1. Describes the languages denoted by the following regular expressions:
   a. a(a|b)*a.
   b. ((ε|a)b*)*.
   c. (a|b)*a(a|b) (a|b).
   d. a*ba*ba*ba*.
   e. (aa|bb)*((ab|ba)(aa|bb)*(ab|ba)(aa|bb)*)*

a. String of a's and b's that begins and ends with an "a", length ≥ 2
b. String of a's and b's, can be empty
c. String of a's and b's that the 3rd character from the last is "a".
d. String of a's and b's that contains only 3 b's.
e. String of a's and b's that contains even number of a's and b's, can be empty.

2. Write regular definitions for the following languages:
   a. All strings of lowercase letters that contain the five vowels in order.
   b. All strings of lowercase letters in which the letters are in ascending lexicographic order.
   c. Comments, consisting of a string surrounded by / and /, without an intervening */, unless it is inside double-quotes (")
   d. All strings of digits with no repeated digits. Hint: Try this problem first with a few digits, such as {0, 1, 2}.
   e. All strings of a's and b's that do not contain the substring abb.
   f. All strings of a's and b's that do not contain the subsequence abb.

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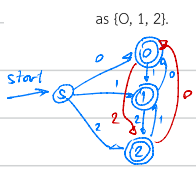
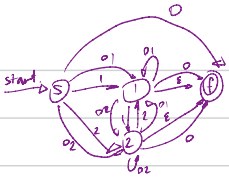
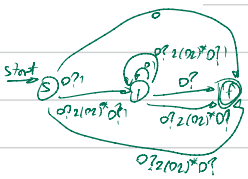
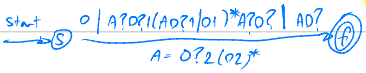
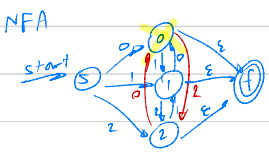
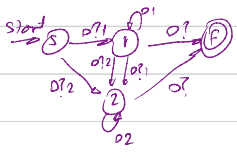
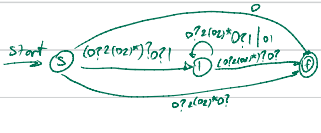
a. A = [bcdfghjklmnpqrstvwxyz]
   A*a (a|A)*e(e|A)*i(i|A)*o(o|A)*u(u|A)*
b. a* b* c* ... x* y* z*
c. \/*([^*"]*|".*"|*+[^/])**\/
   escape char; any char; * recurring; not; or
d. A = 0?2(02)* (0? = 0 | ε)
   0|A?0?1(A0?1|01)*A?0?|A0?
   a+ = a | aa | aaa | aaaa...
e. b*(a+b?)*
f. b*a* | b*a+ba*

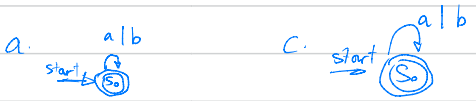
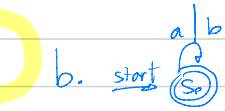
3. Write character classes for the following sets of characters:
   a. The first ten letters (up to "j") in either upper or lower case.
   b. The lowercase consonants.
   c. The "digits" in a hexadecimal number (choose either upper or lower case for the "digits" above 9).
   d. The characters that can appear at the end of alegitimate English sentence (e.g. , exclamation point)

a. [A-Ja-j]
b. [bcdfghjklmnpqrstvwxyz]
c. [0-9a-f]
d. [.!?]

4. Design finite automata (deterministic or nondeterministic) for this language
   a. All strings of digits with no repeated digits. Hint: Try this problem first with a few digits, such as {0, 1, 2}.

5. Convert the following regular expressions to deterministic finite automata:
   a. (a|b)*
   b. (a*|b*)*
   c. ((ε|a)|b*)*
   d. (a|b)*abb(a|b)*


Exercise 1

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    e. (aa|bb)*((ab|ba)(aa|bb)*(ab|ba)(aa|bb)*)*.
2. Write regular definitions for the following languages:
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4. Design finite automata (deterministic or nondeterministic) for this language
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