§11.2 – Finite State Machines with Output

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- Remember the general picture of a computer as being a transition function $T: S \times I \rightarrow S \times O$?
  - If the state set S is finite (not infinite), we call this system a *finite state machine*.
- If the domain $S \times I$ is reasonably small, then we can specify T explicitly by writing out its complete graph.
  - However, this is practical only for machines that have a very small information capacity.

Size of FSMs

- The information capacity of an FSM is $C = \log |S|$.
  - Thus, if we represent a machine having an information capacity of C bits as an FSM, then its state transition graph will have $|S| = 2^C$ nodes.
- *E.g.* suppose your desktop computer has a 512MB memory, and 60GB hard drive.
  - Its information capacity, including the hard drive and memory (and ignoring the CPU's internal state), is then roughly $\sim 512 \times 2^{23} + 60 \times 2^{33} = 519{,}691{,}042{,}816$ b.
  - How many states would be needed to write out the machine's entire transition function graph?

$2^{519,691,042,816}$ = A number having >1.7 trillion decimal digits!