COMPSCI 351 The University of Auckland + Southwest University

Fundamentals of Database Systems - Assignment 2

2024

Note: Collaboration on assignments is encouraged, but you must write up your work individually and in your own words.

1. **(Relational Algebra)**

   Consider the relational database schema {CUSTOMER, ORDER, DRIVER} with the relation schemata:

   - CUSTOMER={*customer_id, name, email*} with key {customer_id}

   - DRIVER={*date, driver_name, vehicle*} with key {*date*}

   - ORDERS={*order_id, customer_id, address, payment_method, order_date*} with key {order_id} and with foreign keys

   [customer_id] $\subseteq$ CUSTOMER[customer_id]

   [order_date] $\subseteq$ DRIVER[date]

   (a) For the following English language description of a query write the corresponding relational algebra query. Only use operators of relational algebra that were used in the lecture.

   i) Which are the orders (the order_ids) that have been delivered by neither the driver 'Karl' nor 'Lenny' (not been delivered by 'Karl' or 'Lenny')?

   [4 marks]

   ii) Who are the drivers that have never driven a bus and drove a motorbike when they delivered an order to the address '742 Evergreen Tce'?

   [4 marks]

   (b) Write down an English language description of the query that is equivalent to the following relational algebra query:

   i) $Q_1 = \pi_{address}(\texttt{ORDERS} \bowtie (\sigma_{driver\_name='Karl'}(\texttt{DRIVER})))$
   $Q_2 = \pi_{address}(\sigma_{payment\_method='cash'}\texttt{ORDERS})$
   $Q = Q_1 - Q_2$

   [3 marks]

   ii) $\pi_{name,email}(\texttt{CUSTOMER} \bowtie (\pi_{customer\_id,payment\_method}(\texttt{ORDERS}) \div \pi_{payment\_method}(\texttt{ORDERS})))$

   [3 marks]

2. **(Relational Calculus)**

Consider the relational database schema {CUSTOMER, ORDER, DRIVER} with the relation schemata:

- CUSTOMER={*customer_id, name, email*} with key {customer_id}

- DRIVER={*date, driver_name, vehicle*} with key {*date*}

- ORDERS={*order_id, customer_id, address, payment_method, order_date*} with key {order_id} and with foreign keys

[customer_id] $\subseteq$ CUSTOMER[customer_id]

[order_date] $\subseteq$ DRIVER[date]

(a) Write the following query in safe relational calculus:
Who are the customers that have ordered on April 1st 2024 (2024-04-01) and paid in cash?

[3 marks]

(b) Write down in English what the following relational calculus query returns:
$\texttt{CUSTOMER}(x_{customer\_id}, x_{name}, x_{email}) \wedge$
$\forall x_{order\_id}, x_{address}, x_{payment\_method}, x_{order\_date}, x_{date}$
$((\texttt{ORDERS}(x_{order\_id}, x_{customer\_id}, x_{address}, x_{payment\_method}, x_{order\_date}) \Rightarrow$
$\exists x_{vehicle}\ \texttt{DRIVER}(x_{date}, \text{'Karl'}, x_{vehicle})) \wedge (x_{order\_date} = x_{date}))$

[3 marks]

Possible Marks: 20