function BuildTree$(\theta, r, u, v, j, \epsilon)$
if $j = 0$ **then**
  Base case—take one leapfrog step in the direction v.
  $\theta', r' \leftarrow \text{Leapfrog}(\theta, r, v\epsilon)$.
  $\mathcal{C}' \leftarrow \begin{cases} \{(\theta', r')\} & \text{if } u \leq \exp\{\mathcal{L}(\theta') - \frac{1}{2}r' \cdot r'\} \\ \emptyset & \text{else} \end{cases}$
  $s' \leftarrow \mathbb{I}[\mathcal{L}(\theta') - \frac{1}{2}r' \cdot r' > \log u - \Delta_{\max}]$.
  return $\theta', r', \theta', r', \mathcal{C}', s'$.
else
  Recursion—build the left and right subtrees.
  $\theta^-, r^-, \theta^+, r^+, \mathcal{C}', s' \leftarrow \text{BuildTree}(\theta, r, u, v, j-1, \epsilon)$.
  if $v = -1$ **then**
    $\theta^-, r^-, -, -, \mathcal{C}'', s'' \leftarrow \text{BuildTree}(\theta^-, r^-, u, v, j-1, \epsilon)$.
  else
    $-, -, \theta^+, r^+, \mathcal{C}'', s'' \leftarrow \text{BuildTree}(\theta^+, r^+, u, v, j-1, \epsilon)$.
  end if
  $s' \leftarrow s's''\mathbb{I}[(\theta^+ - \theta^-) \cdot r^- \geq 0]\mathbb{I}[(\theta^+ - \theta^-) \cdot r^+ \geq 0]$.
  $\mathcal{C}' \leftarrow \mathcal{C}' \cup \mathcal{C}''$.
  return $\theta^-, r^-, \theta^+, r^+, \mathcal{C}', s'$.
end if