# Summary and Conclusions

(Teaching Inspired by Research)

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the Medical Data Science Team


UNIVERSITÄT ZU LÜBECK
INSTITUT FÜR MEDIZINISCHE INFORMATIK

# Contents of the Course

| Week | Lecture | Practical Exercises |
|---|---|---|
| 1 | **(05/04)** Introduction to Medical Information Retrieval (MIR) | **(05/04)** Introduction to Python |
| 2 | **(12/04)** Main Components and Classification of MIR Systems | **(12/04)** Introduction to Python |
| 3 | **(19/04)** Metadata in Medical Information Retrieval Systems | **(19/04)** CBIR in Medical Applications |
| 4 | ***(26/04)*** *No Lecture due to a Business Trip* | **(26/04)** CBIR in Medical Applications |
| 5 | **(03/05)** Set Theoretic Model: Boolean Retrieval | **(03/05)** CBIR in Medical Applications |
| 6 | **(10/05)** Set Theoretic Model: Fuzzy Retrieval | **(10/05)** Flask Tutorial |
| 7 | **(17/05)** Vector Space Model: Similarity Measures | **(17/05)** Flask Tutorial |

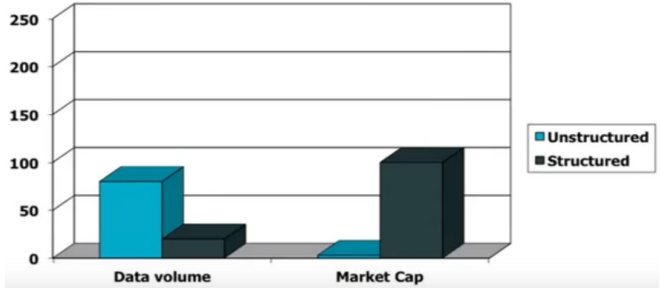
# Contents of the Course

| | | |
|---|---|---|
| **8** | **(24/05)** Vector Space Model: Distance Functions | **(24/05)** HTML |
| **9** | **(31/05)** Vector Space Model: Latent Semantic Indexing | **(31/05)** HTML |
| **10** | **(07/06)** Probabilistic Model | **(07/06)** HTML |
| **11** | **(14/06)** Text-based Retrieval of Medical Information | **(14/06)** Deep Learning |
| **12** | **(21/06)** Audio-based Retrieval of Medical Information | **(21/06)** Deep Learning |
| **13** | **(28/06)** Image-based Retrieval of Medical Information | **(28/06)** Relevance Feedback |
| **14** | **(05/07)** Demonstrators from Current Research Projects | **(05/07)** Relevance Feedback |
| **15** | **(12/07)** Summary and Conclusions | **(12/07)** Evaluation |

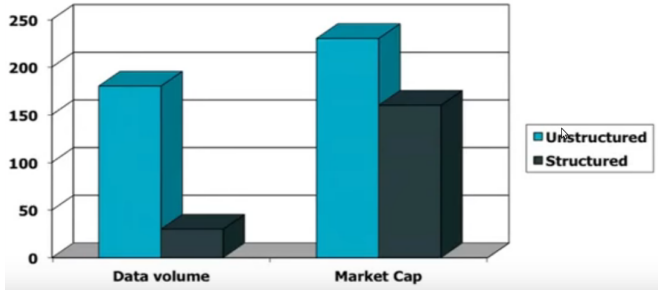
## General Definition of Information Retrieval

- **Information Retrieval** (IR) is finding material (usually documents) of an unstructured nature (usually text) that satisfies an information need from within large collections (usually stored on computers).
- **Structured data** is usually stored in databases.
- **Unstructured data** are just human language documents.

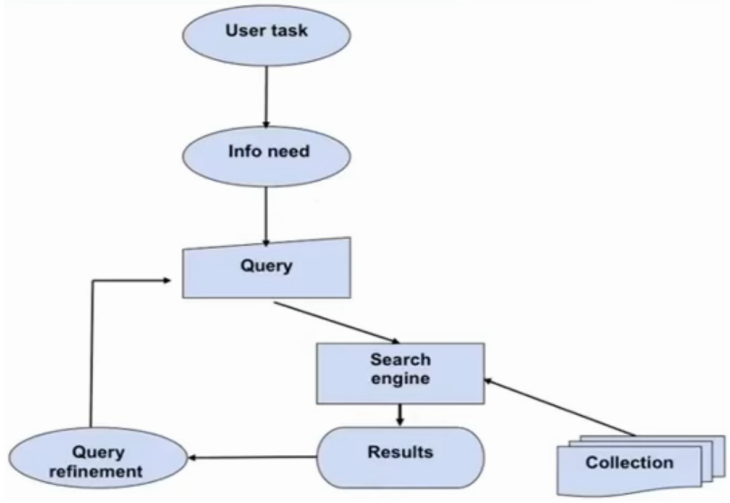
# Unstructured vs. Structured Data in the Mid-Nineties



# Unstructured vs. Structured Data Today



# Classic Search Model



# Lecture 2 – Components and Classification of MIR Systems

- Introduction
- Set Theoretic Model
- Vector Space Model
- Probabilistic Model
- Conclusion

# Lecture 3 – Metadata in Medical Information Retrieval

- Introduction
- Semantic Gap
- Data Representation
- Knowledge Representation
- Conclusion

# Lecture 4 – Evaluation of Information Retrieval Systems

- Introduction
- Datasets for Medical Information Retrieval
- Evaluation of Unranked Retrieval Results
- Evaluation of Ranked Retrieval Results
- Conclusion

# Lecture 5 – Set Theoretic Model: Boolean Retrieval

- Introduction
- Indexing
- Conclusion

# Lecture 6 – Set Theoretic Model: Fuzzy Retrieval

- Introduction
- Fuzzy Logic
- Fuzzy Retrieval
- Conclusion

# Lecture 7 – Vector Space Model: Similarity Measures

- Introduction
- Feature Extraction from Signals
- Selected Similarity Functions
- Aggregation of Similarities
- Conclusion

# Lecture 8 – Vector Space Model: Distance Functions

- Introduction
- Distance Functions for Real Points
- Distance Functions for Binary Points
- Distance Functions for Sequences
- Conclusion

# Lecture 9 – Vector Space Model: Latent Semantic Indexing

- Introduction
- Mathematical Formulation
- Singular Value Decomposition
- Conclusion

# Lecture 10 – Probabilistic Model

- Introduction
- Bayes Decision Theory
- Statistical Document Modelling
- Conclusion

# Lecture 11 – Text-based Retrieval of Medical Information

- Introduction
- Statistical Language Modelling
- Neural Networks in Language Modelling
- Conclusion

# Lecture 12 – Audio-based Retrieval of Medical Information

- Introduction
- Wrap-up on the Fourier Transform
- Short Time Processing of Signals
- Spectral Features of Signals
- Conclusion

# Lecture 13 – Image-based Retrieval of Medical Information

- Introduction
- Regional Features
- Shape and Size Features
- Conclusion

# MedDS Team – Research Directions

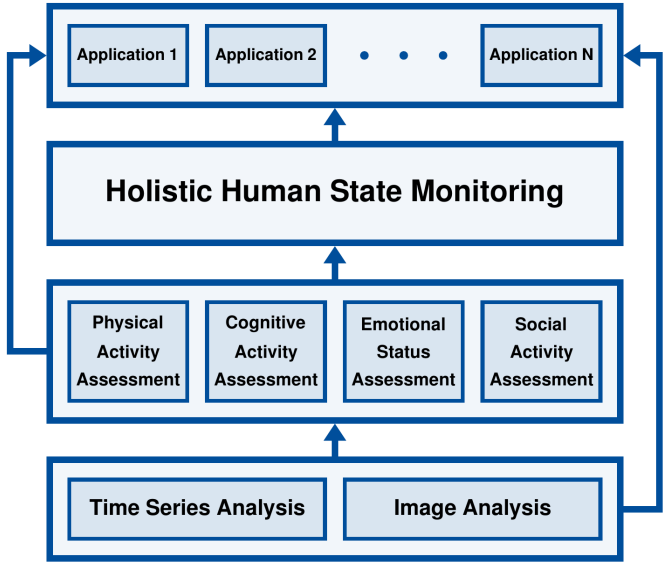
## Scientific Goal

- Extracting health-related knowledge from multimodal sensor data using pattern recognition and machine learning algorithms.

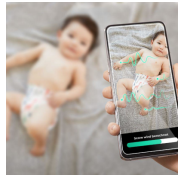
## Scientific Fields

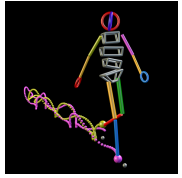
- **Medical Data Science**
- Human-centred Pattern Recognition
- Sensor Data Understanding
- Machine Learning
- Assistive Health Technologies

# MedDS Team – Human Monitoring



# MedDS Team – Applications




## MedDS Team – APPS Lab