**CMPSC 4473 Theory of Programming Languages**

**Spring 2021 Post-Midterm Exam – 100 points + 8 bonus**

**Make sure to write the answers in your own words, do not just copy paste from the slides.**

**NAME:**

1. What is a procedural programming language? Briefly describe and give an example of one. – 6 points
2. Who developed FORTRAN? – 2 points
3. Briefly describe the main application of FORTRAN and the main application of COBOL. – 6 points
4. Describe what a programming paradigm is and provide 3 examples of different programming paradigms. – 8 points
5. Briefly describe the phases involved in the compilation process. – 8 points
6. Draw the parse tree for the following derivation: - 8 points

<assign> => <id> = <expr>

=> A = <expr>

=> A = <id> + <expr>

=> A = B + <expr>

=> A = B + <id> + <expr>

=> A = B + C + <expr>

=> A = B + C + <id>\*<expr>

=> A = B + C + D\*<expr>

=> A = B + C + D\*(<expr>)

=> A = B + C + D\*(<id> + <expr>)

=> A = B + C + D\*(A + <expr>)

=> A = B + C + D\*(A + <id>)

=> A = B + C + D\*(A + B)

1. What does an assembler do? – 4 points
2. Briefly describe Von Neumann Architecture and the Instruction Cycle. – 8 points
3. What are data abstractions and control abstractions? Describe each one, specify the different levels of abstraction, and provide an example for each level and type. – 14 points
4. Provide an example of syntactic sugar. – 2 points
5. Briefly describe the difference between syntax and semantics. – 4 points
6. In reference to programming languages, what is expressiveness? – 4 points
7. In reference to programming languages, what is regularity? Make sure to describe the 3 concepts that it is subdivided into. – 8 points
8. Why did Stroustrup choose to use C as a basis for C++? – 6 points
9. How are loops implemented in functional programming? – 4 points
10. What is the advantage of tail recursion over non-tail recursion. Briefly describe. – 8 points
11. **Bonus 8 points-** Draw the expression tree for the following prefix expression:

(\* (\* (+1 2)(+ 3 4))(+5 6)) and specify the result of the expression.