SOEN 342 - Sections H and II:
Software Requirements and Specifications

Project

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1 Formal specification in Z

The formal specification of the system introduces the following three types:

$$SENSOR\_TYPE, LOCATION\_TYPE, TEMPERATURE\_TYPE$$

The system's formal specification is given in the Z language and it consists of schemas and the definitions of operations that constitute the system's exposed interface.

1.1 Schemas

```
┌─ TempMonitor ──────────────────────────────────────────
│ deployed  :  ℙ SENSOR_TYPE
│ map : SENSOR_TYPE ⇸ LOCATION_TYPE
│ read : SENSOR_TYPE ⇸ TEMPERATURE_TYPE
├────────────────────────────────────────────────────────
│ deployed = dom map
│ deployed = dom read
└────────────────────────────────────────────────────────
```

```
┌─ DeploySensorOK ───────────────────────────────────────
│ Δ TempMonitor
│ sensor? : SENSOR_TYPE
│ location? : LOCATION_TYPE
│ temperature? : TEMPERATURE_TYPE
├────────────────────────────────────────────────────────
│ sensor? ∉ deployed
│ location? ∉ ran map
│ deployed' = deployed ∪ {sensor?}
│ map' = map ∪ {sensor? ↦ location?}
│ read' = read ∪ {sensor? ↦ temperature?}
└────────────────────────────────────────────────────────
```

```
┌─ ReadTemperatureOK ────────────────────────────────────
│ Ξ TempMonitor
│ location? : LOCATION_TYPE
│ temperature! : TEMPERATURE_TYPE
├────────────────────────────────────────────────────────
│ location? ∈ ran map
│ temperature! = read(map⁻¹(location?))
└────────────────────────────────────────────────────────
```

```
┌─ Success ─────────────────────────────────────────────────
│ Ξ TempMonitor
│ response! : MESSAGE
├───────────────────────────────────────────────────────────
│ response! = 'ok'
└───────────────────────────────────────────────────────────
```

```
┌─ SensorAlreadyDeployed ───────────────────────────────────
│ Ξ TempMonitor
│ sensor? : SENSOR_TYPE
│ response! : MESSAGE
├───────────────────────────────────────────────────────────
│ sensor? ∈ deployed
│ response! = 'Sensor deployed'
└───────────────────────────────────────────────────────────
```

```
┌─ LocationAlreadyCovered ──────────────────────────────────
│ Ξ TempMonitor
│ location? : LOCATION_TYPE
│ response! : MESSAGE
├───────────────────────────────────────────────────────────
│ location? ∈ ran map
│ response! = 'Location already covered'
└───────────────────────────────────────────────────────────
```

```
┌─ LocationUnknown ─────────────────────────────────────────
│ Ξ TempMonitor
│ location? : LOCATION_TYPE
│ response! : MESSAGE
├───────────────────────────────────────────────────────────
│ location? ∉ ran map
│ response! = 'Location not covered'
└───────────────────────────────────────────────────────────
```

```
┌─ ReplaceSensorOK ──────────────────────────────────────────┐
│ ΔTempMonitor                                                │
│ sensor? : SENSOR_TYPE                                       │
│ newSensor? : SENSOR_TYPE                                    │
├─────────────                                                │
│ sensor? ∈ deployed                                          │
│ newSensor? ∉ deployed                                       │
│ deployed' = (deployed \ {sensor?}) ∪ newSensor?            │
│ map' = map ⊕ {newSensor? ↦ map(sensor?)}                   │
│ read' = read ⊕ {newSensor? ↦ read(sensor?)}                │
└─────────────────────────────────────────────────────────────┘
```

```
┌─ OldSensorNotDeployed ─────────────────────────────────────┐
│ ΞTempMonitor                                                │
│ sensor? : SENSOR_TYPE                                       │
│ response! : MESSAGE                                         │
├─────────────                                                │
│ sensor? ∉ deployed                                          │
│ response!  = 'The sensor to be replaced is not deployed'    │
└─────────────────────────────────────────────────────────────┘
```

```
┌─ NewSensorAlreadyDeployed ─────────────────────────────────┐
│ ΞTempMonitor                                                │
│ newSensor? : SENSOR_TYPE                                    │
│ response! : MESSAGE                                         │
├─────────────                                                │
│ sensor? ∈ deployed                                          │
│ response!  = 'The new sensor is already deployed'           │
└─────────────────────────────────────────────────────────────┘
```

```
┌─ ReadCollectionOK ─────────────────────────────────────────┐
│ ΞTempMonitor                                                │
│ inputSensors? : ℙ SENSOR_TYPE                               │
│ outputLocationsTemperatures! : ℙ(LOCATION_TYPE × TEMPERATURE_TYPE) │
├─────────────                                                │
│ inputSensors? ⊆ deployed                                    │
│ outputLocationsTemperatures! = { l : LOCATION_TYPE;         │
│    t : TEMPERATURE_TYPE | l ∈ dom map ∩ inputSensors ∧ t = read(l) } │
└─────────────────────────────────────────────────────────────┘
```

1.2 Operations

$DeploySensor \;\hat{=}$
  $(DeploySensorOK \land Success) \;\oplus$
  $(SensorAlreadyDeployed \lor LocationAlreadyCovered)$

$ReadTemperature \;\hat{=}$
  $(ReadTemperatureOK \land Success) \oplus LocationUnknown$

$ReplaceSensor \;\hat{=}$
  $(ReplaceSensorOK \land Success) \;\oplus$
  $(OldSensorNotDeployed \lor NewSensorAlreadyDeployed)$