## 1. General Information

1a. Submitted by the College of: PUBLIC HEALTH

Date Submitted: 8/11/2014

1b. Department/Division: Dept Of Biostatistics

1c. Contact Person

Name: Andrea Perkins

Email: andrea.perkins@uky.edu

Phone: 218-2021

Responsible Faculty ID (if different from Contact)

Name: Ramakanth Kavuluru

Email: ramakanth.kavuluru@uky.edu

Phone: 218-2246

1d. Requested Effective Date: Semester following approval

1e. Should this course be a UK Core Course? No

## 2. Designation and Description of Proposed Course

2a. Will this course also be offered through Distance Learning?: Yes [4]

2b. Prefix and Number: BMI 732

2c. Full Title: Biomedical Ontologies and Semantic Web Techniques

2d. Transcript Title: Biomed Ontologies and Semantic Web

2e. Cross-listing:

2f. Meeting Patterns

LECTURE: 45

2g. Grading System: Letter (A, B, C, etc.)

2h. Number of credit hours: 3

2i. Is this course repeatable for additional credit? No

If Yes: Maximum number of credit hours:

If Yes: Will this course allow multiple registrations during the same semester?

2j. Course Description for Bulletin: This course is a conceptual introduction to biomedical ontologies and ontological modeling in biomedicine through Semantic Web techniques. Students will learn about RDF, OWL, description logics, and SPARQL and their role in designing ontologies. Biomedical terminologies such as GO, ICD-9/10, SNOMED-CT, and MeSH will be discussed as case studies.

2k. Prerequisites, if any:   MA 123 (or equivalent) or consent of the instructor

2l. Supplementary Teaching Component:

3.  Will this course taught off campus?   No

    If YES, enter the off campus address:

4.  Frequency of Course Offering:   Spring,

    Will the course be offered every year?:   Yes

    If No, explain:

5.  Are facilities and personnel necessary for the proposed new course available?:   Yes

    If No, explain:

6.  What enrollment (per section per semester) may reasonably be expected?:   25

7.  Anticipated Student Demand

    Will this course serve students primarily within the degree program?:   No

    Will it be of interest to a significant number of students outside the degree pgm?:   Yes

    If Yes, explain:   Ontologies provide a systematic of curating knowledge in many fields ranging from humanities to engineering and medicine. As such, ontological foundations and design principles are of great interest to students from a wide range of programs on campus. Students especially from the Colleges of Public Health, Medicine, and Pharmacy as well as students in Computer Science and Electrical Engineering might find this course suitable for their career and research endeavors.

8.  Check the category most applicable to this course:   Relatively New – Now Being Widely Established,

    If No, explain:

9.  Course Relationship to Program(s).

    a. Is this course part of a proposed new program?:   No

    If YES, name the proposed new program:

    b. Will this course be a new requirement for ANY program?:   No

    If YES, list affected programs:

10. Information to be Placed on Syllabus.

    a. Is the course 400G or 500?:   No

    b. The syllabus, including course description, student learning outcomes, and grading policies (and 400G-/500-level grading differentiation if applicable, from **10.a** above) are attached:   Yes

## Distance Learning Form

Instructor Name:   Ramakanth Kavuluru

Instructor Email: kavuluru@uky.edu

Internet/Web-based: Yes

Interactive Video: No

Hybrid: No

1. How does this course provide for timely and appropriate interaction between students and faculty and among students? Does the course syllabus conform to University Senate Syllabus Guidelines, specifically the Distance Learning Considerations? Students and faculty will regularly communicate through Blackboard facilitated email and discussion forums. Furthermore, students can contact the faculty member via conventional email or through phone during the office hours. Three live sessions through Adobe Connect will also be conducted to further enhance virtual communication between students and the instructor. Yes, the syllabus conforms to the general senate guidelines and also the distance learning considerations.

2. How do you ensure that the experience for a DL student is comparable to that of a classroom-based student's experience? Aspects to explore: textbooks, course goals, assessment of student learning outcomes, etc. The narrative component part of the lecture is delivered as voice recordings over the slides. However, to render class-room level clarity to the more technical and mathematical aspects, the slides will be designed with expanded intermediate steps with appropriate use of colors and boxed formulae to carefully take the students through the derivations. Assessment, goals, and outcomes will be maintained equal to the class-room offering of the course.

3. How is the integrity of student work ensured? Please speak to aspects such as password-protected course portals, proctors for exams at interactive video sites; academic offense policy; etc. Faculty will be circumspect to monitor plagiarism from online resources and among students; this aspect will be no different from the class-room setting. Password protected Blackboard portal will help retain the integrity and also enforce adherence to submission due dates through time stamping. In addition to stating the academic offense policies in the syllabus, the instructor will emphasize the policies during the beginning of the semester in a recorded session so students are given ample opportunity to familiarize themselves with what is considered plagiarism and what consequences they stand to face when resorting to academic dishonesty.

4. Will offering this course via DL result in at least 25% or at least 50% (based on total credit hours required for completion) of a degree program being offered via any form of DL, as defined above? No

If yes, which percentage, and which program(s)? N/A

5. How are students taking the course via DL assured of equivalent access to student services, similar to that of a student taking the class in a traditional classroom setting? Students can interact with the faculty member through the live sessions or offline during office hours either in person or via phone calls; other ad hoc means of interactive Web based communication can be utilized within the weekly office hour slots. Students may borrow books from the library and utilize campus resources like students who would take the course in a classroom setting. Students will also be encouraged to take advantage of the DL library resources.

6.How do course requirements ensure that students make appropriate use of learning resources?   Slide shows are necessary but not sufficient in understanding the nuances in this course. The voice recordings are thus indispensable to gain a deeper understanding of the subtleties of the subject. Furthermore, the assignments and exams will also test portions of the text book that are not necessarily covered in detail during the lectures. This further promotes the habit of comprehending abstract concepts from technical manuscripts. Students will also be able to play with interactive online tutorial on SPARQL language that is part of the syllabus that lets them interactively learn a query language.

7.Please explain specifically how access is provided to laboratories, facilities, and equipment appropriate to the course or program.   The assignments will be based on free open source software platforms with proper documentation to install on personal computers. Conventional homework that does not need any programming can be solved using the material (recordings and textbook) and written up using a Word processor.

8.How are students informed of procedures for resolving technical complaints? Does the syllabus list the entities available to offer technical help with the delivery and/or receipt of the course, such as the Information Technology Customer Service Center (http://www.uky.edu/UKIT/)?   Yes. Additional resources for resolving technical issues are stated on the syllabus, including instructions to notify the instructor immediately.

9.Will the course be delivered via services available through the Distance Learning Program (DLP) and the Academic Technology Group (ATL)?   YES

If no, explain how student enrolled in DL courses are able to use the technology employed, as well as how students will be provided with assistance in using said technology.   N/A

10.Does the syllabus contain all the required components?   YES

11.I, the instructor of record, have read and understood all of the university-level statements regarding DL.

Instructor Name:   Ramakanth Kavuluru

SIGNATURE|ALHAYS0|Andrea L Perkins|BMI 732 NEW College Review|20140319

SIGNATURE|CHAPPELL|Joseph Chappell|BMI 732 ZCOURSE_NEW Approval Returned to Dept|20140425

SIGNATURE|ZNNIKO0|Roshan N Nikou|BMI 732 NEW Graduate Council Review|20140425

SIGNATURE|JTHU222|Jeffrey T Huber|BMI 732 ZCOURSE_NEW Approval Returned to Dept|20140428

SIGNATURE|ZNNIKO0|Roshan N Nikou|BMI 732 NEW Graduate Council Review|20140428

SIGNATURE|ZNNIKO0|Roshan N Nikou|BMI 732 NEW Graduate Council Review|20140428

SIGNATURE|ALHAYS0|Andrea L Perkins|BMI 732 ZCOURSE_NEW Approval Returned to Dept|20140820

SIGNATURE|ALHAYS0|Andrea L Perkins|BMI 732 NEW College Review|20140811

SIGNATURE|ZNNIKO0|Roshan N Nikou|BMI 732 NEW Graduate Council Review|20140926

| Courses | Request Tracking |
|---------|------------------|

## New Course Form

https://myuk.uky.edu/sap/bc/soap/rfc?services=

Open in full window to print or save

**Attachments:**

Browse... No file selected.

|       | ID   | Attachment |
|-------|------|------------|
| Delete | 3270 | BMI 732 Syllabus InClass 2-05-14 (Rama).pdf |
| Delete | 3271 | BMI 732 Syllabus Online 2-05-14 (Rama).pdf |
| Delete | 3544 | CCTS Letters of Support.pdf |

First | 1 | Last |

Select saved project to retrieve...

(*denotes required fields)

### 1. General Information

a. * Submitted by the College of:  PUBLIC HEALTH                    Submission Date:    8/11/2014

b. * Department/Division:    Dept Of Biostatistics

c.

   * Contact Person Name:                    Andrea Perkins      Email: andrea.perkins@uky.edu  Phone: 218-2021

   * Responsible Faculty ID (if different from Contact)  Ramakanth Kavuluru    Email: ramakanth.kavuluru@uky  Phone: 218-2246

d. * Requested Effective Date:    ⦿ Semester following approval  OR  ○ Specific Term/Year [1]

e.

Should this course be a UK Core Course?    ○ Yes  ⦿ No

**If YES, check the areas that apply:**

☐ Inquiry – Arts & Creativity          ☐ Composition & Communications – II

☐ Inquiry – Humanities                ☐ Quantitative Foundations

☐ Inquiry – Nat/Math/Phys Sci        ☐ Statistical Inferential Reasoning

☐ Inquiry – Social Sciences          ☐ U.S. Citizenship, Community, Diversity

☐ Composition & Communications – I   ☐ Global Dynamics

### 2. Designation and Description of Proposed Course.

a. * Will this course also be offered through Distance Learning?    ⦿ Yes [4]  ○ No

b. * Prefix and Number:    BMI 732

c. * Full Title:    Biomedical Ontologies and Semantic Web Techniques

d. Transcript Title (if full title is more than 40 characters):  Biomed Ontologies and Semantic Web

e. To be Cross-Listed [2] with (Prefix and Number):

f. * Courses must be described by at least one of the meeting patterns below. Include number of actual contact hours [3] for each meeting pattern type.

| 45 | Lecture | | Laboratory [1] | | Recitation | | Discussion |
|----|---------|--|------------|--|-----------|--|-----------|
|    | Indep. Study | | Clinical | | Colloquium | | Practicum |
|    | Research | | Residency | | Seminar | | Studio |
|    | Other | If Other, Please explain: | | | | | |

g. * Identify a grading system:
   ⦿ Letter (A, B, C, etc.)
   ○ Pass/Fail
   ○ Medicine Numeric Grade (Non-medical students will receive a letter grade)
   ○ Graduate School Grade Scale

h. * Number of credits:    3

i. * Is this course repeatable for additional credit?    ○ Yes  ⦿ No
   If YES: Maximum number of credit hours:
   If YES: Will this course allow multiple registrations during the same semester?  ○ Yes  ○ No

j. * Course Description for Bulletin:
This course is a conceptual introduction to biomedical ontologies and ontological modeling in biomedicine through Semantic Web techniques. Students will learn about RDF, OWL, description logics, and SPARQL and their role in designing ontologies. Biomedical terminologies such as GO, ICD-9/10, SNOMED-CT, and MeSH will be discussed as case studies.

k. Prerequisites, if any:
MA 123 (or equivalent) or consent of the instructor

i. Supplementary teaching component, if any:  ○ Community-Based Experience  ○ Service Learning  ○ Both

3. * Will this course be taught off campus?     ○ Yes  ⦿ No

If YES, enter the off campus address:

4. Frequency of Course Offering.

a. * Course will be offered (check all that apply):     ☐ Fall   ☑ Spring   ☐ Summer   ☐ Winter

b. * Will the course be offered every year?     ⦿ Yes ○ No
If No, explain:

5. * Are facilities and personnel necessary for the proposed new course available?     ⦿ Yes ○ No
If No, explain:

6. * What enrollment (per section per semester) may reasonably be expected?     25

7. Anticipated Student Demand.

a. * Will this course serve students primarily within the degree program?     ○ Yes ⦿ No

b. * Will it be of interest to a significant number of students outside the degree pgm?     ⦿ Yes ○ No
If YES, explain:
Ontologies provide a systematic of curating knowledge in many fields ranging from humanities to engineering and
medicine. As such, ontological foundations and design principles are of great interest to students from a wide

8. * Check the category most applicable to this course:

☐ Traditional – Offered in Corresponding Departments at Universities Elsewhere
☑ Relatively New – Now Being Widely Established
☐ Not Yet Found in Many (or Any) Other Universities

9. Course Relationship to Program(s).

a. * Is this course part of a proposed new program?     ○ Yes ⦿ No
If YES, name the proposed new program:

b. * Will this course be a new requirement [5] for ANY program?     ○ Yes ⦿ No
If YES [5], list affected programs::

10. Information to be Placed on Syllabus.

a. * Is the course 400G or 500?     ○ Yes ⦿ No
If YES, the *differentiation for undergraduate and graduate students must be included* in the information required in **10.b.** You must include: (i) identification of additional
assignments by the graduate students; and/or (ii) establishment of different grading criteria in the course for graduate students. (See SR 3.1.4.)

b.  ☑ * The syllabus, including course description, student learning outcomes, and grading policies (and 400G-/500-level grading differentiation if applicable, from **10.a**
above) are attached.

### Distance Learning Form

This form must accompany *every* submission of a new/change course form that requests distance learning delivery. This form may be required when changing a course already approved for DL delivery. **All fields
are required!**

Introduction/Definition: For the purposes of the Commission on Colleges Southern Association of Colleges and Schools accreditation review, *distance learning* is defined as a formal
educational process in which the majority of the instruction (interaction between students and instructors and among students) in a course occurs when students and instructors are
not in the same place. Instruction may be synchronous or asynchronous. A distance learning (DL) course may employ correspondence study, or audio, video, or computer
technologies.

A number of specific requirements are listed for DL courses. **The *department* proposing the change in delivery method is responsible for ensuring that the requirements
below are satisfied at the individual course level.** It is the responsibility of the instructor to have read and understood the university-level assurances regarding an equivalent
experience for students utilizing DL (available at http://www.uky.edu/USC/New/forms.htm).

| | | | |
|---|---|---|---|
| Course Number and Prefix: | BMI 732 | Date: | 3/19/2014 |
| Instructor Name: | Ramakanth Kavuluru | Instructor Email: | kavuluru@uky.edu |

Check the method below that best reflects how the majority of the course content will be delivered.

Internet/Web-based ☑     Interactive Video ☐     Hybrid ☐

*Curriculum and Instruction*

1. How does this course provide for timely and appropriate interaction between students and faculty and among students? Does the course syllabus conform to University Senate Syllabus Guidelines, specifically the Distance Learning Considerations?

   Students and faculty will regularly communicate through Blackboard facilitated email and discussion forums. Furthermore, students can contact the faculty member via conventional email or through phone during the office hours.

2. How do you ensure that the experience for a DL student is comparable to that of a classroom-based student's experience? Aspects to explore: textbooks, course goals, assessment of student learning outcomes, etc.

   The narrative component part of the lecture is delivered as voice recordings over the slides. However, to render class-room level clarity to the more technical and mathematical aspects, the slides will be designed with expanded

3. How is the integrity of student work ensured? Please speak to aspects such as password-protected course portals, proctors for exams at interactive video sites; academic offense policy; etc.

   Faculty will be circumspect to monitor plagiarism from online resources and among students; this aspect will be no different from the class-room setting. Password protected Blackboard portal will help retain the integrity and also

4. Will offering this course via DL result in at least 25% or at least 50%* (based on total credit hours required for completion) of a degree program being offered via any form of DL, as defined above?

   No

   Which percentage, and which program(s)?

   N/A

   *As a general rule, if approval of a course for DL delivery results in 50% or more of a program being delivered through DL, the effective date of the course's DL delivery will be six months from the date of approval.

5. How are students taking the course via DL assured of equivalent access to student services, similar to that of a student taking the class in a traditional classroom setting?

   Students can interact with the faculty member through the live sessions or offline during office hours either in person or via phone calls; other ad hoc means of interactive Web based communication can be utilized within the weekly

*Library and Learning Resources*

6. How do course requirements ensure that students make appropriate use of learning resources?

   Slide shows are necessary but not sufficient in understanding the nuances in this course. The voice recordings are thus indispensable to gain a deeper understanding of the subtleties of the subject. Furthermore, the assignments and

7. Please explain specifically how access is provided to laboratories, facilities, and equipment appropriate to the course or program.

   The assignments will be based on free open source software platforms with proper documentation to install on personal computers. Conventional homework that does not need any programming can be solved using the material (recordings and

*Student Services*

8. How are students informed of procedures for resolving technical complaints? Does the syllabus list the entities available to offer technical help with the delivery and/or receipt of the course, such as the Information Technology Customer Service Center (http://www.uky.edu/UKIT/)?

   Yes.
   Additional resources for resolving technical issues are stated on the syllabus, including instructions to notify the

9. Will the course be delivered via services available through the Distance Learning Program (DLP) and the Academic Technology Group (ATL)?

   ⊛ Yes
   ○ No

   If no, explain how students enrolled in DL courses are able to use the technology employed, as well as how students will be provided with assistance in using said technology.

   N/A

10. Does the syllabus contain all the required components, below? ☑ Yes

    ○ Instructor's *virtual* office hours, if any.

    ○ The technological requirements for the course.

    ○ Contact information for Distance Learning programs (http://www.uky.edu/DistanceLearning) and Information Technology Customer Service Center (http://www.uky.edu/UKIT/Help/; 859-218-HELP).

    ○ Procedure for resolving technical complaints.

    ○ Preferred method for reaching instructor, e.g. email, phone, text message.

    ○ Maximum timeframe for responding to student communications.

    ○ Language pertaining academic accommodations:

       ▪ "If you have a documented disability that requires academic accommodations in this course, please make your request to the University Disability Resource Center. The Center will require current disability documentation. When accommodations are approved, the Center will provide me with a Letter of Accommodation which details the recommended accommodations. Contact the Disability Resource Center, Jake Karnes, Director at 859-257-2754 or jkarnes@email.uky.edu."

    ○ Specific dates of face-to-face or synchronous class meetings, if any.

    ○ Information on Distance Learning Library Services (http://www.uky.edu/Libraries/DLLS)

       ▪ Carla Cantagallo, DL Librarian

       ▪ Local phone number: 859 257-0500, ext. 2171; long-distance phone number: (800) 828-0439 (option #6)

       ▪ Email: dllservice@email.uky.edu

       ▪ DL Interlibrary Loan Service: http://www.uky.edu/Libraries/libpage.php?lweb_id=253&llib_id=16

11. I, the instructor of record, have read and understood all of the university-level statements regarding DL.

    Instructor Name:
    Ramakanth Kavuluru

Abbreviations: DLP = Distance Learning Programs ATG = Academic Technology Group Customer Service Center = 859-218-HELP (http://www.uky.edu/UKIT/Help)

Revised 8/09

[1] Courses are typically made effective for the semester following approval. No course will be made effective until all approvals are received.

[2] The chair of the cross-listing department must sign off on the Signature Routing Log.

[3] In general, undergraduate courses are developed on the principle that one semester hour of credit represents one hour of classroom meeting per week for a semester, exclusive of any laboratory meeting. Laboratory meeting, generally, represents at least two hours per week for a semester for one credit hour. (from SR 5.2.1)

[4] You must also submit the Distance Learning Form in order for the proposed course to be considered for DL delivery.

[5] In order to change a program, a program change form must also be submitted.

Rev 8/09

Submit as New Proposal    Save Current Changes

<u>**Course Syllabus**</u>
**BMI 732:**
**Biomedical Ontologies and Semantic Web Techniques**

**Location: MDS 206, Day and Time: Wednesdays (9:30am to 12pm, EST)**

## Contact information

| | | |
|---|---|---|
| Instructor: | Dr. Ramakanth Kavuluru | |
| | 230E MDS Building, 725 Rose Street | |
| Telephone: | 859-218-2246 | |
| E-mail: | rvkavu2@uky.edu (Preferred method of contact) | |
| Office Hours: | Wednesdays 2-3 or by appointment | |

## Course description

This course is a conceptual introduction to biomedical ontologies and ontological modeling in biomedicine through Semantic Web techniques. Students will learn about the fundamentals of different well-known terminologies from different biomedical areas such as the Gene Ontology, Medical Subject Headings (MeSH), Systematic Nomenclature of Medicine (SNOMED-CT), and International Classification of Diseases (ICD-9/10). These will be used to lay the foundations for modeling customized knowledge bases. Besides the straightforward taxonomical relationships, students will also learn formal approaches to modeling knowledge bases and building simple ontologies in their field of research (not necessarily biomedicine) that handle associative relationships with domain/range constraints and other restrictions. Class projects will highlight different aspects of knowledge representation and applications of biomedical ontologies in semantic search and information extraction. The vision of "Semantic Web" is to enable a semantic perspective on the text and hyperlink laden World Wide Web. Besides contributing to this vision, techniques arising from the Semantic Web field are also useful for standalone healthcare and biomedical applications. In this course, students will learn how Semantic Web technologies including RDF, OWL, and SPARQL enable ontological modeling and querying of knowledge bases.

## Course rationale:

Ontologies are structured representations of established knowledge in various fields. As such, they act as references to understand a field of study or topic of interest and in biomedicine they have been used to standardize representation and communication of biomedical concepts, an important part of obviating medical errors. The national center for biomedical ontology (NCBO) at Stanford University has compiled a list of nearly 350 ontologies in the field and provides Web services to get information on various ontologies they provide. Besides being able to understand the structure of ontologies and their applications, it is important to learn to build ontologies for new domains of interest. This will allow researchers to tailor new ontologies to their domain of interest and use them to standardize their communication and allow better retrieval of

information in that field. User-friendly tools to build ontologies and to use them in annotating datasets are equally important in this digital age. Finally, a good understanding of ontologies is important to leverage them in annotation, information extraction, and other more important applications.

## Course prerequisites

MA123 (or equivalent) or consent of the instructor.

## Course objectives

1. Identify the building blocks (classes, instances, properties) of ontologies
2. Summarize reasoning algorithms and their complexities
3. Summarize different biomedical terminologies and their applications
4. Discuss principles of knowledge representation in ontologies

### Public Health Competency attainment
Your attainment after completing BMI 732 will be at least the following and perhaps more, depending on the other courses in which you have enrolled.

## Competencies for the PhD in Epidemiology and Biostatistics

- Draw appropriate inferences from data.
- Demonstrate proficiency in using computing tools commonly encountered in epidemiology and biostatistics.

## Public Health Competencies for Biomedical Language Processing
http://www.phf.org/resourcestools/pages/core_public_health_competencies.aspx

- Uses information technology to collect, store, and retrieve data
- Demonstrates the use of public health informatics practices and procedures
- Retrieves scientific evidence from a variety of text and electronic sources
- Applies public health informatics skills to improve program and business operations (e.g., business process analysis, enterprise-wide information planning)

## Student learning outcomes:

Upon completion of this course, the student will:

1. Describe the structure and uses of different popular biomedical terminologies such as SNOMED-CT, ICD-9/10, MeSH, and GO.
2. Represent data in RDF syntax and perform simple reasoning by hand
3. Design a customized ontology in a domain of interest
4. Query RDF graphs using SPARQL
5. Use open source tools to build an application that uses existing biomedical ontologies

## Textbook - required

(readings outside the book will be provided in the form of papers)

- Foundations of Semantic Web Technologies, by Hitzler, Krotzsch, Rudolph, Chapman and Hall, 2009 (abbreviated HKR for class schedule)

## Course requirements and learner evaluation

Course grades will be based upon evaluation of the following activities:

- 120 points - individual class project that uses biomedical ontologies in a real world application (proposal 20 points, implementation and report 70 points, and demo and presentation 30 points)
- 150 points - building a sample ontology (involving different levels of expressiveness including class/property hierarchies, domain/range constraints, qualified cardinality constraints, disjoint and closed classes, 50 points for each of the three phases mentioned in the course schedule)
- 120 points - final exam
- 10 points – class attendance

Point Grading scheme (undergrad requirements in parentheses):

    400-360=A  (340-400)
    359-320=B  (280-339)
    319-280=C  (240-279)
    0-279=E    (0-239)

## Submission of Assignments

Assignments should be submitted via email to rvkavu2@uky.edu by 11:59PM on the day they are due unless otherwise specified. Multiple submissions are allowed but only the last submission that is submitted by the deadline will be considered for grading.

## Instructor expectations

1. I expect you to attend every class session. The components are highly interrelated; missing a class will detract from the learning potential of subsequent sessions.
2. I expect you to be in the classroom and prepared to begin work at the scheduled starting time for each session.
3. I expect you to actively participate in the discussions. This is not the type of class where you can "sit back and listen."
4. I expect you to submit papers using proper English grammar, syntax, and spelling. You are encouraged to use spell check and grammar check prior to submitting your written work. The Writing Laboratory is available to anyone who may need assistance.
5. I expect (and encourage) you to provide honest and timely feedback regarding the content and process of this course throughout the semester.
6. I expect you to share in the responsibility for making this course an enjoyable and beneficial learning experience.
7. Wikipedia *cannot* be used as a cited reference as noted by a co-founder of Wikipedia! You may use Wikipedia to identify appropriate source material. Remember Wikipedia is *not* peer reviewed!

## Academic honesty

Academic honesty is highly valued at the University. You must always submit work that represents your original words or ideas. If any words or ideas used in a class assignment submission do not represent your original words or ideas, you must cite all relevant sources and make clear the extent to which such sources were used. Words or ideas that require citation include, but are not limited to, all hard copy or electronic publications, whether copyrighted or not, and all verbal or visual communication when the content of such communication clearly

originates from an identifiable sources. Per university policy, students shall not plagiarize, cheat, or falsify or misuse academic records. Students are expected to adhere to University policy on cheating and plagiarism in all courses. The minimum penalty for a first offense is a zero on the assignment on which the offense occurred. If the offense is considered severe or the student has other academic offenses on their record, more serious penalties, up to suspension from the university, may be imposed. All incidents of cheating and plagiarism are taken very seriously at the University of Kentucky, and there are specific policies and procedures in place to prosecute them. See S.R. 6.3.0 (PDF) for the exact Senate Rules regarding academic offenses.

## Accommodations

If you have a documented disability that requires academic accommodations, please see me as soon as possible during scheduled office hours. In order to receive accommodations in this course, submit to me a Letter of Accommodation from the Disability Resource Center). If you have not already done so, please register with the Disability Resource Center for coordination of campus disability services available to students with disabilities. Contact Jake Karnes via email at jkarnes@email.uky.edu or by telephone 859-257-2754. You may also visit the DRC website for information on how to register for services as a student with a disability: http://www.uky.edu/StudentAffairs/DisabilityResourceCenter/

## Religious Observances

Students will be given the opportunity to make up work (typically, exams or assignments) when students notify their instructor that religious observances prevent the student from completing assignments according to deadlines stated in this syllabus. Students must notify the course instructor **at least two weeks prior to such an absence** and propose how to make up the missed academic work.

## Inclement weather

The University of Kentucky has a detailed policy for decisions to close in inclement weather. The snow policy is described in detail at http://www.uky.edu/PR/News/severe_weather.htm or you can call (859) 257-1754.

## Late work policy

Late homework will not be accepted unless arranged with the instructor under extenuating circumstances as allowed by the excused absences policy.

## Excused absences policy

Attendance, excused absences and make-up opportunities for this course will conform to the course policies established by the Office of Academic Ombud Services as found at www.uky.edu/Ombud/policies.php

## Course schedule and topics with text book chapter numbers for reading

| Date | Topic | Readings/Assignments |
|------|-------|----------------------|
| 1/16 | Introduction to biomedical ontologies, syllabus review | Review custom slides |
| 1/21 | Intro to semantic web techniques (vision, need, core specs, outline) | Read HKR chapter 1 |
| 1/23 | Exemplars of semantic web applications including linked open data | Read HKR chapter 1 |
| 1/28 | Introduction to gene ontology, ICD-9 | Review custom slides |
| 1/30 | RDF (XML, Turtle Syntax, data types, blank nodes) | Read HKR chapter 2.1-2.3 |
| 2/4 | RDF Schema (classes/properties, hierarchies, restrictions, lists) | Read HKR chapter 2.4 |
| 2/6 | RDF Semantics (model theoretic semantics, entailment and syntactic reasoning) | Read HKR chapter 3 Sample ontology phase 1 (the RDF part) due |
| 2/11 | Intro description logics, the ALC variant | Read HKR chapter 5.1 |
| 2/13 | SROIQ (D) class and Semantics | Read HKR chapter 5.1-5.2 |
| 2/18 | Intro to reasoning in description logics | Read HKR chapter 5.3.1-5.3.2 Sample ontology phase 2 (the RDFS part) due |
| 2/20 | Reasoning in ALC using Tableaux algorithm | Read HKR chapter 5.3.3 Project proposals due |
| 2/25 | OWL syntax for SROIQ(D) constructs | Read HKR chapter 4 |
| 2/27 | Variants of OWL | Read HKR chapter 4 Sample ontology phase 3 (description logic part) due |
| 3/4 | Introduction to SNOMED | IHTSDO intro slides |
| 3/6 | SNOMED post coordination and usage | IHTSDO basics slides |
| 3/11 | SPARQL to query RDF data | Cambridge semantics online interactive tutorial and Read HKR Chapter 7.1 |
| 3/13 | Topic review and proposal review | |
| 3/17-3/22 | spring break | |
| 3/25 | Intro to linked open data | EUCLID online tutorial |
| 3/27 | Linked open data applications | Custom slides |
| 4/1 | OWL Rules | Read HKR chapter 6 |
| 4/3 | Intro to unified medical language system | NLM UMLS reference manual |
| 4/8 | UMLS Metathesaurus and Semantic Network | NLM reference manual |
| 4/10 | Biomedical ontologies for data integration | Olivier Bodenreider's papers |
| 4/15 | Biomedical ontologies for named entity recognition and information extraction. | NLM MetaMap JAMIA paper, MetaMap reference paper |
| 4/17 | Biomedical ontologies for semantic similarity and word sense disambiguation | Pedersen et al tutorial |
| 4/22 | Biomedical ontologies for decision support | Custom slides Final project reports due |
| 4/24 | Project presentations and Demos - 1 | |
| 4/29 | Project presentations and Demos - 2 | |
| 5/1 | Review sessions and questions before final | Final exam questions posted on class page by Thursday 11:59 PM, week before finals week. |
| 5/6 | Final examination 9:30 -10.45 am in MDS 206 | Instructions: open book |

## UNIVERSITY OF KENTUCKY
## COLLEGE OF PUBLIC HEALTH

Last modified: 2/05/2014

## Course Syllabus
## BMI 732: Biomedical Ontologies and Semantic Web Techniques
## (Distance Learning Offering through Blackboard)

## Classroom and Meeting Hours

- Online course materials posting date: Since this is a distance learning course, new materials are made available every Mondays by 11:59PM, EST through Blackboard courseware

- Online live sessions: During the semester, three one hour online meetings will be conducted via UKY Adobe Connect facility during which students can ask questions about the course material or assessment (homework, assignments etc.). This is in addition to email and phone.

- Face to face meetings are not scheduled for this course. Course materials (slides, recordings) can be viewed offline and all assessment is also conducted through Blackboard submissions.

## Contact information

- Instructor:      Dr. Ramakanth Kavuluru, Asst. Professor, Biomedical Informatics
- Office:           230E MDS Building, 725 Rose Street
- Telephone:    859-218-2246
- E-mail:          rvkavu2@uky.edu (preferred way of communication, maximum response time frame is 48 hours)
- Office Hours:    2 hours will be maintained per week during which phone calls will be taken in addition to regular email communication.

## Course description

This course is a conceptual introduction to biomedical ontologies and ontological modeling in biomedicine through Semantic Web techniques. Students will learn about the fundamentals of different well-known terminologies from different biomedical areas such as the Gene Ontology, Medical Subject Headings (MeSH), Systematic Nomenclature of Medicine (SNOMED-CT), and International Classification of Diseases (ICD-9/10). These will be used to lay the foundations for modeling customized knowledge bases. Besides the straightforward taxonomical relationships, students will also learn formal approaches to modeling knowledge bases and building simple ontologies in their field of research (not necessarily biomedicine) that handle associative relationships with domain/range constraints and other restrictions. Class projects will highlight different aspects of knowledge representation and applications of biomedical ontologies in semantic search and information extraction. The vision of "Semantic Web" is to enable a semantic perspective on the text and hyperlink laden World Wide Web. Besides contributing to this vision, techniques arising from the Semantic Web field are also useful for standalone healthcare and biomedical applications. In this course, students will learn how Semantic Web technologies including RDF, OWL, and SPARQL enable ontological modeling and querying of knowledge bases.

## Course rationale:

Ontologies are structured representations of established knowledge in various fields. As such, they act as references to understand a field of study or topic of interest and in biomedicine they have been used to standardize representation and communication of biomedical concepts, an important part of obviating medical errors. The national center for biomedical ontology (NCBO) at Stanford University has complied a list of nearly 350 ontologies in the field and provides Web services to get information on various ontologies they provide. Besides being able to understand the structure of ontologies and their applications, it is important to learn to build ontologies for new domains of interest. This will allow researchers to tailor new ontologies to their domain of interest and use them to standardize their communication and allow better retrieval of information in that field. User-friendly tools to build ontologies and to use them in annotating datasets are equally important in this digital age. Finally, a good understanding of ontologies is important to leverage them in annotation, information extraction, and other more important applications.

## Course prerequisites

- MA123 (or equivalent) or consent of the instructor.

## Course objectives

1. Identify the building blocks (classes, instances, properties) of ontologies
2. Summarize reasoning algorithms and their complexities
3. Summarize different biomedical terminologies and their applications
4. Discuss principles of knowledge representation in ontologies

## Public Health Competency attainment

Your attainment after completing BMI 732 will be at least the following and perhaps more, depending on the other courses in which you have enrolled.

## Competencies for the PhD in Epidemiology and Biostatistics

- Draw appropriate inferences from data.
- Demonstrate proficiency in using computing tools commonly encountered in epidemiology and biostatistics.

## Public Health Competencies for Biomedical Language Processing
http://www.phf.org/resourcestools/pages/core_public_health_competencies.aspx

- Uses information technology to collect, store, and retrieve data
- Demonstrates the use of public health informatics practices and procedures
- Retrieves scientific evidence from a variety of text and electronic sources
- Applies public health informatics skills to improve program and business operations (e.g., business process analysis, enterprise-wide information planning)

## Student learning outcomes

Upon completion of this course, the learner will:

1. Describe the structure and uses of different popular biomedical terminologies such as SNOMED-CT, ICD-9/10, MeSH, and GO.
2. Represent data in RDF syntax and perform simple reasoning by hand
3. Design a customized ontology in a domain of interest

4. Query RDF graphs using SPARQL
5. Use open source tools to build an application that uses existing biomedical ontologies

**Textbook - required**

(readings outside the book will be provided in the form of papers)

- Foundations of Semantic Web Technologies, by Hitzler, Krotzsch, Rudolph, Chapman and Hall, 2009 (abbreviated HKR for class schedule)

**Course requirements and learner evaluation**

Course grades will be based upon evaluation of the following activities:

- 120 points - individual class project that uses biomedical ontologies in a real world application (proposal 20 points, implementation and report 70 points, and demo and presentation 30 points)
- 150 points - building a sample ontology (involving different levels of expressiveness including class/property hierarchies, domain/range constraints, qualified cardinality constraints, disjoint and closed classes, 50 points for each of the three phases mentioned in the course schedule)
- 120 points - final exam
- 10 points – class attendance

Point Grading scheme (undergrad requirements in parentheses):

        400-360=A  (340-400)
        359-320=B  (280-339)
        319-280=C  (240-279)
        0-279=E    (0-239)

**Submission of Assignments**

Assignments should be submitted via Blackboard by 11:59PM on the day they are due unless otherwise specified.

**Technology Requirements**

Since this is a distance-learning course, students are required to have stable access to a computer and hence encourage students to own a personal computer (laptop/desktop is okay but tablets are not sufficient) according to these requirements:
http://www.uky.edu/ukit/hardwareguide
Furthermore, to fully participate in the distance learning experience students are also required to install the following software and acquire useful hardware:

http://www.uky.edu/DistanceLearning/current/technology/techReqs.html

**Technical Issues**

Students should contact the instructor (via email) and the UKIT help desk in case they are unable to access the materials (http://www.uky.edu/UKIT, 859-218-HELP) so that issues can be resolved in a timely fashion and homeworks can be submitted on time.

## Contact information for:

TASC   http://www.uky.edu/ukit/atg/tasc
Information Technology Customer Service Center   http://www.uky.edu/ukit/


## Distance Learning Library Services

Students are encourage to take advantage of the library services to find additional online materials or borrow books through inter-library loan (**Carla Cantagallo**, *DL Librarian  (859) 218-1240  Email: dllservice@email.uky.edu*)

## Instructor expectations

1.  I expect you to review materials from every class session.  The components are highly interrelated; missing a class will detract from the learning potential of subsequent sessions.
2.  I expect you to actively participate in the discussions via blackboard and also interact with me via email for clarifications and course related discussion.
3.  I expect you to submit papers using proper English grammar, syntax, and spelling.  You are encouraged to use spell check and grammar check prior to submitting your written work.  The Writing Laboratory is available to anyone who may need assistance.
4.  I expect (and encourage) you to provide honest and timely feedback regarding the content and process of this course throughout the semester.
5.  I expect you to share in the responsibility for making this course an enjoyable and beneficial learning experience.
6.  Wikipedia *cannot* be used as a cited reference as noted by a co-founder of Wikipedia!  You may use Wikipedia to identify appropriate source material.  Remember Wikipedia is *not* peer reviewed!


## Academic honesty

Academic honesty is highly valued at the University.  You must always submit work that represents your original words or ideas.  If any words or ideas used in a class assignment submission do not represent your original words or ideas, you must cite all relevant sources and make clear the extent to which such sources were used.  Words or ideas that require citation include, but are not limited to, all hard copy or electronic publications, whether copyrighted or not, and all verbal or visual communication when the content of such communication clearly originates from an identifiable sources.  Per university policy, students shall not plagiarize, cheat, or falsify or misuse academic records. Students are expected to adhere to University policy on cheating and plagiarism in all courses.  The minimum penalty for a first offense is a zero on the assignment on which the offense occurred.  If the offense is considered severe or the student has other academic offenses on their record, more serious penalties, up to suspension from the university, may be imposed.  All incidents of cheating and plagiarism are taken very seriously at the University of Kentucky, and there are specific policies and procedures in place to prosecute them. See S.R. 6.3.0 (PDF) for the exact Senate Rules regarding academic offenses.


## Accommodations

If you have a documented disability that requires academic accommodations, please see me as soon as possible during scheduled office hours.  In order to receive accommodations in this course, submit to me a Letter of Accommodation from the Disability Resource Center).  If you have not already done so, please register with the Disability Resource Center for coordination of campus disability services available to students with disabilities. Contact Jake Karnes via email at jkarnes@email.uky.edu or by telephone 859-257-2754. You may also visit the DRC website

for information on how to register for services as a student with a disability:
http://www.uky.edu/StudentAffairs/DisabilityResourceCenter/

## Religious Observances

Students will be given the opportunity to make up work (typically, exams or assignments) when students notify their instructor that religious observances prevent the student from completing assignments according to deadlines stated in this syllabus. Students must notify the course instructor **at least two weeks prior to such an absence** and propose how to make up the missed academic work.

## Inclement weather

The University of Kentucky has a detailed policy for decisions to close in inclement weather. The snow policy is described in detail at http://www.uky.edu/PR/News/severe_weather.htm or you can call (859) 257-1754.

## Late work policy

Late homework will not be accepted unless arranged with the instructor on a case-by-case basis under extenuating circumstances

## Excused absences policy

Attendance, excused absences and make-up opportunities for this course will conform to the course policies established by the Office of Academic Ombud Services as found at www.uky.edu/Ombud/policies.php

## Course schedule and topics with text book chapter numbers for reading

| Date | Topic | Readings/Assignments |
|------|-------|----------------------|
| 1/16 | Introduction to biomedical ontologies, syllabus review and blackboard intro. Live session through adobe connect (time: 1:00-2:15pm) | Review custom slides, recording will be made available |
| 1/21 | Intro to semantic web techniques (vision, need, core specs, outline) | Read HKR chapter 1 |
| 1/23 | Exemplars of semantic web applications including linked open data | Read HKR chapter 1 |
| 1/28 | Introduction to gene ontology, ICD-9 | Review custom slides |
| 1/30 | RDF (XML, Turtle Syntax, data types, blank nodes) | Read HKR chapter 2.1-2.3 |
| 2/4 | RDF Schema (classes/properties, hierarchies, restrictions, lists) | Read HKR chapter 2.4 |
| 2/6 | RDF Semantics (model theoretic semantics, entailment and syntactic reasoning) | Read HKR chapter 3 Sample ontology phase 1 (the RDF part) due |
| 2/11 | Intro description logics, the ALC variant | Read HKR chapter 5.1 |
| 2/13 | SROIQ (D) class and Semantics (live session through Adobe connect, time: 1:00-2:15pm) | Read HKR chapter 5.1-5.2 |
| 2/18 | Intro to reasoning in description logics | Read HKR chapter 5.3.1-5.3.2 Sample ontology phase 2 (the RDFS part) due |
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| | | |
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| 2/25 | OWL syntax for SROIQ(D) constructs | Read HKR chapter 4 |
| 2/27 | Variants of OWL | Read HKR chapter 4<br>Sample ontology phase 3<br>(description logic part) due |
| 3/4 | Introduction to SNOMED | IHTSDO intro slides |
| 3/6 | SNOMED post coordination and usage | IHTSDO basics slides |
| 3/11 | SPARQL to query RDF data | Cambridge semantics online<br>interactive tutorial and Read<br>HKR Chapter 7.1 |
| 3/13 | Live class review and project proposal review<br>(time: 1:00-2:15pm) | Instructions: through adobe<br>connect |
| 3/17-3/22 | spring break | |
| 3/25 | Intro to linked open data | EUCLID online tutorial |
| 3/27 | Linked open data applications | Custom slides |
| 4/1 | OWL Rules | Read HKR chapter 6 |
| 4/3 | Intro to unified medical language system | NLM UMLS reference manual |
| 4/8 | UMLS Metathesaurus and Semantic Network | NLM reference manual |
| 4/10 | Biomedical ontologies for data integration | Olivier Bodenreider's papers |
| 4/15 | Biomedical ontologies for named entity<br>recognition and information extraction. | NLM MetaMap JAMIA paper,<br>MetaMap reference paper |
| 4/17 | Biomedical ontologies for semantic similarity<br>and word sense disambiguation | Pedersen et al tutorial |
| 4/22 | Biomedical ontologies for decision support | Custom slides<br>Final project reports and<br>presentation slides due |
| 4/24 | Project presentations and Demos - 1 | Instructions: through adobe<br>connect |
| 4/29 | Project presentations and Demos - 2 | Instructions: through adobe<br>connect |
| 5/1 | Review sessions and questions before final | Final exam question paper<br>provided through Black Board<br>by Thursday 11:59 PM of the<br>week before finals week. |
| 5/6 | Final examination due 11:59 PM through<br>Blackboard | Instructions: take home |