707.009
Foundations of Knowledge Management
„Overview and Motivation“

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web: http://www.markusstrohmaier.info
About me

**Education:**
- 2002 - 2004 PhD. Institute of Knowledge Management, TU Graz
- 1997 - 2002 M.Sc., Telematik, TU Graz

**Background:**
- 2011 – 2012: Visiting Assistant Prof., Stanford U., USA
- 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, Network Science, Knowledge Management

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
(Wahlfach)

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

+ Multimedia Information Systems

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
  – 6th 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 acquisition
• Knowledge acquisition methods
• types of knowledge organization
• types of knowledge bases

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**

  Oct 2012 – Nov 2012, blocked
  HS i3
  *Mostly* Mo, Tu, Wed

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<th>Date</th>
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**Exceptions!**

Final Exam: 19.11.2012 16:00
Course Organization and Logistics

- **Language**: English/German

- **Website**: http://markusstrohmaier.info/courses/WS2012-13/707.009_knowledge-management/

  *Enroll!*

  You need to enroll for this course via TUG online!

- **Slides** will be made available on the course website

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

Screencasts of each lecture are available through the TUG teach center
Grading

So how do you receive a grade in this course?

- There will be one written exam at the end of the classes (Standard). No limit on the number of students that can take the exam.
- Two dates for additional 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:
- 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 may be earned during the course (for this semester ‘s written exam)
Course Information

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


Newsgroup available at tu-graz.lv.gwm
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)
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.

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<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>TOTAL</td>
<td>5,609,121</td>
<td>3,416,281</td>
<td>3,212,731</td>
<td>2,132,238</td>
<td>74.5%</td>
</tr>
</tbody>
</table>

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

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

| Kilobyte (KB) | 1,000 bytes OR $10^3$ bytes  
|              | 2 Kilobytes: A Typewritten page.  
|              | 100 Kilobytes: A low-resolution photograph. |
| Megabyte (MB) | 1,000,000 bytes OR $10^6$ bytes  
|              | 1 Megabyte: A small novel OR a 3.5 inch floppy disk.  
|              | 2 Megabytes: A high-resolution photograph.  
|              | 5 Megabytes: The complete works of Shakespeare.  
|              | 10 Megabytes: A minute of high-fidelity sound.  
|              | 100 Megabytes: 1 meter of shelved books.  
|              | 500 Megabytes: A CD-ROM. |
| Gigabyte (GB) | 1,000,000,000 bytes OR $10^9$ bytes  
|              | 1 Gigabyte: a pickup truck filled with books.  
|              | 20 Gigabytes: A good collection of the works of Beethoven.  
|              | 100 Gigabytes: A library floor of academic journals. |
| Terabyte (TB) | 1,000,000,000,000 bytes OR $10^{12}$ bytes  
|              | 1 Terabyte: 50,000 trees made into paper and printed.  
|              | 2 Terabytes: An academic research library.  
|              | 10 Terabytes: The print collections of the U.S. Library of Congress.  
|              | 400 Terabytes: National Climatic Data Center (NCDC) database. |
| Petabyte (PB) | 1,000,000,000,000,000 bytes OR $10^{15}$ bytes  
|              | 1 Petabyte: 3 years of EOS data (2001).  
|              | 2 Petabytes: All U.S. academic research libraries.  
|              | 200 Petabytes: All printed material. |
| Exabyte (EB) | 1,000,000,000,000,000,000 bytes OR $10^{18}$ bytes  
|              | 2 Exabytes: Total volume of information generated in 1999.  
|              | 5 Exabytes: All words ever spoken by human beings. |

Source: Many of these examples were taken from [Roy Williams’ Data Powers of Ten?](http://www.caltech.edu) web page at Caltech.
A record if it is to be useful to science, must be continuously extended, it must be stored, and above all it must be consulted.

http://www.wired.com/wired/archive/5.11/es_bush.html
Memex (memory extender) by Vannevar Bush 1945

- Consists of a desk containing
  - a very large set of documents stored on microfilm
  - screens on which those documents are projected
  - a device for photographing new documents
  - a mechanism for retrieving documents at the push of a button
  - the ability to create links between documents
  - the ability to build trails through documents, add comments to documents, insert new documents, etc.

- Note how everything revolves around documents

A “sort of mechanized private file and library”

Foreclosures Slow as Document Flaws Emerge

By DAVID STREIFELD
Published: September 30, 2010

The foreclosure machinery that has forced millions of Americans out of their homes is beginning to seize up as some lenders and their lawyers are accused of cutting corners in their pursuit of rapid home repossessions.

Evictions are expected to slow sharply, housing analysts said, as state and national law enforcement officials shine a light on questionable foreclosure methods revealed by two of the country’s biggest home lenders in the last two weeks.

Even lenders with no known problems are expected to approach defaulting homeowners more cautiously and look more aggressively for resolutions short of outright eviction.

Despite the turmoil, some economists said the breakdown
Library Catalogs

How does this compare to other catalogs?
Categorization: The DMOZ Project

In partnership with AOL search

Arts
Movies, Television, Music...

Business
Jobs, Real Estate, Investing...

Computers
Internet, Software, Hardware...

Games
Video Games, RPGs, Gambling...

Health
Fitness, Medicine, Alternative...

Home
Famly, Consumers, Cooking...

Kids and Teens
Arts, SchoolTime, Teen Life...

Recreation
Travel, Food Outdoors, Humor...

Reference
Maps, Education, Libraries...

Regional
US, Canada, UK, Europe...

Science
Biology, Psychology, Physics...

Shopping
Clothing, Food, Gifts...

Sports
Baseball, Soccer, Basketball...

Society
People, Religion, Issues...

World
Catalan, Danish, Deutsch, Español, Français, Italiano, 简体中文, Nederlands, Polski, Русский, Svenska...

Become an Editor: Help build the largest human-edited directory of the web

Copyright © 1998-2008 Netscape

4,607,363 sites - 81,339 editors - over 590,000 categories

Markus Strohmaier
2012
Large Image Collections

What is wrong about this list?
Microblogging

What is wrong with this?
Geographical/Social Knowledge
Tupalo: An Austrian Startup Company

Why is this difficult to achieve / What are main problems?
Wikipedia vs. Brittanica

Why are people maintaining and building 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?
How can we translate Wikipedia to all major spoken languages? (e.g. only 10-15 % of all english articles are available in spanish)

How would an approach to do that look like?
Why YOU should you learn about KM [Yu 2007]

Most knowledge intensive activities presuppose technology support.
- You (computer scientists) are expect to provide it.
- Do we have the right methods and tools?
- This course provides you with a set of selected tools for knowledge acquisition and organization.

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?
Note!

• This course **does not focus on what we can’t do** in knowledge management (and there ‘s a lot we can‘t do)

• **but rather focuses on what can be done** (at least technically).
An Interaction View of Knowledge Management
[Rollett 2003]

Figure 2.2. The interaction view of knowledge management.

In the scope
Out of scope
of this course
KM methods and techniques

- Knowledge Organization
- Broad Knowledge Bases
- Categorization and Formal Concept Analysis
- Categorization and Latent Semantic Indexing
- Probabilistic Topic Models
- Association Rule Learning
- Participative Knowledge Acquisition Methods

http://markusstrohmaier.info/courses/WS2012-13/707.009_knowledge-management/
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?
Classification & Categorization

Carl Linnaeus, Systema Naturae

Classis 1. Mammalia
Classis 2. Aves
Classis 3. Amphibia
Classis 4. Pisces
Classis 5. Insecta
Classis 6. Vermes

ICD-10 Version:2010

- I Certain infectious and parasitic diseases
- II Neoplasms
- III Diseases of the blood and blood-forming organs, certain disorders involving the immune mechanism
- IV Endocrine, nutritional and metabolic diseases
- V Mental and behavioural disorders
- VI Diseases of the nervous system
- VII Diseases of the eye and adnexa
- VIII Diseases of the ear and mastoid process
- IX Diseases of the circulatory system
- X Diseases of the respiratory system
- XI Diseases of the digestive system
- XII Diseases of the skin and subcutaneous tissue
- XIII Diseases of the musculoskeletal system and connective tissue
- XIV Diseases of the genitourinary system
- XV Pregnancy, childbirth and the puerperium
- XVI Certain conditions originating in the perinatal period
- XVII Congenital malformations, deformations and chromosomal abnormalities

Bristol Stool Chart

- Type 1: Separate hard lumps, like nuts (hard to pass)
- Type 2: Sausage-shaped but lumpy
- Type 3: Like a sausage but with cracks on the surface
- Type 4: Like a sausage or snake, smooth and soft
- Type 5: Soft blobs with clear-cut edges
- Type 6: Fluffy pieces with ragged edges, a mushy stool
- Type 7: Watery, no solid pieces. Entirely liquid
Some Course Highlights
Categorization & Formal Concept Analysis

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

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<th>Green</th>
<th>Yellow</th>
<th>Round</th>
<th>Long</th>
<th>Sweet</th>
<th>Sour</th>
<th>Smooth</th>
<th>Bumpy</th>
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Some Course Highlights
Commonsense Knowledge

Common Sense Knowledge
ConceptNet, MIT, 2007
Some Course Highlights
Game with a Purpose
Enron email data

From: PGE News
To: ALL PGE EMPLOYEES
Date: 8/14/01 2:54PM
Subject: Jeff Skilling resigns as CEO of Enron

PGE News ...................... August 14, 2001

Jeff Skilling resigns as CEO of Enron

Enron today announced that President and CEO Jeff Skilling has resigned, effective immediately, and that the Enron Board of Directors has asked Ken Lay to resume his role as Chairman and CEO.

"Stan Horton called this afternoon to inform me of Jeff's decision to step down for personal reasons," says PGE CEO and President Peggy Fowler. Horton, CEO of Enron Transportation, is Fowler's executive connection to the Enron team. "He wanted to let me know that Mr. Skilling's departure will not in any way impact PGE's ongoing strategy for success and we should expect no near-term dramatic organizational changes."

"Clearly, Enron will continue to focus on increasing the company's stock value," Fowler added. "PGE can help in this effort by remaining committed to our Scorecard goals and operational excellence."

Below is the letter I received from Jeff Skilling announcing his resignation:

Markus Strohmaier

Enron email data

May 22, 2000
Start of California energy crisis
Inductive Concept Learning

How would you define the `daughter(X,Y)` relationship based on 1) Background K and 2) Training examples?

<table>
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<th>Training examples</th>
<th>Background knowledge</th>
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<tr>
<td>daughter(mary, ann). ⊕</td>
<td>parent(ann, mary).</td>
</tr>
<tr>
<td>daughter(eve, tom). ⊕</td>
<td>parent(ann, tom).</td>
</tr>
<tr>
<td>daughter(tom, ann). ⊗</td>
<td>female(ann).</td>
</tr>
<tr>
<td>daughter(eve, ann). ⊗</td>
<td>parent(tom, eve).</td>
</tr>
<tr>
<td></td>
<td>female(mary).</td>
</tr>
<tr>
<td></td>
<td>parent(tom, ian).</td>
</tr>
<tr>
<td></td>
<td>female(eve).</td>
</tr>
</tbody>
</table>

\[
c = \text{daughter}(X, Y) \leftarrow \text{female}(X), \text{parent}(Y, X)
\]
Memex (memory extender) by Vannevar Bush

- **Consists of a desk containing**
  - a very large set of documents stored on microfilm
  - screens on which those documents are projected
  - a device for photographing new documents
  - a mechanism for retrieving documents at the push of a button
  - the ability to create links between documents
  - the ability to build trails through documents, add comments to documents, insert new documents, etc.

- **Note how everything revolves around documents**

A “sort of mechanized private file and library”

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