Homework 2 Morally Due Feb 16
WARNING: THIS HW IS FIVE PAGES LONG!!!!!!!!!!!!!!!!!!!!!!

1. (0 points, but if you actually miss the midterm without telling Dr. Gasarch ahead of time, you will lose 100 points on this homework)
   When will the midterm be (give date and time)? When will the final be (give date and time)? By when do you have to tell Dr. Gasarch that you cannot make the midterm?

2. (20 points) The alphabet is \{a, b\}. Let \(n \in \mathbb{N}\).
   Let \(n\) be even. Write a DFA for the language:
   \[
   \left\{ w : |w| = n \text{ and } #_a(w) = #_b(w) = \frac{n}{2} \right\}
   \]
   by specifying \(Q\), \(s\), \(\delta\), and \(F\).
   Give as a table.
   How many states does your DFA have (as a function of \(n\)?)

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3. (20 points) Draw an NFA for the language $a^*b^* \cup bba^*b$. 

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4. (20 points) The alphabet is \{0, 1, 2, 3, 4, 5, 6\}. We view strings as numbers in base 7. We read them least-sig-digit-first. So for example, if we want to input 5314 it will go in 4 THEN 1 THEN 3 THEN 5. Write the DFA-classifier (as a table) that tells us what a number is mod 5.

Specify \(Q\), \(s\), \(\delta\) and which state (or states) a number \(\equiv i \pmod{5}\) ends up in. Note that \(\delta(q, \sigma)\) has to be defined for every state \(q\) and \(\sigma \in \Sigma\).

Also note how many STATES your classifier has.

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5. (20 points) RECALL:
   Let $M$ be an NFA. Then

   \[ L(M) = \{ x : \text{the set of final states } M(x) \text{ COULD reach is } \geq 1 \}. \]

   We define different accept conditions.
   A language is *Saadiq-regular* if there is an NFA $M$ such that

   \[ L(M) = \{ x : \text{the set of final states } M(x) \text{ COULD reach is } \geq 2 \}. \]

   Show that if $L$ is Saadiq-regular then $L$ is regular.
6. (20 points)

Let $M = (Q, \Sigma, \Delta, s, F)$ be an NFA for $L$

Construct an NFA for $L^*$ from the NFA for $L$. 