Lab. 8. Standard Turing Machine. Calculability

1. Consider the Turing machine with input alphabet {a,b}, start state q_0 and the following transitions:

State	Symbol	δ(State,Symbol)
q_0	#	$(q_1,\#,R)$
q_1	a	(q_1,a,R)
q_1	b	(q_1,b,R)
q_1	#	$(q_2,\#,L)$
q_2	a	$(q_3,\#,R)$
q_2	b	$(q_5,\#,R)$
q_2	#	$(q_2,\#,Y)$
q_3	#	(q_4,a,R)
q_4	a	(q_4,a,R)
q_4	b	(q_4,b,R)
q_4	#	(q_7,a,L)
q_5	#	(q_6,b,R)
q_6	a	(q_6,a,R)
q_6	b	(q_6,b,R)
q_6	#	(q_7,b,L)
q_7	a	(q_7,a,L)
q_7	b	(q_7,b,L)
q_7	#	$(q_2,\#,L)$

   a) What is the final configuration if the input is #ab#?
   b) What is the final configuration if the input is #baa#?
   c) Describe what the Turing machine does for an arbitrary input string in {a,b}*.

2. Construct Turing machines to compute the following functions (assume that the number x is in unary notation):

   (a) $f(x) = x + 2$
   (b) $f(x) = 2x$
   (c) $f(x) = x \bmod 2$

3. Is B = { $a^n b^n c^n$ | n = 0, 1, 2, …} Turing enumerable? Is it decidable?

4. Give a high-level definition of a TM that recognizes the set {$a^n b^{2n}$ | n = 0, 1, 2, …}.

5. Define a TM that decide all strings in {0, 1}* that contains an even number of 1`s.