SOEN 342 - Sections H and II:

Software Requirements and Specifications

Project

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1 Partial formal specification in Z

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

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

The system's (partial) 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 ──────────────────────────
│ ΔTempMonitor
│ 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 ───────────────────────
│ ΞTempMonitor
│ 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 Already 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
│ oldSensor? : SENSOR_TYPE
│ sensor? : SENSOR_TYPE
├───────────────────────────────────────────────────────────────
│ oldSensor? ∈ deployed
│ sensor? ∉ deployed
│ deployed' = (deployed \ {oldSensor?}) ∪ {sensor?}
│ map' = (map \ {oldSensor? ↦ map(oldSensor?)}) ∪ {sensor? ↦ map(oldSensor?)}
│ read' = (read \ {oldSensor? ↦ read(oldSensor?)}) ∪ {sensor? ↦ read(oldSensor?)}
└───────────────────────────────────────────────────────────────
```

```
┌─ SensorNotFound ──────────────────────────────────────────────
│ ΞTempMonitor
│ oldSensor? : SENSOR_TYPE
│ response! : MESSAGE
├───────────────────────────────────────────────────────────────
│ oldSensor? ∉ deployed
│ response! =' sensor not found'
└───────────────────────────────────────────────────────────────
```

```
┌─ GetTemperatureReadingsOK ────────────────────────────────────
│ ΞTempMonitor
│ temperatureReadings! : ℙ(LOCATION_TYPE × TEMPERATURE_TYPE)
├───────────────────────────────────────────────────────────────
│ temperatureReadings! = {loc : dom map | loc ∈ ran map • loc ↦ read(map⁻¹(loc))}
└───────────────────────────────────────────────────────────────
```

```
┌─ NoTemperatureReadingsAvailable ──────────────────────────────
│ ΞTempMonitor
│ response! : MESSAGE
├───────────────────────────────────────────────────────────────
│ #(dom map) = 0
│ response! =' No temperature readings available'
└───────────────────────────────────────────────────────────────
```

1.2 Operations

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

$ReplaceSensor \, \hat{=}$
  $(ReplaceSensorOK \, \wedge \, Success) \, \oplus$
  $(SensorNotFound \vee SensorAlreadyDeployed)$

$ReadTemperature \, \hat{=}$
  $(ReadTemperatureOK \wedge Success) \oplus LocationUnknown$

$GetTemperatureReadings \, \hat{=}$
  $(GetTemperatureReadingsOK \, \wedge \, Success) \, \oplus \, NoTemperatureReadingsAvailable$