Assignment 2: Go Card

Course coordinator: Graeme Smith **Due: 5pm, Fri 22 April**

The purpose of this assignment is to give you experience in modelling part of a software system in Z. The case study is the go card system used on Brisbane's public transport network.

Task description

Below is an extract from the Wikipedia entry for Brisbane's go-card system.[1] Using the extract as a set of requirements, your task is to specify the following operations for a (single) go card:

- *TouchOn* – corresponding to the user of the go card starting a journey, or segment of a journey

- *TouchOff* – corresponding to the user of the go card ending a journey, or segment of a journey

such that the operations can be combined to form the operation *Touch == TouchOn ∨ TouchOff*.

To do this you will need to specify a state schema with variables which allow you to capture the required functionality at a suitable level of abstraction (not all details in the requirements below will be relevant). You can assume values such as time, location, etc. appear as inputs when needed in operations. The types of these values can be given types, and constants and functions using these given types can be defined as required. The schema calculus can be used, if necessary, to simplify your schemas.

Each type definition, axiomatic definition and schema in your specification should be preceded by explanatory text. This text should not simply paraphrase the Z, but explain it in the context of the case study. Further text may follow a definition or schema where necessary, e.g., to help clarify complicated predicates.

CSSE7032 students only: You will need to write a short reflection (a few paragraphs only) on the level of abstraction you chose (which details you included and which you left out) and any incompleteness or ambiguities you found in the case study description and how you resolved them. Your reflection should justify your decisions.

A pdf file of your completed assignment must be submitted via Blackboard by the due date.

Fare Classes

The go card is available in Adult, Child, Concession and Seniors fare types:

- Adult is for use by passengers without concessions.

- Child is for use by children under the age of 15 years.

- Concession is for use by passengers entitled to a concession, such as full-time secondary and tertiary students, holders of a Pensioner Concession Card, and holders of a Repatriation Health Card.

- Seniors is for use by passengers who have a Queensland Seniors Card issued by the Queensland Government.

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[1]https://en.wikipedia.org/wiki/Go_card, 14 March, 2016.

Fare Calculation

When purchasing a go card, a refundable deposit is applied, on top of the starting balance. The deposit allows users to finish their journey even when they have insufficient funds on the go card, although the go card has to have a positive balance at the start of the journey.

To use the go card, users need to hold their card less than 10 cm away from the reader to "touch on" and do the same to "touch off" at the end of each journey or segment travelled (depending on the mode of travel). On the CityTrain network, users are only required to "touch on" at their station of origin and "touch off" at their destination station - transfers between CityTrain services do not require additional touches. On buses and ferries, users must "touch on" and "touch off" for each service boarded.

For inter-modal, bus and ferry travel, TransLink allows go card users to transfer between services (up to 3 times and within 3 and a half hours) without being regarded as having started a new journey.

The fare is calculated and deducted from the go card balance each time the user touches off, based on the number of zones travelled through since the first segment of the journey. On a transfer segment, the user is only charged the difference between the amount already charged and the total fare for the journey.

Users who do not "touch off" are charged a fixed amount which varies depending on the mode of travel. In the event of inadvertent error, technical faults or other excusable circumstances, penalty fares can be adjusted via the TransLink website (for registered go cards) or telephone call centre.

Incentives

Peak and off-peak is used by TransLink to encourage passengers to travel during non-busy hours. TransLink does this by offering discounts to passengers for traveling during off-peak hours. Peak is from 3am to 8.30am and 3.30pm to 7pm weekdays, except public holidays, while Off-peak is from 8.30am to 3.30pm and after 7pm weekdays until 3am the following day and all day weekends and gazetted public holidays. To qualify for off-peak, the journey or segment must be commenced and completed before the off-peak period ends. If a journey straddles the peak and off-peak periods, the fare system applies an off-peak fare to those segments of the journey commenced and completed within the off-peak period.

Under the current frequent user scheme, go card users are able to travel free after completing nine journeys in a week (Monday through to Sunday). The previous frequent user scheme offered a 50% discount after 10 trips traveled in a given week.

Sale and Top-up Points

Automated go card top-up machines are located at major transport hubs (such as at Carindale bus station within Westfield Carindale), QR train stations and most stations on the busway network. Cards can also be purchased and topped-up at various retailers, newsagents and convenience stores. go cards can also be ordered online through the TransLink website. Selected bus operators are also able to top-up cards on board, although this is not implemented on services operated by Brisbane Transport.

Users who register their go card online have access to an online portal to enable them to perform automatic and manual top-ups via credit card, report fare issues, maintain their details and download transaction histories. Further, the balance of registered cards can be permanently transferred to another card and the account balance can be frozen if the go card is reported as lost or stolen.

TransLink also operates a phone hotline for customer service, card top-ups and enquiries.

Card Readers

Card readers are installed on each bus and ferry operating within the TransLink network. On the CityTrain network, card readers are located at each train station, rather than on each train.

Fare enforcement officers, who randomly patrol services, are also equipped with portable card readers.

CityCycle Scheme integration

In March 2012, the then opposition transport spokesman, Scott Emerson, proposed that an LNP government if elected would consider integrating go cards with the Brisbane City Council/JCDecaux-operated CityCycle bicycle

hire scheme. A similar proposal had previously been rejected by the incumbent Labor government in January 2012. From November 2012, CityCycle subscribers can link a go card account to a CityCycle account, which also operates on a smart-card based system. However, the current integration does not yet allow bicycle hire charges to be deducted from the go card account balance.

Marking criteria

The assignment is worth 20% of your final grade.

For CSSE4603 students:

> You will be given a mark out of 20 comprising
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> - a mark out of 15 based on the percentage of required declarations and predicates that are both syntactically and semantically correct, and
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> - a mark out of 5 for accompanying English text that is clear and concise.
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> A mark of 0 will be given for work with little or no academic merit.

For CSSE7032 students, the above multiplied by 16/20 plus:

> A mark out of 4 for a clear and concise reflection.

School Policy on Student Misconduct:

You are required to read and understand the School Statement on Misconduct, available on the School's website at:

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http://www.itee.uq.edu.au/itee-student-misconduct-including-plagiarism

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