CS/ECE 374 Spring 2017	Lanxiao Bai (lbai5@illinois.edu)
Homework 1 Problem 1	Renheng Ruan (rruan2@illinois.edu)

For each of the following languages over the alphabet {`0`, `1`}, give a regular expression that describes that language, and briefly argue why your expression is correct.

1. All strings except `101`.
2. All strings that end in `01` and contain `000` as a substring.
3. All strings in which every nonempty maximal substring of `0`s is of odd length. For instance `1001` is not in the language while `0100010` is.
4. All strings that do not contain the substring `101`.
5. All strings that do not contain the subsequence `101`.

Solution:

1. $(0+11+100+101(0+1))(0+1)^* + \varepsilon + 1 + 10$

   Reason: Empty string is accepted, all strings start with `0, 11, 100` are accepted, strings with length greater than 4 are accepted, `1` and `10`, although not start with the prefix above, are accepted.

2. $(0+1)^*000(1+(0+1)^*01)$

   Reason: String can start with everything, but must contain `000`, which can immediately ends with `1` to form `01` tail or has any substring after that with a `01` ending.

3. $(0+1)^*1(00)^*01(0+1)^*$

   Reason: Since what we concern about is the substring, so basically the start and end any be any string formed under alphabet. And the consecutive `0`s of odd length and be formed by $(00)^*0$. Since the question requires it to be maxima substring, `1`s on the both sides are required to separate the substring from the rest part.

4. $0^*(1(\varepsilon + 000^*)1)^*0^*$

   Reason: The main idea is that, in the string, every 2 `1`s has 0 or more than 2 `0`s between them. Also, the string can start or end with `0`.

5. $0^*1^*0^*$

   Reason: The main idea is that in the string, there should be nothing or `1`s only between 2 `1`s and string can start and/or end with `0`.

■