

Indiana University
School of Informatics and Computing
IUPUI Campus

Master of Science in Informatics
Program Proposal

INSTITUTION: Indiana University, Indianapolis (IUPUI)

SCHOOL: School of Informatics and Computing

DEGREE PROGRAM TITLE: Master of Science in Informatics

FORM OF RECOGNITION TO BE
AWARDED/DEGREE CODE: Master of Science Degree

SUGGESTED CIP CODE: TBD

LOCATION OF PROGRAM/
CAMPUS CODE: Indianapolis/IUPUI

PROJECTED DATE OF
IMPLEMENTATION: Spring 2015

DATE PROPOSAL WAS APPROVED BY INSTITUTIONAL BOARD OF TRUSTEES:

SIGNATURE OF AUTHORIZING INSTITUTIONAL OFFICER

DATE

DATE RECEIVED BY COMMISSION FOR HIGHER EDUCATION

COMMISSION ACTION

(DATE)

1. Characteristics of the Program

Title of Degree: Master of Science in Informatics
Indiana University School of Informatics and Computing
IUPUI Campus

Indiana University proposes an MS in Informatics, offered on the campus of Indiana University Purdue University Indianapolis (IUPUI) and administered by the School of Informatics and Computing.

- a. *Campus(es) Offering Program:* Indiana University-Purdue University Indianapolis
- b. *Scope of Delivery (Specific Sites or Statewide):* Indianapolis
- c. *Mode of Delivery (Classroom, Blended, or Online):* Blended
- d. *Other Delivery Aspects (Co-ops, Internships, Clinicals, Practica, etc.):* Internships, research practica
- e. *Academic Unit(s) Offering Program:* Department of Human-Centered Computing, School of Informatics and Computing
- f. *Form of Recognition to be awarded/Degree code:* Master of Science in Informatics
- g. *Suggested CIP code:* 11.0104
- h. *Projected Date of Implementation:* Fall 2015

2. Rationale for the Program

a. Institutional Rationale (Alignment with Institutional Mission and Strengths)

Why is the institution proposing this program?

It is clear from our discussions with other schools at IUPUI that informatics has become not only an integral part of many disciplines and professions but also an essential skill for their graduates. To enhance greatly their graduates' career prospects, these schools have expressed strong interest in combining a Master of Science in Informatics with their undergraduate majors in five-year BS/MS programs. Given the scope of their disciplines—Business and Finance, Physical Education and Tourism Management, Philanthropy, Health and Rehabilitation Sciences, and Liberal Arts, to name a few—no one school can address the multidisciplinary need for informatics. Collaboration among schools is essential.

Informatics is the application of information technology (IT) to other fields. *The MS in Informatics will expand the career opportunities of undergraduate students and degree holders in nontechnical disciplines by enabling them to apply IT skills to their own*

field or to transition into IT fields. This would make MS graduates effective informaticians, that is, professionals with a solid IT background and knowledge of how to apply IT to their area of expertise.

The first objective of the MS in Informatics is to enable students to apply informatics in their respective disciplines. To achieve this goal, we propose first to establish the new degree itself, providing specializations from within our School, and then to propose interdisciplinary five-year BS/MS programs and dual degrees with other schools to meet the competitive requirements of Indiana's job market. The four proposed specializations from within the school are *Data Analytics*, *Biomedical Informatics*, *Knowledge and Information Management*, and *User Experience Design (UXD)*. The second objective of the MS in Informatics is to provide a path for students and graduates from non-IT backgrounds to transition rapidly into in-demand, well-remunerated IT positions, which increasingly require knowledge and skills in both informatics and in the application domain.

What will completing this program prepare the students to do?

The MS in Informatics provides core competencies in data analytics, data management and infrastructure, client-server application development, and ethical and professional management of informatics projects.

The Biomedical Informatics Specialization provides additional competencies in the technologies and methodologies for processing and managing data, information, and knowledge in healthcare and/or the engineering of algorithms, databases, and other tools to solve problems on biological data, leading to the following careers: Bioinformatics Analyst, Bioinformatics Application Developer, Bioinformatics Scientist, Bioinformatics Technician, Biomedical Informatician, Clinical Applications Analyst, Clinical Data Analyst, Clinical Informatics Consultant, Clinician Leader, Health Information Exchange Specialist, Healthcare Analyst, Healthcare Informatician, Informatics Analyst, Information Systems Lead, Medical Informatician, Project Manager, and Research Informatics Associate.

The Data Analytics Specialization provides additional competencies in the management of massive, high-throughput data stores, cloud computing, and the data lifecycle, leading to the following careers: Data Scientist, Informatics Scientist, Data Analyst, Big Data Consultant, Business Intelligence Analyst, Business Technology Analyst, IT Consultant, Software Developer, Database Administrator, System Administrator, Web Administrator, Information Architect, and Information Manager.

The User Experience Design Specialization provides additional competencies in the application of human-computer interaction (HCI) theory and user-centered practices to user experience design, leading to the following careers: Application Design Architect,

Application Developer, Human Factors Specialist, Interactive Media Designer, Interface Developer, Product Analyst, Usability Engineer, Usability Research Analyst, Usability Tester, User Experience (UX) Consultant, UX Designer, UX Researcher, and Web Designer.

The Knowledge and Information Management Specialization provides additional competencies in the development and management of information resources, leading to the following careers: Business Intelligence Analyst, Data Analyst, Data Curator, Data Governance Specialist, Data Quality Controller, Data Repository Manager, Database Administrator, Digital Knowledge Coordinator, Informatics Analyst, Information Architect, Information Manager, Information Systems Lead, Knowledge Sharing Systems Consultant, Metadata Analyst, and Project Manager.

How is it consistent with the mission of the institution?

The proposed MS in Informatics aligns well with Indiana University's vision and mission as laid out in "The Principles of Excellence," because it will be an exemplar of "an excellent world-class, relevant, and responsive education across a wide range of disciplines in baccalaureate, graduate, and professional education"¹ The MS is designed to integrate with undergraduate degrees in accelerated five-year programs as well as with professional degrees and certificates. By addressing the demand for professionals capable of applying informatics principles to specific domains, it will also provide "leadership in creative solutions for 21st century problems."¹ In addition, the Master of Science in Informatics aligns well with the University's vision, because it is an innovative program with few peers of its type in the US and abroad.

The mission of the School of Informatics and Computing is to excel and lead in education, research, and civic engagement in informatics. Informatics is an integrative discipline that advances knowledge in computing, information, and media technologies, addresses the implications those technologies have for individuals and society, and applies them to any field of study, adapting it to the challenges and opportunities of the Information Age. The proposed Master of Science in Informatics is consistent with the mission of the School of Informatics and Computing to transcend the study of technology itself: identifying, defining, and addressing information problems in a range of disciplines with a variety of technologies and methodologies.

How does this program fit into the institution's strategic and/or academic plan?

The MS also aligns well with IUPUI's Strategic Plan "Increase Capacity for Graduate Education" and, specifically, to "aggressively develop professional master's degrees."²

¹ <http://pres.iu.edu/vision/principles-of-excellence/> Indiana University's The Principles of Excellence, 2010.

² <http://strategicplan.iupui.edu/StudentSuccess> IUPUI's Strategic Plan: The Success of our Students, 2010.

This degree combination is a key strategy for developing and retaining IT talent in the State and is expected to enhance recruitment and retention for the School and campus.

The proposed degree program also aligns well with the Strategic Plan (2014–2019) of the School of Informatics and Computing’s Department of Human-Centered Computing. The plan specifically cited the creation of the MS in Informatics as a strategic action to undertake in support of the broader objective of improving the quality and quantity of graduate students in the department’s programs.³

The four specializations have, to varying extents, a health and life science focus, and thus align with IUPUI’s Strategic Plan for Advances in Health and Life Sciences:

- Improve the organization, integration, and alignment of IUPUI’s healthcare education infrastructure to achieve the common goals of our various healthcare programs....
- Engage students and faculty from the various health and life sciences schools in collaborating in classroom and clinical settings to deliver higher quality, comprehensive patient care.
- Implement, integrate, and evaluate interprofessional health education programs and exemplary practices sites and translate outcomes into collaborative practice models in order to improve patient outcomes, quality, and cost effectiveness.⁴

The second and third point align with the 4+1 BS/MS programs under development with schools in the health and life sciences (e.g., the School of Health and Rehabilitation Sciences).

How does this program build upon the strengths of the institution?

The MS in Informatics is administered by the Department of Human-Centered Computing (HCC), which already administers the BS in Informatics, BS in Media Arts and Science, MS in HCI, and PhD in Informatics, HCI Specialization. Therefore, HCC faculty are well equipped to teach and advise the MS in Informatics core and its specializations in Data Analytics and in User Experience Design. The Department of BioHealth Informatics (BHI) already administers the BS in Health Information Management (formerly Health Information Administration), the MS in Bioinformatics, the MS in Health Informatics, and the PhD in Informatics, Bioinformatics and Health Informatics Specializations. Therefore, BHI faculty are well equipped to teach and advise the specialization in Biomedical Informatics.⁵ The Department of Library and Information Science (LIS) already administers the Master of Library Science. Therefore, LIS faculty are well equipped to teach and advise the Knowledge and Information Management Specialization.

³ <https://iu.box.com/HCC-Strategic-Plan>

⁴ <http://strategicplan.iupui.edu/HealthLifeSciences>

⁵ The BHI faculty will determine the date of implementation of the Biomedical Informatics Specialization.

School of Informatics and Computing is addressing the increasing demand for professionals trained in the application of informatics principles to the ever-expanding pools of information and data that both enhance and hamper virtually every field and profession. Given the combined expertise of its faculty, the school offers students a broad curriculum enabling them to gain the knowledge and experience necessary to compete for employment in rapidly developing fields that rely on informatics.

Describe the student population to be served?

The School of Informatics and Computing’s Indianapolis location supports collaborations with other schools on the IUPUI campus in the curricular development of 4+1 BS/MS and dual MS degree programs. The location enables nontraditional students who are employed by local industries to pursue an MS in Informatics while remaining employed at their institutions. This is a very significant need for the local community and is also one of the primary missions of the IUPUI campus.

Appendix 1: See links to Institutional Rationale, Detail and institution’s strategic plan or the plans.

b. State Rationale

How does this program address state priorities as reflected in Reaching Higher, Achieving More?

The proposed Master of Science in Informatics is a student-centered program that is “Workforce-aligned, recognizing the increasing knowledge, skills and degree attainment needed for lifetime employment and ensuring Indiana’s economic competitiveness.”

The proposed Master of Science in Informatics will take its place alongside “high demand academic programs that are critical to Indiana’s economy,” because of the expected demand for trained professionals with the skills to apply informatics principles to specific domains; the MS will be an example of a program demonstrating “continuous efficiency.” It will have high quality instruction from our faculty. Interdisciplinary and interdepartmental coordination will produce operational efficiencies. In terms of quality, the Master of Science in Informatics will have clearly defined and empirically measurable student learning outcomes and rigorous learning assessment procedures.

During the fall 2013 semester, faculty representatives of the School of Informatics and Computing met with numerous other academic units across the IUPUI campus to investigate potential academic collaborations. One recurring theme arising from these meetings was a desire to pair a graduate degree in informatics with existing undergraduate programs in other disciplines—providing the advanced information management skills needed in each of those specific disciplines. The other units

expressing this need include the following: The Kelley School of Business, McKinney School of Law, School of Education, Herron School of Art and Design, School of Physical Education and Tourism Management, School of Nursing, School of Health and Rehabilitation Sciences, and School of Science. This desired pairing of programs (and more specifically, the subsequent BS/MS collaborative programs we plan to pursue) reflect the theme of “smarter pathways” expressed in *Reaching Higher, Achieving More*. Thus, we believe this is the right time for this program. The quantity of information to be managed and exploited for the benefit of the stakeholders in virtually every domain continues to mushroom around us. (All quotes from *Reaching Higher, Achieving More*)

c. Evidence of Labor Market Need

i. National, State, or Regional Need

Recent reports highlight the fact that the shortage of qualified workers with technical skills is a challenge for organizations across industries and geographical boundaries.

In Central Indiana, the increase in job growth in computer-related occupations is outpacing job growth in all areas 7.3% to 2%. A 2014 TechPoint Foundation report found among organizations surveyed “85 percent of those companies experienced a high level of competition for talent in Indiana and 65 percent perceived a skills gap between available talent and the jobs that the companies are looking to fill.” The competition for workers with strong IT skills is not merely among technology companies but also those in the healthcare, financial, marketing, retail, and manufacturing industries.

Regionally and nationally the demand for skilled IT workers creates challenges for organizations. The Accenture 2013 Skills and Employment Trends Survey of 400 executives at large US companies reported that, among those who have or expect to face a skills shortage, the biggest demand is for IT skills (44%). One of the main reasons for a continued skills shortage is a lack of qualified candidates (38%).

The TECNA 2013 National Survey of Technology, Policy, and Strategic Issues surveyed over 1700 IT and business executives from industries including IT, finance, healthcare, media, education, life sciences, and telecommunications from across the United States and reported similar shortages of workers with the necessary IT skills to meet their needs. These organizations report they are expecting year over year shortages of workers to fill their open positions ranging from 25% to 44%.

In 2010, 1.2 zettabytes of digital data were produced, and that number is expected to grow to by a factor of 30 by 2020 (IDC Digital Universe Study, April 2010). Demand for talent in data analytics is projected to exceed supply by 50–60% by 2018. (McKinsey Global Institute. *Big Data: The Next Frontier for Innovation, Competition and Productivity*. May, 2011.)

The shortage of IT professionals combined with the increasing demand for them place the School of Informatics and Computing at IUPUI in a position to graduate Master of Science degree holders with industry-specific knowledge fused with the IT acumen that is in high demand across industries locally, regionally, and nationally.

<http://blog.techpoint.org/blog/internal-hidden/workforcereport1>

<http://www.accenture.com/SiteCollectionDocuments/PDF/Accenture-2013-Skills-And-Employment-Trends-Survey-Perspectives-On-Training.pdf>

<http://www.slideshare.net/techcouncils/teca-nationa-survey-of-technology-policy-strategic-issues-2013>

ii. Preparation for Graduate Programs or Other Benefits

The main purpose of the Master of Science in Informatics program is to complement the student's existing field of expertise (e.g., art, business, education, law, liberal arts, PETM, rehabilitation science) with graduate-level informatics competencies. Thus, the program will create practitioners who are highly skilled at applying informatics to their respective field and are ready to take on information technology positions in their field's job market. Our graduates will be well versed in the principles and tools of informatics and information technology and, by the time of graduation, will be skilled in applying those tools to their respective fields of undergraduate expertise.

Although this degree is primarily intended to enable students to apply informatics to their respective fields, it can also serve as a conversion course to prepare the student with a non-IT background for IT-related master's and doctoral studies. For example, a major in psychology or business who wanted to enter a Ph.D. program with a specialization in Human-Computer Interaction or Biomedical Informatics could use the Master of Science in Informatics to make that career transition. This would be especially effective when coupled with a certificate in one of those areas to fulfill the elective requirements and with the thesis option.

iii. Summary of Indiana DWD and/or U.S. Department of Labor Data

Nationally, the BLS projects that for all "Computer and Mathematical Applications," the U.S. will see an increase of 18% between 2012 and 2022—or approximately 685,800 additional jobs. While the Bureau of Labor Statistics does not track information professionals specifically, it does track the industry code for "Computer and Information Systems Managers" within the "Computer and Mathematical Applications" category. For this industry code, the BLS expects an increase of 15.3%, or 97,100 jobs. Finally, at the local level, Indiana's Department of Workforce Development expects that, by 2018, Indiana will see an increase of 1.5% or 604 additional jobs in the Information sector.

Within this sector, jobs are shifting away from Publishing Industries (−4.7%) and Telecommunications (−3.9%) to informatics-related areas, such as Internet Service Providers, Web Search Portals, and Data Professionals (+52.2%).

Appendix 2: Summary of Indiana DWD and/or U.S. Department of Labor Data, Detail (This appendix should contain the detailed tables, upon which the summary of the labor market demand is based.)

iv. National, State, or Regional Studies

In its Technology Workforce Report: Employment Trends and the Demand for Computer-Related Talent in Central Indiana, the Central Indiana Corporate Partnership (CICP) found that computer-related occupations were one of only two occupational groups in Central Indiana that are growing faster than the national average—at 7.3% locally as compared with 6.4% nationally. Indeed, Forbes magazine’s November 2013 issue included a story on “The Surprising Cities Creating the Most Tech Jobs”—an article that included Indianapolis–Carmel in the top 10 such cities. The article went on to speculate that, because of lower costs, cities like Indianapolis had potential to attract more investment in technology.

Recent research by the McKinsey Global Institute (2011) forecasts a 50–60% gap between the supply and demand of people with deep analytical talent. These data scientists will have advanced training in statistics, data mining, or machine learning as well as the ability to analyze large datasets. The study projects approximately 140,000 to 190,000 unfilled positions of data analytics experts in the U.S. by 2018 and a shortage of 1.5 million managers and analysts who have the ability to understand and make decisions using big data.

An important part of the Master of Science in Informatics curriculum is big data analytics and technologies. It is predicted that by 2018, in the United States 4 million positions will require these types of skills in almost all application areas. However, if we add together the number of people with these skills and new graduates who will enter the market based on current trends, we reach a total of only 2.5 million people in the United States in 2018. So there is a potential shortfall of 1.5 million data-savvy managers and analysts. Vesset et al. (2012) project rapid and substantial growth in this domain over the next three to years, they expect the big data technology and services market to grow from \$3.2 billion in 2010 to \$16.9 billion in 2015. This represents a compound annual growth rate (CAGR) of 39.4% or about seven times that of the overall information and communication technology (ICT) market.

Appendix 3: See the links to National, State, or Regional Studies

v. Surveys of Employers or Students and Analyses of Job Postings

A recent survey of job postings in Indiana listed over 2000 careers related to IT and Informatics. Many of these postings are looking for graduates to work in information content development, user experience design, biomedical informatics, data analytics and other areas related to the knowledge and skills for which the proposed degree program will prepare students.

Appendix 4: See the Survey results of Job Postings and associated Details.

vi. Letters of Support

Letters of support are provided from the Deans of various Schools demonstrating the need for the proposed MS in Informatics degree program as it crosslinks and benefits students from all disciplines.

Appendix 5: Letters of Support from various Schools are provided.

3. Cost of and Support for the Program

a. Costs

Faculty and Staff

The required faculty are currently in place to deliver this degree program. They are currently teaching in the Department of Human-Centered Computing in the School of Informatics and Computing on the IUPUI campus. Because the program mainly uses existing courses, faculty, and facilities, no additional resources are required apart from those required to open up additional course sections.

Appendix 6: See the list of faculty with appointments to teach in the program.

Facilities

The proposed program can be delivered with existing facilities. There will be no major impact on facilities caused by this program.

Other Capital Costs (e.g., Equipment)

The proposed program can be delivered with existing equipment. There will be no major new capital costs associated with this program.

b. Support

There is no need to reallocate resources to support the proposed Master of Science in Informatics degree program. No programs will have to be eliminated or downsized to provide resources for this program. There will be no special fees above baseline tuition needed to support this program.

4. Similar and Related Programs

List of Similar Programs

Master’s programs in informatics are listed below as well as programs in information science and information technology. The informatics programs range from 30 to 45 credit hours and are generally designed to be completed within 12 months or two years. Some adopt a cohort model, admitting a restricted number of students who proceed through the program in lockstep. However, the unique feature of our program is its linkage with other disciplines, which provides students with an opportunity to enroll in an integrated BS-MS program. As described above, many departments on the IUPUI campus have expressed strong interest in developing 4+1 programs with the School of Informatics and Computing, and a 30 credit hour Masters of Science in Informatics provides graduate coursework that can be completed in the fifth year.

| Informatics Programs | | |
|--------------------------------------|--|---------------------|
| <i>School</i> | <i>Degree</i> | <i>Credit Hours</i> |
| University of South Carolina Upstate | Master of Science in Informatics | 30 |
| University of Iowa | Master of Science in Informatics | 32 |
| Lipscomb University | Master of Science in Informatics and Analytics | 36 |
| University of California, Irvine | Master of Science, ICS Concentration in Informatics | 37 |
| Northeast University | Master of Professional Studies in Informatics | 45 |
| Related Programs | | |
| Cornell University | Master of Professional Studies in Information Science | 30 |
| North Carolina State University | Master of Science in Analytics | 30 |
| Dakota State University | Master of Science in Analytics | 30 |
| Penn State | Master of Professional Studies in Information Sciences | 33 |
| Villanova University | Master of Science in Analytics | 33 |
| Texas A&M University | Master of Science in Analytics | 36 |
| University of Chicago | Master of Science in Analytics | 36 |

| | | |
|------------------------------------|---|----|
| Louisiana State University | Master of Science in Analytics | 39 |
| Kent State University | Master of Science in Knowledge Management | 42 |
| University of Tennessee, Knoxville | Master of Science in Information Science | 42 |
| Indiana University | Master of Information Science | 42 |
| Carnegie Mellon | Master of Science in Information Technology | 48 |
| University of California, Berkeley | Master of Information and Data Science | 48 |
| University of North Carolina | Master of Science in Information Science | 48 |

The MS in Informatics does not compete with the school’s existing MS degrees in Bioinformatics, Health Informatics, and HCI. These highly specialized degrees have particular undergraduate degree requirements, which include a background in programming, databases, and statistics. As a conversion course, the MS in Informatics assumes no such background but instead trains students in fundamental informatics knowledge and skills through its five-course core.

The MS in Informatics also does not compete with the school’s Master of Information Science (MIS) degree on the Bloomington campus offered since 1996 by the Department of Information and Library Science. This 42-credit hour degree program educates information professionals whose expertise includes understanding the human side of information technologies and applying that understanding to practical problems. The MIS has little overlap with the Master of Science in Informatics, which is intended for a different audience, namely, students at IUPUI and Indianapolis colleges interested in an integrated BS/MS program that they can complete in five years and in dual MS degrees.

5. Quality and Other Aspects of the Program

a. Credit Hours Required/Time To Completion

A minimum of 30 credit hours will be required. The program can be completed in 12 months if courses are taken during the summer; otherwise, the time to completion will be three regular semesters: fall, spring, and the following fall.

***Appendix 10:** See the semester-by-semester, course-level detail on the program curriculum, including how long it will take to complete the program.*

b. Program Description

The Master of Science in Informatics is a graduate degree program offered by the Department of Human-Centered Computing in the School of Informatics and Computing.

A minimum of 30 credit hours will be required for the proposed degree, including a five-course 15-credit hour core. Proposed degree options include the following:

- **Coursework Only Options**

An additional 15 credit hours of graduate-level courses in informatics or related disciplines. <http://soic.iupui.edu/graduate/courses/>

- *General*. The student and academic advisor work together to develop a plan of study, which must be approved by the academic advisor, and show a clear career path.
- *Data Analytics Specialization* (see Appendix 10)
- *Biomedical Informatics Specialization* (see Appendix 10)
- *Knowledge and Information Management Specialization* (see Appendix 10)
- *User Experience Design Specialization* (see Appendix 10)
- One of the previously approved stand-alone Graduate Certificates in the School of Informatics and Computing.⁶ Although the Graduate Certificate in Clinical Informatics, Health IT, and Health Information Management and Exchange are 18 credit hours, they would only require 15 credit hours for MS in Informatics students to complete owing to a one-course overlap (i.e., INFO-I 505 Informatics Project Management).

<http://soic.iupui.edu/graduate/degrees-programs/>

The Graduate Certificate in Data Science is a fully online four-course degree offered by the School of Informatics and Computing at IUB.

<http://www.soic.indiana.edu/graduate/programs/data-science/>

- **Research Options**

- An additional 15 credit hours of graduate-level courses in informatics or related disciplines, approved by the student's academic advisor, which may include a specialization and one of the following:
 - A *thesis* of 6 credit hours (Students are typically advised to take additional research-preparatory courses such as INFO-H 575: Informatics Research Design and applied statistics courses, such as PSY 600, PSY 601, PSY 608, NURS-L 650, NURS-R 612)
 - A *project* of 3–6 credit hours
 - One or two *research rotations* for a total of 3–6 credit hours

Elective courses are selected in consultation with an academic advisor assigned upon matriculation. Students will complete the program, demonstrating both breadth and depth, from the list of classes in Appendix 10.

A thesis committee must include at least three faculty members, and project committees must include at least two faculty members. The majority of faculty members must be

⁶ Degrees are conferred by the school and IU, and not the Graduate school, and thus are not subject to the Graduate School's 8 credit hour limit on program overlap.

from the IU School of Informatics and Computing without any limitation on the department or campus. Because the Graduate Certificate in Data Science is only 12 credit hours, it may be combined with either a 3 credit hour project or research rotation.

The five core courses cover the following topics: (1) an overview of the breadth of informatics applications, (2) data management, (3) data analytics, (4) client–server application development, and (5) informatics project management. Elective courses enable a deeper exploration of these areas (e.g., nonrelational databases, cloud computing, high-throughput computing, quantitative research methods, informatics research design) and/or a specialization in a particular field or domain to which informatics is applied. These include specializations offered in the School of Informatics or specializations offered by other Schools. This combination of a core with electives enables students to specialize in ways that complement their disciplinary background. It also enables the construction of five-year BS–MS dual degree programs to exploit overlap, thereby holding the number of required hours to 30.

The program should be attractive to current and former IUPUI students who have completed a bachelor’s degree in another discipline (e.g., art, business, education, law, liberal arts, PETM, rehabilitation science) and are seeking informatics skills to complement their domain knowledge to access a broader range of career opportunities. During the initial years, it is expected that the program will attract at least 10 students per year for a period of five years. This will increase to 20 students per year during the following years. The first group of students may graduate as early as 18 months from the start of the program.

Students must maintain a minimum cumulative GPA of 3.0 on a 4.0 scale and earn a minimum of a B– in every course. If a minimum grade is not earned in a course, that course must be retaken. Students may not take any course using the Pass/Fail option. Graduate students may not replace a grade. If a course is repeated then both grades apply toward the cumulative GPA. After each semester the Graduate Committee will review the performance of each student in the program. Students are placed on academic probation following a semester in which their graduate cumulative or semester grade-point average falls below 3.0. Students on probation are required to attain an average of at least 3.0 on all graduate coursework completed by the end of the next semester. Failure to do so is cause for dismissal. The Master of Science in Informatics will be granted upon completion of the program.

c. Admissions requirements

Applicants for the MS in Informatics must have a bachelor’s or master’s degree from an accredited college or university, with a minimum grade point average of 3.0 on a 4.0

scale in the student's undergraduate major, documented by an official transcript. The applicant must include the following material:

- *Official transcripts* from all previous undergraduate and/or graduate institutions.
- Nonnative speakers of English must present campus-approved evidence of *English language proficiency* (<http://iapply.iupui.edu/graduate/english/>). A student may accomplish this in various ways (e.g., by scoring within the past two years at least 79 on the iBT TOEFL, 550 on the paper-based TOEFL, 6.5 on the IELTS, or G011 on the IUPUI EAP Placement exam).
- *Graduate Record Exam* (GRE) scores from within the past five years *if the applicant is seeking direct financial assistance* (such as an assistantship or fellowship) from the School of Informatics and Computing.
- *A personal statement* clearly explaining the candidate's background in a relevant undergraduate (or graduate) major and the reasons the candidate wishes to pursue the degree.
- *A resume* listing the applicant's education, work, research, and any honors and awards.
- *Three letters of recommendation* from professors or employers who have knowledge of the candidate's academic potential or, when necessary, from others familiar with the candidate's relevant work. It is preferred that at least two of the letters come from faculty.

Members of the graduate faculty from the Department of Human-Centered Computing determine admissions. Admission is selective: The Graduate Admissions Committee evaluates applicants' abilities to succeed academically and their potential to contribute to the program.

Unlike our Master of Science in Bioinformatics, Health Informatics, or Human-Computer Interaction, this program will not require students to possess degrees in specific undergraduate majors. Unlike those programs, it also will not have specific prerequisites in application development, data management, and data analysis, because those topics will be taught in the coursework.

d. Specific Student Clientele for Program

The MS in Informatics degree has three audiences. The first audience is IUPUI seniors graduating with a bachelor's degree in another field (e.g., Biology, Chemistry, Sports Management, Business, Finance, Health and Rehabilitation Sciences) who are interested in acquiring informatics knowledge and skills that will make them eligible for employment in the growing information management segment of their field. As described previously, once this degree program has been approved, the School of Informatics and Computing intends to pursue collaborative five-year BS–MS programs with other schools

at IUPUI and with other colleges in the Indianapolis region—resulting in maximum efficiency for undergraduate students who plan to include a graduate program in their academic career.

The second audience is IUPUI graduate students who are seeking a second master’s degree to gain additional expertise in Informatics to compete for informatics-oriented positions within their prior fields of expertise. The demand for skilled informaticians to manage the data produced in nearly every field continues to grow. The MS in Informatics is intended to meet this demand by providing students in different disciplines with the knowledge, skills, and experience to enable them to compete for information management jobs in their disciplinary areas. If this degree is approved, we will propose dual degrees with other schools at IUPUI.

The third audience is working professionals in private and public sector organizations in Indianapolis who are trying to cope with the increasing pervasiveness of informatics and information technology within their own field—and who are seeking additional training on a part-time basis to upgrade their on-the-job skills. These individuals would already hold a BS in another area.

e. Sample Curriculum and course sequences

This is an example of a full-time path through the program.

| | |
|------------------|---|
| Year 1 – Fall: | INFO-I 501: Introduction to Informatics Two Electives |
| Year 1 – Spring: | NEWM-N 510 Web Database Concepts ¹ Two Electives |
| Year 1 – Summer: | INFO-B 505: Informatics Project Management (web) |
| Year 2 – Fall: | INFO-B 573 Programming for Science Informatics ² INFO-H 515 Introduction to Data Analytics (web) ³ One Elective |

This is an example of a part-time path through the program. This is a sequence of courses and not a formal track:

| | |
|------------------|--|
| Year 1 – Fall: | INFO-I 501: Introduction to Informatics Elective |
| Year 1 – Spring: | NEWM-N 510 Web Database Concepts ¹ Elective |
| Year 1 – Summer: | INFO-B 505: Informatics Project Management (web) |
| Year 2 – Fall: | INFO B573 Programming for Science Informatics ² Elective |

Year 2 – Spring: INFO-H 515 Introduction to Data Analytics (web)³
Elective

Year 2 – Summer: Elective

¹ Alternative: INFO-B 556 Biological Database Management

² Alternative: INFO-I 590 Client-Server Application Development

³ Alternatives: INFO-B 578: Data Analysis for Clinical and Administrative Decision-Making (web), INFO-B 529 Machine Learning in Bioinformatics, or INFO-H 540 Data Mining for Security

f. Faculty and Administrators

Robert Schnabel, Ph.D., University Dean and Professor, IUB

Mathew Palakal, Ph.D., Executive Associate Dean and Professor, IUPUI

Karl MacDorman, Ph.D., Associate Dean for Academic Affairs and Associate Professor, IUPUI

Steven Mannheimer, M.F.A., Associate Dean for Faculty Affairs and Professor, IUPUI

Brad Doebbeling, M.D., M.Sc., FACP, FNAP, Department Chair of BioHealth Informatics and Professor, IUPUI

Davide Bolchini, Ph.D., Interim Department Chair of Human-Centered Computing and Assistant Professor, IUPUI

Anthony Faiola, Ph.D., Director, Human-Computer Interaction Human-Computer Interaction Program and Associate Professor, IUPUI

Sara Hook, M.B.A., J.D., Director, Informatics Program and Professor, IUPUI

Josette Jones, Ph.D., Director, Health Informatics Program and Associate Professor, IUPUI

Huanmei Wu, Ph.D., Director, Bioinformatics Program and Associate Professor, IUPUI

Appendix 6: See the complete list of affiliated faculty.

g. Exceeding the Standard Expectation of Credit Hours

N/A

h. Program Competencies or Learning Outcomes

Master of Science in Informatics Core

1. Students will demonstrate competency in **data analytics**.

- Design and execute ethical research using quantitative and experimental methods.
- Organize, visualize, and analyze large, complex datasets using descriptive statistics and graphs to make decisions.

- Apply inferential statistics, predictive analytics, and data mining to informatics-related fields.
 - Analyze datasets with supervised learning methods for functional approximation, classification, and forecasting and unsupervised learning methods for dimensionality reduction and clustering.
 - Identify, assess, and select appropriately among data analytics methods and models for solving a particular real-world problem, weighing their advantages and disadvantages.
 - Write programs to perform data analytics on large, complex datasets.
2. Students will demonstrate competency in **data management and infrastructure**.
- Design and implement relational databases using commercial database management systems according to database concepts and theory.
 - Diagram a relational database design based on an identified scenario.
 - Produce database queries using SQL.
 - Perform database administration tasks.
 - Describe the data management activities associated with the data lifecycle.
 - Overcome difficulties in managing very large datasets, both structured and unstructured, using nonrelational data storage and retrieval (NoSQL), parallel algorithms, and cloud computing.
 - Apply the MapReduce programming model to data-driven discovery and scalable data processing for scientific applications.
3. Students will demonstrate competency in **client–server application development**.
- Design and implement client–server applications that solve real-world problems.
 - Design, implement, test, and debug programs in object-oriented and scripting languages involving control constructs, variables, expressions, assignments, I/O, functions, parameter passing, data structures, and modularization.
 - Apply software development methodologies to create efficient, well-structured applications that other programmers can easily understand.
 - Design user-friendly web and mobile interfaces.
 - Implement the model-view-controller software pattern in web and mobile user interfaces.
 - Create well-formed static and dynamic webpages using current versions of HTML, CSS, and JavaScript or their equivalents.
 - Diagram the phases of the Secure Software Development Lifecycle.
 - Demonstrate the techniques of defensive programming and secure coding.
4. Students will demonstrate competency in the **ethical and professional management of informatics projects**.
- Apply project management methods to overcome the complexities of informatics projects.
 - Plan informatics projects, setting their scope and assigning team members appropriately to roles.

- Apply to informatics projects time management concepts, such as network diagrams, CPM, and PERT.
- Apply cost management and budgeting principles.
- Manage unanticipated changes in informatics projects.
- Perform risk analysis by means of quantitative and qualitative methods.
- Employ both “hard” and “soft” skills in leading a project team.
- Use project management software effectively.
- Apply communication, negotiation, and group decision-making abilities in team projects.
- Demonstrate ethical and professional behavior in response to ethically challenging situations.

Biomedical Informatics Specialization (Bioinformatics Focus)

Students will demonstrate competency in the **engineering of algorithms, databases, and other tools to solve problems on biological data.**

- Extract information from different types of bioinformatics data (gene, protein, disease, etc.), including their biological characteristics and relationships.
- Employ different data representation models and formats used for bioinformatics data representation, including markup languages such as SBML and CellML, and ontologies such as GO ontology.
- Apply the different approaches used for data integration and data management, including data warehouse and wrapper approaches.
- Master computational techniques and diversified bioinformatics tools for processing data, including statistical, machine learning and data mining techniques.
- Analyze processed data with the support of analytical and visualization tools.
- Carry out bioinformatics research under advisement, including systems biology, structural bioinformatics and proteomics.
- Interact with non-bioinformatics professionals, such as biologists and biomedical researchers, to better understand their bioinformatics needs for improved support and service delivery.
- Design and develop bioinformatics solutions by adapting existing tools, designing new ones or a combination of both.

Biomedical Informatics Specialization (Health Informatics Focus)

Students will demonstrate competency in the **technologies and methodologies for processing and managing data, information, and knowledge in healthcare.**

- Integrate data from disparate systems found in hospitals and clinics.
- Implement standards and terminologies for documenting health events and exchanging protected health information.
- Either individually or as a member of a group, use information effectively to accomplish a specific healthcare purpose.

- Propose and justify decision support systems algorithm to support care delivery.
- Integrate natural language processing (NLP) with standards and terminologies used in healthcare.
- Evaluate outcomes of the use of information in clinical practice.
- Assure confidentiality of protected patient health information and access control and the security of health information systems
- Estimate the return of investment (ROI) of health information technology applications for healthcare.
- Possess the skills as outlined in direct care component of the HL7 EHRS model, such as navigation decision support, and output reports.
- Understand the principles upon which organizational and professional health information system for providers and consumers are based.
- Mine data from electronic health record (EHR) systems using advanced statistical and data programming techniques.
- Design data models that integrate patient data from multiple sources to create comprehensive, patient-centered views of data.
- Design an analytic strategy to frame a potential issue and solution relevant to the health improvement of patient populations.
- Analyze the distribution of disease and health outcomes in relevant populations of interest (e.g., general population, health system members, patient subgroups).
- Apply clinical analytics to various contexts of quality improvement (e.g., chronic disease, patient use, population health, public health).

Data Analytics Specialization

Students will demonstrate competency in the **management of massive, high-throughput data stores, cloud computing, and the data lifecycle.**

- Demonstrate an understanding of the data lifecycle, including data curation, stewardship, and long-term preservation.
- Explain the main concepts, models, technologies, and services of cloud computing, the reasons for the shift to this model, and its advantages and disadvantages.
- Examine the technical capabilities and commercial benefits of hardware virtualization.
- Analyze tradeoffs for data centers in performance, efficiency, cost, scalability, and flexibility.
- Explain the core challenges of cloud computing deployments, including public, private, and community clouds, in terms of privacy, security, and interoperability.
- Create cloud computing infrastructure models.
- Demonstrate and compare the use of cloud storage vendor offerings, such as Amazon S3, Microsoft Azure, OpenStack, and Hadoop distributed file system.
- Develop, install, and configure cloud-computing applications under software-as-a-service principles, employing cloud-computing frameworks and libraries.
- Apply the MapReduce programming model to data analytics and enhance its performance by redesigning the system architecture (e.g., provisioning and cluster

configurations).

User Experience Design Specialization

Students will demonstrate competency in the **application of HCI theory and a user-centered practices to interaction design.**

- Assess user needs and requirements.
- Design and develop user design prototypes based on user assessments, while applying HCI principles and models.
- Apply evaluation and usability testing methods to interactive products to validate design decisions using user testing and heuristic evaluation.
- Categorize, design, and develop information in proper architectural structures.
- Analyze test data and write a comprehensive report on the product development process of a redesigned interface, including the stages of pre-design, design, and post-design, testing, and data analysis.
- Apply the research methods regarding qualitative and quantitative data.
- Implement a HCI research proposal, including research questions, collecting the relevant literature, and methodology.

Knowledge and Information Management Specialization

Students will demonstrate competency in the **development and management of information resources.**

- Apply major knowledge sources and structures serving organizational information needs.
- Select, manage, and evaluate knowledge systems for information sharing, storage, retrieval and use by individuals and organizations.
- Design and apply policies and procedures that support the selection and acquisition of information resources for particular communities of users.
- Manage, evaluate, and preserve physical and virtual collections of information resources.
- Understand and apply principles of representation and organization.
- Analyze and evaluate information systems and services in a variety of settings.
- Implement and evaluate information and communication technologies for efficiency, usability, and value to users.
- Design, conduct, interpret, and take action based upon research and evaluation.

i. Assessment

The HCC Department employs the following assessment methods:

1. *Course and Instructor Evaluation.* Students are required to complete a course and instructor evaluation survey for each course taken in the School of Informatics and Computing. The survey includes quantitative and open-ended items. The survey is

conducted by school staff in the last five weeks of the semester and is reviewed by the HCC Department's Chair and Curriculum Committee in February and September. The Chair uses the results for both faculty and curricular development.

2. *Curriculum Survey*. Students participate in an annual curriculum survey. The survey provides comprehensive, detailed, qualitative feedback on course quality and availability. The survey is conducted by student members of the HCC department's Curriculum Committee in May, and their report is reviewed by the HCC Department's Chair and Curriculum Committee in September. Specific courses are developed or revised each year based on their report.
3. *Student Satisfaction Survey*. Graduates participate in an exit survey. The survey provides feedback on the program, department, school, and campus. The survey is conducted by the Communications Manager in May and December and is reviewed by the deans, chairs, and department curriculum committees in September and February.
4. *Alumni Surveys*. Alumni complete a career survey 90 days after graduation and two years and 90 days after graduation. Questions on curricular development are appended to this survey, which include the identification of the most and least helpful courses. The survey is prepared by the school's Academic Affairs Committee, administered by its Director of Career Services in March and August, and reviewed by the chairs and department curriculum committees in September. The Chair uses the results for both faculty and curricular development.
5. *HCC Advisory Board*. The board is composed of directors at major employers. The HCC Chair consults with them semiannually on the department's mission and program goals. Findings related to the curriculum are reported to the HCC Curriculum Committee in September and February.
6. *Pretesting and Posttesting*. Two courses per year will be selected for pretesting and posttesting based on rubrics developed by certification bodies (e.g., INFORMS for analytics, PMI for project management). Based on students' results on the tests, the instructor, chair, and HCC Curriculum Committee engage in a dialog on how to improve the course in September and February.
7. *Student Assessments*. Students will be assessed for mastery of program competencies by different methods in different classes. The methods include assignments, exams, laboratories, reports, and individual and team-based projects. The assessments will be used to evaluate the success of the courses on student learning outcomes and the Principles of Graduate and Professional Learning (PGPLs).

j. Licensure and Certification

Graduates of this program will be prepared to earn the following:

State License: N/A

National Professional Certifications: N/A

Third-Party Industry Certifications: N/A

k. Placement of Graduates

Please describe the principal occupations and industries, in which the majority of graduates are expected to find employment.

Our graduates will be able to compete for jobs in the mushrooming information-management sector of *virtually every industry*: as technically-savvy specialists who can gather, organize, analyze, and interpret data to inform decisions, drive successful operations, and shape technology and resource investments. Related occupational titles include data analyst, quantitative developer, risk analytics lead, predictive modeling analyst, information analytics specialist and big data platform engineer. A third occupational opportunity is as supporting technology personnel who develop, implement, and maintain the hardware and software tools needed to make use of big data including databases and analytic programs.

We expect our graduates to be employed in the Federal, state, and local governments, and in a wide range of public and private sectors including healthcare, retail, pharmaceutical, insurance, finance, manufacturing, education, and service industries.

If the program is primarily a feeder for graduate programs, please describe the principal kinds of graduate programs, in which the majority of graduates are expected to be admitted. N/A

l. Accreditation

Accrediting body from which accreditation will be sought and the timetable for achieving accreditation.

There is no accrediting body for programs in informatics, so program evaluation will be internal.

6. Projected Headcount and FTE Enrollments and Degrees Conferred

Report headcount and FTE enrollment and degrees conferred data in a manner consistent with the Commission's Student Information System

See table on the last page of this document.

Report a table for each campus or off-campus location at which the program will be offered

The degree will only be offered on the Indianapolis campus.

If the program is offered at more than one campus or off-campus location, a summary table, which reports the total headcount and FTE enrollments and degrees conferred across all locations, should be provided.

N/A

Round the FTE enrollments to the nearest whole number

10

If the program will take more than five years to be fully implemented and to reach steady state, report additional years of projections.

N/A

Appendix 1: Institutional Rationale, Detail (This appendix should contain links to the institution's strategic and/or academic plan or the plans themselves.)

Indiana University Strategic Plan

<http://pres.iu.edu/vision/principles-of-excellence/index.shtml>

IUPUI Strategic Plan

<http://strategicplan.iupui.edu/media/0c79db91-f95e-4412-ae1-539cf89adf1d/-177625181/StrategicPlanContent/PDF/OurCommitment.pdf>

Department of Human-Centered Computing Strategic Plan (included)

<https://iu.box.com/HCC-Strategic-Plan>

Appendix 2: Summary of Indiana DWD and/or U.S. Department of Labor Data, Detail (This appendix should contain the detailed tables, upon which the summary of the labor market demand is based.)

Long Term Industry Projections: Indiana in 2018 (partial list)

From Indiana DWD / Hoosiers by the Numbers - <http://www.hoosierdata.in.gov/nav.asp?id=214>

| Industry | Base Year | Projected Year | Percent Change | Numeric Change |
|---|------------------|-----------------------|-----------------------|-----------------------|
| Total Employment, All Jobs | 3,096,546 | 3,362,953 | 8.6% | 266,407 |
| Total Self-Employed and Unpaid Family Workers, Primary Job | 217,838 | 233,191 | 7.0% | 15,353 |
| Self-Employed Workers, Primary Job | 215,418 | 231,301 | 7.4% | 15,883 |
| Unpaid Family Workers, Primary Job | 2,420 | 1,890 | -21.9% | -530 |
| Goods-Producing | 684,275 | 678,954 | -0.8% | -5,321 |
| Natural Resources and Mining | 18,892 | 18,973 | 0.4% | 81 |
| Construction | 144,482 | 172,270 | 19.2% | 27,788 |
| Manufacturing | 520,901 | 487,711 | -6.4% | -33,190 |
| Services-Providing | 2,194,433 | 2,450,808 | 11.7% | 256,375 |
| Trade, Transportation, and Utilities | 578,805 | 607,929 | 5.0% | 29,124 |
| Information | 39,589 | 40,193 | 1.5% | 604 |
| Publishing Industries | 13,973 | 13,321 | -4.7% | -652 |
| Telecommunications | 15,068 | 14,473 | -3.9% | -595 |
| Internet Service Providers, Web Search Portals, and Data Professionals | 1,632 | 2,484 | 52.2% | 852 |
| Other Information Services | 721 | 945 | 31.1% | 224 |
| Financial Activities | 132,853 | 140,007 | 5.4% | 7,154 |
| Professional and Business Services | 284,825 | 347,179 | 21.9% | 62,354 |
| Professional, Scientific, and Technical Services | 98,023 | 131,182 | 33.8% | 33,159 |
| Education and Health Services | 617,071 | 730,690 | 18.4% | 113,619 |
| Leisure and Hospitality | 284,697 | 308,857 | 8.5% | 24,160 |
| Other Services (Except Government) | 84,138 | 90,437 | 7.5% | 6,299 |

Bureau of Labor Statistics Employment by Detailed Occupation 2012 and projected 2022

http://www.bls.gov/emp/ep_table_102.htm

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Employment Projections

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 EMPLOYMENT REQUIREMENTS MATRDX
 FACTOR ANALYSIS
 INDUSTRY OUTPUT AND EMPLOYMENT
 INTER-INDUSTRY RELATIONSHIPS (INPUT-OUTPUT MATRDX)
 LABOR FORCE
 OCCUPATIONAL EMPLOYMENT

Employment by detailed occupation

Other available formats: [\(XLS, 1.5 MB\)](#)

Table 1.2 Employment by detailed occupation, 2012 and projected 2022 (Numbers in thousands)

| 2012 National Employment Matrix title and code | Employment | | | | Change, 2012–22 | | Job openings due to growth and replacements |
|--|------------|-----------|----------------------|-------|-----------------|---------|---|
| | Number | | Percent distribution | | Number | Percent | |
| | 2012 | 2022 | 2012 | 2022 | | | |
| Total, all occupations | 145,355.8 | 160,983.7 | 100.0 | 100.0 | 15,628.0 | 10.8 | 50,557.3 |
| Management occupations | 8,861.5 | 9,498.0 | 6.1 | 5.9 | 636.6 | 7.2 | 2,586.7 |
| Top executives | 2,361.5 | 2,626.8 | 1.6 | 1.6 | 265.2 | 11.2 | 717.4 |
| Chief executives | 330.5 | 347.9 | 0.2 | 0.2 | 17.4 | 5.3 | 87.8 |
| General and operations managers | 1,972.7 | 2,216.8 | 1.4 | 1.4 | 244.1 | 12.4 | 613.1 |
| Legislators | 58.4 | 62.1 | 0.0 | 0.0 | 3.7 | 6.4 | 16.5 |
| Advertising, marketing, promotions, public relations, and sales managers | 637.4 | 700.5 | 0.4 | 0.4 | 63.1 | 9.9 | 203.3 |
| Advertising and promotions managers | 35.5 | 38.0 | 0.0 | 0.0 | 2.4 | 6.9 | 13.4 |
| Marketing and sales managers | 539.8 | 592.5 | 0.4 | 0.4 | 52.7 | 9.8 | 168.6 |
| Marketing managers | 180.5 | 203.4 | 0.1 | 0.1 | 22.9 | 12.7 | 61.7 |
| Sales managers | 359.3 | 389.0 | 0.2 | 0.2 | 29.8 | 8.3 | 106.9 |
| Public relations and fundraising managers | 62.1 | 70.1 | 0.0 | 0.0 | 8.0 | 12.9 | 21.3 |
| Operations specialties managers | 1,647.5 | 1,799.7 | 1.1 | 1.1 | 152.1 | 9.2 | 459.1 |
| Administrative services managers | 280.8 | 315.0 | 0.2 | 0.2 | 34.2 | 12.2 | 79.9 |
| Computer and information systems managers | 332.7 | 383.6 | 0.2 | 0.2 | 50.9 | 15.3 | 97.1 |
| Financial managers | 532.1 | 579.2 | 0.4 | 0.4 | 47.1 | 8.9 | 146.9 |
| Industrial production managers | 172.7 | 168.6 | 0.1 | 0.1 | -4.1 | -2.4 | 31.4 |
| Purchasing managers | 71.9 | 73.4 | 0.0 | 0.0 | 1.5 | 2.1 | 17.3 |
| Transportation, storage, and distribution managers | 105.2 | 110.3 | 0.1 | 0.1 | 5.1 | 4.9 | 29.1 |
| Compensation and benefits managers | 20.7 | 21.4 | 0.0 | 0.0 | 0.6 | 3.1 | 6.1 |
| Human resources managers | 102.7 | 116.3 | 0.1 | 0.1 | 13.6 | 13.2 | 40.6 |
| Training and development managers | 28.6 | 31.8 | 0.0 | 0.0 | 3.2 | 11.2 | 10.7 |

Bureau of Labor Statistics Employment Projections – Employment by major occupational group, 2012 and projected 2022 - <http://www.bls.gov/news.release/ecopro.t06.htm>

UNITED STATES DEPARTMENT OF LABOR
 BUREAU OF LABOR STATISTICS

Economic News Release

Table 6. Employment by major occupational group, 2012 and projected 2022
 (Employment in thousands)

| 2012 National Employment Matrix title and code | Employment | | Change, 2012-22 | |
|---|------------|-----------|-----------------|---------|
| | 2012 | 2022 | Number | Percent |
| Total, all occupations..... 00-0000 | 145,355.8 | 160,983.7 | 15,628.0 | 10.8 |
| Management occupations..... 11-0000 | 8,861.5 | 9,498.0 | 636.6 | 7.2 |
| Business and financial operations occupations..... 13-0000 | 7,167.6 | 8,065.7 | 898.1 | 12.5 |
| Computer and mathematical occupations..... 15-0000 | 3,814.7 | 4,500.5 | 685.8 | 18.0 |
| Architecture and engineering occupations..... 17-0000 | 2,474.5 | 2,654.0 | 179.6 | 7.3 |
| Life, physical, and social science occupations..... 19-0000 | 1,249.1 | 1,374.8 | 125.7 | 10.1 |
| Community and social service occupations..... 21-0000 | 2,374.7 | 2,783.4 | 408.8 | 17.2 |
| Legal occupations..... 23-0000 | 1,247.0 | 1,379.9 | 132.9 | 10.7 |
| Education, training, and library occupations..... 25-0000 | 9,115.9 | 10,131.7 | 1,015.8 | 11.1 |
| Arts, design, entertainment, sports, and media occupations..... 27-0000 | 2,570.9 | 2,751.6 | 180.6 | 7.0 |
| Healthcare practitioners and technical occupations..... 29-0000 | 8,049.7 | 9,782.6 | 1,732.9 | 21.5 |
| Healthcare support occupations..... 31-0000 | 4,110.2 | 5,266.0 | 1,155.8 | 28.1 |
| Protective service occupations..... 33-0000 | 3,325.3 | 3,588.3 | 263.0 | 7.9 |
| Food preparation and serving related occupations..... 35-0000 | 11,780.1 | 12,852.0 | 1,101.8 | 9.4 |
| Building and grounds cleaning and maintenance occupations..... 37-0000 | 5,522.3 | 6,213.3 | 691.0 | 12.5 |
| Personal care and service occupations..... 39-0000 | 5,375.6 | 6,498.5 | 1,122.9 | 20.9 |
| Sales and related occupations..... 41-0000 | 15,105.0 | 16,200.5 | 1,095.5 | 7.3 |
| Office and administrative support occupations..... 43-0000 | 22,470.1 | 24,004.1 | 1,534.0 | 6.8 |
| Farming, fishing, and forestry occupations..... 45-0000 | 947.2 | 915.0 | -32.2 | -3.4 |
| Construction and extraction occupations..... 47-0000 | 6,092.2 | 7,394.1 | 1,301.9 | 21.4 |
| Installation, maintenance, and repair occupations..... 49-0000 | 5,514.8 | 6,046.0 | 531.2 | 9.6 |
| Production occupations..... 51-0000 | 8,941.9 | 9,017.5 | 75.6 | 0.8 |
| Transportation and material moving occupations..... 53-0000 | 9,245.7 | 10,036.4 | 790.6 | 8.6 |

Table of Contents

Appendix 3: National, State, or Regional Studies, Detail (This appendix should contain links to the studies cited or the studies themselves.)

Battelle Technology Partnership Practice (Battelle Memorial Institute). (2012). Indiana's Competitive Economic Advantage: the Opportunity to Win the Global Competition for College Educated Talent. https://mpcms.blob.core.windows.net/e30e30cc-342f-4bd2-9b6e-c5cb1c39f202/docs/1d2a86b8-577b-4cae-8223-a23222396e09/cicp_battelle-college-workforce-study.pdf

Central Indiana Corporate Partnership. (2014). Technology Workforce Report – Employment Trends and the Demand for Computer-Related Talent in Central Indiana. <https://docs.google.com/file/d/0BzGIwixIZHZPYmw4UEtNZGtrUUU/edit>

Kotkin, Joe, “The Surprising Cities Creating the Most Tech Jobs”, *Forbes*, November 11, 2013. <http://www.forbes.com/sites/joelkotkin/2013/11/20/the-surprising-cities-creating-the-most-techjobs/>

Manyika, J., Chui, M., Brown, B., Bughin, J., Dobbs, R., Roxburgh, C. and Byers, A.H. (2011). Big data: The next frontier for innovation, competition, and productivity. McKinsey Global Institute.

Royster, S. (2013). Working with Big Data. Occupational Outlook Quarterly. Bureau of Labor Statistics

Vesset, D., Woo, B., Morris, H.D. Villars, R.L., Little, G., Bozman, J.S., Borovick, L., Olofson, C.W., Feldman, S., Conway, S., Eastwood, M., Yezhkova, N. (2012). Market Analysis: Worldwide Big Data Technology and Services 2012 - 2015 Forecast. IDC.

Yan, J. (2013). Big Data, Bigger Opportunities - Data.gov's roles: Promote, lead, contribute, and collaborate in the era of big data. President Management Council Inter-agency Rotation Program

Appendix 4: *Surveys of Employers or Students and Analyses of Job Postings, Detail (This appendix should contain links to the surveys or analyses cited, or the documents themselves.)*

Computing Research Association. (2012). Taulbee Survey May 2012

http://cra.org/uploads/documents/resources/taulbee/CRA_Taulbee_2011-2012_Results.pdf

National Science Foundation Survey: Characteristics of Recent Science and Engineering Graduates (includes employment data for graduates with master's degrees in science and engineering, page 6)

<http://www.nsf.gov/statistics/nsf12328/pdf/nsf12328.pdf>

Appendix 5: *Letters of Support, Detail (This appendix should contain the letters of support for the program.)*

Appendix 6: *Faculty and Staff, Detail (This appendix should contain a list of faculty with appointments to teach in the program and a brief description of new faculty positions yet to be filled.)*

Core Faculty currently affiliated with the Master of Science in Informatics Program

- Rachel Applegate, Ph.D., Associate Professor and Department Chair (LIS), School of Informatics and Computing
- Davide Bolchini, Ph.D., Associate Professor and Interim Department Chair (HCC), School of Informatics and Computing
- Jake Yue Chen, Ph.D., Associate Professor, School of Informatics and Computing
- Hsin-Liang (Oliver) Chen, Ph.D., Associate Professor, School of Informatics and Computing
- Andrea Copeland, Ph.D., Assistant Professor, School of Informatics and Computing
- Joseph Defazio, Ph.D., Associate Professor, School of Informatics and Computing
- Brad Doebbeling, M.D., Professor and Department Chair (BHI), School of Informatics and Computing
- Anthony Faiola, Ph.D., Associate Professor, School of Informatics and Computing
- Richard Holden, Ph.D., Assistant Professor, School of Informatics and Computing 08/2014–
- Sara Hook, M.B.A., J.D., Professor, School of Informatics and Computing

- Edgar Huang, Ph.D., Associate Professor, School of Informatics and Computing
- Sarath Chandra Janga, Ph.D., Assistant Professor, School of Informatics and Computing
- Josette Jones, Ph.D., Assistant Professor, School of Informatics and Computing
- Xiaowen Liu, Ph.D., Assistant Professor, School of Informatics and Computing
- Karl MacDorman, Ph.D., Associate Dean and Associate Professor, School of Informatics and Computing
- Steven Mannheimer, M.F.A., Associate Dean and Professor, School of Informatics and Computing
- Xi Niu, Ph.D., Assistant Professor, School of Informatics and Computing
- Mathew Palakal, Ph.D., Executive Associate Dean and Professor, School of Informatics and Computing
- Katherine Schilling, Ed.D., Associate Professor, School of Informatics and Computing
- Amy Volda, Ph.D., Assistant Professor, School of Informatics and Computing
- Stephen Volda, Ph.D., Assistant Professor, School of Informatics and Computing
- Huanmei Wu, Ph.D., Associate Professor, School of Informatics and Computing (joint appointee with the Purdue University School of Engineering and Technology)
- Jingfeng Xia, Ph.D., Associate Professor, School of Informatics and Computing

Adjunct Faculty currently affiliated with the Master of Science in Informatics Program

- Pauline Baker, Ph.D., Adjunct Professor, School of Informatics and Computing
- Paul Biondich, M.D., Adjunct Assistant Professor, School of Medicine
- David Bodenhammer, Ph.D., Adjunct Professor, School of Liberal Arts
- James Brown, Ph.D., Adjunct Professor, School of Journalism (emeritus)
- Thomas Carr, M.D., Adjunct Associate Professor, School of Medicine
- Brian Dixon, Ph.D., Adjunct Professor, School of Informatics and Computing
- Thompson Doman, Ph.D., Adjunct Associate Professor, Eli Lilly & Co.
- Ernst Dow, Ph.D., Adjunct Professor, Eli Lilly & Co.
- Stephen Downs, M.D., Adjunct Professor, School of Medicine
- Jon D. Duke, M.D., Adjunct Professor, School of Medicine
- Valita Fredland, J.D., Adjunct Professor, IU Health
- David Haggstrom, M.D., Adjunct Professor
- Mark Hill, M.B.A., Adjunct Professor, Collina Ventures, LLC
- Marilyn Irwin, Ph.D., Emeritus Associate Professor, School of Informatics and Computing
- Scott Jones, Ph.D., Adjunct Assistant Professor, ChaCha, TuneSat, Precise Path, MOG, Allos Ventures, Gazelle, TechVentures
- Neil Kirby, Ph.D., Adjunct Professor, Dow
- Xiaoman Li, Ph.D., Adjunct Assistant Professor, School of Medicine
- Yunlong Liu, Ph.D., Adjunct Assistant Professor of Informatics, School of Medicine
- Burke Mamlin, M.D., Adjunct Assistant Professor, School of Medicine
- Marc Overhage, M.D., Adjunct Associate Professor, School of Medicine
- Edwin Parks, Ph.D., Adjunct Professor, School of Dentistry
- Sandra Petronio, Ph.D., Adjunct Professor, School of Liberal Arts
- David Russomanno, Ph.D., Adjunct Professor, School of Engineering and Technology
- Li Shen, Ph.D., Adjunct Professor, School of Medicine
- James Stevens, Ph.D., Adjunct Professor, Eli Lilly & Co.
- William Tierney, M.D., Adjunct Professor, School of Medicine

- Mu Wang, Ph.D., Adjunct Assistant Professor, School of Medicine
- Yang Wang, Ph.D., Adjunct Associate Professor, School of Medicine
- Marianne Wokeck, Ph.D., Adjunct Professor, School of Liberal Arts

Appendix 7: *Facilities, Detail (This appendix should contain additional information on major impacts on facilities caused by this program.)*

N/A

Appendix 8: *Other Capital Costs, Detail (This appendix should contain additional information on other capital costs associated with the program.)*

N/A

Appendix 9: *Articulation of Associate/Baccalaureate Programs, Detail (This appendix should contain the actual articulation agreements relevant to the proposed program.)*

N/A

Appendix 10: *Credit Hours Required/Time To Completion, Detail (This appendix should contain the semester-by-semester, course-level detail on the program curriculum, including how long it will take to complete the program, assuming full-time study.)*

Curriculum: The following courses have been identified as contributing to the Master of Science in Informatics program. The list is not exhaustive; courses will be deleted and new courses added as departments make changes to their curricula. All of the courses will be offered on a regular schedule, although topics may change. Students will be required to take five 3-credit hour core courses and 15 credit hours of electives with the option of a 3 to 6 credit hour project or research rotation or a 6 credit hour thesis.

This is not an online degree, although a few courses have online sections or are offered only online. We may bring additional courses online in coming semesters. Our goal is eventually to have sufficient coursework offered online and in the classroom that the degree may be completed entirely online, entirely in residence, or with a mix of online and residential courses. Because we are offering a multimodal degree, we expect that there will be students who will opt to take a year of online courses and then complete the degree in residence. For example, students may come to campus for production or laboratory oriented courses that are not offered online.

This is an example of a full-time path through the program.

| | |
|------------------|---|
| Year 1 – Fall: | INFO-I 501: Introduction to Informatics Two Electives |
| Year 1 – Spring: | NEWM N510 Web Database Concepts ¹ Two Electives |

Year 1 – Summer: INFO-B 505: Informatics Project Management (web)
 Year 2 – Fall: INFO-B 573: Programming for Science Informatics²
 INFO-B 578: Data Analysis for Clinical and
 Administrative Decision-Making (web)³
 One Elective

This is an example of a part-time path through the program. This is a sequence of courses and not a formal track:

Year 1 – Fall: INFO-I 501: Introduction to Informatics
 Elective
 Year 1 – Spring: NEWM N510 Web Database Concepts¹
 Elective
 Year 1 – Summer: INFO-B 505: Informatics Project Management (web)
 Year 2 – Fall: INFO-B 573: Programming for Science Informatics²
 Elective
 Year 2 – Spring: INFO-H515 Introduction to Data Analytics (web)³
 Elective
 Year 2 – Summer: Elective

¹ Alternative: INFO-B 556 Biological Database Management, INFO-B 512 Scientific and Clinical Data Management

² Alternative: INFO-I 590 Client/Server Application Development

³ Alternatives: INFO-B 529 Machine Learning in Bioinformatics, INFO-B 578: Data Analysis for Clinical and Administrative Decision-Making (web) or INFO-H 540 Data Mining for Security.

What follows is a list of potential specializations that may be used to fulfill the 15 credit hours of electives. These specializations are in Biomedical Informatics, Data Analytics, Knowledge and Information Management, and User Experience Design.

Biomedical Informatics Specialization (e.g., with a Bioinformatics Focus)

Select Four or Five:

FALL

INFO B519 Introduction to Bioinformatics

INFO B573 Programming for Science Informatics

SPRING

INFO B529 Machine Learning in Bioinformatics

INFO B556 Biological Database Management

INFO B619 Structural Bioinformatics

INFO B646 Computational System Biology

INFO B656 Translational Bioinformatics Applications

Biomedical Informatics Specialization (e.g., with a Health Informatics Focus)

Select Four or Five:

FALL

INFO-B 530 Foundations of Health Informatics

INFO-B 585 Biomedical Analytics

INFO-B 641 Business of Health Informatics

INFO-B 643 Natural Language Processing for Biomedical Records and Reports

SPRING

INFO-B 535 Clinical Information Systems

INFO-B 581 Health Informatics Standards and Terminology

INFO-B 582 Health Information Exchange

INFO-B 583 Security and Privacy Policies and Regulations for Health Care

INFO-B 642 Clinical Decision Support Systems

LIS-S 644 Consumer Health Informatics

Data Analytics Specialization

Select Four or Five:

FALL

INFO-H 516 Applied Cloud Computing for Data Intensive Sciences (IUPUI)

INFO-B 510 Data Acquisition and Lab Automation (IUPUI)

INFO-B 512 Scientific and Clinical Data Management (IUPUI)

INFO-B 578 Data Analysis for Clinical and Administrative Decision-Making

INFO-I 590: Topics in Informatics: Big Data Open Source Software and Project (web, IUB)

INFO-I 590: Topics in Informatics: Big Data Applications and Analytics (web, IUB)

INFO-I 590: Topics in Informatics: Data Science in Drug Discovery, Health and Translational Medicine (web, IUB)

INFO-I 590: Topics in Informatics: Management, Access, and Use of Big and Complex Data (web, IUB)

INFO-Z 636: Semantic Web (web, IUB)

SPRING

INFO-B 529 Machine Learning for Bioinformatics (IUPUI)

INFO-B 556 Biological Database Management (IUPUI)

INFO-H 540 Data Mining for Security (IUPUI)

INFO-I 590: Topics in Informatics: Big Data Applications and Analytics (web, IUB)

INFO-B 649: Topics in Systems: Cloud Computing for Data Intensive Sciences (web, IUB)

INFO-Z 637: Information Visualization (web, IUB)

INFO-I 590: Topics in Informatics: Big Data in Drug Discovery, Health and Translational Medicine (web, IUB)

User Experience Design Specialization

Select INFO H541, H561, and Two or Three Additional Courses:

FALL

INFO H541 Interaction Design Practice (HCI 1) (R)

INFO H543 Interaction Design Methods (Usability and Evaluative Methods) (M)

INFO H563 Psychology of HCI (web)

SPRING

INFO H561 Meaning and Form in HCI (HCI 2) (M)

INFO H564 Prototyping for Interactive Systems (T)

INFO H565 Collaborative and Social Computing (T)

INFO H566 Experience Design for Ubiquitous Computing (R)

Knowledge and Information Management Specialization*

FALL

Choose one from each of the following two categories:

Library/information organization context course:

- LIS-S 550 Perspectives
- LIS-S 501 Information Resources and Services, or
- LIS-S 502 Acquisitions and Management of Knowledge and Information

Information Organization Course:

- LIS-S 503 Organization and Representation of Knowledge and Information, or
- LIS-S 634 Metadata

SPRING

Take both of the following courses:

- LIS-S 604 Knowledge Management, and
- LIS-S 505 Evaluation of Information Sources and Services

Choose one from the following technical-applications courses:

- LIS-S 532 Information Architecture,
- LIS-S 652 Digital Libraries, LIS-S 554 Library Systems, or
- LIS-S 574 Information Instruction

*Note: Each student who selects the Knowledge and Information Management Specialization will be assigned a DLIS advisor. Course substitutions are possible with advisor approval.

Appendix II: *Exceeding the Standard Expectation of Credit Hours, Detail. (This appendix should contain detailed information on why it is necessary to exceed the standard credit hour expectation, such as links to relevant licensure and/or accreditation standards the standards themselves.)*

N/A

IUPUI Informatics Ph.D.

| 6. Projected Headcount and FTE Enrollments and Degrees Conferred | | | | | | | | | |
|---|--------------|--|--|----------|-----------|-----------|-----------|-----------|--|
| 12-Mar-14 | | | | | | | | | |
| Institution/Location: Indiana University-Purdue University Indianapolis | | | | | | | | | |
| Program: Master of Science in Informatics | | | | | | | | | |
| | | | | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | |
| | | | | FY2014 | FY2015 | FY2016 | FY2017 | FY2018 | |
| Enrollment Projections (Headcount) | | | | | | | | | |
| | Full-Time | | | 5 | 10 | 10 | 10 | 15 | |
| | Part-Time | | | 0 | 0 | 0 | 0 | 0 | |
| | Total | | | 5 | 10 | 10 | 10 | 15 | |
| Enrollment Projections (FTE) | | | | | | | | | |
| | Full-Time | | | 5 | 10 | 10 | 10 | 15 | |
| | Part-Time | | | 0 | 0 | 0 | 0 | 0 | |
| | Total | | | 5 | 10 | 10 | 10 | 15 | |
| Degrees Conferred Projections | | | | 0 | 5 | 5 | 5 | 5 | |
| CHE Code: xx-xx | | | | | | | | | |
| Campus Code: 1813 | | | | | | | | | |
| County: Marion | | | | | | | | | |
| Degree Level: 07 | | | | | | | | | |
| CIP Code: Federal - 11.0401; State - 11.0401 | | | | | | | | | |



March 18, 2013

TO: Indiana Commission for Higher Education
Indiana University Trustees
Indiana University–Purdue University of Indianapolis Graduate Affairs Committee
Indiana University Bloomington Academic Leadership Committee

RE: MS in Informatics
School of Informatics & Computing, IUPUI

I write this letter to express my support for the creation of a new MS Informatics degree.

We know that many of our students at Herron School of Art and Design use their undergraduate degree as a springboard to obtain a Masters in other disciplines. It would be a natural progression to offer a dual tract that would give students with strong art and design skills the opportunity to obtain an MS in Informatics. This would provide them with essential skills that prepares them for the job market.

There has been a huge growth in the data and computer related fields in Indiana. Employers are looking for talented programmers and designers every day to fill positions. Herron's graduates possess the visual acuity, spatial relationship talents and creative problem-solving skills that make them valuable to these types of firms.

This dual degree will help keep the best and brightest in Indiana. I can also see these students being better prepared in jobs in the medical sciences and other areas that require design, programming and problem solving skill sets.

This proposed degree tract is in alignment with IUPUI's goal of increasing capacity for graduate education as stated in the 2013 Strategic Plan. I am pleased to support the work of Executive Associate Dean Palakal and his staff as they prepare this new, exciting and innovative program for our students.

Sincerely,

Dean




**SCHOOL OF PHYSICAL
EDUCATION AND
TOURISM MANAGEMENT**

INDIANA UNIVERSITY
IUPUI

DATE: March 19, 2014

TO: Indiana Commission for Higher Education
Indiana University Trustees
Indiana University–Purdue University of Indianapolis Graduate Affairs
Committee
Indiana University Bloomington Academic Leadership Committee

RE: MS in Informatics
School of Informatics & Computing, IUPUI

FROM: Jay Gladden, Dean 

I am very excited about the prospects for the proposed masters degree in Informatics. Given the relevance of informatics to a variety of disciplines, I envision some of our undergraduate students being very interested in pairing undergraduate majors in Tourism, Conventions and Event Management and Kinesiology with a masters degree in Informatics. We would also be very willing to collaborate with the School of Informatics and Computing on an accelerated pathway to achieve the BS/MS combination.

This degree proposal has our complete support.



**SCHOOL OF HEALTH
AND REHABILITATION
SCIENCES**

INDIANA UNIVERSITY
IUPUI

March 12, 2014

Dear Commission of Higher Education Members:

This letter is written in support of the proposal for the Master of Science in Informatics, a proposal prepared and submitted by the faculty of the Indiana University School of Informatics and Computing.

The proposed Master of Science in Informatics program is designed to provide intensive education to talented students who are interested in applying information science and technology to their discipline of expertise or to transition to a more technology-oriented career path. Specifically, the two-fold purpose of the proposed degree is to enable students to apply informatics in their respective disciplines and to provide a career path for students and graduates from non-IT backgrounds to transition rapidly into in-demand, well-remunerated IT positions.

The IU School of Health and Rehabilitation Sciences will collaborate with the School of Informatics and Computing on this exciting interdisciplinary degree program by developing a joint five-year Bachelor of Science in Health Sciences-Master of Science in Bioinformatics. In addition, students enrolled in our Ph.D in Health and Rehabilitation Sciences will be encouraged to consider in minor in Bio-health Informatics.

I strongly endorse this proposal without any reservation or hesitation. Please feel free to contact me at 317-274-4702 if you have any questions.

Sincerely,

Augustine O. Agho

Augustine O. Agho, Ph.D., Dean
Indiana University School of Health and Rehabilitation Sciences



**ROBERT H. MCKINNEY
SCHOOL OF LAW**

INDIANA UNIVERSITY
Indianapolis

March 20, 2014

To: Indiana Commission for Higher Education
Indiana University Trustees
Indiana University-Purdue University of Indianapolis Graduate Affairs
Committee
Indiana University Bloomington Academic Leadership Committee

Re: MS in Informatics
School of Informatics & Computing, IUPUI

I write in strong support of the proposal from the School of Informatics & Computing to offer a MS degree in Informatics. The proposal is well aligned with the IUPUI Strategic Plan goal of increasing capacity for graduation education. Perhaps more importantly, it would be a crucial step toward further integrating Informatics with our campus' multidisciplinary and collaborative education efforts.

As the program summary explains, expertise in informatics is important to a range of disciplines and professions. In law, for example, skills related to information technology are increasingly important, given developments in the areas of "e-discovery," and societal challenges posed by digitization, ranging from issues of privacy to protection of intellectual property rights.

Having a new master's degree in the field would provide opportunities for partnership between Law and Informatics that are not currently available – both for J.D. students and, perhaps more immediately, for those who might enroll in our new Masters of Jurisprudence program. Dean Palakal and I have discussed, for example, the possibility of a dual master's program between our schools, as well as the creation of an accelerated BS-MS degree track that could provide our campus with a competitive advantage in recruiting strong students.

Thank you for considering my comments in support of this proposal. Feel free to contact me if you have any questions.

Andrew R. Klein

Dean and Paul E. Beam Professor of Law