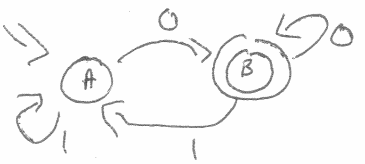
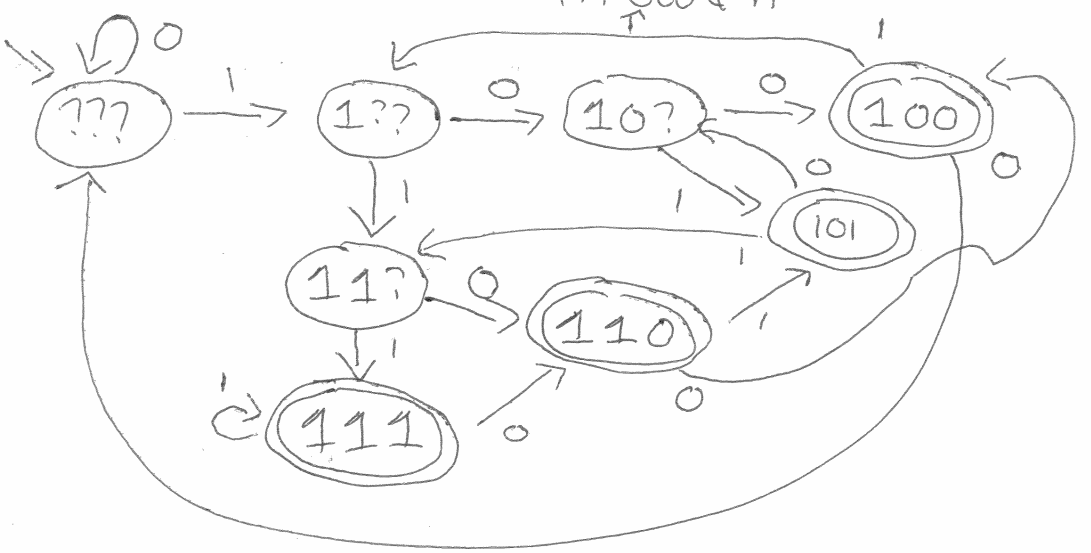
Even machine (number is even, last char = 0)



= Even

3rd to last is 1 = A 100 ∈ A 0111 ∈ A

111000 ∉ A




```
enum states { A, B };
state st = A;
while (chrc = getc();) {
  switch (st) {
    case A: switch (c) {
              case 0: st=B; br;
              case 1: st=A; br;
            }
    }
    case B : switch(c) {  case 0: st=B; br;
                          case 1: st=A; br; } }
return (st == B);
```

UML Statecharts

1-2/

NFA - non-deterministic finite automata

differences: 1) every input doesn't need a next state

2) there may be multiple transitions per input char

3) you may transition w/o reading

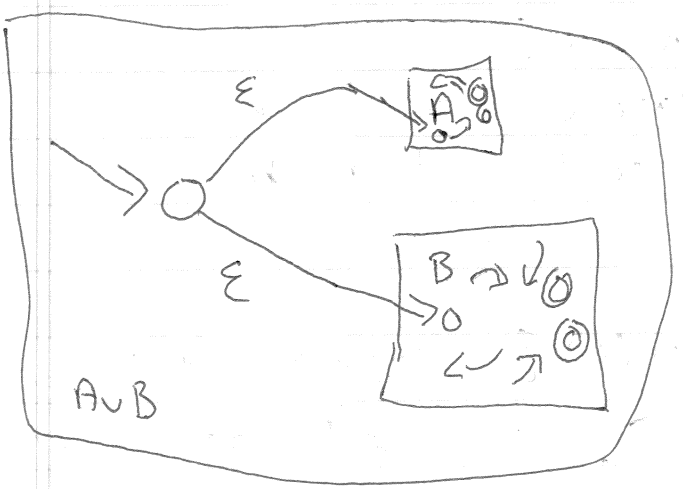
interpretations: 1) the NFA sees the future (rest of input) and chooses what works

2) the NFA fork()s and does both

3) the NFA tries the first, if it doesn't work, go back and try second (a long time) — backtracking

4). math & cleverness

L() = (3rd to last is 1)



4-3/

DFA $d = (Q, \Sigma, q_0 \in Q, \delta: Q \times \Sigma \to Q, F \subseteq Q)$

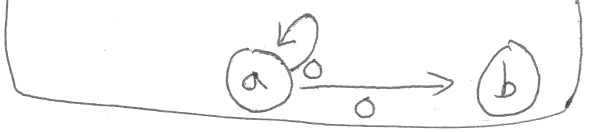
NFA $n = (Q, \Sigma, q_0 \in Q, \delta: Q \times \Sigma_\epsilon \to P(Q), F \subseteq Q)$

$\Sigma_\epsilon = \Sigma \cup \{\epsilon\}$

(input alphabet plus epsilon)

$Q = \{a, b, c\}$ $P(Q) = \{\emptyset, \{a\}, \{b\}, \{c\}, ab, ac, bc, abc\}$

$\delta(a, 0) = \{a, b\}$



DFA $\delta: Q \times \Sigma \to Q$

NFA $\delta: Q \times \Sigma_\epsilon \to P(Q)$

$L(\text{NFA } n) = \text{someset} = \{x \in \Sigma^* \mid x \text{ is accepted by } N\}$ (such that)

A string x is accepted by NFA n iff

$q_0 \overset{x}{\Rightarrow}{}^* q_f$ s.t. $q_f \in F$

An NFA n transitions (or runs) from q_i to q_k via string x ($q_i \overset{x}{\Rightarrow}{}^* q_k$) iff

$q_i \overset{\epsilon}{\Rightarrow}{}^* q_i$

$$\frac{q_i \overset{a}{\Rightarrow} q_\ell \quad \text{and} \quad q_\ell \overset{y}{\Rightarrow}{}^* q_k \qquad a \in \Sigma_\epsilon,\ y \in \Sigma^*}{q_i \overset{ay}{\Rightarrow}{}^* q_k}$$

An NFA n steps from q_i to q_ℓ on a iff

$q_\ell \in \delta(q_i, a)$

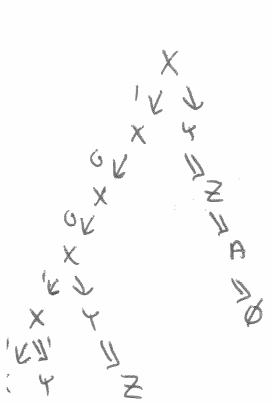
4-4

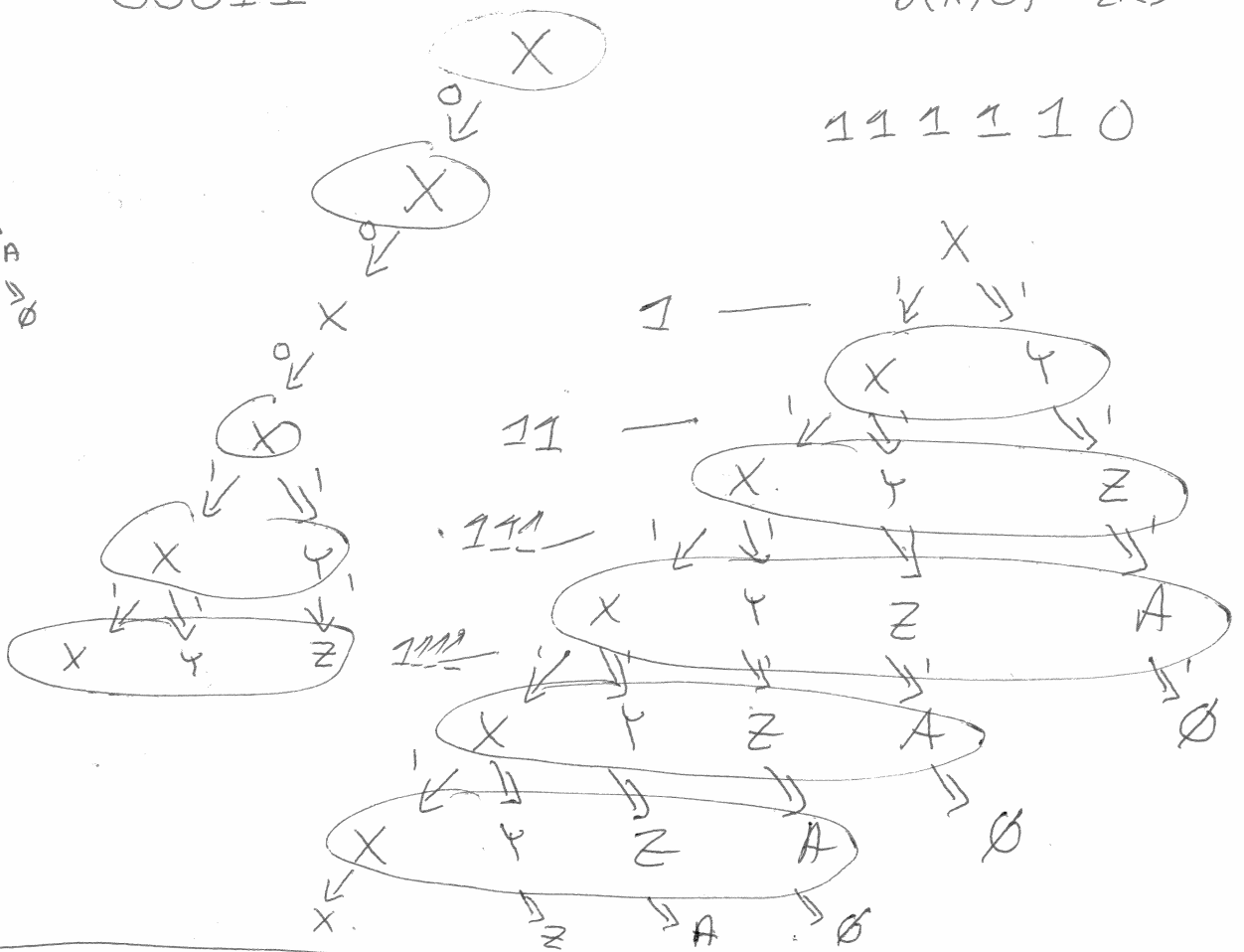
10011

$\delta(X, 1) = \{X, Y\}$

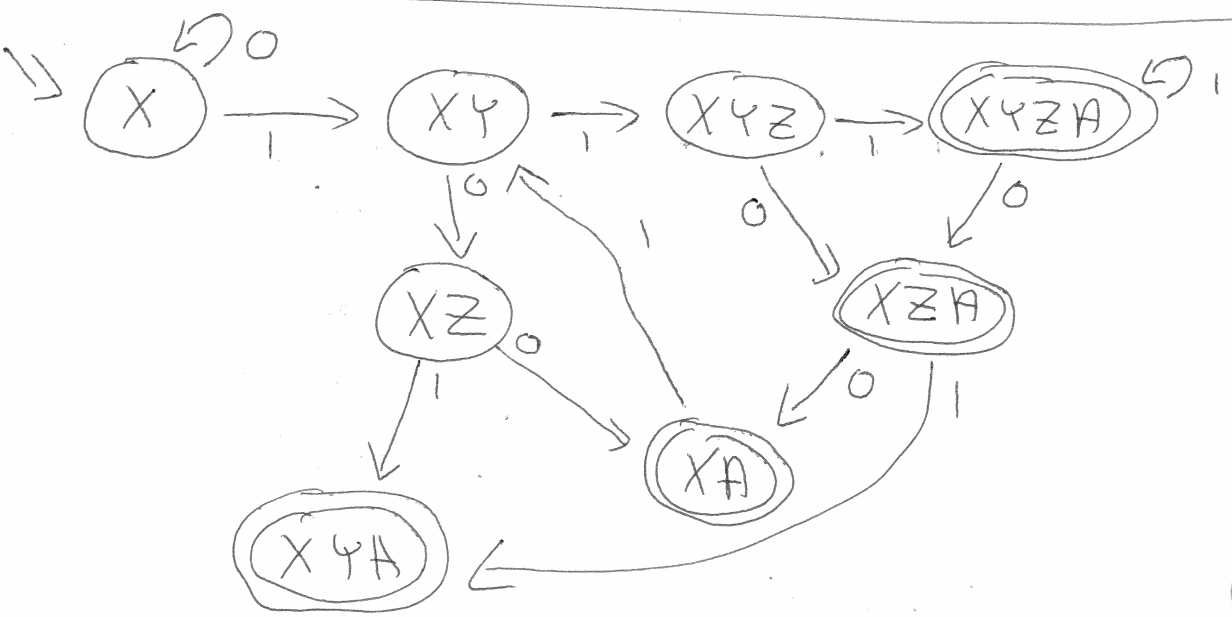
$\delta(X, 0) = \{X\}$

00011





111110



(refer back to DFA)