Final Exam

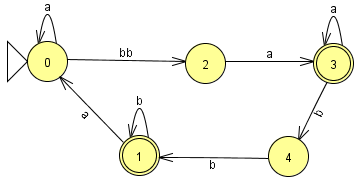
CIS 306  
Dr. John P. Baugh – Winter 2021

**Total: \_\_\_\_\_\_\_\_\_\_\_\_ / 200**

**Printed Name: \_\_\_Demetrius Johnson\_\_\_\_\_\_\_\_\_**

**GRADER/TA: *[No CO Data]***

I, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, have neither given nor received assistance on this examination except that which is provided by, or approved by, the instructor.

1. [15 pts] Let the alphabet Σ = {a, b}. Given the regular expression r = a\*(a + b), assume a language L® is the language defined by the regular language r. Explain in English, what accepted strings in the language are like.
2. [15 pts] Design and draw the state transition diagram of a finite automaton (FA) for the regular language in question 1, above.
3. [20 pts] Write a regular expression r, for the language L(r) using the alphabet {a, b, c} where all strings of the language start with at least one a or b, followed by ab, followed by any number of c’s.
4. [20 pts] Determine whether the following strings are accepted by the transition graph (TG) that is listed.
   1. abb
   2. aaabbb
   3. aaabbaaabbb
   4. baab
5. [20 pts] Give the configuration after applying the appropriate transition function, using the symbols a, b, c. Only apply the transition function *once*.   
   Assume the **original configuration is: bbabcq3baab**

**Available transition functions:**

* **δ(q1, a) = (q2, a, R)**
* **δ(q1, b) = (q3, c, L)**
* **δ(q2, a) = (q2, b, L)**
* **δ(q2, b) = (q3, c, R)**
* **δ(q3, a) = (q4, c, R)**
* **δ(q3, b) = (q2, a, L)**

1. [20 pts] Solve the following modular arithmetic questions, using the integer representation discussed in class, namely, x = cq + r (find the remainder, r. Hint: r should *always* be non-negative)
   1. -25 mod 4
   2. 26 mod 5
   3. -42 mod 7
   4. -30 mod 6
2. [15 pts] Determine whether the following congruences hold using the modular difference/division property [Hint: (a-b)/c is an integer?]
   1. Is 9 7 mod 4?
   2. Is 16 6 mod 3?
   3. Is 16 6 mod 5?
3. [15 pts] Use Euclid’s algorithm the find the following greatest common divisors (GCDs)
   1. GCD(15, 48)

* 1. GCD(2, 28)

1. [20 pts] Consider the line segments connecting points p1 and p2 in each of the following scenarios. Find a vector = (x, y) that represents these line segments.
   1. p1 = (4, 3) and p2 = (3, 5)
   2. p1 = (-5, 2) and p2 = (5, 4)
   3. p1 = (6, 0) and p2 = (7, 0)
   4. p1 = (4, -1) and p2 = (-5, -10)

1. [20 pts] Given your solutions in question (9) above, find the **magnitudes** of each of the vectors.
   1. =
   2. =
   3. =
   4. =
2. [20 pts] Find the distances from a point to a line, given the following information
   1. You are given a point (5, 3) **not** on the line, and two points (0, -2) and (5, 15) through which the line passes

* 1. You are given a point (2, 3) **not** on the line, and a line y = 2x + 4