Steps: 1. Develop abstract model ✓
2. Specify input-output behavior ✓
3. Select state representation ✓
4. Obtain logic expression for output & next-state ←
5. Implement FSM with FF and gates.

Example: Design a modulo-6 counter.

0 → 1 → 2 → 3 → 4 → 5 → 0
000 001 010 011
Next-state Table

<table>
<thead>
<tr>
<th>$S_2$</th>
<th>$S_1$</th>
<th>$S_0$</th>
<th>$S_2^+$</th>
<th>$S_1^+$</th>
<th>$S_0^+$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ s_2^+ = s_2 s_0' + s_1 s_0 \]
When \( S_2 S_1 S_0 = 110 \)

\[
\begin{align*}
S_2^+ &= 1 \\
S_1^+ &= 1 \\
S_0^+ &= 1
\end{align*}
\]

\[
\begin{array}{cccc}
1 & 0 & 0 & 1 \\
1 & 0 & 1 & \\
1 & 1 & 0 & \\
1 & 1 & 1 & \\
\end{array}
\]

\[
\begin{array}{cccc}
0 & 1 & 0 & 0 \\
0 & 0 & 1 & 0 \\
0 & 0 & X & X \\
0 & 0 & X & X \\
\end{array}
\]

\[
S_1^+ = S_1 S_0' + S_2' S_1 S_0
\]

\[
\begin{array}{cccc}
00 & 01 & 11 & 10 \\
1 & 0 & 0 & 1 \\
1 & 0 & X & X \\
\end{array}
\]

\[
S_0^+ = S_0'
\]
Example: FSM for keyless entry for a car

1. Abstract model

<table>
<thead>
<tr>
<th>Action</th>
<th>Driver's door</th>
<th>Remaining Doors</th>
<th>Alarm</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle locked</td>
<td>LOCKED</td>
<td>LOCKED</td>
<td>No</td>
<td>LOCKED</td>
</tr>
<tr>
<td>Driver's door</td>
<td>UNLOCKED</td>
<td>LOCKED</td>
<td>No</td>
<td>DRIVER</td>
</tr>
<tr>
<td>All doors unlocked</td>
<td>UNLOCKED</td>
<td>UNLOCKED</td>
<td>No</td>
<td>UNLOCKED</td>
</tr>
<tr>
<td>Alarm sounds</td>
<td>LOCKED</td>
<td>LOCKED</td>
<td>YES</td>
<td>PANIC (ALARM)</td>
</tr>
</tbody>
</table>
Inputs:
- Unlock button (U) 1 when pressed
- Alarm button (A) 1
- Lock button (L) 1

Outputs:
- Alarm (A) 1 means Yes
- Driver's door (D) 1 means unlocked
- Remaining doors (R) 1

Next-state Table

<table>
<thead>
<tr>
<th>State</th>
<th>Action (Input)</th>
<th>Next state</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOCKED</td>
<td>Press &quot;Unlock&quot;</td>
<td>DRIVER</td>
</tr>
<tr>
<td>DRIVER</td>
<td>Press &quot;Unlock&quot;</td>
<td>UNLOCKED</td>
</tr>
<tr>
<td>any</td>
<td>Press &quot;lock&quot;</td>
<td>LOCKED</td>
</tr>
<tr>
<td>-any</td>
<td>Press &quot;Panic&quot;</td>
<td>ALARM</td>
</tr>
</tbody>
</table>
State Transition Diagram
Lumetta

Abstract to Digital refer to notes Section 3.1.3