1(a). $(0|1)((0|1)(0|1))^*$

1(b). $1^*0(1|01^*0)^*$

1(c). $(0|1)^*0(0|1)^*0(0|1)^* \mid 0^*10^*10^*$

1(d). $(0|10)^*(\varepsilon|1)$

1(e). $(0|1)^*(01|10)$

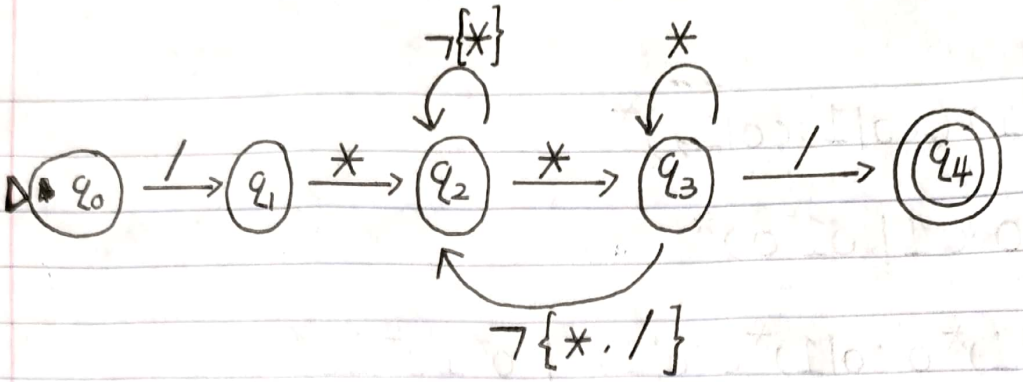
1(f). $(1(0|1))^*(\varepsilon|1)$

2(a). This given regular expression matches /**/*/, which is a nested comment that should be forbidden, and otherwise the lexer would recognize comments wrongly.
For example, If our string is /* comment1*/ code /* comment2*/, because lexers are implemented to be greedy, it would recognize the later */ and consider the whole string, including code, as a comment, which is not we want.

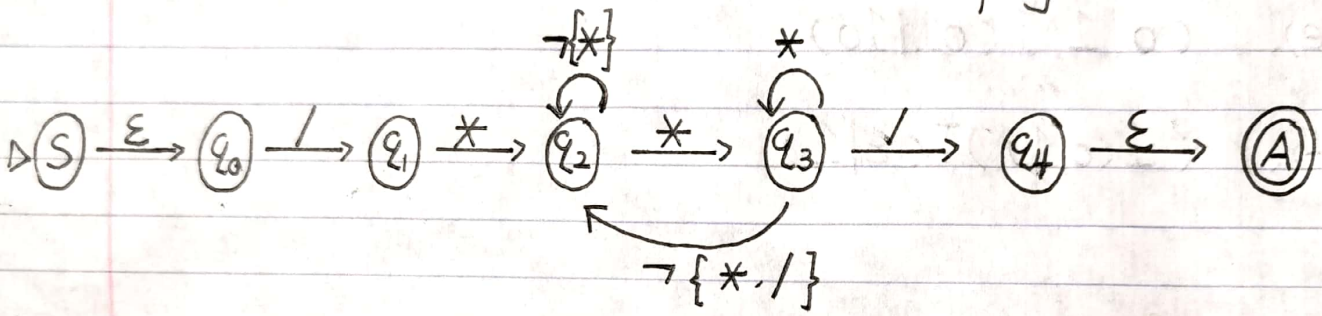
2(b). a legal 5-character comment : /***/

a 7-character ill-formed string : /***/*/

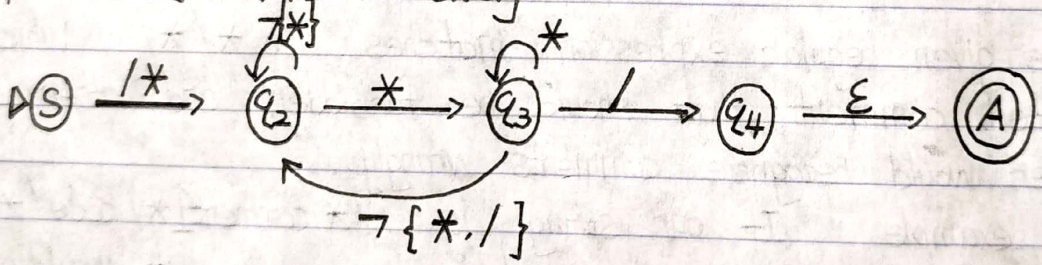
2(c).



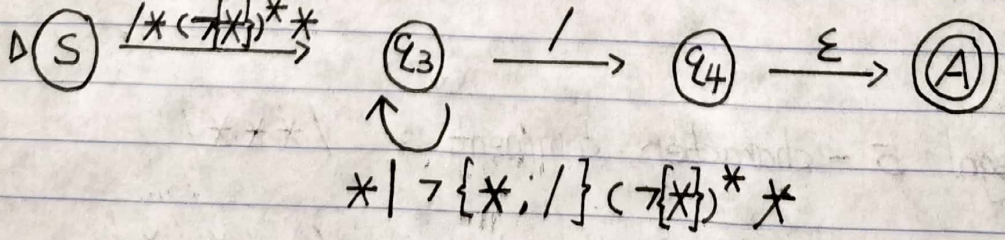
2(d). Create a new start state and a new accepting state



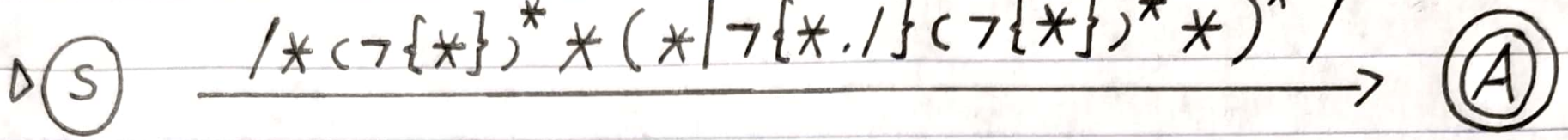
Remove q_0, q_1 successively



Remove q_2



Remove q_3, q_4 successively



Finally, we get the correct regular expression:

$/*(\neg\{*\})^**(*|\neg\{*./\}(\neg\{*\})^**)^*/$

3. Step 1 : Mark the first 0 of the string as $\hat{0}$
- If there is no first 0, halt and reject
- If there is only one 0 in the string, halt and accept
- Else, keep going to Step 2

Step 2 : Move to the last 0 that is not marked and cross it off
- If there is no unmarked 0 left, halt and reject

Step 3 : Return back to the first 0 behind $\hat{0}$
- If there is no 0 left, remove the mark ^ and back to Step 1
- Else, move the mark ^ onto that 0, and back to Step 2

4. Step 1 : Read the first letter and cross it off
- If there is no first letter, halt and reject
- Else if the first letter is 0, halt and reject
- Else, the first letter is 1, keep going

Step 2 : Move to the last letter that is not crossed off
- If it is ␣ (there are no letters left), halt and reject

Step 3 : Read the last letter and cross it off
- If the letter is 1, halt and reject
- Else, the letter is 0, keep going

Step 4 : Return back to the first letter that is not crossed off
- If it is ␣ (there are no letters left), halt and accept
- Else if the letter is 0, halt and reject
- Else, go back to Step 1