Angluin's Algorithm

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& Utkarsh Joshi

The Learner L^*

Initialize S and E to {λ}.
Ask membership queries for λ and each $a \in A$.
Construct the initial observation table (S, E, T)

Repeat:

While (S, E, T) is not closed or not consistent:

If (S, E, T) is not consistent,

then find s_1 and s_2 in S, $a \in A$, and $e \in E$ such that
$row(s_1) = row(s_2)$ and $T(s_1.a.e) \neq T(s_2.a.e)$,
add a.e to E,
and extend T to $(S \cup S.A).E$ using membership queries.

If (S, E, T) is not closed.

then find $s_1 \in S$ and $a \in A$ such that
$row(s_1.a)$ is different from row(s) for all $s \in S$,
add $s_1.a$ to S,
and extend T to $(S \cup S.A).E$ using membership queries.

Once (S, E, T) is closed and consistent. let M = M(S, E, T).
Make the conjecture M.
If the Teacher replies with a counter-example t, then

add t and all its prefixes to S
and extend T to $(S \cup S.A).E$ using membership queries.

Until the Teacher replies yes to the conjecture M.

Halt and output M.

Lets run the algorithm, taking the unknown regular set to be

$$U = \{ w \mid \#_a(w) \bmod 3 = 0 \}$$

I

Initialize S and E to {λ}.

Ask membership queries for λ and each a ∈ A.

Construct the initial observation table (S, E, T)

S = {λ}

E = {λ}

I

Initialize S and E to {λ}.

Ask membership queries for λ and each a ∈ A.

Construct the initial observation table (S, E, T)

$T(\lambda) = ?$

$T(a) = ?$

$T(b) = ?$

I

Initialize S and E to {λ}.

Ask membership queries for λ and each a ∈ A.

<u>Construct the initial observation table (S, E, T)</u>

	λ
λ	1
a	0
b	1

II

Repeat:

While (S, E, T) is not closed or not consistent:

If (S, E, T) is not consistent,
then find s_1 and s_2 in S, $a \in A$, and $e \in E$ such that $row(s_1) = row(s_2)$ and $T(s_1.a.e) \neq T(s_2.a.e)$,
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a	0
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Repeat:

While (S, E, T) is not closed or not consistent:

If (S, E, T) is not consistent,
then find s_1 and s_2 in S, a ∈ A, and e ∈ E such that row(s_1) = row(s_2) and T(s_1.a.e) ≠ T(s_2.a.e),
add a.e to E,
and extend T to (S ∪ S.A).E using membership queries.

If (S, E, T) is not closed,
then find s_1 ∈ S and a ∈ A such that row(s_1.a) is different from row(s) for all s ∈ S,
add s_1.a to S,
and extend T to (S ∪ S.A).E using membership queries.

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λ	1
a	0
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While (S, E, T) is not closed or not consistent:

If (S, E, T) is not consistent,
then find s_1 and s_2 in S, a $\in$ A, and e $\in$ E such that row(s_1) = row(s_2) and T(s_1.a.e) $\neq$ T(s_2.a.e),
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then find s_1 $\in$ S and a $\in$ A such that row(s_1.a) is different from row(s) for all s $\in$ S,
add s_1.a to S,
<u>and extend T to (S $\cup$ S.A).E using membership queries.</u>

	λ
λ	1
a	0
b	1
aa	0
ab	0

III

Make the conjecture M.

If the Teacher replies with a counter-example t, then

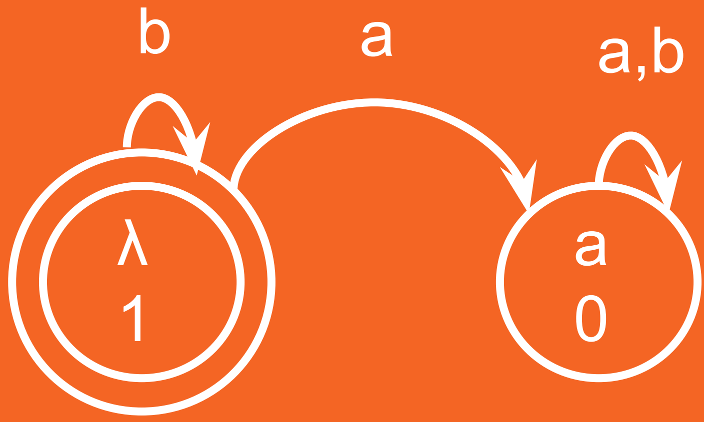
add t and all its prefixes to S

and extend T to $(S \cup S.A).E$ using membership queries.

Repeat until the Teacher replies yes to the conjecture M.

	λ
λ	1
a	0
b	1
aa	0
ab	0

Q= {row(s):sES},
q_0 = row(λ),
F= { row(s) :
s∈S and T(s)=I},
δ(row(s), a) = row(s .a)



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Repeat until the Teacher replies yes to the conjecture M.

t = aaa

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	λ
λ	1
a	0
aa	0
aaa	
b	1
ab	0
aab	
aaaa	
aaab	

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Repeat until the Teacher replies yes to the conjecture M.

	λ
λ	1
a	0
aa	0
aaa	1
b	1
ab	0
aab	0
aaaa	0
aaab	1

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Repeat:

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	λ	a
λ	1	
a	0	
aa	0	
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b	1	
ab	0	
aab	0	
aaaa	0	
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	λ	a
λ	1	0
a	0	0
aa	0	1
aaa	1	0
b	1	0
ab	0	0
aab	0	1
aaaa	0	0
aaab	1	0

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	λ	a
λ	1	0
a	0	0
aa	0	1
aaa	1	0
b	1	0
ab	0	0
aab	0	1
aaaa	0	0
aaab	1	0

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λ	1	0
a	0	0
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aaa	1	0
b	0	0
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$Q = \{row(s) : sES\}$,
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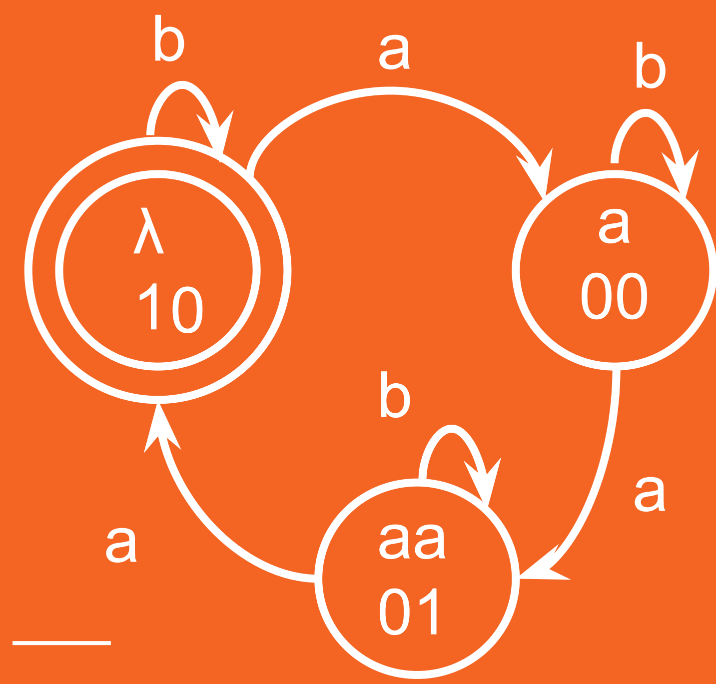
$s \in S$ and $T(s)=I\}$,
$\delta(row(s), a) = row(s.a)$



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