8 Algorithms 1 (jkf21)

(*a*) Draw a diagram showing the final state of the data structure after inserting the following hash keys (in order) into an initially empty hash table of size 10. Resolve collisions by chaining, use the hash function $h(x) = x \bmod 10$, and use a method that ensures that, on average, searches for present and absent keys will take equal time.

$$3, 37, 16, 75, 27, 4, 8, 84$$

[5 marks]

(*b*) Draw a diagram showing the final state of the data structure after inserting the same keys (in order) into a table of size 16 using open addressing with the hash function $h(x) = x \bmod 16$, and the quadratic probe sequence given by

$$h(x, i) = \left(h(x) + \frac{i}{2} + \frac{i^2}{2} \right) \bmod 16$$

[6 marks]

(*c*) Suppose we need to support efficient deletion from a hash table of length `T.length` that uses open addressing and the same quadratic probe sequence as in part (*b*). You may assume that an appropriate hash function $h(x)$ has been implemented so you can call it where necessary.

(*i*) Provide pseudocode for the DELETE operation. [4 marks]

(*ii*) Provide pseudocode for the SEARCH operation. [3 marks]

(*d*) The probe sequence given in (*b*) hits every table position before revisiting any position, provided the table size is a power of 2. Explain why this is useful.

[2 marks]