

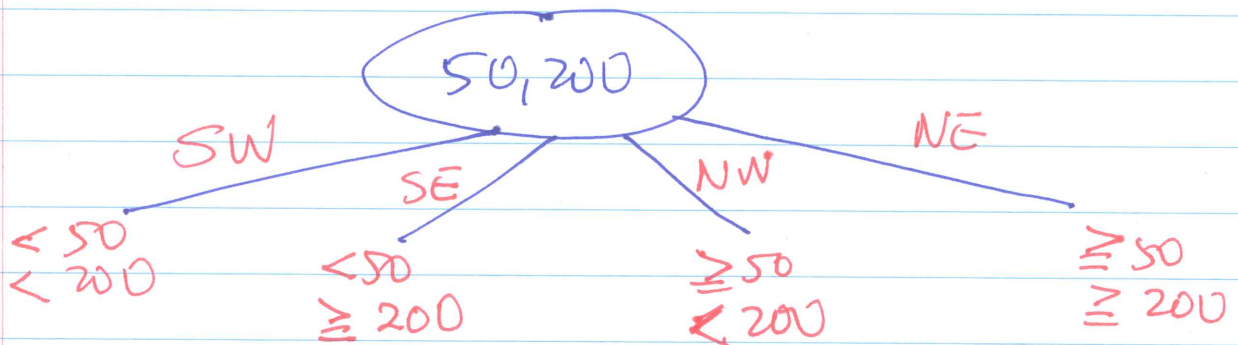
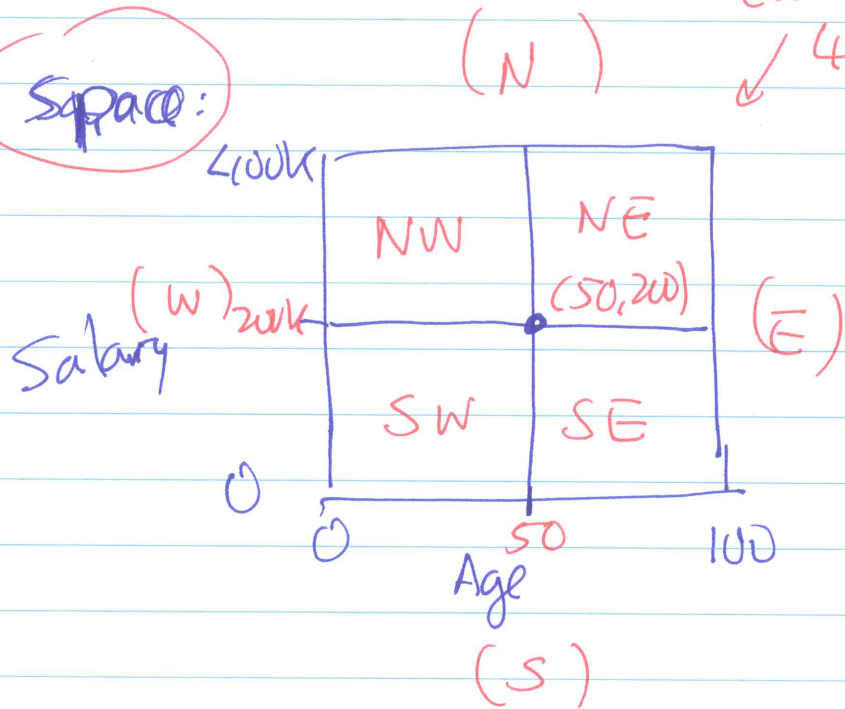
Multi-Dim Indexes (trees)

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Quad-tree:

2-dim. quad tree:

Space:



Example:

Data: (25, 60) (45, 60) (50, 75) (50, 100)
(50, 120) (70, 110) (85, 140) (30, 260)
(25, 400) (45, 350) (50, 275) (60, 260)

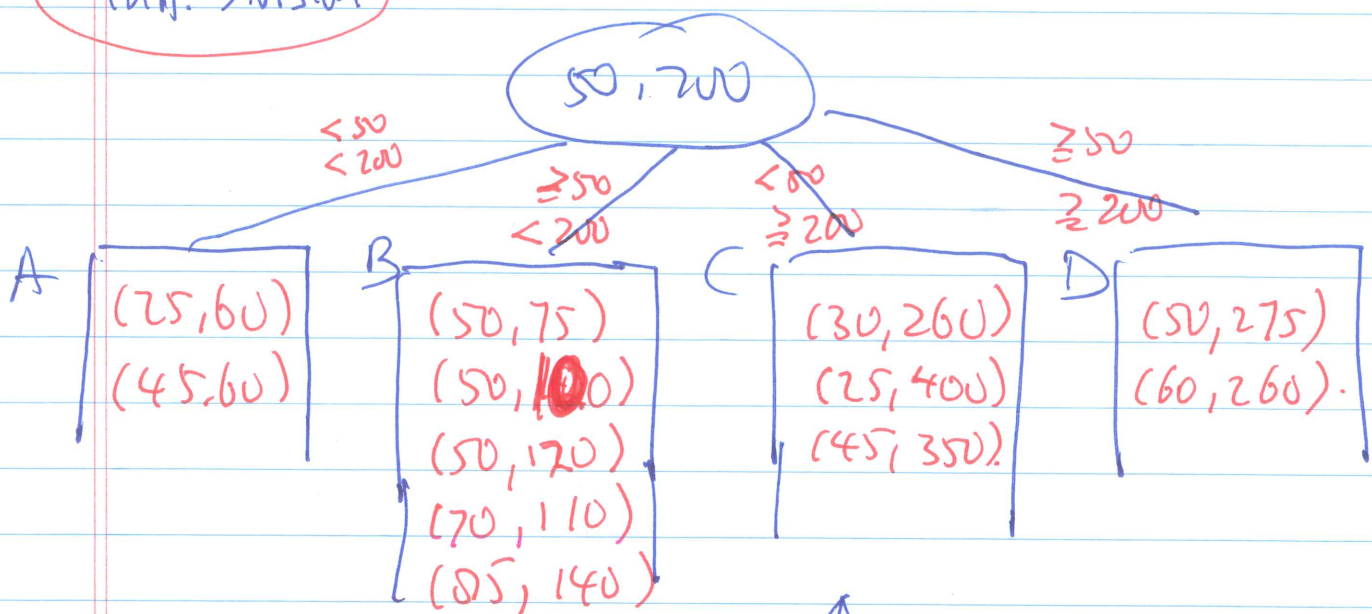
Assume: 2 records per block.

Ranges:

$0 \leq \text{age} \leq 100$
 $0 \leq \text{salary} \leq 400$

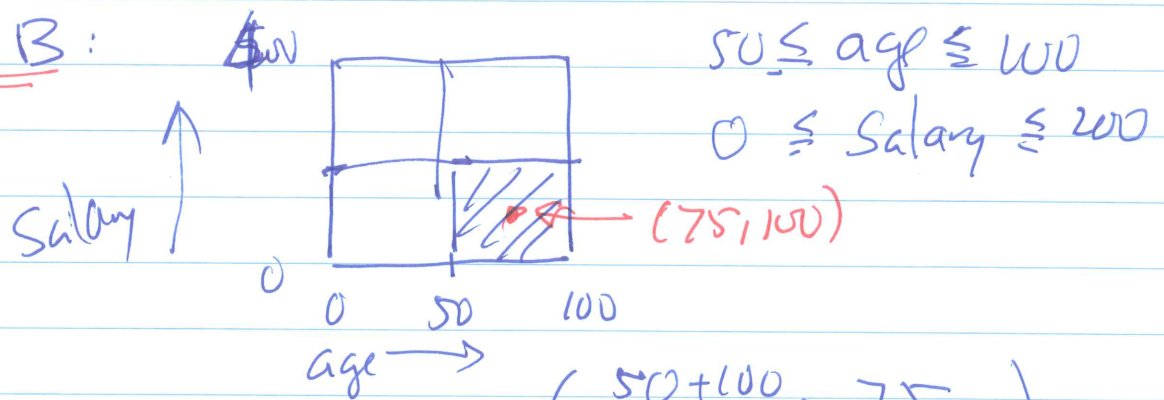
First division: $\frac{0+100}{2} = 50$ (age)
 $\frac{0+400}{2} = 200$ (salary)

Int. Division:

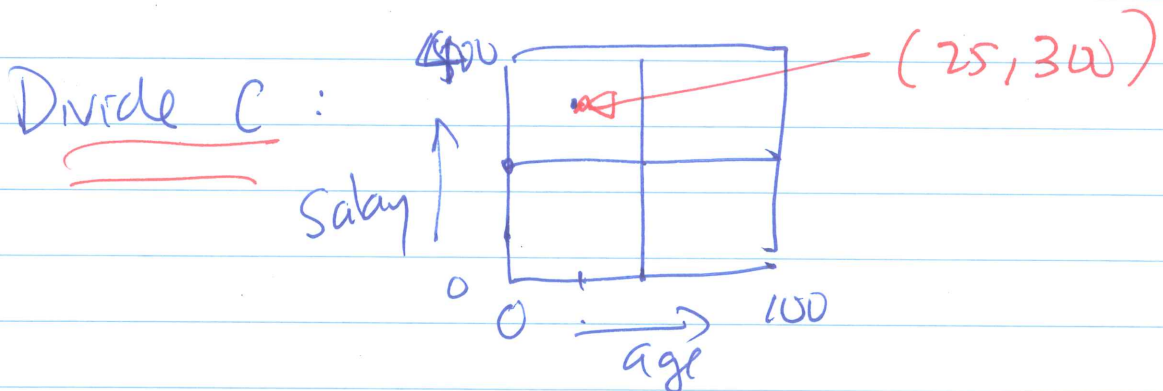


split further.

Divide B:

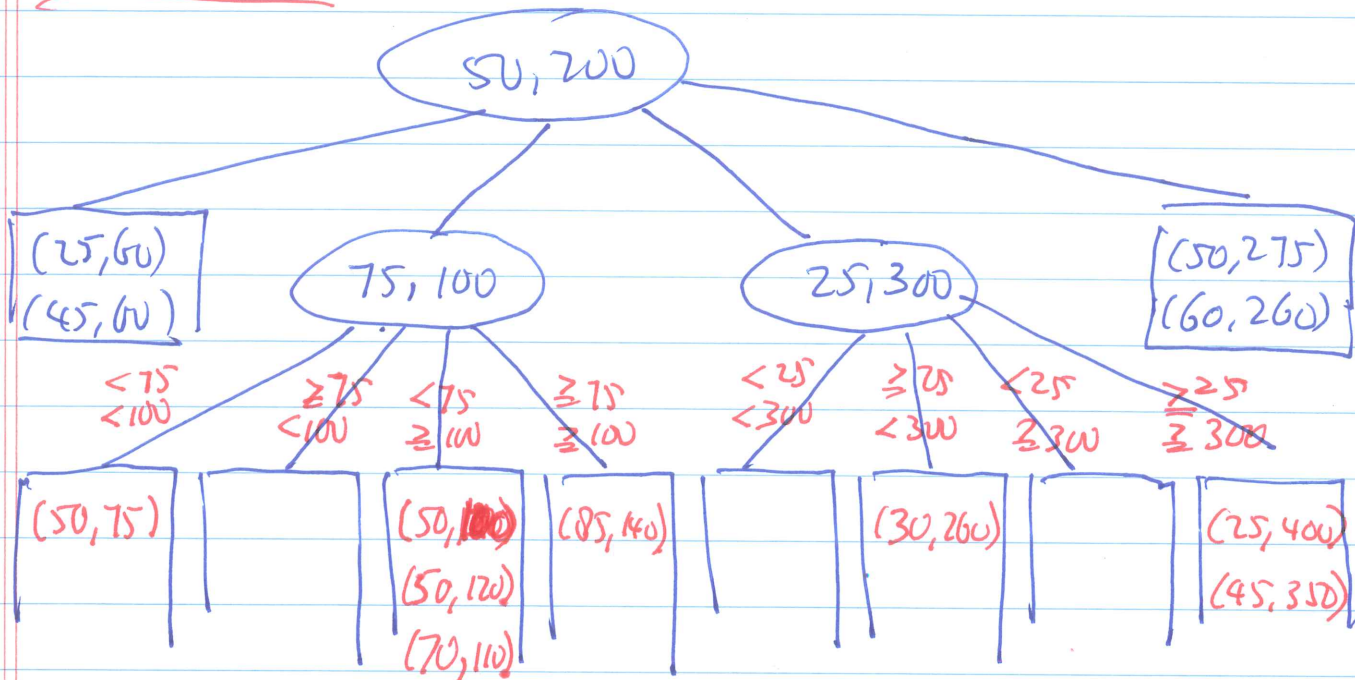


$$\text{mid point} = \left(\begin{array}{l} \frac{50+100}{2} = 75 \\ \frac{0+200}{2} = 100 \end{array} \right)$$
$$= (75, 100)$$



$$\text{mid point} = (25, 300)$$

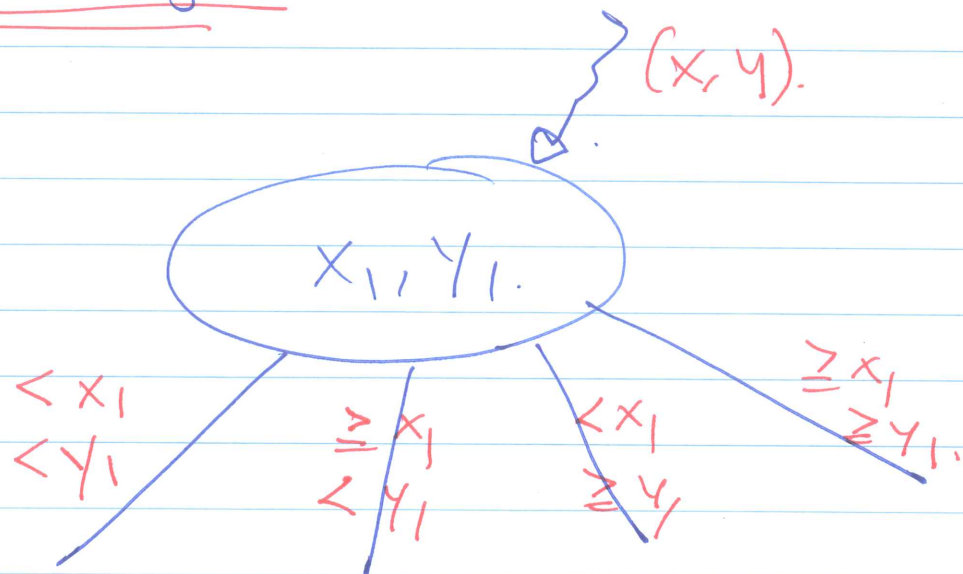
2nd dimension:



Split again.

Not done

Search Algorithm: clear.



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Pick the branch based on
the outcome of:

$x ? x_1$
and $y ? y_1$.

Insert Algorithm: generalization of Bin. Search tree

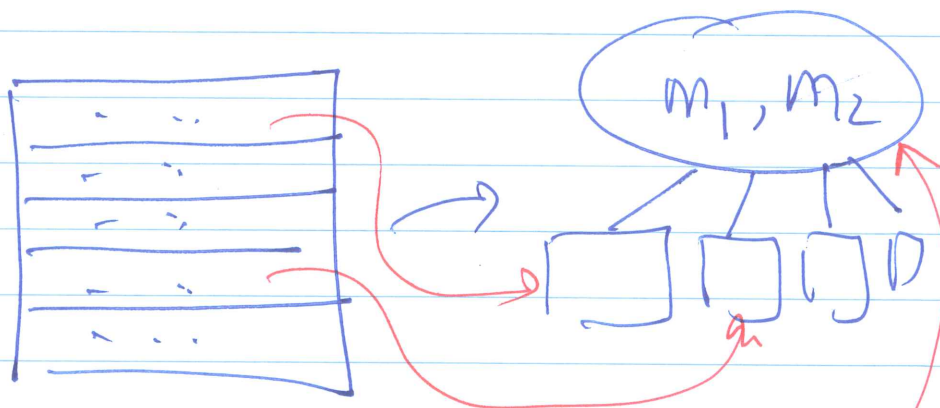
(1) ~~Insert~~ (x, y) :

(A) find leaf node that contains (x, y)

(B) If leaf node (block) has space $\rightarrow$ insert

if leaf node overflows

$\Downarrow$
split node.



(1) find the range of the values

(2) Find middle of each dimension
(m_1, m_2)

(3) Partition tuples (records)
over 4 diff. blocks.

Performance of Quad tree:

Similar to kd-trees