**Tutorial 2**

**3.3.2**

Describe the languages denoted by the following regular expressions:

1. a(a|b)\*a
2. ((ε|a)b\*)\*
3. (a|b)\*a(a|b)(a|b)
4. a\*ba\*ba\*ba\*
5. (aa|bb)\*((ab|ba)(aa|bb)\*(ab|ba)(aa|bb)\*)\*

**Answer**

1. String of a's and b's that start and end with a.
2. String of a's and b's.
3. String of a's and b's that the character third from the last is a.
4. String of a's and b's that only contains three b.
5. String of a's and b's that has a even number of a and b.

**3.3.5**

Write regular definitions for the following languages:

1. All strings of lowercase letters that contain the five vowels in order.
2. All strings of lowercase letters in which the letters are in ascending lexicographic order.
3. Comments, consisting of a string surrounded by /\* and \*/, without an intervening \*/, unless it is inside double-quotes (")
4. All strings of digits with no repeated digits. Hint: Try this problem first with a few digits, such as {O, 1, 2}.
5. All strings of digits with at most one repeated digit.
6. All strings of a's and b's with an even number of a's and an odd number of b's.
7. The set of Chess moves,in the informal notation,such as p-k4 or kbp\*qn.
8. All strings of a's and b's that do not contain the substring abb.
9. All strings of a's and b's that do not contain the subsequence abb.

**Answer**

1、

want -> other\* a (other|a)\* e (other|e)\* i (other|i)\* o (other|o)\* u (other|u)\*

other -> [bcdfghjklmnpqrstvwxyz]

2、

a\* b\* ... z\*

3、

\/\\*([^\*"]\*|".\*"|\\*+[^/])\*\\*\/

**3.3.6**

Write character classes for the following sets of characters:

1. The first ten letters (up to "j") in either upper or lower case.
2. The lowercase consonants.
3. The "digits" in a hexadecimal number (choose either upper or lower case for the "digits" above 9).
4. The characters that can appear at the end of alegitimate English sentence (e.g. , exclamation point) .

**Answer**

1. [A-Ja-j]
2. [bcdfghjklmnpqrstvwxzy]
3. [0-9a-f]
4. [.?!]

**3.4.1**

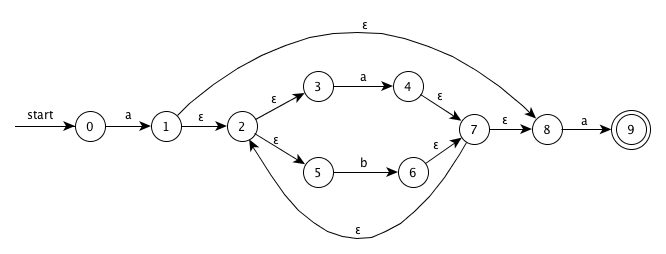
给出识别练习 3.3.2 中各个正则表达式所描述的语言状态转换图。

**解答**

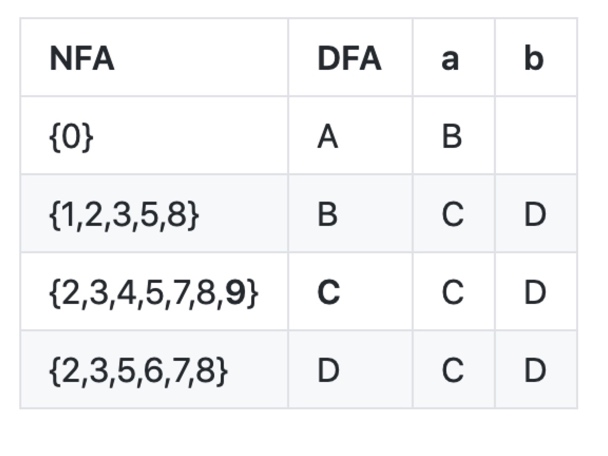
解答步骤：NFA -> DFA -> 最少状态的 DFA（状态转换图）

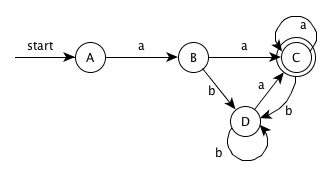
1. a(a|b)\*a

NFA:

[](https://camo.githubusercontent.com/a2584407a12dd887e728224fd891826e64023109/68747470733a2f2f662e636c6f75642e6769746875622e636f6d2f6173736574732f3334303238322f3431323334332f63386234303562322d616261652d313165322d383533362d6337613037356164336163642e676966)

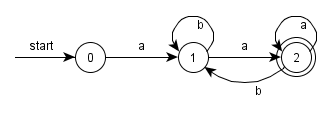
DFA:



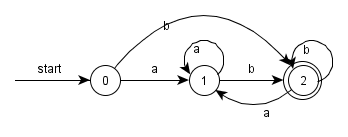
[](https://camo.githubusercontent.com/fd67654e48a47e76a36d4e24799c63c8004b9790/68747470733a2f2f662e636c6f75642e6769746875622e636f6d2f6173736574732f3334303238322f3431323334352f64333366346131652d616261652d313165322d386435362d6536323330666235663635312e676966)

最少状态的 DFA(状态转换图):

合并不可区分的状态 B 和 D

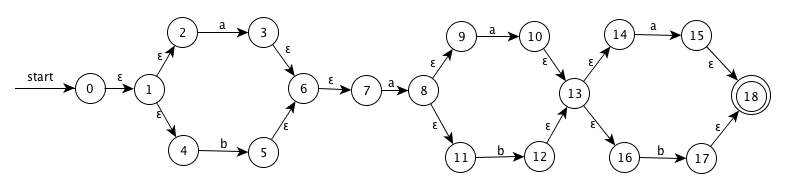
[](https://camo.githubusercontent.com/084a40306145bd79298790dbe6eac100a08a82f6/68747470733a2f2f662e636c6f75642e6769746875622e636f6d2f6173736574732f3334303238322f3135353837382f66643831613738632d373637342d313165322d396364632d3830393765363635313631662e676966)

1. ((ε|a)b\*)\*

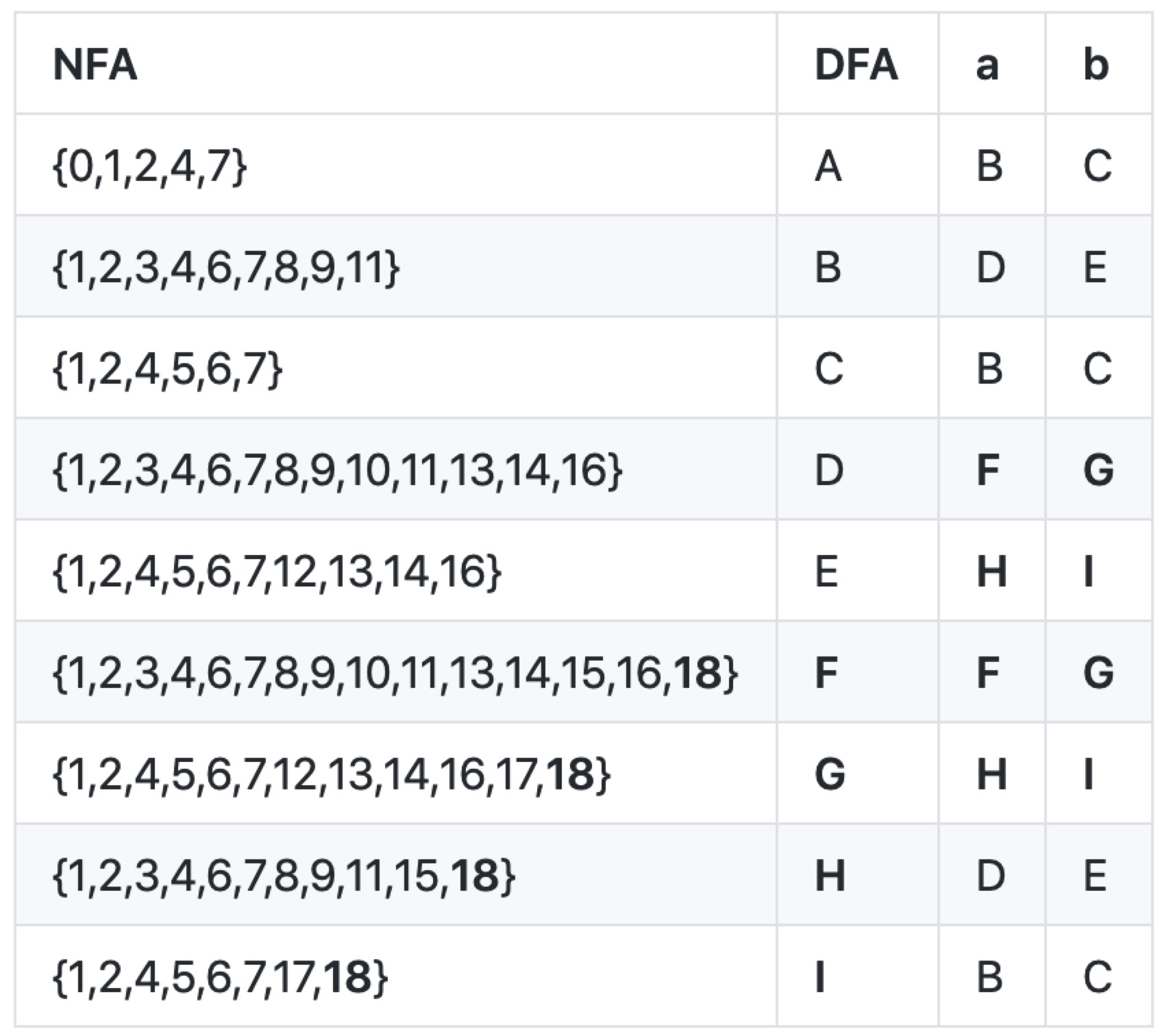
[](https://camo.githubusercontent.com/726967362a0f2570a3450fef2f761d0e9f03bd9a/68747470733a2f2f662e636c6f75642e6769746875622e636f6d2f6173736574732f3334303238322f3135353839332f63613035656239322d373637352d313165322d393835322d3665303038316263646530632e676966)

1. (a|b)\*a(a|b)(a|b)

NFA:

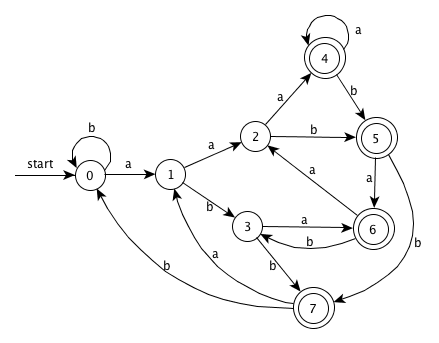
[](https://camo.githubusercontent.com/3702f2df01914b75cbb2de1f029d4606e5c1332a/68747470733a2f2f662e636c6f75642e6769746875622e636f6d2f6173736574732f3334303238322f3431323433392f33616438303266302d616262352d313165322d393064382d6238653962663037303734342e676966)

DFA:

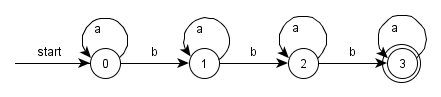


最少状态的 DFA(状态转换图):

合并不可区分的状态 A 和 C

[](https://camo.githubusercontent.com/e494548e538c03f1f72367f98dfd00083c3ef6af/68747470733a2f2f662e636c6f75642e6769746875622e636f6d2f6173736574732f3334303238322f3431323533362f37303064653265302d616262622d313165322d396633342d3161323630356338656666342e676966)

1. a\*ba\*ba\*ba\*

[](https://camo.githubusercontent.com/89564fec7f63fd804f4c7eab3a9e9db6daf9f7e9/68747470733a2f2f662e636c6f75642e6769746875622e636f6d2f6173736574732f3334303238322f3135353839382f34363633316438362d373637362d313165322d383561362d3064376337393939333530322e676966)