

Single-Server Queuing Model.

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Introducton

This is a discrete-event simulation of a simple M/M/1 queue.

An M/M/1 system has exponential arrivals (M/M/1), a single server (M/M/1) with exponential service time (M/M/1) and an infinite queue (implicit M/M/1/(infty)).

For instance, people arriving at an ATM at rate (λ), waiting their turn in the street and withdrawing money at rate (μ).

Simmer is discrete-event simulation library we used for simulation.

```
library(simmer)
library(ggplot2)
library(simmer.plot)
set.seed(1234)

lambda <- 2
mu <- 4
rho <- lambda/mu # = 2/4

mm1.trajectory <- trajectory() %>%
  seize("resource", amount=1) %>%
  timeout(function() rexp(1, mu)) %>%
  release("resource", amount=1)

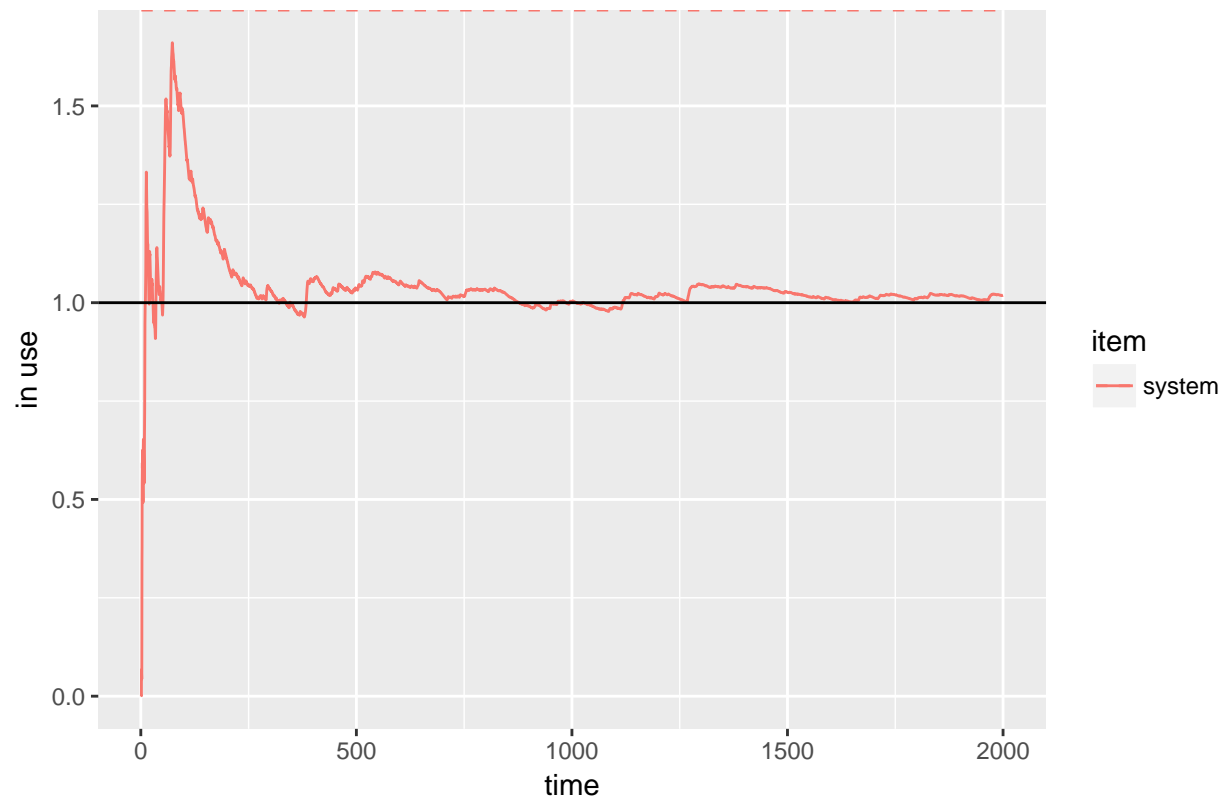
mm1.env <- simmer() %>%
  add_resource("resource", capacity=1, queue_size=Inf) %>%
  add_generator("arrival", mm1.trajectory, function() rexp(1, lambda)) %>%
  run(until=2000)

# Evolution of the average number of customers in the system
graph <- plot_resource_usage(mm1.env, "resource", items="system")

## Warning: 'plot_resource_usage' is deprecated.
## Use 'simmer.plot::plot' instead.
## See help("Deprecated")

# Theoretical value
mm1.N <- rho/(1-rho)
graph + geom_hline(yintercept=mm1.N)
```

Resource usage: resource



```
plot_resource_usage(mm1.env, "resource", items=c("queue", "server"), steps=TRUE) +  
  xlim(0, 20) + ylim(0, 4)
```

```
## Warning: 'plot_resource_usage' is deprecated.
```

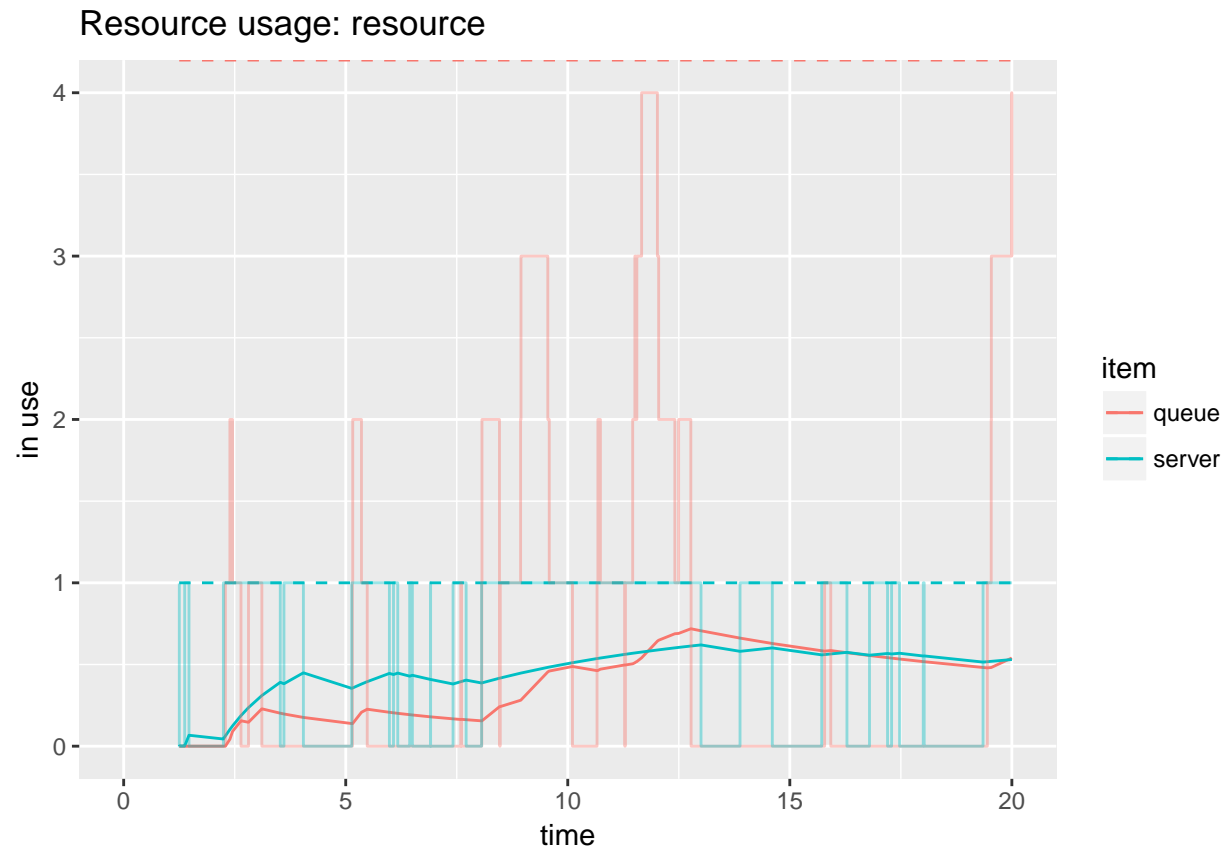
```
## Use 'simmer.plot::plot' instead.
```

```
## See help("Deprecated")
```

```
## Warning: Removed 16112 rows containing missing values (geom_path).
```

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```



```
mm1.arrivals <- get_mon_arrivals(mm1.env)
mm1.t_system <- mm1.arrivals$end_time - mm1.arrivals$start_time

mm1.T <- mm1.N / lambda
mm1.T ; mean(mm1.t_system)
```

```
## [1] 0.5
```

```
## [1] 0.5012594
```