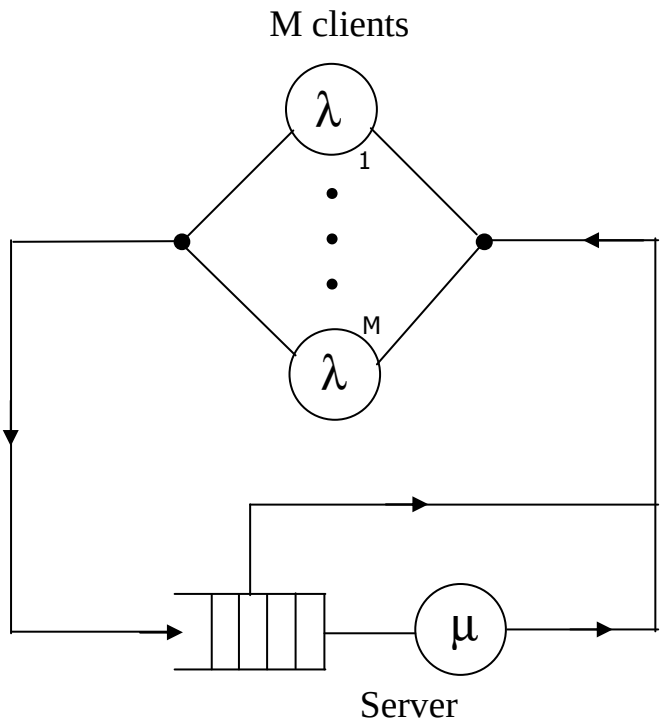
Network Technologies

Consider a client-server system with M users. Each user, independently of the others, after a *think time* that is exponentially distributed with mean $1/\lambda$ seconds, sends a request to the server.
The server executes requests with FCFS queuing discipline. Assume that the *service time* per request is exponentially distributed with mean $1/\mu$ seconds and that an user generates a new request only after the previous request has been served (always after a preliminary think time).
Users, however, are a bit impatient and can cancel requests sent to the server: each user, independently of the others, decides to cancel the request sent after a time interval (starting from the instant when the request was sent) whose length is exponentially distributed with parameter γ. The request, however, can be cancelled <u>only if it is still waiting</u>.
Once the request has been canceled, the user generates a new request after a think time.
Assuming that service times, think times and cancellation times are statistically independent random variables,
a) draw the state diagram of a CTMC modeling the above system;
b) evaluate the steady-state probability that there are ***i*** requests executing or waiting on the CPU, the CPU utilization, the average throughput, the average number of users who are in *thinking* state;
c) assuming that requests cannot be cancelled, plot the average response time as a function of the number of clients, M, in case $1/\lambda = 15$ s and $1/\mu = 1$ s.