$\rightsquigarrow$ For each $x \in \mathcal{X}$, $y = g(x)$ is the system output when the current state is x

REMARK: State automata are state automata with outputs where:

- $\mathcal{Y} = \mathcal{X}$
- $g(x) = x$ for all $x \in \mathcal{X}$ (identity function)

EXAMPLE: Queueing system (cont'd)

Assume we are only interested to know whether the server is idle or working.

$\Rightarrow$ Define the output:

$$y = \begin{cases} 0 & \text{if } x = 0 \quad [\text{server is idle}] \\ 1 & \text{if } x > 0 \quad [\text{server is working}] \end{cases}$$

Question: Does the model work if we define the state as

$$x = \begin{cases} 0 & \text{if the server is idle} \\ 1 & \text{if the server is working} \end{cases} \quad (*) \qquad ?$$

Let's try it...

- $\Gamma(0) = \{a\}$

  $\Gamma(1) = \{a, d\}$ ok...

- $f(x,a) = 1$ for $x = 0,1$ ok, but...

$f(1,d) = ???$ we are in trouble here

$$f(1,d) = \begin{cases} 0 & \text{if there is only one customer in the system} \\ 1 & \text{if there are two or more customers in the system} \end{cases}$$

Information we don't have, if we only know that the server is working

=> The variable defined in (*) is not informative enough to determine uniquely its next value in all circumstances

It's <u>NOT</u> a definition of state for the system

<u>REMARK</u> : State automata with outputs include Moore machines as a special case (when $\mathcal{X}$ is finite)

finite state machines used in sequential logic implementation