COMP 598

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Question 1

$((ba)^* + b^*)^* b + \epsilon$

Question 2

First, we minimize this DFA. If it can be minimize as one state. Then we check if this state is accepted. If this state is accepted, then it can accept Σ^*

Question 3

3.1

It is decidable.
Since L is a CFL and R is a regular language. So their intersection is also a CFL. We know that whether a CFL is nil is decidable. So we done!

3.2

It is undecidable. To decide whether $L \cap R = \Sigma^*$, it is similar as whether $L = \Sigma^*$. But we know that this is undecidable. So we done!

Question 4

It is context free but not regular.

It is not regular. Prove shown below.
$L \cap a^*c^* = \{a^nc^n | n \geq 0\}$. Clearly, $\{a^nc^n | n \geq 0\}$ is not regular but a^*c^* is regular.
So L is not regular.
It is context free because we can write a grammar to generate it.
Here comes the grammar:
$S \rightarrow aSc \mid B \mid \epsilon$
$B \rightarrow bBc \mid \epsilon$
So we prove it!

Question 5

5.1

It is not decidable because if we pick a input which is not in that set, M never halts.

5.2

We will use the reductions to do this. First, define M' as a turing machine. Pick arbitrary input $w \in \Sigma^*$ and run on the M. If M accept it, then M' accept Σ^*. Otherwise pick another input to run on M.
Since $EMPTY$ is not CE, so is FIN.

Question 6

6.1

It is decidable. First, Inversing the DFA. Change the reject and accepting states. By doing this, we will get a DFA for $\overline{L}$. By looking at the new DFA, assume the states' number is n. we can checking all the strings with length between n to $2n$. If exists a string with length between n to $2n$ and accepted by this new DFA, which means this DFA has a loop.
Then by pumping lemma,$\overline{L}$ is infinite. so the original regular language is not cofinite. Otherwise, it is cofinite.

6.2

It is undecidable.
Since L is a CFL, so $\overline{L}$ is recursive. We know that it is undecidable for a given Turing machine to accept finite or inifinite inputs. So it's undecidable.

6.3

It is not decidable. We can use Rice's Thm to prove it.

Question 7

7.1

True

7.2

True

7.3

True

7.4

True

7.5

False

Finally

I solemly swear that I am up to no mischief. I did not consult anyone nor did I use the internet to search for answers to these questions.