Architecting and Engineering Main Memory Database Systems in Modern C

Chapter 0
Organization & Introduction

Marcus Pinnecke, M.Sc.
Research associate / Working Group Database & Software Engineering
Institute of Technical and Business Information Systems (ITI)

OTTO VON GUERICKE UNIVERSITÄT MAGDEBURG

Lecturers

Marcus Pinnecke, M.Sc.
Room G29 125
Website: http://www.dbse.ovgu.de/Mitarbeiter/Marcus+Pinnecke.html
E-Mail: pinnecke{at}ovgu.de

Tutors

Gabriel Campero Durand, M.Sc.
Room G29 125
Website: http://www.dbse.ovgu.de/Mitarbeiter/Gabriel+Campero+Durand.html
E-Mail: campero{at}ovgu.de

Mahmoud Mohsen, B.Sc.
E-Mail: mahmoud.mohsen{at}st.ovgu.de

The course is held in english!

PREFACE

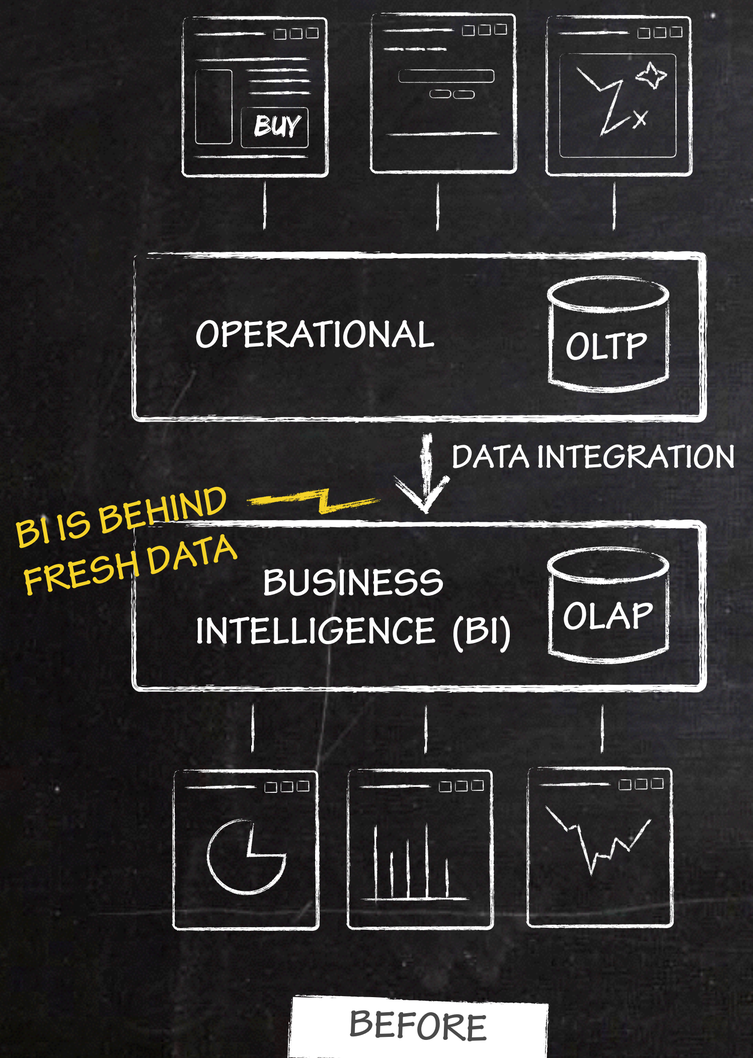
Face it: you learn basics in your studies!

NOVEL KIND OF IN-MEMORY PLATFORM OUTPERFORMING

- ONLINE TRANSACTION PROCESSING (OLTP), AND
- ONLINE ANALYTICAL PROCESSING (OLAP)

Let's begin with a question

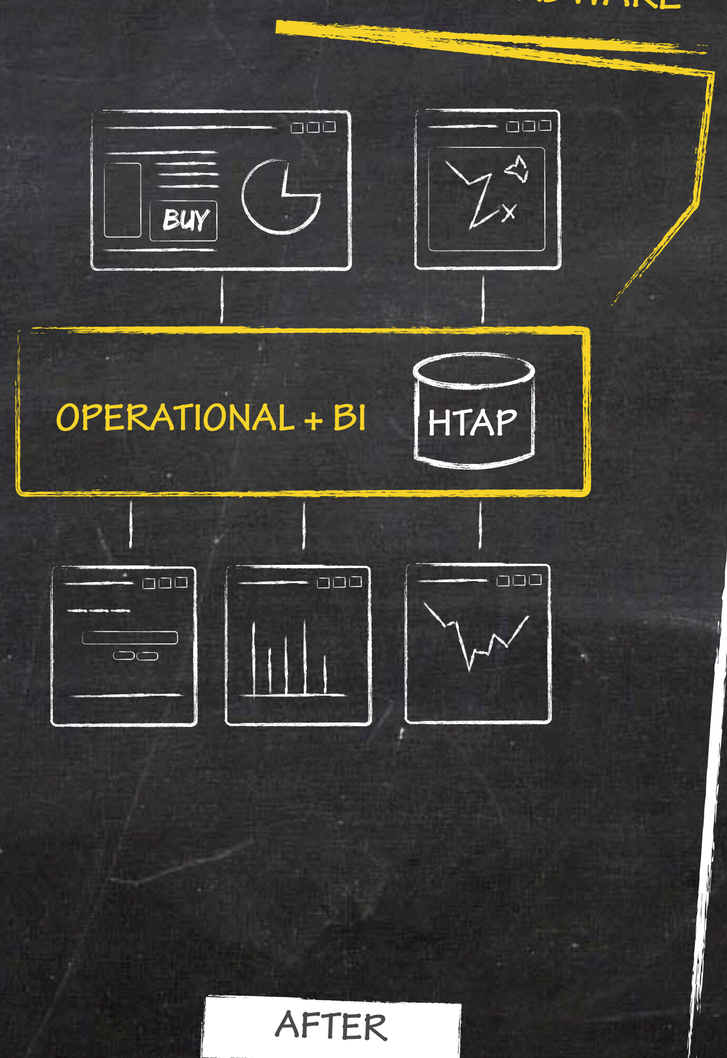
What's HTAP?



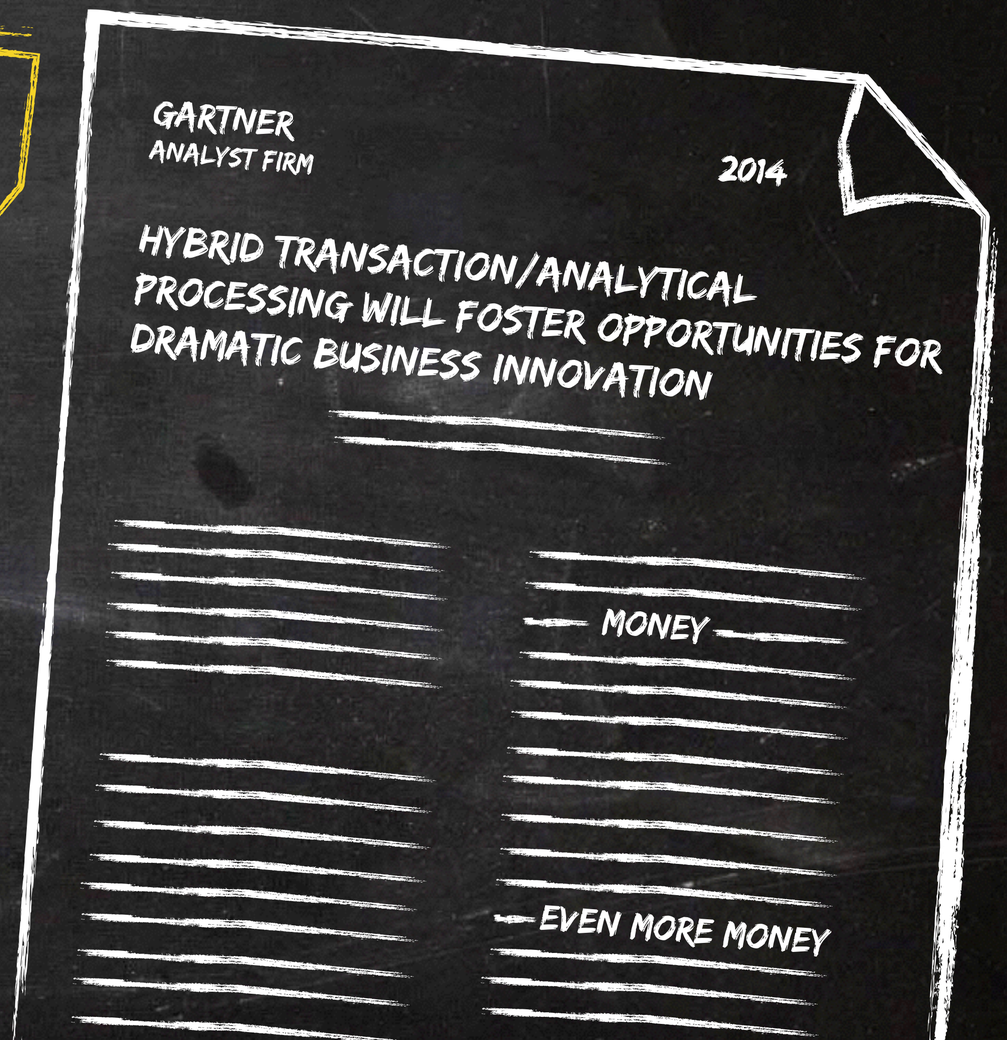
BEFORE

ENABLED BY

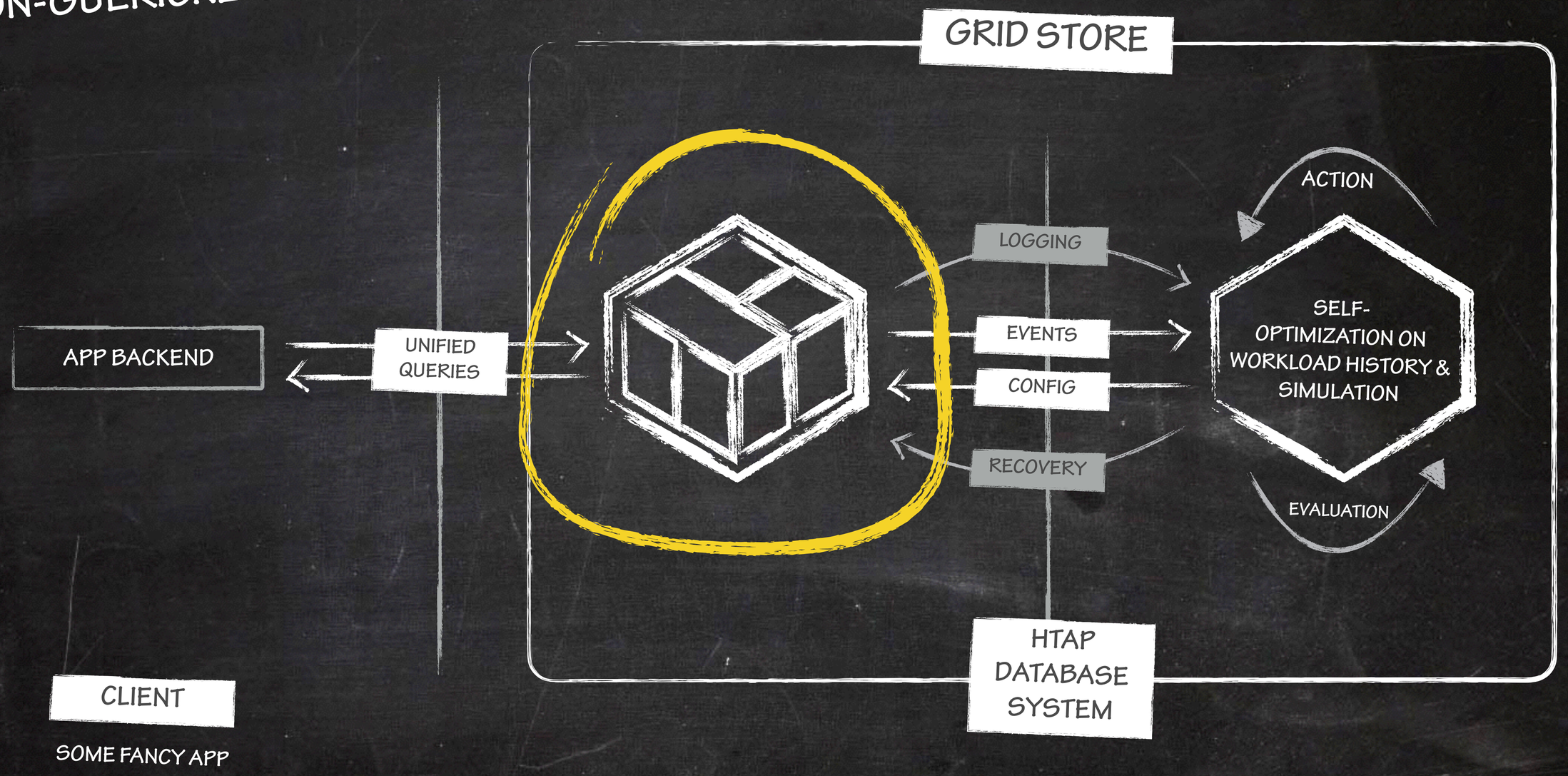
MODERN HARDWARE

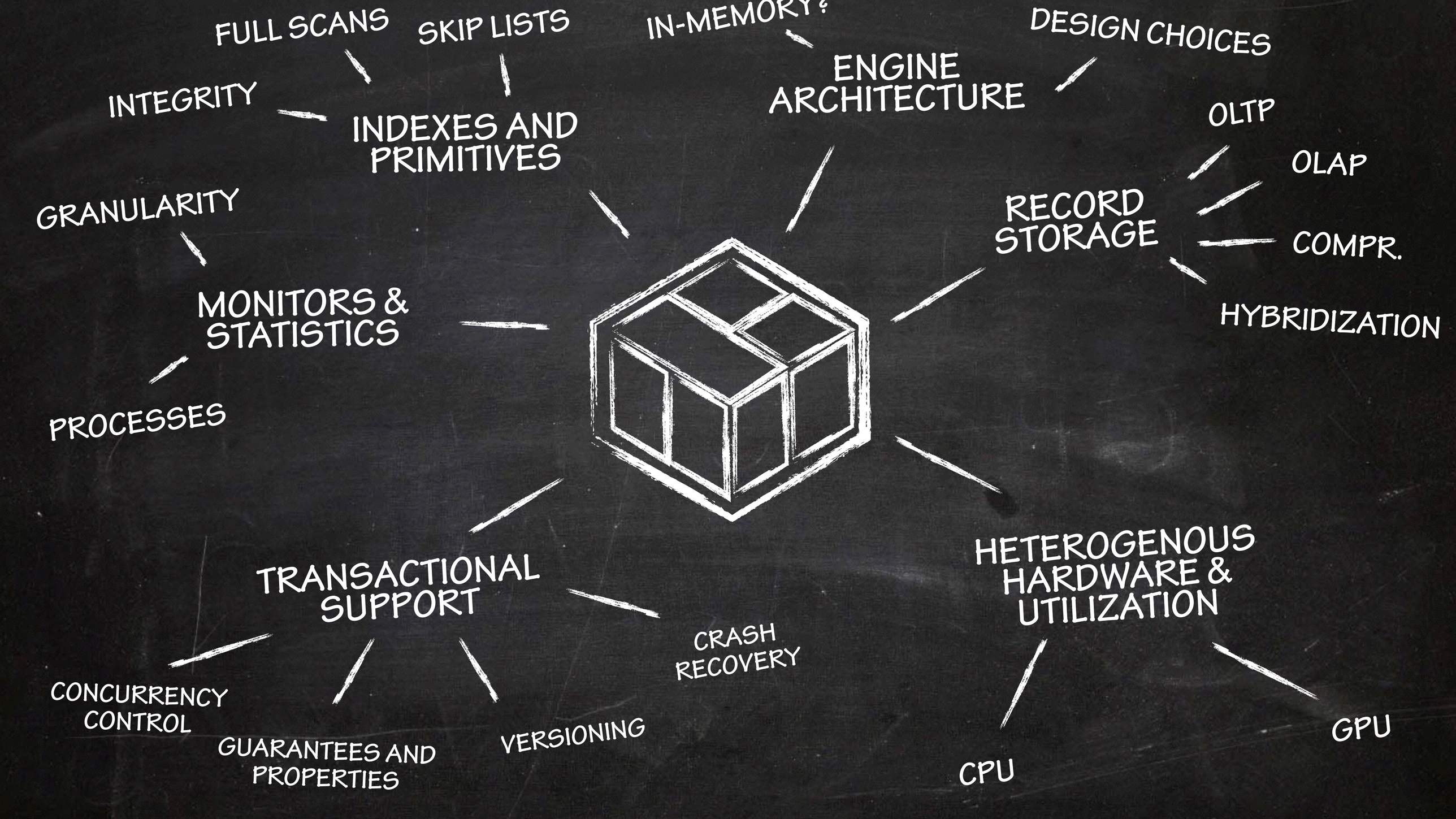


AFTER

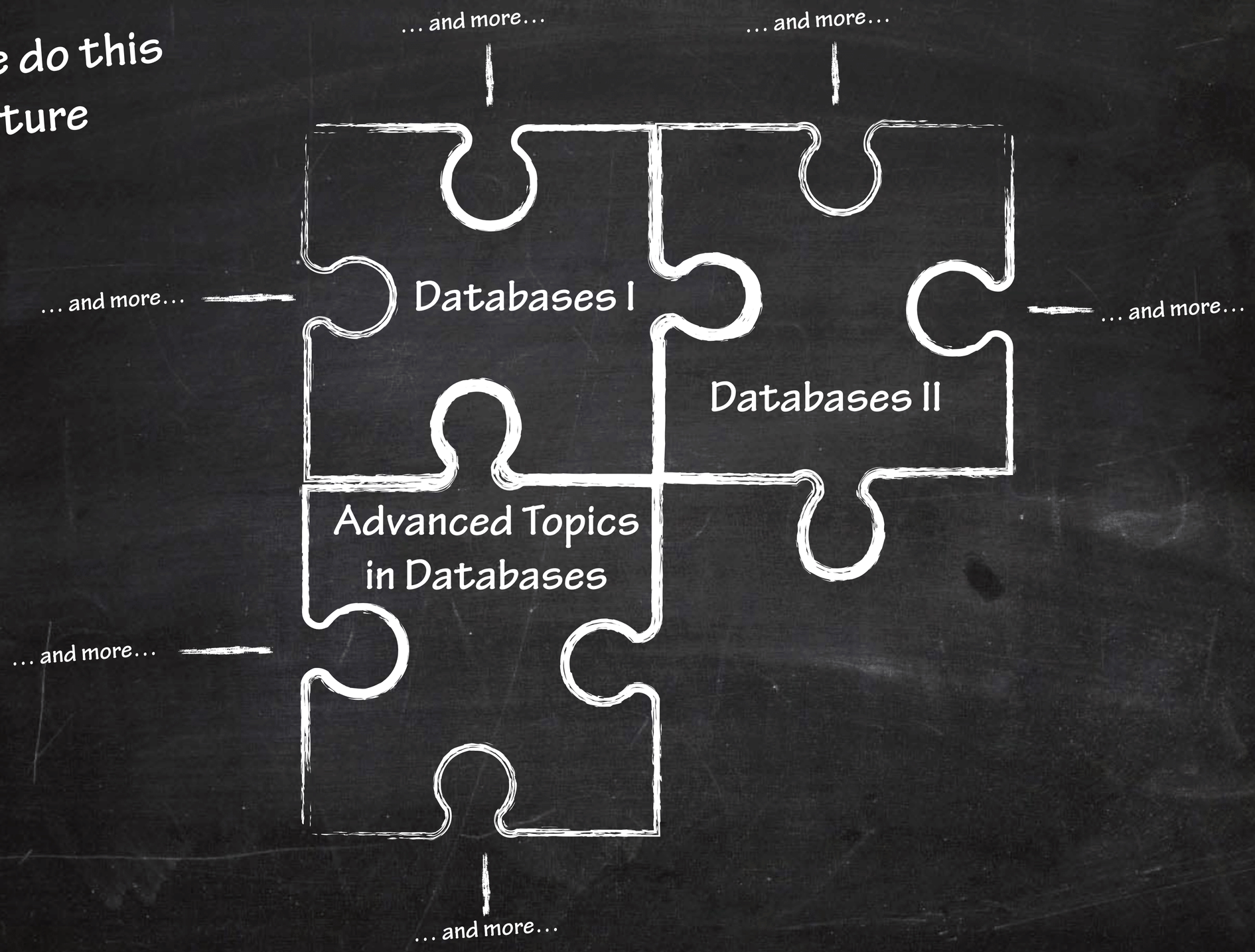


OUR RESEARCH AT OTTO-VON-GUERICKE UNIVERSITY



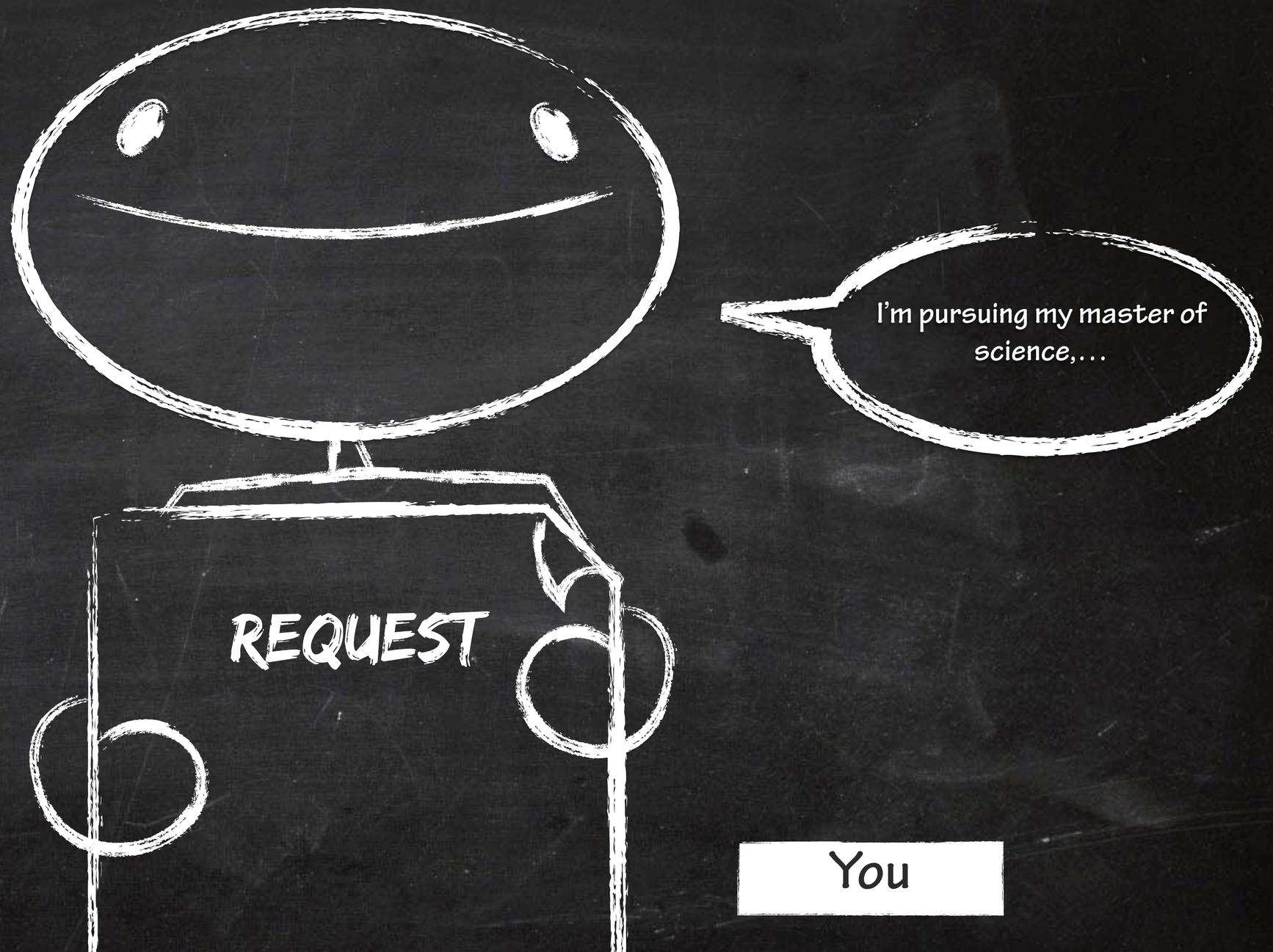

FULL SCANS
SKIP LISTS
IN-MEMORY?
DESIGN CHOICES
INTEGRITY
INDEXES AND PRIMITIVES
ENGINE ARCHITECTURE
OLTP
OLAP
GRANULARITY
RECORD STORAGE
COMPR.
MONITORS & STATISTICS
HYBRIDIZATION
PROCESSES
TRANSACTIONAL SUPPORT
HETEROGENOUS HARDWARE & UTILIZATION
CRASH RECOVERY
CONCURRENCY CONTROL
GUARANTEES AND PROPERTIES
VERSIONING
CPU
GPU

Why we do this lecture



Why we do this lecture

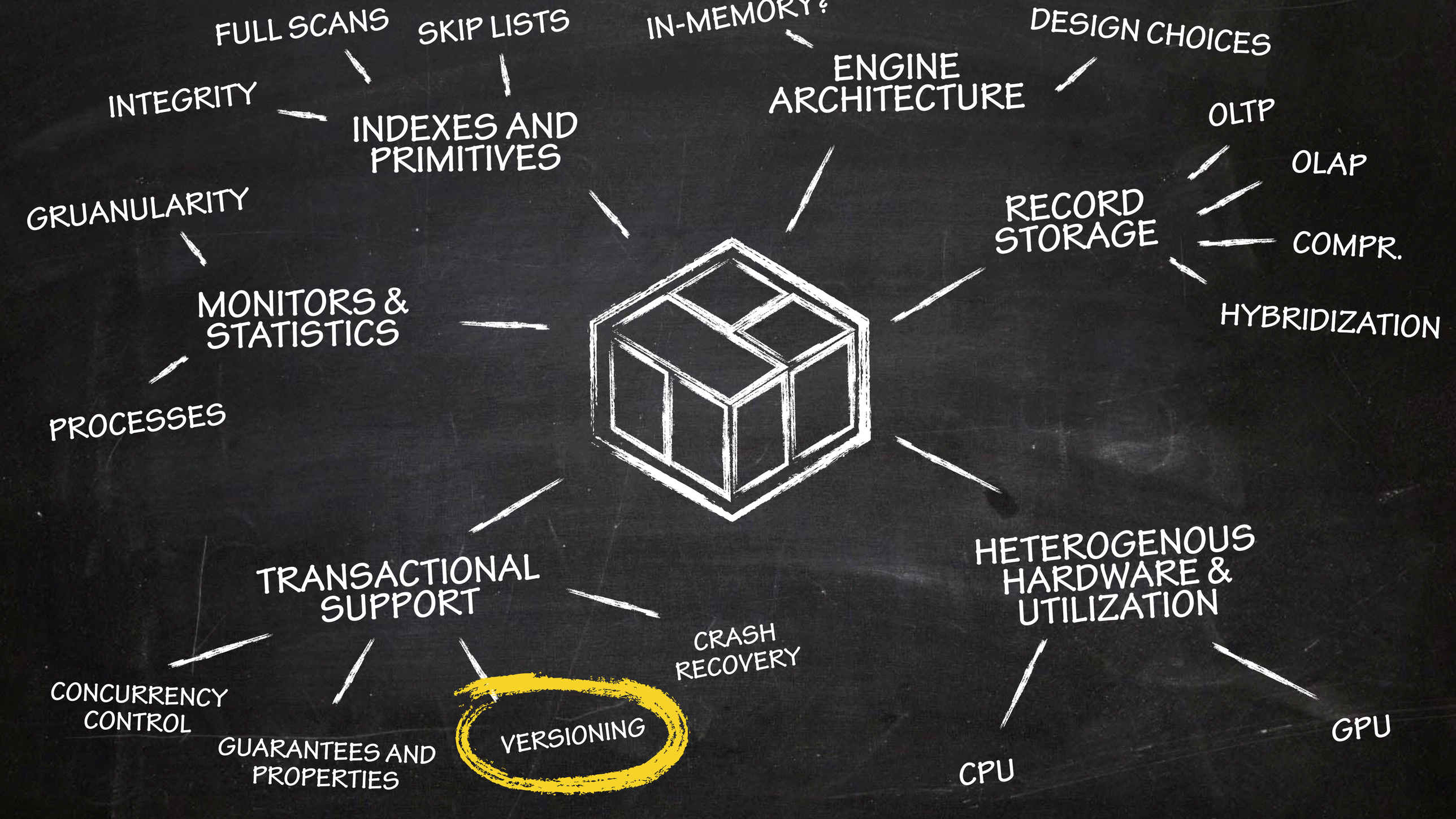
Why we do this lecture



Why we do this lecture

Supervisor

Why we do this lecture


FULL SCANS
SKIP LISTS
IN-MEMORY?
DESIGN CHOICES
INTEGRITY
INDEXES AND PRIMITIVES
ENGINE ARCHITECTURE
OLTP
OLAP
GRUANULARITY
RECORD STORAGE
COMPR.
MONITORS & STATISTICS
HYBRIDIZATION
PROCESSES
TRANSACTIONAL SUPPORT
HETEROGENOUS HARDWARE & UTILIZATION
CRASH RECOVERY
CONCURRENCY CONTROL
VERSIONING
GUARANTEES AND PROPERTIES
CPU
GPU

Why we do this lecture

1st

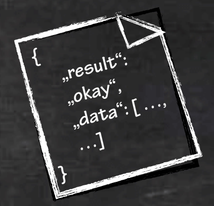
You learned how to engineer this

App Frontend

Java, JS, C#, PHP, Python, Scala, Haskell,…

XML, JSON, Swing, CSS, HTML, CSV,…

App Backend



DB Binding

JDBC, Hibernate, Libraries,…

You learned how to connect client and database system

Query Language

SQL, Cypher,…

2nd

You learned basic concepts of this

3rd

You know how to use this

PostGres, MySQL, Neo4j,…

Relational DBMS, Object DBMS, Graph DBMS,…

4th

Eventually, you learned internal concepts of this

Why we do this lecture

you have not much time to do the job *and* to understand the state of the art

```
#define FLAG_NULLABLE   1 << 3

#define DELEGATE_CALL(instance, fun)                                    \
  ({                                                                    \
    REQUIRE_NONNULL(instance);                                          \
    REQUIRE_IMPL(instance->fun);                                        \
    instance->fun(instance);                                            \
  })

static inline void field_update(tuplet_field_t *field, const void *data) {
  assert (field && data);
  const attr_t *attr = schema_attr_by_id(field->tuplet->fragment->schema, field->att
  if (attr_isstring(attr)) {
    const char *str = *(const char **) data;
    strcpy(field->attr_value_ptr, str);
  } else memcpy(field->attr_value_ptr, data, tuplet_field_size(field));
```

you don't know the language

you don't know the standard functions

you know „only" the basics of the domain

you rarely know how to avoid pitfalls

you don't know the toolchain

you might never get in touch w/ such a large code base

you don't know best practise

you don't know performance knobs

Why we do this lecture

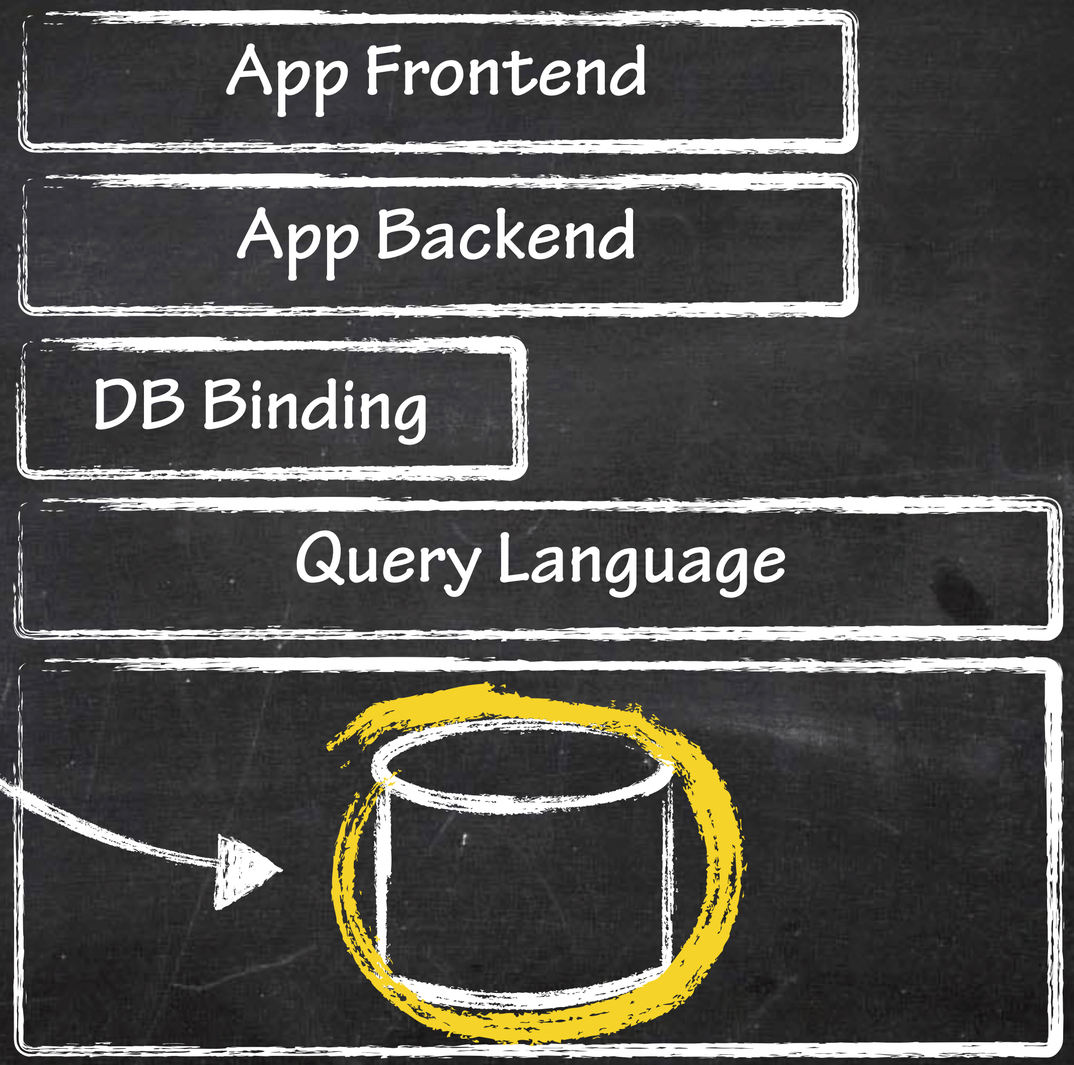
LEARNING CURVE

CURRENT STATE

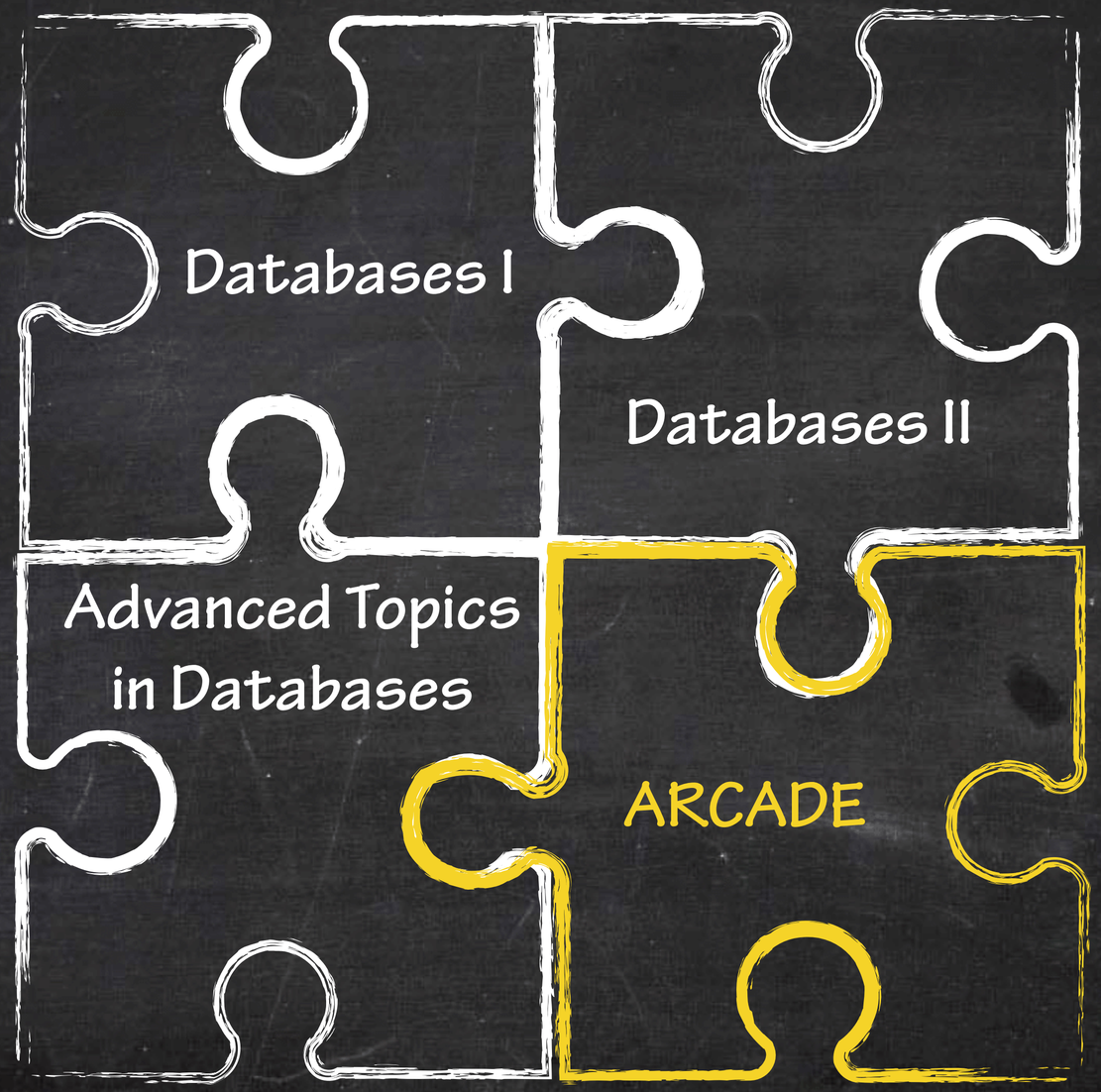
TARGET ONE

Why we do this lecture

In this lecture you will learn the black magic of architecting and engineering one of these



Why we do this lecture



ACKNOWLEDGEMENTS

Thanks to

Prof. Dr. Bernhard Seeger, full professor at Philipps University Marburg & chair of AG Datenbanksysteme
… for his slides to „Programming in C++“ and also for the mentorship through the years

Dr. Sebastian Breß, researcher at German Research Center for Artificial Intelligence (DFKI)
… for all his guidance on database systems internals (go CoGaDB go!), and his focus on co-processors

Dr. Thomas Neumann, full professor at Technical University Munich & chair of Datenbanksysteme
… for fruitful discussion and sharing best practices on teaching system-level programming to students

Dr. Gunter Saake, full professor at Otto-von-Guericke University Magdeburg and chair of AG DBSE
… for his support to bring novel ideas into existence and his trust into his employees

Gabriel Campero Durand, M.Sc., research associate at our working group Database & Software Engineering
… for „being the most collaborative person (one) will ever meet“, his support for this lecture, and drive

David Broneske, M.Sc. and Andreas Meister, M.Sc. for fruitful discussion & help with administrative tasks.

Last but not least, thanks to my wife Pinni for being so pinnifull.

ORGANIZATION

Course Materials and Sources

facebook

NEWS, DISCUSSION,...

https://www.facebook.com/Arcade-479499219098113/

GitHub

SLIDES AND MATERIALS

https://github.com/Arcade-Lecture

GitHub

YOUR EXERCISE SUBMISSIONS

Up to you

About the Course

The course is held in english!

Schedule Time

Lecture Part

11:00am to 1:00pm

Monday | Tuesday | Wednesday | Thursday | Friday

Location
G05-312

Material
Slides-Only

Make notes!

Schedule Time

Exercise Part („Tutorium“)

11:00am to 1:00pm

Monday | Tuesday | Wednesday | Thursday | Friday

Location
G22A-113

Start
16th Oktober

About the Course

The course is held in english!

Schedule Time

Lecture Part

11:00am to 1:00pm

Monday | Tuesday | Wednesday | Thursday | Friday

Location
G05-312

Material
Slides-Only

Make notes!

Schedule Time

Exercise Part („Tutorium“)

11:00am to 1:00pm

Monday | Tuesday | Wednesday | Thursday | Friday

Location
G22A-113

Start
16th Oktober

Make Notes!

WHAT YOU ARE ALLOWED TO DO…

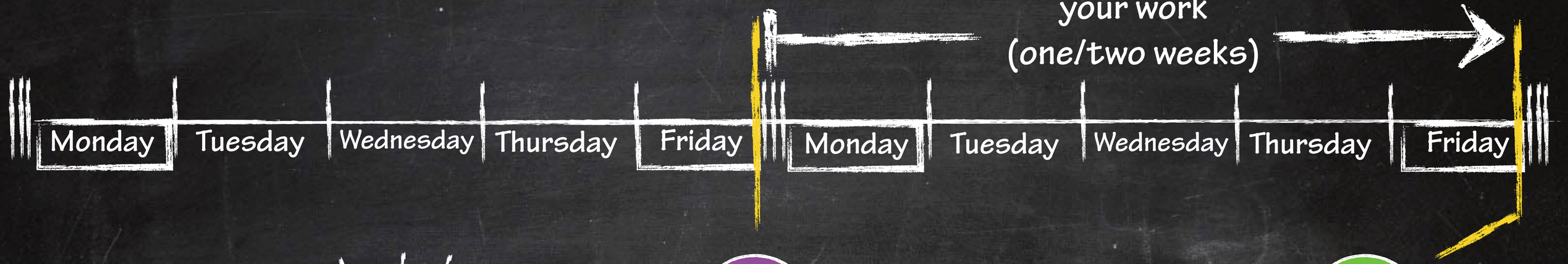
Everything else that is not not allowed.

WHAT YOU ARE NOT ALLOWED TO DO…

Recording

Exercise Proceeding

Issuing & Submission



The first sheet will be published today

Issuing

Each Friday during the day the exercise sheet will be published

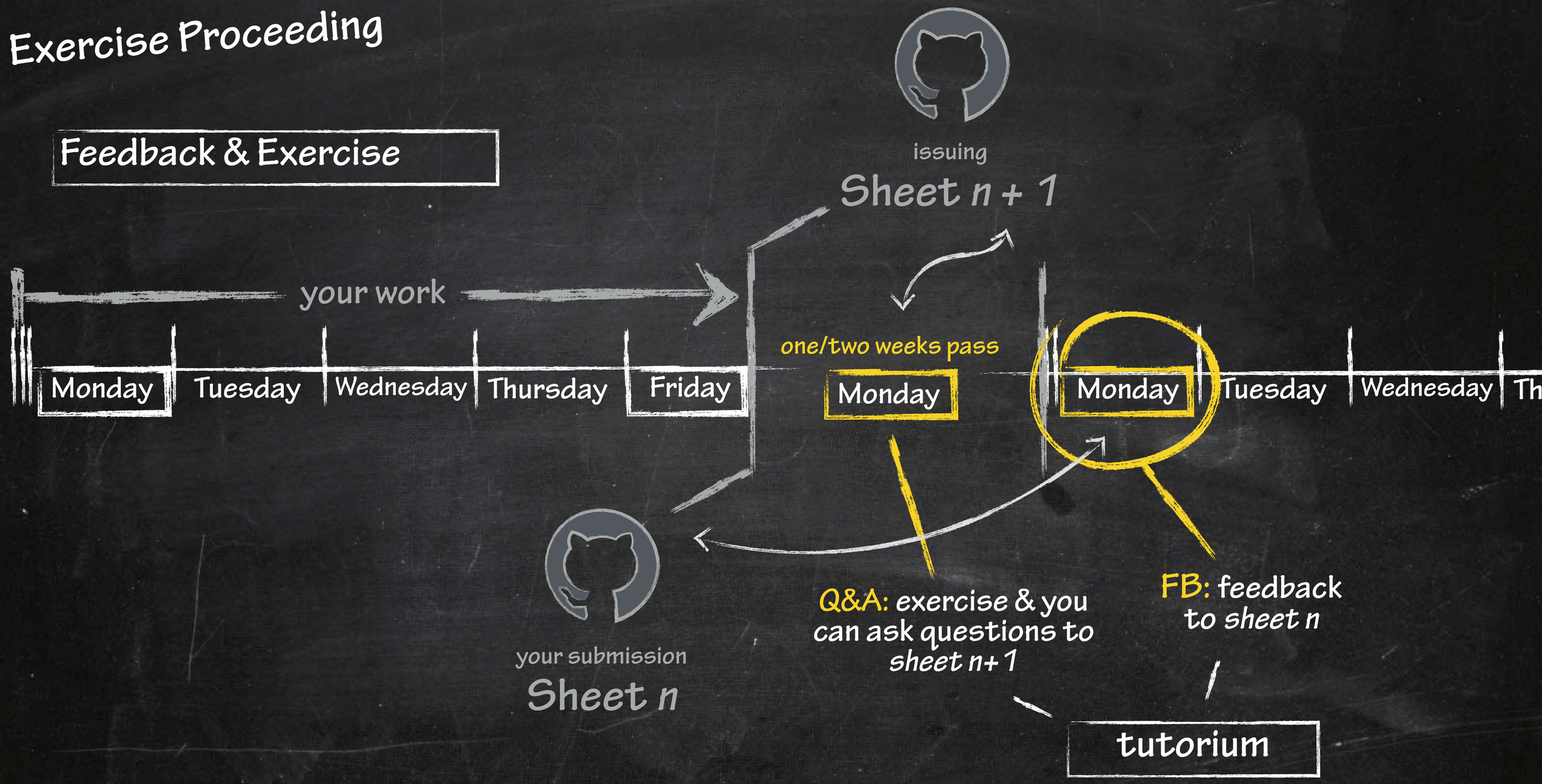
https://github.com/Arcade-Lecture/exercises

Submission

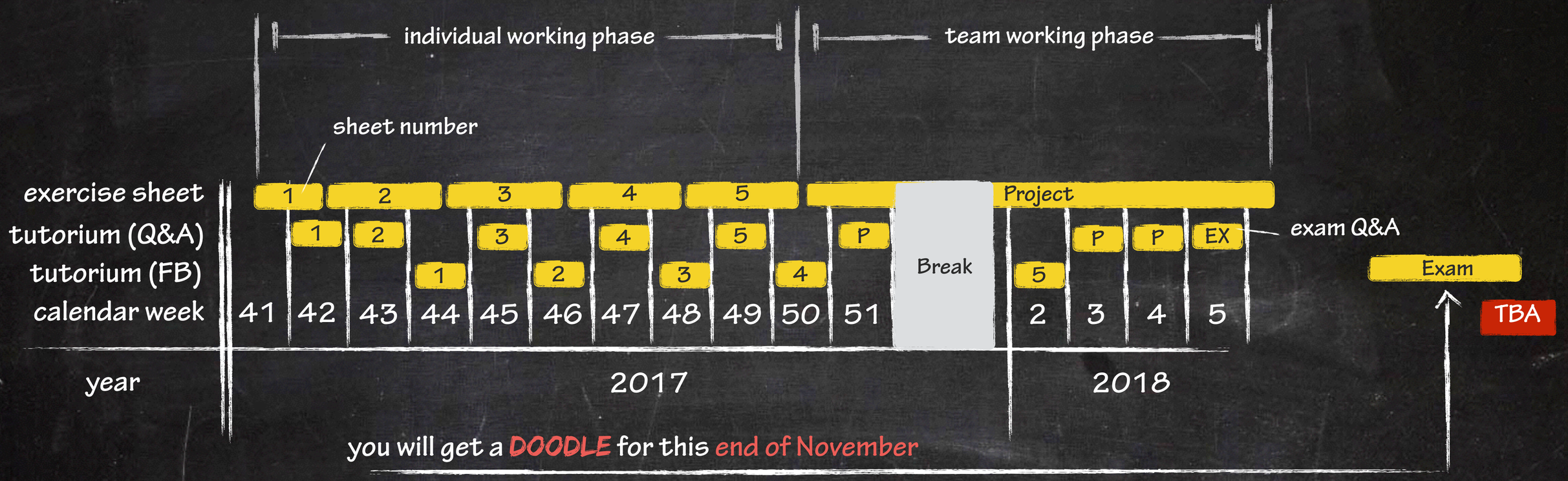
The latest change to your repository until 11:59pm of the (next) following Friday is your submission

Exercise Proceeding

Feedback & Exercise

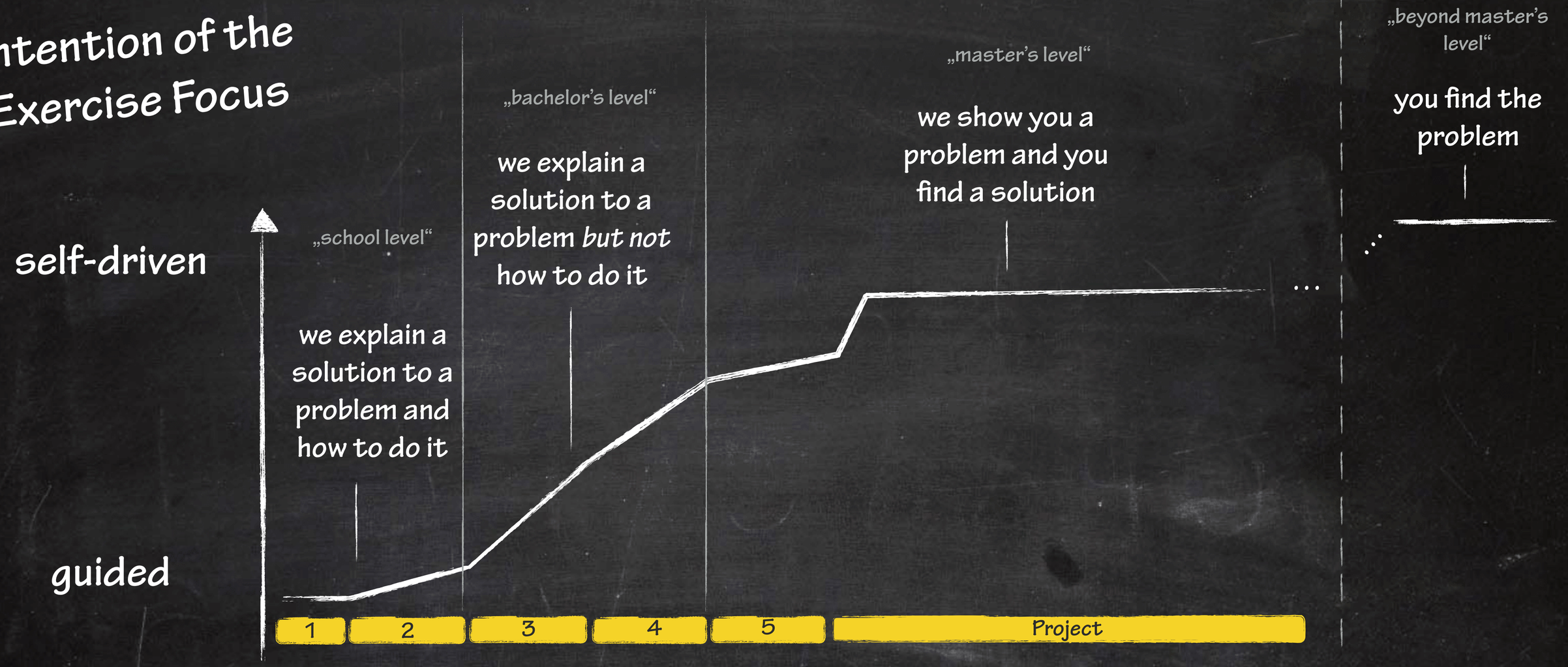


Lecture Proceeding at a Glance



you will get a DOODLE for this end of November

Intention of the Exercise Focus



“ This is a picture and it should be on the wall since the wall is too naked. Take that hammer and that nail. Do the following move over and over again. “

“ This is a picture and it should be on the wall using a hammer and some nails since the wall is too naked. “

“ The wall is too naked. Something must be changed. “

“ People don't like my flat. Maybe there's something wrong. “

Your Way to your Grade

6 CP

Note the difference to „volunteering“ !

- manage to have **50%** of the **5** exercise sheets tasks **correct in total** (individual work).
- find **team mates** to form a group of at least two and at most *k** students. Do the **project sheet** together.
- do an **oral exam** that takes **30min** :
  individual check of your knowledge (15min)
  team presentation & defense of your project (15min)

if you want a „schein“ only, then there's no oral exam but you must at least come to this position

Feel free to visit or not to visit the lecture or tutorium

* the number *k* depends on the actual number of students participating the course.

What's Next after your Grade?

you're already familiarized with the system

you are trained in a more complex engineering process rather than „just exercising"

- you are a better engineer than now*
- individual and team projects
- software projects
- bachelor's/master's thesis
- … maybe even jobs ;)

it's easier to find a topic that you like

you are skilled enough to write code that remains in the code base

you are more productive in a shorter time: you can do high-quality tasks

* hopefully

Important Dates

1st Sheet	1st Tutorial (Q&A)	1st Sheet Deadline	1st Sheet Feedback
Today	16th Okt 17	20th Okt 17	30th Okt 17

Last Sheet Deadline / Project Start	Exam
15th Dec 17	TBA

feedback is welcome!