

Event Machine

● — *State of the Art* —>

Traffic Lights



Traffic Lights



 States

1  // Red State

2  // Yellow State

3  // Green State

 Events

1  // TIMER_RED

2  // TIMER_YELLOW

3  // TIMER_GREEN



Machine with If-Else

```
1  class TrafficLightStateMachine
2  {
3      private string $currentState;
4
5      public function __construct()
6      {
7          $this->currentState = 'green';
8      }
9      public function getCurrentState(): string
10     {
11         return $this->currentState;
12     }
13     public function transitionOnTimer()
14     {
15         if ($this->currentState === 'green') {
16             $this->currentState = 'yellow';
17         } elseif ($this->currentState === 'yellow') {
18             $this->currentState = 'red';
19         } elseif ($this->currentState === 'red') {
20             $this->currentState = 'green';
21         }
22     }
23 }
```



Machine with Match

```
1  class TrafficLightStateMachine
2  {
3      private string $currentState;
4
5      public function __construct()
6      {
7          $this->currentState = 'green';
8      }
9      public function getCurrentState(): string
10     {
11         return $this->currentState;
12     }
13     public function transitionOnTimer()
14     {
15         $this->currentState = match ($this->currentState) {
16             'green' => 'yellow',
17             'yellow' => 'red',
18             'red' => 'green',
19             default => $this->currentState,
20         };
```

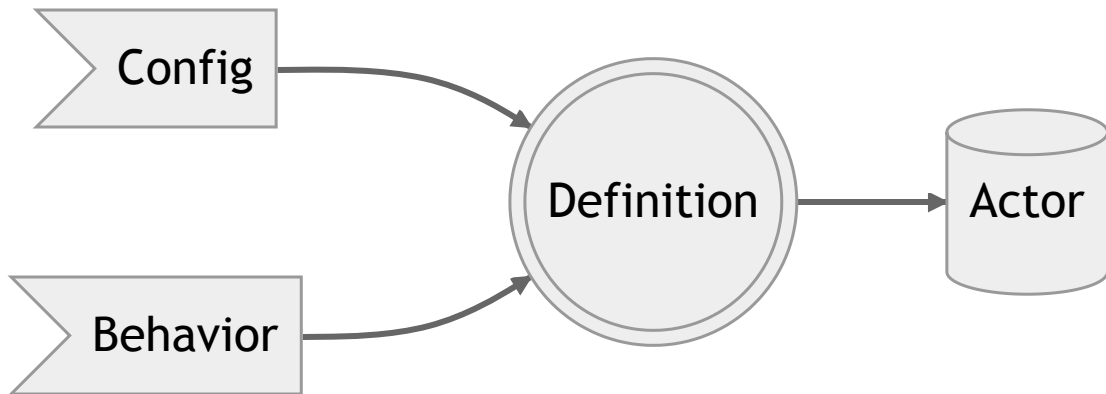


EventMachine



EventMachine

Concept





Machine ID

traffic_lights_machine

```
1  [  
2    'id' => 'traffic_lights_machine',  
3  ]
```



States I

traffic_lights_machine

```
1  [  
2    'id' => 'traffic_lights_machine',  
3    States?  
4  ]
```



States II

traffic_lights_machine

```
1  [  
2    'id' => 'traffic_lights_machine',  
3    'states' => [],  
4  ]
```



States III

```
1  [  
2    'id' => 'traffic_lights_machine',  
3    'states' => [  
4      'red',  
5      'yellow',  
6      'green',  
7    ],  
8  ]
```

traffic_lights_machine

Green

Yellow

Red



Transitions I

```
1  [  
2    'id' => 'traffic_lights_machine',  
3    'states' => [  
4      'red' => [  
5        Transitions?  
6      ],  
7      'yellow',  
8      'green',  
9    ],  
10 ]
```

traffic_lights_machine

Green

Yellow

Red



Transitions II (Events)

```
1  [  
2    'id' => 'traffic_lights_machine',  
3    'states' => [  
4      'red' => [  
5        'on' => [  
6          Event Driven, What Event?  
7          🌀 EVENT STORMING 🌀  
8        ]  
9      ],  
10     'yellow',  
11     'green',  
12   ],  
13 ]
```

traffic_lights_machine

Green

Yellow

Red



Transitions III

```
1  [  
2    'id' => 'traffic_lights_machine',  
3    'states' => [  
4      'red' => [  
5        'on' => [  
6          'EVENT?' => 'TARGET STATE?'  
7        ]  
8      ],  
9      'yellow',  
10     'green',  
11   ],  
12 ]
```

traffic_lights_machine

Green

Yellow

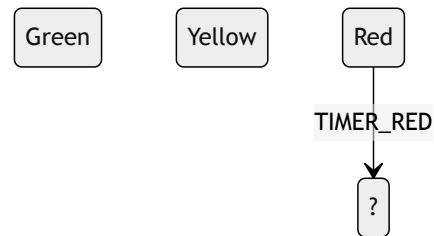
Red



Transitions III

```
1  [  
2      'id' => 'traffic_lights_machine',  
3      'states' => [  
4          'red' => [  
5              'on' => [  
6                  'TIMER_RED' => '?'  
7              ]  
8          ],  
9          'yellow',  
10         'green',  
11     ],  
12 ]
```

traffic_lights_machine

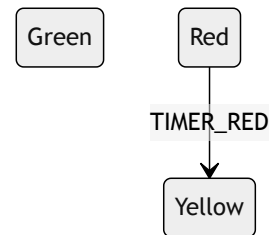




Transitions IV

```
1  [  
2    'id' => 'traffic_lights_machine',  
3    'states' => [  
4      'red' => [  
5        'on' => [  
6          'TIMER_RED' => 'yellow'  
7        ]  
8      ],  
9      'yellow',  
10     'green',  
11   ],  
12 ]
```

traffic_lights_machine

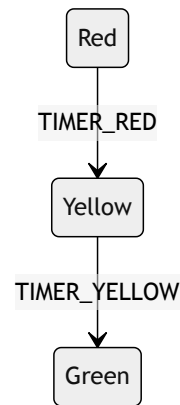




Transitions V

```
1  [  
2    'id' => 'traffic_lights_machine',  
3    'states' => [  
4      'red' => [  
5        'on' => [  
6          'TIMER_RED' => 'yellow'  
7        ]  
8      ],  
9      'yellow' => [  
10       'on' => [  
11         'TIMER_YELLOW' => 'green'  
12       ]  
13     ],  
14     'green',
```

traffic_lights_machine



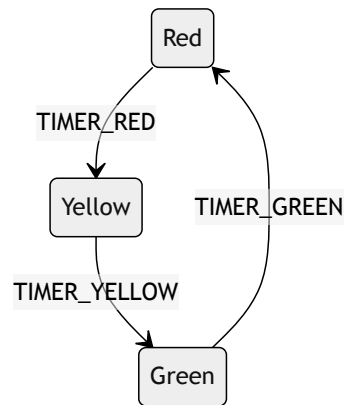


Transitions VI

```
1  [  
2    'id' => 'traffic_lights_machine',  
3    'states' => [  
4      'red' => [  
5        'on' => [  
6          'TIMER_RED' => 'yellow'  
7        ]  
8      ],  
9      'yellow' => [  
10       'on' => [  
11         'TIMER_YELLOW' => 'green'  
12       ]  
13     ],  
14     'green' => [  

```

traffic_lights_machine

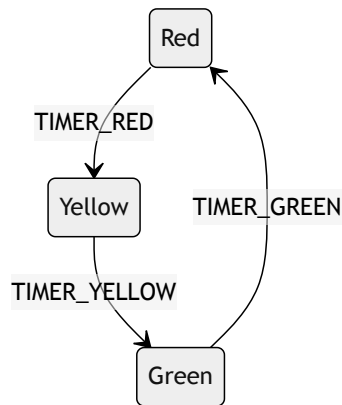




Transitions VII

```
1  [  
2    'id' => 'traffic_lights_machine',  
3    'states' => [  
4      'red' => [  
5        'on' => [  
6          'TIMER_RED' => 'yellow'  
7        ]  
8      ],  
9      'yellow' => [  
10       'on' => [  
11         'TIMER_YELLOW' => 'green'  
12       ]  
13     ],  
14     'green' => [  
15       'on' => [  
16         'TIMER_GREEN' => 'red'  
17       ]  
18     ],  
19   ],  
20 ]
```

traffic_lights_machine

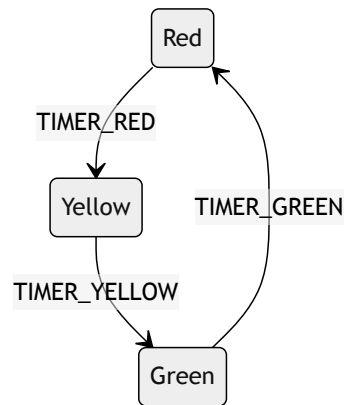




Initial State I

```
1  [  
2    'id' => 'traffic_lights_machine',  
3    Initial State?  
4    'states' => [  
5      'red' => [  
6        'on' => [  
7          'TIMER_RED' => 'yellow'  
8        ]  
9      ],  
10   'yellow' => [  
11     'on' => [  
12       'TIMER_YELLOW' => 'green'  
13     ]  
14   ],
```

traffic_lights_machine

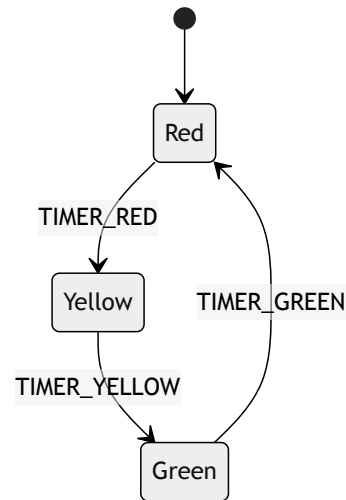




Initial State II




```
1  [  
2    'id' => 'traffic_lights_machine',  
3    'initial' => 'red',  
4    'states' => [  
5      'red' => [  
6        'on' => [  
7          'TIMER_RED' => 'yellow'  
8        ]  
9      ],  
10   'yellow' => [  
11     'on' => [  
12       'TIMER_YELLOW' => 'green'  
13     ]  
14   ],
```

traffic_lights_machine



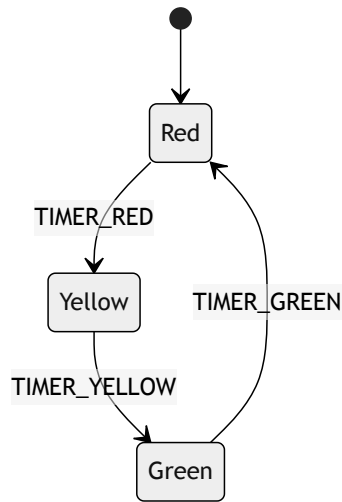


Context I (Extended State)

```
1  [  
2    'id' => 'traffic_lights_machine',  
3    How long should the lights be on ?  
4                                     ?  
5                                     ?  
6    'initial' => 'red',  
7    'states' => [  
8      'red' => [  
9        'on' => [  
10         'TIMER_RED' => 'yellow'  
11       ]  
12     ],  
13     'yellow' => [  
14       'on' => [  

```

traffic_lights_machine

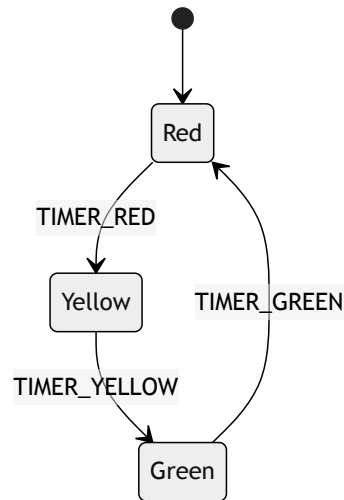




Context II (Extended State)

```
1  [  
2    'id' => 'traffic_lights_machine',  
3    'context' => [],  
4    'initial' => 'red',  
5    'states' => [  
6      'red' => [  
7        'on' => [  
8          'TIMER_RED' => 'yellow'  
9        ]  
10     ],  
11    'yellow' => [  
12      'on' => [  
13        'TIMER_YELLOW' => 'green'  
14      ]  
15    ]  
16  ]
```

traffic_lights_machine

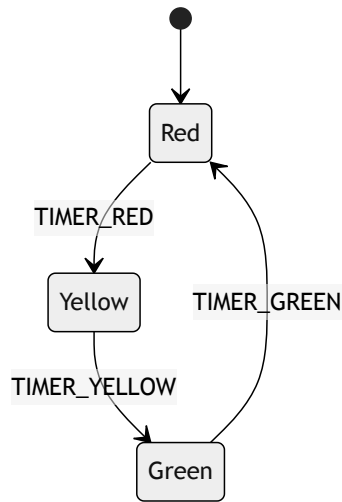




Context III (Extended State)

```
1  [  
2    'id' => 'traffic_lights_machine',  
3    'context' => [  
4      'red_duration'      => 30,  
5      'yellow_duration'   => 5,  
6      'green_duration'    => 20,  
7    ],  
8    'initial' => 'red',  
9    'states' => [  
10     'red' => [  
11       'on' => [  
12         'TIMER_RED' => 'yellow'  
13       ]  
14     ],
```

traffic_lights_machine

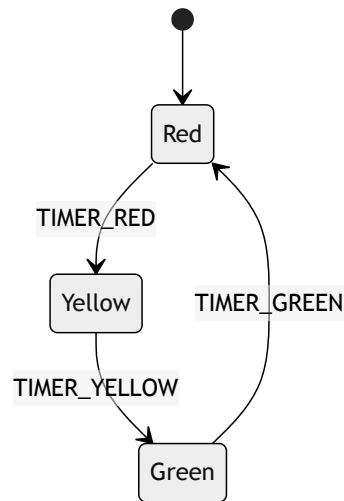




Actions I

```
1  [  
2    'id' => 'traffic_lights_machine',  
3    'context' => [  
4      'red_duration'      => 30,  
5      'yellow_duration'   => 5,  
6      'green_duration'    => 20,  
7    ],  
8    'initial' => 'red',  
9    'states' => [  
10     'red' => [  
11       'on' => [  
12         Action?  
13         'TIMER_RED' => 'yellow'  
14       ]  
15     ]  
16  ]
```

traffic_lights_machine

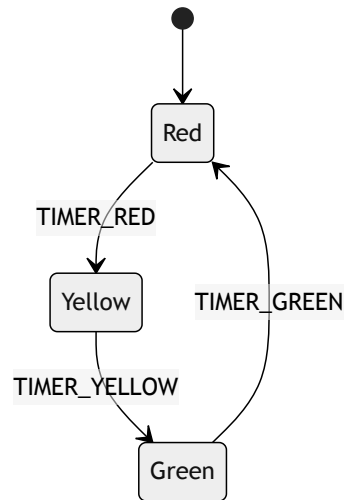




Actions II

```
1  [  
2    'id' => 'traffic_lights_machine',  
3    'context' => [  
4      'red_duration'      => 30,  
5      'yellow_duration'   => 5,  
6      'green_duration'    => 20,  
7    ],  
8    'initial' => 'red',  
9    'states' => [  
10     'red' => [  
11       'on' => [  
12         'TIMER_RED' => [  
13           'target' => 'yellow',  
14           'actions' => ?,
```

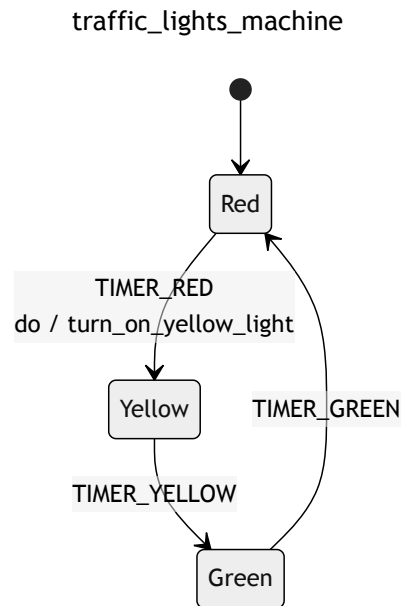
traffic_lights_machine





Actions III

```
1  [  
2    'id' => 'traffic_lights_machine',  
3    'context' => [  
4      'red_duration'      => 30,  
5      'yellow_duration'   => 5,  
6      'green_duration'    => 20,  
7    ],  
8    'initial' => 'red',  
9    'states' => [  
10     'red' => [  
11       'on' => [  
12         'TIMER_RED' => [  
13           'target' => 'yellow',  
14           'actions' => 'turn_on_yellow_
```



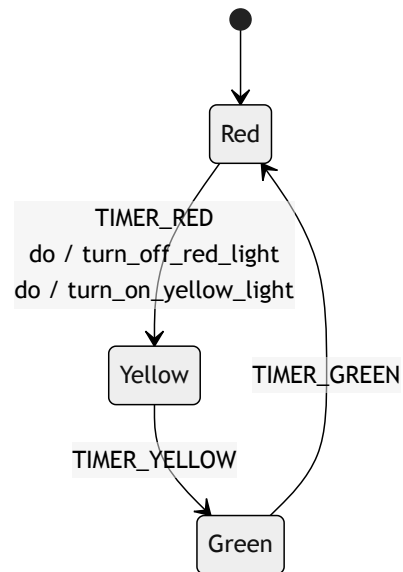


Actions IV

```
1  [  
2    'id' => 'traffic_lights_machine',  
3    'context' => [  
4      'red_duration'      => 30,  
5      'yellow_duration'   => 5,  
6      'green_duration'    => 20,  
7    ],  
8    'initial' => 'red',  
9    'states' => [  
10     'red' => [  
11       'on' => [  
12         'TIMER_RED' => [  
13           'target' => 'yellow',  
14           'actions' => [  

```

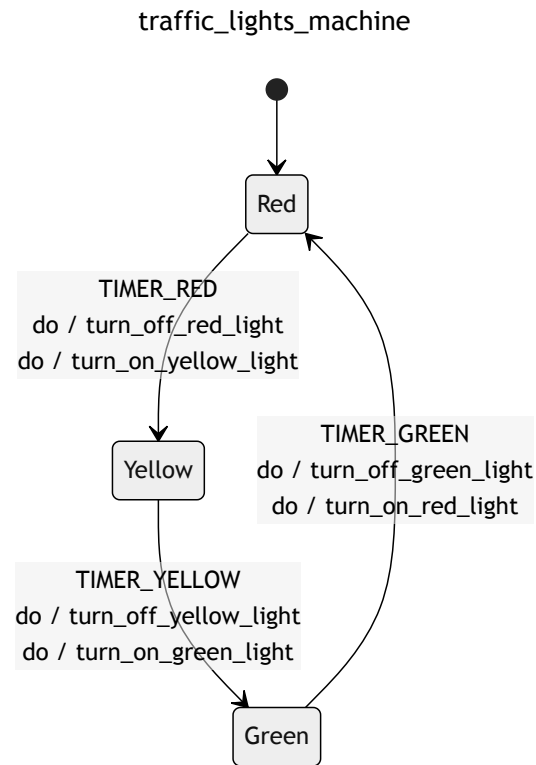
traffic_lights_machine





Actions V

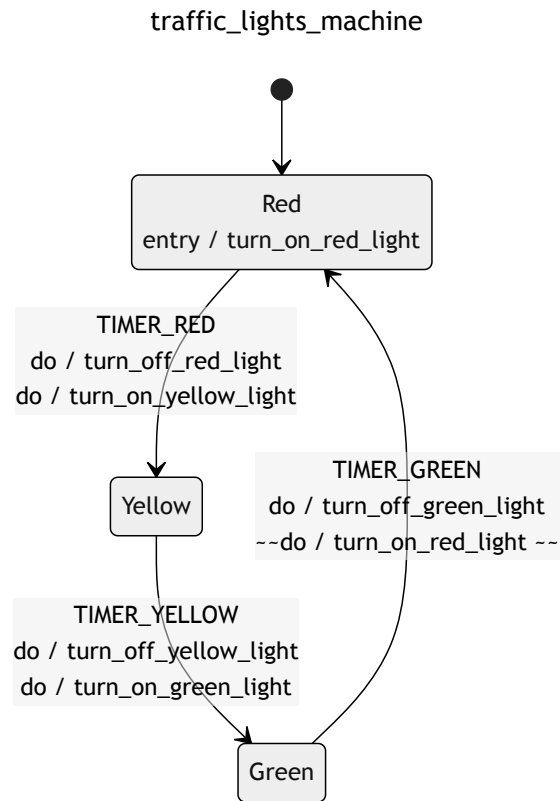
```
1  [
2    'id' => 'traffic_lights_machine',
3    'context' => [
4      'red_duration'    => 30,
5      'yellow_duration' => 5,
6      'green_duration'  => 20,
7    ],
8    'initial' => 'red',
9    'states' => [
10     'red' => [
11       'on' => [
12         'TIMER_RED' => [
13           'target' => 'yellow',
14           'actions' => [
15             'turn_off_red_light',
16             'turn_on_yellow_light',
17           ],
18         ],
19       ],
20     ],
21     'yellow' => [
22       'on' => [
```





Entry Actions I

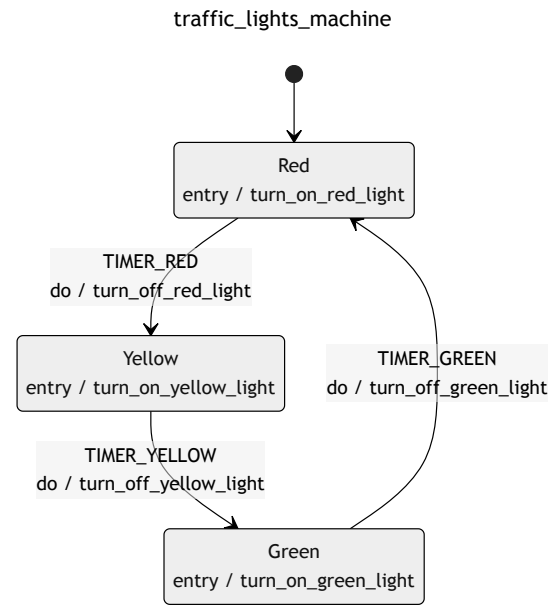
```
1  [  
2    'id' => 'traffic_lights_machine',  
3    'context' => [  
4      'red_duration'    => 30,  
5      'yellow_duration' => 5,  
6      'green_duration'  => 20,  
7    ],  
8    'initial' => 'red',  
9    'states' => [  
10     'red' => [  
11       'entry' => [  
12         'turn_on_red_light',  
13       ],  
14       'on' => [  
15         'TIMER_RED' => [  
16           'target' => 'yellow',  
17           'actions' => [  
18             'turn_off_red_light',  
19             'turn_on_yellow_light',  
20           ],  
21         ],  
22       ]  
23     ]  
24   ]
```





Entry Actions II

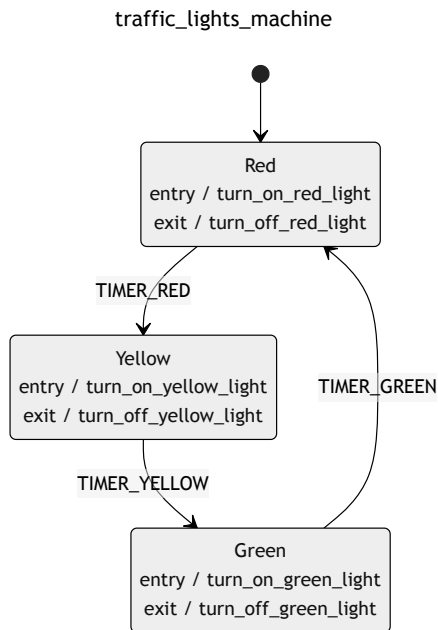
```
1  [
2    'id' => 'traffic_lights_machine',
3    'context' => [...],
4    'initial' => 'red',
5    'states' => [
6      'red' => [
7        'entry' => 'turn_on_red_light',
8        'on' => [
9          'TIMER_RED' => [
10             'target' => 'yellow',
11             'actions' => 'turn_off_red_light',
12           ],
13         ],
14      ],
15      'yellow' => [
16        'entry' => 'turn_on_yellow_light',
17        'on' => [
18          'TIMER_YELLOW' => [
19             'target' => 'green',
20             'actions' => 'turn_off_yellow_light',
21           ],
22        ],
23      ],
24    ],
25  ]
```





Exit Actions

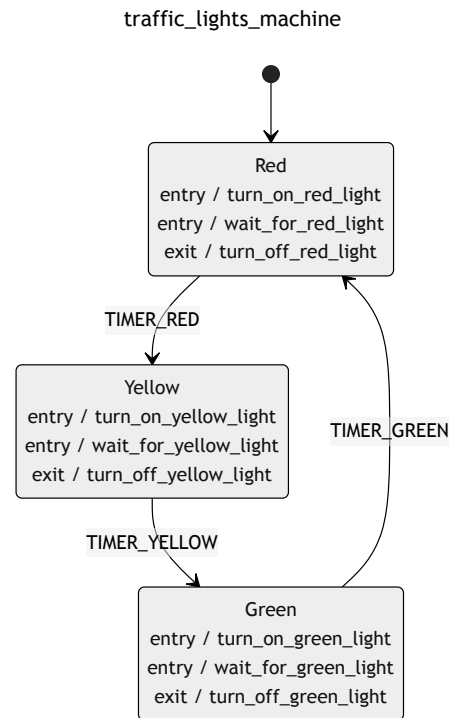
```
1  [  
2    'id' => 'traffic_lights_machine',  
3    'context' => [...],  
4    'initial' => 'red',  
5    'states' => [  
6      'red' => [  
7        'entry' => 'turn_on_red_light',  
8        'exit' => 'turn_off_red_light',  
9        'on' => [  
10         'TIMER_RED' => 'yellow',  
11       ]  
12    ],  
13    'yellow' => [  
14      'entry' => 'turn_on_yellow_light',  
15      'exit' => 'turn_off_yellow_light',  
16      'on' => [  
17        'TIMER_YELLOW' => 'turn_off_yellow_light',  
18      ]  
19    ],  
20    'green' => [  
21      'entry' => 'turn_on_green_light',  
22      'exit' => 'turn off green light',
```





Actions VI

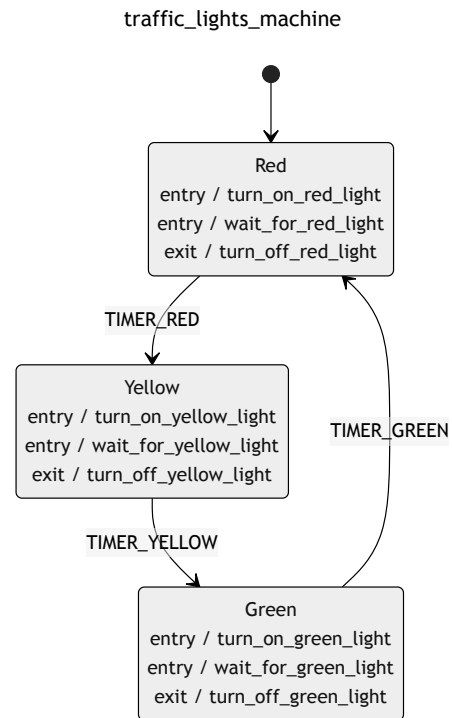
```
1  [  
2    'id' => 'traffic_lights_machine',  
3    'context' => [  
4      'red_duration'      => 30,  
5      'yellow_duration'   => 5,  
6      'green_duration'    => 20,  
7    ],  
8    'initial' => 'red',  
9    'states' => [  
10     'red' => [  
11       'entry' => [  
12         'turn_on_red_light',  
13         'wait_for_red_light',  
14       ],  
15       'exit' => 'turn_off_red_light',  
16       'on' => ['TIMER_RED' => 'yellow']  
17     ],  
18     'yellow' => [  
19       'entry' => [  
20         'turn_on_yellow_light',  
21         'wait_for_yellow_light',  
22       ],
```





Behavior

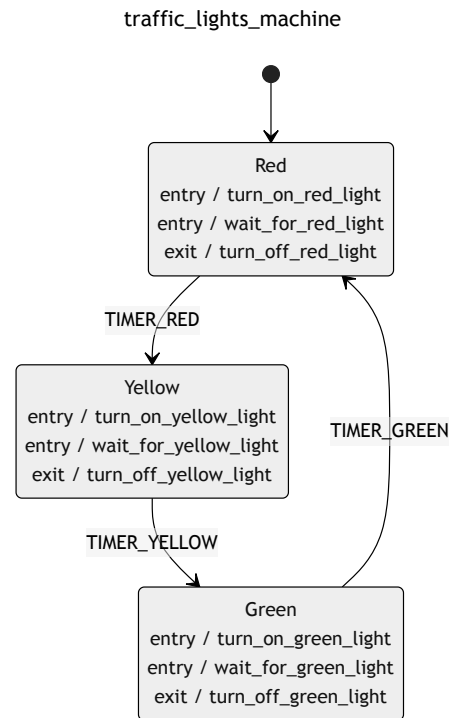
```
1  [  
2    config: [...],  
3    behavior: ?,  
4  ]
```





Action Behaviors I

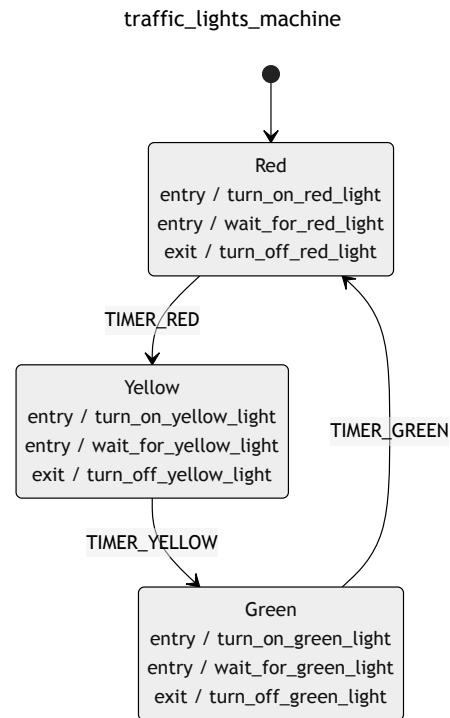
```
1  [  
2    config: [...],  
3    behavior: [  
4      'actions' => ?,  
5    ],  
6  ]
```





Action Behaviors II

```
1  [
2    config: [
3      'context' => [
4        'red_duration'      => 30,
5      ],
6      'initial' => 'red',
7      'states' => [
8        'red' => [
9          'entry' => [
10             'turn_on_red_light',
11             'wait_for_red_light',
12           ],
13         ...
14       ],
15     behavior: [
16       'actions' => [
17         'wait_for_red_light' => ?,
18       ],
19     ],
20   ]
```





Action Behaviors III

```
1  [
2      config: [
3          'context' => [
4              'red_duration'      => 30,
5          ],
6          'initial' => 'red',
7          'states' => [
8              'red' => [
9                  'entry' => [
10                     'turn_on_red_light',
11                     'wait_for_red_light',
12                 ],
13                 ...
14             ],
15         behavior: [
16             'actions' => [
17                 'wait_for_red_light' => function (ContextManager $context, EventDefinition $eventDefinition): void
18                 {
19                     sleep($context->get('red_duration'));
20                 },
21             ],
22         ],
```



Action Behaviors IV

```
1  [  
2    config: [  
3      'id' => 'traffic_lights_machine',  
4      'context' => [  
5        'red_duration'    => 30,  
6        'yellow_duration' => 5,  
7        'green_duration'  => 20,  
8      ],  
9      'initial' => 'red',  
10     'states' => [  
11       'red' => [  
12         'entry' => [  
13           'turn_on_red_light',  
14           'wait_for_red_light',  
15         ],  
16         'exit'  => 'turn_off_red_light',  
17         'on'    => ['TIMER_RED' => 'yellow']  
18       ],  
19       'yellow' => [  
20         'entry' => [  
21           'turn_on_yellow_light',  
22           'wait for yellow light',
```




Action Behaviors V

```
1  [
2    config: [
3      'id' => 'traffic_lights_machine',
4      'context' => [
5        'red_duration'    => 30,
6        'yellow_duration' => 5,
7        'green_duration'  => 20,
8      ],
9      'initial' => 'red',
10     'states' => [
11       'red' => [
12         'entry' => [
13           'turn_on_red_light',
14           'wait_for_red_light',
15         ],
16         'exit' => 'turn_off_red_light',
17         'on' => [
18           'TIMER_RED' => 'yellow'
19         ]
20       ],
21       'yellow' => [
22         'entry' => [
```



Guarded Transitions I

```
1  [
2    config: [
3      'id' => 'traffic_lights_machine',
4      'context' => [
5        'red_duration'    => 30,
6        'yellow_duration' => 5,
7        'green_duration'  => 20,
8      ],
9      'initial' => 'red',
10     'states' => [
11       'red' => [
12         'entry' => [
13           'turn_on_red_light',
14           'wait_for_red_light',
15         ],
16         'exit' => 'turn_off_red_light',
17         'on' => [
18           'TIMER_RED' => [
19             [
20               'target' => 'power_off',
21               'guards' => 'is_power_off'
22             ],
```



Guarded Transitions II

```
1  [
2    config: [
3      'id' => 'traffic_lights_machine',
4      'context' => [
5        'red_duration'    => 30,
6        'yellow_duration' => 5,
7        'green_duration'  => 20,
8      ],
9      'initial' => 'red',
10     'states' => [
11       'red' => [
12         'entry' => [
13           'turn_on_red_light',
14           'wait_for_red_light',
15         ],
16         'exit' => 'turn_off_red_light',
17         'on' => [
18           'TIMER_RED' => [
19             [
20               'target' => 'power_off',
21               'guards' => 'is_power_off',
22               'actions' => 'do something',
```



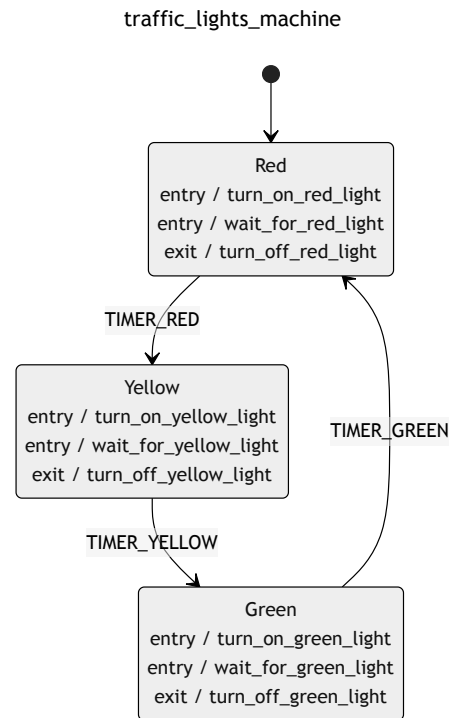
Guarded Actions I

```
1  [
2    config: [
3      'id' => 'traffic_lights_machine',
4      'context' => [
5        'red_duration'    => 30,
6        'yellow_duration' => 5,
7        'green_duration'  => 20,
8      ],
9      'initial' => 'red',
10     'states' => [
11       'red' => [
12         'entry' => [
13           'turn_on_red_light',
14           'wait_for_red_light',
15         ],
16         'exit' => 'turn_off_red_light',
17         'on' => [
18           'TIMER_RED' => [
19             [
20               'target' => 'power_off',
21               'guards' => 'is_power_off'
22             ],
```



Definition I

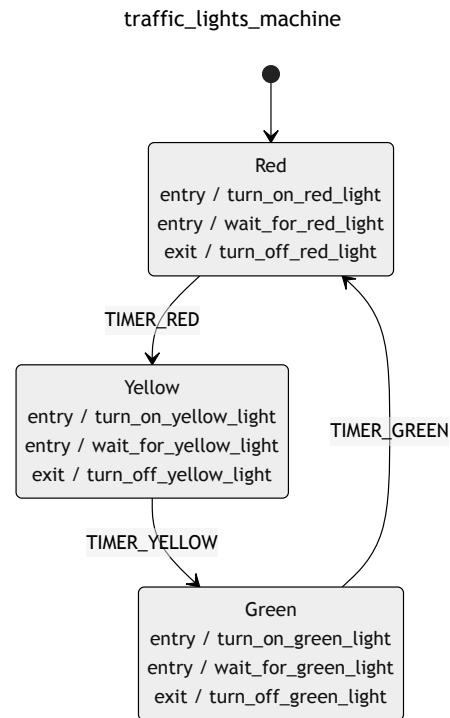
```
1  [  
2    config: [...],  
3    behavior: [...],  
4  ]
```





Definition II

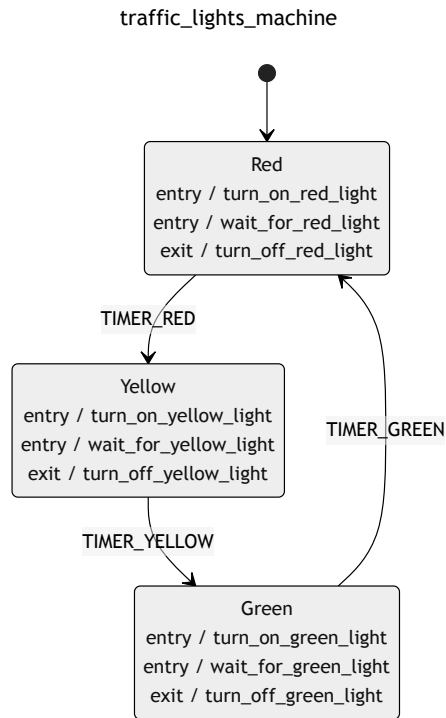
```
1  $machineDefinition = MachineDefinition::define([  
2      config: [...],  
3      behavior: [...],  
4  ]);
```





Pure Transitions I

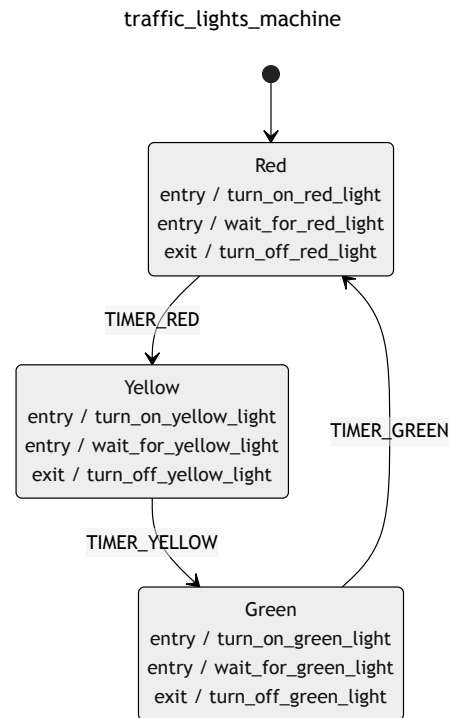
```
1  $machineDefinition = MachineDefinition::define([
2      config: [...],
3      behavior: [...],
4  ]);
5
6  // Transitions as Pure Functions?
7  $machineDefinition->transition(?);
```





Pure Transitions II

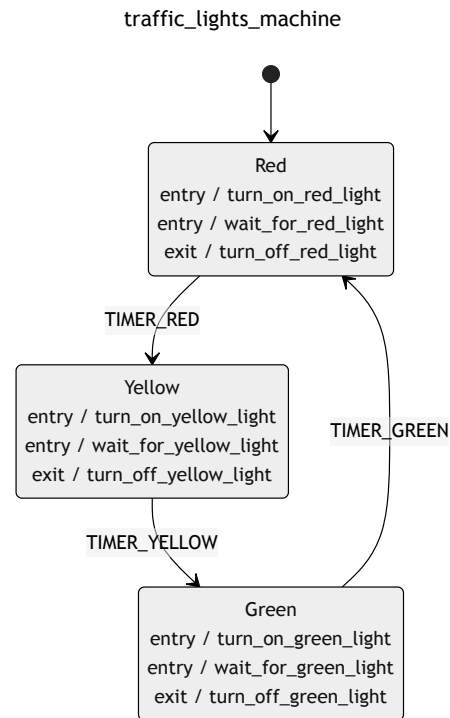
```
1  $machineDefinition = MachineDefinition::define([
2      config: [...],
3      behavior: [...],
4  ]);
5
6  // Transitions as Pure Functions?
7  $machineDefinition->transition($state, $event);
```





Pure Transitions III

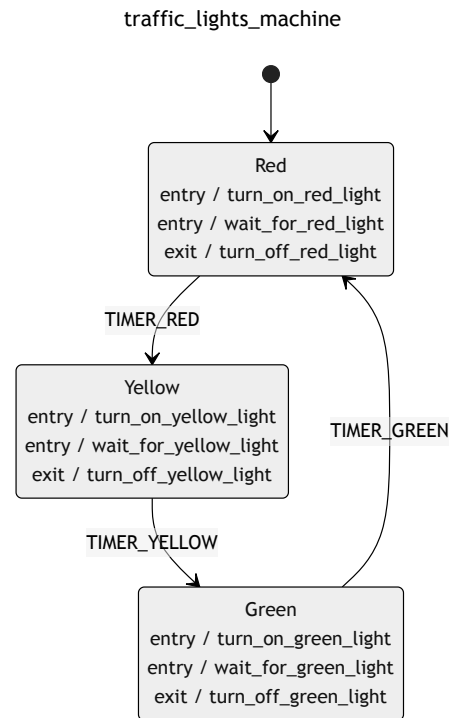
```
1  $machineDefinition = MachineDefinition::define([
2    config: [...],
3    behavior: [...],
4  ]);
5
6  // Transitions as Pure Functions?
7  $machineDefinition->transition(
8    state: $machineDefinition->initial,
9    event: ['type' => 'TIMER_RED'],
10 );
```





Pure Transitions IV

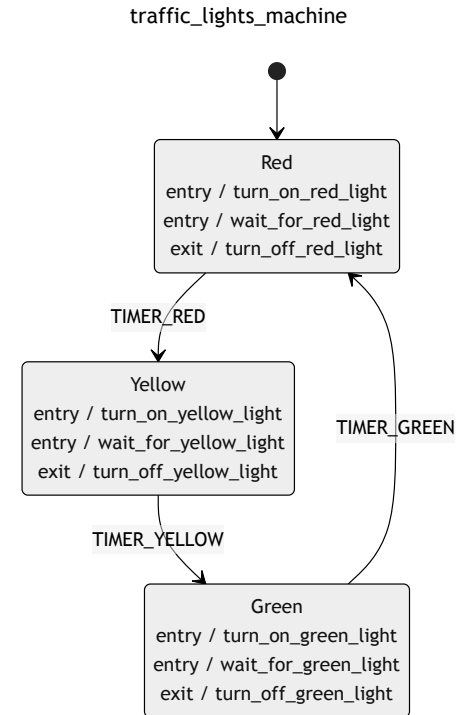
```
1  $machineDefinition = MachineDefinition::define([
2    config: [...],
3    behavior: [...],
4  ]);
5
6  // Transitions as Pure Functions?
7  $state = $machineDefinition->transition(
8    state: null,
9    event: ['type' => 'TIMER_RED'],
10 );
```





Event Machines I

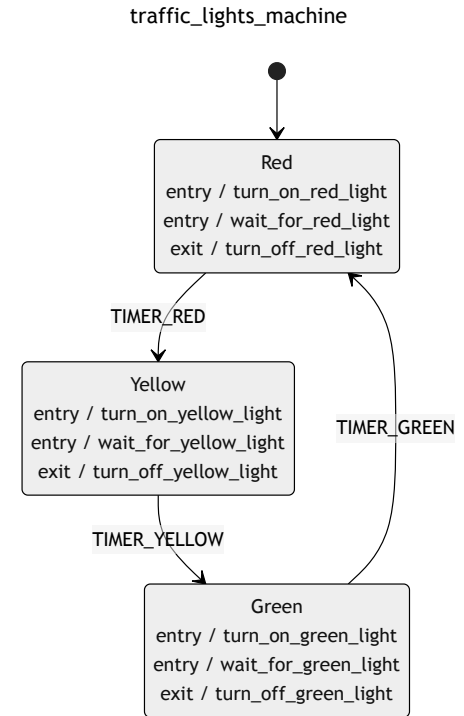
```
1  class TrafficLightsMachine extends EventMachine
2  {
3      public static function build(): MachineDefinition
4      {
5          return [
6              config: [...],
7              behavior: [...],
8          ];
9      }
10 }
11 }
```





Event Machines II

```
1  class TrafficLightsMachine extends EventMachine
2  {
3      public static function build(): MachineDefinition
4      {
5          return [
6              config: [
7                  'id' => 'traffic_lights_machine',
8                  'context' => [
9                      'red_duration'      => 30,
10                     'yellow_duration'   => 5,
11                     'green_duration'    => 20,
12                 ],
13                 'initial' => 'red',
14                 'states' => [
15                     'red' => [
16                         'entry' => [
17                             'turn_on_red_light',
18                             'wait_for_red_light',
19                         ],
20                         'exit'  => 'turn_off_red_light',
21                         'on'   => [
22                             'TIMER RED' => [
```

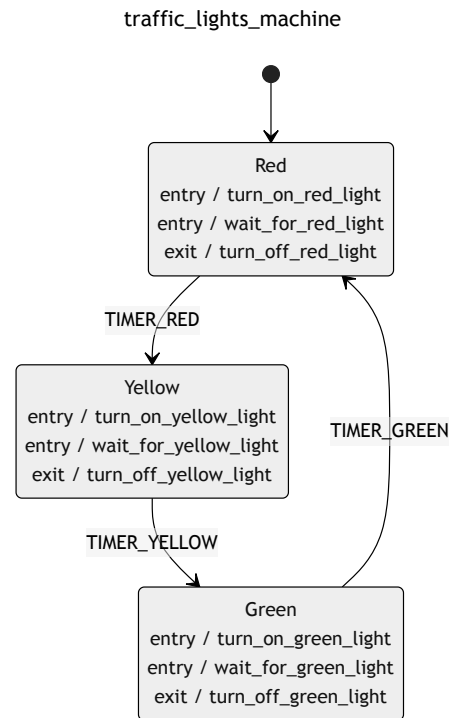




Event Machines III

```
1  class TrafficLightsMachine extends EventMachine
2  {
3      public static function build(): MachineDefinition
4      {
5          return [
6              config: [
7                  'id' => 'traffic_lights_machine',
8                  'context' => MachineContext::class,
9                  'initial' => 'red',
10                 'states' => [
11                     'red' => [
12                         'entry' => [
13                             TurnOnRedLightAction::class,
14                             WaitForRedLightAction::class,
15                         ],
16                         'exit' => TurnOffRedLightAction::class,
17                         'on' => [
18                             TimerRedEvent::class => [
19                                 [
20                                     'target' => 'power_off',
21                                     'guards' => IsPowerOffGuard::class
22                                 ],

```





Event Machines IV

```
1  class TrafficLightsMachine extends EventMachine
2  {
3      public static function build(): MachineDefinition
4      {
5          return [
6              config: [...],
7              behavior: [
8                  'context' => [...],
9                  'actions' => [...],
10                 'guards' => [...],
11                 'events' => [...],
12             ],
13         ];
14     }
15 }
16 }
```

