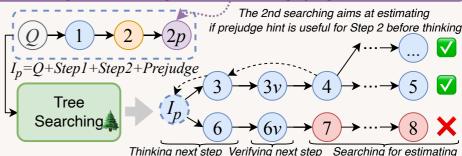**Q:** Three vertices of a cube are $P=(7,12,10)$, $Q=(8,8,1)$, and $R=(11,3,9)$. What is the surface area of the cube? Let's think step by step, and put the final answer within \boxed{}.

① Thought Generating

LLM as a generator

Step1: To find the surface area of the cube, we first must determine the side length of the cube. First, calculate the distance between points P and Q, ...<|think|>

Step2: Using the distance formula, we can find the distance between points \(P \) and \(Q \): ... <|think|>

② Process Estimating

$I=Q+Step1+Step2$

Tree Searching

LLM as a judger

The 1st searching aims at estimating Step 2 can be a prejudge node

$Q \rightarrow 1 \rightarrow 2 \xrightarrow{I}$

$v(I)=1$
$v(3')=1$
$v(5')=1$ ✅
$v(6')=0$ ❌
$v(4')=0$ ❌

③ Reasoning Critiquing

$Q \rightarrow 1 \rightarrow 2 \xrightarrow{I}$

Prejudge Node

Putting all incorrect steps after current reasoning step

LLM as a critic

Error Analysis   Prejudge Hint

④ Prejudge Estimating

Step2-Prejudge: Wait, I need to ensure that the distance calculated between the points is actually the edge length of the cube; it should not be the length of a face diagonal. I should ... <|prejudge|>

The 2nd searching aims at estimating if prejudge hint is useful for Step 2 before thinking

$Q \rightarrow 1 \rightarrow 2 \rightarrow 2p$

$I_p=Q+Step1+Step2+Prejudge$

Tree Searching

I_p

$3 \rightarrow 3v \rightarrow 4 \rightarrow ... \rightarrow$ ✅   ... ✅
$6 \rightarrow 6v \rightarrow 7 \rightarrow ... \rightarrow 8$ ❌

Thinking next step *Verifying next step* *Searching for estimating*

Step3: Distance between P and Q: is \[d_{PQ} = \sqrt{(8 - 7)^2 + (8 - 12)^2 + (1 - 10)^2} = ... = 7\sqrt{2} \] <|think|>

Step3-Verify: Since all distances are equal to \(7\sqrt{2} \), these points ... Thus:\[7\sqrt{2} = a\sqrt{2} \implies a = 7 \]<|verify|>

⑤ Thought Expanding

Expanding rationale with next thinking and verify step

$Q \rightarrow 1 \rightarrow 2 \rightarrow 2p \rightarrow 3 \rightarrow 3v$

$I_{for\_next}=Q+Step1+Step2+Prejudge+Step3+Verify$

② ③ ④ ⑤
② ③ ④ ...

Continual Dynamic Searching Util Finish