Alias _____ PID _____

Midterm 1

COMP – 520, Spring 2024

Please fill in today's date (YYYY-MM-DD)

_____-____-____

Write your name and PID here:

_____

Write your ALIAS here:

_____

Your alias and PID should be written on ALL exam pages.
Your alias represents you and will be equivalent to your name throughout the exam.

Alias _____ PID _____

Instructions

1. Open notes. (Anything you wrote down)
2. Open course website. (Including lectures)
3. Limited IDE access. (IntelliJ, Eclipse, notepad, etc.)
    a. IDE access is given so that you can reliably see the syntax highlighting of your code, and that's it!
    b. You may open your IDE but not write any new code.
    c. You may NOT compile any code. (javac)
    d. You may NOT run anything in your IDE.
4. No websites other than the course website.
    a. No Piazza, Canvas, Sakai, email, etc.
5. No phones at all, even if you forgot your laptop.
6. No collaboration. No communication with others, other than instructors, TAs, and proctors.

7. Be concise in your answers.
8. You get about the full class period (70 minutes).
9. Sign below with either your name or alias.

I pledge I have not given nor received unauthorized aid on this exam:

_____

Alias _____ PID _____

Notation:

Followers(A) ≡ FL(A)
Starters(A) ≡ ST(A)
Nullable(A) ≡ N(A)
Capitals are non-terminals, lowercase are terminals.
Greek letters are sequences.

Nullable Induction:

Observed	*Rule*
1. $\alpha = \varepsilon$	Nullable(α) = true
2. $\alpha = t$	Nullable(α) = false
3. $\alpha = A$	Nullable(α) = Nullable(A)
4. $\alpha = \alpha_1\alpha_2 \ldots \alpha_n$	Nullable(α) = Nullable(α_1) ∧ … ∧ Nullable(α_n)
5. $\alpha = \alpha_1 \mid \alpha_2 \mid \ldots \mid \alpha_n$	Nullable(α) = Nullable(α_1) ∨ … ∨ Nullable(α_n)
6. $\alpha = \beta^*$	Nullable(α) = true

Starters Induction:

Observed	*Rule*
1. $\alpha = \varepsilon$	Starters(α) = { ε }
m2. $\alpha = t$	Starters(α) = { t }
3. $\alpha = A$	Starters(α) = Starters(A)
4. $\alpha = \alpha_1\alpha_2 \ldots \alpha_n$	Starters(α) = Starters(α_1)⊕Starters($\alpha_2 \ldots \alpha_n$)
5. $\alpha = \alpha_1 \mid \alpha_2 \mid \ldots \mid \alpha_n$	Starters(α) = Starters(α_1) ∪ … ∪ Starters(α_n)
6. $\alpha = \beta^*$	Starters(α) = Starters(β) ∪ { ε }

$$A \oplus B = \begin{cases} A & \text{if } \varepsilon \notin A \\ (A \backslash \{\varepsilon\}) \cup B & \text{otherwise} \end{cases}$$

Followers first step:

$$\mathrm{FL}_0(\mathrm{A}) = \left(\bigcup_{\mathrm{C}::=\alpha\mathrm{A}\beta} \mathrm{ST}(\beta) \right) \backslash \{\varepsilon\}$$

Followers inductive step:

$$\mathrm{FL}_{i+1}(A) = \mathrm{FL}_i(A) \cup \bigcup_{\mathrm{C}::=\alpha\mathrm{A}\beta \text{ and } \mathrm{Nullable}(\beta)} \mathrm{FL}_i(\mathrm{C})$$

Followers final step:

$$\mathrm{FL}(\mathrm{A}) = \mathrm{FL}_n(\mathrm{A}) \cup \begin{cases} \{\varepsilon\} & \text{if } \mathrm{S} \Rightarrow^* \alpha\mathrm{A} \\ \{\} & \text{otherwise} \end{cases}$$