Health Informatics (BHI) aligns with this definition while also meeting the requirements for accreditation in the said discipline. CAHIIM (Commission on Accreditation for Health Informatics and Information Management Education) accredits programs in both Health Informatics and Health Information Management as major contributors to the field of Biomedical & Health Informatics. We are therefore proposing three tracks in the Biomedical and Health Informatics Science Master’s: the Health Informatics track, with a focus on Intelligent Health Systems, the Health Information Management track, with a focus on Health Data Science, and the Health Informatics Professional Science Master’s track. After presenting the global program mission and educational goals, the objectives and learning outcomes of each program will be presented in separate subsections.

A. Program Mission

The mission of the Biomedical & Health Informatics Science Master's (BHI MS) program is to educate students to effectively analyze, design, integrate, and manage health information systems using information technology for scientific inquiry, problem solving, and decision making, motivated by efforts to improve human health. Furthermore the program will strive at constantly forming students to the most innovative and advanced information technology for healthcare, health services, and health research in a fast-paced, connected, and ubiquitous environment. We believe that information science and technology improves and will

continue to improve human health, and furthermore in a more global and inclusive manner than at any time in human history.

**B. Educational Goals**

**Educational Goals of the Proposed MS Program**

The goals of the proposed MS program are to:

- provide a broad overview of the methods and technologies supporting biomedical information systems, with a focus on intelligent, ubiquitous, and data-intensive technology and devices.
- emphasize theoretical (conceptual knowledge), as well as practical (embodied knowledge), foundations of health information systems.
- emphasize the ability to synthesize and apply concepts in a professional setting.
- prepare students with an in-depth competence in a specialization of the field that builds upon the program core.

![Figure 1 – Interrelation of biomedical informatics and health informatics](image)

**Figure 1 – Interrelation of biomedical informatics and health informatics**

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Recently, the American Medical Informatics Association (AMIA) has defined a set of core competencies for graduate education in biomedical informatics discipline\(^4\), which includes health informatics (see Fig 1). Tables 1a and 1b list these competencies and how they are taught in the BHI Master’s program and shared between the proposed tracks.

**Table 1a List of core competencies in biomedical informatics.**

<table>
<thead>
<tr>
<th>Competency</th>
<th>BHI 552 Biomedical and Health</th>
<th>BHI 501 Intro Biomed Info Sys</th>
<th>BHI 502 Health Info Methods</th>
<th>BHI 503 eHealth Systems</th>
<th>BHI 504 Design Integ. Safety Security</th>
<th>BHI 505 Digital Health</th>
<th>BHI 506 DSS</th>
<th>BHI 507 Quality Assurance</th>
<th>BHI 508 Databases</th>
<th>BHI 509 Data Analytics</th>
<th>BHI 510 Geo Temp Analytics</th>
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</thead>
<tbody>
<tr>
<td><strong>Fundamental Scientific Skills</strong></td>
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<td>Acquire professional perspective</td>
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<tr>
<td>Analyze problems</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Produce solutions</td>
<td>✓</td>
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<td>Articulate the rationale</td>
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<td>Implement, evaluate, refine</td>
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<td>Innovate</td>
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<td>Work collaboratively</td>
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<td>Educate, disseminate, and discuss</td>
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<td><strong>Scope and Breadth of the Discipline</strong></td>
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<tr>
<td>Prerequisite knowledge and skills</td>
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<tr>
<td>Fundamental knowledge</td>
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</tbody>
</table>
Table 1b List of core competencies in biomedical informatics.

<table>
<thead>
<tr>
<th>Competency</th>
<th>BHI 552 Biomedical and Health</th>
<th>BHI 501 Intro Biomed Info</th>
<th>BHI 502 Health Info Methods</th>
<th>BHI 503 eHealth Systems</th>
<th>BHI 504 Sys Design Integ Safety Security</th>
<th>BHI 505 Digital Health</th>
<th>BHI 506 DSS</th>
<th>BHI 507 Quality Assurance</th>
<th>BHI 508 Databases</th>
<th>BHI 509 Data Analytics</th>
<th>BHI 510 Geo Temp Analytics</th>
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<td>Theory and Methodology</td>
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<td>Theories</td>
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At completion of any of the three tracks, students will be qualified and encouraged to take certification exams in their specialty as is expected in biomedical disciplines. These certification exams include in particular the following, depending upon the respective track, the student’s educational background, and the student’s professional experience:

- Certified Professional in Healthcare Information & Management Systems (CPHIMS) from the Healthcare and Information and Management Systems Society (HIMSS)
- Board Certification in Clinical Informatics from the American Board of Medical Specialties (ABMS)
- Registered Health Information Administrator (RHIA) from CAHIIM
- Informatics Nursing from the American Nurses Credentialing Center (ANCC)
- Certified Associate in Healthcare Information & Management Systems (CAHIMS) from HIMSS
- Other certifications exams in biomedical informatics they may choose to take.

C. Objectives and Learning Outcomes of the Health Information Management Track

Program Objectives of the Proposed MS in Health Information Management Track

The program will prepare students to:

a) Demonstrate advanced proficiency in health information technology and health information management concepts, skills, techniques, methods, and innovations with a focus on systems integration, safety, and security, as well as health data science practices.

b) Demonstrate advanced knowledge of computerized tools used in the healthcare-related fields. This includes the ability to:
   - use and optimize programs such as electronic medical records, databases, and multimedia data and decision analytics programs to create health-related reports and recommendations.
   - use online databases and programs to research and code biomedical terms using biomedical terminologies.
   - use online databases for scientific literature search to obtain background information pertaining to a specific topic, experimental method, or research project.

c) Make an oral presentation to a small and medium size audience about on a specific topic in health information management or his or her own research.

d) Create a formal report (scholarly paper or thesis) summarizing experimental results obtained by the student. The report should contain an introduction with a thesis statement, a background section summarizing prior knowledge about the project field, a research question addressed, a description of a research plan including material and methods used, a set of evaluation criteria, relevant tables and graphs based on evaluation results, and a discussion of the significance of research results.

e) Evaluate the research results and data obtained by other scientists to assess its correctness, importance, and relevance, and to produce meaningful conclusions and recommendations.

f) Demonstrate effective leadership ability, confidence, communication and team member skills through participation in a cooperative system design project, internship, or directed research.
g) Demonstrate a higher level of content knowledge in two out of three core domains of health information management (Health data management, Information technology and systems, Organization and management).

**Learning Outcomes for the Proposed MS in Health Information Management Track**

Graduates of the proposed MS in Health Information Management track program will be assessed in the following manner:

a) Student’s advanced proficiency in health information technology concepts, skills, techniques, methods, and innovations will be assessed through student’s grades and by his/her research mentor based on his/her observations of the student utilizing concepts, skills, and techniques, which are required in the specific field while working in the healthcare, public health, or health services community.

b) Student’s advanced knowledge of computerized tools will be assessed according to student’s performance in the respective courses teaching said specific tools, in their written report (scholarly paper or thesis) and oral presentations. Individual assignments are required matching the different types of tools and results from these assignments are aggregated.

c) Student’s oral communication skills will be assessed by their overall performance in the required class participation as well as their presentation of their project-based classwork in several classes, at Quest or professional conferences. These presentations are evaluated by the BHI faculty in attendance according to a rubric.

d) Student’s writing skills will be assessed by their overall performance in the required scholarly paper or technical report. These papers are evaluated by the primary research adviser. The grading rubric takes into account all the following areas: 1) introduction and thesis statement, 2) background and literature review, 3) research hypothesis, 4) description of materials and methods, 5) description of evaluation results, 6) discussion of results, and 7) overall writing.

e) Student’s ability to critically evaluate data obtained by others will be assessed by the grade given for critical analysis assignments in the form of assigned annotated bibliographies.

f) Student’s effective leadership ability, confidence, communication and team member will be assessed by his / her average grade in group projects and team members’ evaluations.

g) Student’s content knowledge in different core domains of health information management will be assessed by student’s performance on the Registered Health Information Administrator (RHIA) and/or other certification exams in biomedical informatics they may choose to take depending upon their professional experience and educational background.

h) Graduate alumni’s job placement and overall satisfaction will be assessed by Institutional Graduate Alumni Job Placement survey.

**D. Objectives and Learning Outcomes of the Health Informatics Track**

Program Objectives of the Proposed MS in Health Informatics Track

11
The program will prepare students to:

a) Demonstrate advanced proficiency in health information technology and health informatics concepts, skills, techniques, methods, and innovations with a focus on systems integration, safety, and security, as well as intelligent health systems practices.

b) Demonstrate advanced knowledge of computerized tools used in the healthcare-related fields. This includes the ability to:
   - use and optimize programs such as electronic medical records, databases, and multimedia data and decision analytics programs to create health-related reports and recommendations.
   - use online databases and programs to research and code biomedical terms using biomedical terminologies.
   - use online databases for scientific literature search to obtain background information pertaining to a specific topic, experimental method, or research project.

c) Make an oral presentation to a small and medium size audience about on a specific topic in health informatics or his or her own research.

d) Create a formal report (scholarly paper or thesis) summarizing experimental results obtained by the student. The report should contain an introduction with a thesis statement, a background section summarizing prior knowledge about the project field, a research question addressed, a description of a research plan including material and methods used, a set of evaluation criteria, relevant tables and graphs based on evaluation results, and a discussion of the significance of research results.

e) Evaluate the research results and data obtained by other scientists to assess its correctness, importance, and relevance, and to produce meaningful conclusions and recommendations.

f) Demonstrate effective leadership ability, confidence, communication and team member skills through participation in a cooperative system design project, internship, or directed research.

g) Demonstrate a higher level of content knowledge in two out of three core domains of health informatics (Information systems, Informatics, Information technology).

**Learning Outcomes for the Proposed MS in Health Informatics Track**

Graduates of the proposed MS in Health Informatics track program will be assessed in the following manner:

  a) Student's advanced proficiency in health information technology concepts, skills, techniques, methods, and innovations will be assessed through student's
grades and by his/her research mentor based on his/her observations of the student utilizing concepts, skills, and techniques, which are required in the specific field while working in the healthcare, public health, or health services community.

b) Student’s advanced knowledge of computerized tools will be assessed according to student’s performance in the respective courses teaching said specific tools, in their written report (scholarly paper or thesis) and oral presentations. Individual assignments are required matching the different types of tools and results from these assignments are aggregated.

c) Student’s oral communication skills will be assessed by their overall performance in the required class participation as well as their presentation of their project-based classwork in several classes and at Quest or professional conferences. These presentations are evaluated by the BHI faculty in attendance according to a rubric.

d) Student’s writing skills will be assessed by their overall performance in the required scholarly paper or technical report. These papers are evaluated by the primary research adviser. The grading rubric takes into account all the following areas: 1) introduction and thesis statement, 2) background and literature review, 3) research hypothesis, 4) description of materials and methods, 5) description of evaluation results, 6) discussion of results, and 7) overall writing.

e) Student’s ability to critically evaluate data obtained by others will be assessed by the grade given for critical analysis assignments in the form of assigned annotated bibliographies.

f) Student’s effective leadership ability, confidence, communication and team member will be assessed by his / her average grade in group projects and team members’ evaluations.

g) Student’s content knowledge in different core domains of health informatics will be assessed by student’s performance on the Certified Professional in Healthcare Information & Management Systems (CPHIMS) exam and/or other certification exams in biomedical informatics they may choose to take depending upon their professional experience and educational background, including the Informatics Nursing certification exam from the American Nurses Credentialing Center (ANCC) and the Certified Associate in Healthcare Information & Management Systems (CAHIMS) exam.

h) Graduate alumni’s job placement and overall satisfaction will be assessed by Institutional Graduate Alumni Job Placement survey.

E. Objectives and Learning Outcomes of the Health Informatics Professional Track

Program Objectives of the Proposed MS in Health Informatics Professional Track
In addition to the objectives of the Health Informatics Track above, the program will prepare students to:

a) Demonstrate a basic understanding of business principles, methods, and techniques.

**Learning Outcomes for the Proposed MS in Health Informatics Professional Track**

In addition to the assessment of graduates of the proposed MS in Health Informatics track program, graduates of the professional track will be assessed in the following manner:

a) Student’s basic understanding of business principles, methods, and techniques will be assessed through student’s grades and by his/her research mentor based on his/her observations of the student utilizing principles, methods, and techniques, which are required in the specific field while working in the healthcare, public health, or health services community.

**F. Curriculum**

1. Course of Study

Primary candidates for this course of study will be healthcare professionals such as physicians, nurses, and physician assistants, as well as information technology (IT) professionals working or intending to work in health environments. In addition the proposed MS program has been designed to accommodate both students whose bachelor’s degree was awarded from a Computer Science (CS)/Information Science (IS)/Computer Engineering (CE) / Information Technology (IT) program as well as those whose bachelor’s degree was awarded in non-CS-related disciplines. To accommodate such a diverse population of students, as well as those students who may not have the necessary background to immediately matriculate into a BHI MS program, we have devised multiple paths of entry, transition, progression, and completion. New or revised courses’ descriptions to be developed are contained in Section 7.

The curriculum (see Fig. 2) was developed according to the standards of the CAHIIM for accreditation of health informatics and health information management programs. The programs also follow the recommendations of the American Medical Informatics Association (AMIA) which has defined the core competencies of biomedical informatics.

There are three tracks in the MS program: the Health Informatics (Intelligent Health Systems) track, the Health Information Management (Health Data Science) track, and the Health Informatics Professional track.

For students having a CS/IS/CE/IT degree, some courses will be substituted by others. However these students will have to take additional biomedical science
coursework. On the other end of the spectrum, health professionals will not be required to take foundational biomedical science coursework, however they will have to take all core coursework unless decided otherwise by the program Director.

The credit hour requirements of these three tracks are commensurate with leading students to the same quality graduation standards.

<table>
<thead>
<tr>
<th>FOUNDATIONS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>BHI 552 Biomedical and Health Terminologies</td>
<td>0-3</td>
</tr>
<tr>
<td>CORE (12 credits)</td>
<td></td>
</tr>
<tr>
<td>BHI 501 Introduction to Biomed Information Systems(^+)</td>
<td>3</td>
</tr>
<tr>
<td>BHI 502 Health Informatics Methods</td>
<td>3</td>
</tr>
<tr>
<td>BHI 503 eHealth Systems</td>
<td>3</td>
</tr>
<tr>
<td>BHI 504 Systems Design, Integration, Safety &amp; Security</td>
<td>3</td>
</tr>
</tbody>
</table>

| TRACKS CORE (9 credits)                     |         |
| Health Informatics / Intelligent Health Systems Track |         |
| Health Information Management / Health Data Science Track |         |
| Health Informatics Professional Track       |         |
| BHI 505 Digital Health                     |         |
| BHI 508 Database Applications\(^+\)         | 3       |
| BHI 506 Decision Support & Intelligent Systems |         |
| BHI 509 Data Analytics\(^+\)               | 3       |
| BHI 507 Quality Assurance Informatics      |         |
| BHI 510 Geospatial. Temporal & Text Analytics |         |
| MBA 517 Organizational Management           |         |
| BHI 506 Decision Support & Intelligent Systems (or other advisor approved BHI graduate course) | 3       |
| BHI 507 Quality Assurance Informatics      |         |
| MBA Electives                              | 6       |

| ELECTIVES (6 credits)                      |         |
| BHI / HCI Electives                       |         |
| MBA Electives                             | 6       |

| THESIS / INTERNSHIP (6 credits)            |         |
| Project / Thesis                          |         |
| Internship                                | 6       |

| TOTAL CREDITS                              | 33-36   |

**Figure 2. Multi-track curriculum of the BHI Master's (dual-enrolled courses are annotated with \(+\)).**

2. MS in Health Informatics / Intelligent Health Systems track

The proposed MS program (Health Informatics Track) is a thirty-three credit hour program. It would consist of the following courses:

- BHI 501 (3) Introduction to Biomedical Information Systems.
- BHI 502 (3) Health Informatics Methods
• BHI 503 (3) eHealth Systems
• BHI 504 (3) Systems Design, Integration, Safety, and Security
• BHI 505 (3) Digital Health
• BHI 506 (3) Decision Support & Intelligent Systems
• BHI 507 (3) Quality Assurance Informatics
• BHI/HCI 5** (6) Electives from 500 level courses
• BHI 699 / BHI 700 (6) Project/Thesis.

BHI 501 Introduction to Biomedical Information Systems is required in the first year of the program to prepare students to understand the literature of the field and to become disciplined in using the literature to remain current. Students have their choice of capstone experience in the program. They may choose a project or a thesis supervised by faculty and eventually in addition industry professionals.

The main difference between a project and a thesis is that a thesis is more research oriented and is meant to lead to a publication in a peer-reviewed venue. A project on the other end is more systems design, integration, or evaluation oriented and would best lead to a different type of artifact such as a software package, Web application, or Social computing application. It can also lead to an applied type of publication or alternate forms of dissemination.

According to CAHIIM, the discipline of health informatics can be viewed as composed of three main facets. Although a program can study one of the facets more in-depth, all three facets and curricular components must be introduced in the course of the program study. The three facets, plus the desired fourth facet, are listed below along with their curricular components and how they are introduced in the MS in Health Informatics track.

1. Information systems – concerned with such issues as information systems analysis, design, implementation, and management. Curricular components include:
   b. Health information systems characteristics, strengths, and limitations. BHI 501, BHI 504, BHI 507.
   c. Health information systems assessment methods and tools. BHI 501, BHI 502, BHI 507.
   e. Health IT standards. BHI 501, BHI 502, BHI 506, BHI 507.
   f. Use of healthcare terminologies, vocabularies and classification systems. BHI 501, BHI 502, BHI 506, BHI 507.
g. Health information exchange (HIE). \textit{BHI 501, BHI 507.}

h. Electronic health records and personal health records. \textit{BHI 501, BHI 502, BHI 507.}

i. Patient rights and associated regulations. \textit{BHI 501, BHI 507.}

j. Privacy and confidentiality of patient health information. \textit{BHI 501, BHI 504, BHI 507.}

k. Information security practices. \textit{BHI 501, BHI 504, BHI 507.}

l. Management of information systems including life cycle analysis, system design, planning methods and tools. \textit{BHI 501, BHI 504.}

m. Evidence-based systems and tools (such as Pubmed, UpToDate). \textit{BHI 501, BHI 506, BHI 507.}

n. Workflow process re-engineering. \textit{BHI 504, BHI 507.}

o. Human factor engineering, work organization and tools. \textit{BHI 501, BHI 504, BHI 507.}

p. Strategic planning. \textit{BHI 501, BHI 504, BHI 507.}

q. Project planning and management. \textit{BHI 501, BHI 504, BHI 507.}

r. Change management. \textit{BHI 501, BHI 504, BHI 507.}

s. Finance and budgeting and cost-benefit analysis for information systems. \textit{BHI 501, BHI 504, BHI 507.}

t. Assessment of commercial vendor products and software applications. \textit{BHI 504.}

u. Policy development and documentation. \textit{BHI 501, BHI 504.}

v. Personnel management, negotiation, communication skills, business ethics, leadership and governance. \textit{BHI 501, BHI 504.}

w. Systems thinking and theory. \textit{BHI 501.}

2. Informatics – concerned with such issues as the structure, function and transfer of information, sociotechnical aspects of health computing, and human-computer interaction. Curricular components include:

   a. History of health informatics development and health informatics literature. \textit{BHI 501.}

   b. Medical decision-making: principles, design, implementation. \textit{BHI 501, BHI 506, BHI 507.}

   c. Development of healthcare terminologies, vocabularies, ontologies. \textit{BHI 501, BHI 506.}

   d. Clinical data standards theory and development. \textit{BHI 501, BHI 502, BHI 506.}
e. Clinical data and clinical process modeling (such as UML- Unified Modeling Language, UP – Unified Process). **BHI 501, BHI 504.**

f. Cognitive support (i.e. clinical decision support). **BHI 501, BHI 506.**

g. Biomedical simulations. **BHI 501, BHI 505, BHI 506.**

h. Personalized medicine. **BHI 501, BHI 505, BHI 506.**

i. Human-computer interface. **BHI 501, BHI 506.**

j. Principles of health information systems data storage design, including patient-centered. **BHI 501, BHI 504.**

k. Principles of research and clinical literature research. **BHI 501, BHI 502.**

l. Natural language processing. **BHI 506.**

m. Knowledge discovery (such as text and data mining). **BHI 506.**

3. **Information technology –** concerned with such issues as computer networks, database and systems administration, security, and programming. Curricular components include:

   a. Principles of computer science. **BHI 501, BHI 503.**

   b. Programming languages (such as SQL, Java). **BHI 501, BHI 502. BHI 503.**

   c. Software applications – design, development, use. **BHI 501, BHI 504.**

   d. Systems testing and evaluation. **BHI 501, BHI 502, BHI 503, BHI 504.**

   e. System integration tools. **BHI 503, BHI 504.**

   f. Networking principles, methods, design. **BHI 505.**

   g. Principles of data representation. **BHI 501, BHI 504, BHI 506.**

   h. Electronic data exchange. **BHI 501, BHI 503, BHI 504, BHI 507.**

   i. Health information technology: systems architecture, database design, data warehousing. **BHI 501, BHI 503, BHI 504.**

   j. Technical security applications and issues. **BHI 501, BHI 504.**

   k. Information technology (IT) system documentation. **BHI 504.**

   l. Business continuity and disaster recovery. **BHI 504.**

   m. Virtual network applications and storage (such as cloud computing). **BHI 501, BHI 505.**

4. **Additional desired course(s) content.** Curricular components include:

   a. Biomedical sciences (such as medical terminology, anatomy, physiology, pathophysiology). **BHI 552.**

   b. Quantitative, qualitative, and mixed methods. **BHI 501, BHI 502.**
c. Epidemiology (public health or clinical). BHI 501, BHI 502, BHI 506.

New Courses

The new courses are the following:

- BHI 502 – Health Informatics Methods.
- BHI 503 – eHealth Systems.
- BHI 505 – Digital Health.
- BHI 506 – Decision Support & Intelligent systems.
- BHI 507 – Quality Assurance Informatics.

Electives

Electives can preferably be taken from the other track, BHI electives, the HCI program, the MBA-HSA program, or other programs, under advisement:

- BHI 508 – Database Applications.
- BHI 509 – Data Analytics.
- BHI 510 – Geospatial, Temporal & Text Analytics.
- BHI 550 – Graduate Seminar.
- BHI 557 – Bioinformatics.
- BHI 553 – Terminologies and Coding.
- BHI 554 – Information Assurance.
- HCI 500 – Human computer Interaction.
- HCI 520 – Designing User Interfaces.
- HCI 525 - Multimedia/Hypermedia Design & Authoring.
- HCI 530 – Seminar in Contemporary Topics.
- HCI 530 – Game Design.
- HCI 530 – System Simulation and Virtual Worlds.
- HCI 530 – Data Visualization.
- BRC 521 – Social Networks and the Web.
- MBA 602 – Management Epidemiology.
- MBA 604 – Health Policy.
- MBA 650 – Healthcare Leadership.

3. MS in Health Information Management / Health Data Science Track

The proposed MS program (Health Information Management Track) is a thirty-three credit hour program. It would consist of the following courses:

- BHI 501 (3) Introduction to Biomedical Information Systems.
- BHI 502 (3) Health Informatics Methods
BHI 501 Introduction to Biomedical Information Systems is required in the first year of the program to prepare students to understand the literature of the field and to become disciplined in using the literature to remain current. Students have their choice of capstone experience in the program. They may choose a project or a thesis supervised by faculty and eventually in addition industry professionals.

The main difference between a project and a thesis is that a thesis is more research oriented and is meant to lead to a publication in a peer-reviewed venue. A project on the other end is more systems design, integration, or evaluation oriented and would best lead to a different type of artifact such as a software package, Web application, or Social computing application. It can also lead to an applied type of publication or alternate forms of dissemination.

According to CAHIIM, the discipline of health information management can be viewed as composed of three main domains. Although a program can study one of the domains more in-depth, all three domains and curricular competencies must be introduced in the course of the program study. The three domains are listed below along with their curricular components and how they are introduced in the MS in Health Information Management track:

I. Health data management.
   A. Data structure.
      1. Evaluate reference terminologies to satisfy organizational information needs (such as SNOMED-CT, LOINC). BHI 501, BHI 502.
      2. Map data terminologies to each other and to classification systems (such as transition from ICD-9-CM to ICD-10-CM/PCS). BHI 501, BHI 502.
      3. Ensure data are in a format that will satisfy data integration needs (such as interoperability, decision support, legacy systems). BHI 501, BHI 502, BHI 503.
      4. Ensure the standardization of data dictionaries to meet the needs of the enterprise. BHI 501, BHI 502, BHI 508.
      5. Establish policies and procedures to ensure data integrity internal and external to the enterprise. BHI 501, BHI 508.
6. Ensure compliance with internal data dictionary requirements and external (such as HL7, ASTM, Joint Commission, NCQA, HEDIS, ACS) data standards. BHI 501, BHI 508.

7. Create, evaluate, maintain and recommend data architectural models for the enterprise (such as clinical data, financial data, and administrative data). BHI 501, BHI 504, BHI 508.

8. Develop enterprise wide policies for collection, use and maintenance of health care data. BHI 501, BHI 504.

9. Apply data capture technologies (such as Natural Language Text Processing (NLP), voice recognition, document imaging). BHI 501, BHI 509, BHI 510.

10. Advocate policy initiatives that influence data integrity. BHI 501, BHI 504, BHI 508.

11. Advocate information interoperability and information exchange. BHI 501, BHI 504, BHI 508.


B. Data Analysis and Outcomes

1. Conceptualize, design, and manage data analysis projects (such as clinical research, operational research, utilization review, quality assurance, public health, epidemiology, biotechnology research). BHI 501, BHI 502, BHI 509, BHI 510.

2. Identify data sources and design the extraction methodology (such as clinical, financial, and administrative). BHI 501, BHI 502, BHI 509, BHI 510.

3. Direct data clustering and data mining activities such as trend analysis of enterprise-wide data base systems. BHI 501, BHI 502, BHI 509, BHI 510.


5. Interpret and communicate analytical results in a format that can be used for decision making. BHI 501, BHI 502, BHI 509, BHI 510.

6. Ensure adherence to research administration processes and policies (such as Institutional Review Board (IRB), HIPAA
security and privacy; research regulatory agencies). BHI 501, BHI 502.

II. Information Technology and Systems

A. Healthcare Information Systems

1. Assess systems capabilities to meet regulatory requirements (such as electronic signatures, data correction, and audit logs). BHI 501, BHI 502, BHI 504, BHI 508.

2. Recommend device selection based on work flow, ergonomic and human factors (such as PDAs, screen size, mobile carts, beside terminals). BHI 501, BHI 502, BHI 503, BHI 504, BHI 508.

3. Select or design application or systems interfaces for ease of data entry, data transfer, and data display. BHI 501, BHI 502, BHI 503, BHI 504, BHI 508.

4. Understand artificial intelligence applications and user interface design concepts. BHI 501, BHI 502, BHI 503.

5. Develop and oversee technical and operational policies and procedures for inter-organizational health data exchange (such as Health Information Exchanges (HIEs), Regional Health Information Organizations (RHIO), health data banks, other health care providers). BHI 501, BHI 502, BHI 504, BHI 508.

6. Design and evaluate the processes and systems that ensure compliance with regulatory, governmental, legal, accreditation and certification requirements for health information technologies. BHI 501, BHI 502, BHI 504.

7. Engage in policy development, analysis, and advocacy as related to the uses, protection and dissemination of health information. BHI 501, BHI 502, BHI 504.

8. Ensure the strategic and operational relevance of clinical information resources important to the health care industry. BHI 501, BHI 502, BHI 504.

B. Data Security, Privacy, Confidentiality

1. Develop and implement policies and technologies to protect data integrity and validity. BHI 501, BHI 502, BHI 504, BHI 508.

2. Develop and implement information security policies and procedures. BHI 501, BHI 502, BHI 504, BHI 508.

3. Design and implement risk assessment, risk management and business continuity (such as downtime, routine backup) plans to ensure data security and confidentiality. BHI 501, BHI 502, BHI 504, BHI 508.
4. Design and test disaster recovery plans for data and service delivery. \textit{BHI 501, BHI 502, BHI 504, BHI 508}.

5. Adhere to the requirements of the legal health record. \textit{BHI 501, BHI 502, BHI 504, BHI 508}.

C. Information Management Planning

1. Develop information management plans that support the organization’s strategic initiatives. \textit{BHI 501, BHI 502, BHI 504, BHI 508}.

2. Analyze and redesign workflow processes and jobs in order to develop the information infrastructure to meet organizational needs. \textit{BHI 501, BHI 504}.

3. Assess and justify investment in healthcare information technology projects (such as return on investment, cost/benefit analysis, compliance with regulatory requirements, quality improvement, and decreased risk). \textit{BHI 501, BHI 504}.

4. Apply project management tools and techniques to ensure successful design and implementation of information systems. \textit{BHI 501, BHI 504}.

5. Plan and promote initial and ongoing information systems training programs. \textit{BHI 501, BHI 502, BHI 504}.


7. Plan and implement networks, including intranet and internet applications, to facilitate the electronic health record (EHR), personal health record (PHR), public health, and other administrative application. \textit{BHI 501, BHI 503, BHI 504, BHI 508}.

8. Develop criteria, review, evaluate and select clinical, administrative and specialty information technology applications used in healthcare organizations. \textit{BHI 501, BHI 502, BHI 504}.

9. Employ systems life cycle concepts, including systems analysis, design, to information systems. \textit{BHI 501, BHI 504}.

10. Guide user interface design through application of key ergonomic and human factors. \textit{BHI 501, BHI 503, BHI 504}.

11. Manage the installation, training and implementation of healthcare systems and ensure ongoing maintenance and performance upgrades. \textit{BHI 501, BHI 504}.


III. Organization and Management
A. Leadership

1. Develop performance management measures (such as benchmarking, productivity standards, and report cards). *BHI 501, BHI 504.*

2. Develop business plans, strategic forecast and operational plans for health information management systems. *BHI 501, BHI 504.*

3. Establish and promote health information as a key strategic resource and mission tool. *BHI 501, BHI 504.*

4. Advocate the use of health information technology to promote quality of care and patient safety (such as clinical decision support systems, electronic health records, and interoperable systems). *BHI 501, BHI 503, BHI 504.*

5. Advise key stakeholders regarding the impact and optimal use of current and future information technology on the organization. *BHI 501, BHI 504.*


7. Participate in and/or chair executive level committees for information management. *BHI 501, BHI 502, BHI 504.*


B. Resource Management

1. Prepare, evaluate and manage capital, operating and/or project budgets. *BHI 501, BHI 504.*

2. Collaborate with multiple disciplines to manage revenue cycle compliance (such as claims management, charge- master, decision support, contracts). *BHI 501, BHI 504.*


5. Perform cost/benefit analysis for resource planning and allocation (such as outsourcing, acquisition). *BHI 501, BHI 504.*

6. Manage human resources (such as retention and recruitment planning, skills assessment, mentoring, team management, organizational structure). *BHI 501, BHI 504.*
7. Collaborate with multiple disciplines to ensure effective project/program outcomes. BHI 501, BHI 502, BHI 504.

8. Allocate physical assets including technology, hardware, and space for information systems planning. BHI 501, BHI 504.

9. Develop contingency plans for information management functions including decentralized, across disciplines, across delivery systems. BHI 501, BHI 504.

10. Apply concepts of change management theories, techniques and leadership. BHI 501, BHI 504.

C. Education and Training

1. Develop, implement and evaluate initial and ongoing training programs (such as information systems, clinical documentation improvement, HIPAA compliance, Prospective Payment System [PPS] changes). BHI 501, BHI 502, BHI 504.

2. Educate the public and consumers on privacy, security, access to and maintenance of personal health records (PHRs), requirements and legalities. BHI 501, BHI 502.

3. Design, execute and/or manage enterprise-wide compliance training programs on topics including regulatory, reimbursement, and legal issues. BHI 501, BHI 504.

4. Develop effective communication through project reports, business reports and professional communications. BHI 501, BHI 502, BHI 504.

5. Demonstrate executive decision making. BHI 501, BHI 502, BHI 504.


New Courses

The new courses are the following (the first three are common with the Health Informatics Track):

- BHI 502 – Health Informatics Methods.
- BHI 503 – eHealth Systems.
- HCI 510 – Geospatial, Temporal & Text Analytics.

Electives

Electives can preferably be taken from the other track, BHI electives, the HCI program, the MBA-HSA program, or other programs, under advisement:

- BHI 505 – Digital Health.
4. MS in Health Informatics Professional Track

The proposed MS program (Health Informatics Professional Track) is a thirty-three credit hour program. It would consist of the following courses:

- BHI 501 (3) Introduction to Biomedical Information Systems.
- BHI 502 (3) Health Informatics Methods
- BHI 503 (3) eHealth Systems
- BHI 504 (3) Systems Design, Integration, Safety, and Security
- BHI 506 (3) Decision Support & Intelligent Systems or another advisor approved graduate BHI course
- BHI 507 (3) Quality Assurance Informatics
- MBA 517 (3) Organizational Management: A Global Perspective.
- MBA 5** (6) Electives from 500 level courses
- BHI 698 (6) Professional Internship.

BHI 501 Introduction to Biomedical Information Systems is required in the first year of the program to prepare students to understand the literature of the field and to become disciplined in using the literature to remain current. Students have their choice of capstone experience in the program.

New Courses

The new courses are the same as those for the Health Informatics Track.
Electives

Electives can be taken from the MBA or the MBA HSA, preferably from the following list, under advisement:

- MBA 511 – Management Information Systems.
- MBA 514 – Marketing Management.
- MBA 515 – Management Science I.
- MBA 516 – International Business.
- MBA 538 – Personnel Management.
- MBA 568 – Project Management.
- MBA 580 - Entrepreneurship.
- MBA 590 – Special Topics
- MBA 590 – Technology Management
- MBA 590 – New Product.
- MBA 590 – Project Management II.
- MBA 600 – Healthcare Systems in the U.S.
- MBA 602 – Management Epidemiology.
- MBA 604 – Health Policy.
- MBA 650 – Healthcare Leadership.

5. Sample Courses of Study

Initially, the program will be launched on a 4 semester, or a 3-semester, course of study plan (see Fig. 3 and 4).

Fig. 3 Course progression in the Biomedical & Health Informatics Master’s (Health Informatics Track) showing courses dependencies.
However when faculty staffing allows for it, we plan on moving to a one-year – 3 semesters – course of study (see Fig. 5 and 6).

Fig. 4 Course progression in the Biomedical & Health Informatics Master’s (Health Information Management Track).

Fig. 5 Accelerated course progression in the Biomedical & Health Informatics Master’s (Health Informatics Track) showing courses dependencies.

6. Course Sharing

There are no formal plans for course sharing at this time beyond those stated above with the HCI program and the MBA / MBA-HSA programs. However, we encourage students, both within and outside of our program, to pursue broad intellectual and academic interests by studying topics outside of their primary discipline. In
particular, we encourage students to take upper-level electives in the CS/IS/CE programs even if these will not count directly as graduate credit, unless they are combined with a graduate independent study. Students within the proposed MS program will have the opportunity to select additional elective studies outside of the BHI Program in consultation with his/her adviser.

2. Relationship to Institutional Role, Mission, Program Priorities

The technology initiatives at the State University of New York Oswego are playing a key role to foster the future growth of technology leadership and innovation in our region. The mission of the Computer Science Department is to provide students with a learning environment which will nurture their growth in computing and information disciplines. As part of this mission, the Computer Science Department in particular strives to maintain a diverse faculty capable of engaging students in meaningful learning activities steeped in classic computer science yet application to contemporary problems associated with computer and information science.

While the existing undergraduate programs in Computer Science (CS), Software Engineering (SE), Information Science (IS), Cognitive Science (COG), and Electrical and Computer Engineering (ECE), and the existing graduate program in Human Computer Interaction (HCI) address these needs for part of the student population, there continues to be a demand for a graduate degree program whose intellectual focus is different from focusing on the technology, cognitive, or information pieces to determining how technology is part of a wider system, and particularly a healthcare system, in order to solve real-world problems. The degree program in Biomedical and Health Informatics is proposed to address this gap in higher education opportunities in Upstate New York. In this context the unique mission of the Biomedical and Health Informatics Science Master’s degree program will be to provide students with advanced concepts and skills to effectively analyze, design, integrate, maintain, and manage health information systems using information technology solutions for scientific inquiry and decision making, motivated by efforts
to improve human health. Also, this is the key differentiation of this program compared to any other computing program in the region.

Across the nation, institutes and colleges within numerous universities are charted with a similar mission to offer a variety of computing programs with significant variance in the types of graduates they produce; ranging from traditional computer scientists with general software development skills, to computing technology consultants who focus on specific technology areas. Most of these programs are synergistic within the university system and significantly enhance that university’s brand as a driver for technology innovation in respective regions.

Figure 6: Diversity in Computing Programs is needed at the Computer Science Department at SUNY Oswego (Blue=Undergraduate, Purple=Graduate).

The current programs in Computer Science (BS and BA in CS\(^5\), BS in SE\(^6\)), Information Science (BS in IS\(^7\)), Electrical and Computer Engineering (BS in ECE\(^8\)),

\(^5\) Bachelor of Science and Bachelor of Arts in Computer Science at SUNY Oswego, [http://www.oswego.edu/academics/colleges_and_departments/departments/computer_science/degree_programs/ba.html](http://www.oswego.edu/academics/colleges_and_departments/departments/computer_science/degree_programs/ba.html)

\(^6\) Bachelor of Science in Software Engineering at SUNY Oswego, [http://www.oswego.edu/academics/colleges_and_departments/departments/computer_science/software_engineering.html](http://www.oswego.edu/academics/colleges_and_departments/departments/computer_science/software_engineering.html)

\(^7\) Bachelor of Arts in Information Science at SUNY Oswego, [http://www.oswego.edu/academics/colleges_and_departments/departments/computer_science/degree_programs/bs.html](http://www.oswego.edu/academics/colleges_and_departments/departments/computer_science/degree_programs/bs.html)
Cognitive Science (BA in COG\(^9\)), and Human Computer Interaction (MA and PSM in HCI\(^{10}\)) within the Computer Science Department, address the need in their respective areas. In addition to this, the increasingly technology savvy student population, local community, specialized computing industry, and local government, has expressed significant interest for greater diversity in computing and information technology education to produce multi-disciplinary computing graduates specialized in healthcare applications. As seen in Fig. 6, the proposed degree in Biomedical and Health Informatics (BHI) is a step towards addressing this need for diversity in computing education while creating a new program that will be significantly different from, yet synergistic with other department-wide computing initiatives. BHI intellectual differentiation is in the track-structure of the proposed program where it is envisioned that eventually several tracks involving Health Informatics, Heath Information Management, a Professional Science Master, and others will evolve over the coming years as demand for specialized yet diversified health information technology and systems education grows in Upstate New York, in New York State, and globally as these programs will have a global reach through online delivery. By providing this framework for potential growth, the Biomedical and Health Informatics program meets the vision and mission of the Computer Science Department of promoting interdisciplinary computing education for the community it serves.

According to Dr. James Canton of Institute for Global Futures, “no force will enable and empower change - in healthcare - as deeply or as fast as technology. ... This shift will present a cornucopia of new business opportunities for companies that can provide agile and tech-enabled solutions to health-care delivery problems”. Among the radical changes emerging in healthcare and wellness are the coming of a global, tech-enabled community involving patients, family, care-givers, care-providers, local and world-scale health agents networks; ubiquitous computing where intelligent medical devices, robots, and softbots all play an increasing role to support health and wellness in society; and meeting the Big Data in healthcare and health services to improve monitoring, diagnosis, treatment, education, and prevention. Actually as the global digital health networks and ubiquitous intelligent agents grow and are predicted to dominate healthcare and health services, the sheer amount of electronic data grows with them, fueling the need for sophisticated data and decision analytics tools to analyze them. Therefore the Intelligent Health Systems track and the Health Data Science track are complementary and synergistic, the former generating more and more data, information, and knowledge, and the latter analyzing, synthesizing, and managing these complex datasets.

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\(^{8}\) Bachelor of Science in Electrical and Computer Engineering at SUNY Oswego, [http://www.oswego.edu/academics/colleges_and_departments/departments/computer_science/electrical_and_computer_engineering.html](http://www.oswego.edu/academics/colleges_and_departments/departments/computer_science/electrical_and_computer_engineering.html)

\(^{9}\) Bachelor of Science and Bachelor of Arts in Cognitive Science at SUNY Oswego, [http://www.oswego.edu/academics/colleges_and_departments/departments/interdisciplinary/cognitive_science.html](http://www.oswego.edu/academics/colleges_and_departments/departments/interdisciplinary/cognitive_science.html)

\(^{10}\) Master of Arts in Human Computer Interaction at SUNY Oswego, [http://www.oswego.edu/academics/colleges_and_departments/departments/interdisciplinary/hci.html](http://www.oswego.edu/academics/colleges_and_departments/departments/interdisciplinary/hci.html)
To summarize, the healthcare industry is undergoing shifts which will revolutionize how we are treated, encourage greater patient engagement, and lead to improved health outcomes. According to recent trends, the projected landscape of healthcare and wellness involves the following tech-enhanced facets:

1. The coming of globally connected digital health networks involving:
   a. Telehealth services for underserved communities.
   b. Connecting most medical facilities, physicians, and patients to one large network, providing access to critical medical information.

2. The advance of ubiquitous intelligent agents involving:
   a. New generation smart drugs and medical devices.
   b. Virtual reality simulations as a dominant method of training medical professionals and of educating patients.
   c. Serious games as an efficient method of educating children, and adults to change and overcome the barrier of health disparities.
   d. Nonhuman medical bots and robots to dispense medical care to patients and doctors worldwide to save money and share expertise.

3. The harnessing of Big Data analytics and decision analytics involving:
   a. Customized and personalized cyber health care which better monitors, diagnoses, educates, and treats.
   b. Preventive care made possible by detecting diseases at the molecular level and reversing pathological unbalances at their beginning – in particular through DNA analysis and bioinformatics.

The synergistic effect of tech-enabled globally connected health networks, ubiquitous intelligent agents and bots, and Big Data analytics and decision analytics provides the answer to ramping healthcare and health services costs by dramatically improving health outcomes through prevention and education.

In our region, Crouse Hospital, Upstate Medical Center, HealtheConnections, and the Veterans Administration Hospitals have already explored and implemented ground-breaking tools -- including robotics, telehealth, and statewide sharing of electronic medical records.

SUNY Oswego serves the Upstate New York region through undergraduate and graduate level programs of the highest quality. SUNY Oswego’s rigorous, enriching programs prepare students from a wide diversity of backgrounds for challenging careers and fuller lives. These accessible programs produce highly knowledgeable and capable graduates who are skilled in critical thinking and oral and written communication, who are able to work effectively with diverse populations, and who go on to make impressive contributions in their careers and in their communities.
Course schedules are designed to accommodate, as much as possible, the variety of work and family commitments that many SUNY Oswego’s students must balance.

3. Need for the Program

The demand for biomedical and health informatics graduates is high and is expected to increase both due to the rising infusion of technology and data analytics in healthcare, public health, health services, and wellness, and the ensuing drive for constant and fast upgrades inherent to tech-enabled fields.

The high level of specialization in the field requires specialists trained in this domain to make a real difference and impact. It is no accident that several large associations, the main being the International Medical Informatics Association (IMIA), the American Health Informatics Association (AMIA), the American Health Information Management Association (AHIMA), and the Centers for Disease Control and Prevention (CDC), have precisely defined the landscape of what biomedical informatics and public health informatics competencies are.

![Job Listing Growth in healthcare between 2007 and 2011](image)

**Figure 8. Job Listing Growth in healthcare between 2007 and 2011**

1. Documentation of Need for Program

**Market Demand for HI and HMI Graduates**

Jobs for the Future joined forces in 2012 with Burning Glass and Credentials that Work to document the demand for healthcare informatics graduates in a report entitled "A Growing Jobs Sector". Due to the interdisciplinarity of the field, the Bureau of Labor Statistics (BLS) does not adequately track employment in this field. The BLS only reports on one type of job in health informatics, namely Medical Records and Health Information Technicians. Although this outlook is excellent,

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11 http://www.jff.org/sites/default/files/CTW_burning_glass_publication_052912.pdf
12 http://www.bls.gov/ooh/Healthcare/Medical-records-and-health-information-technicians.htm
with a projected growth of 21%, faster than average (actually one of the 20 fastest growing occupations in the country) between 2010-20, it captures only a small part of the BHI job market.

Jobs for the Future determined that the job listings growth of health informatics between 2007 and 2011 reached 36%, much higher than all healthcare jobs, which represented only a 9% growth during the same time period (see Fig. 8). In particular, job demand for registered nurses (RNs) stayed flat during the same period of time.

Even more importantly health care informatics jobs are taking a larger share of the healthcare market, rising to the eighth largest share. Although not documented in all other areas such as bioinformatics and public health informatics, there is no doubt that the same trend is taking place and rapidly changing the biomedical field employment landscape.

Among the reasons highlighted by the report, the growing influence of federal incentives and mandates to adopt electronic health records (EHRs) and to document their ‘meaningful use’, play a major role (Health Information Technology for Economic and Clinical Health or HITECH Act of 2009). However HITECH and for example the Health Insurance Portability and Accountability Act of 1996 are in fact following a larger trend toward the adoption of technology in society in general.

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13 [http://www.brookings.edu/research/reports/2013/07/01-healthcare-metro-monitor](http://www.brookings.edu/research/reports/2013/07/01-healthcare-metro-monitor)
The biomedical field interest lies in adopting technology for its greater good like other service and manufacturing areas. The report notes in particular “New data mining technologies and artificial intelligence engines are able to make sense of the mass of clinical and financial data available. The real significance of IBM’s Watson will not be winning Jeopardy but revolutionizing clinical health care decision making”. These are exactly the areas the new BHI Master’s is specializing in.

The report also notes that among these job prospects, the higher increase is in Clinical Documentation & Improvement Analysts, which the proposed HIM Track in Health Data Science specifically addresses. However the HI Track in Intelligent Health Systems focuses in designing these intelligent systems which are in the process of revolutionizing the health care work. Additionally, the proposed programs are also of great relevance for other biomedical professions such as in health services and public health.

Given that the BLS projects that the healthcare sector will gain 5.6 million jobs during 2010-20, reportedly the most of any sector, and the results from the study above showing that the largest growth comes from health informatics, the perspectives for BHI graduates is excellent.

In the State of New York in particular, the proportion of health care workers is very high and represents a large share of the jobs available (see Fig. 9). There are numerous healthcare or computing professionals in healthcare in the area that possess a science-related bachelor’s degree and seek opportunities to increase their education and subsequent opportunities through a biomedical health informatics MS degree program. The MS in Biomedical and Health Informatics would also meet this need.

Table 2. Degree or certificate offerings in BHI in the CS Department.

<table>
<thead>
<tr>
<th>DEGREE OR CERTIFICATE</th>
<th>Graduate Certificate</th>
<th>MS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health Information Management</td>
<td>Health Information Technology</td>
<td>Health Data Science Track</td>
</tr>
<tr>
<td>Health Informatics</td>
<td>Integrated Health Systems</td>
<td>Intelligent Health Systems track</td>
</tr>
</tbody>
</table>

**Differentiation from HCI**

The HCI MA program is an interdisciplinary program with psychology. The BHI MS is interdisciplinary with biomedical sciences and is a science-based program. Therefore these two programs have very distinct educational goals and should attract different types of students.

Additionally students having taken one of the two Graduate Certificates in Health Information Technology (HIT) and Integrated Health Systems (IHS) will be able to
pursue their studies as the HIT Graduate Certificates will give them 15 credits toward the HIM Track while the IHS Graduate Certificate will give them 15 credits toward the HI Track of the proposed BHI Master’s (see Table 2). Several graduate certificate’ students have already expressed a strong interest in pursuing their graduate education toward the BHI Master’s.

2. Relationship to Other Institutions

Alternatives for Obtaining an MS in BHI in Upstate New York

Currently, according to CAHIIM, there is no accredited Master’s in health information management (HIM) or health informatics (HI) in the state of New York. Table 3 shows all the accredited HIM or HI programs in New York State\(^\text{14}\). Close to Oswego, Onondaga Community College offers an Associate degree in HIM, which could lead to transfer students in the BHI MS. Consequently, the proposed Master’s would provide to undergraduates in HIM a possibility to advance their education. Many graduates of these programs seek an opportunity to continue their education in the field in Upstate New York.

Table 3: Accredited CAHIIM programs in New York State.

<table>
<thead>
<tr>
<th>#</th>
<th>Institution</th>
<th>BHI related programs</th>
<th>Degree awarded</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Alfred State College – SUNY</td>
<td>HIM</td>
<td>Associate</td>
<td>Alfred, NY</td>
</tr>
<tr>
<td>2</td>
<td>Borough of Manhattan Community College</td>
<td>HIM</td>
<td>Associate</td>
<td>New York, NY</td>
</tr>
<tr>
<td>3</td>
<td>Broome community College</td>
<td>HIM</td>
<td>Associate</td>
<td>Binghamton, NY</td>
</tr>
<tr>
<td>4</td>
<td>Erie community College – North Campus</td>
<td>HIM</td>
<td>Associate</td>
<td>Williamsville, NY</td>
</tr>
<tr>
<td>5</td>
<td>Long Island University</td>
<td>HIM</td>
<td>Baccalaureate</td>
<td>Brookville, NY</td>
</tr>
<tr>
<td>6</td>
<td>Mohawk Valley community College</td>
<td>HIM</td>
<td>Associate</td>
<td>Utica, NY</td>
</tr>
<tr>
<td>7</td>
<td>Monroe Community College</td>
<td>HIM</td>
<td>Associate</td>
<td>Rochester, NY</td>
</tr>
<tr>
<td>8</td>
<td>Onondaga Community College</td>
<td>HIM</td>
<td>Associate</td>
<td>Syracuse, NY</td>
</tr>
<tr>
<td>9</td>
<td>Suffolk County Community College</td>
<td>HIM</td>
<td>Associate</td>
<td>Brentwood, NY</td>
</tr>
<tr>
<td>10</td>
<td>SUNY Institute of Technology</td>
<td>HIM</td>
<td>Baccalaureate</td>
<td>Utica, NY</td>
</tr>
<tr>
<td>11</td>
<td>Trocaire College</td>
<td>HIM</td>
<td>Associate</td>
<td>Buffalo, NY</td>
</tr>
</tbody>
</table>

Similarly, graduates of Health Information Technology (HIT) undergraduate certificates and degrees would find in this new Master’s an opportunity to continue their education.

Of the Universities proposing BHI related Masters’ in the region, none is currently accredited – according to CAHIIM’s Web-site. We can list in particular Weill Cornell Medical College Center for Healthcare Informatics and Policy in New York City, offering a Master of Science in Health Informatics, NYU Center for Health Informatics and Bioinformatics, offering a MS/PHD program in Health Informatics,\[^{14}\] \[http://www.cahiim.org/accredpgms.asp\] retrieved on 10/31/2013.
SUNY Downstate Medical Center, offering a Master's degree in Biomedical Informatics, and the University of Rochester Medical Center offering an MS program in Medical Informatics.

Additionally, there are currently only three accredited Health Informatics Master’s degrees in the country (in WV, OR, and IL) and five Health Information Management Master’s degrees in the country (MN, PA, MD, PA, TN)\(^\text{15}\).

For HIM education, accreditation is very important as only students from accredited programs can apply to the RHIA certification test, highly regarded by employers. Therefore an accredited Master's in HIM will be extremely attractive to students and employers alike.

For HI education, although there are other unaccredited programs in NY state, the proposed Master’s will strive at obtaining accreditation, which will set it aside any other program in the region. Additionally, none of the said NY programs focus on either data analytics or intelligent systems – which are both predicted to lead the health technology advances.

**Consequently, one objective of the proposed MS program is to provide that source of advanced educational opportunities to the underserved Upstate New York market.** Moreover, the program will provide the entire state with an additional needed resource.

### 4. Students

#### 1. Admission Requirements

Students who might be interested in this program may come from three main sources. Some will be healthcare professionals or biomedical scientists (MD, RN, PA, etc.), some will be CS/IS/CE/BHI/HIM/IT baccalaureate students, and others may be IT professionals, health IT, or health informatics professionals.

**Table 4: Program Entrance Requirements**

<table>
<thead>
<tr>
<th>MS in BHI</th>
<th>MS in BHI</th>
</tr>
</thead>
<tbody>
<tr>
<td>BS/BA in any non-CS major or MD, RN, or other biomedical professional degree</td>
<td>BS in CS/IS/CE/BHI/IT</td>
</tr>
<tr>
<td>Mathematics (college algebra)</td>
<td></td>
</tr>
<tr>
<td>Science (biology or medicine preferred)</td>
<td></td>
</tr>
<tr>
<td>Statistics</td>
<td></td>
</tr>
<tr>
<td>TOEFL 88 for international students</td>
<td>TOEFL 88 for international students</td>
</tr>
<tr>
<td>3.0 GPA Minimum</td>
<td>3.0 GPA Minimum</td>
</tr>
</tbody>
</table>

Each applicant will be required to provide evidence of a biomedical professional degree or the successful completion of a bachelor’s degree from an accredited

institution as well as all requirements specified by the Graduate Studies (3.0 GPA for last 2 years, career objectives consistent with program goals, two letters of recommendation ...). A competitive GRE score will increase chances of acceptance in the program, however professionals with a higher degree are not required to take a GRE. Calculus or Pre-calculus is preferred as well. Additional requirements required by the BHI program include specific prior coursework as indicated in table 4.

As stated earlier, students from non-health professions will have to take a foundational Medical Science graduate course. Students not meeting the prerequisite courses may need to enroll in prerequisite courses as well. Students could petition the BHI MS director for waiving some core courses based on their professional experience. A system of equivalency between professional experience and prior coursework will be decided by the program’s Director.

2. Diversity

The proposed MS program in BHI is committed to the principles of a diverse student population as articulated by the State University of New York. Every effort will be made to recruit and retain a diverse student body. SUNY Oswego seeks diverse applications with respect to individual characteristics, experiences, culture, ethnicity, gender, and physical abilities. The State University of New York has in place anti-discrimination policies that are reprinted in the Faculty and Professional Staff Handbook and disseminated to students, staff, and faculty. Those affiliated with this proposed program are strongly committed to implementing these policies.

<table>
<thead>
<tr>
<th>Table 5: Projected enrollment.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS HI / PSM Tracks</td>
</tr>
<tr>
<td>MS HIM Track</td>
</tr>
<tr>
<td>Total Headcount</td>
</tr>
<tr>
<td>Total FTE</td>
</tr>
</tbody>
</table>

Further, the proposed BHI MS is likely to attract more women to computer-related disciplines because it has been demonstrated that a majority of women scientists choose biomedical sciences over computer science and engineering for their career. Therefore an informatics degree with biomedical sciences will prove more attractive to women. According to a 2004 report from the American Society of Engineering Education, biomedical engineering is the specialty of choice for women receiving an undergraduate, graduate, or doctoral degree in engineering.

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16 [http://www.oswego.edu/administration/provost/fpsh/fps_handbook_sec5.html](http://www.oswego.edu/administration/provost/fpsh/fps_handbook_sec5.html)
5. Faculty

1. Projected Enrollment

This graduate program will serve both full-time and part-time students. It is expected that about one-half will be full-time. Table 5 is based upon that mix. Additionally this table does not take into account that several courses will be cross-listed with HCI, IS, and potentially other programs.

It is not clear when this program will reach full enrollment. The demand will likely continue to rise for a considerable period of time.

2. Expected Time to Completion

Assuming a full load of 9 credits per semester (3 courses):

- the MS program may be completed in four semesters (one academic year and a half if including summer semester to two academic years) if no prior coursework is credited toward the Master’s.

- the MS program may be completed in two semesters (one to two academic years) for students having prior credit based on their professional experience or other graduate credit. A minimum of 30 graduate credit hours must be obtained from SUNY Oswego.

These estimates are doubled for part-time students who would be taking but a single course each semester. To assist and encourage students working full-time, courses will be offered entirely online.

3. Academic Advising

Advising will be the responsibility of the BHI MS director. Advising will take place at least once every semester. The director will be responsible for:

- All advising.
- Admission of students.
- Schedule of courses until graduation for each student.
- Determination of transfer or equivalent credit.
- Graduation sign-off.
- Monitor and recommend curriculum revisions to the CS Department Curriculum Committee.
- Represent the BHI MS program at appropriate School and College committees.
- Manage the program budget.
- Other duties as deemed appropriate for the academic and other operations of the program.
The BHI MS director may delegate some or all of these responsibilities to other faculty and in particular to faculty committees.

4. Faculty

The program is planned to be first offered with three courses per semester (see Figures 3 and 4). The CS Department has the talent to offer this program however not the complete availability. Additional faculty will have to be brought on-board as the program grows.

The expected faculty load for the program is shown in Table 6. This table shows that for the first year of the program, the program can be started with one full time faculty, one adjunct, and participation of some CS faculty. CS faculty will be recruited to teach some electives and core courses as well if they so desire. For the second year of the program, we expect a line to be approved such that a second full time faculty member could start teaching courses Fall 2015. When the program reaches steady state, which we estimate at 30-40 enrolled students, another full-time faculty member will be required because this program involves significant thesis and project advising as part of its core requirements, which full-time faculty members are the most qualified to offer. Because the program will be taught online, some teaching assistants (TAs) and/or graduate assistant (GAs) will be required to assist in the instructional media management.

Table 6: Projected teaching loads (FTi = Full Time Faculty #i, ADi = Adjunct Faculty #i, CS = Other Faculty from CS)

<table>
<thead>
<tr>
<th>Semester 1</th>
<th>Course #1</th>
<th>Course #2</th>
<th>Course #3</th>
<th>Course #4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semester 1</td>
<td>BHI 501</td>
<td>FT2</td>
<td>BHI 502</td>
<td>FT2</td>
</tr>
<tr>
<td></td>
<td>BHI 506</td>
<td>AD1 or summer</td>
<td>BHI 507</td>
<td>AD2 or summer</td>
</tr>
<tr>
<td>Semester 2</td>
<td>BHI 699 / 700 / 698</td>
<td>FT1</td>
<td>BHI 699 / 700 / 698</td>
<td>FT2</td>
</tr>
<tr>
<td></td>
<td>BHI 504</td>
<td>FT1</td>
<td>BHI 505</td>
<td>FT2</td>
</tr>
</tbody>
</table>

It is traditional – and highly valued for accreditation purposes - in this type of program to select highly regarded professionals to bring to the classroom their...
unique experience working as health information management or health informatics professionals. In addition, it is conceivable to have classes co-taught by a BHI faculty and a professional, under the supervision of the BHI faculty. It is therefore in the best interest of the program to hire some adjunct faculty to increase the prestige and attractiveness of the program for community professionals and students. Adjuncts will be compensated at $3,000/course.

The first full time faculty and director of the program, Dr. Isabelle Bichindaritz, is already hired. It is required for accreditation purposes that the director be involved full-time in the program.

Table 6 demonstrates that over the first two years, at least four courses will be taught by adjunct faculty (AD*) or other CS faculty.

Faculty CV's are provided in appendix of this document. Adjunct faculty recruited for this program will have a minimal Master's of Science degree or MD/RN/PA professional degree.

5. Administration

The BHI MS will have same program administrator as the other CS department programs.

6. Facilities and Operations

6.1. Equipment, Labs, Hardware, and Software

Technology is integral to everything that the BHI Program does in terms of substantive content, practical skills, and the delivery of information. The CS Department has a well-articulated and well-supported state-of-the-art technological infrastructure that will be of enormous benefit to the proposed BHI program.

The new BHI MS will be taught entirely online. The program plans to add as often as possible concurrent face-to-face teaching either at SUNYSUNY Oswego or at the SUNY Oswego Metro Center in Syracuse in a hyflex teaching formula leaving students the choice of either attending classes in person or online as their schedule permits. Synchronous session with Elluminate will be planned as often as possible as professional invited speakers from the community will be regularly invited to present on various topics of their expertise.

However some specialized equipment for online demos as well as a server for database applications, online EHRs, and other online health software would be very valuable to increase the quality of education of the students.

Faculty, staff, advisers and students make use of email for frequent communication, assignments, advising and discussions. There are multiple
opportunities for faculty development in the use of educational technology in the new Shineman Center for Science and Technology, including many "smart" classrooms fully outfitted with computers to assist with the delivery of content. Web pages are typically developed for individual courses in order to enhance students' access to content. Other web-based tools such as Blackboard and Angel provide collaborative tools for facilitating interactions between students and instructors outside of the classroom.

Students have access to an extensive collection of productivity and development software on demand (in the cloud). This software may be run online or installed on the students' personal computers. For on-site students, they can be found installed on campus computers, or students may obtain free/discounted copies for their personal computers, as appropriate licensing agreements exist. Faculty will prepare training videos for their courses whenever appropriate.

6.2. Library
Students have access to online library services and a librarian on-call 24 hours a day. Bundled journals and technical books are available online. Research papers not available in the library system can be requested and delivered freely by email within a few days of the request. Since the National Institute of Health (NIH) has adopted a resolution for open access publishing of articles funded by its grants, most quality biomedical informatics publications are available in open access.

7. List of Courses

**BHI 552 Biomedical and Health Terminologies**
*Catalog Description:* An introduction to anatomy, physiology, pathophysiology, population health, and more broadly biomedical and medical concepts, terminology, and problems.
*Prerequisites:* none
*Credit:* 3
*Course Type:* Core

**BHI 501 Introduction to Health Information Systems**
*Catalog Description:* The course is an introduction to technologies and practices in medical, health, and biological information systems. Topics include biomedical terminologies, controlled vocabularies, health data concepts, relational, and distributed databases, electronic health records, privacy, computer and network security, web services, human-computer interaction, systems integration and interoperability, ethical issues, legal and regulatory requirements and compliance, health information systems management, and emerging trends. Students engage in projects which apply computing and information technologies to one or more areas of these information systems.
*Prerequisites:* Graduate standing
BHI 502 Health Informatics Methods
Catalog Description: This course provides an in-depth study of biomedical informatics methodological approaches and their applications, bearing in mind their present day and future impact on health information systems. Main topics include electronic health records, terminologies, biostatistics, mathematical and computational modelling, quantitative and qualitative methods, evaluation methods in biomedical informatics, including usability studies, and information sciences, are covered, with special emphasis on applications to health information systems. For each topic, the course goes over historical developments, the state of the art and potential future directions. Furthermore, students are exposed to the present situations in the world for each topic.
Prerequisites: Graduate standing

BHI 503 eHealth Systems
Catalog Description: Students are introduced to Internet technologies fostering the emergence of a global connected world. Two topics, namely Web systems and social technologies are covered. The course provides an overview of Web design concepts and skills, including usability and accessibility in a health context, and scripting languages. Emerging client-side technology is explored as well as Web services. Social media and collective intelligence technologies are also applied to enhance health and wellness in communities and create patient-centered or home-based information systems.
Prerequisites: Graduate standing

BHI 504 Systems Design, Integration, Safety & Security
Catalog Description: This course studies systems analysis, design, and integration methods for healthcare and health services environments with the goal of ensuring that the systems engineered are both safe and secure. The course relies on advanced software tools to support the system creation process and emphasizes systems integration for health environments as well as safety-critical systems. Topics include requirements engineering, systems engineering, systems analysis, systems architectural design, interoperability, legal and regulatory constraints, systems safety, safety critical systems, information assurance, computer security, clinical information systems components and major vendors, project management, documentation, human factors, and cost/benefit analysis.
Prerequisites: Graduate standing
BHI 505 Digital Health
Catalog Description: Health informatics is more and more ubiquitous, distributed, and pervasive. This course studies how to conceive and use ubiquitous and distributed systems and information for health and wellness and how to integrate them with clinical and other health services. Topics include networks, wireless technologies, mobile health, advanced networking technologies, sensor-based systems, sensor data analysis and mining, disaster informatics, digital libraries, telemedicine, and telehealth.
Prerequisites: BHI503 or permission of the instructor
Credit: 3
Course Type: Core

BHI 506 Decision Support & Intelligent Systems
Catalog Description: Intelligent systems have made a significant impact on medicine and biology through their ability to expand human information processing abilities to infinity. This course gives students methods and skills to use and integrate computational intelligence systems in clinical and health settings for decision support in diagnosis, treatment planning, long-term follow-up, monitoring, quality control and insurance, preventative care, and education. Topics include evidence-based medicine, electronic clinical guidelines, knowledge-based systems, decision-support systems, clinical knowledge management systems, knowledge representation, medical reasoning process, ontologies, reasoning under uncertainty, decision theory, machine learning, and nature-inspired computing.
Prerequisites: BHI502 & BHI503 or permission of the instructor
Credit: 3
Course Type: Core

BHI 507 Quality Assurance Through Informatics
Catalog Description: This course studies the motivations, evolution, state-of-the-art, current limitations, and future research to improve health quality and outcomes. Methods and techniques to define, measure, improve, and document health quality are presented, including meaningful use reporting skills. Several high-stake types of systems are analysed such as electronic health records, computerized provider order entry systems, clinical reminders, care protocols selection and management systems, decision support systems, health information exchange, HL7, information retrieval and summarization, public health information networks and decision support systems, and consumer health informatics. Students are led through case studies to critically appraise actual health informatics initiatives at all levels from the computer system level to the patient outcome level and from the local scope to the national and global scopes, with an emphasis on patient and population health outcomes.
Prerequisites: BHI503 & BHI504 or permission of the instructor
Credit: 3
Course Type: Core
**BHI 508 Databases**

**Catalog Description:** The course stresses database applications development through fourth-generation programming techniques. Content of the course stresses basic knowledge of normalization of data, data modeling, database methods, database design, and the use of databases in business. Students will learn the rudiments of construction of database schemata.

**Prerequisites:** Graduate standing  
**Credit:** 3  
**Course Type:** Core

**BHI 509 Data Analytics**

**Catalog Description:** Data analytics and decision analytics are examined in this course. This course discusses the manager's strategies and tools for problem solving and decision making in domains in which data, including text, web, and social networks information, and computer models can be used as descriptive and predictive tools to gain the insight needed to guide decision making.

**Prerequisites:** Graduate standing  
**Credit:** 3  
**Course Type:** Core

**BHI 510 Geospatial Temporal & Text Analytics**

**Catalog Description:** The objective of this course is to develop an understanding and practice of geospatial, temporal, and textual data and their analysis for decision analytics and data science in healthcare, health research, and public health. The course provides methods of description, estimation, testing, prediction, and clustering developed for geospatial, temporal, and textual models. Concepts, methods, and applications are emphasized, rather than theory. Topics include spatial statistical inferences, variograms, spatial autoregressive models, time series representation, time series prediction, survival analysis, temporal clustering, spatial clustering, machine learning methods, text summarization, text classification, and text clustering.

**Prerequisites:** Graduate standing  
**Credit:** 3  
**Course Type:** Core

**BHI 557 Bioinformatics**

**Catalog Description:** A projects-based introduction to biological databases, computational tools and techniques (including programming) applied to biological data, scripting languages and libraries.

**Prerequisites:** BHI502 & BHI503 or permission of the instructor  
**Credit:** 3  
**Course Type:** Elective

**BHI 553 Terminologies and Coding**

**Catalog Description:** The objective of this course is to develop an understanding and practice of standardized terminologies in healthcare, health research, and public
health. The course provides both theory and practice in classification systems, terminologies, standards, coding, and ontologies as well as their effect on health information systems and health information sciences. Topics include classifications models, varied terminologies such as SNOMED, ICD, DRG, MeSH, standards such as HL7, medical ontologies, bioinformatics ontologies.
Prerequisites: Graduate standing
Credit: 3
Course type: Elective

**BHI 554 Information Assurance**
**Catalog Description:** The need for information security policies, standards, and procedures will be studied. This course focuses on the formulation of an effective and implementable security policy. It also acquaints students with many issues involved with privacy and security policies as outlined by various national and international governmental and industrial bodies. Topics include: Trust models, Security policy design and incident response, Security policy monitoring and auditing, Cyber-security, Tools and techniques to defend against, react to, and recover from a cyber-attack, Economics of cybercrime, Security and privacy policies, Compliance, and Legal issues.
Prerequisites: Graduate standing
Credit: 3
Course type: Elective

**BHI 550 Seminar in BHI**
**Catalog Description:** This course studies one advanced topic in biomedical and health informatics.
Prerequisites: Graduate standing
Credit: 3
Course Type: Elective

**BHI 600 Independent Study or Research in BHI**
**Catalog Description:** Examines current topics and issues associated with biomedical and health informatics.
Prerequisites: BHI 503, and permission of adviser.
Credit: 3
Course Type: Elective

**BHI 698 Graduate Internship in BHI**
**Catalog Description:** Completion of project as delineated in a contract among student, graduate faculty adviser, and community sponsor.
Prerequisites: BHI 504, and permission of adviser.
Credit: 1-12 hours of credit
Course Type: Core
BHI 699 Project in BHI
Catalog Description: Completion of project as delineated in a contract among student and graduate faculty adviser.
Prerequisites: BHI 504, and permission of adviser.
Credit: 1-12 hours of credit
Course Type: Core

BHI 700 Master's Thesis in BHI
Catalog Description: Completion of a research project led by a BHI graduate faculty member.
Prerequisites: BHI 504, and permission of adviser.
Credit: 1-12 hours of credit
Course Type: Core

8. Program Assessment

The program assessment will include assessment of the program production of graduates to meet state accreditation expectations, and also an assessment of quality of graduates to insure they meet or exceed the biomedical informatics standards for quality of professionals.

1. Assessment Plan for the Program

To assess the achievement of the MS in BHI Program objectives, the following benchmarks will be utilized:

- Employers of graduates and graduates will be surveyed one, three, and five years after graduation to determine if students are:
  - Proficient in identifying technological and information management solutions to commonly encountered biomedical issues
  - Successfully applying critical thinking skills and knowledge in their working in biomedical environments
  - Demonstrating effective leadership, communication skills, and team membership skills.

- Graduation rates of 6 MS degrees per year by the third year, and 10 MS degrees per year by the fifth year.
2. Student Learning Outcomes Assessment Plan

The educational quality assessment measures are presented in Section 1 in terms of precise and measurable learning outcomes.

Assessment data will be used to improve the curriculum and the methods used to facilitate the ability of learners to meet projected outcomes.

9. Accreditation

As previously mentioned, accreditation by the CAHIIM will be sought for the Biomedical and Health Informatics program tracks in Health Informatics and in Health Information Management. Accreditation application of these programs will start as soon as the criteria for accreditation outlined in the CAHIIM accreditation manual\(^{18}\) are met.

10. Local Resolution and Support documents

Several letters of support have been received for this program, including from:

- Jiancheng Huang, MD, MSc, Director of Public Health, Oswego County Health Department (also advisory board member).
- Robert M. Simpson, President, Centerstate Corporation for Economic Opportunity.
- Ioana L. Coman, Research Assistant Professor, Center for Psychiatric Neuroimaging, SUNY Upstate Medical University (also advisory board member).

Other letters of support are pending.

11. Background Statement / Abstract for Master Plan Amendment

TBD

\(^{18}\) [http://www.cahiim.org/policiescurriculum.html](http://www.cahiim.org/policiescurriculum.html)