ComSS 331 **Fall 2017** **Name:**_____

HW 11 Due 15 nov 2017

1. Are the following languages Turing decidable, Turing acceptable but not Turing-decidable, or not even Turing acceptable?

   - $L = \{\rho(M)\rho(w) : M$ uses a finite number of tape cells when running on input $w\}$.
   - $L = \{\rho(M)\rho(w)01^n0 : M$ uses at most n tape cells when running on input $w\}$.

   Here, "using n cells" means that the head of the (deterministic) TM M reaches the n-th cell from the left during its computation. Justify your answers clearly: both exercises require careful thinking. 100

2. Are the following languages Turing-decidable? Turing-acceptable but not Turing-decidable? Not even Turing-acceptable? For each answer, just give an intuitive explanation of your reasoning, no formal proof is required (just as in class, M is a generic deterministic Turing machine, w a generic input string to it, and ρ is an encoding function).

   - $\{\rho(M) : |L(M)| \leq 10\}$
   - $\{\rho(M) : |L(M)| \geq 10\}$
   - $\{\rho(M)\rho(w) : M \searrow w$ in 10 steps or less$\}$
   - $\{\rho(M)\rho(w) : M \searrow w$ in 10 steps or more$\}$

   100

3. Use reduction to prove that the language

   $$L = \{\rho(M_1)\rho(M_2) : L(M_1) \subseteq L(M_2)\}$$

   is not decidable (M_1 and M_2 are Turing machines, of course). 50