707.009
Foundations of Knowledge Management
„Overview and Motivation“

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About me

Education:
• 2002 - 2004 PhD. in Knowledge Management, Faculty of Computer Science, TU Graz
• 1997 - 2002 M.Sc., Telematik, TU Graz

Background:
• July 2007 - present: Ass. Prof. (Univ.Ass.), TU Graz, Austria
• 2006 - 2007 Post-Doc, University of Toronto, Canada
• 2002 - 2006 Researcher, Know-Center, Austria
About me

Research Interests:
• Web Science with a focus on networks, Social Computing and knowledge transfer
• Intentional Structures and Representations on the Web

Interesting topics for projects, Bachelor/Master/PhD thesis:
• If you are interested in the topics of this course, it is likely that you are interested in doing a project / a thesis with me as well. Contact me to discuss opportunities.
Overview

Agenda

- Welcome & Introduction
- Course organization
- KM Motivation
- Course overview
- Course highlights
Teaching @ KMI

**Introduction to KM**
KM Orientation and Overview
Klaus Tochtermann
2. Semester, Softwareentwicklung-Wirtschaft
707.012, 2 VO

**Web-Science & WT**
Network Theory, Social Networks, Web Technologies
Markus Strohmaier
6. Semester, Softwareentwicklung-Wirtschaft
707.000, 2 VU

**Foundations of KM**
Theories of KM, KM Processes
Markus Strohmaier
7. Semester, Softwareentwicklung-Wirtschaft
707.009, 2 VO

**Knowledge Technologies**
Ontologies and Semantic Technologies
Michael Granitzer
7./9. Semester, Softwareentwicklung-Wirtschaft
707.011, 2 VU

**Applications of KM**
Selected Topics, Real-World Applications
Markus Strohmaier, Michael Granitzer
8. Semester, Softwareentwicklung-Wirtschaft
707.010, 2 VO

+ Project Information Systems, Bachelor Thesis „Informatik“, Bachelor Thesis „Telematik“, Seminar/Project Knowledge Management, Master Project, Master Thesis
Course Context

• 707.009 Foundations of Knowledge Management
  – 2nd year as a „VL“
  – Has been held as a „VU“ before

• Part of studies „Software Engineering & Business“
  – Master studies, 7th semester
Goals I

At the end of the course, you should know about and understand different
• kinds of knowledge
• types of knowledge transfer
• perspectives on knowledge management
• types of knowledge organization
• types of knowledge acquisition techniques
• types of knowledge repositories
• types of knowledge-based analysis techniques

And you should be able
to distinguish between them, preliminarily assess their relevance for given contexts and apply them selectively
Non-Goals

In the research community, there is no broad consensus regarding the theoretical foundations of a „Scientific Discipline of Knowledge Management“.

So the topics of this course are subjectively selective.

Instead of giving an authoritative account of KM, this course aims to give an overview of prominent, interesting and fundamental research results generated by the field of KM so far.
Course Organization and Logistics

- **Lectures**
  
  *in most weeks: Monday, 12:15 - 13:45,*
  October 2008 - January 2009,
  Room HS Modul (Inffeldgasse 21a, Ground Floor)

Exceptions! (and updates)

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Room</th>
<th>Type</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.10.2008</td>
<td>12:00 - 14:00</td>
<td>HS12</td>
<td>Abh.</td>
<td></td>
</tr>
<tr>
<td>7.10.2008</td>
<td>12:00 - 14:00</td>
<td>HS12</td>
<td>Abh.</td>
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<td>HS12</td>
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<td>Modul</td>
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<td>Abh.</td>
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<td>HS Modul</td>
<td>Abh.</td>
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<tr>
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<td>HS Modul</td>
<td>Abh.</td>
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<td>14:00 - 16:00</td>
<td>HS12</td>
<td>Abh.</td>
<td></td>
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</table>

Final Exam
Course Organization and Logistics

- **Language**: English/German


- **Enroll!**
  You need to enroll for this course via TUG online!

- **Readings**
  Password to access protected documents on the course website:
Grading

So how do you receive a grade in this course?
  – There will be one **written exam** at the end of each semester (Standard). No limit on the number of students that can take the exam
  – Two dates for **oral exams** (limited seats - First come, first serve)

➤ *See policy on course website for more details*

What will be part of the exam?
  – Contents of slides **AND** weekly readings

How does class attendance affect your grade?
  Indirectly:
  – Slides only capture a part of the course content, **Type of Exam Questions**
  – In class, we will discuss issues from the weekly readings
  – The papers discussed in the weekly readings will be part of the final exam
  – Participating will likely increase your understanding of the subject
  – Extra points to be earned during the course (for this semester’s written exam)
Course Information

Please find **further information** about the course at

Recommended Literature

There is no required text book for this course, however you might find it helpful to have a look at the following resources:

- An Illustrated Guide to Knowledge Management (For Practitioners), Knowledge Management Forum Graz, 2003
- Plus literature listed on the course website (weekly readings)
Questions?

Raise them **NOW**!

Or ask them later:
- At the end of each class
- Via e-mail: markus.strohmaier @ tugraz.at

(now would be a good time though)
Let‘s start!
- Knowledge Management –

(it‘s all about questions today)
Knowledge Management - Motivation

NASA to unveil moon plan
Agency plans to send 4 astronauts to the moon in 2018
By Brian Berger
SPACE.com
Thursday, September 15, 2005: Posted 11:46 a.m. EDT (15:46 GMT)

NASA has targeted 2018 for its first human lunar landing since Apollo 17 in 1972.

NASA has targeted 2018 for its first human lunar landing since Apollo 17 in 1972.

Copyright © NASA, Apollo 11 mission
Why YOU should you learn about KM [Yu 2007]

Most KM initiatives presuppose technology support.

- You (computer scientists) are expect to provide it.
- Do we have the right methods and tools?

Software engineering work is itself knowledge-intensive.

- We should apply KM concepts to analyze and improve software engineering – software development, deployment, evolution, etc.

Often, software projects do not fail because of technological reasons

- What kind of knowledge plays a role in software engineering? What are the implications of mis-management?
What do enterprises think?

- Survey of CEOs

Which of the following areas of activity offer the greatest potential for productivity gains over the next 15 years? Select up to three activities. (% respondents)

- Knowledge management: 43%
- Customer service and support: 35%
- Operations and production processes: 29%
- Strategy and business development: 29%
- Marketing and sales activities: 28%
- Human resource management and training: 23%
- Corporate performance management: 22%
- Product development: 19%
- Financial management and reporting: 17%
- Supply-chain management: 17%
- Risk management and compliance: 14%
- Procurement: 10%

Source: Economist Intelligence Unit survey, 2005.
Motivation

Organizational work becomes increasingly knowledge intensive and complex. [Eppler 1999]

Knowledge Intensity:
- Learning time
- Half life
- Decision scope
- Agent impact

Complexity:
- Process steps
- Involved agents
- Interdependency
- Process dynamic

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2008
Factors determining Knowledge Work
[Drucker 1999]

- Knowledge about the task
- Autonomy
  - Knowledge workers have to manage themselves, they have autonomy
- Continuing innovation
- Continuous learning and teaching
- Quality at least as important as quantity
- Motivation
  - It requires that knowledge workers want to work for the organization
Knowledge in Computing & Info Systems [Yu 2007]

Trend is toward (increasingly explicit) “knowledge representation” in systems

- Programs 1960’s-
- Database schemas (data independence from programs) 1970’s-
- Conceptual data modeling (domains, enterprises) 1980’s-
- Knowledge-based systems (knowledge about world separate from inference engine) 1980’s-
- Knowledge sharing among systems (“ontologies”) 1990’s-
- Software agents 1990’s-
- Semantic web 2000’s-
- …
How much information is being produced?
http://www2.sims.berkeley.edu/research/projects/how-much-info-2003/

In 2003

• The **World Wide Web** contains about 170 **terabytes** of information on its surface; in volume this is **seventeen times** the size of the Library of Congress print collections.

• **Instant messaging** generates **five billion messages a day** (750GB), or 274 Terabytes a year.

• **Email** generates about **400,000 terabytes** of new information each year worldwide.

• **P2P file exchange** on the Internet is growing rapidly. Seven percent of users provide files for sharing, while 93% of P2P users only download files. The largest files exchanged are video files larger than 100 MB, but the most frequently exchanged files contain music (MP3 files).
## How much information is being produced?

http://www2.sims.berkeley.edu/research/projects/how-much-info-2003/

### Table 1.2: Worldwide production of original information, if stored digitally, in terabytes circa 2002. Upper estimates assume information is digitally scanned, lower estimates assume digital content has been compressed.

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper</td>
<td>1,634</td>
<td>327</td>
<td>1,200</td>
<td>240</td>
<td>36%</td>
</tr>
<tr>
<td>Film</td>
<td>420,254</td>
<td>76,69</td>
<td>431,690</td>
<td>58,209</td>
<td>-3%</td>
</tr>
<tr>
<td>Magnetic</td>
<td>5187130</td>
<td>3,416,230</td>
<td>2,779,760</td>
<td>2,073,760</td>
<td>87%</td>
</tr>
<tr>
<td>Optical</td>
<td>103</td>
<td>51</td>
<td>81</td>
<td>29</td>
<td>28%</td>
</tr>
<tr>
<td><strong>TOTAL:</strong></td>
<td><strong>5,609,121</strong></td>
<td><strong>3,416,281</strong></td>
<td><strong>3,212,731</strong></td>
<td><strong>2,132,238</strong></td>
<td><strong>74.5%</strong></td>
</tr>
</tbody>
</table>

*Source: How much information 2003*
## How much information is being produced?


### Table 1.1: How Big is an Exabyte?

<table>
<thead>
<tr>
<th>Kilobyte (KB)</th>
<th>1,000 bytes OR $10^3$ bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 Kilobytes: A Typewritten page.</td>
</tr>
<tr>
<td></td>
<td>100 Kilobytes: A low-resolution photograph.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Megabyte (MB)</th>
<th>1,000,000 bytes OR $10^6$ bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 Megabyte: A small novel OR a 3.5 inch floppy disk.</td>
</tr>
<tr>
<td></td>
<td><strong>2 Megabytes: A high-resolution photograph.</strong></td>
</tr>
<tr>
<td></td>
<td>5 Megabytes: The complete works of Shakespeare.</td>
</tr>
<tr>
<td></td>
<td>10 Megabytes: A minute of high-fidelity sound.</td>
</tr>
<tr>
<td></td>
<td>100 Megabytes: 1 meter of shelved books.</td>
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<tr>
<td></td>
<td>500 Megabytes: A CD-ROM.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Gigabyte (GB)</th>
<th>1,000,000,000 bytes OR $10^9$ bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>1 Gigabyte: a pickup truck filled with books.</strong></td>
</tr>
<tr>
<td></td>
<td>20 Gigabytes: A good collection of the works of Beethoven.</td>
</tr>
<tr>
<td></td>
<td>100 Gigabytes: A library floor of academic journals.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Terabyte (TB)</th>
<th>1,000,000,000,000 bytes OR $10^{12}$ bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 Terabyte: 50000 trees made into paper and printed.</td>
</tr>
<tr>
<td></td>
<td><strong>2 Terabytes: An academic research library.</strong></td>
</tr>
<tr>
<td></td>
<td><strong>10 Terabytes: The print collections of the U.S. Library of Congress</strong></td>
</tr>
<tr>
<td></td>
<td><strong>400 Terabytes: National Climactic Data Center (NOAA) database.</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Petabyte (PB)</th>
<th>1,000,000,000,000,000 bytes OR $10^{15}$ bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>1 Petabyte: 3 years of EOS data (2001).</strong></td>
</tr>
<tr>
<td></td>
<td><strong>2 Petabytes: All U.S. academic research libraries.</strong></td>
</tr>
<tr>
<td></td>
<td><strong>20 Petabytes: Production of hard-disk drives in 1995.</strong></td>
</tr>
<tr>
<td></td>
<td><strong>200 Petabytes: All printed material.</strong></td>
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<table>
<thead>
<tr>
<th>Exabyte (EB)</th>
<th>1,000,000,000,000,000,000 bytes OR $10^{18}$ bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>2 Exabytes: Total volume of information generated in 1999.</strong></td>
</tr>
<tr>
<td></td>
<td><strong>5 Exabytes: All words ever spoken by human beings.</strong></td>
</tr>
</tbody>
</table>

Source: Many of these examples were taken from Roy Williams’ Data Powers of Ten web page at Caltech.
Categorization: The DMOZ Project

What's wrong with this picture?
Sergey Brin’s Blog

THURSDAY, SEPTEMBER 18, 2008

LRRK2

For more than 20 years, my mother has worked very hard to keep the pain in her hands and other symptoms at bay. As her mysterious symptoms progressed it varied and so forth. It was only after visits to many specialists and tests -- Parkinson’s Disease. Since there is no cure -- we only grew certain as those symptoms developed.

My mother had always been haunted by Parkinson’s disease. She would often reason with me that since Parkinson’s is not hereditary, Parkinson’s incidence among close relatives, so she was safe.

In 2004, my wife, Anne, introduced me to her future cofounders in 23andMe as they were studying the genetics of Parkinson’s Disease. As with my mother’s fear, I was skeptical about the study. I reasoned that if there was much to be learned about Parkinson’s in the genome, there would have to be a high percentage of inherited cases. In fact, I appeared to be right in that this particular study did not bear immediate fruit.

Nonetheless, there are some cases of familial Parkinson’s but they are quite rare. Over the past few years researchers have been honing in on the genes that are responsible for those cases. One gene that stands out in those studies is LRRK2. There is one particular mutation of the LRRK2 gene -- known as G2019S -- that, while rare even among people with the disease, accounts, in some ethnic groups, for a substantial proportion of familial Parkinson’s.

But, of course, I learned something very important to me -- I carry the G2019S mutation and when my mother checked her account, she saw she carries it too.

The exact implications of this are not entirely clear. Early studies tend to have small samples with various selection biases. Nonetheless it is clear that I have a markedly higher chance of developing Parkinson’s in my lifetime than the average person. In fact, it is somewhere between 20% to 80% depending on the study and how you measure. At the same time, research into LRRK2 looks intriguing (both for LRRK2 carriers and potentially for others).
Geographical/Social Knowledge
Tupalo: An Austrian Startup Company

What is difficult about this undertaking?
Wikipedia vs. Britannica

Why are people maintaining it?
What is the difference in quality?
What is the difference in categorization?
What is the difference in contribution?
What would happen if the people „caring“ for Wikipedia/Britannica were to stop caring?
Wikipedia & Trust

The huge amount of semi-arid sand available in the Kalahari Desert is used to satisfy increasing demands of industry and construction. The Kalahari Desert sand is dried and transported via the Trans-Kalahari Highway to industrial areas and is used in, for example, manufacturing as an abrasive, to make concrete. Sand mining plays an increasing factor in Botswana's economy and is a direct and obvious cause of erosion. It also impacts the local wildlife, including meerkats, antelopes and the endangered African Wild Dog.

What are factors influencing the quality/vulnerability/usability of wikipedia as an authoritative resource?

Markus Strohmaier

2008
Corporate Weblogs as a KM instrument

SEPTEMBER 25, 2007

WORDPRESS 2.3

By Matt. Filed under Development, Releases.

I'm thrilled to announce that Version 2.3 “Dexter” of WordPress is now ready for the world. This release includes native tagging support, plugin update notification, URL handling improvements, and much more. This release is named for the great tenor saxophonist Dexter Gordon.

The entire team is really proud of this release, and I'm happy that this is our second on-time release under our new development schedule. The grand experiment of a more agile WordPress with significant features in the hands of users more often is working. I could write a blog post about each new feature, but I'll try to be brief:

1. **Native tagging support** allows you to use tags in addition to categorize on your posts, if you so choose. We've included importers for the Ultimate Tag Warrior, Jerome's Keywords, Simple Tags, and Bunny's Technorati Tag plugins so if you've already been using a tagging plugin you can bring your data into the new system. The tagging system is also wicked-fast, so your host won't mind.

2. **Our new update notification** lets you know when there is a new release of WordPress or when any of the plugins you use has an update available. It works by sending your blog URL, plugins, and version information to our new api.wordpress.org service which then compares it to the plugin...
Corporate Wikis as a KM instrument
KM failures

- Under which conditions can such instruments fail?
- Do you know of failed projects where blogs/wikis/portals/etc did not achieve the desired effect?
- What was the cause to that?
KM failures

• Lack of motivation
• Lack of ability
• Low/wrong quality of communication channel
• Lack of awareness
• Lack of management support
• Lack of purpose
• …
Knowledge
[Maier 2002]

Knowledge management
systems

is supported by

create
identify
formalize
organize

feedback
apply
refine
distribute
share

Knowledge management life cycle

organization-external
(electronically) inaccessible
unsecured
individual
informal, unapproved
tacit
specific, particular, contextualized

organization-internal
(electronically) accessible
secured
collective
formal, institutionalized, approved
explicit
abstract, general, decontextualized

object
social system
individual

Knowledge

knowledge as production factor
knowledge as product
knowledge-intensive organization
knowledge influences decisions & actions
knowledge in business administration

knowledge = truth
knowledge is socially constructed

FIGURE B-9. The term knowledge and its application in knowledge management [Maier 2002]
## Preliminary Schedule I

<table>
<thead>
<tr>
<th></th>
<th>Date</th>
<th>Topic</th>
<th>Reading</th>
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<tbody>
<tr>
<td>1</td>
<td>3.10.2008</td>
<td>Overview and Motivation</td>
<td>In this class, we will discuss the course organization and give a basic motivation for and introduction to the course. See <a href="#">Protected Access</a>.</td>
</tr>
<tr>
<td></td>
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<td>(slides)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>7.10.2008</td>
<td>Knowledge Types and Processes</td>
<td>What is knowledge? What forms of knowledge can we identify? We will discuss some basic distinctions and characterizations. See <a href="#">Protected Access</a>.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(slides)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>14.10.2008</td>
<td>Knowledge Management Perspectives</td>
<td>A series of different roles and perspectives on knowledge management have been proposed by KM researchers in the past. We will discuss selected perspectives and some implications for knowledge management. See <a href="#">Protected Access</a>.</td>
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<td>(slides)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>17.10.2008</td>
<td>Knowledge Organization</td>
<td>How can knowledge be organized? We will discuss some basic principles of knowledge organization, such as categorization, taxonomies and concept systems. See <a href="#">Protected Access</a>.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(slides)</td>
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<tr>
<td>5</td>
<td>27.10.2008</td>
<td>Broad Knowledge Bases</td>
<td>What kinds of broad knowledge bases exist? We will discuss different forms of knowledge bases and representations, such as metadata, worldnet, framesets, etc., openmind and others. See <a href="#">Protected Access</a>.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(slides)</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>10.11.2008</td>
<td>Knowledge Acquisition</td>
<td>How can knowledge be acquired in a way that is amenable to computation and/or analysis? See <a href="#">Protected Access</a>.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(slides)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>17.11.2008</td>
<td>Knowledge Transfer</td>
<td>How can knowledge transfer be characterized and what factors can influence knowledge transfer? We will discuss these and further issues. See <a href="#">Protected Access</a>.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(slides)</td>
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### Preliminary Schedule II

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<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Event</th>
<th>Notes</th>
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</thead>
</table>
| 8    | 24.11.2008 | Organizational Knowledge Repositories (slides) | How can knowledge repositories be designed and deployed? We will discuss concepts such as knowledge reuse, discretionary databases, experience factories and selected concepts from case based reasoning. 
| 9    | 1.12.2008  | Guest Lecture                 | TBA                                                                  |
| 10   | 4.12.2008  | Guest Lecture                 | TBA                                                                  |
| 11   | 12.1.2009  | Business Process Oriented Knowledge Management I (slides) | In this class, we will discuss different approaches aimed at integrating knowledge management into an organization’s business processes. 
| 12   | 19.1.2009  | Knowledge-based Analysis (slides) | How can socio-technological systems be organized from a knowledge perspective? We will discuss an agent-oriented modeling approach for analyzing knowledge transfer instruments. 
| 13   | 26.1.2009  | Open Topic (TBD)              |                                                                      |
| 14   | 29.1.2009  | Final Exam                    | No aids are allowed at the final exam.                              |
Discussion

• What models of knowledge management did you hear about before this course?
• What are their uses/qualities/disadvantages?
Some Course Highlights
Explicit or Implicit? [Kirsh 1990]

1. Is 5 as the solution to $\sqrt{125}$ explicit in $\sqrt{125}$?

2. Is the $200^{100}$ digit of $\pi$ explicit?

3. Is 3 explicit in $A: \{1,5,3,7,4,4\}$?

4. Is the cardinality of $A$ explicit in $A: \{1,5,3,7,4,4\}$?

5. Is $(6754, 9629)$ in a matrix of $10,000 \times 10,000$ explicit?

6. Is the answer to „Why does the pop star P!nk perform 4 Non Blondes songs at her concert“ explicit on the web?
Some Course Highlights
Knowledge Flow Visualization

B-KIDE,
[Strohmaier05]
Some Course Highlights
Categorization

Taste: Sweet/Sour, Shape: Round/Long/, Color: Red/Yellow/..., Texture: Smooth/Bumpy,

<table>
<thead>
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<th></th>
<th>Red</th>
<th>Green</th>
<th>Yellow</th>
<th>Round</th>
<th>Long</th>
<th>Sweet</th>
<th>Sour</th>
<th>Smooth</th>
<th>Bumpy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>X</td>
<td>X</td>
<td>X</td>
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Experience Factories (EF) focus on the facilitation of Knowledge Transfer between Software Developers

- Experience Base
  - “Packages Experiences”

- Goals
  - Knowledge Transfer
  - Knowledge Reuse
Some Course Highlights
Analyzing Knowledge Transfer

Experience Factory

Under which conditions can the Experience Factory concept fail?
Some Course Highlights
Commonsense Knowledge

Common Sense Knowledge
ConceptNet, MIT, 2007
Some Course Highlights

Game with a Purpose

[Image of the game 'Peekaboom']

Problems? Peekaboom requires the Java JRE version 1.4 or later.

Knowledge Management Institute

Markus Strohmaier 2008
Check

- Is there anything else you want to know w.r.t. this course?
- What aspects are you most interested in?
- Anything else?
Any further questions?

Have a good start in the new semester!
- See you next week