**Knowledge Engineering**

Lecturer: Professor Gavrilova Tatiana Albertovna, DSc, head of Information Technologies in Management Department, tavrilova@gsom.pu.ru  
Bachelor Program in Management, Spring Semester 2008/2009 Academic Year

**Course Summary**

This is a 4th year Bachelor Program course  
Course Layout: The class will feature lectures, discussions, short tests and students will have hands-on practice using mind-mapping and concept mapping software. Student would prepare a short paper and presentation based on it. *(lectures, guest lectures, discussion sessions (seminars), hands-on training sessions, assignments, projects, essay writing, case studies and so on.)*

**General Course Goals and Objectives**

Students will be introduced to major issues in the field and to the role of the knowledge analyst in strategic information system development. Attention will be given to relating knowledge engineering to other professional areas, e.g., information management and business administration.  
Students will gain an understanding the role of knowledge engineering and knowledge management in companies and organizations; in decision-making by members of an organization. The main learning outcome will be the practical skill of visual business information structuring with the use of special software (mind mapping and concept mapping).  
The course features the knowledge engineering as the methodology of data and knowledge processing. Knowledge engineering will be defined as an information elicitation and structuring methodology for different domains.  
The course will examine a number of related topics, such as:  
- system analysis and its applications;  
- the relationship among, and roles of, data, information, and knowledge in different applications including marketing and management, and the varying approaches needed to ensure their effective implementation and deployment;  
- characteristics of theoretical and methodological topics of knowledge acquisition, including the principles, visual methods, issues, and programs;  
- defining and identifying of cognitive aspects for knowledge modelling and visual representation (mind mapping and concept mapping techniques).
Topics Covered

- **Topic 1.** *Brief Introduction to Systems Analysis and Information management.* Systems, elements, relations, hierarchy. Information Management: modern approach. History: brief synopsis of evolution. Main branches of SA and IM. Information work


- **Topic 5.** *Theoretical issues and Practical aspects of KE.* Psychological, linguistic and methodological issues. Classification and practice of KE methods. Knowledge structuring techniques. Knowledge Representation


- **Topic 7.** Knowledge Management (KM). Traditional approach and definition. Social and organizational aspects of KM. Cognitive problems of KM. Knowledge sharing techniques. Corporate memory. Corporate knowledge lifecycle. IT-Tools for KM. KM management and company culture. Modern examples and case study management and etc.
## Outline of Overall Course Structure

### Topic 1. Brief Introduction to Systems Analysis and Information management

<table>
<thead>
<tr>
<th>Session 1.</th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-Course Assignment</strong></td>
<td>Reading Assignment for Session 1: Paper 1 from Compendium - Chapter 1 from the book DOCUMENT ENGINEERING by Glushko R. &amp; McGrath T. The MIT Press 2005.</td>
</tr>
<tr>
<td><strong>Date</strong></td>
<td>Issues covered:</td>
</tr>
<tr>
<td><strong>Time</strong></td>
<td>- Systems, elements, relations, hierarchy.</td>
</tr>
<tr>
<td><strong>Classroom</strong></td>
<td>- Information Management: modern approach.</td>
</tr>
<tr>
<td><strong>Issues covered:</strong></td>
<td>Intended learning outcomes: After this session you should be able to…</td>
</tr>
<tr>
<td></td>
<td>- Understand main paradigms of SA</td>
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<tr>
<td></td>
<td>- Explain why a systems approach is important</td>
</tr>
<tr>
<td></td>
<td>- Know main trends of IM</td>
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<tr>
<td><strong>Assignment for Session 2:</strong></td>
<td># Reading Assignment: Chapter 13 from Glushko (paper 5 from compendium).</td>
</tr>
<tr>
<td></td>
<td># Tasks and exercises: prepare well-structured CV.</td>
</tr>
</tbody>
</table>

### Session 2.

<table>
<thead>
<tr>
<th>Date</th>
<th>Issues covered:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>- History: brief synopsis of evolution.</td>
</tr>
<tr>
<td>Classroom</td>
<td>- Main branches of SA and IM. Information work</td>
</tr>
<tr>
<td><strong>Issues covered:</strong></td>
<td>Intended learning outcomes: After this session you should be able to…</td>
</tr>
<tr>
<td></td>
<td>- Understand and use SA</td>
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<tr>
<td></td>
<td>- Know main branches of IM</td>
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<tr>
<td></td>
<td>- Have basic skills in information work</td>
</tr>
<tr>
<td><strong>Assignment for Session 3:</strong></td>
<td># Reading Assignment: Глава 1. Гаврилова Т.А., Хорошевский В.Ф. Базы знаний интеллектуальных систем. Учебник.-СПб, Изд-во «Питер», 2001.</td>
</tr>
<tr>
<td></td>
<td># Tasks and exercises: make a visual systemic map of information you use in your life.</td>
</tr>
</tbody>
</table>

### Topic 2. Intelligent technologies in IM.

<table>
<thead>
<tr>
<th>Session 3.</th>
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<tbody>
<tr>
<td><strong>Date</strong></td>
<td>Issues covered:</td>
</tr>
<tr>
<td><strong>Time</strong></td>
<td>- Short history.</td>
</tr>
<tr>
<td><strong>Classroom</strong></td>
<td>- Knowledge-based systems.</td>
</tr>
<tr>
<td><strong>Issues covered:</strong></td>
<td>- Expert systems.</td>
</tr>
<tr>
<td></td>
<td>Intended learning outcomes: After this session you should be able to…</td>
</tr>
<tr>
<td></td>
<td>- Understand what is knowledge-based system</td>
</tr>
<tr>
<td></td>
<td>- Know the main applications of expert systems</td>
</tr>
<tr>
<td><strong>Assignment for Session 4:</strong></td>
<td># Reading Assignment : Глава 2 (п.2.1-2.2). Гаврилова Т.А., Хорошевский В.Ф. Базы знаний интеллектуальных систем. Учебник.-СПб, Изд-во «Питер», 2001.</td>
</tr>
</tbody>
</table>
### Tasks and exercises

Make INTENSIONAL AND EXTENSIONAL definitions of a concept (bird, book, bus, bag, etc.).

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### Session 4.

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<th>Date</th>
<th>Time</th>
<th>Classroom</th>
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**Issues covered:**
- Data mining and Knowledge discovery

**Intended learning outcomes:** After this session you should be able to…
- Have general understanding and scope of ML and DM
- Know the market of DM tools

**Assignment for Session 5:**
- Reading Assignment: Site by Tony Busen on mind mapping.
- Tasks and exercises: Make a visual draft of computer science history in Visio via cause–and effect diagram on the basis of main facts given in the task.

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### Topic 3. Introduction to Knowledge Engineering (KE) and Visual Approach.

### Session 5.

<table>
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<tr>
<th>Date</th>
<th>Time</th>
<th>Classroom</th>
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</table>

**Issues covered:**
- Knowledge and data.
- Practical knowledge structuring: visual approach.
- Mental models.
- Mind maps and mind-mapping tools.

**Intended learning outcomes:** After this session you should be able to…
- Use practically mind mapping
- Use software tools Mind Manager™ and FreeMind

**Assignment for Session 4:**
- Tasks and exercises: 1) Draw a mind map of UNIVERSITY. 2) Use Freemind tool to design your visual CV in a form of a mind map.

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### Session 6.

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<th>Date</th>
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**Issues covered:**
- Concept maps and tools.
- Roadmaps and knowledge maps

**Intended learning outcomes:** After this session you should be able to…
- Use concept mapping techniques.
- Use software tools Cmap ©

**Assignment for Session 5:**
- Reading Assignment: Compendium –part 3 of hand-outs.
- Tasks and exercises: create a concept map for a sentence “EVTEK Company will implement an expensive CRM system into routine daily performance due to the end of 2008”.
**Topic 4. Knowledge representation and practical knowledge engineering.**

<table>
<thead>
<tr>
<th>Session 7.</th>
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</thead>
</table>
| Date | Issues covered:  
- Knowledge models classification.  
- Knowledge engineer and development team.  |
| Time | Intended learning outcomes: After this session you should be able to…  
- Create semantic networks, frames and rule-based models |
| Classroom | Assignment for Session 4:  
# Reading Assignment: Глава 2 (пп. 2.3-2.5) Гаврилова Т.А., Хорошевский В.Ф. Базы знаний интеллектуальных систем. Учебник.- СПб, Изд-во «Питер», 2001  
# Tasks and exercises: 1) draw a SEMANTIC NETWORK “Shopping” using C map tool, 2) write down the RULE-BASED MODEL “What gift to bring for a birthday”. |

<table>
<thead>
<tr>
<th>Session 8.</th>
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</table>
| Date | Issues covered:  
- Portrait of knowledge engineer and knowledge manager: psychological and professional profile.  |
| Time | Intended learning outcomes: After this session you should be able to…  
- Think creatively about and understand the strategic role of knowledge acquisition techniques in information processing and the role of information analysts in this area. |
| Classroom | Assignment for Session 5:  
# Reading Assignment: paper 8 from the compendium “Advancement, voluntary turnover and women in IT: A cognitive study of work–family conflict” by Deborah J. Armstrong, Cynthia K. Riemenschneider, Myria W. Allen, Margaret F. Reid  
# Tasks and exercises: create a concept map “VACATIONS” using C-map tool. |

**Topic 4. Intelligent technologies in IM.**

<table>
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<tr>
<th>Session 9.</th>
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</thead>
</table>
| Date | Issues covered:  
- Short history.  
- Knowledge-based systems.  
- Expert systems.  |
| Time | Intended learning outcomes: After this session you should be able to…  
- Recognise any intelligent system  
- Name main factors of effective expert system development  
- Know the lifecycle in intelligent system development |
| Classroom | Assignment for Session 4:  
# Reading Assignment: Глава 3 (первые 3 параграфа). |
### Session 10.

<table>
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<th>Date</th>
<th>Time</th>
<th>Classroom</th>
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</table>

**Issues covered:**
- Data mining and Knowledge discovery

**Intended learning outcomes:** After this session you should be able to...
- Know main trends and approaches to DM

**Assignment for Session 5:**
- Reading Assignment: Глава 3. Гаврилова Т.А., Хорошевский В.Ф. Базы знаний интеллектуальных систем. Учебник.- СПб, Изд-во «Питер», 2001
- Tasks and exercises: 1) create DECISION TABLE “What clothes to put on when going out?”,
  2) create DECISION TREE “Preparing a birthday party”.

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### Topic 5. Theoretical issues and Practical aspects of KE.

**Session 11.**

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**Issues covered:**
- Psychological issue of KE,
- Linguistic issue of KE
- Methodological issue of KE.

**Intended learning outcomes:** After this session you should be able to...
- Understand main levels of KE structure
- Use methodological and professional tips of KE

**Assignment for Session 4:**
- Reading Assignment: Глава 4. Гаврилова Т.А., Хорошевский В.Ф. Базы знаний интеллектуальных систем. Учебник.- СПб, Изд-во «Питер», 2001
- Tasks and exercises: 1)Work out the FRAME for a concept “News paper”.
  2) Extract knowledge from the given text.

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### Session 12.

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**Issues covered:**
- Classification and practice of KE methods.
- Knowledge structuring techniques.
- Knowledge Representation

**Intended learning outcomes:** After this session you should be able to...
- Understand and use different approaches to knowledge representation models as a key knowledge engineering concept and as an underlying theme for knowledge management.
• **Topic 6. Ontological Engineering.**

**Session 13.**

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**Issues covered:**
- Semantic ontology design: step by step.
- Algorithms and tips for visual design of ontologies.

**Intended learning outcomes:** After this session you should be able to...
- Create taxonomy, partonomy, genealogy and other types of corporate ontologies.

**Assignment for Session 14:**

- Reading Assignment: paper 7 from the compendium “Information technology as a facilitator for enhancing dynamic capabilities through knowledge management” by Peter J. Shera & Vivid C. Leea

- Tasks and exercises: Describe the LINGUISTIC VARIABLE “Price of a gift” as a group of fuzzy sets, and describe one set using the basic scale.

**Session 14.**

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</table>

**Issues covered:**
- Ontologies as a kernel of knowledge management.
- Taxonomy and development of corporate ontologies.
- Visual tools for ontology development

**Intended learning outcomes:** After this session you should be able to...
- Have skills to use visual tools for ontology design and development.
- Know Gestalt principles of good shape.

**Assignment for Session 15:**

- Reading Assignment: 1) Any papers on KM by Gomez-Peres or Dieter Fensel.
- 2) Paper 6 from the compendium – “A Delphi study of knowledge management systems: Scope and requirements” by Dorit Nevo & Yolande E. Chan

- Tasks and exercises: Create ontology of a conception “Management”.

**Topic 7.**

**Session 15.**

<table>
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<tr>
<th>Date</th>
<th>Time</th>
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**Issues covered:**
- Knowledge Management (KM).
Classroom.

- Social and organizational aspects of KM.
- Cognitive problems of KM.
- Corporate memory.
- Corporate knowledge lifecycle.
- KM management and company culture.
- Modern examples and case study management and etc.

Intended learning outcomes: After this session you should be able to…
- Understand traditional approach and definition of KM.
- Use the knowledge sharing techniques
- Have general ideas about IT-Tools for KM and market of these tools.

Topics for analytical overviews (papers & presentations):
1. Semantic Web technologies
2. Systems analysis today
3. Knowledge Elicitation Techniques
4. Knowledge Engineering approaches
5. Business Intelligence
6. Ontology Design methods
8. Information Management and Knowledge Engineering
9. Knowledge Engineering Component in Knowledge Management
10. ES in law
11. ES in marketing
12. ES in education
13. ES in finance
14. Decision support ES
15. Intelligent Agents
16. Concept maps in practice
17. Knowledge Management Market
18. Corporate Memory
19. Knowledge Portal
20. Knowledge Sharing
21. Role of CIO
22. Role of CKO
23. ES market
24. Intelligent Enterprise
25. ES in economics
26. ES in finance
27. IT in management: new trends
28. ERP systems :critical view
29. E-commerce: problems and success stories
30. IT in finance
31. IT in marketing
32. IT in law

Consultations:
T.Gavrilova, Tuesday, 16:00-18:00, room 415.

General Course Requirements

Mid-term exam: March 30
Pre-examination tutorial: 2 days before Zachot
Final Zachot: May 25
Final Exam results: 2 days after exam
Deadlines for submitting assignments (exercises, projects, presentations etc)

<table>
<thead>
<tr>
<th>Assessment output</th>
</tr>
</thead>
<tbody>
<tr>
<td># All types of current assessment procedures (midterm assessment, paper, presentations, exercises and tests in the class, homeworks).</td>
</tr>
<tr>
<td># Final assessment – Zachot.</td>
</tr>
<tr>
<td># Grading requirements (indicate the percentage of the course grade that each assignment will be worth) 20% - fulfilment of tasks, 10% - paper, 10% - presentation, 60% - midterm + final Zachot.</td>
</tr>
</tbody>
</table>

### Basic Reading (not more than 3 core textbooks + compendium)


*Compendium on the course.*

### Supplementary Reading

- *Novak, Joseph D. The Theory Underlying Concept Maps and How To Construct Them, Original material at* http://cmap.coginst.uwf.edu/info/printer.html