COURSE DESCRIPTION CARD - SYLLABUS

Course name
Medical Informatics [S2Bioinf1>IwM]

Course

Field of study
Bioinformatics

Year/Semester
1/2

Area of study (specialization)
–

Profile of study
general academic

Level of study
second-cycle

Course offered in
polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
15

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

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Lecturers

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Prerequisites

The student starting this course should have basic knowledge in information system architectures, statistics and data analysis, artificial intelligence, physics and biomedicine. 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 knows the basic techniques, methods and tools used in the process of solving complex tasks in bioinformatics, especially in the field of medical informatics.
2. The student knows and understands the main trends in the development of medical informatics, in particular in diagnostic techniques and digitization of processes in health care.
3. The student knows the social, economic and legal circumstances of activity in medical informatics, and the need to take them into account in practice, including issues related to the protection of intellectual and industrial property.

Skills:
1. The student is able to use specialized techniques and IT tools, in particular methods of data analysis, data mining, and basic image analysis techniques to describe processes and analyze biological data.
2. The student is able to assess the usefulness and opportunities for using new developments in the field of medical informatics in research and clinical practice.

Social competences:
1. The student is ready to cooperate and work in a group, taking various roles in it.
2. The student is ready to identify and resolve ethical dilemmas related to working in IT positions in medical care.
3. The student is ready to systematically update his knowledge in the field of medical informatics and identify the opportunities of its practical application.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

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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 university e-mail.
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 devoted to the introduction and presentation of types of medical data, their sources and specificity. We also discuss integrated hospital information systems (HIS) and the more important medical standards used for encoding and transmitting non-image data, including HL7, SNOMED CT, LOINC, MeSH, and ICD, are discussed.
In the second part of the course, we present selected medical devices for laboratory, signal and imaging diagnostics. Within the first category we present devices for selected types of laboratory tests, as well as laboratory information systems (LIS) integrating laboratory diagnostic devices. The second category includes diagnostic devices generating multidimensional waveforms (EEG, ECG). We devote the most time to imaging diagnostic devices, both transmission and emission ones, including traditional X-ray diagnostics, computed tomography (CT) and nuclear magnetic resonance (MRI). We pay particular attention to modern techniques of functional imaging, especially fMRI or Doppler imaging (e.g., in combination with ultrasound or optical coherence tomography). Presentation of diagnostic devices is supplemented by a discussion of selected aspects of the processing and analysis of diagnostic data,

algorithms used in these processes and the presentation of related standards and IT solutions, including picture archiving and communication systems (PACS), radiology information systems (RIS), and the DICOM (Digital Imaging and Communication in Medicine) standard.
The third part of the lecture is devoted to the application of advanced data analysis techniques in medicine, including artificial intelligence, machine learning and knowledge discovery. We present examples of clinical decision support systems, including mobile ones, as well as IT solutions for effective information retrieval, supporting the paradigm of evidence-based medicine.
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.
During the laboratory sessions, students individually or in groups of two conduct projects related to medical IT. The projects are practical and include design, implementation and testing of simple systems implementing the indicated functionality. 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. Progress is checked during the classes. Projects end 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 (red.): Biomedical Informatics: Computer applications in Health Care and Biomedicine. Springer, 2014.
2. R. Tadeusiewicz: Informatyka medyczna. Wydawnictwo UMCS, 2011 (darmowy e-book: http://otworzksiazke.pl/ksiazka/informatyka_medyczna/).
Additional
1. R. Rudowski (red.): 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 (red.): Clinical Decision Support: The Road to Broader Adoption. Elsevier, 2014.
6. W. Hersh: Information Retrieval: A Health and Biomedical Perspective. Springer 2009.

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,00
Classes requiring direct contact with the teacher	45	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	30	1,00