1. **Relative complexity** Consider three algorithms $A$, $B$, and $C$. If $A$ performs $T_A(n) = 2n^4$ operations, $B$ performs $T_B(n) = 2^{n/4}$, and $C$ performs $T_C(n) = 4\sqrt{n}$ operations.

   a. for what problem sizes will each algorithm be best?
   b. if, using algorithm $A$, you are guaranteed to solve a problem of size $n = 20$ in one hour, what size problem could you solve with a machine 4 times as fast?
   c. show that $T_B(n)$ is $O(2^n)$.
   d. show that $T_B(n)$ is not $\Theta(2^n)$.

   2 marks

2. **Algorithm analysis** Describe and give the pseudo code for a sorting algorithm that *does not appear in the notes* (i.e. not insertion sort, merge sort, quick sort or heap sort).

   a. Prove that the algorithm is correct.
   b. Derive its complexity in $\Theta$ notation.

   4 marks

3. **Basic clustering** Find a $\Theta(n \log n)$ algorithm that given a set $S$ of $n$ integers, partitions them into two non-empty sets $A$ and $B$, such every element of $A$ is less than or equal to every element of $B$ and the difference between the average of sets $A$ and $B$ is minimized.

   2 marks

4. **Applied algorithms** Describe a problem you have encountered outside this unit that requires a non-trivial algorithm to solve. State the problem clearly, identifying the inputs, outputs and their relationship, and describe an algorithm that solves the problem.

   2 marks

These tutorial exercises count for 4% of your final assessment. These tutorial exercises must be your own work. Make sure your name, student number and clearly marked on your submission. Submit your tutorial exercises by the due date/time to Tim French.