Decimal system: 0123456789 \[356=3\times10^2 + 5\times10 + 6\]

Binary system: 01 \[110=1\times2^2 + 1\times2^1 + 0\]

Why do computer use binary numeral system?

Why do we use decimal system? 10 fingers? Why do we have 10 fingers?

Why not decimal time?

Ancient China: decimal and duodecimal systems (base 12)

France revolution: duodecimal vs. decimal system 1795~1805

\[3:65:78 = 0.36578 \text{ day}\]

***
Let's remind ourselves

**Truth table of JK FF**

<table>
<thead>
<tr>
<th>J</th>
<th>K</th>
<th>Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>unchange</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Q̄</td>
</tr>
</tbody>
</table>

*rising edge triggered.

⇒ Q₀ flips every time it's triggered
⇒ Q₁ flips every time Q₀ & CLK switch on
⇒ Q₂ flips every time Q₁ & CLK switch on

⇒ Q₀ 0 1 0 1 0 1
    Q₁ 0 0 1 1 0 0
    Q₂ 0 0 0 0 1 1

(Q₂⊙Q₀) 0 1 2 3 4 5 ...
There is also the ripple counter: Nth JKFF triggered by (N-1)th JKFF.

Logic on (5V)

CLK

\( Q_0 \quad Q_1 \quad Q_2 \)

But the cascade leads to delay which accumulates.

Variations:

**Counting huge #:**

\[ Q = (Q_{12} \ldots Q_1)_2 = (H_3 \ H_2 \ H_1)_{16} \quad \text{Hexadecimal} \]

\[ H = (Q_3 Q_2 Q_1)_2 \]

\[ = 123 \ldots 9 \ ABCDEF \]
Other useful functions: reset → 000...

decimal counter
reverse counting

Reset is typically provided by the IC.

decimal counting ⇒ overflow when $Q = 1001_2 = 9$

⇒ LED display