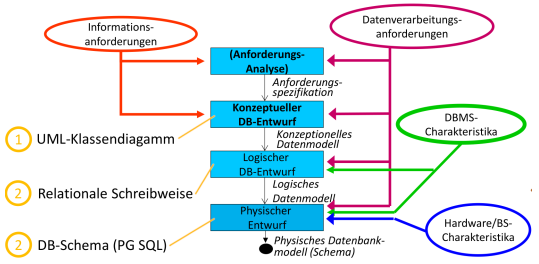
- uml diagramm (konzeptionell)
  - assoziationen, bedingungen
- transaktionen
  - fuzzy read, deadlock, dirty read, write skew, phantom read, serializable snapshot isolation, cascading rollbacks
  - schedule analysieren + Serialisierbarkeitsgraph
- begriffe (physisches schema, DBMS)
- b-baum indexe einfügen


Informations-anforderungen
Datenverarbeitungs-anforderungen
(Anforderungs-Analyse)
Anforderungs-spezifikation
Konzeptueller DB-Entwurf
Konzeptionelles Datenmodell
Logischer DB-Entwurf
Logisches Datenmodell
Physischer Entwurf
Physisches Datenbank-modell (Schema)
DBMS-Charakteristika
Hardware/BS-Charakteristika
1 UML-Klassendiagamm
2 Relationale Schreibweise
2 DB-Schema (PG SQL)

DataBase System

Besteht aus Datenbankmanagementsystem und Datenbasen

DataBase Management System

- Redundanzfreiheit
- Datenintegrität
- Kapselung

ANSI Modell Logische Ebene:
Interne Ebene:
Externe Ebene:
Mapping:

Unified Modeling Language

→	Assoziation	◆	Komposition
◇	Aggregation	▷	Vererbung

Complete: Alle Subklassen sind definiert
Incomplete: Zusätzliche Subklassen sind erlaubt
Disjoint: Ist Instanz von genau einer Unterklasse
Overlapping: Kann Instanz von mehreren überlappenden Unterklassen sein

Normalisierung

1NF: Atomare Attributwerte
2NF: Nichtschlüsselattr. voll vom Schlüssel abhängig
3NF: Keine transitiven Abhängigkeiten
BCNF: Nur abhängigkeiten vom Schlüssel
(Voll-)funktionale Abhängigkeit:
Transitive Abhängigkeit:
Einfügeanomalie, Löschanomalie, Änderungsanomalie

Vererbung

Tabelle pro Sub- und Superklasse:

```
-- TODO: check if correct
CREATE TABLE sup (id SERIAL PRIMARY KEY, -- 3.a
  name TEXT UNIQUE);
CREATE TABLE sub1 (id SERIAL PRIMARY KEY, age INT);
CREATE TABLE sub2 (id SERIAL PRIMARY KEY);
ALTER TABLE sub1 ADD CONSTRAINT id FOREIGN KEY
REFERENCES sup (id); -- Auch für sub2
```

Tabelle pro Subklasse: Enthält jeweil. Subklassattribute

```
CREATE TABLE sub1 (id SERIAL PRIMARY KEY, -- 3.b
  name TEXT UNIQUE, age INT);
CREATE TABLE sub2 (id SERIAL PRIMARY KEY,
  name TEXT UNIQUE);
```

Einzige Tabelle für Superklasse: Enthält alle Attribute

```
CREATE TABLE sup (id SERIAL PRIMARY KEY, -- 3.c
  name TEXT UNIQUE, age INT);
```

Data Definition Language

```
CREATE SCHEMA s;
CREATE TABLE t ( id SERIAL PRIMARY KEY,
  name TEXT UNIQUE,
  grade DECIMAL(2,1) NOT NULL,
fk INT FOREIGN KEY REFERENCES t2.id ON DELETE CASCADE,
  added TIMESTAMP DEFAULT CURRENT_TIMESTAMP,
  u VARCHAR(9) DEFAULT CURRENT_USER,
  CHECK (grade between 1 and 6));
ALTER TABLE t2 ADD CONSTRAINT c PRIMARY KEY (a, b);
TRUNCATE/DROP TABLE t;
```

Data Manipulation Language

```
INSERT INTO t (added, grade) VALUES ('2002-10-10', 1)
RETURNING id;
```

Views

```
CREATE VIEW v (id, grade, u) AS SELECT id, grade, u
FROM t;
```

Data Control Language

```
CREATE ROLE r WITH LOGIN PASSWORD ''
GRANT INSERT ON TABLE t TO r;
REVOKE CREATE ON SCHEMA s FROM r;
ALTER ROLE r CREATEROLE, CREATEDB, INHERIT;
GRANT r TO user_name;
-- read all future created tables
ALTER DEFAULT PRIVILEGES IN SCHEMA s GRANT SELECT ON
TABLES TO readonlyuser;
CREATE POLICY p ON t FOR ALL TO PUBLIC USING (u =
current_user);
ALTER TABLE t ENABLE ROW LEVEL SECURITY;
```

Common Table Expressions

```
WITH RECURSIVE q AS (SELECT * FROM t WHERE grade>1
UNION ALL SELECT * FROM t INNER JOIN q ON q.u =
t.name) SELECT id as 'ID' FROM q;
```

Window Functions

```
SELECT id, RANK() OVER
  (ORDER BY grade DESC) as r FROM t;
SELECT id, u, LAG(name, 1) OVER
  (PARTITION BY fk ORDER BY id DESC) FROM t;
-- PERCENT/DENSE_RANK(), FIRST_VALUE(v), LAST_VALUE(n)
-- NTH_VALUE(v,n), NTILE(n), LEAD(v,o), ROW_NUMBER()
```

Subqueries

```
SELECT * FROM t WHERE grade > ANY (SELECT g FROM t2);
SELECT * FROM t WHERE EXISTS (SELECT g FROM t2);
-- ALL, IN, =
```

JOIN

```
SELECT a.*, b.* FROM a INNER JOIN b ON a.id = b.id;
SELECT y.*, x.* FROM t AS y JOIN LATERAL
  (SELECT * FROM t2 WHERE t2.id = y.id) AS x;
```

GROUP BY

```
SELECT id, COUNT(*) FROM t
  GROUP BY grade, id HAVING COUNT(*) > 2;
```

WHERE

```
BETWEEN 1 AND 5; LIKE '___%'; AND; IS (NOT) NULL
IN (1, 5)      ; LIKE '%asd'; OR ;
```

INDEX

```
CREATE INDEX i ON t /*USING BTREE*/ (grade, UPPER(u))
INCLUDE (added);
CREATE INDEX i ON t (grade) WHERE grade > 4;
DROP INDEX i;
```

Transaktionen

```
BEGIN;  SAVEPOINT s;
COMMIT; ROLLBACK /*TO SAVEPOINT s*/;
```

Isolation

```
SET TRANSACTION ISOLATION LEVEL ...;
SET SESSION CHARACTERISTICS AS TRANSACTION ISOLATION
LEVEL ...;
```

TODO: check

	Read Uncommitted	*Read Committed*	*Repeatable Read*
Dirty Write	⋆	⋆	⋆
Dirty Read	✓	✗	✗
Lost Update	✓	✓	✗
Fuzzy Read	✓	✓	✗
Phantom Read	✓	✓	✓
Read Skew	✓	✓	✗
Write Skew	✓	✓	✓

Dirty Read: Lese Daten von nicht committed T’s
Fuzzy Read: Versch. Werte beim mehrmaligen Lesen gleicher Daten (da durch andere T geändert)
Phantom Read: Neue/Gelöschte Rows einer anderen T
Deadlock:
Cascading Rollback:

Relationale Algebra

$\pi_{R1,R4}(R)$ `SELECT R1,R4 FROM R;`
$\sigma_{R1>30}(R)$ `SELECT * FROM R WHERE R1 > 30;`
$\rho_{a\leftarrow R}$ `SELECT * FROM R AS a;`
$R \times S$ `SELECT * FROM R,S;`
$R \underset{A=B}{\bowtie} S$ `SELECT * FROM R JOIN S ON R.A=S.B;`

Serialisierbarkeit

Backup

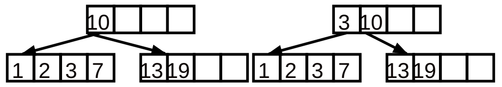
<<<<<<< HEAD *Write-Ahead Log*

TODO: LSN, TaID, PageID, Redo, Undo, PrevLSN

Dreiwertige Logik (cursed)

```
SELECT NULL IS NULL; -- true
SELECT NULL = NULL; -- [null]
```

B-Baum


10
1 2 3 7
13 19
3 10
1 2 3 7
13 19