Tuesday 12/04/2022 Midterm Exam Duration: 90 minutes

Name: Student No:

P1 [25 points]

1. Compute the weakest precondition for each of the following sequences of assignment statements and their postconditions: (5p each)

   (a)
   ```
   a = 2 * b + 1;
   b = a - 3
   {b < 0}
   ```

   (b)
   ```
   a = 3 * (2 * b + a);
   b = 2 * a - 1
   {b > 5}
   ```

2. Write a single regular expression for numbers including integers (5, 0, -3, etc.) and floating numbers(7.2, -0.3, etc.). (5p)

3. Do regular expressions $b^+a^*b^*$ and $b^*a^*b^+$ generate the same language? (2p) Justify your answer. (3p)

4. Do regular expressions $a^*b^+a^*b^*a^*$ and $a^*b^*a^*b^+a^*$ generate the same language? (2p) Justify your answer. (3p)

P2 [20 points] Consider the following grammar and find out which of the following strings are in the language generated by this grammar? (Circle correct options.)

$\langle S \rangle \rightarrow \langle A \rangle \text{a} \langle B \rangle \text{b}$

$\langle A \rangle \rightarrow \langle A \rangle \text{a} \mid \text{b}$

$\langle B \rangle \rightarrow \langle B \rangle \text{b} \mid \text{a}$

aababbab	Yes	No
abab	Yes	No
baba	Yes	No
baaaabb	Yes	No

P3 [30 points] Consider the following grammar:

$\langle S \rangle \rightarrow \langle S \rangle + \langle S \rangle \mid \langle id \rangle$

$\langle id \rangle \rightarrow$ a | b | c

a. Write a leftmost derivation for the string `c+b+a`

b. Prove that the grammar is ambiguous.

c. Modify this grammar so that it is no longer ambiguous.

P4 [25 points] Consider the grammar and the corresponding LR parsing table from the textbook. Write the trace of a parse of the string id+(id)

1. E → E + T
2. E → T
3. T → (E)
4. T → id

	Action					GoTo	
State	id	+	(	)	$	E	T
0	S4		S3			1	2
1		S5			accept		
2	R2	R2	R2	R2	R2		
3	S4		S3			6	2
4	R4	R4	R4	R4	R4		
5	S4		S3				8
6		S5		S7			
7	R3	R3	R3	R3	R3		
8	R1	R1	R1	R1	R1		

Stack	Input	Action
0	id+(id)$	