

1.

(a) $\pi_{\text{Road_No}}(\text{Road})$

$\max(\text{Road}) = 6$

$|T| = 1 \quad |T| = (\text{Road_No})$

(b) $\pi_{\text{Road_No}}(\text{Intersection})$

$\max(\text{intersection}) = 11$

$|T| = 1 \quad |T| = (\text{Road_No})$

(c) $\text{Road} * \text{Intersection}$

$|T| = 4 \quad |T| = (\text{Road_No}, \text{Forest_No}, \text{Road_No}, \text{Name}, \text{Length})$

$\min = 3 \quad \max = 11$

(d) $(\sigma_{\text{Length} > 100}(\text{Road})) \bowtie \text{Road.Road_No} = \text{Intersection.Road_No}$

(Intersection)

$|T| = 5 \quad |T| = (\text{Road_No}, \text{Name}, \text{Length}, \text{Road_No}, \text{Forest_No})$

$\min = 0 \quad \max = 11$

2.

(a) $\pi_{\text{Name}}(\sigma_{\text{acid_level} > 75\%}(\text{Forest}))$

(b) $\pi_{\text{Name}}(\sigma_{\text{state} = \text{"PA"} \text{ and } \text{percentage} > 50\%}((\text{Forest}) \text{ JOIN forest_No}(\text{Coverage})))$

3.

(a) $L1 \leftarrow \pi_{\text{Name}} = \text{"Allegheny National Forest"}(\text{Forest})$

$L2 \leftarrow \pi_{\text{Forest_No}} = L1.\text{Forest_No}(\text{Intersection})$

$L3 \leftarrow \sigma \text{ name } (\pi \text{ Road_No } = L2.\text{Road_No } (\text{Road}))$

(b) $L1 \leftarrow \pi \text{ Name } = \text{“ Allegheny National Forest” } (\text{Forest})$

$L2 \leftarrow X > \text{MBR_Min} \text{ and } Y < \text{MBR_XMax} \text{ and } Y > \text{MBR_Ymin}$
 $Y < \text{MBR_YMax}(\text{Sensor})$

$L3 \leftarrow (L2) \text{ sensor_ID } = \text{sensor_ID}(\text{Report})$

$L4 \leftarrow \sigma X, Y (\pi \text{ report_time } < \text{Jan.11.2018} \text{ and } \text{report} > \text{Jan.10.2018}(L2))$

4.

(a) $\text{List1 } (\text{Sensor_Id}) \leftarrow F \text{ between Jan 10, 2018 and Jan 11, 2018 } (\text{Report})$

$L2 \leftarrow \pi \text{ List1.sensor_ID } = \text{sensor.sensor_ID } (\text{Sensor})$

$L3 \leftarrow \pi \text{ name } (\text{Forest} - \text{List})$

(b) $\text{List1 } (X, Y) \leftarrow \text{Sensor_Id } F \text{ average temperature } (\text{Report} * \text{Sensor})$

$\text{List2} \leftarrow \pi \text{ Name } (\text{List Join } x = \text{MBR_XMin}, \text{MBR_XMax } Y = \text{MBR_Ymin},$
 $\text{MBR_YMax Forest})$

(c) $\text{State_Area } (\text{Name}, \text{Area}) \leftarrow \text{Name } F \text{ average area } (\text{State})$

$\text{Max_Area } (\text{Area}) \leftarrow F \text{ max area } (\text{State_Area})$

$\text{RSLT} \leftarrow \pi \text{ name } (\text{Forest Join area} = \text{area Max_Area})$

(d)