**Asian Institute of Technology**
**Mid-semester Examination**
**August 2021**

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| Course: AT82.02 Data Management & Modeling | Total score: 100 (20 %) |
| Date: Friday 8 October 2021 | Time: 13:15-15:15 (2 hours) |

**Exam Instructions**

- This examination is Open-Book. Number of pages: 3, Number of Questions: 2.
- Be concise!
- **Refer to given Case Study to answer Questions 1 and 2. For any missing details, explicitly state necessary assumptions or conditions you make. Make your assumptions rational and practical.**

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**Case Study: Citizen Mobility Tracking and COVID-19 Status Monitoring System**

COVID-19 pandemic has led to the imposition of several policies in many countries, such as social gathering restrictions, lockdown implementations and quarantine regulations, hence affecting citizen mobility within/across the countries.

In order to better contain the disease, monitor the national and regional situations closely and evaluate the effectiveness of the policies enforced by the government, the **Citizen Mobility Tracking and COVID-19 Status Monitoring System** is designed and developed. In essence, it provides as a database system for tracking and tracing the spread of the disease. That is, it keeps track of citizen movement when visiting public places/areas. In addition, infection and disease status is updated every time a person is diagnosed with COVID-19 positive and must undergo a treatment at a hospital.

During the first phase, the following operations and queries are of highest priority that should be supported by the system.

- Q1: Record of COVID-19 status updates. For example, a citizen is tested with COVID-19 positive; hospitalized at a specific hospital, recovered, released from a hospital, or die due to the disease. His/her status is recorded properly together with the necessary details, such as his/her citizen ID, address, admitted hospital, contact details and contact person, etc.
- Q2: Generate important daily/monthly statistics, consisting of totals number of COVID-19 infections, recovery, deaths within a day, a month, grouped by province and sort by the number of infections from highest to lowest.
- Q3: Find top 5 hospitals with the highest number of COVID-19 admissions in September 2021. List the hospital name, province, the number of new admissions within the specified month.
- Q4: Record a check-in/check-out of a person visiting/leaving a public place, such as a mall, a school, an office, a restaurant, a sport center, etc. Each place should have a name, address, responsible/contact person, type or category of the place (such as a restaurant, a government office).
- Q5: When a person is found infected, anybody who are suspected to encounter with the infected person within the past 7 days should be identified and informed in order to prevent further disease transmission. This query is then to list ID, names and contact details of those people; hence proper communications can be made to have those people undergo a self-quarantine for another 14 days.

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**Exam Questions**

1. Relational model design and data management:
    a. (20 points) Perform conceptual design and logical design. Show few sample data in your database tables with proper use of PKs, FKs.
    b. (20 points) Implement the given basic operations/queries Q1, Q2, Q3, Q4, Q5 in SQL.
    **Hint:** Useful SQL date/time functions are given on the last page of this exam paper.
    c. (10 points) Suggest two additional queries that can support the government to closely monitor the situation, provide certain insight into the situation and/or support a plan/policy to implement such as setting new vaccination programs, field hospitals or some mobility restrictions, etc. Implement your queries in SQL.
2. To ensure fast query and operation processing, NoSQL models, specifically, the key-value and document models are considered to design and implement appropriate use cases/scenarios of the system.
    a. (25 points) Discuss any possible use cases/scenarios that t**he key-value model** could be used to implement the **Citizen Mobility Tracking and COVID-19 Status Monitoring System**. Elaborate and show your design/implementation. Analyze the benefits/limitations of your work.
    b. (25 points) Discuss any possible use cases/scenarios that **the document model** could be used to implement the **Citizen Mobility Tracking and COVID-19 Status Monitoring System**. Elaborate and show your design/implementation. Analyze the benefits/limitations of your work.

**Useful SQL Functions**

- `MONTH(date)`

  Returns the month for `date`, in the range `1` to `12` for January to December, or `0` for dates such as `'0000-00-00'` or `'2008-00-00'` that have a zero month part.

```
mysql> SELECT MONTH('2008-02-03');
        -> 2
```

- `MONTHNAME(date)`

  Returns the full name of the month for `date`. The language used for the name is controlled by the value of the `lc_time_names` system variable (Section 10.16, "MySQL Server Locale Support").

```
mysql> SELECT MONTHNAME('2008-02-03');
        -> 'February'
```

**-- End of Exam Paper --**