

Automata Learning Reading Group: Assignment 2(a)

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A *channel system* or *communicating automaton* is a set of finite automata communicating via channels, i.e. unbounded fifo queues. In addition to reading some input (from the input alphabet Σ), an automaton in this system can also send a message to a channel or wait for a particular message from a channel. Messages are from a special message alphabet Γ . The automaton sends to the back of a channel and receives from the front. Without loss of generality, we can assume that the system only contains one automaton and one channel (call it c).

A transition in this automaton has one of the following forms:

- $\langle q_1, a, c!m, q_2 \rangle$, where q_1, q_2 are states and $a \in \Sigma$, $m \in \Gamma$. Reads a and sends m on the channel while moving from q_1 to q_2 . Updates the channel content from $m_1 \cdots m_n$ to $m_1 \cdots m_n \cdot m$.
- $\langle q_1, a, c?m, q_2 \rangle$, where q_1, q_2 are states and $a \in \Sigma$, $m \in \Gamma$. Reads a and receives m from the channel. This transition is only enabled if the channel content is of the form $m \cdot m_1 \cdots m_n$. Updates the channel to contain $m_1 \cdots m_n$.
- $\langle q_1, a, q_2 \rangle$, where q_1, q_2 are states and $a \in \Sigma$. Reads a symbol without modifying the channel.

Sketch a proof of the following theorem:

Theorem 1 *A channel system with binary message alphabet ($|\Gamma| = 2$) can simulate a Turing machine.*