

# COMPUTER SCIENCE TRIPOS Part IA – 2022 – Paper 1

## 2 Foundations of Computer Science (jdy22)

One way to represent sets of integers is as lists of intervals:

```
type intset = (int * int) list
```

For example,  $\{1, 2, 3, 9, 10, 11, 12\}$  can be represented as  $[(1, 3); (9, 12)]$ , the union of the intervals  $[1..3]$  and  $[9..12]$ .

(a) Each set of integers has many different interval list representations. An interval list (`intset`) is in *standard form* if it is an ascending sequence of non-empty intervals that cannot be merged.

(i) Write a function that tests whether an `intset` is in standard form:

```
val is_standard : intset -> bool
```

[4 marks]

(ii) Write a function that adds an interval to an `intset` in standard form, producing a new `intset` in standard form:

```
val add_interval : (int * int) -> intset -> intset
```

[4 marks]

(iii) Write a function that converts an `intset` to standard form:

```
val standardize : intset -> intset
```

[2 marks]

(iv) Write a function to test whether two `intset` values represent the same set:

```
val equal : intset -> intset -> bool
```

[2 marks]

(b) Write a function that computes the intersection of integer sets:

```
val inter : intset -> intset -> intset
```

You may assume that the arguments to `inter` are in standard form. [8 marks]