

## Homework # 1

Assigned Date: August 27

Due Date: September 9

### Exercise 1

#### 1-1

There are two Honda Accord cars driving on the roads. Both can reach at most 116 mph. Quail enters the road with the speed of 90mph and Roadrunner enters the road with the speed of 60 mph. For the first five miles, Quail moves in a constant speed of 90mph and for the next 5 mile, it moves in a constant speed of 40 mph. On the other road, Roadrunner moves in a constant speed of 60 mph. The actual speed trajectory has the property of continuous function. But when it comes to measurement, we assume the measured speed trajectory to be measured in discrete time based, it records the time interval Quail and Roadrunner spent every 0.5 mile. In the first 8 mile, Quail is ahead of Roadrunner, and after 8 miles, Roadrunner overtake Quail. They pass the same distance at the 8-minutes mark.

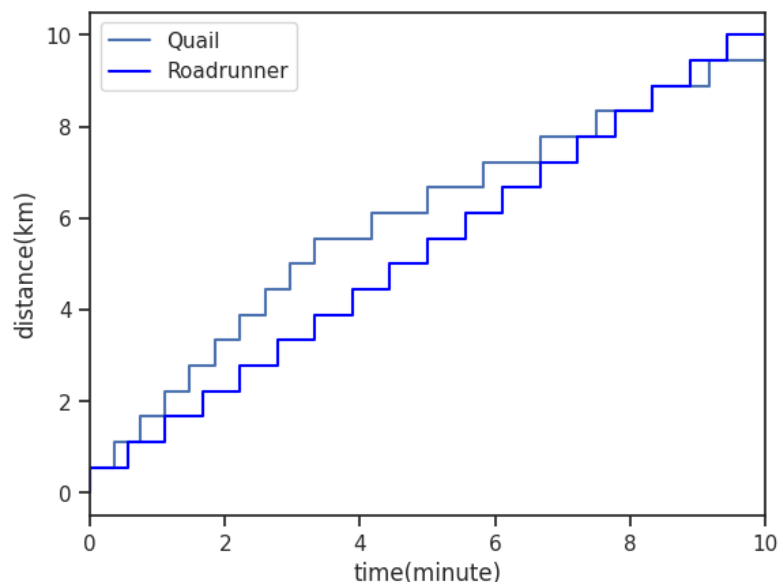
#### 1-2

Quail's formula:  $t = d_1 \cdot 2/3$  (first 5 miles),  $t = d_1 \cdot 3/2$

Roadrunner's formula:  $t = d_2$

#### 1-3

(use python)



### Exercise 2

#### 2-1

My answer:

No. It can't be restricted to integer since the time base of discrete event trajectory is continuous.

ChatGPT:

**Begin AIG**

Yes, the time axis  $t$  of a discrete-event data trajectory can typically be restricted to integer values. In many real-world applications and simulations, events are often recorded and processed at discrete time intervals, which are usually represented as integers. This discretization simplifies modeling and analysis, as it aligns with the discrete nature of many systems and processes.

For example, in discrete-event simulation, time is often divided into discrete time steps, and events are scheduled to occur at specific integer time points. This simplifies event scheduling and makes it easier to manage the progression of the simulation.

However, in some cases, you might encounter situations where non-integer time values are used for specific modeling purposes, such as when modeling continuous-time processes with discrete-event simulation techniques. In such cases, it's possible to use non-integer values for time, but the underlying simulation engine or data representation may still discretize and round time values for practical implementation.

In summary, while it's common and practical to restrict the time axis of discrete-event data trajectories to integer values, there may be exceptions where non-integer values are used for specialized purposes or to represent continuous-time processes in a discretized manner.

**End AIG**

2-2

ChatGPT provides incorrect but persuasive answer to this question, which can potentially mislead us when trying to acquire new knowledge.

Exercise 3

3-1

in simulation, real-time and physical-time have same time rates. That is,  $\Delta_{\text{realTime\_t}} = \Delta_{\text{physicalTime\_t}}$ . However, the values they represent may differ. For instance, even though it is 10 p.m. in the physical world, we can still set our real-time simulation clock to 9 a.m..

3-2

Logical time can have varying time rates compared to real time. Sometimes accelerating or slowing down the simulation helps us obtaining more accurate measurements. Take exercise-1 as an example, speeding up simulation process allows us to achieve the same result as a 10-minute run but in a more efficient manner.

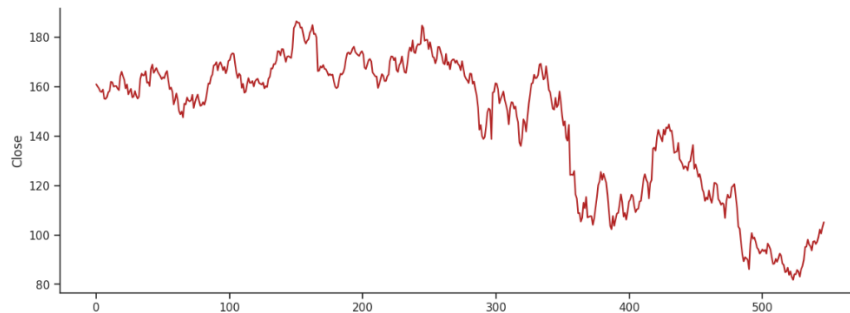
3-3

Both of them can be made repeatable because they are artificially generated. Since they are represent virtual values, so we have the flexibility to modify them according to our experimental needs.

3-4

For logical-time:

Yes. For logical-time, we have the option to utilize bigger time intervals in superdense time data trajectories, which enable us to capture rapid fluctuations along the y axis. Just like the graph below.



For real time:

No. Real time simulations matches the time passage in the physical world, making it challenging to accurately represent superdense data, especially when rapid fluctuations occur within a small amount of time.