

Study Handbook



Study Program: Magister Ilmu Komputer (M.Sc. in Computer Science)
Faculty of Computer Science
Universitas Indonesia



2020 Edition

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1 Introduction

The Magister Ilmu Komputer (MIK) is a graduate research program opened in 1988, and is designed to produce research-oriented graduates in the field of computing, following on from the undergraduate education in computer science or related fields. Academic activities are carried out at the Depok campus of the Faculty of Computer Science, Universitas Indonesia (CS UI).

The MIK program emphasises the strong links between postgraduate education and research activities. Students are expected to be actively involved in the various research labs at the Faculty of Computer Science, Universitas Indonesia. The curriculum has been designed to provide students with the opportunity to deepen their understanding and also carry out significant research into the latest developments in the broad field of computing, including computer science, information systems, software engineering, etc.

The MIK program aims to produce experts in the field of computing who:

1. Possess integrity of character,
2. Upholds the ethics and code of conduct in academia and research,
3. Keeps abreast of the state of the art in the field of computing,
4. Able to apply their know-how and skills to solve real-world problems,
5. Able to make scientific contributions to the field of computing.

2 Admission Criteria

To be admitted to the Magister Ilmu Komputer (MIK) program, candidates must satisfy the following academic and administrative requirements:

2.1 Academic Requirements

- The candidate must already hold an undergraduate degree (S1) in the area of computer science, informatics, computer engineering, electrical engineering, mathematics, physics, or other fields related to computation.
- The candidate must have obtained a minimum GPA (or Indeks Prestasi Kumulatif / IPK) of no less than 3.00 (on a scale of 4.0).
- The candidate must successfully pass the entrance exam held by Universitas Indonesia, which consists of Academic Aptitude and English.

2.2 Administrative Requirements

The candidate must follow all registration steps and fulfill all requirements as stated in UI regulations. All detailed information and online registration forms can be obtained from <http://penerimaan.ui.ac.id>.

3 Curriculum

The Magister Ilmu Komputer program curriculum, henceforth simply the curriculum, is designed to provide students with the opportunity to deepen their understanding and also carry out significant research into the latest developments in the broad field of computing, including computer science, information systems, software engineering, etc.

In 2018, a significant curriculum revision was carried out. This section will describe the structure of the revised curriculum.

A summary of the curriculum can be seen in Table 1.

Subject Type	SKS	Percentage
Compulsory	8	20%
Basic Electives	10	25%
Advanced Electives	12	30%
Thesis (including proposal)	10	25%
Total	40	100%

Tabel 1. Summary of 2018 Curriculum

3.1 Compulsory Subjects

A list of the compulsory subjects can be seen in Table 2. Compulsory subjects are offered each semester.

Code	Subjects	SKS
CSCM801091	Research Methodology	4
CSCM801092	Independent Study	2
CSCM801093	Scientific Publication	2

Tabel 2. Detail of Compulsory Subjects

3.2 Basic Electives Courses

The MIK 2018 curriculum offers 7 (seven) different areas of specializations, i.e.:

1. Architecture & Infrastructure/Cloud Computing (related research lab: Computer Networks, Architecture & High-Performance Computing)
2. Computational Intelligence/Artificial Intelligence (related research lab: Machine Learning and Computer Vision)
3. Software Technology (related research lab: Reliable Software Engineering)
4. Large Scale Information Processing/Data Science(related research lab: Information Retrieval, Digital Libraries & Distance Learning, Computer Networks, Architecture & High-Performance Computing)
5. IS/IT Management/ IS/IT Governance(related research lab: Information Management, E-Gov & E Bussiness)
6. Enterprise Solution/ E-business (related research lab: Information Management, E-Gov & E Bussiness)
7. Information Security/Cyber Security (related research lab: Reliable Software Engineering, Computer Networks, Architecture & High-Performance Computing)

Elective subjects in the curriculum consist of:

- **Basic Elective Subjects** – which are designed to provide students with a strong theoretical foundation in their chosen topics of interest in computer science and information systems –
- **Advanced Elective Subjects** – which expose students to the latest developments and state-of-the-art in various research areas.

Basic elective subjects are shared with upper level electives in the undergraduate (or Sarjana) programs at UI, both in computer science and information systems, and are chosen due to their relevance and appropriateness to serve as foundations for studying the various research topics that are the focus of the various research labs at CS UI. On the other hand, advanced elective subjects are specifically designed for the postgraduate program, and the learning modality is typically more open-ended, with more discussion sessions and presentations of the latest work, e.g. conference and journal papers.

Students must take at least 10 SKS of basic elective subjects and 12 SKS of advanced elective subjects. From these, at least 6 SKS of basic elective subjects must belong to the same specialization, and at least 8 SKS of the advanced elective subjects must belong to that same specialization as well.

Tabel 3. Basic Electives Course List

Code	Course Name (Indonesian, English)		SKS	Architecture & Cloud Computing	Software Technology	Data Science	Artificial Intelligence	IS/IT Governance	Cyber Security	E-business
CSCE604129	Pemrograman Paralel	Parallel Programming	4	•	•	•	•			
CSCE604130	Bioinformatika	Bioinformatics	3				•			
CSCE604133	Pengolahan Citra	Image Processing	3			•	•			
CSCE604151	Embedded Systems	Embedded Systems	3	•						
CSCE604174	Basis Data Lanjut	Advanced Database	3	•	•			•		•
CSCE604210	Teori Informasi	Information Theory	3			•	•			
CSCE604212	Persamaan Diferensial	Differential Equation	3				•			
CSCE604228	Teknik Kompilator	Compiler Techniques	4	•	•					
CSCE604235	Pemelajaran Mesin	Machine Learning	3			•	•			
CSCE604231	Pengolahan Bahasa Manusia	Natural Language Processing	3			•	•			
CSCM604142	Desain & Analisis Algoritma	Analysis and Algorithm Design	4		•	•	•			
CSCE604241	Grafika Komputer	Computer Graphics	3		•					
CSCE604243	Kriptografi & Keamanan Informasi	Cryptography and Information Security	4	•	•				•	
CSCE604150	Organisasi Sistem Komputer	Computer System Organization	3	•					•	
CSCE604271	Layanan & Aplikasi Web	Web Services and Application	3	•	•	•			•	
CSCE604111	Simulasi & Pemodelan	Modelling and Simulation	3	•			•			
CSCE604113	Aproksimasi Sistem Nonlinier	Non-linear System Approximation	3				•			
CSCE604126	Penjaminan Mutu Perangkat Lunak	Software Quality Assurance	4		•					
CSCE604132	Komputasi Lunak	Soft Computing	3				•			
CSCE604135	Perolehan Informasi	Information Retrieval	3			•				
CSCE604131	Semantic Web	Semantic Web	3		•	•	•			
CSCE604144	Logika Komputasional	Computational Logics	3		•		•			
CSCE604152	Pengolahan Sinyal Dijital	Digital Signal Processing	3	•		•				
CSCE604154	Sistem Terdistribusi	Distributed Systems	3	•						
CSCE604184	Sistem Informasi Geografis	Geography Information Systems	3		•	•				
CSCE604225	Metode Formal	Formal Methods	4		•					
CSCE604233	Data Mining	Data Mining	3		•	•	•			
CSCE604134	Pengolahan Multimedia	Multimedia Processing	3			•				
CSCE604232	Robotika	Robotics	3	•			•			
CSCE604253	Rancangan Sistem Dijital	Digital System Design	3	•						
CSIE604276	Manajemen Infrastruktur	Infrastructure Management	3	•				•	•	
CSIE604163	Customer Relationship Management	Customer Relationship Management	3							•

Code	Course Name (Indonesian, English)		SKS	Architecture & Cloud Computing	Software Technology	Data Science	Artificial Intelligence	IS/IT Governance	Cyber Security	E-business
CSIE604278	Manajemen Layanan TI	IT Service Management	3					•		
CSIM603189	Manajemen Proyek TI	IT Project Management	3					•		
CSCE604179	Teknologi Mobile	Mobile Technology	3	•	•				•	
CSIE604180	Knowledge Management	Knowledge Management	3			•		•		•
CSIE604181	Dasar-Dasar Audit SI	Fundamental of IS Audits	3						•	
CSIM604182	Manajemen Sistem Informasi	IS Management	3					•		•
CSIE604161	E-health	E-health	3							•
CSIE604160	E-commerce	E-commerce	3							•

Tabel 4. Advanced Course

Code	Course name (Indonesia, English)		SKS	Architecture & Cloud Computing	Software Technology	Data Science	Artificial Intelligence	IS/IT Governance	Cyber Security	E-business
CSCE802231	Pengolahan Citra Lanjut	Advanced Image Processing	4			•	•			
CSCE802121	Verifikasi Perangkat Lunak Lanjut	Advanced Software Verification	4		•					
CSCE802222	Komputasi Paralel Lanjut	Advanced Parallel Computing	4	•		•				
CSCE802232	Kecerdasan Buatan Lanjut	Advanced Artificial Intelligence	4				•			
CSCE802133	Pemelajaran Mesin Lanjut	Advanced Machine Learning	4			•	•			
CSCE802141	Teori Komputasi Lanjut	Advanced Computational Theory	4		•					
CSCE802242	Logika Komputasional Lanjut	Advanced Computational Logic	4		•					
CSCE802134	Robotika Lanjut	Advanced Robotics	4	•			•			
CSCE802251	Jaringan Komputer Lanjut	Advanced Computer Network	4	•		•			•	
CSCE802171	Infrastruktur TI Lanjut	Advanced IT Infrastructure	4	•				•	•	
CSCE802262	CRM Lanjut	Advanced CRM	4							•
CSCE802181	Manajemen Pengetahuan Lanjut	Advanced Knowledge Management	4					•		•
CSCE802111	Komputasi Numerik Lanjut	Advanced Numeric Computing	4				•			
CSCE802123	Rekayasa Perangkat Lunak Lanjut	Advanced Software Engineering	4		•					
CSCE802235	Jejaring Semantik Lanjut	Advanced Semantic Web	4		•	•				
CSCE802172	Layanan TI Lanjut	Advanced IT Services	4	•				•		
CSCE802236	Perolehan Informasi Lanjut	Advanced Information Retrieval	4			•	•			
CSCE802237	Informatika Biomedis Lanjut	Advanced Biomedical Informatics	4			•	•			

Code	Course name (Indonesia, English)	SKS	Architecture & Cloud Computing	Software Technology	Data Science	Artificial Intelligence	IS/IT Governance	Cyber Security	E-business
CSCE802138	Analisis Data Spasial Lanjut	Advanced Data Spasial Analysis	4			•			
CSCE802143	Grafika Komputer Lanjut	Advanced Computer Graphics	4	•					
CSCE802144	Keamanan Informasi Lanjut	Advanced Information Security	4	•	•			•	
CSCE802152	Rancangan Sistem Dijital Lanjut	Advanced Digital System Design	4	•					
CSCE802245	Forensik Digital	Digital Forensics	4		•			•	
CSCE802147	Kriptografi Lanjut	Advanced Cryptography	4			•		•	
CSCE802246	Keamanan Jaringan dan Mobile	Network and Mobile Security	4	•				•	
CSCE802273	Teknologi Basis Data Lanjut	Advanced Database Technology	4		•		•		•
CSCE802124	Manajemen Proyek Lanjut	Advanced Project Management	4				•		
CSCE802282	Sistem Informasi Lanjut	Advanced information System	4				•		•
CSCE802264	E-Commerce Lanjut	Advanced E-Commerce	4						•
CSCE802265	E-Health Lanjut	Advanced E-Health	4						•
CSCE802099	Kapita selekta	<i>Capita selecta</i>	4						

Subjects with a code prefix of CSCE8021 may be offered during odd semesters, whereas subjects with a code prefix of CSCE8021 may be offered during even semesters. Subject offerings are made based on student interest and teaching capacity of the faculty.

3.3 Independent Study (Studi Mandiri) and Scientific Publication

Students should take Independent Study (Studi Mandiri) and Publication subject NOT earlier than 2nd semester. Those subject will prepare the students to deepen their interest in the area of computer science under guidance and supervision of a PhD holder lecture in the area or M.Sc holder with more than 5 years experiences. Note that the supervisor of Independent Study, Scientific Publication, Thesis Proposal, and Thesis SHOULD be the same. The minimum deliverable of independent study is an accepted publication (national/international journal article /conference paper). The grade is given by the supervisor based on the quality of the publication. Minimum passing grade is B.

Independent Study can be:

1. Literature study of their thesis/proposal topic based on books and papers.
2. Continuation of the previous works within the laboratory (inline with the Thesis' topic and under the same supervision). Students can do some research works (experiment) and write journal article or conference paper based on their works.

Scientific Publication can be publish in:

1. National Journal
2. International Conference

3.4 Thesis

One requirement for graduation from the MIK program is that students must carry out a significant research activity and produce a report in the form of a Thesis. The Thesis is a structured academic activity carried out by a student under the guidance of a thesis supervisor and must be a sufficiently thorough research activity concerning the area of computer science and/or information systems. Thesis topics will typically be related to the research interests of a faculty member.

In the 2018 MIK curriculum, the successful completion of a thesis entails passing two separate subjects, as shown in Table 5.

Code	Subject	SKS
CSCM802098	Thesis Proposal	2
CSCM802099	Thesis	8

Tabel 5. Stages of Thesis completion

CSCM802098 - Thesis Proposal (2 SKS): during the initial stages of writing a Thesis, students must first state their research plan in a proposal document, which must at least contain a description of the problem to be addressed, the objective and scope of the research, an overall workplan, and a suggestion of the evaluation technique. This proposal must be defended during an examination by a panel which includes the thesis supervisor and at least 2 (two) faculty members whose expertise is relevant to the topic. Students who are considered to not yet have an appropriate thesis proposal may apply for another defense until they eventually pass. There should be at least 3 (three) weeks before the preceding defense.

CSCM802099 - Thesis (8 SKS): students who have had their thesis proposals approved may proceed to work on their research in accordance to what was described in the proposal. After completing their thesis, and having obtained approval from their supervisor, a student must undergo a thesis defense with an examination panel of at least 3 (three) faculty members whose expertise is relevant to the topic, at least 1 (one) of whom served on the thesis proposal defense panel. The thesis supervisor does not become a

member of the examination panel, but may be present during the examination as an observer. The grade of a thesis, worth 8 SKS, is a combination of the following two aspects:

- An assessment made by the thesis supervisor on the performance of the student throughout the period of working on the thesis, which must be submitted to the academic secretariat before the thesis defense is held, and
- An assessment made by the examination panel of the quality and impact of the thesis work, which is submitted to the academic secretariat immediately after the thesis defense is concluded.

CSCM802098 and **CSCM802099** are not to be taken in the same semester.

3.4.1 Requirements

1. In order to be allowed to take the *Thesis Proposal* subject, students must submit a copy of a *Thesis Supervision Approval form* that has been signed by the supervisor.
2. In order to be allowed to take the *Thesis* subject, students must have passed **Research Methodology and Scientific Writing, Independent Study and Publication** and **Thesis Proposal**, and must have obtained a minimum of **28 SKS**, with an average GPA of at least **3.00**.

3.4.2 Thesis Activity and Assessment

1. The thesis research is conducted under the guidance of the thesis advisor. Each Student must produce a log that keeps track of all the scheduled meetings between the student and the thesis advisor. This control sheet can be obtained from the academic secretariat of the program.
2. A thesis advisor must have a Doctorate degree, or at least a Masters degree with a minimum of five years teaching experience, and a comprehensive understanding of the thesis topic concerned.
3. A thesis may be advised by one or two thesis advisors. The final deliverable of the thesis is a thesis document.
4. The format of the thesis document must follow the standard rules laid out by UI, which can be obtained from the library.
5. After the thesis is submitted to the academic secretariat, a thesis defense is scheduled, which consists of an oral presentation by the student and is followed by a defense of the thesis in front of a thesis committee.
6. In order to be allowed to take a Thesis Defense, students must have had passed Independent Study and Publication with the status of publication is Accepted.
7. The thesis defense is open to audience to attend. The chair of the thesis committee administers the defense process.
8. The thesis committee consists of the thesis advisor(s) and at least 3 (three) examiners.
9. The minimum passing grade for the thesis is B.

Selected thesis can be included into the Journal of Computer Science and Information Technology, published by the Faculty of Computer Science, Universitas Indonesia. Students (under the guidance of their thesis advisors) are expected to summarize their thesis into a paper by observing the rules and guidelines of the journal.

3.5 Matriculation

There are 4 (four) subjects that are considered to form the foundations of the field of study of the Magister Ilmu Komputer program, i.e. Discrete Mathematics 1, Data Structures & Algorithms, Operating Systems, and Database. If students enrolling into the program are deemed not to have a sufficient background in any of these areas, they may be required to take these subjects as matriculation subjects. Matriculation subjects are not considered part of the main curriculum, and are given a weight of 0 SKS in the academic transcript, as they do not affect the GPA of a student. The MIK course organizers will determine the number of matriculation subjects a student must take, if any, based on their results on a *placement test* conducted shortly after a student is first admitted to the program. The minimum passing grade of matriculation subjects is B.

Subjects	SKS
Discrete Mathematics 1	3 (counted as 0)
Data Structures & Algorithms	4 (counted as 0)
Operating Systems	4 (counted as 0)
Database	4 (counted as 0)

Tabel 6. List of matriculation subjects

3.6 Recommended Study Plan

This is a recommended study plan for the 2018 curriculum, to be completed in 4 (four) semesters:

Kode	MATA KULIAH	SKS
SEMESTER 1		
CSCM801091	Research Methodology	4
(elective)	Basic elective 1	3
(elective)	Basic elective 2	3
Total SKS semester 1		10
SEMESTER 2		
(elective)	Basic elective 3	4
CSCM801092	Independent Study	2
CSCM801093	Scientific Publication	2
(elective)	Advanced elective 1	4
Total SKS semester 2		12
SEMESTER 3		
CSCM802098	Thesis Proposal	2
(elective)	Advanced Elective 2	4
(elective)	Advanced Elective 3	4
Total SKS semester 3		10
SEMESTER 4		
CSCM802099	Thesis	8
Total SKS semester 4		8

The curriculum may also be completed in fewer than four semesters, by taking more subjects each semester. The maximum number of subjects that can be taken is determined by UI regulations, based on the academic performance of a student.

3.7 Transition Rules for Existing Students

The 2018 curriculum applies to existing students. The different with the previous curriculum is minor, only on the new modification in compulsory subject of Independent Study, i.e. Independent Study and Publication. Students who enrolled **before** the Odd semester of academic year 2017/18 can still follow the previous curriculum structure. The compulsory subject of independent study and publication can be replaced by one of the advanced elective.

3.8 Credit Transfer

For compulsory and basic electives, students who have previously passed subjects that are considered equivalent can apply to transfer the credits, which would (1) exempt them from taking the MIK subjects, and (2) count towards the credits achieved. When applying, students must submit all relevant documentation, i.e. copies of academic transcripts, course descriptions, syllabi, sample exams, etc. The MIK course organizers will assess whether the subject is eligible to be transferred or not, based on the following rules:

1. The subject to be transferred teaches the same matter and competencies as the corresponding subject in the MIK curriculum.
2. The subject to be transferred was taken within the last 5 (five) years.
3. The subject to be transferred was successfully passed with a minimum grade of B.
4. The subject to be transferred was taken at a study program that was held by a reputable institution. If at an Indonesian institution, the study program must have been accredited by the national accreditation board (BAN-PT) with a minimum grade of A.
5. The MIK course organizer reserves the right to impose any additional requirements to determine eligibility of credit transfer.

4 Academic Guidelines

4.1 Assessment

The credit units used at UI are Satuan Kredit Semester (semester credit unit), or SKS, which has the following guidelines:

1. The meaning of 1 (one) SKS roughly corresponds to 150 minutes/week, consisting of a combination of lecture session, structured study (e.g. lab session), or independent study and Publication. A four 4 SKS course will typically constitute 4 x 50 minute lectures per week for 14-16 weeks.
2. The final mark of a subject will be determined by the lecturer based on various marking components, including assignments, quizzes, midterms (UTS) or final exams (UAS). The weighting of each component is determined by the lecturer.
3. Midterm exams (UTS) are usually held after 7 (seven) full weeks of the semester, and final exams (UAS) are given at the end of the semester, i.e. after 14 (fourteen) weeks. Weighting of the exam grades and other assignments determined by the lecturer concerned.
4. Final grades are given in the form of letter marks, i.e. E,D,C,C+,B-,B,B+,A-, and A. The Grade Point Average (GPA), or *Indeks Prestasi Kumulatif* (IPK), is an aggregate measure of academic achievement across all subjects. IPK follows a scale of 0 (lowest) to 4 (highest), and the conversion from grades to IPK score uses the following table:

Grade (letter)	Score/weight
A	4.0
A-	3.7
B+	3.3
B	3.0
B-	2.7
C+	2.3
C	2.0
D	1.0
E	0.0

4.2 Academic Honesty and Code of Conduct

1. According to UI rule no.1/1996 dated 30 December 1996 concerning the Code of Regulations of Academic Life at UI, specifically Article 4 concerning Code of Conduct, all students must be honest in following the education process, research, writing publications, and other academic activities, and uphold the rules in carrying out any activity that is associated with the university in general.
2. Dishonesty that is not allowed includes, but is not limited to: plagiarism, unauthorized distribution of exam papers, forgery of exam and/or publication works, cheating, providing false information or data, etc.
3. The Dean of CS UI will take disciplinary action in the form of either warnings, admonishment, punishment, probation, suspension, or expulsion based on the severity and frequency of dishonesty cases.

4. Students are provided a mechanism for appealing any such decision to be reviewed.

4.3 Study Evaluation

4.3.1 Semester Evaluation (drop-out criteria)

The maximum study duration for the MIK program is 6 (six) semesters, excluding academic leave semesters. Academic achievement will be evaluated under the following rules (in accordance with UI Rector Decree No. 015/SK/R/UI/2016):

1. If after the end of the first 2 (two) semesters the IPK of a student does not reach a minimum of 3.00 from 14-18 SKS, the student is unable to continue (**drop-out**).
2. If after the end of 6 (six) semesters the IPK of a student does not reach a minimum of 3.00, or the student has not completed the curriculum requirements, and by additional requirement mentioned in UI Rector Decree, the student is unable to continue (**drop-out**).
3. If after two consecutive semesters, a student is not registered, that student is unable to continue (**drop-out**).

4.3.2 Degree Completion

After a student has obtained 40 SKS and completed all the curriculum requirements and UI requirements as mentioned in UI Rector Decree No. 015/SK/R/UI/2016, the student is eligible to obtain the degree of *Magister Ilmu Komputer (M.Kom)*.

4.3.3 Graduation Evaluation

Upon graduation, students achieve one of the following graduation predicates:

- **Cum Laude**, when IPK exceeds 3.70 and the study duration is no longer than 4 (four) semesters. If the study duration exceeds 4 (four) semesters, the graduation predicate is **Very Satisfactory**.
- **Very Satisfactory**, when IPK is between 3.41 and 3.70
- **Satisfactory**, when IPK is between 3.00 and 3.40

5 Description of Basic Electives

Parallel Programming

This course covers the theory of concurrency and parallelism, the history of high-performance machines, and how to utilize high-performance computing facilities such as computing on Clusters and GPUs. Students will be taught theories about parallel programming paradigms, SIMD and MIMD machine concepts, as well as issues such as shared memory, mutual exclusion, and semaphores, and are also equipped with practical knowledge of the latest standards such as Open MP, CUDA, etc. Topics of this course including (1) Introduction of high-performance and distributed computing: what is (Distributed and High-Performance Computing) DHPC, DHPC history, application & application of DHPC. (2) HPC Architecture: types of HPC architecture and their development; MIMD machine; cluster-based computing and Beowulf PC cluster; (3) Parallel programming models, parameterization, performance analysis, efficiency, benchmarking HPC systems, programming on parallel computers, parallel languages, parallelize compilers, message passing and parallel data programming; (4) Parallel data programming paradigms, 151 background, and SIMD machine usage, array syntax, Fortran 90 and HPF, shared-memory programming, threads, and Open MP; (5) use of shared memory machines, mutual exclusion, locks, semaphores and monitors, parallel Java, programming using Open MP; (6) cluster computing, message passing programming and MPI; (7) History and use of MIMD machines, programming with MPI, distributed computing middleware's; General Purpose on GPU (Graphical Processing Unit) Computing: Cuda, OpenCL; General Purpose on GPU (Graphical Processing Unit) Computing: Cuda, OpenCL; Introduction to Grid Computing; Introduction to Cloud Computing.

- Vladimir Silva, Grid Computing for Developers, Charles River Media, Inc, ISBN: 1-58450-424-2, year 2006;
- David B Kirk, Wen-mei W. Hwu, Programming Massively Parallel Processors, Morgan Kaufmann, 2010
- Cluster computing international conference proceeding, <http://www.buyya.com/clustercomp/>
- Cluster computing information center, <http://www.gridbus.org/~raj/cluster/>
- Grid Info Ware, <http://www.gridcomputing.com/>
- <http://www.singlehop.com/cloud/>
- Cloud Computing Journal, <http://cloudcomputing.sys-con.com/>
- GPGPU.ORG, <http://gpgpu.org/>
- OpenCL, <http://www.khronos.org/opencv/>,
- Thomas Rauber dan Gudula Runger, Parallel Programming for Multicore and Cluster Systems, Springer, 2010, ISBN 978-3-642-04817-3

Bioinformatics

This course introduces the participants to the resources needed to apply various approaches to artificial intelligence to produce information on biological applications such as gene function, protein structure, and molecular evolution. Participants will be taught methods for mining as well as data analysis for sequence matching, searching for similarities, phylogenetic analysis, gene search, and protein structure prediction. Topics of this course including Introduction to Biological Molecular; Sequence Similarity (pairwise alignment, multiple sequence alignment, evolutionary model, hidden Markov model, motif/domain prediction, gene finding); Molecular Phylogenetics; Structural Bioinformatics (secondary protein structure prediction, tertiary protein structure prediction, dan RNA structure prediction); Genomics dan Proteomics (genome annotation, GO ontology/protein classification, protein-protein interaction)

- N. Cristianini and M.W Hahn. 2006. Introduction to Computational Genomics: A Case Study Approach. Cambridge Press
- P. Pevzner. (2000). Computational Molecular Biology - an Algorithmic Approach. MIT Press 107
- P. Baldi and S. Brunak. (2001). Bioinformatics: The Machine Learning Approach. MIT Press

Image Processing

This course discusses data processing methodology in the form of 2D images and basic concepts of pattern recognition, which can be applied in various fields such as remote sensing, medical diagnosis, document

processing, robotics, etc. Topics to be discussed include the basic concepts of a digital image, image transformation, quality improvement and restoration, color transformation, morphology, compression, segmentation, feature extraction and selection, clustering, image classification, performance evaluation, intelligent multimedia information processing, soft computing, and self-taught learning. Students will be trained with programming assignments using C ++, Java, or Matlab, both individually and in groups. Topics of this course including: Introduction to Digital Image Processing: The relation between Image Processing, Computer Graphics, Pattern Recognition/Computer Vision/Artificial Intelligence fields, Various digital image processing applications; Image Processing Methodology: Fundamental steps in Image Processing, Components of Image Processing System; Human Visual System: Human visual system and camera system model, Data acquisition, World to image system transformation, Radiometric and Geometric; Spatial-domain Image Enhancement: Point Processing, Mask Processing, Low and high pass filtering, linear and non-linear filtering, and edge detection; introduction to MATLAB; Image transformation: Image transformation concept, Fourier, Hadamard-Walsh, Discrete Cosine and Wavelet transform; Frequency-domain Image Enhancement: Spatial to frequency domain image transformation, Low pass filtering and high pass filtering, Correlation and convolution; Color transformation: RGB, CMY, HSI, YUV, YIQ color model, Intensity and bit slicing, image smoothing and sharpening; Image Restoration: Noise model, Data and information fusion; Image Compression: Relative data redundancy, coding redundancy, interpixel redundancy, psychovisual redundancy, and image compression model, Elements of information theory, lossy and error-free compression, and Karhunen-Loeve transformation; Morphological Image Processing: Dilation and erosion process, Open and close process, Watershed transform; Image Segmentation: Top-down and bottom-up approach, edge and region-based segmentation, Thresholding, region growing, split and merge; Feature extraction and selection: Color, texture, shape features, Feature selection, feature fusion and normalization, and quality measures; Clustering and Classification: Unsupervised and supervised classifier, Statistical classifier and Soft computing, and performance evaluation; Advanced Topics: Intelligent Multimedia Information Processing, Ensemble Classifier, Selftaught Learning.

- Digital Image Processing 3rd Ed. Prentice Hall, R.C. Gonzalez and R.E. Woods 2008

Embedded Systems

An embedded system (Embedded System) is a microcontroller-based system and is a combination of hardware and software for a function. Since the discovery of microprocessors in the early 70s, embedded systems technology and applications have developed very rapidly and penetrated various aspects of human life such as mobile devices (handphones, MP3 players, etc.), medical systems, robotics, automation, etc. This course is intended to provide provisions for the design of embedded systems, especially in terms of the ability to produce reliable software. Topics of this course including Hardware Fundamentals for the Software Engineers; Microprocessor & Interfacing; Interrupts & Interrupt Handler Concepts; Software Architectures for Embedded Systems; Communication Protocols, Task Management, Introduction to Real-Time Operating Systems; Operating System Services for Embedded Applications; Basic Design Using Real-Time Operating System; Embedded Software Development Tools; Debugging Techniques; Simple Project; Interfacing with Sensors and Actuators; Standard Interfaces and Device Handlers;

- David E. Simon, "Embedded Software Primer." Addison-Wesley, 1999
- Jack Ganssle, "The Art of Designing Embedded Systems," Newnes, 2010.

Advanced Database

This course aims to introduce students to techniques, current methods, and results from the database system and data management area. In general, students will study topics around query planning and optimization, transaction processing, and concurrency control; big data management; data warehousing and OLAP; theory of databases. Topics of this course including Review Database; Query Processing; Query Optimization; Transactions; Concurrency Control; Recovery System; Monitoring and Tuning; Storage and File Structure; Indexing; Data warehouse; Data analysis and mining; Information Retrieval; Distributed Databases; Big Data.

- Elmasri and Navathe, Fundamental of Database Systems 7th Edition, Addison-Wesley, 2016
- Silberschatz, Korth, and Sudarshan, Database System Concepts, 5th Edition, Mc Graw Hill, International Edition, 2006
- Connolly, Thomas, and Begg, Carolyn: Database 106 Systems 6th edition, Prentice Hall, 2015

Information Theory

Information theory studies fundamental boundaries in information transmission and storage. This course provides a general introduction to information theory and its applications: entropy and information, data compression, communication with the appearance of noise, capacity, coding in channels, and separation of source-channels. Topics of this course including Introduction to information theory: possibility of reliable communication over unreliable channels; Probability, entropy, conditional entropy, mutual information; Asymptotic Equipartition Property (AEP), the idea of typicality and the use of typical sets for source coding; Entropy Rates of Stochastic Process, Markov Chain; Data Compression: Optimal Codes, Shannon's source coding theorem, Uniquely decodable codes, and the Kraft-MacMillan inequality, Completeness of a symbol code, Prefix Codes, Huffman Codes, Arithmetic coding; Definition of channel capacity, Capacity of binary symmetric channel, binary erasure channel; binary symmetric channel, Joint typicality, Hamming codes, Zero-Error Codes, Feedback Capacity, Source-Channel Separation Theorem; Differential Entropy: AEP for Continuous Random Variables, Relation of Differential Entropy to Discrete Entropy, Joint and Conditional Differential Entropy

- Elements of Information Theory, Thomas M. Cover, Wiley Publication, 2006
- Information Theory, Inference, and Learning Algorithms, David J.C. MacKay, Cambridge University Press, 2004

Differential Equation

This course is designed to provide understanding and knowledge of various types of differential equations, their methods of solving them, and their application in multiple fields through mathematical modeling of these differential equations. This course focuses on mathematical modeling of various natural phenomena by the rules of natural law that apply by using the differential equation approach, especially one- or two-degree differential equations. Participants are encouraged to get used to using computing applications such as MAPLE, MATLAB, MATHEMATICA, and others. Topics of this course including Introduction, overview on modeling with differential equation; 1st order Differential Equation, terminology on solution; 1st order Differential Equation: separable equation, 1st order linear equation, exact differential equation, homogeneous differential equation, method of substitutions; Modeling with 1st order Differential Equation; 2nd order Differential Equation; 2nd order Differential Equation: characteristics of solution; Reduction of order; 2nd order Differential Equation homogeneous – non-homogeneous; 2nd order Differential Equation with constant coefficients, method of undetermined coefficients, method of variation of parameters; 2nd order Differential Equation with variable coefficients, homogeneous – non-homogeneous; Modeling with 2nd order Differential Equation; Power Series Solution; Solution using Laplace Transformation, Laplace Transformation on Special Function;

- A First Course in Differential Equations, Dennis G. Zill, 9th Ed, 2009

Compiler Techniques

This course discusses several compiler-making techniques for a programming language that is defined by a grammar. These techniques will be addressed by the stages of processing a compiler, namely, reading the source code, grammar analysis, and code generation. Topics covered include lexical analysis, symbol tables, parsing, syntax-directed translation, type checking, target code generation, code optimization, etc. Students will be trained with simple compiler design assignments. Topics of this course including Function and the use of compiler techniques; Leksikon analyzer; Introduction to Grammar; Parsing Tree and derivation, Parsing Shift and reduction; Parsing SLR and LALR; Linear table and Hash; Operation of symbol table; Name/ variable declaration; Attribute operation – type checking; Example of Semantic analyzer – Context Checker; RunTime Environment; Storage Allocation technique; Code Generating; Optimization, review on current compiler developments.

- Compilers: Principles, Techniques, and Tools. Aho, A. V., Sethi, R., Ullman, J. D. Addison Wesley 1986
- Heru Suhartanto, Model Pemroses Bahasa Pemrograman Dengan tools berbasis Java, 2006

Machine Learning

This lecture discusses the basics of machine learning, which is a software development technique that can produce models to explain a complex phenomenon by observing some data. The methods taught are based

on a statistical approach to pattern recognition, including perceptron, support vector machines, hidden Markov models, expectation-maximization, etc. Topics of this course including Introduction. Linear classification. Perceptron updating rule; Perceptron convergence. Generalization; Maximum margin classification. Classification errors regularization. Logistic & Linear regression; Active learning. Kernels. Kernel regression; Support vector machine (SVM). Kernel Optimization; Model selection. Model selection criteria; Description length. Feature selection; Combining classifiers. Boosting; Margin and complexity. Margin and generalization; Mixtures Model; Expectation maximization (EM) Algorithm. EM regularization; Markov models. Hidden Markov models (HMMs); Bayesian networks. Learning Bayesian networks; Probabilistic inference.

- Christopher M. Bishop, Pattern Recognition & Machine Learning, New York, Springer. 2006
- Duda, Richard, Peter Hart, and David Stork. Pattern Classification. 2nd Ed. New York, NY: Wiley-Interscience, 2000

Natural Language Processing

This course studies various techniques for building software that processes human language. In general, the structure of the course material is organized according to the level of language representation, ranging from (i) morphology: finite-state, two-level morphology, part of speech tagging, (ii) syntax: context-free grammars, probabilistic parsing, dependency parsing; (iii) semantics: rule-based semantic analysis; (iv) discourse: discourse structure, coreference resolution. This course focuses on Natural Language Understanding, but also briefly introduces Natural Language Generation. This lecture discusses the symbolic approach and statistical approach in solving several problems in NLP. Several assignments train college participants to understand language modeling, where participants will build a software system that can process input in the form of human language. The purpose of the assignment is to support concept understanding, practice practical abilities, and provide experience for students to recognize existing NLP tools and resources. Topics of this course including Introduction & Background of NLP; Morphology; N-Gram Language Model, Word class & POS tagging, Viterbi algorithm; Context-Free Grammars for NLP; Decomposition of sentences, parsing charts; Probabilistic CFGs; Dependency Parsing, Named Entity Recognition, Computational semantics; Lexical semantics, Word Sense Disambiguation, Word Representation; Discourse modeling; Natural language generation.

- Daniel Jurafsky & James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing., Computational Linguistics, and Speech Recognition," Prentice Hall, 2000
- Christopher D. Manning & Hinrich Schütze, "Foundations of statistical natural language processing." MIT Press, 1999

Algorithms Design & Analysis

This lecture teaches how to design and analyze an algorithm in solving problems that require programming. The two main issues emphasized in designing and analyzing these algorithms are aspects of correctness and complexity. Various techniques and approaches will be discussed, including dynamic programming, greedy algorithms, backtracking, graph algorithms, approximation algorithms, etc. Topics of this course including (1) Introduction to algorithms: bubble sort, insertion sort, selection sort, searching, Growth of functions (2) Algorithm analysis: worst-case, best-case, average-case. Divide and conquer, Quicksort, Mergesort (3) Recurrence relation: master method, method of substitution, recursive tree (4) Heap sort (5) Lower bound of comparison-based sorting. Linear sorting: bucket sort, radix sort, counting sort (6) Order statistics: selecting problem (7) Dynamic programming: LCS, Matrix-chain multiplication (8) Greedy algorithm: fractional knapsack, job scheduling, MST (9) Backtracking: 0/1 Knapsack (10) Backtracking: branch and bound (11) Graph algorithms: BFS, DFS, shortest path, maximum flow (12) Sorting networks, parallel algorithms (13) Approximation algorithms (14) NP-completeness

- Cormen, T.H., Leiserson, C.E., Rivest, R.L. and Stein, C., Introduction to Algorithms (2nd edition), MIT Press, 2001.

Computer Graphics

This course covers the explanation of graphical systems, algorithms for handling essential graphical elements, 2D and 3D systems, illumination models, object models, curves, and surfaces. College participants train programming through assignments using the OpenGL language, both individually and in

groups. Topics of this course including Introduction to graphical systems: History of computer graphics, graphical systems: raster, vector, display, interaction devices, applications; OpenGL: Introduction; OpenGL Tutorial: building simple interactive computer graphics program using OpenGL; Graphical primitives: algorithm for lines, circle, ellips, polygon filling; 2D Transformation & clipping: 2D coordinate systems, line and polygon clipping algorithms, 2D transformations; 3D concepts and transformations and viewing: 3D coordinate systems and transformations; 3D viewing: 3D viewing, Hidden surface elimination; Hierarchical Modelling: 3D object models and modeling, case study: robot model; Hierarchical Modelling: 3D object models and modeling, case study: robot model; Illumination models: Color systems: illumination models; Shading: Flat, smooth and phong shading, shadow construction; Rendering using images: Texture mapping; Curves and surfaces: Interpolation and approximation curves: Hermit, Bezier and Spline curves and surfaces, NURBS;

- Interactive Computer Graphics: A Top-Down Approach Using Open-GL 6th Ed. Edward Angel, Addison Wesley, 2012
- Computer Graphics with OpenGL 3rd Ed., Donald Hearn & Pauline Baker, Prentice Hall, 2004
- Computer Graphics: Principles and Practice 2nd Ed. In C, Foley, Vandam, Feiner, Hughes, Addison Wesley, 1997

Cryptography & Information security

This course teaches cryptography and information security, which covers the basics of mathematics, algorithms, protocols, security engineering, and their applications in various aspects. Topics of this course including Classical encryption techniques; Block ciphers; Data Encryption Standard (DES); Number theory; Finite fields; Advanced Encryption Standard (AES); Block cipher modes of operations; Pseudorandom number generation; Stream ciphers; Public-key cryptography; Cryptographic hash functions; Message Authentication Codes; Digital signatures; Key management; User authentication; Security Engineering; Special topics.

- William Stallings. Cryptography and Network Security: Principles and Practice. 7th Edition. Prentice Hall, 2016.
- Christof Paar and Jan Pelzl. Understanding Cryptography: A Textbook for Students and Practitioners. Springer, 2010.
- Ross J. Anderson. Security Engineering: A Guide to Building Dependable Distributed Systems. Second Edition. Wiley, 2008.

Computer System Organization

This course contains a detailed discussion of the main components of a computer system: processor, memory, and input/output. The emphasis is on the analysis and performance improvement techniques of computer systems. Topics covered include an introduction to computer design, historical perspectives; components of computer systems, the essential organization of computer machines; performance and cost, choice in design; realization of the organization of computer systems; RISC; the implementation and analysis of the set of instructions in the examples of the organization of a computer system provided; processor design: data path unit and processor controller, microprogramming and hardwired control; memory design: cache memory, pipelining; input and output (I / O). Topics of this course including Introduction Concept Performance and costs; Performance measurement. Concept of instruction; Address design in directions. Design of control instructions; Design of control instructions & examples. Example of Instruction Implementation; Measurement / statistical data Instructions. Processor: Introduction & datapath processor; Basic Execution. Hardwired & microprogram control; Interrupt in the processor and its aspects. Primary pipeline; Pipeline & pipeline hazard constraints, Dynamic Scheduling; Memory: locality principle; The principle of the memory hierarchy, Caches Memory; Main Memory. Virtual Memory; I / O concept: I / O performance, Magnetic Disk; Bus & Graphic Display.

- Hennessy, John L. dan David A. Patterson. Computer Architecture: A Quantitative Approach. Morgan Kaufmann Publisher, Inc., San Mateo, California, Second Edition 1996
- William Stallings. Computer Organization and Architecture, 4th edition: Designing for Performance. Prentice Hall Inc, New Jersey 1996

Web Service and Application

This course discusses the development of applications and software services that use the latest web technology. Topics covered include a brief review of HTML and XML standards, Servlet, Tomcat, JSP-based web service technology, technical issues such as cookies & sessions, SQL, JDBC, DAOs, JavaBeans & BeanFactories, MVC paradigm (Model View Controller), JSP Standard Tag Library, Security (Including SSL), Web Services (SOAP / WSDL / UDDI), Frameworks, Internationalization, Scalability & Performance Issues. Topics of this course including: Review HTML, XML; Server scripting: JSP, PHP, NodeJS, etc; Cookies & Session; Databases including database for big data SQL, JDBC, DAOs, MongoDB; Model View Controller; Component-Based Web Application: ANgularJS/REACT; Web Security (Including SSL); Web Service (SOAP/REST); Internationalization; Scalability & Performance Issues;

- Murat Yener, Alex Theodom. Professional Java EE Design Patterns. Wrox, 2015.

Simulation and Modeling

This course introduces the basics of system modeling using computer simulations and mathematical techniques, especially with approaches using differential equations (understanding topics / having taken Differential Equation courses, which will be very helpful). Some case studies will be elaborated both in lectures and in the training and assignments of lectures given. Examples of system modeling discussed will cover various fields with an emphasis on analysis and modeling of computer and communication systems, queuing systems, and several other systems using several modeling paradigms such as simulations, queuing theories, and stochastic process approaches. Topics of this course including Introduction, Modeling, and Simulation; Monte Carlo simulation; Continuous system simulation; Discrete-event Simulation; Mixed Simulation (discrete and continuous); Quantitative Modeling; Petri Nets; Queuing Networks; Stochastic Algebra; Sample generation; Concepts in Discrete event simulation (DES): Components of DES; Input Data Modeling, Verification, and Validation; Output Analysis; Model Design; Parallel and Distributed Simulation; Distributed Virtual Environments; High-Level Architecture.

- Simulation Modeling & Analysis, by A. Law and D. Kelton, McGraw Hill Publishing Co., 3rd Edition, 2000
- Creating Computer Simulation Systems: An Introduction to the High-Level Architecture, Kuhl, Weatherly, and Dahmann, Prentice Hall, 2000

Nonlinear system approximation

This course introduces the analysis of nonlinear system design. Topics of this course include linearization, equilibrium points, limit cycles, chaotic attractors, stability, Liapunov's methods, describing functions, Popov and circle criteria, contraction mappings, exact linearization, variable structure, simulation. Topics of this course including Introduction to nonlinear systems; Equilibrium points and phase plane analysis; Limit Cycle; Stability concepts; Lyapunov Stability Theory; Liapunov's direct method; Stability of non-autonomous systems; Describing functions; Feedback linearization; Feedback linearization; Nonlinear system identification or PLLs; Select Project Presentation and Discussion

- J.-J. E. Slotine and W. Li, 1991. Applied Nonlinear Control, Upper Saddle River, NJ: Prentice Hall
- H. K. Khalil, Nonlinear Systems, Third Edition, Prentice Hall: Upper Saddle River, NJ, 2002

Software Quality Assurance

This course covers topics related to software quality assurance. This course studies the integration of various PMPL techniques and components, such as PMPL activities usually carried out by external parties, the application of PMPL activities to project scheduling and budget control, PMPL implementation issues, PMPL risk management considerations, and costs associated with PMPL. This course also discusses quality issues throughout the software development process, including design, implementation, testing, and operation. Matters related to pre-project and post-project activities will also be addressed. Relevant quality standards will also be discussed. Topics of this course including The Software Quality Challenge; Software Quality Factors; Components of a Software Quality Assurance System; Pre-Project Software Quality Components; Group Presentation.

Development and Quality Plans; SQA Components in the Project Life Cycle; Group Presentation; Software Testing Strategies and Implementation; Software testing tools and best practices; Assuring the Quality of

External Participants; CASE Tools and Their Effect on Software Quality; Group Presentation; Staff Training and Certification; Corrective and Preventative Actions; Configuration Management

- Software Quality Assurance, by Daniel Galin, Pearson Education Limited, 2004

Soft Computing

This lecture discusses how to process information with a soft computing approach based on fuzzy theory. Problems encountered in computing include the issue of impression and uncertainty, try to be handled with a fuzzy approach. Topics of this course including What is soft computing; Fuzzy logic, classical logic, linguistic variables; fuzzy numbers, fuzzy number concepts, operations on fuzzy numbers, triangular fuzzy numbers; fuzzy set, fuzzy set concept, basic operations on fuzzy set; Operations on fuzzy sets, fuzzy complement, combined fuzzy, sliced fuzzy, T-Norm & S-Norm; Krisp relation, the nature of a single set, relations, and composition of fuzzy; Graph and fuzzy relations, characteristics of fuzzy relations. Fuzzy relation classification. Other fuzzy relations; Fuzzy Functions, Types of Fuzzy Functions, Fuzzy Extrema of Functions, Integration, and Differentiation of Fuzzy Functions; Probability & uncertainty. Probability and Probability; Fuzzy Events, Uncertainty, size of fuzziness; Fuzzy inference and composition rules; Fuzzy Rules and Implications. Inference mechanism, inference method; Fuzzy Control and Fuzzy Expert System. Fuzzy Logic Controller. Defuzzification. Fuzzy Expert System; Hybrid System.

- Lee, H.K., First Course on Fuzzy Theory & Applications, Springer 2006
- Klir, G.J., Fuzzy Sets and Fuzzy Logic: Theory and Applications, Prentice Hall, 2001

Information Retrieval

This course discusses the basic concepts of information acquisition in organizing and retrieving text and multimedia data. Topics of this course including Introduction to Information Retrieval; Corpus Statistics; Learning Perl; Text encoding: tokenization, stemming, stopwords, proximity, phrases; Index construction; Information Retrieval Model; Information Retrieval Model; Evaluation; Relevance feedback; Web search; Question answering; Summarization; CrossLanguage Information Retrieval; Multimedia Information Retrieval

- Introduction to Information Retrieval by C. Manning, P. Raghavan, H. Schütze, 2008
- Modern Information Retrieval by Richardo Baeza-Yates & B. Ribeiro-Neto, 1999

Semantic Web

This course discusses the basics of Semantic Web technology covering the language of knowledge representation, both in the aspect of graph-based data modeling using RDF, as well as the schema and terminological aspects of using OWL ontology languages. Then, this course also discusses techniques for enriching data and information with metadata and meta-information to enable data and knowledge to be shared, openly published, reused, and integrated with data from other sources (including publicly available sources on the Web) in a standard format for the Web. Moreover, the students will also learn about query techniques and automated reasoning that can be applied to data and knowledge already represented in the knowledge representation language above. Therefore, the machines or computer systems can express (make explicit) the information and expertise implicitly contained in data and knowledge that have been modeled using semantic technology components. Then, the course will discuss semantic data storage techniques in a triple store. Topics of this course including: Introduction to Semantic Web: the Web vs. the Semantic Web; Web-standardized data format: XML, JSON; Web-standardized graph-based data model: RDF; Querying RDF data with SPARQL; Lightweight semantics for RDF: RDF Schema (RDFS); Reasoning with RDFS; Ontology language with richer semantics: OWL, including syntax and semantics based on description logic; Reasoning with OWL; Linked data publishing (implementation and infrastructure); Linked data storage with triple stores; Ontology engineering for linked data publishing (e.g., using ontology patterns); Overview of various W3C standard vocabulary for representing spatial information, temporal information, thesauri (SKOS), personal information (FOAF), etc.; Advanced topics: rule languages for Semantic Web, ontology alignment, linked data fragments, checking data consistency with SHACL.

- Pascal Hitzler, Markus Krötzsch, Sebastian Rudolph. Foundations of Semantic Web Technologies. Chapman & Hall/CRC, 2009.
- Dean Allemang, Jim Hendler. Semantic Web for the Working Ontologies. Morgan Kaufmann, 2008.

- Pascal Hitzler, Aldo Gangemi, Krzysztof Janowicz, Adila Krisnadhi, Valentina Presutti. *Ontology Engineering with Ontology Design Patterns: Foundations and Applications*. IOS Press, 2016.
- David Wood, Marsha Zaidman, Luke Ruth, Michael Hausenblas. *Linked Data: Structured Data on the Web*. Manning Publications, 2014.

Computational Logics

Like Mathematical Logic, Computational Logic deals with syntax, semantics, correctness, and completeness of reasoning. But Computational Logic is also very concerned about efficiency aspects so that automated reasoning becomes feasible in practice. Computational Logic plays an essential role in various fields of Computer Science, including semantic web, hardware/software verification, programming language technology, databases, and KRR (knowledge representation and reasoning). Topics: (1) Propositional Logic: syntax, Semantics, Resolution, Tableaux algorithm; (2) First order logic: syntax, semantics, resolution, tableau algorithm; (3) Advanced topics of choice: (a) DPLL algorithm, SAT solver, problem solving using MiniSAT; (b) description logics: syntax, semantics, reasoning algorithm, relationship with web ontology languages; (c) modal logic: necessity and possibility, syntax, axiomatic systems, Kripke semantics, semantic tableaux, normal modal logics; (d) Lambda calculus: alpha conversion, beta reduction, eta reduction; the fixed-point theorem, combinators, applications.

- Uwe Schöning. *Logic for Computer Scientists*. Springer, 2009.
- Franz Baader, Ian Horrocks, Carsten Lutz, Uli Sattler. *An Introduction to Description Logic*. Cambridge University Press, 2017.
- Graham Priest. *An Introduction to Non-Classical Logic*. Second Edition. Cambridge University Press, 2008.
- G. E. Hughes and M. J. Cresswell. *A New Introduction to Modal Logic*. Routledge, 1996.
- J. Roger Hindley and Jonathan P. Seldin. *LambdaCalculus and Combinators*. Cambridge University Press, 2008.

Digital Signal Processing

This course will focus on the concept of digital signal processing (DSP), whether in the form of audio, video, or other types of signals generated from sensors/transducers, as well as how much processing can process signal data to be more useful to support various application. Some theoretical basis will be introduced, such as ADC / DAC conversion, probability and noise, linear systems, and convolution operations. Then discuss processing such as Fourier transforms, various types of digital filters, data compression, and aspects of implementation on the microcontroller. Topics: Introduction and Overview; ADC & DAC; DSP Software; Convolution & Its Properties; Convolution & Its Properties; Fourier Transform; Fourier Transform; Continuous Signal Processing; Digital Filters, Audio Processing & Image Formation and Display; Digital Filters, Audio Processing & Image Formation and Display Data Compression; Data Compression; Final Exam.

- Steven W. Smith, "The Scientist and Engineer's Guide to Digital Signal Processing". 2nd edition. California Technical Publishing, 1999. Electronic Edition

Distributed Systems

This course explores issues related to the design and implementation of distributed systems with an emphasis on how the shared state, interactions, and communication between several processes that run on the system. Topics: Introduction; Architectures; Processes; Communication; Naming; Synchronization; Synchronization; Agreement & Fault Tolerant; Consistency & Replication; Security; Distributed Web System Technology.

- Tanenbaum, A., M., van Steen, Distributed System Principles and Paradigms 2nd Ed, Prentice Hall: 2007
- Coulouris, Dollimore, Kindberg, Distributed Systems: Concepts and Design 4th ed, Addison Wesley: 2005
- Distributed Systems: Concepts and Design 5th Ed, Pearson: 2011

Geography Information Systems

This course discusses concepts, theories, and techniques for acquiring, representing, processing, and utilizing geospatial data such as maps. Topics: Introduction: Definition, History, Difference with other MIS, Characteristics; GIS Applications; Maps and Geospatial Data: maps characteristics, coordinate systems, map projections, topographic mapping, thematic mapping; Digital Representation and Organization of Geospatial Data: Digital representation of geospatial data, database and DBMS, raster representation, vector representation, object oriented representation, relationship between representation and analysis of GIS data; Geospatial Data Quality and standards: Concepts and definition of data quality, quality components of geospatial data, data assessments, managing error of geospatial data, geospatial data standard; GIS and Remote Sensing Integration: Remote sensing classifications, image characteristics on remote sensing, metrics information extraction, thematic information extraction, GIS and remote sensing integration; GIS implementation: Software engineering on GIS, GIS project planning, system analysis and user requirements analysis, geospatial database design methodology, GIS application software design methodology, system implementation, system maintenance and technical support; Internet GIS and Distributed GIS services: Internet based GIS and 202 distributed GIS services, Networking fundamentals of internet GIS, Framework and standards, internet GIS applications, internet GIS products review;

- C.P. Lo and A.K.W. Yeung, "Concepts and Techniques of GIS," 2nd ed 2007
- Zhong Ren Peng and Ming-Hsiang Tsou, "Internet GIS", 2003
- R. Tomlinsin, "Thinking about GIS,", 2003;
- P. Burrough, "Principles of GIS";
- M.N. Demers, "Fundamentals of GIS";
- F.S. Purwadhi, "Sistem Informasi Geografis";
- P.A. Longley, "Geographical Information Systems" Volume 1 & 2

Formal Methods

This course is intended to meet the need for a formal approach framework in the framework of making high-quality critical software. This lecture provides a solid foundation based on logic, an introduction to several logical structures used in modeling and reasoning of computer systems. This requires formal training that allows college participants to have the skills to use the existing framework. Topics: Argumentation; Natural Deduction for Propositional Logic; Logical Equivalence; Propositional Logic as a Formal Language; Semantics of Propositional Logic; Soundness of Propositional Logic Forms; Completeness of Propositional Logic; Conjunctive Normal Form (CNF); Negation Normal Form (NNF); Horn Clauses; Natural Deduction for Predicate Logic; Predicate Logic as a Formal Language; Syntax of Predicate Logic; Semantics of Predicate Logic; Lineartime Temporal Logic; Syntax of Lineartime Temporal Logic (LTL); Semantics of Lineartime Temporal Logic (LTL); Semantically Equivalences between LTL formulas Adequate sets of connectives for LTL; Model Checking in LTL; Branching-time Temporal Logic; Syntax of Computational Tree Logic (CTL); Semantics of Computational Tree Logic (CTL); Semantically Equivalences between CTL formulas; Adequate sets of connectives for CTL; Combination of LTL and CTL Logic: CTL*; Syntax of CTL*; Semantics of CTL*; Semantically Equivalences between CTL* formulas; Model Checking Algorithm in 154 CTL; Pseudo-code of the CTL Model Checking Algorithm; CTL Model Checking with Fairness.

- Michael Huth, Mark Ryan. Logic in Computer Science: Modeling and Reasoning about Systems. Second Edition, Published by Cambridge University Press, United Kingdom, 2004
- Jean-Francois Monin, Michael G. Hinchey. Understanding Formal Methods. Published by Springer-Verlag London Limited, 2003

Data Mining

This course introduces basic concepts and problems, methods, and techniques in data mining. Topics: Introduction; Data Preprocessing; Data Warehouse and OLAP Technology: An overview; Data Cube Computation and Data Generalization; Mining Frequent Patterns, Association and Correlations; Classification and Prediction; Cluster Analysis; Mining Stream, Time 167 series and Sequence Data; Mining Stream, Time series and Sequence Data; Graph Mining; Social Network Analysis; Mining Object, Spatial and Multimedia Data; Mining Text; Mining Web Data.

- Han, J. and Kamber, M., Data Mining: Concepts and Techniques, 2nd Edition, Morgan Kaufmann, 2006

Multimedia Processing

This course teaches the principles of representation, compression, transmission, modeling, as well as authoring and annotation of multimedia data, both text, audio, image, and video. This course provides a theoretical and practical understanding of the latest multimedia data standards such as XML, PDF, MP3, MIDI, JPEG, SVG, AVI, OGM. The course will also provide knowledge about the use of multimedia such as animation, hypermedia, and visual design. Topics: Introduction & overview of multimedia processing; Multimedia representation - text: ASCII, Unicode, PDF; Multimedia representation - audio: wave encoding, bitrate, frequency, compression, MP3, 165 MIDI; Multimedia representation - image: bitmap, colour theory, JPEG compression, raster vs. vector, SVG; Multimedia representation - video: audio-video interleaving, compression, AVI, OGM; Multimedia transmission: quality vs. bandwidth, progressive/streaming, multicast, broadcasting protocols; Basics of 3D modelling and animation; Image processing, Video Processing, Sound processing, Interactive multimedia authoring; Interactive multimedia authoring; Multimedia annotation: XML, MPEG-7, SMIL; Multimedia annotation: XML, MPEG- 7, SMIL; Digital preservation repositories, OAIS model. Multimedia Design.

- Nigel Chapman & Jenny Chapman, Digital Multimedia, 3rd ed., John Wiley & Sons.

Robotics

This course provides an introduction to the implementation of robots from the perspective of computer science. Topics covered include motion with wheels or legs (locomotion), sensing and perception with sensors, handling uncertainty in knowledge, representation, and modeling locations in probabilistic ways. In this course, students will use software such as the Robot Operating System (ROS). Topics: Introduction: problem statements, typical applications, video; Locomotion with legs and wheels; Mobile Robots Kinematics; Exercise 1 : Kinematics model and trajectory calculation of wheeled robots; Perception I Sensing and Perception; Exercise 2: Motion control of a differentially driven robot; Perception II: Sensing and Perception, Uncertainty Representation; Localization I: Introduction, odometry; Exercise 3: Vision and/or laser; take picture, feature extraction; uncertainty representation; belief representation; Localization II: Map representation, introduction to probabilistic map- based localization, Markov localization; Localization III: Markov localization and Kalman filter localization (1); Localization IV: Kalman filter localization (2); Other examples of localization systems, map building; Architectures for Navigation, Robot Operating System (ROS).

- Roland Siegwart and Illah R. Nourbakhsh. 2011. Introduction to Autonomous Mobile Robots. The MIT Press.
- Sebastian Thrun and Wolfram Burgard. 2005. Probabilistic Robotics. MIT Press.

- Alonzo Kelly. 2013. Mobile Robotics Mathematics, Models, and Methods. Cambridge.

Digital System Design

This course is intended to understand digital system design techniques using a high-level programming language (High-Level Language). The language used is VHDL (VHSIC Hardware Description Language). The course material provided includes the understanding of VHDL elements, behavior modeling techniques, dataflow modeling, and structural modeling. The programming elements discussed include the concepts of configuration, subprograms, overloading, packages, and libraries, including examples of digital circuit modeling commonly found on digital systems. Laboratory support facilities are a set of FPGA boards and development tools from Xilinx. Topics: Pemodelan behavioral, dataflow, structural dalam VHDL; Subprogram, overloading; Packages, library; Synthesis technique; Registers, shifter, Memory, bus, ALU; Finite State Machine; State optimization; Control Unit; Datapath: sharing, merging; Pipelining, Scheduling.

- Charles H.Roth, Jr., DIGITAL SYSTEMS DESIGN USING VHDL, PWS 1998.

Infrastructure Management

This course introduces modern Information Technology (IT) infrastructure and activities needed to manage the operational infrastructure. Topics: Data Center Concept: Availability Continuum; Data Center Requirement; Data Center Design; Network Infrastructure; Data Center Maintenance; Data Center Power Distribution & HVAC; Data Center Consolidation; Server Performance & Capacity Planning; Server Load Balancing & Fault Tolerance; Data Storage Solutions; Storage Area Networks; Designing Fault-Tolerance Networks; Network Access Technology, Security & Firewalls; Disaster Recovery Concept & Architecture;

- K. Jayaswal, Administering Data Center: Servers, Storage, Voice Over IP, Willey, 2009.

Customer Relationship Management

This lecture focuses on the concepts and technologies of Customer Relationship Management as a complete enterprise-wide business solution. This course is suitable for students planning to become IT, consultants. This lecture will teach students the basic principles, implementation, and practice of Customer Relationship Management to improve the achievements of marketing, sales, and services that cover the phases of the customer life cycle namely customer acquisition, retention and development, which at the same time also supports the objectives larger / broader organization. Topics: 1) Introduction to CRM; 2) Understanding Relationships; 3) Customer Acquisition; 4) Customer Retention; 5) Customer Portfolio Management; 6) Managing Customer Experience; 7) How to Deliver Customer-Experienced Value; 8) Sales Force Automation; 9) Marketing Automation;

10) Service Automation; 11) Developing and Managing Customer-Related Databases; 11) Using Customer-Related Data; 12) Planning to Succeed; 13) Implementing CRM; 14) The Future of CRM.

- Francis Buttle, Customer Relationship Management: Concepts and Technologies, 3rd edition, Routledge, 2015
- Baran, Galka and Strunk, Principles of Customer Relationship Management, SouthWestern, 2008
- Armstrong, Gary., and Philip Kotler., Marketing: An Introduction 10th edition, Pearson, 2011

IT Service Management

This course focuses on the delivery and support of IT services that are suited to the organization's business needs. Topics: Introduction to ITSM; Best Practice dalam Manajemen Layanan TI; Konsep Layanan; Service Management as a Practice; Service Management System; Understanding Current Services; Perencanaan dan Pengaturan Service Management System; Peningkatan Service Management System; Introduction to ITIL; Processes, functions and roles; Service Strategy; Service Design; Service Transition; Service Operation; Continual Service Improvement; Tool and Technology Consideration.

- Dugmore, Jenny dan Shirley Lacy. A Manager's Guide to Service Management, 6th Edition. British Standard Institution. 2011.
- Orand, Brady dan Villareal Julie. Foundations of IT Service Management: The ITIL Foundations Course in a Book 3rd Edition. ITILYaBrady. 2011.
- ITIL V3 Framework.

IT Project Management

This course focuses on the knowledge standards required by the Project Management Institute (PMI), which is the world's leading certification organization for professionals in all Project Management disciplines. This course will also expand knowledge and skills in IT project management for company systems and will provide opportunities for students to learn how practices and procedures are used in organizations. The specific focus of this course is how a project manager can control all constraints in project implementation, both in terms of staff capacity, system development schedules, costs, effort estimates, and quality, and how these limitations are related to the PMI® concept, and how to manage it well in project implementation at various scales. Topics: Introduction of Project Management; The Project Management and IT Context; The Project Management Process Groups: A Case Study; Project Integration Management; Project Scope Management; Project Time Management; Project Cost Management; Project Quality Management; Project Human Resource Management; Project Communication Management; Project Stakeholder Management; Project Risk Management; Project Procurement Management.

- Kathy Schwalbe. Managing Information Technology Project - Seventh Edition. Boston, MA: Thomson Course Technology, 2014
- Project Management Institute, Inc. A guide to the Project Management Body of Knowledge (PMBOK® Guide) 5th Edition, 2013

Mobile Technology

This subject is an introduction to the field of mobile communication aimed at providing an overview of mobile technology from a computer science perspective. At the beginning of the lecture, given some basics about wireless transmission technology. Topics covered include the frequency used for communication, signals, basic multiplexing and modulation schemes, access protocols, and application requirements. Various mobile technologies, such as CDMA, GSM, DECT, W-CDMA, CDMA2000, and UMTS, will be introduced as part of the mobile communication system. In this lecture also discussed how to utilize sensors and services available in mobile communication devices to build applications on mobile platforms.

- Jochen Schiller, Mobile Comunication, Addison-Wesley, 2003.
- Martin Sauter, Beyond 3G – Bringing Networks, Terminals and Web Together: LTE, WiMAX, IMS, 4G Devices and the Mobile Web, Wiley, 2008.
- Mark Grayson, Kevin, Shatzkamer, Scott Wainner, IP Design for Mobile Networks: Revolutionizing the Architecture and Implementation of Mobile Networks, Cisco Press, 2009.
- Frank H.P. Fitzek and Frank Reichert, Mobile Phone Programming and Its Application to Wireless Networking, Springer, 2007.

Knowledge Management

This lecture teaches the theory and application of knowledge management that includes technology and tools used in managing knowledge that is integrated with the needs of managing knowledge in an organization effectively. This lecture also discussed the characteristics, computer representation, access, and utilization of information versus knowledge in the context of human resources. Topics: Introduction to knowledge management; The nature of knowledge; Knowledge management foundations: infrastructure, mechanisms and technologies and knowledge management solutions: processes and systems; Organizational impacts of knowledge management; Knowledge application systems: systems that utilize

knowledge; Knowledge capture systems: systems that preserve and formalize knowledge; KM implementation in certain industries; Knowledge sharing systems: systems that organize and distribute knowledge; Knowledge discovery systems: systems that create knowledge; Emergent knowledge management practices and factors influencing knowledge management; Leadership and assessment of knowledge management and the future of knowledge management.

- Becerra-Fernandez, I, Sabherwal, R. (2010). Knowledge Management: Systems and Processes.
- Elias M. Awad, Hassan M. Ghaziri (2004). Knowledge Management. Prentice Hall. ISBN: 0-13-034820-1.
- Madanmohan Rao (2004). Knowledge Management Tools and Techniques: Practitioners and Experts Evaluate KM Solutions. Butterworth-Heinemann. ISBN: 0750678186. 144
- Amrit Tiwana (2002). The Knowledge Management Toolkit: Orchestrating IT, Strategy, and Knowledge Platforms (2nd Edition). Prentice Hall. ISBN: 013009224X

Fundamental of IS Audits

This lecture discusses 5W + 1H (what, who, where, when, why, and how) Information Systems Audit. Starting from discussing the definition of audit information systems, the order of the audit process, and making the reports needed during the audit activities. Besides that, it will be taught, how to audit several areas of information systems such as IT Governance, Applications, Data Centers, Operating Systems, Networks, Databases, Disaster Recovery, IT Outsourcing, System and network security and Cloud Computing. Methodologies, Frameworks, Laws, and Regulations relating to Information Systems auditing are also discussed in this lecture. Topics: 1. IT Audit Fundamentals; 2. IT Audit Drivers; 3. Types of Audits; 4. IT Audit Component; 5. IT Audit Processes; 6. Auditing in Context; 7. Internal and External Auditing; 8. Framework and Standards; 9. Audit-Related Organization, Standards and Certifications; 10. Auditing IT Governance Controls; 11. Auditing Operating Systems; 12. Auditing Network Security; 13. Auditing Database Systems; 14. Auditing Data Centers; 15. Auditing Applications; 16. Auditing Protections of Information.

- Gantz, S. D. (2014). The basics of IT audit: Purposes, processes, and practical information.
- Davis et. al (2011). IT Auditing Using Controls to Protect Information Assets, 2nd Edition. US: McGraw-Hill Osborne Media.
- COBIT 5 Framework.

IS Management

This course teaches students the aspects and knowledge of managing information systems in a business organization, both in strategic and technical aspects. This course is a bridge between the world of campus and the world of work. Topics: (1) Introduction to Information Systems Management (2) The Role of Leaders in Management of Information Systems (3) Strategic Role of Information Technology (4) Strategic Planning of Information Systems (5) Architecture Design of Corporate IT & Telecommunications Management (7) Management of Information Resources (8)) Operations Management & Information Security Management (9) Management of Support Systems (10) Future Challenges.

- McNurlin, Barbara C.; Sprague, Ralph H. Jr., Information Systems Management In Practice, 8th ed., Prentice-Hall, 2009
- Boar, Bernard H., The Art of Strategic Planning for Information Technology, 2nd ed., John Wiley & Sons, 2001
- Holtsnider, Bill; Jaffe, Brian D., IT Manager's Handbook: Getting Your New Job Done, 2nd ed., Morgan Kaufmann, 2007

E-health

This course leads students to understand the concepts and regulations of e-health that can be used in health organizations. This course will also introduce students to 130 technologies commonly used in implementing e-health such as HL7 technology, PACS, and so on. This course is prepared for students who will work as IT consultants who act as systems architects in organizations. The actualization of this course will be carried out if there are the latest health technology trends. Topics: (1) Introduction to E-health; (2) Health Information System and Health System Regulation in Indonesia; (3) Health Information (Electronic Medical Records); (4) Development of Technology Standards in the Implementation of E-health (HL7 and DICOM); (5) Hospital Management Information System Architecture (SIMRS); (6) Mobile Health Technologies and Applications; (7) Social networks and Cloud Computing on E-health; (8) Security and Privacy in E-health Applications over the Cloud; (9) Management Challenges in the Implementation of SIMRS and SIMRS Project Management.

- [ROD] Rodrigues, J.J.PC., Compte, S.S. & Diez, I.T. E-health Systems: Theory, Advances and Technical Applications. ISTE Press Ltd and Elsevier Ltd, 2016.
- [WAG] Wager, K.A., Lee, F.W. & Glaser, J.P. Health Care Information Systems 3rd Ed. Wiley, 2013.
- (3) [PWH] Handayani, et al. Sistem Informasi Manajemen Rumah Sakit

E-commerce

This lecture will introduce students to the basic principles of electronic commerce, from a business perspective. This lecture also provides an overview of business and technology topics, such as internet retailing and various e-commerce models. In addition, several critical issues related to e-commerce, such as security, privacy, intellectual property rights, authentication, encryption, and law, will also be explored. Topics: Introduction to e-commerce and e-marketplace; E-commerce: mechanisms, platforms and tools; Retailing in e-commerce: products and services; Business-to-business e-commerce; Innovative ecommerce systems: from e-government to elearning, collaborative commerce and C2C commerce; Mobile commerce and ubiquitous computing; Social commerce: foundations, social marketing and advertising; Social enterprise and other social commerce topics; Marketing and advertising in e-commerce; E-commerce security and fraud issues and protections; E-commerce payment systems.

- Turban, E., King, D., Lee, J.K., Liang, T., Turban, D.C. Electronic Commerce: A Managerial and Social Network Perspective, Springer. 2015

6 Descriptions of Advanced Electives

Advanced Image Processing

The course covers the special research topics related to the development in the field of study. At the beginning, several fundamental concepts in pattern recognition and image processing are given. The fundamental concepts includes the concept of digital image, standard methodology of image processing, description of objects in an image, feature extraction and selection methods, image segmentation and classification methods, unsupervised and supervised-based image analysis, soft computing, and development of a knowledge-based system. The discussions of the fundamental concepts are enriched by examples of the research results conducted by the related laboratory. The problem domains include remote sensing, biomedical, cultural heritage, and other applications. The graduate students are requested to find their own papers to be presented and discussed during the term. Several special topics that have ever been chosen include content-based image retrieval system, biomedical image and signal processing, data mining, object detection and recognition using several problem domains. After the period of student presentations, a summary of presented materials is constructed and related to the fundamental concepts that have been studied. The final student assignment is to write a report that could be in the form of a literature review report, or a research proposal, or a paper to be published.

- Gonzalez, R.C., and Woods, R.E., Digital Image Processing, Prentice Hall, 2002.
- Other Pattern Recognition and Image Processing books.
- Journals and Proceedings in Pattern Recognition and Image Processing.

Advanced Software Verification

This course discusses the theory underlying the verification of software that has been or will be produced compared to the initial specifications. The methods and basic theories to declare a formal and precise specification in temporal logic language will be studied. As a masters level course, this course will further discuss the latest developments in this field that include, among others, the language of logic, model checkers, theorem prover, software methodology paradigms that prioritize correctness such as the B-Method. This course will also introduce the applications of software verification in the industry in their simplified form.

- Paul, P. Boca, et.al, Formal Methods: State of the Art and New Directions.
- Larry Paulson, Lecture Notes on Software engineering, Cambridge University
- Papers in conference: Computer Aided Verification.
- Papers in journal : Formal Aspect of Computing , Springer

Advanced Parallel Computation

This course discusses the development of parallel computing technology, based on both super computer, distributed system and graphical processing unit. The topics discussed are the fundamental concepts and the recent topics in various articles published in journals as well as in international seminars/ conferences. The fundamental topics discussed include the basics of parallel and distributed computing, and recent topics from some publications. Among the topics are Introduction to Distributed and High-Performance Computing (HPC) ; Parallel programming models and performance analysis; self reading on High-Performance Computing architectures and Programming parallel computers; Data parallel programming ; Shared memory programming, threads and OpenMP ; High-performance distributed computing; HPC in Grid and cloud computing; GPU Computing; Self reading and experiments on MPI, PVM, Java RMI, and Java Cobra. The current issues coverage will be in the form of final project discussing recent topics in journals and proceedings. After completing this course, the students are expected to master the basics of parallel and distributed computing, to have the ability to apply parallel technology in various platforms, and to know the recent developments in the field of parallel and distributed computing technology and therefore able to apply them to various topics in research and applications.

- Grama, A.; Gupta, A.; Karypis, G; Introduction to Parallel Computing, Second Edition, Addison Wesley, 2003.
- Vladimir Silva, Grid Computing for Developers, Charles River Media Inc, ISBN 1-58450-424-2, 2006.
- Anthony T. Velte, toby J. Velte, Robert Elsenpeter, Cloud Computing: A practical approach, Mg Graw Hill, ISBN 978-0-07-162694-1, 2010
- Jason Sanders, Edward Kandrot, Cuda by Example: an introduction to GP GPU programming, Addison Wesley, 2011
- Research articles related to parallel processing/computing appeared in international proceeding and journals.

CSC6801282 • Advanced Parallel Computation

This course is about the development of parallel computation technology based on super computer machine as well as distributed system. Topics studied in this course are latest issues that are also discussed in various international journals and conferences. The topics include fundamental of parallel and distributed computation and latest issues from scientific journals. For instance, Introduction to Distributed and High-Performance Computing; Parallel programming models and performance analysis; self-reading on High-Performance Computing architectures and Programming parallel computers; Data parallel programming and HPF; Shared memory programming, threads and OpenMP; High-performance distributed computing; Grid computing; Self reading and experiments on MPI, PVM, Java RMI, Java Corba, etc. After completing this course, students are expected to master the fundamental of parallel and distributed computation technology, have a good skill in implementing parallel technology in various fields and aware of latest updated parallel and distributed computation technology hence can be taken as research topics and developed further to be an application.

- Grama, A.; Gupta, A.; Karypis, G; Introduction to Parallel Computing, Second Edition, Addison Wesley, 2003.
- IEEE Transactions on Parallel and Distributed Systems.

CSC6801380 • Advanced Artificial Intelligence

During Basic Artificial Intelligence course, fundamental theories in Artificial Intelligence have been discussed. This course will discuss about advanced materials adapted to the latest development and implementation in on-going researches in Universitas Indonesia.

- Stuart Russell & Peter Norvig, Artificial Intelligence: A Modern Approach. 2nd edition. Prentice Hall, 2002

CSC6801381 • Advanced Machine Learning

This course provides advanced discussion of the Basic Machine Learning course. The materials will be based on the latest researches taken from literatures from scientific journal articles and conference papers as references.

- Goldberg, D.E., Genetic Algorithms in Search, Optimization, and Machine Learning, Addison Wesley, 2004.
- Christopher M. Bishop, Pattern Recognition & Machine Learning, New Yourk, Springer. 2006.
- Duda, Richard, Peter Hart, and David Stork. Pattern Classification. 2nd Ed. New York, NY: Wiley-Interscience, 2000.

CSC6801480 • Advanced Theory of Computation

This course discusses about theory of computation. Materials include detailed treatment on Turing Machine and language theory; theory of complexity; machine modeling (from the simplest Con-neumann (input-

output process) to parallel computation modelling). Discussion topics also include other theories, such as lambda calculus or set theory.

- John C. Martin. Introduction to Languages and the Theory of Computation, 3rd Ed. McGraw-Hill. 2003.
- John E. Hopcroft, Rajeev motwani, Jeffrey D. Ullman. Introduction to Automata Theory, Languages and Computation, 2nd Ed. Addison-Wesley. 2003.
- Michel Sipser. Introduction to the Theory of Computation. PWS Publishing. 1997
- Research articles such as Journal of Theoretical Computer Science.

CSC6801482 • Advanced Computational Logic

This course lead students to propositional logic and first-order predicate logic in computer science perspective. Discussion focusses on syntax and semantics, various normal form, substitution and unification, proof procedures, such as resolution calculus, soundness, completeness and decidability, logic programming with PROLOG. After completing this course, students are expected to have enough knowledge and skill in Computational Logic, thus, they can apply it in diverse application in information technology field.

- Fitting, M., First Order Logic and Automated Theorem Proving, second edition, Springer Verlag, 1996.
- Gallier, J., Logic for Computer Science: Foundations of Automated Theorem Proving, Harper and Row, 1986.
- Hoelldobler, S., Logik und Logikprogrammierung, third edition, Synchron Publishers GmbH, Heidelberg, 2003.
- Bratko, I., PROLOG programming for Artificial Intelligence, third edition. Addison-Wesley, 2001.
- Jurnal ACM Transactions on Computational Logic.

CSC6801581 • Advanced Robotics

This course gives further discussion about robotics, specifically about autonomous robot. The course materials include all aspects in robotics and adapted to the latest update of researches in Universitas Indonesia.

- Roland Siegwart and Illah R. Nourbakhsh. Introduction to Autonomous Mobile Robots. The MIT Press, 2004.
- ODE (Open Dynamic Engine) <http://www.ode.org>

CSC6801582 • Advanced Computer Network

This course discus about the latest update in theory and technology of computer networks, from aspects closer to hardware and electronic level to application aspects in cloud computing and mobile network. Materials are adapted to the latest update of researches in Universitas Indonesia.

- Kurose, J.F., K.W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet 4th ed. Addison-Wesley, Boston, 2008.

CSC6801781 • Advanced IT Management

As business world keeps on expanding, more regulation, various behaviors, morals and ethics, the issue about corporate governance becomes more important. Even in some industries, such as banking, not only regulation corporate governance is strictly managed but also the IT governance. Thus, knowledge and skill in IT governance must be very essential for IS/IT professionals. This course gives student the understanding about various issues related to strategies and techniques in IT governance. Topics will

include but not limited to how IT governance relates to corporate governance, techniques in IT governance, implementation mechanisms, leadership aspects in IT governance, etc.

CSC6801880 • Advanced Information Systems

The development of Information System involves the understanding about user's needs of information and how the information system development can support the organization to reach its goals. Information system development should be an integrated approach to human-computer interaction hence adaptive information system can be accomplished. At last, information system should be able to increase competitiveness and keep its strategic position in an organization. This course aims to see the state-of-the-arts from related Information System researches. This course will focus more on the methodologies to develop information system so that it can improve the organization performance. Several approaches in methodology as well as various methods, techniques, processes, procedures and tools will be discussed in detail. Besides, this course also explores the information system's contribution from being just a supporting system, such as catering application, to being an enabler to push the profitability up in distinct ways, i.e. by producing information quality, increasing decision making performance and improving various resources.

- Avison, David and Fitzgerald, Guy, Information Systems Development: Methodologies, Techniques, and Tools, 3rd Edition, McGraw Hill. 2003.
- Journal of ACM Transactions on Information Systems.
- Journal of Information System Research.

CSC6801881 • Advanced Knowledge Management

This course discusses about theory and application of knowledge management including technology and tools used in managing knowledge, integrated with the management needs for effectively providing knowledge in an organization. This course also discusses about computer representation characteristics, access and the utilization of knowledge versus information in the context of human resources. Through this course, students are expected to understand the fundamental concept of knowledge, creation, acquisition, representation, distribution, management, usage and re-usage; to understand the knowledge's role and usage in an organization and institution, also typical obstacle that needs to be handled; to understand core concept, method, techniques and tools used in knowledge management; to understand how to use and to integrate components and functions of different systems of knowledge management; to prepare to learn further in knowledge creation, engineering, transfer, representation, organization, and sharing; also to evaluate current trends in knowledge management and its benefit to business and industry.

CSC6802180 • Advanced Numeric Computation

This course discusses development, performance evaluation and numerical algorithm implementation to solve a certain mathematic problem. Covered topics are current issues including, i.e. matrix computation (especially related to solving large scale matrix computation problems or storage related problem that needs certain treatment), solving differential equation (both initial and boundary value problems), optimization and approximation (especially related to large scale un-constrained optimization problems and polynomial-based approximation), application (including current issues about the implementation of numeric computation in real world, for instance, image/signal processing, information processing, medical engineering, modeling, etc.). This course is given in a self-study scheme where each student is required to choose a specific case for the class project. Review about theory and fundamental framework of numeric computation is given in the first four sessions. In the next sessions, students are required to present the result of their numerical studies or experiments.

- Higham, N.J., Accuracy and Stability of Numerical Algorithms, SIAM publication, 1996.
- Heath, M., Scientific Computing – an Introductory Survey, 2003.
- Siam Journal on Computing.

CSC6802280 • Advanced Software Engineering

This course discusses the advanced topics on software development from the requirement phase, analysis, design, to the implementation phase. To complete the practical skills, this course teaches UML- based

modelling (Unified Modeling Language) using specialized software. This lecture also teaches object-based development concepts to the software components.

- Humphrey, Watts S., *Managing the Software Process*, The SEI Series in Software Engineering, Addison-Wesley, 1989.
- Pressman, Roger S., *Software Engineering: A Practitioner's Approach*, McGraw-Hill, 199x.
- Jurnal IEEE Transactions on Software Engineering and Methodology.

CSC6802283 • Advanced Semantic Web

This course will discuss fully about semantic web, both on theory and practice to Web 2.0. The ontology concept will be studied here. The topics are adapted on the latest improvement and research undertaken by Universitas Indonesia.

- Pascal Hitzler, Markus Krotzsch, Sebastian Rudolph. *Foundations of Semantic Web Technologies*. Chapman & Hall/CRC, 2009.
- John Hebler, Matthew Fisher, Ryan Blace, Andrew Perez-Lopez. *Semantic Web Programming*. Wiley Publishing, 2009.
- Dean Allemang, Jim Hendler. *Semantic Web for the Working Ontologies*. Morgan Kaufmann, 2008.

CSC6802284 • Advanced Web Services

This course studies the development of web service technology and the implementation on the information systems. The architecture and standard rules of the web service will be explained completely. The detailed issues are adjusted on the ongoing research by Universitas Indonesia.

CSC6802382 • Advanced Information Retrieval

This course explains about research and development of information retrieval systems. It includes a review of the user's behaviour regarding the need of information and how the information retrieval can support this. The development of information retrieval is an integrated approach of the interaction between human and computer. The goal is to find an adaptive information retrieval system. This system can't be considered as a component, but it is interconnected and evolving to respond the changes of information retrieval urgency. Covered topics are information retrieval systems development: system component, data structures and file structures, text and query operations; various methods of information retrieval system development: the use of artificial intelligence in information retrieval; evaluation of information retrieval: Retrieval Evaluation, User Interface and Visualization, Digital Libraries.

- Baeza-Yates, Ricardo and Rebeiro-Neto, Berthier, *Modern Information Retrieval*, Addison-Wesley New York, NY, 1999.
- Jurnal Information Processing & Management: an International Journal.

CSC6802383 • Advanced Biomedical Informatics

The current topics about the application and benefit of computer science on biomedic will be the main topic discussed on this course. It will always be adjusted to the latest research and development especially that managed by Universitas Indonesia.

CSC6802384 • Advanced Data Spasial Analysis

This course discusses specific topics of spatial data analysis in research and development of Geographic Information System (GIS), which basic concepts, methodology, and applications are already given in GIS course. Data sharing is an important issue on GIS, yet in real the GIS databases had been built for various applications that can be accessed by network. The topics covered are the use of automata cellular concept and multi agent on GIS for dynamic modeling, spatial data (graphic) combination and non-spatial data (descriptive) techniques, the use of recent technique in speeding up the spatial query process and query of spatial database network. This course syllabus is highly depend on the status of current research topics.

- Lo, C.P., and Yeung, A.K.W., Concepts and Techniques of Geographics Information Systems, Prentice Hall, 2002.
- Jurnal IEEE transactions on Geoscience and Remote Sensing.

CSC6802481 • Advanced Computer Graphics

This course focused on the concepts and advanced techniques on Computer Graphics and Geometric Modelling, especially the shape representation schemes and algorithms. Some covered topics are affine spaces, polynomial curves and surfaces: Bezier scheme, spline curves and surfaces: B-spline scheme, blossoming concept dan technique (polar forms), subdivision surfaces, applications of geometric computing.

- Gallier, Jean H., Curves and Surfaces in Geometric Design: Theory and Algorithms, Morgan Kaufmann, 2000.

CSC6802483 • Advanced Information Security

This course discusses intensively about the latest improvement of Information Security and fundamental theory as a way to find out the current and future technology development. The issues will be adapted on the last research and progress done by Universitas Indonesia.

- Linda Volonino, Stephen Robinson. Principles and Practices of Information Security. Pearson, 2004.

CSC6802580 • Advanced Digital System Design

This course discusses the application and basic theory of modern digital system design in a large scale. The topics include FPGA, VHDL or other current progress based on the latest scientific paper.

High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices, Hall, Hall and McCall, Wiley.

- Digital Systems Engineering, Dally and Poulton, Cambridge.
- Synthesis and Scripting Techniques for Designing Multi-Asynchronous Clock Designs, Clifford E. Cummings, SNUG-2001. (Clock Domains and Synchronization) FPGA-Based System Design, Wayne Wolf, Prentice Hall PTR.

CSC6802680 • Advanced Enterprise Architecture and Systems

Enterprise Architecture Framework is commonly used by the industry. Therefore, it's important to know the ratio and analysis of some available framework. This course provide the basic knowledge of creating a framework for industry. The student of this course will have a strong basic on applying the rapid development of framework and ICT.

- How to Survive in the Jungle of Enterprise Architecture Frameworks: Creating or Choosing an Enterprise Architecture Framework Jaap Schekkerman Trafford Publishing ISBN 1-4120-1607-X, ISBN-13: 978-1412016070
- Enterprise Architecture As Strategy: Creating a Foundation for Business Execution Jeanne W. Ross, Peter Weill, David Robertson Harvard Business School Press ISBN-10: 1591398398, ISBN-13: 978-1591398394

CSC6802780 • Advanced Database Technology

This course provides a strong theoretical basis in aim to give a lesson about current database system. Students are not taught to use the technology, but they have to be able to understand and analyze the basic theory of the technology. The topics are adapted on the last research taking place in Universitas Indonesia.

- Elmasri and Navathe, Fundamental of Database Systems 4th Edition, Addison-Wesley, 2004

- Silberschatz, Korth and Sudarshan, Database System Concepts, 5th Edition, Mc Graw Hill, International Edition, 2006
- Connolly, Thomas and Begg, Carolyn: Database Systems 4th edition, Prentice Hall, 2005

CSC6802882 • Advanced E-Business & E-Government

This course assists student build the knowledge and skills on designing, guiding, and researching related to e-Bussiness and e-Government development (bussiness systems and goverment that utilize the communications and computation technology as its main competitive factor). This system includes concept and bussiness model, bussiness process, also the application of architecture and infrastructure. Specifically, this lecture explores the distributed application system technology and methods to integrate the bussiness process on one or more organizations. Several recent studies will be provided to give the insight about success factors and general patterns of an e-Bussiness and e-Government design.

7 Manager and Lecturer

7.1 Manager

Dean of Faculty of Computer Science	: Mirna Adriani, Ph.D.
Vice Dean for Education, Research, and Student Affairs	: Petrus Mursanto, Dr.
Vice Dean for Resources, Venture, and General Administration	: Prof. A. Nizar Hidayanto, Dr.
Coordinator of Master and Doctoral Program of Computer Science	: Prof. Wisnu Jatmiko, Dr. Eng.
Manager of Academic and Student Affairs	: Dr. Dina Chahyati, S.Kom., M.Kom.
Administrative Staff	: Rita Prihandanari Dewi Ambarwati

7.2 Lecturer

Prof. Achmad Nizar Hidayanto, S.Kom., M.Kom., Dr.
Prof. Aniasi Murni Arymurthy, Ir., M.Sc., Dr.
Prof. Belawati H. Widjaja, Dra., M.Sc., Ph.D.
Prof. Eko Kuswardono Budiardjo, Ir., M.Sc., Dr.
Prof. Heru Suhartanto, Drs., M.Sc., Ph.D.
Prof. T. Basaruddin, Drs., M.Sc., Ph.D.
Prof. Wisnu Jatmiko, S.T., M.Kom., Dr. Eng.
Prof. Yudho Giri Sucahyo, S.Kom., M.Kom., Ph.D.
Ade Azurat, S.Kom., Dr.
Adhi Yuniarto Laurentius Yohanes, Ir., M.Kom.
Adila Alfa Krisnadhi, S.Kom., M.Sc., Ph.D.
Amril Syalim, S.Kom., M.Eng., Ph.D.
Ari Saptawijaya, S.Kom., M.C.S., Ph.D.
Ave Adriana Pinem, S.Kom., M.Kom.
Bayu Anggoroajati, S.T., M.Sc., Ph.D.
Betty Purwandari, S.Kom., M.Sc., Ph.D.
Bob Hardian Syahbuddin, Ir., M.Kom., Ph.D.
Bobby Achiril Awal Nazief, Drs., M.Sc., Ph.D.
Dadan Hardianto, S.Kom, M.Kom.
Dana Indra Sensuse, Ir., M.LIS, Ph.D.
Denny, S.Kom., M.I.T., Ph.D.
Dina Chahyati, S.Kom., M.Kom., Dr.
Erdefi Rakun, Ir., M.Sc., Dr.
Fariz Darari, S.Kom, M.Sc., Ph.D.
Fatimah Azzahro, S. Kom., M.Sc.
Gladhi Guarddin, S.Kom., M.Kom.
Harry Budi Santoso, S.Kom., M.Kom., Ph.D.
Heri Kurniawan, S.Kom., M.Kom.
Ik Wilarso, dr., MTI.
Ika Alfina, S.Kom., M.Kom.
Indra Budi, S.Kom., M.Kom., Dr.
Kasiyah, Dra., M.Sc., Dr.
Lim Yohanes Stefanus, Drs., M.Math., Ph.D.
M. Ivan Fanany, S.Si., M.Kom., Ph.D.
Mirna Adriani, Dra., Ph.D.
Muhammad Rifki Shihab, B.B.A., M.Sc.
Petrus Mursanto, Ir., M.Sc., Dr.
Puspa Indahati Sandhyaduhita, S.T., M.Sc.
Putu Wuri Handayani, S.Kom., M.Sc., Dr.
R. Yugo Kartono Isal, Drs., M.Sc., Dr.
Rahmat Mustafa Samik-Ibrahim, S.Si., M.Kom.

Rizal Fathoni Aji, S.Kom., M.Kom., Dr.
Satrio Baskoro Yudhoatmojo, S.Kom., M.T.I.
Setiadi Yazid, Ir., M.Sc., Ph.D.
Siti Aminah, S.Kom., M.Kom.
Suryana Setiawan, Ir., M.Sc., Ph.D
Wahyu Catur Wibowo, Ir., M.Sc., Ph.D.
Widia Resti Fitriani, S.Kom., M.Kom.
Widijanto Satyo Nugroho, Drs., M.Math., Ph.D.
Yova Ruldeviyani, S.Kom., M.Kom.

8 Facility

8.1 Laboratories

Research laboratories related to Master Degree Program includes Digital Library and Distance Learning Laboratory, Reliable Software Engineering Laboratory, Computer Networks, Architecture and High Performance Computing Laboratory, Machine Learning and Computer Vision Laboratory, Information Retrieval Laboratory, Information Management Laboratory, E-Government and E-Business Laboratory. Each of them is equipped with personal computers and other specific equipments.

8.2 SCELE

To support teaching-learning activities, CS UI uses an online system called SCELE (Student-Centered E-Learning Environment). SCELE is developed based on Moodle open source learning management system. Via SCELE, students, lecturers and academic staff may access course materials, assignments (including submitting assignments), forums to facilitate communications between lecturers and students, and many other beneficial facilities. SCELE can be accessed through the following link <http://scele.cs.ui.ac.id>.

8.3 Access to Publication

To broader the literature study, UI provides the full access to national as well as to international databases consist of journal articles and conference papers, such as: SCOPUS, IEEEExplorer, ScienceDirect, EBSCO, PubMed, ACM, etc. These access is limited only for internal use inside Universitas Indonesia Campuses. Should lecturers, students and academic staff need the access from outside the campuses, they still can access it via the following link <https://remote-lib.ui.ac.id/login>.

8.4 Journals and Conferences Organized by CS UI

To accommodate CS UI students to publish their articles to national and international publication, CS UI organizes the following journals and conferences:

■ *Journal of Computer Science and Information Systems (JIKI)*

Journal of Computer Science and Information Systems or *Jurnal Ilmu Komputer dan Informasi* (JIKI) is a scientific journal in computer science and information containing the scientific literature on studies of pure and applied research in computer science and information and public review of the development of theory, method and applied sciences related to the subject. JIKI is issued 2 (two) times a year in February and June. This journal contains research articles and scientific studies. It can be obtained directly through the Library of the Faculty of Computer Science Universitas Indonesia. JIKI is accredited by the Ministry for Research, Technology and Higher Education (No:60/E/KPT/2016).

■ *Journal of Information Systems (JSI)*

Jurnal Sistem Informasi (JSI) aims to provide scientific literatures on studies of pure and applied research in information systems (IS)/information technology (IT) and public review of the development of theory, method and applied sciences related to the subject. JSI is projected to facilitate not only local researchers but also international researchers to publish their works either in Indonesian or English. JSI is accredited by the Ministry for Research, Technology and Higher Education (No:51/E/KPT/2017).

■ *International Conference on Advanced Computer Science and Information Systems (ICACISIS)*

ICACISIS provides an international forum that brings together those who are actively involved in the field of Computer Science and Information System to report on up-to-the-minute innovations and developments, to summarize the state-of-the-art, and to exchange ideas and advances in all aspects of systems engineering, human machine interface, and emerging applications.

■ *International Workshop on Big-Data and Information Security (IWBIS)*

IWBIS is an international forum that is designed to examine key critical innovations on the research of Big Data and Information Security areas. IWBIS wants to make a strong relationship between academics, engineers, scientists, and professionals to present their ideas and experiences in the fields of Big Data and Information Security. IEEE IWBIS welcomes paper submissions on innovative work from researchers in academia, industry and government describing original research work in Big Data and Information Security.

8.5 Library

Faculty of Computer Science Library which is located in UI Depok Campus is equipped with the following facilities:

■ *Books Collection*

CS UP's library collections is made up of approximately 11,000 books, magazines, journals, and research papers, including theses and student project reports. A digital library collection is also available, along with the supporting on-line services, that is called LONTAR.

Book borrowing service in CS UP's Library is a close system, means borrowers have no direct access to the book collection. Instead, borrowers need to contact the staff for assistance.

■ *Software and Manuals Collection*

This part contains software used in computer system in CS UI and the manual documentary. Manual documentary collection is available in open system, while software collection is in close system. Should students and academic staff need to access to any software, they may contact the librarians for assistance. Software collections are restricted to use in CS UI area only.

Besides, CS UI Building is located near The Crystal of Knowledge Building where Universitas Indonesia's Main Library is located in.

8.6 Building

The campus of Faculty of Computer Science is located in Universitas Indonesia Depok Campus, West Java. It captivates three buildings, i.e. A Building with two floors, B Building with six floors, and C Building with three floors. The total area of the buildings is approximately 10,000 meter square. A Building is utilized as open use computer laboratories available for all students, staff rooms also some rooms designated for Computer Technical Services Units. B Building is utilized as library, academic administration and student affairs office, also classrooms. C Building is utilized as research laboratories, staff rooms, and some rooms designated for Computer Technical Services Units.

8.7 Praying Room

The faculty has a praying room with air conditioner located in B Building 2nd Floor. It is facilitated with ablution room available separately for male and female.



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