```
Query 1:
PATTERN AND(LongY ly, LongC lc, VLongO vo, VLongY vy)
WHERE ly.bID=lc.bID ∧ lc.bID=vo.bID ∧ vo.bID = vy.bID
WITHIN 24h

Query 2:
PATTERN AND(ShortC sc, LongO lo, LongY ly, VLongC vc)
WHERE sc.bID=lo.bID ∧ lo.bID=ly.bID ∧ ly.bID = vc.bID
WITHIN 24h

Query 3:
PATTERN AND(ShortO so, SEQ(LongO lo, VLongC vc), LongC lc)
WHERE so.bID=lo.bID ∧ lo.bID=vc.bID ∧ vc.bID = lc.bID
WITHIN 24h

Query 4 / QWL:
PATTERN SEQ(ShortO so, AND(ShortY sy, VLongC vc), LongY ly)
WHERE so.bID=sy.bID ∧ sy.bID=vc.bID ∧ vc.bID = ly.bID
WITHIN 24h

PATTERN AND(LongY ly, LongC lc, ShortC sc, VLongY vy)
WHERE ly.bID=lc.bID ∧ lc.bID=sc.bID ∧ sc.bID = vy.bID
WITHIN 24h
```

Listing 1: Queries used for Citi Bike Dataset.

1 CITI BIKE

Characterization for derivation of event types:

(1) short trip $< 100s$
(2) long trip $100s \leq x \leq 5000s$
(3) very long trip $> 5000s$
(4) old, year of birth < 1962
(5) young, year of birth ≥ 1962
(6) customer (instead of member) if not year of birth given

Examples for Event Types:

LongC corresponds to a **long trip** with the driver being a **customer**.

ShortY corresponds to a **short trip** with the driver being a **young** member.

VLongO corresponds to a **verylong trips** with the driver being a member of age group **old**.

```
Query 1 (double Update):
PATTERN SEQ(Submit s, Update1 u1, Schedule h, Update2 u2)
WHERE s.uID=u1.uID ∧ u1.uID=c.uID ∧ c.uID=u2.uID
WITHIN 30min

Query 2 (lost task):
PATTERN SEQ(Submit su, Schedule sh, Lost l, Kill k ,Update2 u2 )
WHERE su.jID=sh.jID ∧ sh.jID=l.jID ∧ l.jID=k.jID
∧ k.jID=u2.jID
WITHIN 30min

Query 3 / QWL (failed updates):
PATTERN SEQ(Update2 u2, Schedule sh, Update1 u1, Lost lo)
WHERE u2.uID=sh.uID ∧ sh.uID=u1.uID ∧ u1.uID=lo.uID
WITHIN 30min

PATTERN SEQ(Update2 u2, Fail f, Update1 u1, Lost lo)
WHERE u2.uID=f.uID ∧ f.uID=u1.uID ∧ u1.uID=lo.uID
WITHIN 30min

Query 3 (unlucky job):
PATTERN SEQ(Schedule sh, Evict e, Fail f, Update u1)
WHERE sh.jID=e.jID ∧ e.jID=f.jID ∧ f.jID=u1.jID
WITHIN 30min
```

Listing 2: Queries used for Google Cluster.

2 GOOGLE CLUSTER MONITORING

A description of the event types contained in the Google Cluster queries can be found at https://drive.google.com/file/d/0B5g07T_gRDg9Z0lsSTEtTWtpOW8/view?resourcekey=0-cozD56gA4fUDdrkHnLJSrQ.

- ○ *Update1* corresponds to Update_Scheduled
- ○ *Update2* corresponds to Update_Running