COURSE DESCRIPTION CARD - SYLLABUS

Course name
Medical informatics [N1Inf1>IWM]

Course

Field of study
Computing

Year/Semester
3/6

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
part-time

Requirements
elective

Number of hours

Lecture
16

Laboratory classes
16

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

dr hab. inż. Szymon Wilk prof. PP
szymon.wilk@put.poznan.pl

Lecturers

Prerequisites

The student starting this course should have basic knowledge in information system architectures, databases, statistics and data analysis, artificial intelligence and physics. The student should be able to design and implement (using selected tools and programming languages) simple information systems. They should also have the ability to obtain information from the indicated sources, as well as understand the need to expand their competences. The student must present attitudes such as honesty, responsibility, perseverance, cognitive curiosity, creativity, personal culture, and respect for other people.

Course objective

1. Provide students with basic knowledge in medical informatics, mainly related to medical data and methods of their acquisition (diagnostic devices), coding, standardization, storage (information systems), sharing, analysis (decision support) and presentation. 2. Present students with sample systems and programming tools used in medical informatics. 3. Develop students' skills in designing and implementing software created for the needs of applications related to the broadly understood health protection. 4. Develop students' ability to independently search and obtain information related to the design of IT solutions for medicine.

Course-related learning outcomes

Knowledge:
1. The student has organized and theoretically founded general knowledge on key issues of medical informatics.
2. The student has knowledge of important directions of development and achievements of medical informatics and other related scientific disciplines.
3. The student knows the basic techniques, methods and tools used in the process of solving tasks in medical informatics.

Skills:
1. The student can obtain information related to medical informatics from various sources (publications, Internet resources), and properly integrate and interpret it.
2. The student is able to select appropriate methods, including simulation or experimental ones, when when formulating and solving tasks in medical informatics.
3. The student is able - following the provided specification - to design and implement a broadly understood medical information system, by selecting programming language appropriate to a given task and using suitable methods, techniques and tools.

Social competences:
1. The student understands that in medical informatics knowledge and skills very quickly become outdated.
2. The student is aware of the importance of knowledge in solving problems in medical informatics and knows examples of malfunctioning medical systems or devices.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

The knowledge acquired during the lecture is verified by a 45-minute test carried out during the last lecture, consisting of 10-15 questions (test and open), with diversified scores. Passing threshold: 50% of the total score. Topics, based on which the questions are developed, will be sent to students by electronically (by the university email or the eKursy system).

The skills acquired during the laboratory classes are verified through 3 projects with programming and experimental elements, implemented during the semester. The final grade is the average score for individual projects.

Programme content

The first part of the lecture is dedicated to the introduction and presentation of types of medical data, their sources, and specifics. We discuss integrated hospital information systems and important medical standards used for coding and transmitting non-imaging data, including HL7, SNOMED CT, LOINC, MeSH, and ICD.

In the second part of the course, we demonstrate selected medical devices for laboratory, signal, and imaging diagnostics. The first category includes devices performing selected types of laboratory tests, as well as Laboratory Information Systems (LIS) that integrate laboratory diagnostic devices. The second category comprises diagnostic devices generating multidimensional time series (EEG, EKG). The third group includes imaging diagnostic devices, both transmission and emission types, used in X-ray diagnostics (RTG), computed tomography (CT), and magnetic resonance imaging (MRI). The discussion of diagnostic devices is complemented by the presentation of related standards and IT solutions, including Picture Archiving and Communication Systems (PACS), Radiology Information Systems (RIS), and the DICOM standard (Digital Imaging and Communication in Medicine).

The third part of the lecture is dedicated to the application of advanced data analysis techniques in medicine, including artificial intelligence, machine learning, and knowledge discovery methods. We present examples of clinical decision support systems, including mobile systems, as well as IT solutions for efficient information retrieval supporting the paradigm of evidence-based medicine.

Course topics

Tentative plan of lectures:

- medical informatics - introduction; characteristics of medical data,
- hospital information systems,
- HL7, SNOMED CT, LOINC, ICD, MeSH standards,
- diagnostic devices - introduction and laboratory diagnostics,
- signal diagnostics: EEG, ECG,
- diagnostic imaging: X-ray. CT, MRI, fMRI,
- DICOM standard; PACS and RIS,
- supporting clinical decisions with the use of artificial intelligence and machine learning techniques (expert and learning systems),
- searching for information in clinical repositories,
- telemedicine and telemonitoring.

Tentative plan of laboratories:

The list of currently proposed projects includes a CT simulator, a system for segmenting fundus images and a system for viewing, visualizing and editing electronic patient documentation using the FHIR standard. This list is updated before the beginning of the semester according to the current state of the art in medical informatics. Students have 7 weeks to complete each project. Progress is checked during the classes. The preparation of each project ends with a short presentation on the group forum, preparation of a short report describing the solution (for selected projects) and handing over the source code to the instructor.

Teaching methods

1. Lecture: multimedia presentation augmented with additional examples given on the whiteboard.
2. Laboratory exercises: preparation of small IT projects in groups of two or individually, multimedia presentation, demonstration.

Bibliography

Basic
1. E.H. Shortliffe, J.J. Cimino (eds): Biomedical Informatics: Computer applications in Health Care and Biomedicine. Springer, 2014.
2. R. Tadeusiewicz: Informatyka medyczna. Wydawnictwo UMCS, 2011 (free e-book: http://otworzksiazke.pl/ksiazka/informatyka_medyczna/).

Extra
1. R. Rudowski (ed.): Informatyka medyczna. Wydawnictwo Naukowe PWN, 2012.
2. E. Piętka: Zintegrowany system informacyjny w pracy szpitala. Wydawnictwo Naukowe PWN, 2004.
3. A. Winter, R. Haux, E. Ammenwerth, B. Brigl. N. Hellrung, F. Jahn: Health Information Systems. Architectures and Strategies. Springer 2011
4. T. Benson: Principles of Health Interoperability. HL7 and SNOMED. Springer, 2012.
5. R. Greenes (ed.): Clinical Decision Support: The Road to Broader Adoption. Elsevier, 2014.
6. W. Hersh: Information Retrieval: A Health and Biomedical Perspective. Springer 2009.
7. Sz. Wilk, W. Michalowski, D. O'Sullivan, K. Farion, J. Sayyad-Shirabad, C. Kuziemsky, B. Kukawka: A Task-based Support Architecture for Developing Point-of-care Clinical Decision Support Systems for the Emergency Department. Methods of Information in Medicine, vol. 52, no. 1, 2013, 18-32.
8. P. Liskowski, K. Krawiec: Segmenting Retinal Blood Vessels with Deep Neural Networks. IEEE Transactions on Medical Imaging, vol. 35, no. 11, 2016, 2369-2380.

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,00
Classes requiring direct contact with the teacher	32	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	43	1,50