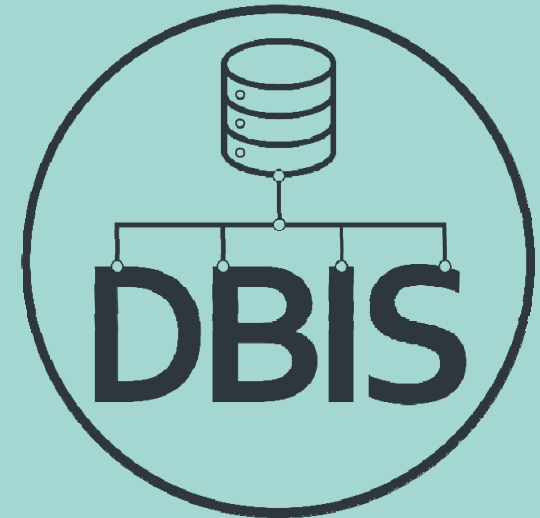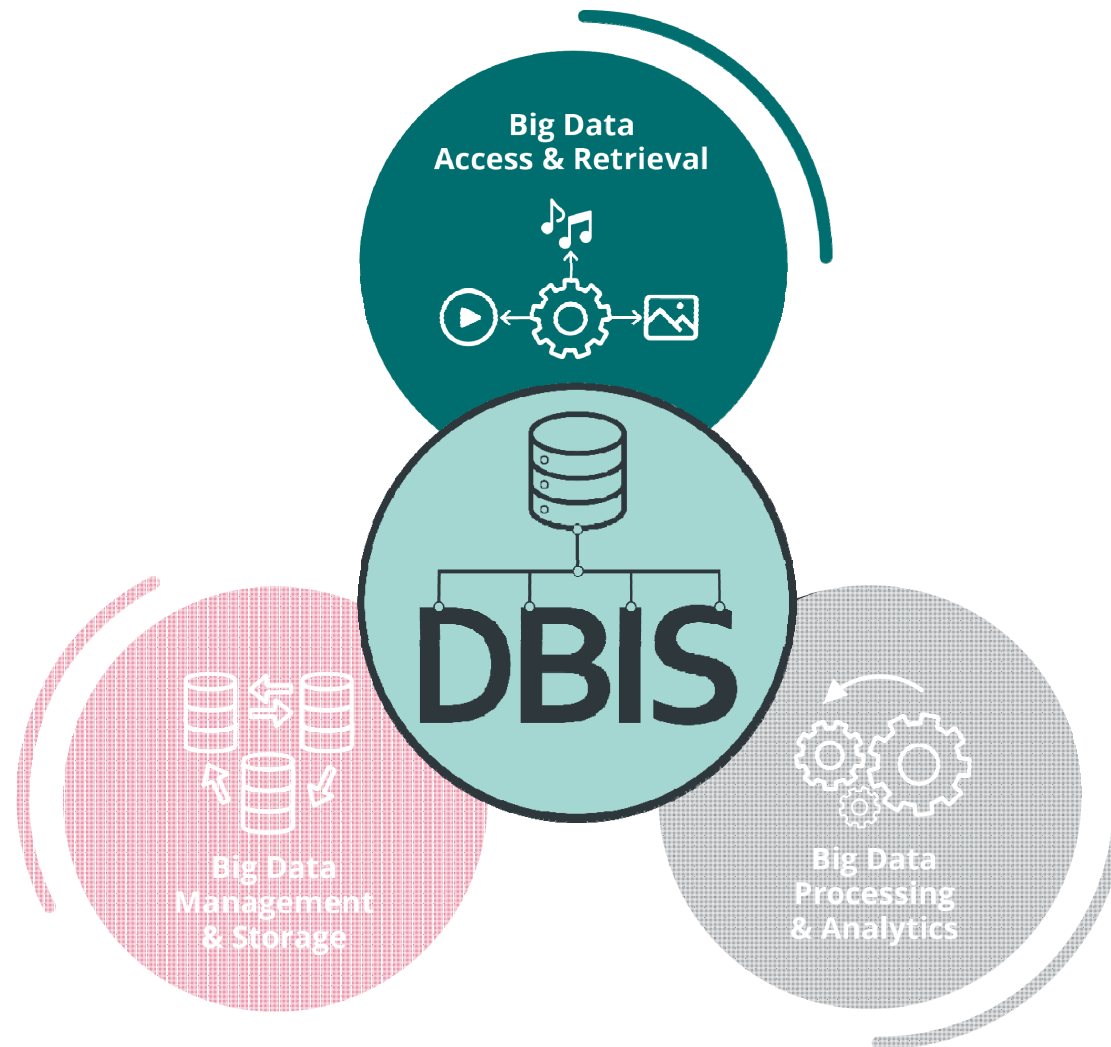# Databases and Information Systems Research Group

Heiko Schuldt (heiko.schuldt@unibas.ch)

dbis.dmi.unibas.ch

The DBIS Group

DBIS Research Group
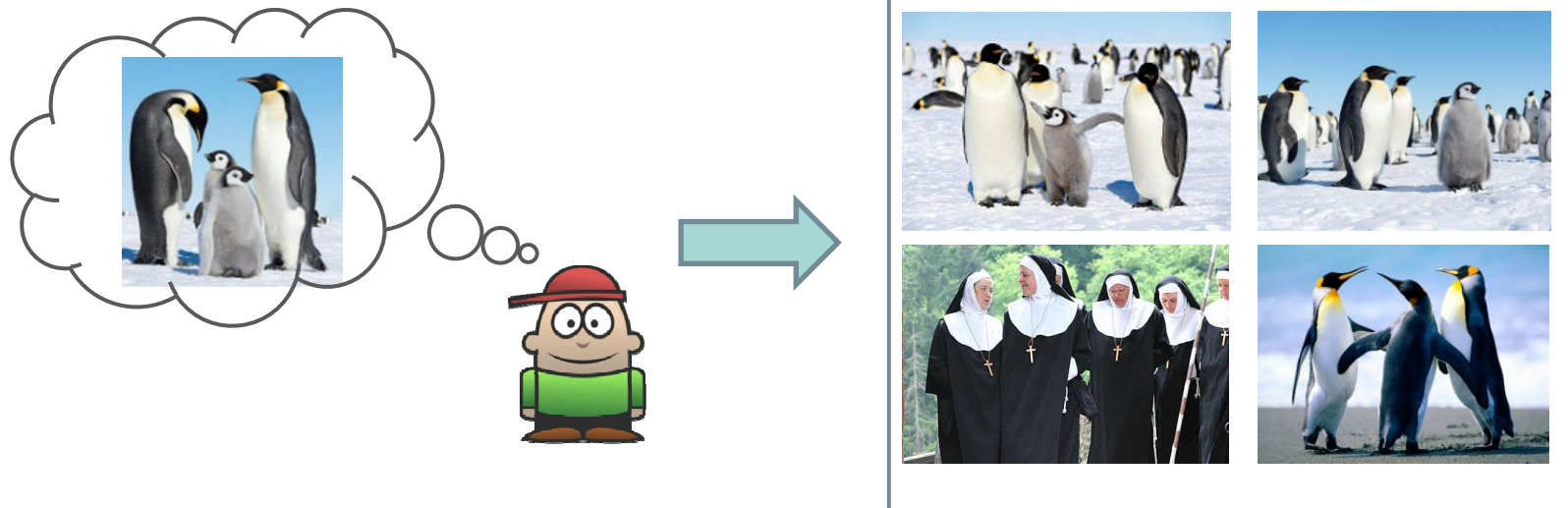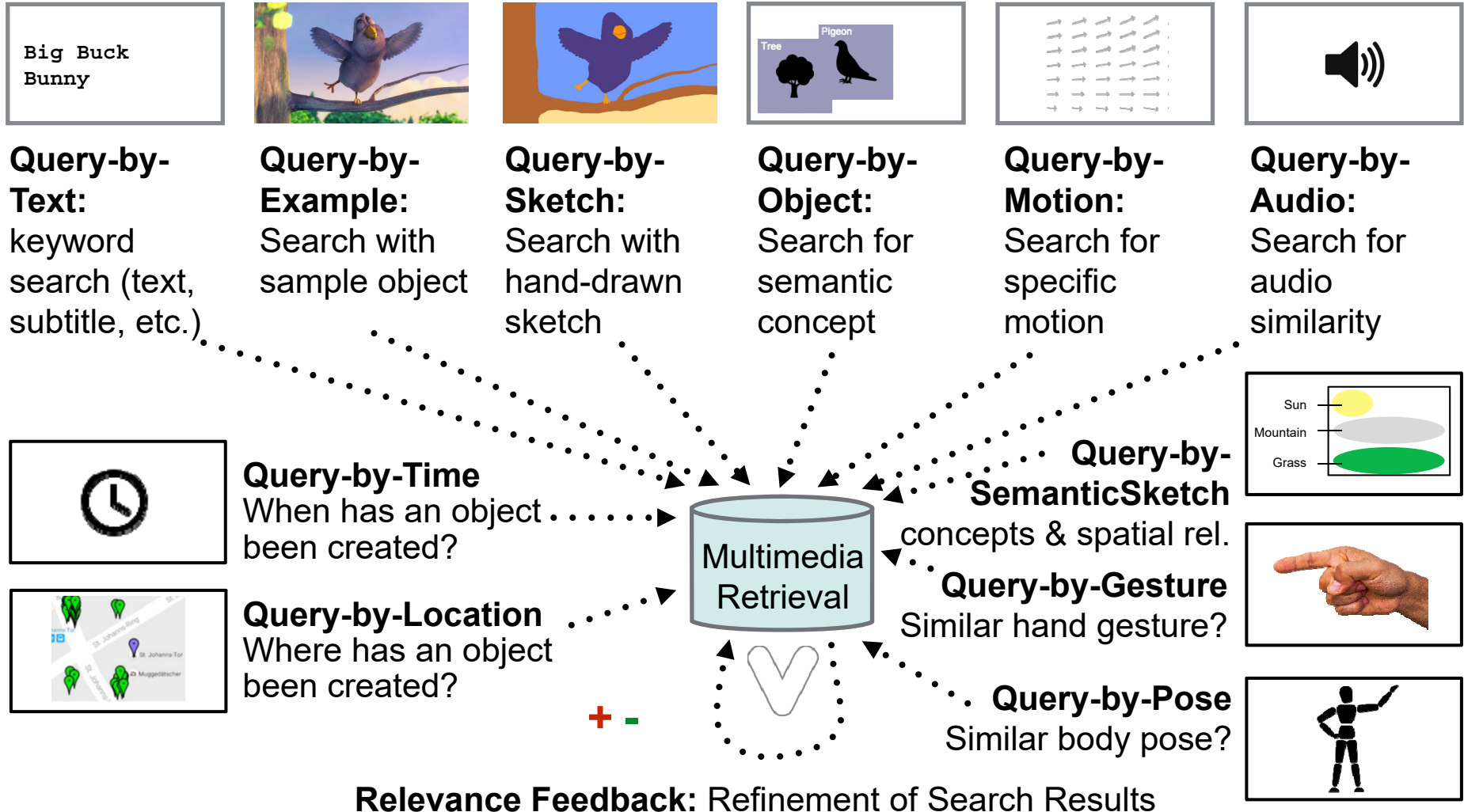
Multimedia Search with

vitrivr

Search in Multimedia Data: Current Approaches

- Keyword Search: Search based on (manually added) textual descriptions

- Query-by-Example: Similarity to query object

Sources: • http://moviespictures.org
           • Penguins by kyuubidemon98 Michel CC BY-SA 3.0 via http://kyuubidemon98.deviantart.com/art/penguins-156283137
           • Emperor Penguins by Christopher Michel CC BY-SA 2.0 via flickr -- https://www.flickr.com/photos/cmichel67/11240231654,
             https://www.flickr.com/photos/cmichel67/11240225716, https://www.flickr.com/photos/cmichel67/11240219084

Query Modes in vitrivr

Query-by-Text: keyword search (text, subtitle, etc.)

Query-by-Example: Search with sample object

Query-by-Sketch: Search with hand-drawn sketch

Query-by-Object: Search for semantic concept

Query-by-Motion: Search for specific motion

Query-by-Audio: Search for audio similarity

Big Buck Bunny

Tree   Pigeon

Sun
Mountain
Grass

Query-by-Time
When has an object been created?

Query-by-Location
Where has an object been created?

Multimedia Retrieval

Query-by-SemanticSketch
concepts & spatial rel.

Query-by-Gesture
Similar hand gesture?

Query-by-Pose
Similar body pose?

+ −

Relevance Feedback: Refinement of Search Results

vitrivr: From the Query to the Result

vitrivr

User interface

Retrieval engine CINEAST

Storage: Cottontail-DB

Query by
- Sketch
- Example
- Semantic concept
- Keyword
- Motion
- Audio

– Query interpretation and execution
– Result merging

– Data storage and retrieval

query

result

Feature module | Feature module | Feature module | Feature module

Online phase: search

Offline phase: feature extraction

– Feature extraction

Images
Videos
Audio
3D

collection

upload

$\begin{bmatrix} 12 \\ 3 \\ 23 \\ 0 \\ 2 \\ 0 \\ .... \\ 255 \end{bmatrix}$ $\begin{bmatrix} 36 \\ 11 \\ 0 \\ 4 \\ 112 \\ 6 \\ .... \\ 55 \end{bmatrix}$ $\begin{bmatrix} 91 \\ 2 \\ 243 \\ 198 \\ 17 \\ 201 \\ .... \\ 188 \end{bmatrix}$ ... $\begin{bmatrix} 0 \\ 2 \\ 0 \\ 1 \\ 2 \\ 255 \\ .... \\ 1 \end{bmatrix}$

store

vitrivr: User Interfaces

- Traditional
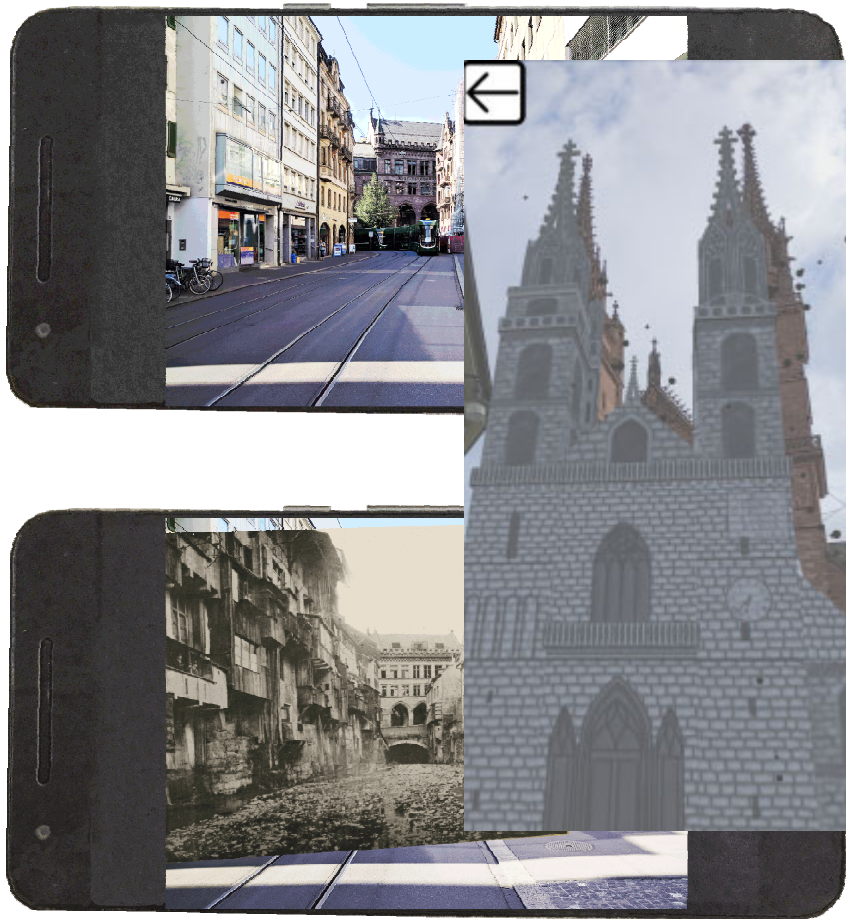 2D desktop UI:
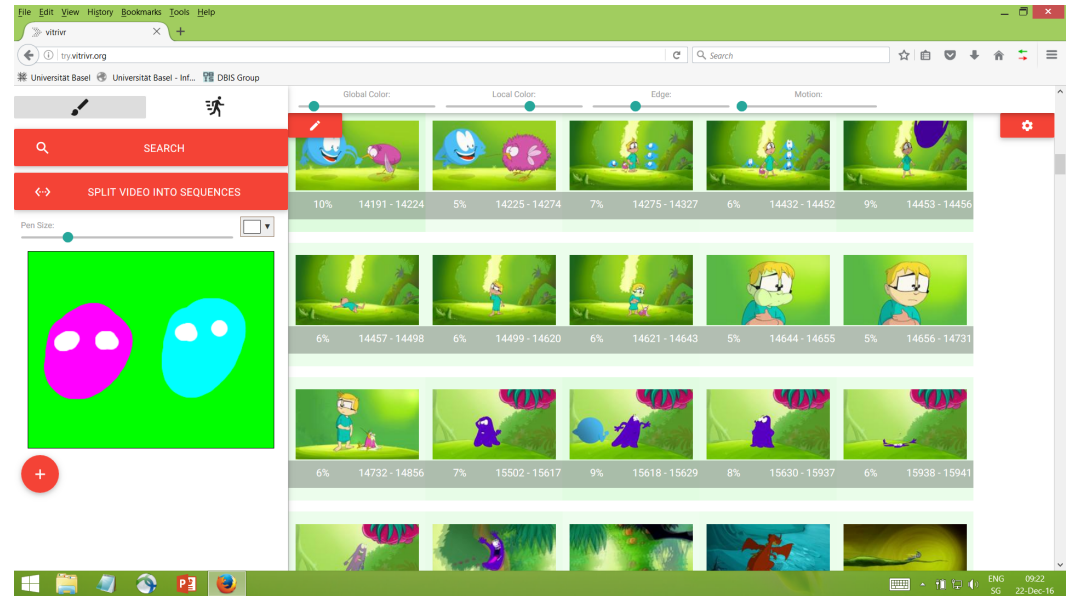
- Virtual Reality
  Interface

Archive Search: Archipanion

- InnoSuisse project together with 4eyes

- AI-based analysis of archive material

- Automatic deep indexing of archive materials

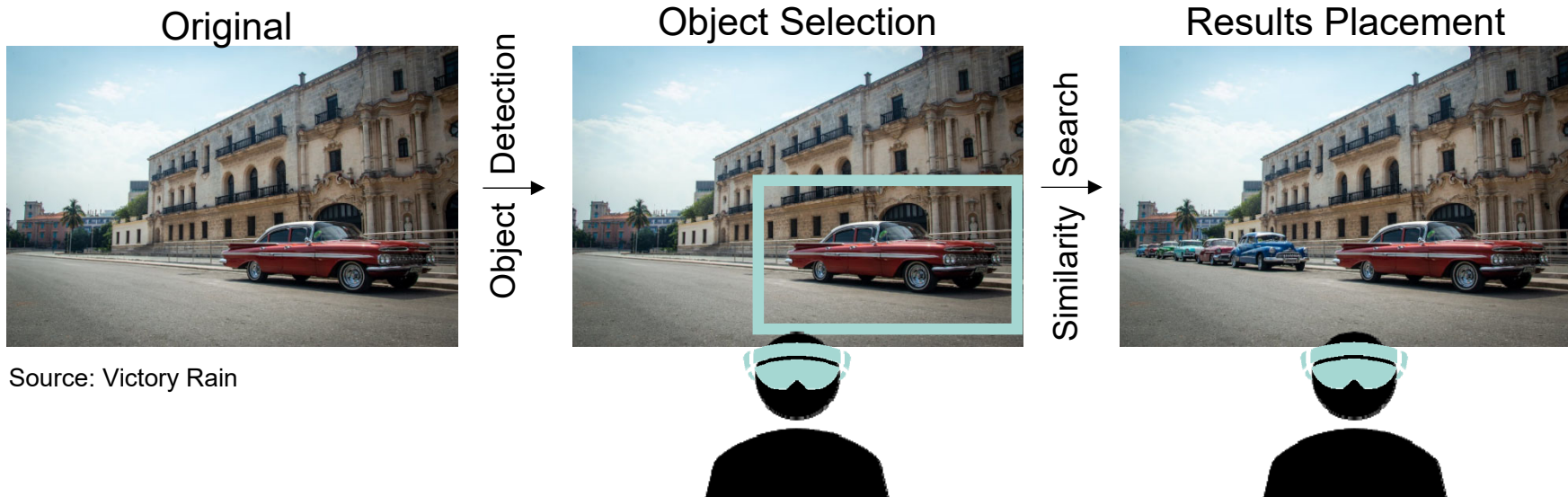- https://archipanion.com
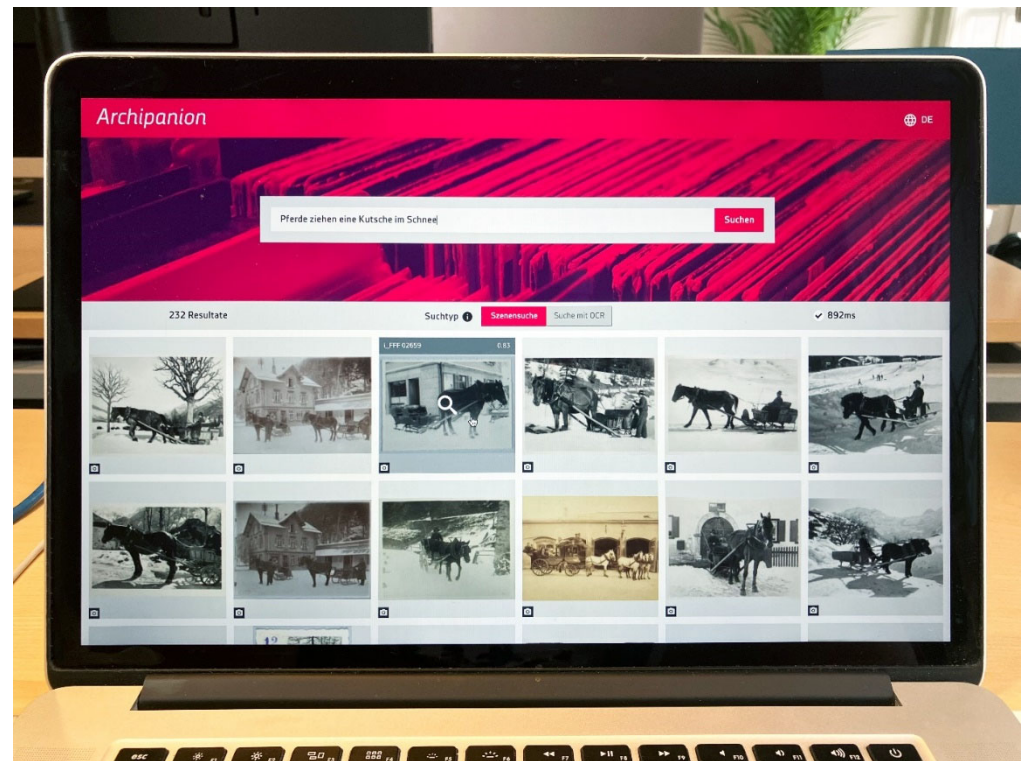
4_eyes

GoFind! Augmented Reality User Interfaces

- GoFind! AR: location-aware augmented reality application for historical images in local context

- Android smart phone application using vitrivr as back-end

- Integration of 3D models

Search in Mixed Reality: xReco

- Horizon Europe project

- Content-based search in Mixed Reality (2D and 3D objects)

  - Live object detection

  - Place results in user's view

Original		Object Selection		Results Placement
	Object Detection →		Similarity Search →	

Source: Victory Rain

VIRTUE: Museum in Virtual Reality

- VIRTUE: 'Walking Around The Globe': prototype for virtual reality art exhibitions
- Currently being extended towards as a front-end for vitrivr to explore novel ways of querying and result exploration
- Has been shown three times at the Basel Museum Night

vitrivr: Potential Topics

Available open source at vitrivr.org, three times at Google Summer of Code

- vitrivr backend: CottontailDB – support for novel types in database system

- vitrivr search engine: vitrivr-engine – temporal search, additional features

- vitrivr-VR: result presentation and relevance feedback in Virtual Reality

- Mixed Reality: spatial anchoring of objects (collaboration with an EU project)

- Explainable multimedia retrieval

- Face detection and facial expression-based retrieval

- GoFind!: AR and VR interfaces on mobile devices ("smart tourist")

- VIRTUE: dynamic creation of museum collections based on user profiles

- Explainable multimedia retrieval in archives (collaboration with local company / local archives)

- … and others

DBIS Research Group
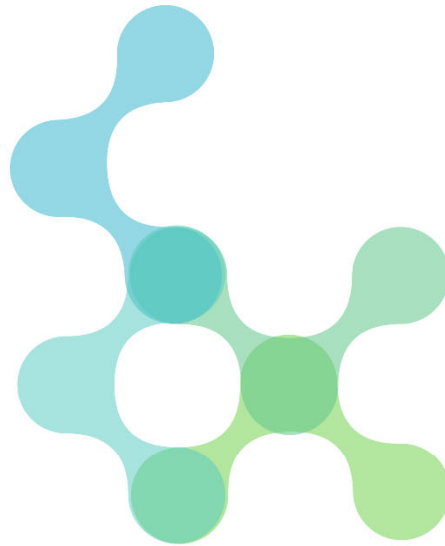
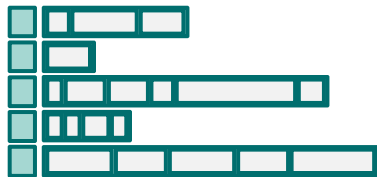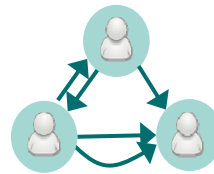# Multi-Model Data Management with Polypheny
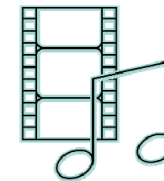
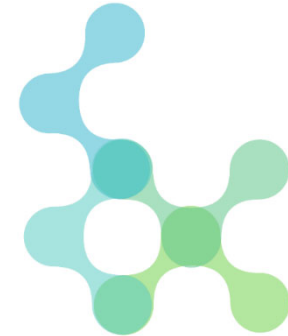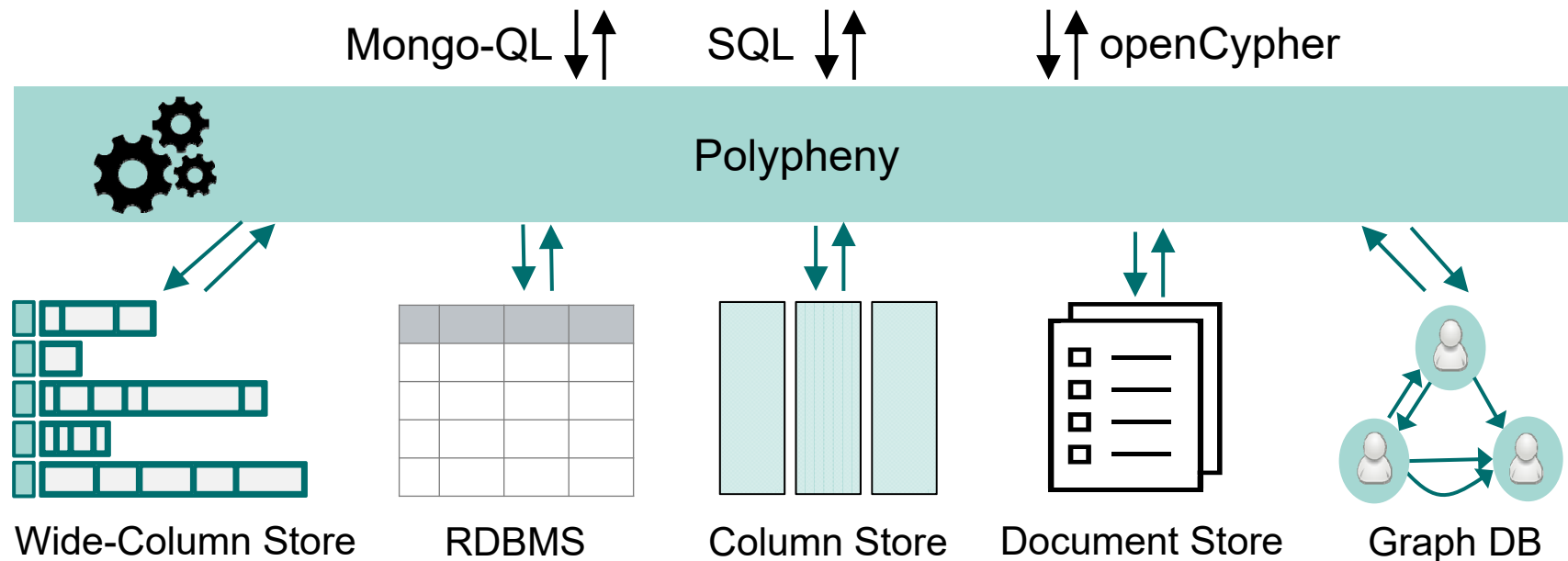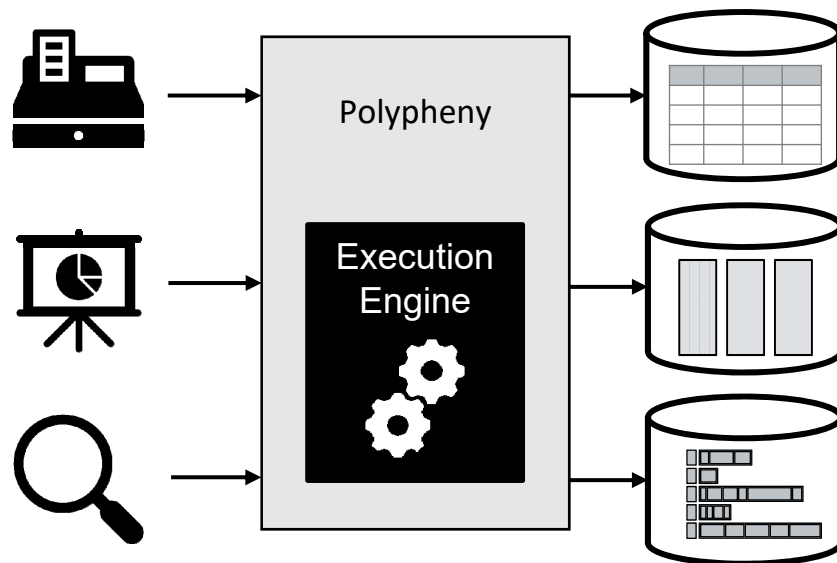# Motivation: One Size Does Not Fit All
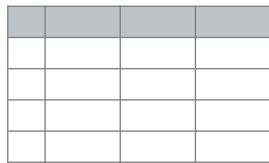
Relational
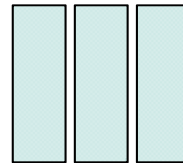
Column

Document

Key-Value

Graph

Multimedia

Polypheny: a Distributed Polystore

- Novel Multi-Model Polystore DBMS (PolyDBMS)
  - Full-fledged DBMS
  - Cross-Model Queries (relational, document & LPG)
  - Joint OLTP & OLAP support
- Open source, Start-up Polypheny GmbH since December 2022

Mongo-QL ↓↑   SQL ↓↑   ↓↑ openCypher

Polypheny

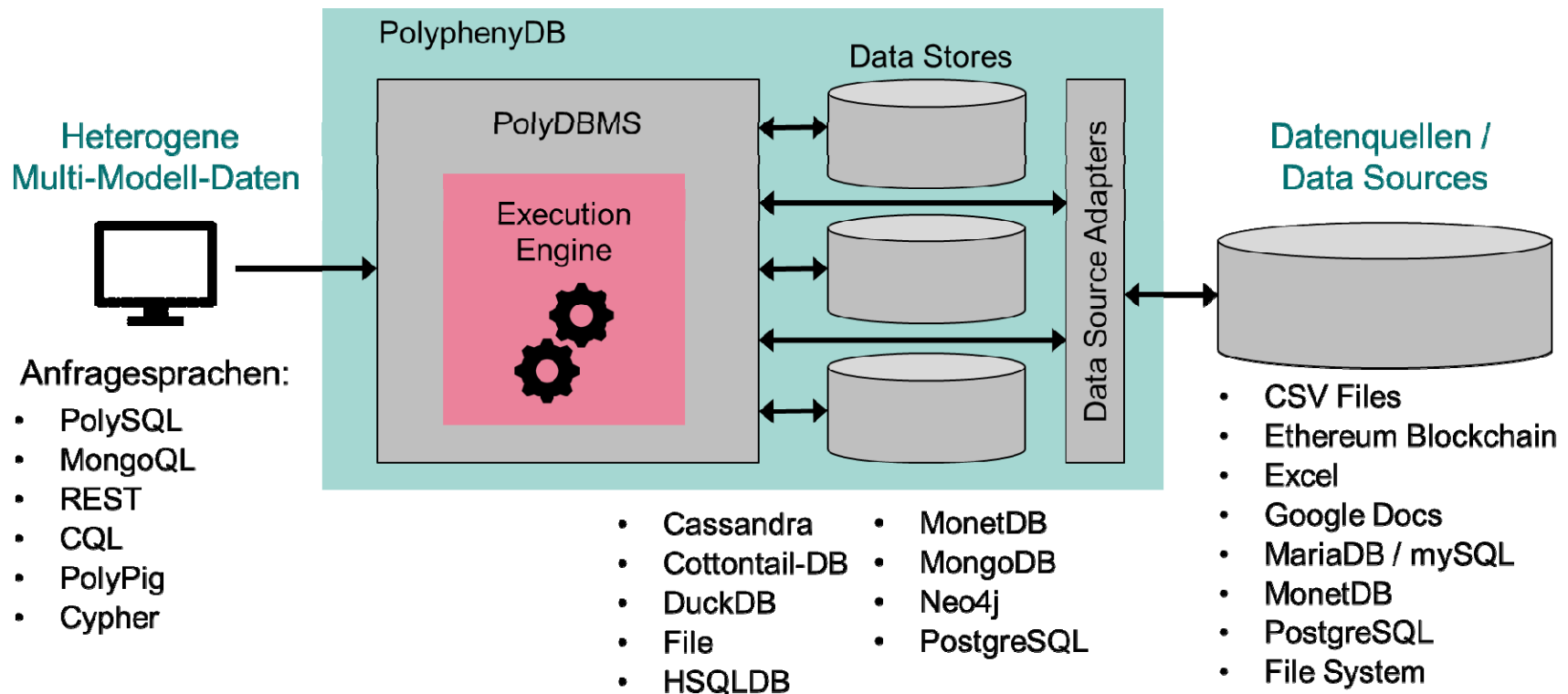Wide-Column Store   RDBMS   Column Store   Document Store   Graph DB
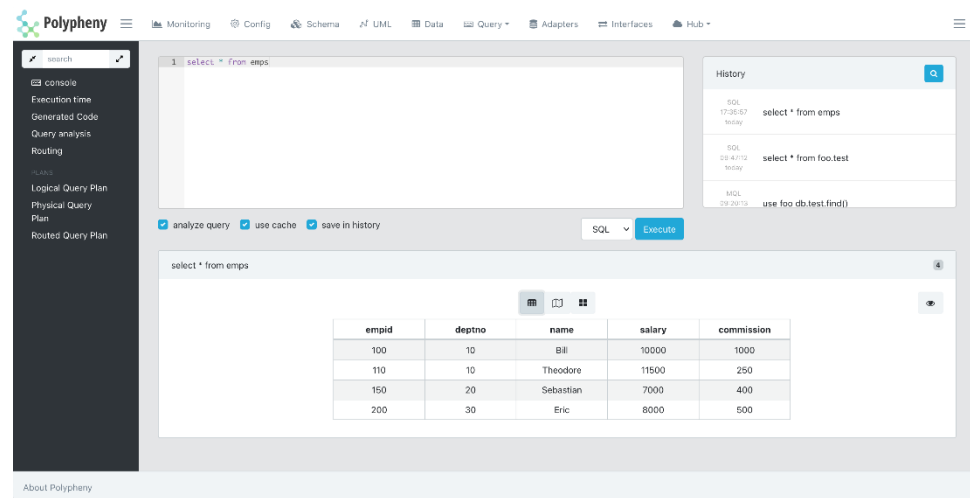
Polypheny

- Using existing database systems as storage and execution engines

- An integrated execution engine that compensates missing features and processes joins

- Utilizes the optimization and domain-knowledge of specialized systems

Multi-Model Data Management with Polypheny

Polypheny

- Open Source (Apache 2 License)

- polypheny.org | @polypheny

- Participated at Google Summer of Code 2021 and 2022

Polypheny: Potential Topics

- Multi-model data streaming

- Multi-model query optimization

- Management and visualization of spatial data

- Temporal and multi-version data management

- Distributed PolyDBMS

- Integration of additional data sources

- Connectors / drivers for different languages (e.g., Go,

- UI for a Polystore (Angular)

- … and others

DBIS Research Group: Summary

- vitrivr
- vitrivr-VR
- VIRTUE
- XReco
- Archipanion
- Fake News Detection
- CityStories
- Participatory Image Archives

Big Data Access & Retrieval

- Cooperation
  - UniZH, UniFR, HES-SO
  - UCLA, Case Western
  - Google (GSoC)
  - Digital Humanities
  - Historical Museum BS
  - HEK Basel
  - 4eyes, ...

- Polypheny-DB
- Polypheny-DDI
- SwissRenov
- Cooperation
  - GSoC
  - Environmental Sciences

Big Data Management & Storage

Big Data Processing & Analytics

- StreamTeam
- SportSense
- Cooperation: BaSpo

Thank you for your attention!

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