In a gas station there are four gas pumps. These pumps are grouped into two groups of two pumps (see figure 1). Cars arrive at the gas station according to a Poisson process with a rate of λ cars per hour and they are served in order of arrival.

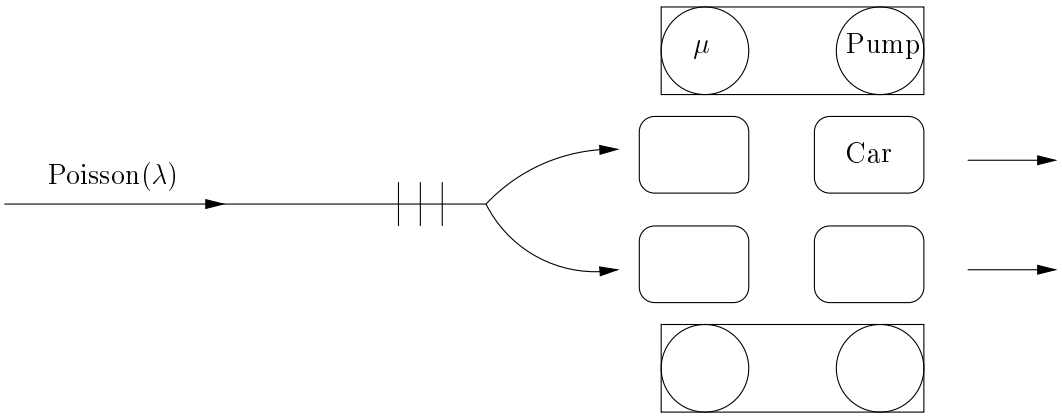

Figure 1: Gas station

Cars at the front pumps can immediatelely leave after service completion. If the service of a car at the back pump has been completed and there is another car in service at the front pump, the car cannot leave the gas station until the service of the one a the front pump has been completed. During this period the back pump cannot be used by the next car. Also, when the front pump becomes available, it cannot be reached by the next car, because it is blocked by the car at the back pump. Both pumps become available again as soon as the car at the back pump completes service. The service times (pumping and paying) are independent and exponentially distributed with a mean of $1/\mu$ hour.

(i) For which values of λ and μ is the system stable?

In the sequel we assume that $\lambda = 35$ and $\mu = 15$.

(ii) Show that this system can be described as a Markov process and determine its equilibrium distribution.

(iii) Compute the mean waiting time.

(iv) Compute the mean number of pumps that are idle while there are cars waiting.