UNIVERSITETET I BERGEN

KANDIDAT

109

PRØVE

INF115 0 Databaser og modellering

Emnekode	INF115
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General exam information

Oppgave	Tittel	Oppgavetype
i	General info about digital campus exam - INF115, spring 22	Informasjon eller ressurser

Instructions for Part 1

Oppgave	Tittel	Oppgavetype
i	Instructions for Multiple Choice Questions	Informasjon eller ressurser

Part 1 - Multiple Choice Questions - 20 Points

Oppgave	Tittel	Oppgavetype
1	Views are	Flervalg (flere svar)
2	Sparse indices	Flervalg (flere svar)
3	Join query	Flervalg (flere svar)
4	Aggregate Functions	Flervalg (flere svar)
5	Instances and Types	Flervalg (flere svar)
6	Files	Flervalg (flere svar)
7	Indices	Flervalg (flere svar)
8	Subqueries	Flervalg (flere svar)
9	Subtypes	Flervalg (flere svar)
10	Subqueries	Flervalg (flere svar)

Instructions for Part 2

Oppgave	Tittel	Oppgavetype

ℹ	Instructions Part 2	Informasjon eller ressurser

Part 2 - Concepts - 15 Points

Oppgave	Tittel	Oppgavetype
11	ER model	Nedtrekk
12	Properties of Transactions	Nedtrekk

Instructions for Part 3

Oppgave	Tittel	Oppgavetype
ℹ	Instructions for Part 3	Informasjon eller ressurser

Part 3 - Exercise on Diagrams and Queries - 15 Points

Oppgave	Tittel	Oppgavetype
13	Diagram	Plasser i bilde
14	Query 1	Plasser i tekst
15	Query 2	Plasser i tekst
16	Algebra 1	Plasser i tekst
17	Algebra 2	Plasser i tekst

Instructions for Part 4

Oppgave	Tittel	Oppgavetype
ℹ	Instructions for Part 4	Informasjon eller ressurser

Part 4 - Normalization of a Table - 20 Points

Oppgave	Tittel	Oppgavetype
18	Redundancy	Langsvar
19	Functional dependencies	Langsvar
20	Candidate Key	Flervalg (flere svar)
21	Types of dependencies	Flervalg (flere svar)
22	Normal Form	Flervalg (flere svar)
23	Normalise the Table	Langsvar

Mandatory Assignments

Oppgave	Tittel	Oppgavetype
24	Mandatory Assignments	Tekstfelt

1 Views are

Which of these statements about views are correct ?

Select one or more alternatives:

- [ ] Views are stored as tables in the database.
- [ ] Views are usually sorted.
- [x] Only the view definition (query) is stored in a system table.
- [x] The query defining a view can use multiple tables.

Maks poeng: 2

2 Sparse indices

Select the correct statements below.

Select one or more alternatives:

- [ ] Multiple sparse indices per file are possible.
- [x] Dense indices are smaller than sparse indices.
- [x] Sparse indices contain one entry per block in a file.
- [ ] Dense indices contain one entry for every entry in the file.

Maks poeng: 2

3 Join query

Which statements are true about the following query ?

```
SELECT *
FROM T1, T2
T1 INNER JOIN T2 ON T1.col1 = T2.col2
```

Select one or more alternatives:

- [x] This inner join can also be written using a WHERE section.
- [ ] col2 is always a foreign key.
- [ ] The order of tables in the query matters.
- [x] This is the standard form of an inner join.

Maks poeng: 2

4 Aggregate Functions

Select all **aggregate functions:**
Select one or more alternatives:

- [ ] LOWER
- [x] AVG
- [x] MIN
- [ ] UPPER
- [x] COUNT

Maks poeng: 2

5 Instances and Types

Which statements about instances and types are correct ?
Select one or more alternatives:

- [x] An entity instance corresponds to a row in a table.
- [ ] An entity instance corresponds to a column in a table.
- [x] The entity type represents the whole table.
- [ ] The entity type represents one row in a table.

Maks poeng: 2

6 Files

Which statements are correct ?

Select one or more alternatives:

- [x] A file consists of records which are made of fields.
- [ ] Every digital storage medium is a numbered sequence of bytes.
- [x] In general, the memory (RAM) is large enough to contain the whole database.
- [ ] The DBMS wants to maximise the number of I/O operations.

Maks poeng: 2

7 Indices

Select the correct statements about indices.

Select one or more alternatives:

- [x] Indices must be kept up-to-date when updating tables.
- [x] Indices optimise and speed up searching.
- [ ] Indices are unsorted data structures.
- [ ] Indices require no additional storage.

Maks poeng: 2

8 Subqueries

The subquery is ...
Select one or more alternatives:

- [ ] run after the main query.
- [x] run first and the result is substituted into the main query.
- [x] can be nested inside another subquery.
- [ ] cannot contain operators such as IN, ALL etc.

Maks poeng: 2

9 Subtypes

Which statements about subtypes are true ?

Select one or more alternatives:

- [x] Subtypes can have additional attributes.
- [ ] A subtype must be an aggregation of another entity.
- [ ] Subtypes correspond to subsets of the sets of instances.
- [x] A subtype is a specialisation of another entity.

Maks poeng: 2

10 Subqueries

Subqueries can be used in :
Select one or more alternatives:

- [x] WHATIF clauses
- [ ] SELECT clauses
- [x] FROM clauses
- [ ] UPDATE, INSERT and DELETE clauses

Maks poeng: 2

11 ER model

Select the correct alternative for each gap:

The structure of a database can be represented [graphically] (graphically, syntactically, experimentally)using [Entity Relationship] (Effectively Random, Entity Relationship, Example Row)diagrams**.** These diagrams can include more or less details, depending on whether the level of the representation is abstract, logical or conceptual. An [entity] (element, essence, entity)is a physical or an abstract object about which we want to store information. Entities have interesting properties called [attributes] (alternatives, arguments, attributes). In addition they must have [identifiers] (identifiers, rows, columns)which composed of one or several [attributes] (alternatives, attributes, arguments)that [uniquely determine] (ambiguously choose, uniquely determine, physically repeat)an occurrence. A [relationship] (graph, relationship, representation)between [entities] (relationships, arguments, entities)represents how they are connected to each other. In Entity Relationship diagrams relationships are represented by [lines connecting] (relative ordering of, lines connecting, multiple repeating)entities. The [cardinality] (abstraction, ordering, cardinality)of a relationship expresses how many [occurrences] (columns, occurrences, attributes)of an entity A can or must be connected to an [attribute] (column, attribute, occurrence) of an entity B.

Maks poeng: 11

12 Properties of Transactions

Select the correct definition for each term:

Atomicity: All or none of the sub-operations of a transaction must be completed. (All or none of the sub-operations of a transaction must be completed., The effect of transactions in progress should not be observable by other transactions., The effect of completed transactions is stored in the database and shall not be lost due to errors., A transaction moves the database from one valid state to another valid state.)

Consistency: A transaction moves the database from one valid state to another valid state. (The effect of transactions in progress should not be observable by other transactions., The effect of completed transactions is stored in the database and shall not be lost due to errors., A transaction moves the database from one valid state to another valid state., All or none of the sub-operations of a transaction must be completed.)

Isolation:

The effect of transactions in progress should not be observable by other transactions. (The effect of completed transactions is stored in the database and shall not be lost due to errors., A transaction moves the database from one valid state to another valid state., The effect of transactions in progress should not be observable by other transactions., All or none of the sub-operations of a transaction must be completed.)

Durability:

The effect of completed transactions is stored in the database and shall not be lost due to errors.
(All or none of the sub-operations of a transaction must be completed., The effect of completed transactions is stored in the database and shall not be lost due to errors., A transaction moves the database from one valid state to another valid state., The effect of transactions in progress should not be observable by other transactions.)

Maks poeng: 4

Data Model

In this exercise, you work on a database for a book club.
The database contains several entities:

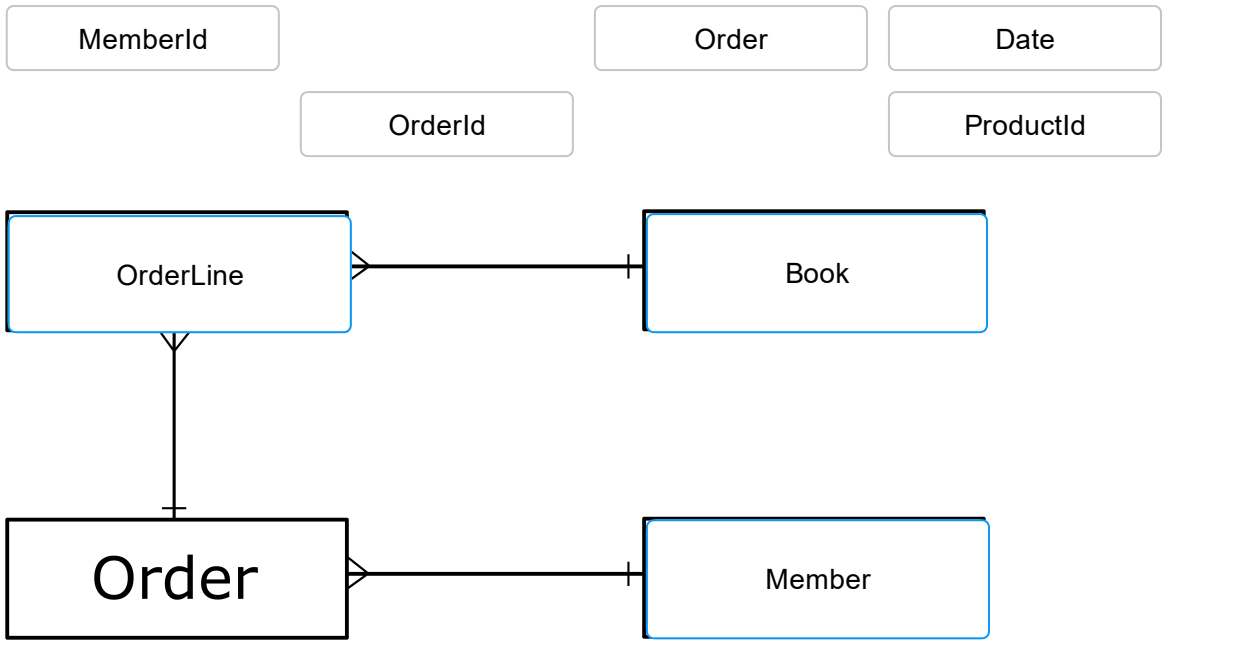
- Book (__ProductId__, Author, Title, Category, Price, NumberInStock)
- Order(__OrderId__, MemberId*, Date)
- Orderline(__OrderId__*,__ProductId__*, Antall)
- Member(__MemberId__, FirstName, LastName, Address)

Primary keys are underlined and foreign keys are followed by a star.

13 Diagram

Correctly position the names of the entities in the gaps in this conceptual diagram.

Hjelp



Maks poeng: 3

14 Query 1

Place the tokens in the gaps in the query below so that it returns the books which cost more than 300 kr and the result is ordered alphabetically by author.

Hjelp

Order | Member | LastName | Date

MemberId | Title

```
SELECT *
FROM [Book]
WHERE [Price] >= 300
ORDER BY [Author]
```

Maks poeng: 3

15 Query 2

Place the tokens in the gaps in the query below so that it returns the number of orders placed by each member in 2021.

Hjelp

ProductId | AVG | Book

OrderLine | DATE | MONTH

```
SELECT [COUNT] (*)
FROM [Order]
WHERE [YEAR] (Date) = 2021
GROUP BY [MemberId]
```

Maks poeng: 4

16 Algebra 1

Translate the following query into relational algebra:

```
SELECT Order.MemberId, OrderLine.ProductId
FROM Order INNER JOIN OrderLine ON Order.OrderId = OrderLine.OrderId
```

Complete the expression below:

Hjelp

σ | MemberId | × | ProductId | =

Π | OrderLine.OrderId | MemberId, ProductId (Order □ Order.OrderId = OrderLine)

Maks poeng: 3

17 Algebra 2

Translate the following query into relational algebra:

```
SELECT *
FROM Book
WHERE NumberInStock > 100
```

Complete the expression below:

Hjelp

Order | Π | × | Member

σ | NumberInStock > 100 (Book)

Maks poeng: 2

Normalization Exercise

The table *Investment* contains data about shares of companies that have been bought by the clients of a bank.

Investment(StockId, CompanyName, ClientId, LastName, StockMarketId, Municipality, Date, Time, TotalPrice, UnitPrice, UnitsBought)

The example row below tells us that shares of the company Twitter Inc with StockId TWTR:US have been bought by a client with ClientId 112233445566 and LastName Musk. The buying transaction was performed on the market with StockMarketId 27 on 17.05.2022 at 21:00 (local time). This market is located in New York City municipality. The client bought 764 180 688 units of the stock at a unit price of 54.20 USD and a total amount of 41 418 593 289.60 USD.

('TWTR:US', 'Twitter Inc', 112233445566, 'Musk', 27, 'New York City', 17.05.2022, 21:00, 41418593289.60, 54.2, 764180688)

Answer all six of the questions below.

Note: You must indicate primary keys by underlining them (or use __PKName__) and foreign keys with a trailing star (e.g. FKName*).

You can give names to tables and use the following notation A → B.

18 Redundancy

The table *Investment* contains redundancy. **Give one example of this (maximum 12 words)**.

Fill in your answer here

TotalPrice, can be calculated using UnitPrice and UnitsBought

Ord: 8

Maks poeng: 2

19 Functional dependencies

Now determine and list all functional dependencies in the table.

Note: Please write **one** functional dependency per line.

Maximum 60 words.

Fill in your answer here

StockId → CompanyName
ClientId → LastName
StockMarketId → Municipality
StockId, Date, Time → UnitPrice
UnitPrice, UnitsBought → TotalPrice
StockId, ClientId, StockMarketId, Date, Time → UnitsBought

Ord: 25

Maks poeng: 6

20 Candidate Key

Which columns are part of the candidate key for this table ?

Note: You have to select all correct columns, otherwise zero points are given.

Select one or more alternatives:

- [x] Date
- [ ] Municipality
- [ ] UnitPrice
- [ ] TotalPrice
- [ ] CompanyName
- [x] ClientId
- [x] Time
- [x] StockId
- [ ] UnitsBought
- [x] StockMarketId
- [ ] LastName

Maks poeng: 2

21 Types of dependencies

Which of these types of dependencies occur in the table *Investment* ?

Note: Select all that apply.

Select one or more alternatives:

- [x] A determinant that is not a super-key
- [x] Transitive dependencies
- [x] Partial dependencies

Maks poeng: 3

22 Normal Form

Which are the normal forms verified by the table *Investment* ?

Note: You have to select all normal forms up to and including the highest normal form that is verified, otherwise zero points are given.

Select one or more alternatives:

- [ ] Third Normal Form
- [ ] Boyce-Codd Normal Form
- [ ] None of these normal forms
- [ ] Second Normal Form
- [x] First Normal Form

Maks poeng: 2

23 Normalise the Table

Perform the normalization to the Boyce-Codd normal form (BCNF) and describe the result in text form. Remember to indicate the primary and foreign keys in the resulting tables.

Maximum 60 words.

Fill in your answer here

The new tables:
Stock(StockId, CompanyName)
StockPrice(StockId*, Date, Time, StockMarketId*, Price)
Client(ClientId, LastName)
StockMarket(StockMarketId, Municipality)
Investment(InvestmentId, StockMarketId*, StockId*, ClientId*, UnitsBought, Date, Time)

I have created a new attribute InvestmentId which is an auto increment id for an investment. Two Investments can have the same InvestmentId if they are in different markets. This makes InvestmentId not grow as fast.

Ord: 57

Maks poeng: 5

24 Mandatory Assignments

Here, you can enter the points (convert to points out of 30) that you earned on your mandatory assignments and leave a comment about the exam.

This field is optional.

Fill in your answer here

In task 19 I assume that the attribute StockMarketId is an id of what market the investment was done on. Where in this case the id 27 refers to the market in New York municipality.

In task 20 I assume that it is not possible for the same person to buy the same stock in the same minute. If this was possible I would add UnitPrice into the candidate key as this removes the possiblity of two rows having identical candidate key.

Maks poeng: 30