INFORMATION SYSTEMS
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In this issue:

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INFORMATION SYSTEMS EDUCATION JOURNAL

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Abstract

Corporate entrepreneurship is a critical area of curricula for computer science and information systems students. Few institutions of computer science and information systems have entrepreneurship in the curricula however. This paper presents entrepreneurial health informatics as a course in a concentration of Technology Entrepreneurship at a leading institution of technology. In the concentration, and in the course, students are learning to be business entrepreneurs in interdisciplinary fields, such as health. This paper can be beneficial to educators in schools of computer science and information systems desiring to enrich offerings to be contemporary with the demands of industry.

Keywords: computer science, computing curricula, entrepreneurship, interdisciplinary, health, health informatics, information systems

1. BACKGROUND

Corporate entrepreneurship is an approach for applying creativity and innovation as a means to entrepreneurial opportunity (Ireland, Kuratko, & Morris, 2006) in a process or product in industry. Entrepreneurship is a discipline of initiative, innovation, opportunity recognition, and pursuit of reward and risk (Phillips, & Garman, 2006). The criticality of enabling entrepreneurship for creativity and innovation is cited in the business literature (Byers, Dorf, & Nelson, 2011). The enablement of entrepreneurship from creativity and innovation fosters entrepreneurial opportunity in industry.

The health industry can benefit from entrepreneurship coming to life from the current Affordable Care Act (ACA) of 2010 – Obama Care - legislation.

The health industry is considered costly (Ratten, 2012), impersonal, and inefficient in methods of operation (Cutler, 2010). The industry is $2.6 trillion or 17.9% of the gross domestic product (GNP) of the country (Norbeck, 2012). Entrepreneurial innovation in an electronic health medical or record system (EMR) can help in cost cutting in a hospital. The industry is additionally considered inefficient in patient-oriented service (De Regge, Gemmel, Degadt,

Verhaeghe, Sijnave, & Duyck, 2012) and performance of staff. Innovation in an intrapreneurial predictive personalized-prescription process and provider system can improve patient service. The industry is also considered in need of improved consumer-oriented systems (Ratten, 2012). Innovation in medical mobile systems (Milian, & MacMillan, 2012 and Briley, 2013) can improve non-patient and patient self-service (Howard, 2008). The health industry is clearly fertile for increased entrepreneurial opportunity (The Economist, 2013) and from increasingly required organizational response (Deluca, & Enmark, 2002) – a field that can be infused by schools of computer science and information systems.

Graduates of schools of computer science and information systems having entrepreneurial skills can be innovators in the health industry. As millennial students, they can be, for example, innovators in medical monitoring applications (apps) on smart-phones (Horowitz, 2012b) and Twitter; in integration of applications, patient record systems and reimbursement systems; in mining of patient record systems (Mathews, 2013) and of patterns and relationships in the systems (Srinivas, Rani, & Govrdhan, 2010); and in process re-engineering and research of health information exchanges (McNickle, 2013) and of service systems and tools (Ebling, & Kannry, 2012). They can be innovators in modeling intervention programs for issues, such as obesity and diabetes, or policies, such as HIV (Greengard, 2013). They can be further innovators in new DNA genetic profiling tools (Howard, 2008) and smart clothing tools (Velshi, 2013). They could explore favorable funding from investors in health industry incubators – a $1.1 billion field in 2012, a 70% increase from $626 million in 2011 (The Economist, 2012b). To be exploiters of health industry opportunity, computer science and information systems students have to learn not merely technology but also the business of the health industry and the economic potential of technology in an interdisciplinary Technology Entrepreneurship concentration. Few schools of computer science and information systems have a Technology Entrepreneurship concentration integrating a health informatics course opportunity for students, an opportunity addressed in this paper.

2. INTRODUCTION

The Seidenberg School of Computer Science and Information Systems of Pace University began a concentration in Technology Entrepreneurship in its Bachelor of Arts in Computer Science (Lawler, & Joseph, 2010). The concentration is designed for students to learn the fundamentals to be business opportunists, not mere scientists or technologists. The emphasis of the concentration is in the development of cutting edge ideas for a process, product or service, infused by entrepreneurial innovation if not invention of systems and tools, in a fictitious firm, or if feasible in an actual firm. The emphasis of the concentration currently is in a course in Entrepreneurial Health Informatics in the disciplinary domain of the health industry, as conceptually depicted in Figure 1 of the Appendix, inasmuch as Obama Care is encouraging entrepreneurship in the industry (The Economist, 2012a). Encouraging for schools, Obama Care is expanding innovation in popular mobile tools (Everett, 2013) interesting to students.

The generic learning objectives of Entrepreneurial Health Informatics are defined below:

- Define a business competitive or cost effectiveness idea for a process, product or service for the health industry that can be infused by innovation or invention of new systems or tools;

- Design and develop a process, product or service, or prototype, for the health industry that can furnish opportunity for productivity if not profitability from integration of new solution systems or tools;

- Design and develop a business and financial plan for the process, product or service for the health industry – hospital or physician practices, provider systems, or mobile non-patient or patient self-service tools - infused by the potential of productivity if not profitability of the new systems or tools;

- Design and develop a customized plan for marketing the process, product or service for the industry, infused by the new solution systems or tools, to marketplace providers and society; and

- Integrate contemporary innovation in the marketplace, such as cloud methodology, data mining and data warehousing technology, which might improve the solution systems or tools of the new venture.

The course is consistent in design with other interdisciplinary domains in the concentration of Technology Entrepreneurship in the school, as depicted in Figure 2, and is 4 credits. The outcomes are in adaptability, analysis, business, collaboration and communication - aspects of an entrepreneurial mind in creative critical thinking, problem-solving and risk-taking – in an expanding field (Brill, 2013). The outcomes are for students to be not mere technologists but business opportunists of technology. These outcomes conform to demands of consumers (Everett, 2013) and of the health industry for persistent and self-motivated students skilled in solution technology (Malugani, 2012). Entrepreneurial Health Informatics, in the concentration curriculum of Technology Entrepreneurship, can be beneficial to Bachelor of Arts in Computer Science students in the Seidenberg School, in the crafting of an experience that can improve hiring prospects (Khan, 2013) in health if not other industries.

3. FOCUS OF PAPER

The course in Entrepreneurial Health Informatics, in the concentration of Technology Entrepreneurship in the Bachelor of Arts in Computer Science program in the Seidenberg School of Computer Science and Information Systems of Pace University, is the focus of the paper. The domain of the health industry, as an entrepreneurial field of interdisciplinary study, is current to the expectations of government, industry and society for computer science and information systems students. The entrepreneurship in the health industry is not as formed as in other industries (Phillips, & Garman, 2006), nor as fulfilled in information technology (Kellermann, & Jones, 2013), furnishing innovation opportunity for students. The paper is not focused on the other courses in the concentration of Technology Entrepreneurship, as depicted in Figure 2, of which the course of Entrepreneurship and Technology was covered in an earlier study (Lawler, & Joseph, 2010). This paper will be beneficial to instructors in schools of computer science and information systems desiring to improve offerings to be current with industrial and societal trends.

4. CONCENTRATION METHODOLOGY - TECHNOLOGY ENTREPRENEURSHIP

The concentration in Technology Entrepreneurship began officially in 2011, from basic courses in the Bachelor of Arts in Computer Science ebbing into courses in entrepreneurship, in a desired sequence:
- Entrepreneurship and Technology, a concept course currently integrating computer science and entrepreneurship on a project for business competitive decision-making;

- Customer Relationship Management (CRM) and Entrepreneurship, a concept course currently integrating data mining and data warehousing on a project for decision-making in strategy;

- Entrepreneurship and Financial Computing, a domain course currently integrating algorithmic computing, entrepreneurship, finance, financial analysis and information systems on a project for financial decision-making and strategy;

- Cloud Sourcing, a domain-enabling course currently integrating cloud methodologies and platforms on a project for financial decision-making and strategy;

- Modeling of Financial Processes, Products and Services through Technology, a domain-enabling course currently integrating cloud platforms, finance and information systems on a project for financial decision-making, on reengineering of systems through prototyped or real software technologies;

- Entrepreneurial Health Informatics, a domain course of the paper;

- Energy Efficiency Entrepreneurship, a domain course in the future, integrating entrepreneurship on a project for decision-making in the energy industry;

- Entrepreneurship and Governmental Security, a domain course in the future,

integrating governmental and industry policy on a project for crisis decision-making in national security strategy; and

- Special Topics in 21st Century Technologies and Ventures, an optional survey course further integrating leading edge marketplace technologies impacting new ventures.

The concentration of the courses of Technology Entrepreneurship covers a 2011-2015 period in the school.

The methodology of Technology Entrepreneurship, with Entrepreneurial Health Informatics, is depicted in Figure 2.

Those majoring in computer science or information systems may be fast tracked through the concentration of Technology Entrepreneurship, so that they may finish the courses, especially Entrepreneurial Health Informatics or Entrepreneurship and Financial Computing, sooner than other undergraduate students in the Seidenberg School; and so that they may be more marketable to domain internship prospects at industry ventures. Otherwise, the concept courses of Entrepreneurship and Technology and Customer Relationship Management (CRM) and Entrepreneurship are the prerequisites, as depicted in Figure 2.

5. COURSE MODEL – ENTREPRENEURIAL HEALTH INFORMATICS

The course in Entrepreneurial Health Informatics, in Technology Entrepreneurship, began in 2012, engaging students in diverse or dueling entrepreneurship innovation in a process, product or service - mobile monitoring applications to process re-engineering of systems in the health industry. They are focused on identifying opportunities from problems learned from industry research and on iterating prototyped simulations or solutions for minimal ventures, and may be iterating solutions even in failure, an integral part of problem-solving and risk-taking. The projects for formulating individualized new solutions and subsequent ventures are initiated in small (3-5) student teams, which are mentored by alumni executives from the health industry in New York City. The executives may have furnished the problems to the teams. The students are also mentored by the instructor. The student teams

may shadow a number of the executives in health industry start-up ventures, which may be pursuing solutions similar to the teams. These teams may moreover, in a mission of municipal service, share solutions of systems or tools with non-profit organizations in the industry. The instructor interacts with the student teams through the Blackboard Academic e-Education Suite – Discussion Boards and through the classroom – 4 hours in the classroom labs a week in a semester of 14 weeks.

At the end of the 14th week, the teams present the projects of systems and tools and the proposals of ventures to the instructor, investors invited by the mentors and regional representatives of the health industry; and they reflect on the results of the semester.

The specific learning of Entrepreneurial Health Informatics is depicted in the syllabus in Table 1 of the Appendix.

The text is Gartee, J (2011), Health Information Technology Management; with Christensen, C. (2011), The Innovator's DNA: Mastering the Five Skills of Disruptive Innovation, Hagen, J. (2010), Concepts in Health Care Entrepreneurship, and Timmons, J., and Spinelli (2009), New Venture Creation: Entrepreneurship for the 21st Century, as supporting text, in the current 2012-2013 semesters.

6. IMPLICATIONS

The course in Entrepreneurial Health Informatics is enabling a firmer foundation for the concentration of Technology Entrepreneurship of the Seidenberg School. The course is enabling entrepreneurial and interdisciplinary learning in an industry in which the highest investment in health technology is in this country (Norbeck, 2012) - an industry formulating as proactive in innovation investment in the technology (Horowitz, 2012a). The course is also enhanced by inclusion in Technology Entrepreneurship. Entrepreneurial Health Informatics is furnishing a product that is reacting to the requirements of the industry (Wagner, 2012). Other schools are frequently furnishing students that are not reacting to the skills of the industry. The implication of the paper is that Entrepreneurial Health Informatics is a marketable product to students desiring an interdisciplinary Technology Entrepreneurship program.

Entrepreneurial Health Informatics is enabling an exciting initiative of students to be innovators in

health industry technology. Evaluating opportunities and problems, and furnishing prototypes and solutions (Hyman, 2013), is ideal learning – not passive but proactive problem-solving. Partnering with a health organization and a technology organization on patient problems is an ideal project (Analytics, 2013). In the period from 2011, the bulk of the 36 students in Technology Entrepreneurship (12 in Entrepreneurial Health Informatics) are notably positive on the marketplace potential of even modest projects and on the overall progress in the semesters (Joseph, & Lawler, 2013). They are especially notably positive on mentor relationships (Joseph, & Lawler, 2013) with small start-up ventures (Cortese, 2013), through Entrepreneurs" Organizations and Startup America Partnership (Max, 2013), and on the potential of recruitment with these ventures, which in the literature is noted as a product of Technology Entrepreneurship programs (Austen, 2013). The implication of the paper is that Entrepreneurial Health Informatics is an appealing proposition to students eager to purse interdisciplinary potentials of technology.

Lastly, Entrepreneurial Health Informatics is facilitating growth into the Bachelor of Arts in Computer Science program of the school. The future of the health industry (McKenna, 2013) is evident to intelligent undergraduate students in the country intending to leverage the opportunities (Tribune Media Services, 2012) and the promises (Horowitz, 2013) of health technology. Schools of computer science and information systems may integrate the cloud methodologies and platforms of Bachelor of Arts in Computer Science programs (Lawler, & Joseph, 2011) into entrepreneurship and innovation projects, as on the projects of Entrepreneurial Health Informatics of the Seidenberg School. As a result, they may inexpensively invest in more entrepreneurship and innovation projects with cloud technology (Sobel, 2012, and Pratt, 2013). The implication of this paper is that Entrepreneurial Health Informatics, as an example of Technology Entrepreneurship, is a definite proposition to instructors of any university intending to be in tandem with industrial trends.

7. LIMITATIONS AND OPPORTUNITIES

Evaluation of Entrepreneurial Health Informatics as a course of the concentration of Technology Entrepreneurship of the Bachelor of Arts in Computer Science program may not be finished until late 2013. Evaluation of perceptions and performances, including products, and of recruitments, of the fall 2012 – fall 2013 students may not be fulfilled until a survey then. The limited number of Technology Entrepreneurship students is also a limitation of the paper. The features of Entrepreneurial Health Informatics may nevertheless be helpful immediately to instructors interested in new offerings for STEM students. Students may be pleased with programs increasing marketable skills, so that they may be more than pure technologists.

8. CONCLUSION

The paper presents a course in Entrepreneurial Health Informatics in the concentration of Technology Entrepreneurship at Pace University. The course is one of entrepreneurship innovation projects, from which students of the Seidenberg School of Computer Science and Information Systems of the university are positioned to be business opportunists, not pure technologists. The course provides the creative thinking, problem-solving and risk-taking of business professionals required by not only the health industry but by other industries. The concentration in Technology Entrepreneurship, and the course in Entrepreneurial Health Informatics, further provides interdisciplinary skills to undergraduate students that may not have nor otherwise would have had such skills. Overall, this paper provides schools of computer science and information systems with a proposition that is timely to industrial and societal trends.

9. ACKNOWLEDGEMENTS

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Editor's Note:

This paper was selected for inclusion in the journal as an ISECON 2013 Meritorious Paper. The acceptance rate is typically 15% for this category of paper based on blind reviews from six or more peers including three or more former best papers authors who did not submit a paper in 2013.

APPENDIX

**Figure 1: Course of Entrepreneurial Health Informatics in a Concentration of
Technology Entrepreneurship in a Bachelor of Arts Program in
Computer Science: 2012-2013**
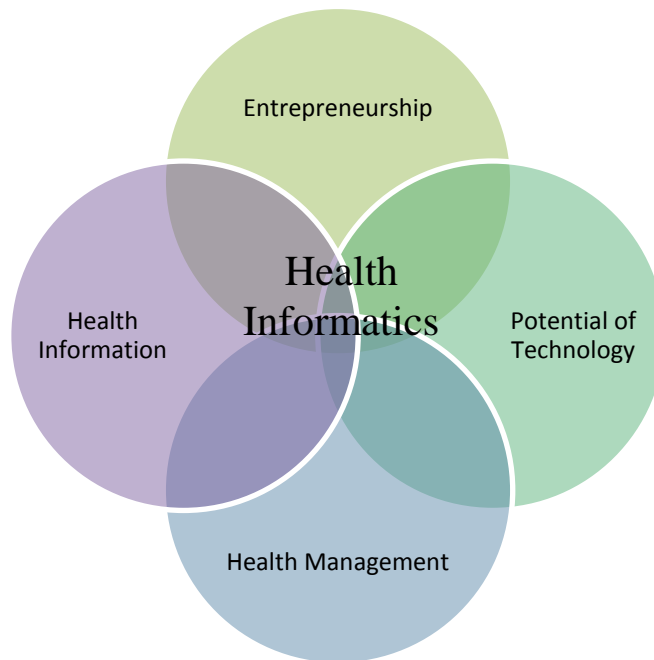
Figure 2: Concentration of Technology Entrepreneurship, with the Course of Entrepreneurial Health Informatics, in a Bachelor of Arts Program in Computer Science: 2011-2015

Bachelor of Arts in Computer Science
Concentration in Technology Entrepreneurship

CONCEPT COURSES

DOMAIN COURSES

ENABLING COURSES

SURVEY COURSES

Entrepreneurship and Technology
Fall 2011

Entrepreneurship and Financial Computing
Spring 2012

Entrepreneurial Health Informatics Fall 2012

Cloud Sourcing
Fall 2011

Special Topics in 21st Century Technologies and Ventures
Summer 2012

Customer Relationship Management (CRM) and Entrepreneurship
Spring 2011

Energy Efficiency Entrepreneurship
Fall 2013

Modeling of Financial Processes, Products ,Services and Systems through Technologies
Spring 2012

Entrepreneurship and National Security
Fall 2014

Note: Periods represent inaugural semesters in the Seidenberg School of Computer Science and Information Systems.

Table 1: Course of Entrepreneurial Health Informatics, within the Concentration of Technology Entrepreneurship, in the Bachelor of Arts Program in Computer Science: 2012 – 2013
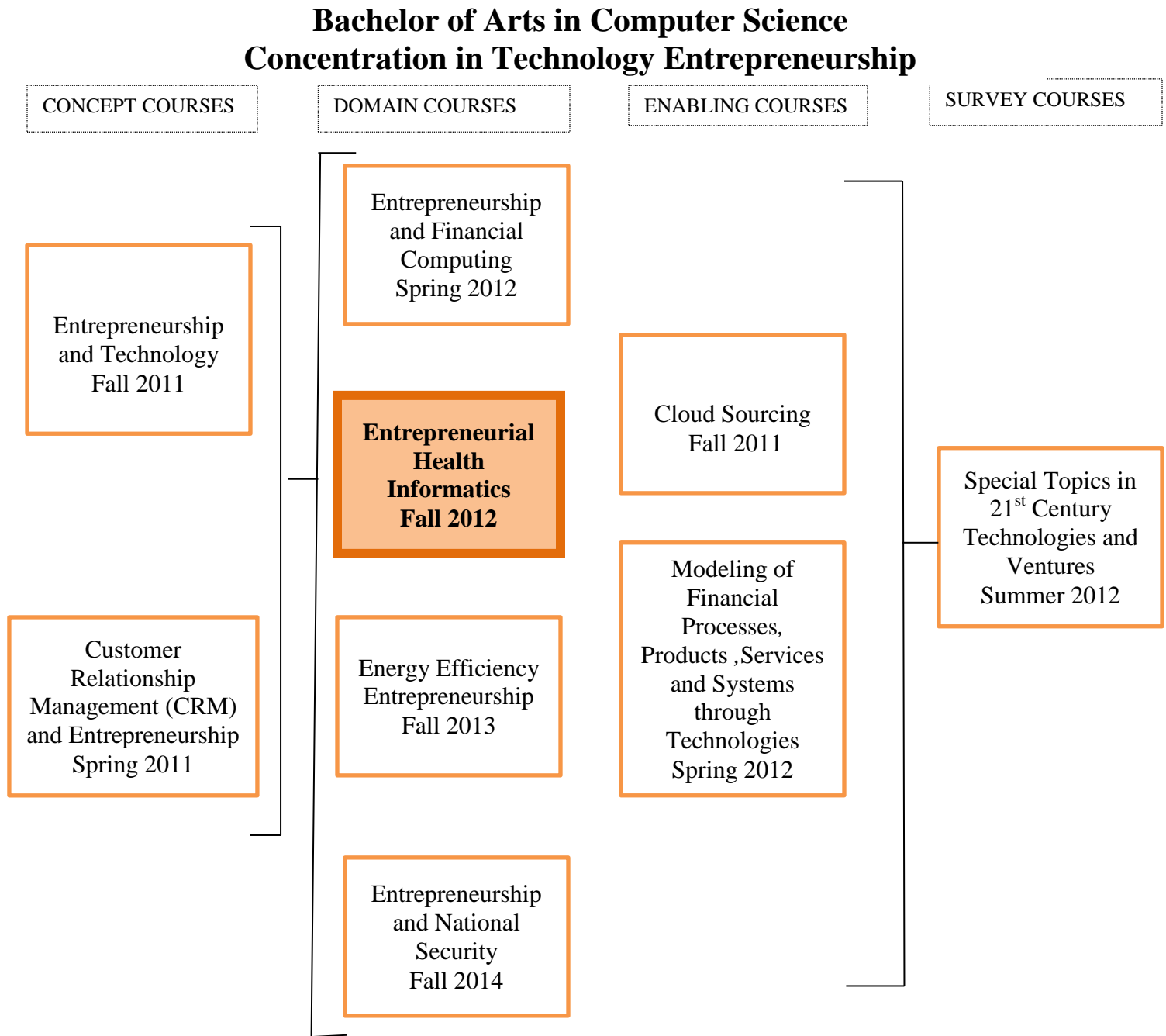
Semester Week	Topics	Optional Treks
1	Business Entrepreneurial Mind Business Entrepreneurial Process Business Entrepreneurial Strategy Ideas vs. Opportunities Rewards vs. Risks *Formation of Project Teams* (Random Selection by Students)	
2	Contemporary Health Entrepreneurship in Health Industry Evolution of Health Record Systems Functions of Health Systems Clinical Data Repository Systems Integrated Device Systems Managed Care Systems Medical Management Systems Systems for Telemedicine Health Insurance Portability and Accountability Act (HIPAA) Legislation Obama Health Legislation Organizational Policies and Procedures Privacy, Risk Management and Security *Mini-Presentations on Health Industry* (by Teams) *to Instructor*	
3	Entrepreneurship Innovation Ideas vs. Opportunities Innovation Opportunities through Systems Medical Mobile Monitoring Applications (Apps) Mining of Patient Record Systems Process Re-engineering of Service Systems Re-engineering of Self-Service Systems and Tools Research of Systems and Tools Level of Maturity of Industry Technology Review of Standards and Terminologies	Executive Mentor Firm(s)

	Integration of Mentors on Project Teams	
4	Entrepreneurship Modeling for Health Policy Opportunities	Hospital Organization
	Computer Modeling and Decision-Making	School of Health Professions of Pace University (Pleasantville, New York)
	Economic Efficiency Models Mathematical Models Statistical Models	
	Entrepreneurship Models for Health Policy Problem-Solving	
	Preliminary Presentation of Innovation Opportunities (by Teams) *to Instructor and Mentors*	
5	Entrepreneurship Program Management Methodology	
	Analysis and Design Development Integration and Testing Deployment Implementation	
	Systems Science Methodology	
	(*)	
	Prototyping or Simulation vs. Solution Systems	
	Rules for Student Team Playing	
	Preliminary Presentations of Innovation Opportunities through Technologies (by Teams) to *Instructor*	
6	Entrepreneurship Scenario – Interdisciplinary Health Project	Equity Investor Firm
	Process, Product or Service Scenario	Start-Up Venture
	Business Plan	
	Critical Success Factors Marketplace Forces and Opportunities New Project Rationale Scenario of Story Outcomes of Story	
	Financial Plan	
	Funding Plan	

	Crowdfunding Equity Investors 　　　Private vs. Public Investors Investor Motivations in New Ventures (**) *Preliminary Presentations of Process, Product or Service Scenarios* (by Teams) *to Instructor and Mentors*	
7	Entrepreneurship Scenario – Interdisciplinary Health Project Process, Product or Service Strategy Objective Definition of New Project Differentiation in Edge of New Project Industry Perspective on New Project Project Scope Strategy (***) *Preliminary Presentations of Process, Product or Service Strategies* (by Teams) *to Instructor and Mentors*	Start-Up Venture
8	Entrepreneurship Scenario – Interdisciplinary Health Project Process, Product or Service Prototype or Solution System Technology Project Specifications Prototyping of Stages of System Rapid Application Development (RAD) and Iteration Steps Scenario Technology (***)	Start-Up Venture
9	Entrepreneurship Scenario – Interdisciplinary Health Project Process, Product or Service Prototype or Solution System Technology Project Specifications Prototyping of Stages of System 　　Rapid Application Development (RAD) and Iteration Steps	Start-Up Venture

	Scenario Technology (***)	
10	Entrepreneurship Scenario – Interdisciplinary Health Project Process, Product or Service Prototype or Solution System Technology Project Specifications Prototyping of Stages of System Rapid Application Development (RAD) and Iteration Steps Scenario Technology (***)	Start-Up Venture
11	Entrepreneurship Scenario – Interdisciplinary Health Project Process, Product or Service Prototype or Solution System Technology Project Specifications Prototyping of Stages of System Rapid Application Development (RAD) and Iteration Steps Scenario Technology (***)	Start-Up Venture
12	Entrepreneurship Scenario – Interdisciplinary Health Project Process, Product or Service Prototype or Solution System Technology Project Specifications Prototyping of Stages of System Rapid Application Development (RAD) and Iteration Steps Scenario Technology (***)	Start-Up Venture
13	Entrepreneurship with Cloud Technology Infrastructure-as-a-Service (IaaS) Platform-as-a-Service (PaaS)	Equity Investor Firm Non-Profit Organization

14	Software-as-a-Service (SaaS)	Start-Up Venture
	Platforms of Cloud Service Providers (CSP) for Scenario Technologies and Ventures	
	Preliminary Presentations of Project (by Teams) to Instructor	
	Field Opportunities	Internship Opportunity – Start-Up Venture
	Bioelectronics, Biotechnology and Genomics Pharmaceuticals Telemedicine	
	Trends in Entrepreneurship Technologies	
	Final Presentations of Projects of Systems and Tools and Proposals of Ventures (by Teams) to Instructor and Investors, Mentors and Health Industry Regional Representatives	
	Reflections on Results of Semester (by Students and Teams)	

(*)   Urban, Osgood, & Mabry, 2011

(**) Byers, Dorf, & Nelson, 2011

(***) Richardson, & Butler, 2006