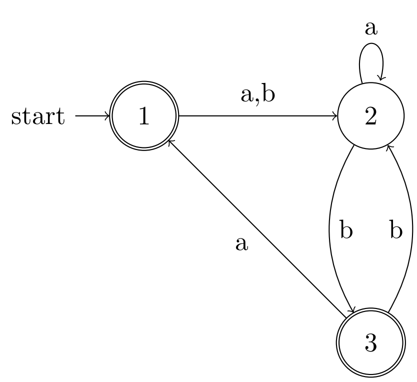
Homework 2

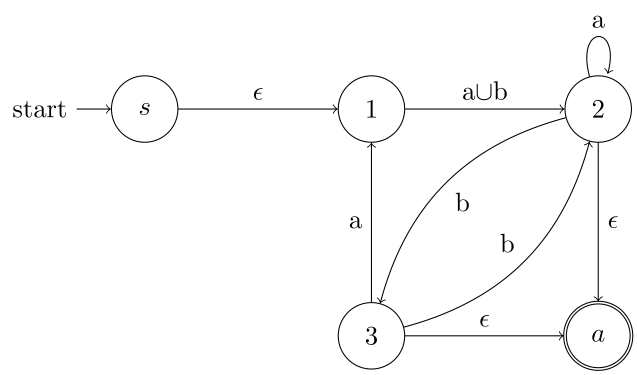
Jose Luiz Magallanes

October 20, 2020

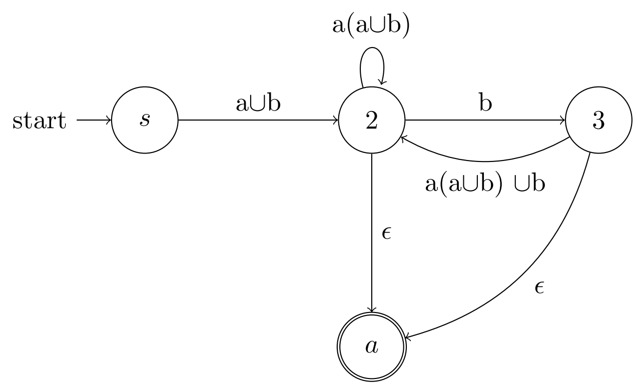
1 Give the regular expression for the FA below. Create a program that generates a regular expression from the language description:



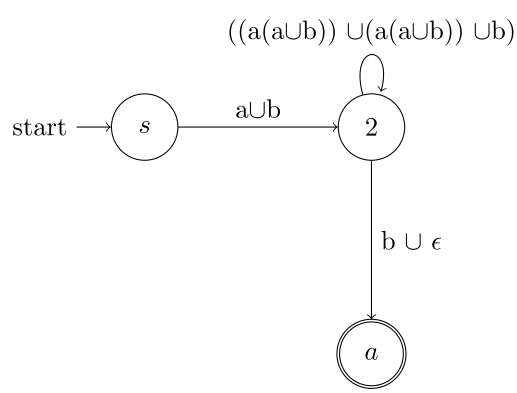
3 *state FA*



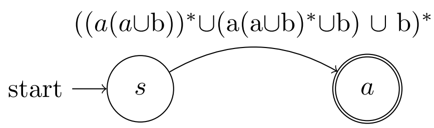
5 *state GFA*



4 *State GFA*



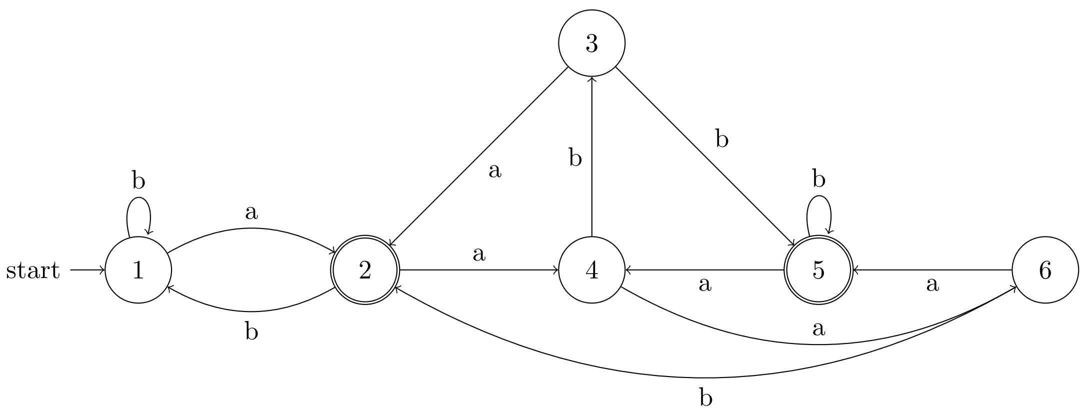
3 *State GFA*



2 State GFA

1.1 Regular Expression: $((a(a\cup \mathbf{b}))^{*}\cup (\mathbf{a}(\mathbf{a}\cup \mathbf{b})^{*}\cup \mathbf{b})\cup \mathbf{b})^{*}$

2 Minimize the FA:



2.1 State Transition Table

q	δ (q,a)	δ (q,b)
1	2*	1
2*	4	1
3	2*	5*
4	6	3
5*	4	5*
6	5*	2*

2.2 Let's create sets of the pairs that are distinguishable:

$\mathbf{P}_0 = \{(1,3,4,6),(2^*,5^*)\}$
$P_1 = \{(1),(3,6),(4),(2^*),(5^*)\}$
$P_2 = \{(1),(3),(6),(4),(2^*),(5^*)\}$

2.3 All sets in P_2 are singletons, hence all pairs are distinguishable. therefore the DFA cannot be minimized further.

3 Use the pumping lemma to show that the language $L = \{a^i b^j c^k | i < j, j < k\}$ is not regular.

3.1 We will prove by contradiction.

Assume that L is a regular language. Let p be the pumping length given by pumping lemma. Since L is infinite, $\exists$ p where s ϵ L and $|s| \geq$ p then s = xyz, xy $\leq$ p, $|y| > 0$, xy$^i z \epsilon$ L and i $\geq$ 0. Let $s = a^p b^{p+1} c^{p+2}$. Then s can be split into xyz, satisfying the conditions of pumping lemma. Consider $a^p b^p c^p$ by the pumping lemma, s = xyz and xy = $a^i a^j ; i + j \leq p$. z = a^{p-i-j} by the pumping lemma. Now, $xy^2 z \epsilon$ L. But $xy^2 z =$ a$^i a^{2j}$a^{p-i-j}b$^p c^p$ =a^{p-j}b$^p c^p \notin$ L. Thus we obtain a contradiction.

4 Give a regular expression which denotes the language L over $\{0, 1\}$ for each of the languages described below:

4.1 all strings that begin or end with 00 or 11.

4.1.1 $(00 + 11) + (00 + 11)$

4.2 all strings that have exactly one occurrence of 00.

4.2.1 $(01)^*00$

4.3 all strings that do not have the sub-string 000.

4.3.1 $(110 + 010 + 011)^*$