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**AC32008 Theory of Computation**  
**Tutorial Sheet 6 - Time Complexity of Turing Machines, Class  $\mathcal{P}$**

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1. Show that (for  $n \geq 1$ )

(a)  $\frac{3n^2}{n+2\log n} = O(n)$ .

(b) Any polynomial of degree  $k$  (in one variable  $n$ ) is  $O(n^k)$ .

2. Construct a 1-tape Turing machine  $M$ , which accepts the set of binary palindromes i.e. the set  $L = \{w \mid w \in \{0, 1\}^*, w = w^R\}$  where  $w^R$  is the string  $w$  reversed, so that for example  $01^R = 10$ ,  $00110^R = 01100$  and  $000^R = 000$ .

The machine  $M$  should halt on all inputs. How many moves does the machine make on an input of length  $n$ ?

3. Recall that if  $L$  is a (binary) language, the complement  $\bar{L}$  of  $L$  is the set of binary strings not in  $L$ . Show that if  $L$  is in the class  $\mathcal{P}$ , then so is  $\bar{L}$ .

4. Show that if  $L$  is regular, then  $L$  is in  $\mathcal{P}$ .