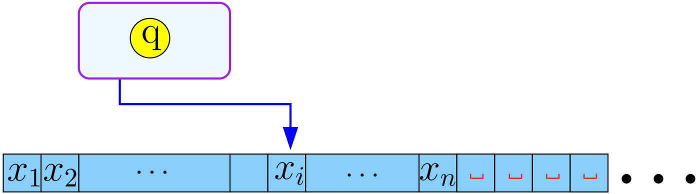
8.3
Snapshots, computation as sequence of strings

Snapshot = ID: Instantaneous Description

1. Contains all necessary information to capture "state of the computation".
2. Includes
    1. state q of M
    2. location of read/write head
    3. contents of tape from left edge to rightmost non-blank (or to head, whichever is rightmost).

Snapshot = ID: Instantaneous Description

As a string



ID: $x_1 x_2 \ldots x_{i-1} q x_i x_{i+1} \ldots x_n$

$x_1, \ldots, x_n \in \Gamma$, $q \in Q$.

A step in computation as rewriting strings

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If transition is $\delta(q, X_i) = (p, Y, \mathtt{L})$, new ID is:

$$\begin{array}{ccc} & \text{current ID :} & x_1 x_2 \ldots x_{i-2} x_{i-1} q x_i x_{i+1} \ldots x_n \\ \delta(q, X_i) = (p, y, \mathtt{L}) & \Longrightarrow & x_1 x_2 \ldots x_{i-2} p x_{i-1} y x_{i+1} \ldots x_n \end{array}$$

If no transition defined, or illegal transition, then no next ID (crash).
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A step in computation as rewriting strings

1. Initial ID: $q_0 w$:
2. Accepting ID: $\alpha q_{\mathrm{acc}} \alpha'$, for some $\alpha, \alpha' \in \Gamma^*$.
3. Rejecting ID: $\alpha q_{\mathrm{rej}} \alpha'$, for some $\alpha, \alpha' \in \Gamma^*$.
4. $\mathcal{I} \rightsquigarrow \mathcal{J}$:Denotes that if we start execution of TM with configuration/ID encoded by $\mathcal{I}$, leads TM (after maybe several steps) to ID $\mathcal{J}$
5. M accepts w: If for some $\alpha, \alpha' \in \Gamma^*$, we have

$$q_0 w \rightsquigarrow \alpha q_{\mathrm{acc}} \alpha'.$$

   Acceptance happens as soon as TM enters accept state.
6. Language of TM M: $L(M) = \{ w \in \Sigma^* \mid M \text{ accepts } w \}$.

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Non-accepting computation

M **does not accept** w if:

1. M enters q_{rej} (i.e., M **rejects** w)
2. M crashes (moves to left of tape, no transition available, etc).
3. M runs forever.

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Everything is a number

THE END

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(for now)