p[17.85] $random_{p1}$[input] x_1[8] $x_{nearest1}[x_1]$ x_{rand1}[0] x_{new1}[0] e_1[1]

q[16.25] $random_{q1}$[input] y_1[10] $y_{nearest1}[y_1]$ y_{rand1}[0] y_{new1}[0] e_2[0]

e_4[0] d_1^1[0] k[0] e_3[0] δ [0.15]

$$\begin{cases} P_{1-1}: e_1 > \min(p, random_{p1}) \\ \Pr_{1-1}: p * random_{p1} \to 1 \mid x_{rand1} \end{cases}$$

$$\begin{cases} P_{2-1}: e_1 > \min(q, random_{q1}) \\ \Pr_{2-1}: 0 * e_1 + q * random_{q1} \to 1 \mid y_{rand1} \end{cases}$$

$$\begin{cases} P_{3-1}: e_1 > k \\ \Pr_{3-1}: k+1 \to 1 \mid e_2 \end{cases} \quad \begin{cases} P_{5-1}: e_2 > k \\ \Pr_{5-1}: k+1 \to 1 \mid e_3 \end{cases} \quad \begin{cases} P_{8-1}: e_3 > k \\ \Pr_{8-1}: k+1 \to 1 \mid e_4 \end{cases}$$

$$\begin{cases} P_{4-1}: e_2 > \min(x_1, y_1, x_{rand1}, y_{rand1}, k) \\ \Pr_{4-1}: 0 * e_2 + k + (x_1 - x_{rand1})^2 + (x_1 - x_{rand1})^2 \to 1 \mid d_1^1 \end{cases}$$

$$\begin{cases} P_{6-1}: e_3 > \min(k, \delta, x_{nearest1}, x_{rand1}, d_1^1) \\ \Pr_{6-1}: 0 * e_3 + k + x_{nearest1} + \dfrac{\delta * (x_{rand1} - x_{nearest1})}{\sqrt{d_1^1}} \to 1 \mid x_{new1} \end{cases}$$

$$\begin{cases} P_{7-1}: e_3 > \min(k, \delta, y_{nearest1}, y_{rand1}, d_1^1) \\ \Pr_{7-1}: k + y_{nearest1} + \dfrac{\delta * (y_{rand1} - y_{nearest1})}{\sqrt{d_1^1}} \to 1 \mid y_{new1} \end{cases}$$

1

$random_{p2}$[input] x_{rand2}[0] d_{rt1}[0] $x_{nearest2}$[0] x_{new2}[0] e_{18}[0] e_{20}[0] e_{22}[0]

$random_{q2}$[input] y_{rand2}[0] d_{rt2}[0] $y_{nearest2}$[0] y_{new2}[0] e_{19}[0] e_{21}[0] d_1^2[0]

$$\begin{cases} P_{1-18}: e_{17} > \min(p, random_{p2}) \\ \Pr_{1-18}: 0 * e_{17} + p * random_{p2} \to 1 \mid x_{rand2} \end{cases}$$

$$\begin{cases} P_{2-18}: e_{17} > \min(q, random_{q2}) \\ \Pr_{2-18}: q * random_{q2} \to 1 \mid y_{rand2} \end{cases}$$

$$\begin{cases} P_{3-18}: e_{17} > k \\ \Pr_{3-18}: k+1 \to 1 \mid e_{18} \end{cases}$$

$$\begin{cases} P_{4-18}: e_{18} > \min(k, x_1, y_1, x_{rand2}, y_{rand2}) \\ \Pr_{4-18}: 0 * e_{18} + k + (x_1 - x_{rand2})^2 + (y_1 - y_{rand2})^2 \to 1 \mid d_{rt1} \end{cases}$$

$$\begin{cases} P_{5-18}: e_{18} > \min(k, x_{rrt1}, y_{rrt1}, x_{rand2}, y_{rand2}) \\ \Pr_{5-18}: 0 * e_{18} + k + (x_{rrt1} - x_{rand2})^2 + (y_{rrt1} - y_{rand2})^2 \to 1 \mid d_{rt2} \end{cases}$$

$$\begin{cases} P_{6-18}: e_{18} > k \\ \Pr_{6-18}: k+1 \to 1 \mid e_{19} \end{cases}$$

$$\begin{cases} P_{7-18}: e_{19} > \min(x_1, x_{rrt1}) \\ \Pr_{7-18}: 0 * e_{19} + k + \begin{cases} x_1, d_{rt1} < d_{rt2} \\ x_{rrt1}, d_{rt1} \geq d_{rt2} \end{cases} \to 1 \mid x_{nearest2} \end{cases}$$

$$\begin{cases} P_{8-18}: e_{19} > \min(y_1, y_{rrt1}) \\ \Pr_{8-18}: 0 * e_{19} + k + \begin{cases} y_1, d_{rt1} < d_{rt2} \\ y_{rrt1}, d_{rt1} \geq d_{rt2} \end{cases} \to 1 \mid y_{nearest2} \end{cases}$$

$$\begin{cases} P_{9-18}: e_{19} > k \\ \Pr_{9-18}: k+1 \to 1 \mid e_{20} \end{cases}$$

$$\begin{cases} P_{10-18}: e_{20} > \min(k, x_{nearest2}, y_{nearest2}, x_{rand2}, y_{rand2}) \\ \Pr_{10-18}: 0 * e_{20} + k + (x_{nearest2} - x_{rand2})^2 + (y_{nearest2} - y_{rand2})^2 \to 1 \mid d_1^2 \end{cases}$$

$$\begin{cases} P_{11-18}: e_{21} > \min(k, x_{nearest2}, x_{rand2}, d_1^2) \\ \Pr_{11-18}: 0 * e_{21} + k + x_{nearest2} + \dfrac{x_{rand2} - x_{nearest2}}{\sqrt{d_1^2}} \to 1 \mid x_{new2} \end{cases}$$

$$\begin{cases} P_{12-18}: e_{21} > \min(k, y_{nearest2}, y_{rand2}, d_1^2) \\ \Pr_{12-18}: 0 * e_{21} + k + y_{nearest2} + \dfrac{y_{rand2} - y_{nearest2}}{\sqrt{d_1^2}} \to 1 \mid y_{new2} \end{cases}$$

$$\begin{cases} P_{13-18}: e_{21} > k \\ \Pr_{13-18}: k+1 \to 1 \mid e_{22} \end{cases}$$

18

ob_{x1}[input] ob_{y1}[input] e_5[0] e_6[0] e_7[0] e_8[0] e_9[0] psd_1^1[0]

d_{sr}^1[0] d_{no1}^1[0] d_{nb1}^1[0] $u_{2\_1}^1$[0] p_{x1}^1[0] p_{y1}^1[0] d_{po1}^1[0] $u_{1\_1}^1$[0]

$$\begin{cases} P_{1-2}: e_4 > \min(k, ob_{x1}, ob_{y1}, x_{nearest1}, y_{nearest1}, x_{new1}, y_{new1}) \\ \Pr_{1-2}: k + (ob_{x1} - x_{nearest1})(x_{new1} - x_{nearest1}) + (ob_{y1} - y_{nearest1})(y_{new1} - y_{nearest1}) \to 1 \mid u_{1\_1}^1 \end{cases}$$

$$\begin{cases} P_{2-2}: e_4 > \min(k, x_{nearest1}, y_{nearest1}, x_{new1}, y_{new1}) \\ \Pr_{2-2}: 0 * e_4 + k + (x_{new1} - x_{nearest1})^2 + (y_{new1} - y_{nearest1})^2 \to 1 \mid d_{sr}^1 \end{cases}$$

$$\begin{cases} P_{3-2}: e_4 > \min(k, ob_{x1}, ob_{y1}, x_{nearest1}, y_{nearest1}) \\ \Pr_{3-2}: k + (x_{nearest1} - ob_{x1})^2 + (y_{nearest1} - ob_{y1})^2 \to 1 \mid d_{no1}^1 \end{cases} \quad \begin{cases} P_{12-2}: e_7 > k \\ \Pr_{12-2}: k+1 \to 1 \mid e_8 \end{cases}$$

$$\begin{cases} P_{4-2}: e_4 > \min(k, ob_{x1}, ob_{y1}, x_{new1}, y_{new1}) \\ \Pr_{4-2}: k + (x_{new1} - ob_{x1})^2 + (y_{new1} - ob_{y1})^2 \to 1 \mid d_{nb1}^1 \end{cases}$$

$$\begin{cases} P_{5-2}: e_4 > k \\ \Pr_{5-2}: k+1 \to 1 \mid e_5 \end{cases} \quad \begin{cases} P_{7-2}: e_5 > k \\ \Pr_{7-2}: k+1 \to 1 \mid e_6 \end{cases} \quad \begin{cases} P_{10-2}: e_6 > k \\ \Pr_{10-2}: k+1 \to 1 \mid e_7 \end{cases}$$

$$\begin{cases} P_{6-2}: e_5 > \min(k, u_{1\_1}^1, d_{sr}^1) \\ \Pr_{6-2}: 0 * e_5 + k + \dfrac{u_{1\_1}^1}{d_{sr}^1} \to 1 \mid u_{2\_1}^1 \end{cases} \quad \begin{cases} P_{13-2}: e_8 > \min(k, d_{no1}^1, d_{nb1}^1, d_{po1}^1) \\ \Pr_{13-2}: 0 * e_8 + k + \begin{cases} d_{no1}^1, u_{2\_1}^1 < 0 \\ d_{nb1}^1, u_{2\_1}^1 > 1 \to 1 \mid psd_1^1 \\ d_{po1}^1, else \end{cases} \end{cases}$$

$$\begin{cases} P_{8-2}: e_6 > \min(k, x_{nearest1}, x_{new1}, u_{2\_1}^1) \\ \Pr_{8-2}: k + x_{nearest1} + u_{2\_1}^1 * (x_{new1} - x_{nearest1}) \to 1 \mid p_{x1}^1 \end{cases}$$

$$\begin{cases} P_{9-2}: e_6 > \min(k, y_{nearest1}, y_{new1}, u_{2\_1}^1) \\ \Pr_{9-2}: 0 * e_6 + k + y_{nearest1} + u_{2\_1}^1 * (y_{new1} - y_{nearest1}) \to 1 \mid p_{y1}^1 \end{cases} \quad \begin{cases} P_{14-2}: e_8 > k \\ \Pr_{14-2}: k+1 \to 1 \mid e_9 \end{cases}$$

$$\begin{cases} P_{11-2}: e_7 > \min(k, ob_{x1}, ob_{y1}, p_{x1}^1, p_{y1}^1) \\ \Pr_{11-2}: 0 * e_7 + k + (p_{x1}^1 - ob_{x1})^2 + (p_{y1}^1 - ob_{y1})^2 \to 1 \mid d_{po1}^1 \end{cases}$$

2

$u_{1\_1}^2$[0] d_{sr}^2[0] d_{no1}^2[0] d_{nb1}^2[0] $u_{2\_1}^2$[0] p_{x1}^2[0] p_{y1}^2[0] d_{po1}^2[0] psd_1^2[0] e_{23}[0] e_{24}[0] e_{25}[0] e_{26}[0]

e_{27}[0]

$$\begin{cases} P_{1-19}: e_{22} > \min(k, ob_{x1}, ob_{y1}, x_{new2}, y_{new2}, x_{nearest2}, y_{nearest2}) \\ \Pr_{1-19}: k + (ob_{x1} - x_{nearest2})(x_{new2} - x_{nearest2}) + (ob_{y1} - y_{nearest2})(y_{new2} - y_{nearest2}) \to 1 \mid u_{1\_1}^2 \end{cases}$$

$$\begin{cases} P_{2-19}: e_{22} > \min(k, x_{new2}, y_{new2}, x_{nearest2}, y_{nearest2}) \\ \Pr_{2-19}: 0 * e_{22} + k + (x_{new2} - x_{nearest2})^2 + (y_{new2} - y_{nearest2})^2 \to 1 \mid d_{sr}^2 \end{cases}$$

$$\begin{cases} P_{3-19}: e_{22} > \min(k, ob_{x1}, ob_{x2}, x_{nearest2}, y_{nearest2}) \\ \Pr_{3-19}: k + (x_{nearest2} - ob_{x1})^2 + (y_{nearest2} - ob_{y1})^2 \to 1 \mid d_{no1}^2 \end{cases}$$

$$\begin{cases} P_{4-19}: e_{22} > \min(k, ob_{x1}, ob_{x2}, x_{new2}, y_{new2}) \\ \Pr_{4-19}: k + (x_{new2} - ob_{x1})^2 + (y_{new2} - ob_{y1})^2 \to 1 \mid d_{nb1}^2 \end{cases}$$

$$\begin{cases} P_{5-19}: e_{22} > k \\ \Pr_{5-19}: k+1 \to 1 \mid e_{23} \end{cases} \quad \begin{cases} P_{14-19}: e_{26} > k \\ \Pr_{14-19}: k+1 \to 1 \mid e_{27} \end{cases}$$

$$\begin{cases} P_{6-19}: e_{23} > \min(k, u_{1\_1}^2, d_{sr}^2) \\ \Pr_{6-19}: 0 * e_{23} + k + \dfrac{u_{1\_1}^2}{d_{sr}^2} \to 1 \mid u_{2\_1}^2 \end{cases}$$

$$\begin{cases} P_{7-19}: e_{23} > k \\ \Pr_{7-19}: k+1 \to 1 \mid e_{24} \end{cases} \quad \begin{cases} P_{12-19}: e_{25} > k \\ \Pr_{12-19}: k+1 \to 1 \mid e_{26} \end{cases}$$

$$\begin{cases} P_{8-19}: e_{24} > \min(k, x_{new2}, x_{nearest2}, u_{2\_1}^2) \\ \Pr_{8-19}: k + x_{nearest2} + u_{2\_1}^2 * (x_{new2} - x_{nearest2}) \to 1 \mid p_{x1}^2 \end{cases}$$

$$\begin{cases} P_{9-19}: e_{24} > \min(k, y_{new2}, y_{nearest2}, u_{2\_1}^2) \\ \Pr_{9-19}: 0 * e_{24} + k + y_{nearest2} + u_{2\_1}^2 * (y_{new2} - y_{nearest2}) \to 1 \mid p_{y1}^2 \end{cases}$$

$$\begin{cases} P_{10-19}: e_{24} > k \\ \Pr_{10-19}: k+1 \to 1 \mid e_{25} \end{cases}$$

$$\begin{cases} P_{11-19}: e_{25} > \min(k, p_{x1}^2, p_{y1}^2, ob_{x1}, ob_{y1}) \\ \Pr_{11-19}: 0 * e_{25} + k + (p_{x1}^2 - ob_{x1})^2 + (p_{y1}^2 - ob_{y1})^2 \to 1 \mid d_{po1}^2 \end{cases}$$

$$\begin{cases} P_{13-19}: e_{26} > \min(k, d_{no1}^2, d_{nb1}^2, d_{po1}^2) \\ \Pr_{13-19}: 0 * e_{26} + k + \begin{cases} d_{no1}^2, u_{2\_1}^2 < 0 \\ d_{nb1}^2, u_{2\_1}^2 > 1 \to 1 \mid psd_1^2 \\ d_{po1}^2, else \end{cases} \end{cases}$$

19

$u_{1\_1}^2$[0] d_{no8}^2[0] d_{nb8}^2[0] $u_{2\_8}^2$[0] p_{x8}^2[0] p_{y8}^2[0] d_{po8}^2[0] psd_8^2[0]

$$\begin{cases} P_{1-26}: e_{22} > \min(k, ob_{x8}, ob_{y8}, x_{nearest2}, y_{nearest2}, x_{new2}, y_{new2}) \\ \Pr_{1-26}: k + (ob_{x8} - x_{nearest2})(x_{new2} - x_{nearest2}) + (ob_{y8} - y_{nearest2})(y_{new2} - y_{nearest2}) \to 1 \mid u_{1\_8}^2 \end{cases}$$

$$\begin{cases} P_{2-26}: e_{22} > \min(k, ob_{x8}, ob_{x8}, x_{nearest2}, y_{nearest2}) \\ \Pr_{2-26}: k + (x_{nearest2} - ob_{x8})^2 + (y_{nearest2} - ob_{y8})^2 \to 1 \mid d_{no8}^2 \end{cases} \quad \begin{cases} P_{6-26}: e_{24} > \min(k, y_{new2}, y_{nearest2}, u_{2\_8}^2) \\ \Pr_{6-26}: 0 * e_{24} + k + y_{nearest2} + u_{2\_8}^2 * (y_{new2} - y_{nearest2}) \to 1 \mid p_{y8}^2 \end{cases}$$

$$\begin{cases} P_{3-26}: e_{22} > \min(k, ob_{x8}, ob_{x8}, x_{new2}, y_{new2}) \\ \Pr_{3-26}: k + (x_{new2} - ob_{x8})^2 + (y_{new2} - ob_{y8})^2 \to 1 \mid d_{nb8}^2 \end{cases} \quad \begin{cases} P_{7-26}: e_{25} > \min(k, p_{x8}^2, p_{y8}^2, ob_{x8}, ob_{y8}) \\ \Pr_{7-26}: 0 * e_{25} + k + (p_{x8}^2 - ob_{x8})^2 + (p_{y8}^2 - ob_{y8})^2 \to 1 \mid d_{po8}^2 \end{cases}$$

$$\begin{cases} P_{4-26}: e_{23} > \min(k, u_{1\_8}^2, d_{sr}^2) \\ \Pr_{4-26}: 0 * e_{23} + k + \dfrac{u_{1\_8}^2}{d_{sr}^2} \to 1 \mid u_{2\_8}^2 \end{cases}$$

$$\begin{cases} P_{5-26}: e_{24} > \min(k, x_{new2}, x_{nearest2}, u_{2\_8}^2) \\ \Pr_{5-26}: k + x_{nearest2} + u_{2\_8}^2 * (x_{new2} - x_{nearest2}) \to 1 \mid p_{x8}^2 \end{cases}$$

$$\begin{cases} P_{8-26}: e_{26} > \min(k, d_{no8}^2, d_{nb8}^2, d_{po8}^2) \\ \Pr_{8-26}: 0 * e_{26} + k + \begin{cases} d_{no8}^2, u_{2\_8}^2 < 0 \\ d_{nb8}^2, u_{2\_8}^2 > 1 \to 1 \mid psd_8^2 \\ d_{po8}^2, else \end{cases} \end{cases}$$

26

ob_{x8}[input] ob_{y8}[input] $u_{1\_8}^1$[0] d_{no8}^1[0] d_{nb8}^1[0] $u_{2\_8}^1$[0] p_{x8}^1[0]

p_{y8}^1[0] d_{po8}^1[0]

$$\begin{cases} P_{1-9}: e_4 > \min(k, ob_{x8}, ob_{y8}, x_{nearest8}, y_{nearest8}, x_{new8}, y_{new8}) \\ \Pr_{1-9}: k + (ob_{x8} - x_{nearest1})(x_{new1} - x_{nearest1}) + (ob_{y8} - y_{nearest1})(y_{new1} - y_{nearest1}) \to 1 \mid u_{1\_8}^1 \end{cases}$$

$$\begin{cases} P_{2-9}: e_4 > \min(k, ob_{x8}, ob_{y8}, x_{nearest1}, y_{nearest1}) \\ \Pr_{2-9}: k + (x_{nearest1} - ob_{x8})^2 + (y_{nearest1} - ob_{y8})^2 \to 1 \mid d_{no8}^1 \end{cases}$$

psd_8^1[0]

$$\begin{cases} P_{3-9}: e_4 > \min(k, ob_{x8}, ob_{y8}, x_{new1}, y_{new1}) \\ \Pr_{3-9}: k + (x_{new1} - ob_{x8})^2 + (y_{new1} - ob_{y8})^2 \to 1 \mid d_{nb8}^1 \end{cases}$$

$$\begin{cases} P_{4-9}: e_5 > \min(k, d_{sr}^1, u_{1-8}^1) \\ \Pr_{4-9}: 0 * e_5 + k + \dfrac{u_{1-8}^1}{d_{sr}^1} \to 1 \mid u_{2\_8}^1 \end{cases} \quad \begin{cases} P_{8-9}: e_8 > \min(k, d_{no8}^1, d_{nb8}^1, d_{po8}^1) \\ \Pr_{8-9}: 0 * e_8 + k + \begin{cases} d_{no8}^1, u_{2\_8}^1 < 0 \\ d_{nb8}^1, u_{2\_8}^1 > 1 \to 1 \mid psd_8^1 \\ d_{po8}^1, else \end{cases} \end{cases}$$

$$\begin{cases} P_{5-9}: e_6 > \min(k, x_{nearest1}, x_{new1}, u_{2\_8}^1) \\ \Pr_{5-9}: k + x_{nearest1} + u_{2\_8}^1 * (x_{new1} - x_{nearest1}) \to 1 \mid p_{x8}^1 \end{cases}$$

$$\begin{cases} P_{6-9}: e_6 > \min(k, y_{nearest1}, y_{new1}, u_{2\_8}^1) \\ \Pr_{6-9}: 0 * e_6 + k + y_{nearest1} + u_{2\_8}^1 * (y_{new1} - y_{nearest1}) \to 1 \mid p_{y8}^1 \end{cases}$$

$$\begin{cases} P_{7-9}: e_7 > \min(k, ob_{x8}, ob_{y8}, p_{x8}^1, p_{y8}^1) \\ \Pr_{7-9}: 0 * e_7 + k + (p_{x8}^1 - ob_{x8})^2 + (p_{y8}^1 - ob_{y8})^2 \to 1 \mid d_{po8}^1 \end{cases}$$

9

sd_1^2[0] sd_2^2[0] sd_3^2[0] sd_4^2[0] e_{28}[0]

$$\begin{cases} P_{1-27}: e_{27} > \min(k, psd_1^2) \\ \Pr_{1-27}: 0 * e_{27} + k + psd_1^2 \to 1 \mid sd_1^2 \end{cases} \quad \begin{cases} P_{4-27}: e_{27} > \min(k, psd_4^2) \\ \Pr_{4-27}: 0 * e_{27} + k + psd_4^2 \to 1 \mid sd_4^2 \end{cases}$$

$$\begin{cases} P_{2-27}: e_{27} > \min(k, psd_2^2) \\ \Pr_{2-27}: 0 * e_{27} + k + psd_2^2 \to 1 \mid sd_2^2 \end{cases} \quad \begin{cases} P_{5-27}: e_{27} > k \\ \Pr_{5-27}: k+1 \to 1 \mid e_{28} \end{cases}$$

$$\begin{cases} P_{3-27}: e_{27} > \min(k, psd_3^2) \\ \Pr_{3-27}: 0 * e_{27} + k + psd_3^2 \to 1 \mid sd_3^2 \end{cases}$$

27

sd_{12}^2[0] sd_{22}^2[0] e_{30}[0]

$$\begin{cases} P_{1-29}: e_{29} > \min(k, sd_1^2) \\ \Pr_{1-29}: 0 * e_{29} + k + sd_1^2 \to 1 \mid sd_{12}^2 \end{cases}$$

$$\begin{cases} P_{2-29}: e_{29} > \min(k, sd_2^2) \\ \Pr_{2-29}: 0 * e_{29} + k + sd_2^2 \to 1 \mid sd_{22}^2 \end{cases}$$

$$\begin{cases} P_{3-29}: e_{29} > k \\ \Pr_{3-29}: k+1 \to 1 \mid e_{30} \end{cases}$$

29

e_{29}[0]

$$\begin{cases} P_{1-28}: sd_1^2 > psd_5^2 \\ \Pr_{1-28}: 0 * sd_1^2 + psd_5^2 \to 1 \mid sd_1^1 \end{cases} \quad \begin{cases} P_{4-28}: sd_4^2 > psd_8^2 \\ \Pr_{4-28}: 0 * sd_4^2 + psd_8^2 \to 1 \mid sd_4^2 \end{cases}$$

$$\begin{cases} P_{2-28}: sd_2^2 > psd_6^2 \\ \Pr_{2-28}: 0 * sd_2^2 + psd_6^2 \to 1 \mid sd_2^2 \end{cases} \quad \begin{cases} P_{5-28}: e_{28} > k \\ \Pr_{5-28}: k+1 \to 1 \mid e_{29} \end{cases}$$

$$\begin{cases} P_{3-28}: sd_3^2 > psd_7^2 \\ \Pr_{3-28}: 0 * sd_3^2 + psd_7^2 \to 1 \mid sd_3^2 \end{cases}$$

28

e_{31}[0]

$$\begin{cases} P_{1-30}: sd_{12}^2 > sd_3^2 \\ \Pr_{1-30}: 0 * sd_{12}^2 + sd_3^2 \to 1 \mid sd_{12}^2 \end{cases}$$

$$\begin{cases} P_{2-30}: sd_{22}^2 > sd_4^2 \\ \Pr_{2-30}: 0 * sd_{22}^2 + sd_4^2 \to 1 \mid sd_{22}^2 \end{cases}$$

$$\begin{cases} P_{3-30}: e_{30} > k \\ \Pr_{3-30}: k+1 \to 1 \mid e_{31} \end{cases}$$

30

sd_3^2[0] e_{32}[0]

$$\begin{cases} P_{1-31}: e_{31} > \min(k, sd_{12}^2) \\ \Pr_{1-31}: 0 * e_{31} + k + sd_{12}^2 \to 1 \mid sd_{13}^2 \end{cases}$$

$$\begin{cases} P_{2-31}: e_{31} > k \\ \Pr_{2-31}: k+1 \to 1 \mid e_{32} \end{cases}$$

31

e_{33}[0]

$$\begin{cases} P_{1-32}: sd_{13}^2 > sd_{22}^2 \\ \Pr_{1-32}: 0 * sd_{13}^2 + sd_{22}^2 \to 1 \mid sd_{13}^2 \end{cases}$$

$$\begin{cases} P_{2-32}: e_{32} > k \\ \Pr_{2-32}: k+1 \to 1 \mid e_{33} \end{cases}$$

32

$collison_2$[0] e_{34}[0] e_{35}[0] $stop$[0]

$$\begin{cases} P_{1-33}: e_{33} > \min(k, \xi, sd_{13}^2) \\ \Pr_{1-33}: 0 * e_{33} + k + \xi - sd_{13}^2 \to 1 \mid collision_2 \end{cases} \quad \begin{cases} P_{3-33}: e_{34} > k \\ \Pr_{3-33}: 0 * e_{34} + k + 1 \to \begin{cases} 1 \mid e_{17}, collision_2 \geq 0 \\ 1 \mid e_{35}, collision_2 < 0 \end{cases} \end{cases}$$

$$\begin{cases} P_{2-33}: e_{33} > k \\ \Pr_{2-33}: k+1 \to 1 \mid e_{34} \end{cases} \quad \begin{cases} P_{4-33}: e_{35} > k \\ \Pr_{4-33}: 0 * e_{35} + k + 1 \to 1 \mid stop \end{cases}$$

33

sd_1^1[0] sd_2^1[0] sd_3^1[0] sd_4^1[0] e_{10}[0]

$$\begin{cases} P_{1-10}: e_9 > \min(k, psd_1^1) \\ \Pr_{1-10}: 0 * e_9 + k + psd_1^1 \to 1 \mid sd_1^1 \end{cases} \quad \begin{cases} P_{5-10}: e_9 > k \\ \Pr_{5-10}: k+1 \to 1 \mid e_{10} \end{cases}$$

$$\begin{cases} P_{2-10}: e_9 > \min(k, psd_2^1) \\ \Pr_{2-10}: 0 * e_9 + k + psd_2^1 \to 1 \mid sd_2^1 \end{cases} \quad \begin{cases} P_{4-10}: e_9 > \min(k, psd_4^1) \\ \Pr_{4-10}: 0 * e_9 + k + psd_4^1 \to 1 \mid sd_4^1 \end{cases}$$

$$\begin{cases} P_{3-10}: e_9 > \min(k, psd_3^1) \\ \Pr_{3-10}: 0 * e_9 + k + psd_3^1 \to 1 \mid sd_3^1 \end{cases}$$

10

sd_{12}^1[0] sd_{22}^1[0] e_{12}[0]

$$\begin{cases} P_{1-12}: e_{11} > \min(k, sd_1^1) \\ \Pr_{1-12}: 0 * e_{11} + k + sd_1^1 \to 1 \mid sd_{12}^1 \end{cases}$$

$$\begin{cases} P_{2-12}: e_{11} > \min(k, sd_2^1) \\ \Pr_{2-12}: 0 * e_{11} + k + sd_2^1 \to 1 \mid sd_{22}^1 \end{cases}$$

$$\begin{cases} P_{3-12}: e_{11} > k \\ \Pr_{3-12}: k+1 \to 1 \mid e_{12} \end{cases}$$

12

e_{11}[0]

$$\begin{cases} P_{1-11}: sd_1^1 > psd_5^1 \\ \Pr_{1-11}: 0 * sd_1^1 + psd_5^1 \to 1 \mid sd_1^1 \end{cases} \quad \begin{cases} P_{4-11}: sd_4^1 > psd_8^1 \\ \Pr_{4-11}: 0 * sd_4^1 + psd_8^1 \to 1 \mid sd_4^1 \end{cases}$$

$$\begin{cases} P_{2-11}: sd_2^1 > psd_6^1 \\ \Pr_{2-11}: 0 * sd_2^1 + psd_6^1 \to 1 \mid sd_2^1 \end{cases} \quad \begin{cases} P_{5-11}: e_{10} > k \\ \Pr_{5-11}: k+1 \to 1 \mid e_{11} \end{cases}$$

$$\begin{cases} P_{3-11}: sd_3^1 > psd_7^1 \\ \Pr_{3-11}: 0 * sd_3^1 + psd_7^1 \to 1 \mid sd_3^1 \end{cases}$$

11

e_{13}[0]

$$\begin{cases} P_{1-13}: sd_{12}^1 > sd_3^1 \\ \Pr_{1-13}: 0 * sd_{12}^1 + sd_3^1 \to 1 \mid sd_{12}^1 \end{cases}$$

$$\begin{cases} P_{2-13}: sd_{22}^1 > sd_4^1 \\ \Pr_{2-13}: 0 * sd_{22}^1 + sd_4^1 \to 1 \mid sd_{22}^1 \end{cases}$$

$$\begin{cases} P_{3-13}: e_{12} > k \\ \Pr_{3-13}: k+1 \to 1 \mid e_{13} \end{cases}$$

13

e_{15}[0]

$$\begin{cases} P_{1-15}: sd_{13}^1 > sd_{22}^1 \\ \Pr_{1-15}: 0 * sd_{13}^1 + sd_{22}^1 \to 1 \mid sd_{13}^1 \end{cases} \quad \begin{cases} P_{2-15}: e_{14} > k \\ \Pr_{2-15}: k+1 \to 1 \mid e_{15} \end{cases}$$

15

sd_3^1[0] e_{14}[0]

$$\begin{cases} P_{1-14}: e_{13} > \min(k, sd_{12}^1) \\ \Pr_{1-14}: 0 * e_{13} + k + sd_{12}^1 \to 1 \mid sd_{13}^1 \end{cases}$$

$$\begin{cases} P_{2-14}: e_{13} > k \\ \Pr_{2-14}: k+1 \to 1 \mid e_{14} \end{cases}$$

14

$collison_1$[0] e_{16}[0] e_{17}[0] ξ[0.04]

$$\begin{cases} P_{1-16}: e_{15} > \min(k, \xi, sd_{13}^1) \\ \Pr_{1-16}: 0 * e_{15} + k + \xi - sd_{13}^1 \to 1 \mid collision_1 \end{cases} \quad \begin{cases} P_{2-16}: e_{15} > k \\ \Pr_{2-16}: k+1 \to 1 \mid e_{16} \end{cases}$$

$$\begin{cases} P_{3-16}: e_{16} > k \\ \Pr_{3-16}: 0 * e_{16} + k + 1 \to \begin{cases} 1 \mid e_1, collision_1 \geq 0 \\ 1 \mid e_{17}, collision_1 < 0 \end{cases} \end{cases}$$

16

x_{rrt1}[0] y_{rrt1}[0]

$$\begin{cases} P_{1-17}: e_{17} > \min(k, x_{new1}) \\ \Pr_{1-17}: k + x_{new1} \to 1 \mid x_{rrt1} \end{cases} \quad \begin{cases} P_{3-17}: e_{17} > k \\ \Pr_{3-17}: k+1 \to 1 \mid e_{18} \end{cases}$$

$$\begin{cases} P_{2-17}: e_{17} > \min(k, y_{new1}) \\ \Pr_{2-17}: 0 * e_{17} + k + y_{new1} \to 1 \mid y_{rrt1} \end{cases}$$

17

34