Explaining the Mechanism of Traffic Lights Using the Concept of the State Machine

The behavior of the state machine can be observed in the operation of many devices. Transducers are one kind of state machines which aim to generate output based on the current state and input. For example, traffic lights generate the color of the lights based on their current state and the time input. To be a finite state transducer, the following conditions should be satisfied:

* A set of states, S
* A set of inputs, I
* A set of outputs, O
* A next-state function, defined as
* An output function, defined as
* An initial state,

So how do traffic lights satisfy these conditions?

Traffic light obviously has three states, which can be represented as state 0, 1 and 2. At each state, it expects an event triggered by the timer when it goes off as the instruction to enter the next state. Each state has its correspond output. When it enters the next state, the timer will be reinitiated and the time interval may be reset to another one. It goes like this:

We assumed that the inputs “True” are generated by the timer when it goes off.

To be described as a continuous process:

The state machine is initiated and the initial state is 0, so the initial output is green. The timer starts timing, and returns a True after certain interval. Both s = 0 and i = True is satisfied, so the state machine enters the state 1. The state machine outputs the color yellow consequently, and the timer is reinitiated. It then returns a True after a certain amount of time, so the conditions s = 1 and i = True are now satisfied, and the state machine enters the state 2. The color red is displayed at this state. When timer returns a True after a while, the conditions s = 2 and i = True are satisfied so the state machine goes to the initial state 0. The above process circulates with no point of termination.

This process can be demonstrated by the following table:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Time | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | …… |
| Input | True | True | True | True | True | True | True | True | …… |
| State | 0 | 1 | 2 | 0 | 1 | 2 | 0 | 1 | …… |
| Output | green | yellow | red | green | yellow | red | green | yellow | …… |