call INSERT with rectangle \#S(P : X 1063/1000 :Y 71/40), R+. structure view:

data view:

a leaf is found: root

the node root is not full, add the record.

call INSERT with rectangle \#S (P : X 41/250 : Y 683/500), $R+$. structure view:

| 0 |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- |

data view:

a leaf is found: root

the node root is not full, add the record.

call INSERT with rectangle \#S (P :X 139/100 :Y 3641/1000), $R+$.
structure view:

| 0 | 1 |  |  |  |
| :--- | :--- | :--- | :--- | :--- |

data view:

a leaf is found: root

$$
\begin{array}{|l|l|l|l|l|}
\hline 0 & 1 & & & \\
\hline
\end{array}
$$

the node root is not full, add the record.

call INSERT with rectangle \#S (P :X 7/100 : Y 98/125), $R+$.
structure view:

$$
\begin{array}{|l|l|l|l|l|}
\hline 0 & 1 & 2 & & \\
\hline
\end{array}
$$

data view:

a leaf is found: root

$$
\begin{array}{|l|l|l|l|l|}
\hline 0 & 1 & 2 & & \\
\hline
\end{array}
$$

the node root is not full, add the record.

call INSERT with rectangle \#S (P :X 1659/1000 :Y 1403/500), R+.
structure view:

$$
\begin{array}{|l|l|l|l|l|}
\hline 0 & 1 & 2 & 3 & \\
\hline
\end{array}
$$

data view:

a leaf is found: root

$$
\begin{array}{|l|l|l|l|l|}
\hline 0 & 1 & 2 & 3 & \\
\hline
\end{array}
$$

the node root is not full, add the record.

$$
\begin{array}{|l|l|l|l|l}
\hline 0 & 1 & 2 & 3 & \\
\hline
\end{array} \quad \rightarrow \quad \begin{array}{|l|l|l|l|l|}
\hline 0 & 1 & 2 & 3 & 4 \\
\hline
\end{array}
$$

call INSERT with rectangle \#S (P : X 204/125 : Y 811/250), $R+$.
structure view:

$$
\begin{array}{|l|l|l|l|l|}
\hline 0 & 1 & 2 & 3 & 4 \\
\hline
\end{array}
$$

data view:

a leaf is found: root

$$
\begin{array}{|l|l|l|l|l|}
\hline 0 & 1 & 2 & 3 & 4 \\
\hline
\end{array}
$$

the leaf root is full, need to split.
call SPLIT-NODE with $R+$ node newnode
generate partition rectangles.
sort the rectangle by their low bounds wrt. axis x and divide them w.r.t fill factor 3 . (310) - (254)
sort the rectangle by their low bounds wrt. axis y and divide them w.r.t fill factor 3 . sort the rectangle by their low bounds wrt. axis y and divide them w.r.t fill factor 3 . $(310)-(452)$

Split the entries into the two areas.
call INSERT with rectangle \#S (P : X 1571/1000 : Y 689/250), R+. structure view:

data view:

it is an interval node, we descent to all childs which intersect the rectangle 6: a leaf is found: B

$$
\begin{array}{|l|l|l|l|l|}
\hline 2 & 4 & 5 & & \\
\hline
\end{array}
$$

the node B is not full, add the record.

$$
\begin{array}{|l|l|l|l|l}
\hline 2 & 4 & 5 & & \\
\hline
\end{array} \quad \longrightarrow \quad \begin{array}{|l|l|l|l|l|}
\hline 2 & 4 & 5 & 6 & \\
\hline
\end{array}
$$

call INSERT with rectangle \#S(P :X 129/40 :Y 611/500), $R+$.
structure view:

data view:

it is an interval node, we descent to all childs which intersect the rectangle 7 :
a leaf is found: B

$$
\begin{array}{|l|l|l|l|l|}
\hline 2 & 4 & 5 & 6 & \\
\hline
\end{array}
$$

the node B is not full, add the record.

$$
\begin{array}{|l|l|l|l|l}
\hline 2 & 4 & 5 & 6 & \\
\hline
\end{array} \quad \longrightarrow \quad \begin{array}{|l|l|l|l|l|}
\hline 2 & 4 & 5 & 6 & 7 \\
\hline
\end{array}
$$

call INSERT with rectangle \#S (P : X 2651/1000 :Y 1099/500), R+.
structure view:

data view:

it is an interval node, we descent to all childs which intersect the rectangle 8:
a leaf is found: B

$$
\begin{array}{|l|l|l|l|l|}
\hline 2 & 4 & 5 & 6 & 7 \\
\hline
\end{array}
$$

the leaf B is full, need to split.
call SPLIT-NODE with $R+$ node newnode
generate partition rectangles.
sort the rectangle by their low bounds wrt. axis x and divide them w.r.t fill factor 3 .
$(265)$ - (487)
sort the rectangle by their low bounds wrt. axis y and divide them w.r.t fill factor 3 . sort the rectangle by their low bounds wrt. axis y and divide them w.r.t fill factor 3 .
$(786)-(452)$
Split the entries into the two areas.
call INSERT with rectangle \#S (P : X 1039/1000 :Y 3177/1000), R+. structure view:

data view:

it is an interval node, we descent to all childs which intersect the rectangle 9: a leaf is found: A

$$
\begin{array}{|l|l|l|l|l|}
\hline 0 & 1 & 3 & & \\
\hline
\end{array}
$$

the node A is not full, add the record.

$$
\begin{array}{|l|l|l|l|l}
\hline 0 & 1 & 3 & & \\
\hline
\end{array} \quad \longrightarrow \quad \longrightarrow \quad \begin{array}{|l|l|l|l|l|}
\hline 0 & 1 & 3 & 9 & \\
\hline
\end{array}
$$

call INSERT with rectangle \#S (P : X 3247/1000 : Y 63/200), R+.
structure view:

data view:

it is an interval node, we descent to all childs which intersect the rectangle 10: a leaf is found: C

$$
\begin{array}{|l|l|l|l|l|}
\hline 6 & 7 & 8 & & \\
\hline
\end{array}
$$

the node C is not full, add the record.

$$
\begin{array}{|l|l|l|l|l}
\hline 6 & 7 & 8 & & \\
\hline
\end{array} \quad \longrightarrow \quad \begin{array}{|l|l|l|l|l|}
\hline 6 & 7 & 8 & 10 & \\
\hline
\end{array}
$$

call INSERT with rectangle \#S (P : X 217/250 : Y 212/125), $R+$.
structure view:

data view:

it is an interval node, we descent to all childs which intersect the rectangle 11: a leaf is found: A

$$
\begin{array}{|l|l|l|l|l|}
\hline 0 & 1 & 3 & 9 & \\
\hline
\end{array}
$$

the node A is not full, add the record.

$$
\begin{array}{|l|l|l|l|l|}
\hline 0 & 1 & 3 & 9 & \\
\hline
\end{array} \quad \longrightarrow \quad \begin{array}{ll|l|l|l|l|}
\hline 0 & 1 & 3 & 9 & 11 \\
\hline
\end{array}
$$

call INSERT with rectangle \#S (P :X 2/5 : Y 277/1000), $R+$.
structure view:

data view:

it is an interval node, we descent to all childs which intersect the rectangle 12 :
a leaf is found: A

$$
\begin{array}{|l|l|l|l|l|}
\hline 0 & 1 & 3 & 9 & 11 \\
\hline
\end{array}
$$

the leaf A is full, need to split.
call SPLIT-NODE with $R+$ node newnode
generate partition rectangles.
sort the rectangle by their low bounds wrt. axis x and divide them w.r.t fill factor 3 . (3 112 ) - (11 9 0)
sort the rectangle by their low bounds wrt. axis y and divide them w.r.t fill factor 3 . sort the rectangle by their low bounds wrt. axis y and divide them w.r.t fill factor 3 .
$(1231)-(1109)$
Split the entries into the two areas.
call INSERT with rectangle \#S (P : X 1927/1000 : Y 296/125), $R+$.
structure view:

data view:

it is an interval node, we descent to all childs which intersect the rectangle 13: a leaf is found: C

$$
\begin{array}{|l|l|l|l|l|}
\hline 6 & 7 & 8 & 10 & \\
\hline
\end{array}
$$

the node C is not full, add the record.

$$
\begin{array}{|l|l|l|l|l|}
\hline 6 & 7 & 8 & 10 & \\
\hline
\end{array} \quad \longrightarrow \quad \begin{array}{|l|l|l|l|l|}
\hline 6 & 7 & 8 & 10 & 13 \\
\hline
\end{array}
$$

call INSERT with rectangle \#S (P : X 353/500 :Y 2233/1000), $R+$.
structure view:

data view:

it is an interval node, we descent to all childs which intersect the rectangle 14: a leaf is found: A

$$
\begin{array}{|l|l|l|}
\hline 0 & 9 & 11 \\
\hline
\end{array}
$$

the node A is not full, add the record.

$$
\begin{array}{|l|l|l|l|l}
\hline 0 & 9 & 11 & & \\
\hline
\end{array} \quad \rightarrow \quad \rightarrow \quad \begin{array}{|l|l|l|l|l|}
\hline 0 & 9 & 11 & 14 & \\
\hline
\end{array}
$$

a leaf is found: $D$

$$
\begin{array}{|l|l|l|l|l|}
\hline 1 & 3 & 12 & & \\
\hline
\end{array}
$$

the node D is not full, add the record.

call INSERT with rectangle \#S (P : X 3091/1000 :Y 271/200), R+.
structure view:

data view:

it is an interval node, we descent to all childs which intersect the rectangle 15 :
a leaf is found: C

$$
\begin{array}{|l|l|l|l|l|}
\hline 6 & 7 & 8 & 10 & 13 \\
\hline
\end{array}
$$

the leaf C is full, need to split.
call SPLIT-NODE with $R+$ node newnode
generate partition rectangles.
sort the rectangle by their low bounds wrt. axis x and divide them w.r.t fill factor 3 . $(6138)-(15710)$
sort the rectangle by their low bounds wrt. axis y and divide them w.r.t fill factor 3 . sort the rectangle by their low bounds wrt. axis y and divide them w.r.t fill factor 3 .
$(10715)-(8136)$
Split the entries into the two areas.
call INSERT with rectangle \#S (P :X 193/500 :Y 1663/500), $R+$.
structure view:

data view:

it is an interval node, we descent to all childs which intersect the rectangle 16 : a leaf is found: D

$$
\begin{array}{|l|l|l|l|}
\hline 1 & 3 & 12 & 14 \\
\hline
\end{array}
$$

the node D is not full, add the record.

$$
\begin{array}{|l|l|l|l|l|}
\hline 1 & 3 & 12 & 14 & \\
\hline
\end{array} \quad \rightarrow \quad \rightarrow \quad \begin{array}{|l|l|l|l|l|}
\hline 1 & 3 & 12 & 14 & 16 \\
\hline
\end{array}
$$

call INSERT with rectangle \#S(P :X 482/125 :Y 91/25), $R+$.
structure view:

data view:

it is an interval node, we descent to all childs which intersect the rectangle 17 : a leaf is found: B

$$
\begin{array}{|l|l|l|l|l|}
\hline 2 & 4 & 5 & 6 & \\
\hline
\end{array}
$$

the node B is not full, add the record.

$$
\begin{array}{|l|l|l|l|l}
\hline 2 & 4 & 5 & 6 & \\
\hline
\end{array} \quad \longrightarrow \quad \begin{array}{|l|l|l|l|l|}
\hline 2 & 4 & 5 & 6 & 17 \\
\hline
\end{array}
$$

call INSERT with rectangle \#S (P : X 3963/1000 : Y 437/125), R+.
structure view:

data view:

it is an interval node, we descent to all childs which intersect the rectangle 18:
a leaf is found: B

$$
\begin{array}{|l|l|l|l|l|}
\hline 2 & 4 & 5 & 6 & 17 \\
\hline
\end{array}
$$

the leaf B is full, need to split.
call SPLIT-NODE with $R+$ node newnode
generate partition rectangles.
sort the rectangle by their low bounds wrt. axis x and divide them w.r.t fill factor 3 . $(265)-(41718)$
sort the rectangle by their low bounds wrt. axis y and divide them w.r.t fill factor 3 . sort the rectangle by their low bounds wrt. axis y and divide them w.r.t fill factor 3 . (645) - (18 17 2)

Split the entries into the two areas.
call SPLIT-NODE with $R+$ node newnode
generate partition rectangles.
sort the rectangle by their low bounds wrt. axis x and divide them w.r.t fill factor 3 . (D A F) - (B E C)
sort the rectangle by their low bounds wrt. axis y and divide them w.r.t fill factor 3 . sort the rectangle by their low bounds wrt. axis y and divide them w.r.t fill factor 3 . (A C D) - (E B F)

Split the entries into the two areas.
call INSERT with rectangle \#S (P : X 1701/500 :Y 281/1000), $R+$.
structure view:

data view:

it is an interval node, we descent to all childs which intersect the rectangle 19: it is an interval node, we descent to all childs which intersect the rectangle 19: a leaf is found: C

$$
\begin{array}{|l|l|l|l|l|}
\hline 7 & 10 & 15 & & \\
\hline
\end{array}
$$

the node C is not full, add the record.

$$
\begin{array}{|l|l|l|l|l|}
\hline 7 & 10 & 15 & & \\
\hline
\end{array} \quad \longrightarrow \quad \begin{array}{|l|l|l|l|l|}
\hline 7 & 10 & 15 & 19 & \\
\hline
\end{array}
$$

call INSERT with rectangle \#S(P :X 739/500 :Y 49/20), $R+$.
structure view:

data view:

it is an interval node, we descent to all childs which intersect the rectangle 20: it is an interval node, we descent to all childs which intersect the rectangle 20: a leaf is found: E

$$
\begin{array}{|l|l|l|}
\hline 6 & 8 & 13 \\
\hline
\end{array}
$$

the node E is not full, add the record.

call INSERT with rectangle \#S(P :X 51/40 :Y 1261/500), $R+$.
structure view:

data view:

it is an interval node, we descent to all childs which intersect the rectangle 21: it is an interval node, we descent to all childs which intersect the rectangle 21: a leaf is found: A

$$
\begin{array}{|l|l|l|l|l|}
\hline 0 & 9 & 11 & 14 & \\
\hline
\end{array}
$$

the node A is not full, add the record.

$$
\begin{array}{|l|l|l|l|l}
\hline 0 & 9 & 11 & 14 & \\
\hline
\end{array} \quad \longrightarrow \quad \begin{array}{|l|l|l|l|l|}
\hline 0 & 9 & 11 & 14 & 21 \\
\hline
\end{array}
$$

it is an interval node, we descent to all childs which intersect the rectangle 21: a leaf is found: E

$$
\begin{array}{|l|l|l|l|l|}
\hline 6 & 8 & 13 & 20 & \\
\hline
\end{array}
$$

the node E is not full, add the record.

$$
\begin{array}{|l|l|l|l|l|}
\hline 6 & 8 & 13 & 20 & \\
\hline
\end{array} \quad \rightarrow \quad \begin{array}{|l|l|l|l|l|}
\hline 6 & 8 & 13 & 20 & 21 \\
\hline
\end{array}
$$

call INSERT with rectangle \#S (P : X 1471/1000 :Y 98/25), $R+$.
structure view:

data view:

it is an interval node, we descent to all childs which intersect the rectangle 22: it is an interval node, we descent to all childs which intersect the rectangle 22 : a leaf is found: $F$

$$
\begin{array}{|l|l|l|l|l}
\hline 2 & 17 & 18 & & \\
\hline
\end{array}
$$

the node F is not full, add the record.

| 2 | 17 | 18 |  |  |
| :--- | :--- | :--- | :--- | :--- |$\quad \longrightarrow \quad$| 2 | 17 | 18 | 22 |  |
| :--- | :--- | :--- | :--- | :--- |

call INSERT with rectangle \#S (P : X 1763/500 :Y 113/500), $R+$.
structure view:

data view:

it is an interval node, we descent to all childs which intersect the rectangle 23: it is an interval node, we descent to all childs which intersect the rectangle 23 : a leaf is found: C

$$
\begin{array}{|l|l|l|l|l}
\hline 7 & 10 & 15 & 19 & \\
\hline
\end{array}
$$

the node C is not full, add the record.

$$
\begin{array}{|l|l|l|l|l|}
\hline 7 & 10 & 15 & 19 & \\
\hline
\end{array} \quad \longrightarrow \quad \begin{array}{|l|l|l|l|l|}
\hline 7 & 10 & 15 & 19 & 23 \\
\hline
\end{array}
$$

call INSERT with rectangle \#S (P :X 607/1000 :Y 3117/1000), R+.
structure view:

data view:

it is an interval node, we descent to all childs which intersect the rectangle 24: it is an interval node, we descent to all childs which intersect the rectangle 24:
a leaf is found: $D$

$$
\begin{array}{|l|l|l|l|l|}
\hline 1 & 3 & 12 & 14 & 16 \\
\hline
\end{array}
$$

the leaf D is full, need to split.
call SPLIT-NODE with $R+$ node newnode
generate partition rectangles.
sort the rectangle by their low bounds wrt. axis x and divide them w.r.t fill factor 3 .
(3 116 ) - (12 2414 )
sort the rectangle by their low bounds wrt. axis y and divide them w.r.t fill factor 3 . sort the rectangle by their low bounds wrt. axis y and divide them w.r.t fill factor 3 .
(1231) - (14 24 16)

Split the entries into the two areas.


