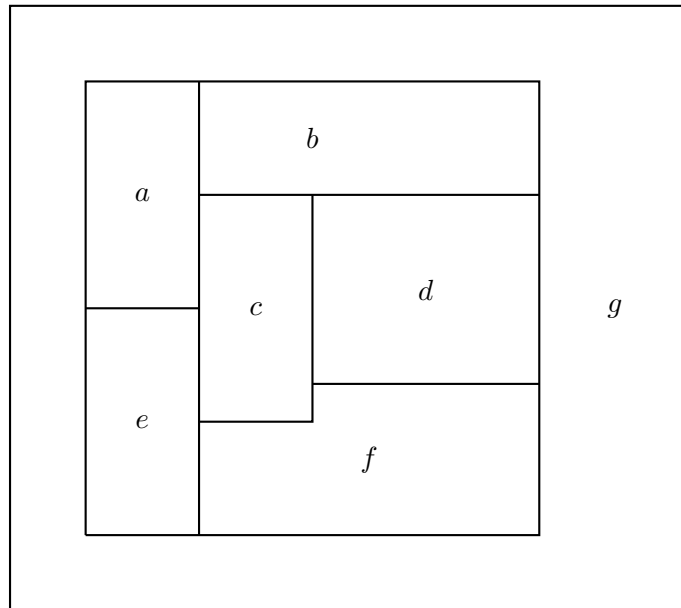


School of Computing and Information Systems
COMP90038 Algorithms and Complexity Tutorial Week 2

1. Consider the usual (unsigned) binary representation of integers. For example, 10110010 represents 178, and 000011 represents 3.
 - (a) If we call the bits in an n -bit word $x_{n-1}, x_{n-2}, \dots, x_2, x_1, x_0$ (so x_0 is the *least significant* bit), which natural number is denoted by $x_{n-1}x_{n-2} \cdots x_2x_1x_0$?
 - (b) Describe, in English, an algorithm for converting from binary to decimal notation.
 - (c) Write the algorithm in (pseudo-) code.
 - (d) Describe, in English, how to convert the decimal representation to binary.
2. Which of the following can be considered an algorithm for computing the area of a triangle whose side lengths are given positive numbers a , b , and c ?
 - (a) $S = \sqrt{p(p-a)(p-b)(p-c)}$, where $p = (a+b+c)/2$
 - (b) $S = \frac{1}{2}bc \sin A$, where A is the angle between sides b and c
 - (c) $S = \frac{1}{2}ah_a$, where h_a is the height to base a
3.
 - (a) Show the stack after each operation of the following sequence that starts with the empty stack:
`push(a), push(b), pop, push(c), push(d), pop`
 - (b) Show the queue after each operation of the following sequence that starts with the empty queue:
`enqueue(a), enqueue(b), dequeue, enqueue(c), enqueue(d), dequeue`
4. Consider the following problem: You are to design an algorithm to determine the best route for a subway passenger to take from one station to another in a city such as Kolkata or Tokyo.
 - (a) Discuss ways of making the problem statement less vague. In particular, what is “best” supposed to mean?
 - (b) How would you model this problem by a graph?
5. You have to search for a given number n in a *sorted* list of numbers.
 - (a) How can you take advantage of knowing that the list is represented as a linked (and sorted) list?
 - (b) How can you take advantage of knowing the list is represented as an array?

6. Extension Question

Consider the following map:



- (a) A cartographer wants to colour the map so that no two neighbouring countries have the same colour. How few colours can she get away with?
- (b) Show how to reduce the problem to a graph-colouring problem.