PROBLEM SET 10

YOUR NAME

(1) Write all the 4 letter strings that are elements of the language described by the regular expression: `A*B*(AB)*`

(2) Consider a Finite State Automaton that has 3 states: 1, 2, and 3. State 1 is the start state, and state 3 is the accepting state. The state transitions are as follows:

In state	and reading	goto state
1	A	2
1	B	3
2	A	1
2	B	3
3	A	1
3	B	3

(a) Write a regular expression that has the same language as this FSA.

(b) Write the transitions for a 2 state FSA that has the same language as the 3 state FSA above. Be sure to say which states are accepting states, and which state is the start state.

(3) Construct a Turing machine that takes in a string of `A`s and `B`s (followed by empty tape), and writes a `B` at the right of the string (the halts) if there are an even number of `A`s, and writes an `A` if the number of `A`s in the string is odd. You can assume that the reader head is at the leftmost character of the string.

(4) Count Vlad Urr gives Ossub Ull, the court Imp (not to be confused with Ido Urr, the court Gog), the task of writing the function `boolean printsA(Program P)` that takes an arbitrary program `P`, and in finite time returns whether `P` (when executed) prints the letter `A`. Can you prove that Imp Ossub Ull's task is impossible?

(5) BONUS: Upon being again countered, Count Urr orders that *Gog Ido Urr go sum*mon The High Programmer. Upon arrival, The High Programmer states "This might not

be as hard as *I think. Therefore, I am* inclined to say that Imp Ossub Ull's task is possible if the input `P` will never have more than 256 lines of code and never use more than 24 bits of memory (including registers).". With these restrictions on `P`, can one construct `printsA`? If so, how would `printsA` work? (An outline of the algorithm is sufficient.) If not, please explain why.