(b) Priority discipline

Table 3. 2: System parameter list of PCCP with priority discipline

Parameters	Description
$\boldsymbol{\lambda_L}$	Arrival rate of LBER packets at the queue
$\boldsymbol{\lambda_H}$	Arrival rate of HBER packets at the queue
$\boldsymbol{\gamma}$	The probability of good channel in each time slot

3.1.2 State balance equations

The system is modeled as a four-dimensional discrete time Markov chain with state (i, j, x, y), for both FIFO and priority disciplines, where i presents the number of LBER packets in queue, j presents the number of HBER packets in queue, x presents the channel state, and y presents the server state. While $x = 0$ means the channel state is bad (state 0), and $x = 1$ means the channel state is good (state 1). And $y = 0$ means there is no one in server, $y = 1$ means the LBER packet in server, and $y = 2$ means the HBER packet in server. The steady sate probability of the model is described as $\pi(i, j, x, y)$; thus, the state space can be denoted as follows:

$$S = \{(i, j, x, y) |\ 0 \leq i \leq Q, 0 \leq j \leq Q - i, 0 \leq x \leq 1, 0 \leq y \leq 2\} \qquad (3-2)$$

Hence, the number of feasible states is as follows:

$$|S| = 3(Q + 1)(Q + 2) \qquad (3-3)$$

As an example, if Q is equal to 20, we can see the total number of feasible states is 1386. For both FIFO and priority disciplines, the feasible states can be classified into 32 cases as below.

(a) First-In-First-Out

Case 1： $i = 0, j = 0, x = 0, y = 0$

$$\pi_{0,0,0,0} = (1 - \lambda_L - \lambda_H)(1 - \gamma)\, \pi_{0,0,0,0} + (1 - \lambda_L - \lambda_H)(1 - \gamma)\pi_{0,0,1,0} + (1 - \lambda_L - \lambda_H)(1 - \gamma)\pi_{0,0,1,1} + (1 - \lambda_L - \lambda_H)(1 - \gamma)\pi_{0,0,1,2}$$

Case 2 : $0 \le i \le K-2, 0 \le j \le K-i-2, x=0, y=1$

$$
\begin{aligned}
\pi_{i,j,0,1} = {} & \lambda_L(1-\gamma)\pi_{0,0,0,0} + (1-\lambda_L-\lambda_H)(1-\gamma)\,\pi_{i,j,0,1} + \lambda_L(1-\gamma)\pi_{i-1,j,0,1} \\
& + \lambda_H(1-\gamma)\pi_{i,j-1,0,1} + \lambda_L(1-\gamma)\pi_{0,0,1,0} + \lambda_L(1-\gamma)\pi_{0,0,1,1} \\
& + \lambda_L(1-\gamma)\pi_{0,0,1,2} + (1-\lambda_L-\lambda_H)(1-\gamma)\,\pi_{i+1,0,1,1} \\
& + \lambda_L(1-\gamma)\pi_{i,0,1,1} + \lambda_H(1-\gamma)\pi_{i+1,0,1,1} \\
& + (1-\lambda_L-\lambda_H)(1-\gamma)\,\pi_{i+1,0,1,2} + \lambda_L(1-\gamma)\pi_{i,0,1,2} \\
& + \lambda_H(1-\gamma)\pi_{i+1,0,1,2} + \beta(1-\lambda_L-\lambda_H)(1-\gamma)\,\pi_{i+1,j,1,1} \\
& + \beta\lambda_L(1-\gamma)\pi_{i,j,1,1} + \beta\lambda_H(1-\gamma)\pi_{i+1,j-1,1,1} \\
& + \beta(1-\lambda_L-\lambda_H)(1-\gamma)\,\pi_{i+1,j,1,2} + \beta\lambda_L(1-\gamma)\pi_{i,j,1,2} \\
& + \beta\lambda_H(1-\gamma)\pi_{i+1,j-1,1,2}
\end{aligned}
$$

Case 3 : $0 \le i \le K-2, 0 \le j \le K-i-2, x=0, y=2$

$$
\begin{aligned}
\pi_{i,j,0,1} = {} & \lambda_H(1-\gamma)\pi_{0,0,0,0} + (1-\lambda_L-\lambda_H)(1-\gamma)\,\pi_{i,j,0,2} + \lambda_L(1-\gamma)\pi_{i-1,j,0,2} \\
& + \lambda_H(1-\gamma)\pi_{i,j-1,0,2} + \lambda_H(1-\gamma)\pi_{0,0,1,0} + \lambda_H(1-\gamma)\pi_{0,0,1,1} \\
& + \lambda_H(1-\gamma)\pi_{0,0,1,2} + (1-\lambda_L-\lambda_H)(1-\gamma)\,\pi_{0,j+1,1,1} \\
& + \lambda_L(1-\gamma)\pi_{0,j+1,1,1} + \lambda_H(1-\gamma)\pi_{0,j,1,1} \\
& + (1-\lambda_L-\lambda_H)(1-\gamma)\,\pi_{0,j+1,1,2} + \lambda_L(1-\gamma)\pi_{0,j+1,1,2} \\
& + \lambda_H(1-\gamma)\pi_{0,j,1,2} + (1-\beta)(1-\lambda_L-\lambda_H)(1-\gamma)\,\pi_{i,j+1,1,1} + (1 \\
& - \beta)\lambda_L(1-\gamma)\pi_{i-1,j+1,1,1} + (1-\beta)\lambda_H(1-\gamma)\pi_{i,j,1,1} + (1 \\
& - \beta)(1-\lambda_L-\lambda_H)(1-\gamma)\,\pi_{i,j+1,1,2} + (1-\beta)\lambda_L(1-\gamma)\pi_{i-1,j+1,1,2} \\
& + (1-\beta)\lambda_H(1-\gamma)\pi_{i,j,1,2}
\end{aligned}
$$

Case 4 : $0 \le i \le K-1, j=K-i-1, x=0, y=1$

$$
\begin{aligned}
\pi_{i,j,0,1} = {} & (1-\gamma)\,\pi_{i,j,0,1} + \lambda_L(1-\gamma)\pi_{i-1,j,0,1} + \lambda_H(1-\gamma)\pi_{i,j-1,0,1} \\
& + \beta\lambda_L(1-\gamma)\pi_{i,j,1,1} + \beta\lambda_H(1-\gamma)\pi_{i+1,j-1,1,1} + \beta\lambda_L(1-\gamma)\pi_{i,j,1,2} \\
& + \beta\lambda_H(1-\gamma)\pi_{i+1,j-1,1,2}
\end{aligned}
$$

Case 5 : $0 \leq i \leq K-1, j = K-i-1, x = 0, y = 2$

$$\begin{aligned}\pi_{i,j,0,2} = &(1-\gamma)\,\pi_{i,j,0,2} + \lambda_L(1-\gamma)\pi_{i-1,j,0,2} + \lambda_H(1-\gamma)\pi_{i,j-1,0,2}\\ &+(1-\beta)\lambda_L(1-\gamma)\pi_{i-1,j+1,1,1} + (1-\beta)\lambda_H(1-\gamma)\pi_{i,j,1,1}\\ &+(1-\beta)\lambda_L(1-\gamma)\pi_{i-1,j+1,1,2} + (1-\beta)\lambda_H(1-\gamma)\pi_{i,j,1,2}\end{aligned}$$

Case 6 : $i = 0, j = 0, x = 1, y = 0$

$$\begin{aligned}\pi_{0,0,1,0} = &(1-\lambda_L-\lambda_H)\gamma\pi_{0,0,0,0} + (1-\lambda_L-\lambda_H)\gamma\pi_{0,0,1,0} + (1-\lambda_L-\lambda_H)\gamma\pi_{0,0,1,1}\\ &+ (1-\lambda_L-\lambda_H)\gamma\pi_{0,0,1,2}\end{aligned}$$

Case 7 : $i = 0, j = 0, x = 1, y = 1$

$$\begin{aligned}\pi_{0,0,1,1} = &\lambda_L\gamma\pi_{0,0,0,0} + (1-\lambda_L-\lambda_H)\gamma\pi_{0,0,0,1} + \lambda_L\gamma\pi_{0,0,1,0} + \lambda_L\gamma\pi_{0,0,1,1}\\ &+ \lambda_L\gamma\pi_{0,0,1,2} + (1-\lambda_L-\lambda_H)\gamma\pi_{1,0,1,1} + (1-\lambda_L-\lambda_H)\gamma\pi_{1,0,1,2}\end{aligned}$$

Case 8 : $i = 0, j = 0, x = 1, y = 2$

$$\begin{aligned}\pi_{0,0,1,2} = &\lambda_H\gamma\pi_{0,0,0,0} + (1-\lambda_L-\lambda_H)\gamma\pi_{0,0,0,2} + \lambda_H\gamma\pi_{0,0,1,0} + \lambda_H\gamma\pi_{0,0,1,1}\\ &+ \lambda_H\gamma\pi_{0,0,1,2} + (1-\lambda_L-\lambda_H)\gamma\pi_{0,1,1,1} + (1-\lambda_L-\lambda_H)\gamma\pi_{0,1,1,2}\end{aligned}$$

Case 9 : $i = 0, 1 \leq j \leq K-1, x = 1, y = 1$

$$\begin{aligned}\pi_{0,j,1,1} = &(1-\lambda_L-\lambda_H)\gamma\pi_{0,j,0,1} + \lambda_H\gamma\pi_{0,j-1,0,1} + \beta(1-\lambda_L-\lambda_H)\gamma\pi_{1,j-1,1,1}\\ &+ \beta\lambda_H\gamma\pi_{1,j-1,1,1} + \beta(1-\lambda_L-\lambda_H)\gamma\pi_{1,j-1,1,2} + \beta\lambda_H\gamma\pi_{1,j-1,1,2}\end{aligned}$$

Case 10 : $i = 0, 1 \leq j \leq K-1, x = 1, y = 2$

$$\begin{aligned}\pi_{0,j,1,2} = &(1-\lambda_L-\lambda_H)\gamma\pi_{0,j,0,2} + \lambda_H\gamma\pi_{0,j-1,0,2} + (1-\lambda_L-\lambda_H)\gamma\pi_{0,j+1,1,1}\\ &+ \lambda_H\gamma\pi_{0,j,1,1} + (1-\lambda_L-\lambda_H)\gamma\pi_{0,j+1,1,2} + \lambda_H\gamma\pi_{0,j,1,2}\end{aligned}$$

Case 11 : $1 \leq i \leq K-1, j=0, x=1, y=1$

$$\pi_{i,0,1,1} = (1-\lambda_L-\lambda_H)\gamma\pi_{i,0,0,1} + \lambda_L\gamma\pi_{i-1,0,0,1} + (1-\lambda_L-\lambda_H)\gamma\pi_{i+1,0,1,1} + \lambda_L\gamma\pi_{i,0,1,1} + (1-\lambda_L-\lambda_H)\gamma\pi_{i+1,0,1,2} + \lambda_L\gamma\pi_{i,0,1,2}$$

Case 12 : $1 \leq i \leq K-1, j=0, x=1, y=2$

$$\pi_{i,0,1,2} = (1-\lambda_L-\lambda_H)\gamma\pi_{i,0,0,2} + \lambda_L\gamma\pi_{i-1,0,0,2} + \gamma\pi_{K-1,0,0,2} + (1-\beta)(1-\lambda_L-\lambda_H)\gamma\pi_{i-1,1,1,1} + (1-\beta)\lambda_L\gamma\pi_{i-1,1,1,1} + (1-\beta)(1-\lambda_L-\lambda_H)\gamma\pi_{i-1,1,1,2} + (1-\beta)\lambda_L\gamma\pi_{i-1,1,1,2}$$

Case 13 : $1 \leq i \leq K-2, 1 \leq j \leq K-i-1, x=1, y=1$

$$\pi_{i,j,1,1} = (1-\lambda_L-\lambda_H)\gamma\pi_{i,j,0,1} + \lambda_L\gamma\pi_{i-1,j,0,1} + \lambda_H\gamma\pi_{i,j-1,0,1} + \lambda_H\gamma\pi_{i+1,0,1,1} + \lambda_H\gamma\pi_{i+1,0,1,2} + \beta(1-\lambda_L-\lambda_H)\gamma\pi_{i+1,j,1,1} + \beta\lambda_L\gamma\pi_{i,j,1,1} + \beta\lambda_H\gamma\pi_{i+1,j-1,1,1} + \beta(1-\lambda_L-\lambda_H)\gamma\pi_{i+1,j,1,2} + \beta\lambda_L\gamma\pi_{i,j,1,2} + \beta\lambda_H\gamma\pi_{i+1,j-1,1,2}$$

Case 14 : $1 \leq i \leq K-2, 1 \leq j \leq K-i-1, x=1, y=2$

$$\pi_{i,j,1,2} = (1-\lambda_L-\lambda_H)\gamma\pi_{i,j,0,2} + \lambda_L\gamma\pi_{i-1,j,0,2} + \lambda_H\gamma\pi_{i,j-1,0,2} + \lambda_L\gamma\pi_{0,j+1,1,1} + \lambda_L\gamma\pi_{0,j+1,1,2} + (1-\beta)(1-\lambda_L-\lambda_H)\gamma\pi_{i,j+1,1,1} + (1-\beta)\lambda_L\gamma\pi_{i-1,j+1,1,1} + (1-\beta)\lambda_H\gamma\pi_{i,j,1,1} + (1-\beta)(1-\lambda_L-\lambda_H)\gamma\pi_{i,j+1,1,2} + (1-\beta)\lambda_L\gamma\pi_{i-1,j+1,1,2} + (1-\beta)\lambda_H\gamma\pi_{i,j,1,2}$$

(b) Priority discipline

Case 1 : $i = 0, j = 0, x = 0, y = 0$

$$\pi_{0,0,0,0} = (1-\lambda_L-\lambda_H)(1-\gamma)\pi_{0,0,0,0} + (1-\lambda_L-\lambda_H)(1-\gamma)\pi_{0,0,1,0} + (1-\lambda_L-\lambda_H)(1-\gamma)\pi_{0,0,1,1} + (1-\lambda_L-\lambda_H)(1-\gamma)\pi_{0,0,1,2}$$

Case 2 : $0 \le i \le K-2, 0 \le j \le K-i-2, x = 0, y = 1$

$$\begin{aligned}\pi_{i,j,0,1} = {} & \lambda_L(1-\gamma)\pi_{0,0,0,0} + (1-\lambda_L-\lambda_H)(1-\gamma)\pi_{i,j,0,1} + \lambda_L(1-\gamma)\pi_{i-1,j,0,1} \\ & + \lambda_H(1-\gamma)\pi_{i,j-1,0,1} + \lambda_L(1-\gamma)\pi_{0,0,1,0} + \lambda_L(1-\gamma)\pi_{0,0,1,1} \\ & + \lambda_L(1-\gamma)\pi_{0,0,1,2} + (1-\lambda_L-\lambda_H)(1-\gamma)\pi_{i+1,j,1,1} \\ & + \lambda_L(1-\gamma)\pi_{i,j,1,1} + \lambda_H(1-\gamma)\pi_{i+1,j-1,1,1} \\ & + (1-\lambda_L-\lambda_H)(1-\gamma)\pi_{i+1,j,1,2} + \lambda_L(1-\gamma)\pi_{i,j,1,2} \\ & + \lambda_H(1-\gamma)\pi_{i+1,j-1,1,2}\end{aligned}$$

Case 3 : $0 \le i \le K-2, 0 \le j \le K-i-2, x = 0, y = 2$

$$\begin{aligned}\pi_{i,j,0,2} = {} & \lambda_H(1-\gamma)\pi_{0,0,0,0} + (1-\lambda_L-\lambda_H)(1-\gamma)\pi_{i,j,0,2} + \lambda_L(1-\gamma)\pi_{i-1,j,0,2} \\ & + \lambda_H(1-\gamma)\pi_{i,j-1,0,2} + \lambda_H(1-\gamma)\pi_{0,0,1,0} + \lambda_H(1-\gamma)\pi_{0,0,1,1} \\ & + \lambda_H(1-\gamma)\pi_{0,0,1,2} + (1-\lambda_L-\lambda_H)(1-\gamma)\pi_{0,j+1,1,1} \\ & + \lambda_L(1-\gamma)\pi_{0,j+1,1,1} + \lambda_H(1-\gamma)\pi_{0,j,1,1} \\ & + (1-\lambda_L-\lambda_H)(1-\gamma)\pi_{0,j+1,1,2} + \lambda_L(1-\gamma)\pi_{0,j+1,1,2} \\ & + \lambda_H(1-\gamma)\pi_{0,j,1,2}\end{aligned}$$

Case 4 : $0 \le i \le K-1, j = K-i-1, x = 0, y = 1$

$$\begin{aligned}\pi_{i,j,0,1} = {} & (1-\lambda_L-\lambda_H)(1-\gamma)\pi_{i,j,0,1} + \lambda_L(1-\gamma)\pi_{i-1,j,0,1} + \lambda_H(1-\gamma)\pi_{i,j-1,0,1} \\ & + (1-\gamma)\pi_{i,j,0,1} + \lambda_L(1-\gamma)\pi_{i,j,1,1} + \lambda_H(1-\gamma)\pi_{i+1,j-1,1,1} \\ & + \lambda_L(1-\gamma)\pi_{i,j,1,2} + \lambda_H(1-\gamma)\pi_{i+1,j-1,1,2}\end{aligned}$$

Case 5 : $0 \leq i \leq K-1, j = K-i-1, x = 0, y = 2$

$$\pi_{i,j,0,2} = (1-\lambda_L-\lambda_H)(1-\gamma)\pi_{i,j,0,2} + \lambda_L(1-\gamma)\pi_{i-1,j,0,2} + \lambda_H(1-\gamma)\pi_{i,j-1,0,2} + (1-\gamma)\pi_{i,j,0,2} + \lambda_L(1-\gamma)\pi_{0,j+1,1,1} + \lambda_H(1-\gamma)\pi_{0,j,1,1} + \lambda_L(1-\gamma)\pi_{0,j+1,1,2} + \lambda_H(1-\gamma)\pi_{0,j,1,2}$$

Case 6 : $i = 0, j = 0, x = 1, y = 0$

$$\pi_{0,0,1,0} = (1-\lambda_L-\lambda_H)\gamma\pi_{0,0,0,0} + (1-\lambda_L-\lambda_H)\gamma\pi_{0,0,1,0} + (1-\lambda_L-\lambda_H)\gamma\pi_{0,0,1,1} + (1-\lambda_L-\lambda_H)\gamma\pi_{0,0,1,2}$$

Case 7 : $i = 0, j = 0, x = 1, y = 1$

$$\pi_{0,0,1,1} = \lambda_L\gamma\pi_{0,0,0,0} + (1-\lambda_L-\lambda_H)\gamma\pi_{0,0,0,1} + \lambda_L\gamma\pi_{0,0,1,0} + \lambda_L\gamma\pi_{0,0,1,1} + \lambda_L\gamma\pi_{0,0,1,2} + (1-\lambda_L-\lambda_H)\gamma\pi_{1,0,1,1} + (1-\lambda_L-\lambda_H)\gamma\pi_{1,0,1,2}$$

Case 8 : $i = 0, j = 0, x = 1, y = 2$

$$\pi_{0,0,1,2} = \lambda_H\gamma\pi_{0,0,0,0} + (1-\lambda_L-\lambda_H)\gamma\pi_{0,0,0,2} + \lambda_H\gamma\pi_{0,0,1,0} + \lambda_H\gamma\pi_{0,0,1,2} + (1-\lambda_L-\lambda_H)\gamma\pi_{0,1,1,1} + (1-\lambda_L-\lambda_H)\gamma\pi_{0,1,1,2}$$

Case 9 : $i = 0, 1 \leq j \leq K-1, x = 1, y = 1$

$$\pi_{0,j,1,1} = (1-\lambda_L-\lambda_H)\gamma\pi_{0,j,0,1} + \lambda_H\gamma\pi_{0,j-1,0,1} + \gamma\pi_{0,K-1,0,1} + \lambda_H\gamma\pi_{1,0,1,1} + \lambda_H\gamma\pi_{1,0,1,2} + (1-\lambda_L-\lambda_H)\gamma\pi_{1,j,1,1} + \lambda_H\gamma\pi_{1,j-1,1,1} + (1-\lambda_L-\lambda_H)\gamma\pi_{1,j,1,2} + \lambda_H\gamma\pi_{1,j-1,1,2}$$

Case 10 : $i = 0, 1 \leq j \leq K-1, x = 1, y = 2$

$$\pi_{0,j,1,2} = (1-\lambda_L-\lambda_H)\gamma\pi_{0,j,0,2} + \lambda_H\gamma\pi_{0,j-1,0,2} + \gamma\pi_{0,K-1,0,2} + (1-\lambda_L-\lambda_H)\gamma\pi_{0,j+1,1,1} + \lambda_H\gamma\pi_{0,j,1,1} + (1-\lambda_L-\lambda_H)\gamma\pi_{0,j+1,1,2} + \lambda_H\gamma\pi_{0,j,1,2}$$

Case 11 : $1 \leq i \leq K-1, j = 0, x = 1, y = 1$

$$\pi_{i,0,1,1} = \lambda_L\gamma\pi_{i-1,0,0,1} + \gamma\pi_{K-1,0,0,1} + \lambda_L\gamma\pi_{i,0,1,1} + \lambda_L\gamma\pi_{i,0,1,2}$$

Case 12 : $1 \le i \le K-1, j=0, x=1, y=2$

$$\pi_{i,0,1,2} = (1-\lambda_L-\lambda_H)\gamma\pi_{i,0,0,2} + \lambda_L\gamma\pi_{i-1,0,0,2} + \gamma\pi_{K-1,0,0,2} + \lambda_L\gamma\pi_{0,1,1,1} + \lambda_L\gamma\pi_{0,1,1,2}$$

Case 13 : $1 \le i \le K-2, 1 \le j \le K-i-1, x=1, y=1$

$$\begin{aligned}\pi_{i,j,1,1} = &(1-\lambda_L-\lambda_H)\gamma\pi_{i,j,0,1} + \lambda_L\gamma\pi_{i-1,j,0,1} + \lambda_H\gamma\pi_{i,j-1,0,1} + \gamma\pi_{i,K-i-1,0,1}\\ &+ \lambda_H\gamma\pi_{i+1,0,1,1} + \lambda_H\gamma\pi_{i+1,0,1,2} + (1-\lambda_L-\lambda_H)\gamma\pi_{i+1,j,1,1}\\ &+ \lambda_L\gamma\pi_{i,j,1,1} + \lambda_L\gamma\pi_{i+1,j-1,1,1} + (1-\lambda_L-\lambda_H)\gamma\pi_{i+1,j,1,2} + \lambda_L\gamma\pi_{i,j,1,2}\\ &+ \lambda_H\gamma\pi_{i+1,j-1,1,2}\end{aligned}$$

Case 14 : $1 \le i \le K-2, 1 \le j \le K-i-1, x=1, y=2$

$$\begin{aligned}\pi_{i,j,1,2} = &(1-\lambda_L-\lambda_H)\gamma\pi_{i,j,0,2} + \lambda_L\gamma\pi_{i-1,j,0,2} + \lambda_H\gamma\pi_{i,j-1,0,2} + \gamma\pi_{i,K-i-1,0,2}\\ &+ \lambda_L\gamma\pi_{0,j+1,1,1} + \lambda_L\gamma\pi_{0,j+1,1,2}\end{aligned}$$

3.1.3 State diagram

(a) First-In-First-Out

(1) $i=0, j=0, x=0, y=0$

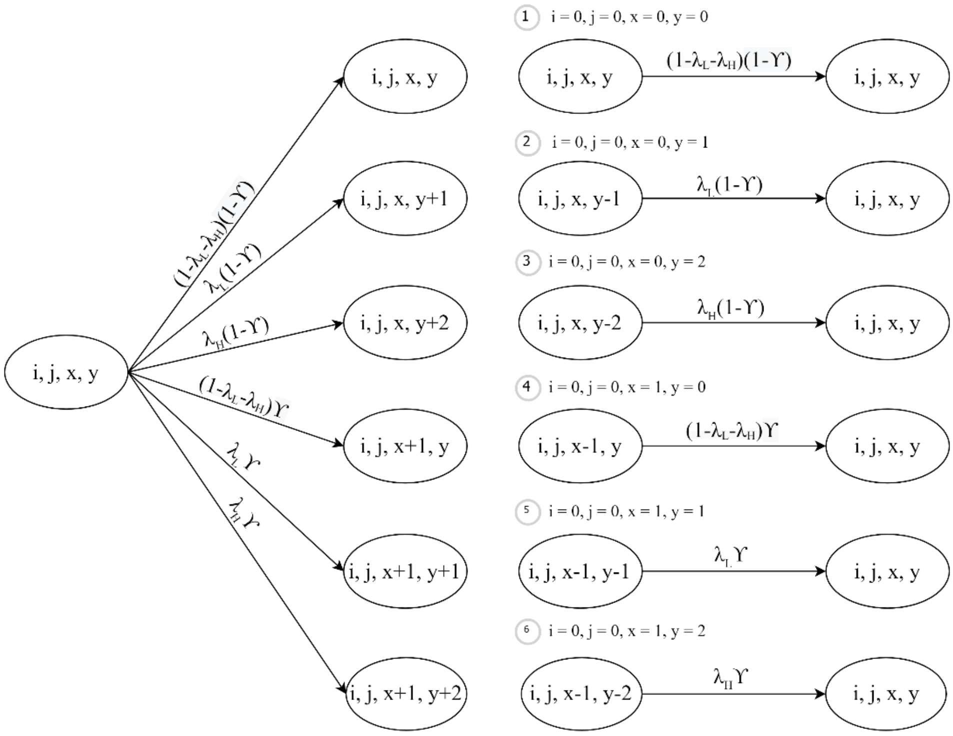


Fig 3. 3: The state diagram for $i=0, j=0, x=0, y=0$

(2) $0 < i < K-2, 0 \leq j \leq K-i-2, x=0, y=1$ 、2

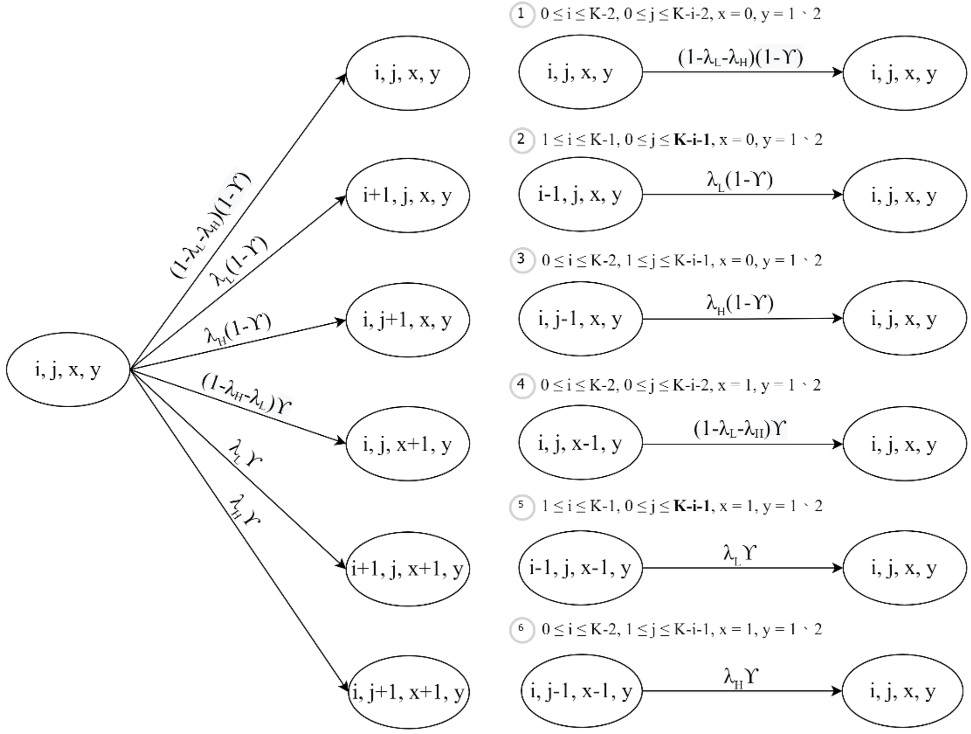


Fig 3. 4: The state diagram for $0 < i < K-2, 0 \leq j \leq K-i-2, x=0, y=1$ 、2

(3) $0 \leq i \leq K-1, j=K-i-1, x=0, y=1$ 、2

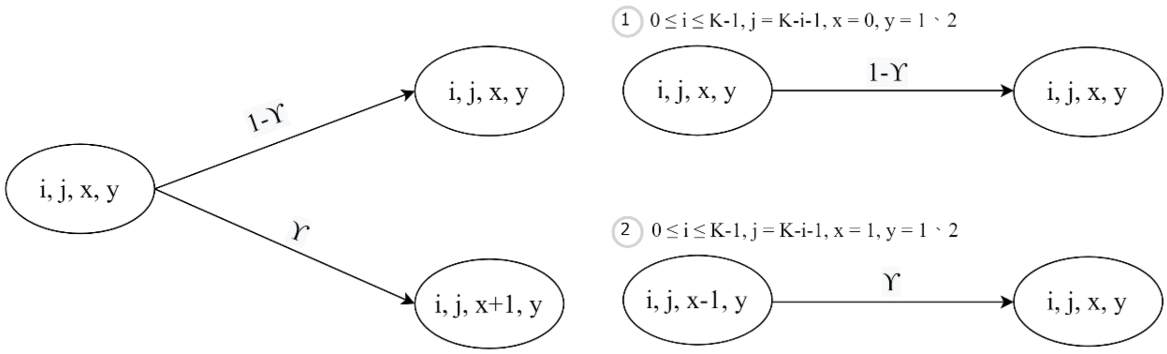


Fig 3. 5: The state diagram for $0 \leq i \leq K-1, j=K-i-1, x=0, y=1$ 、2

(4) $i = 0, j = 0, x = 1, y = 0$

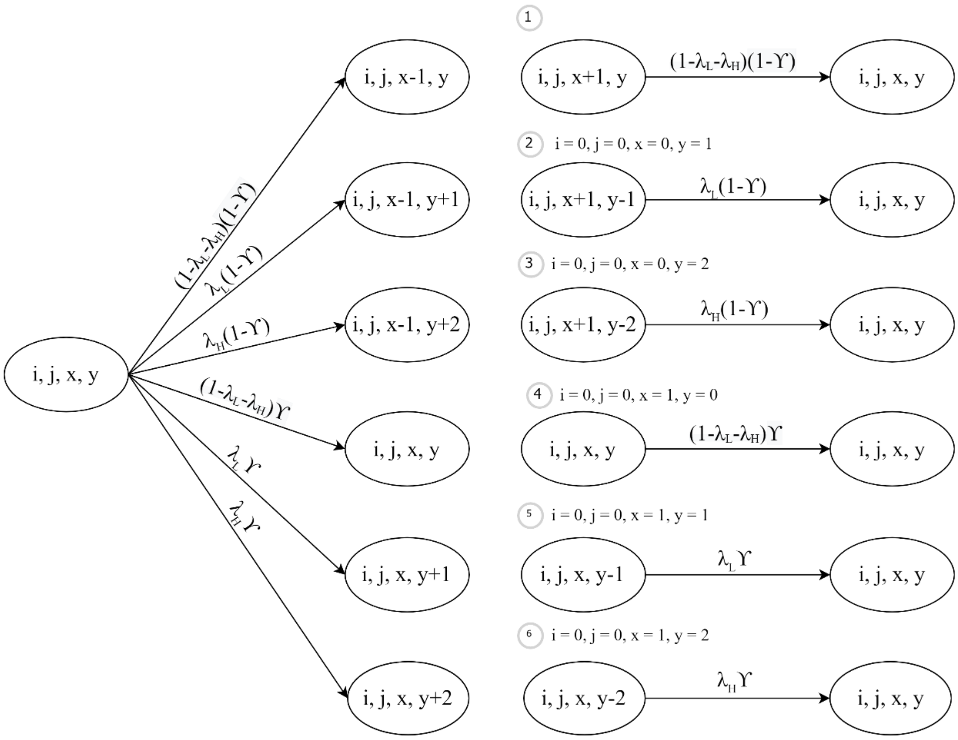


Fig 3. 6: The state diagram for $i = 0, j = 0, x = 1, y = 0$

(5) $i = 0, j = 0, x = 1, y = 1$

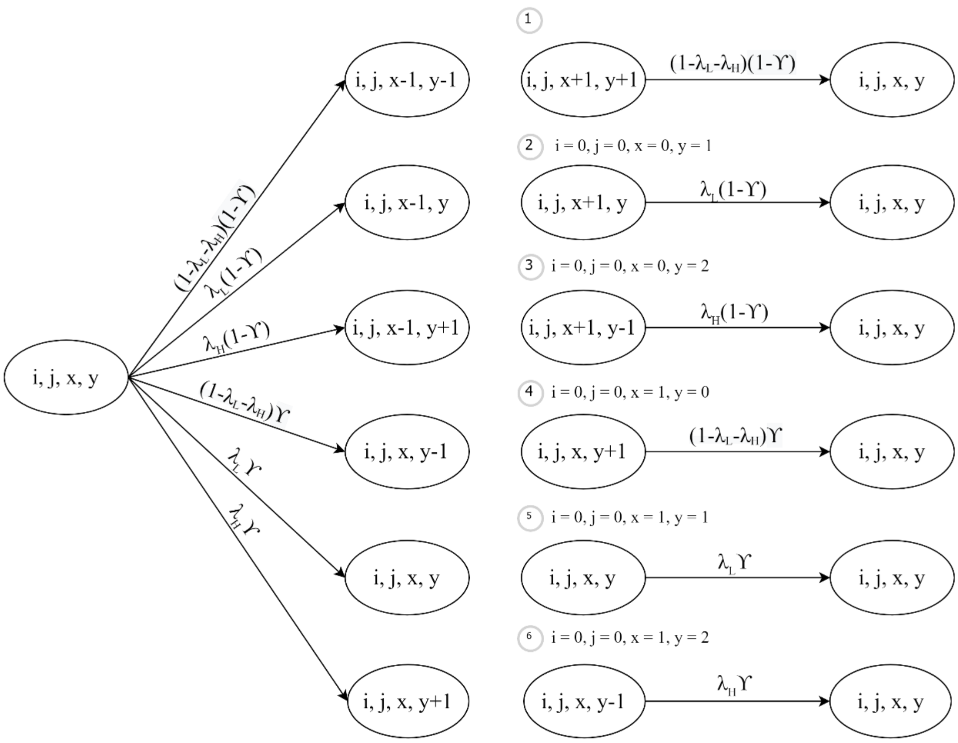


Fig 3. 7: The state diagram for $i = 0, j = 0, x = 1, y = 1$

(6) $i = 0, j = 0, x = 1, y = 2$

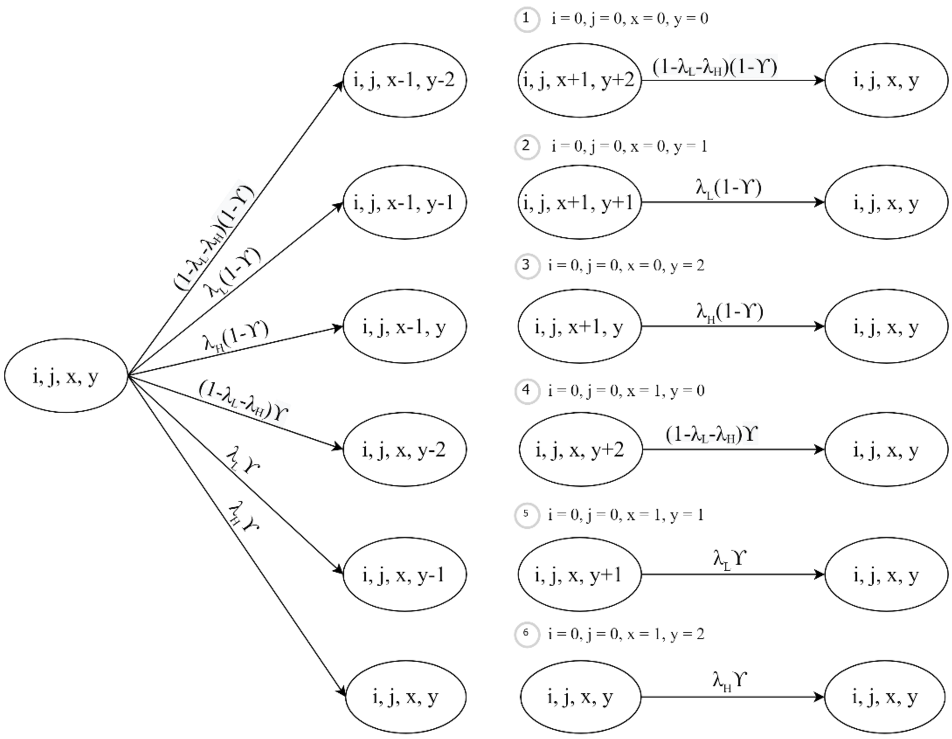


Fig 3. 8: The state diagram for $i = 0, j = 0, x = 1, y = 2$

(7) $i = 0, 1 \leq j \leq K - 1, x = 1, y = 1$

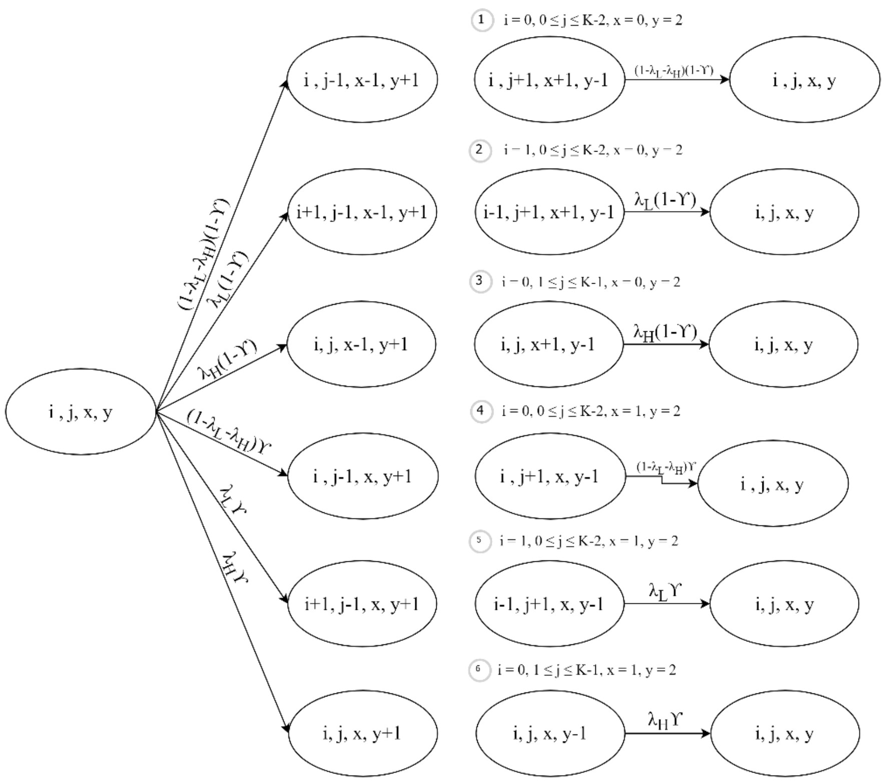


Fig 3. 9: The state diagram for $i = 0, 1 \leq j \leq K - 1, x = 1, y = 1$

(8) $i = 0, 1 \leq j \leq K-1, x = 1, y = 2$

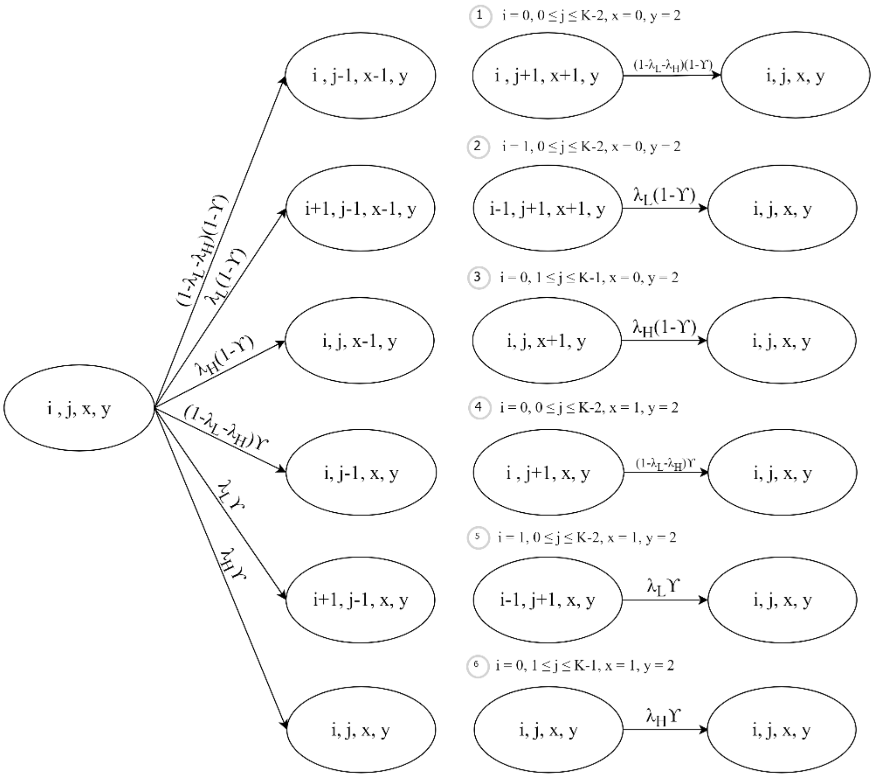


Fig 3. 10: The state diagram for $i = 0, 1 \leq j \leq K-1, x = 1, y = 2$

(9) $1 \leq i \leq K-1, j = 0, x = 1, y = 1$

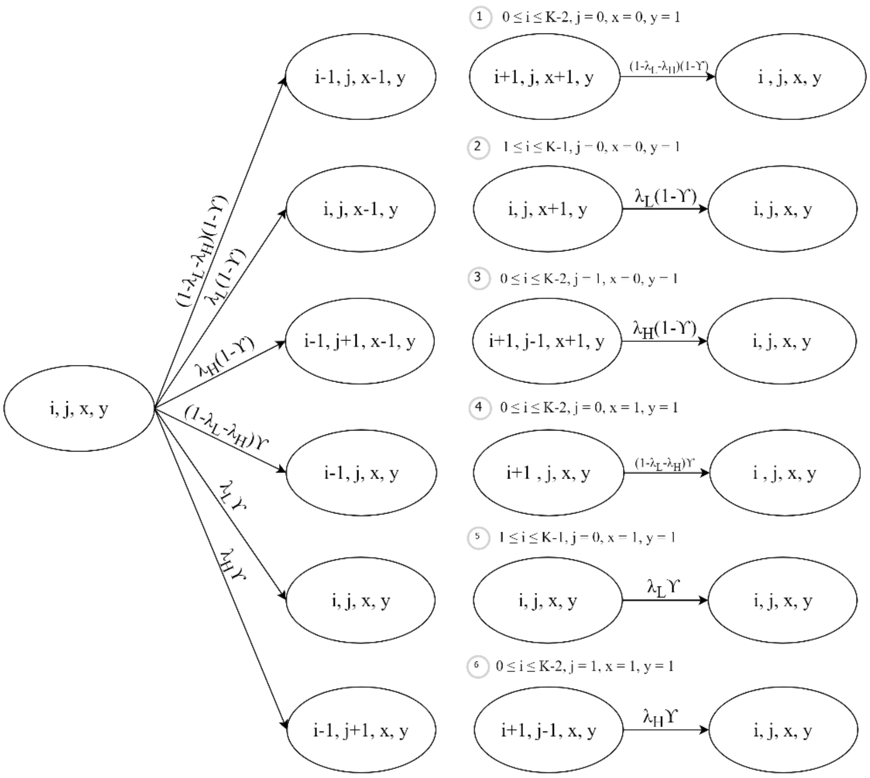


Fig 3. 11: The state diagram for $1 \leq i \leq K-1, j = 0, x = 1, y = 1$

(10) $1 \le i \le K-1, j=0, x=1, y=2$

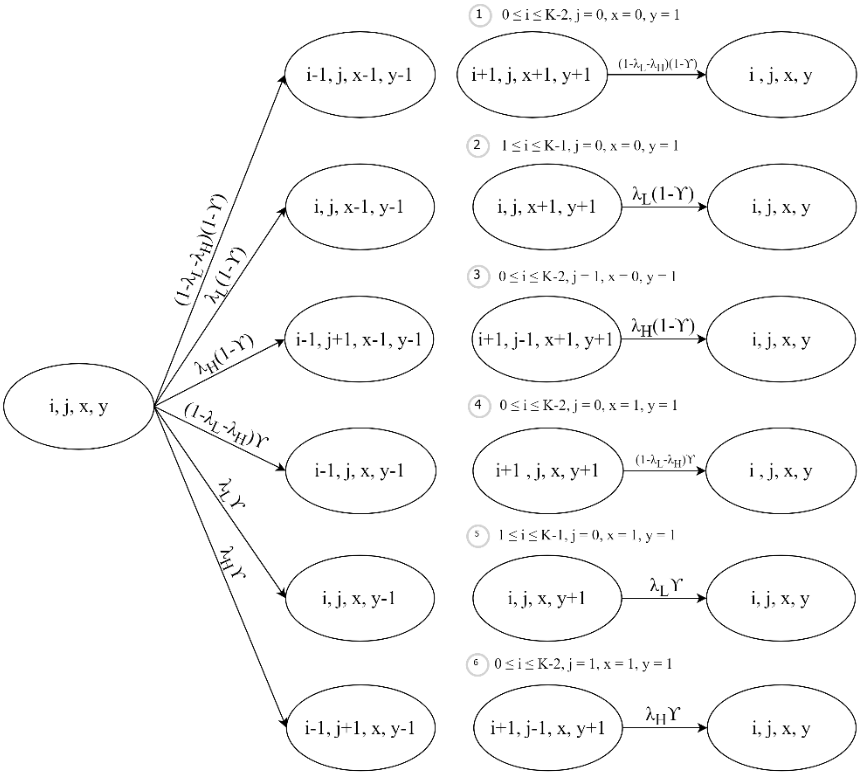
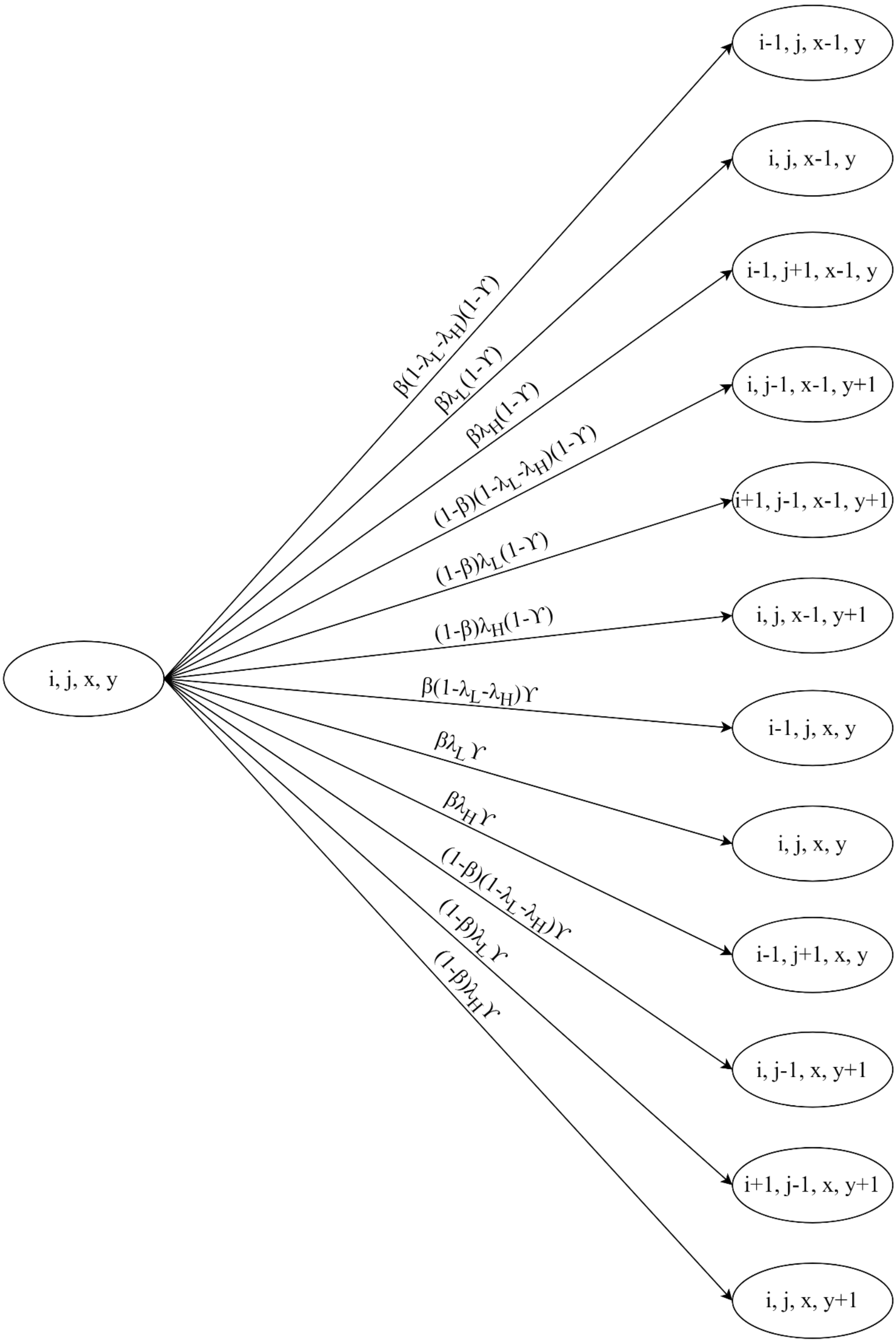


Fig 3. 12: The state diagram for $1 \le i \le K-1, j=0, x=1, y=2$

(11) $1 \le i \le K-2, ,1 \le j \le K-i-1, x=1, y=1$



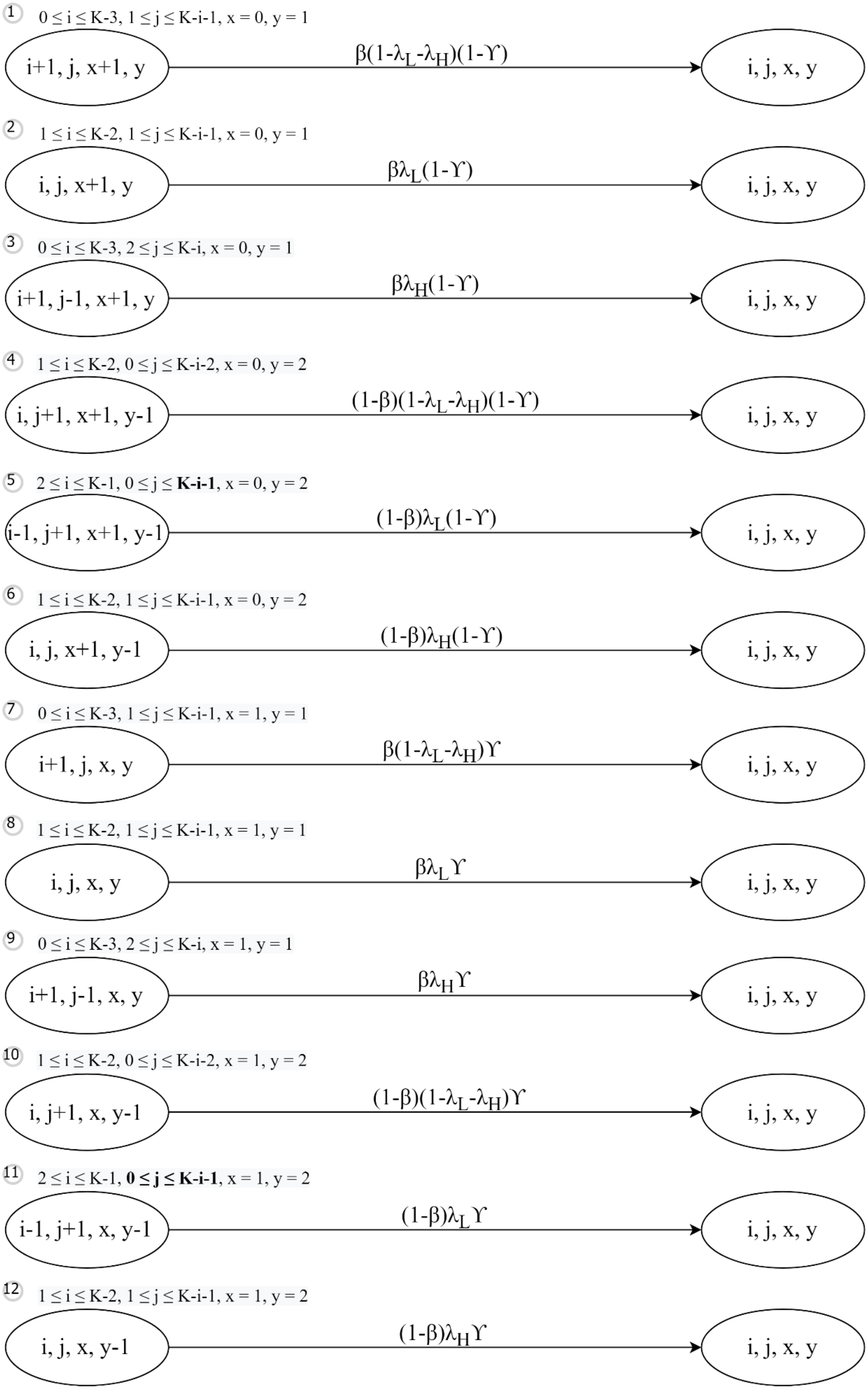
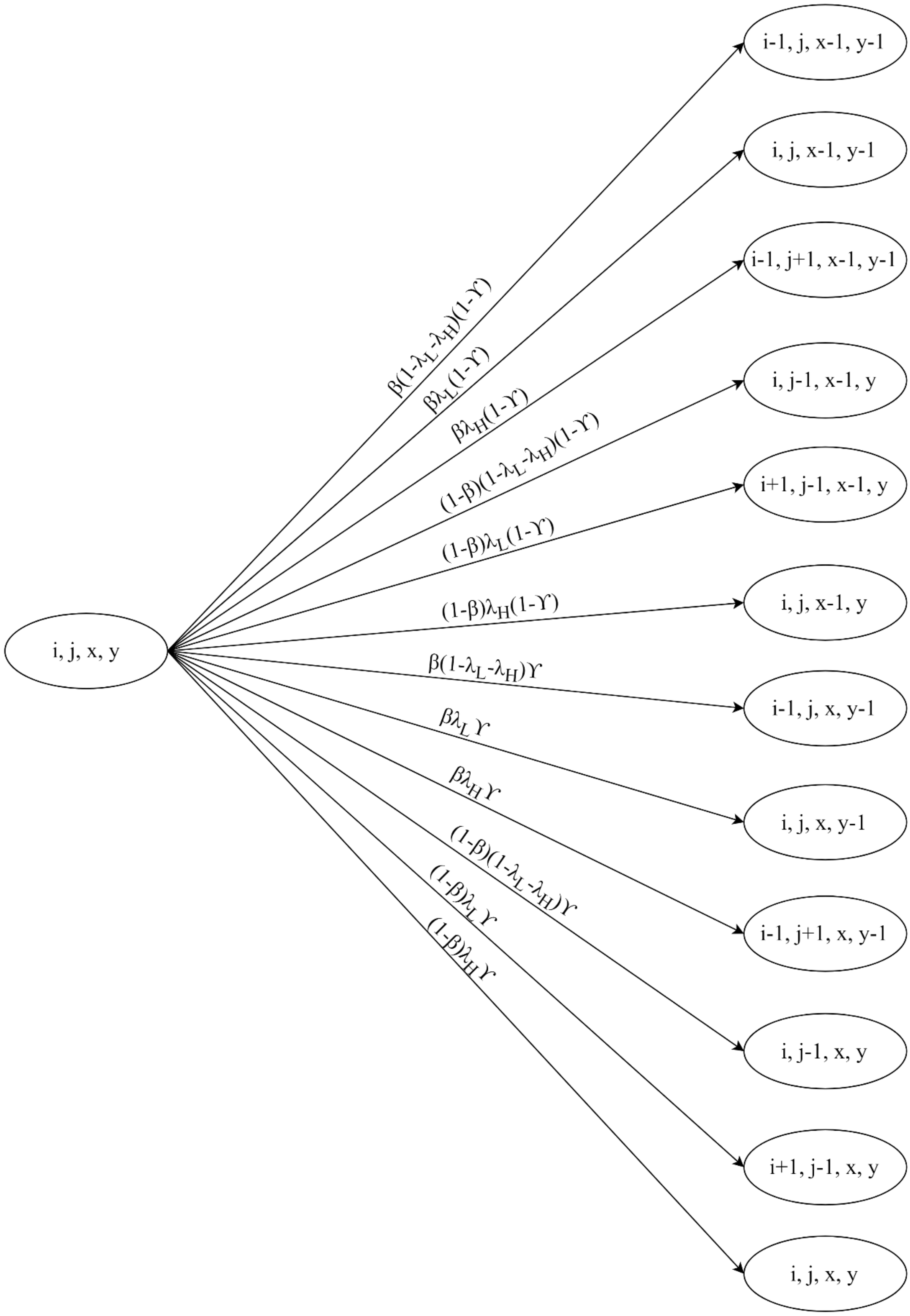


Fig 3. 13: The state diagram for $1 \le i \le K-2, ,1 \le j \le K-i-1, x=1, y=1$

(12) $1 \leq i \leq K-2, , 1 \leq j \leq K-i-1, x=1, y=2$



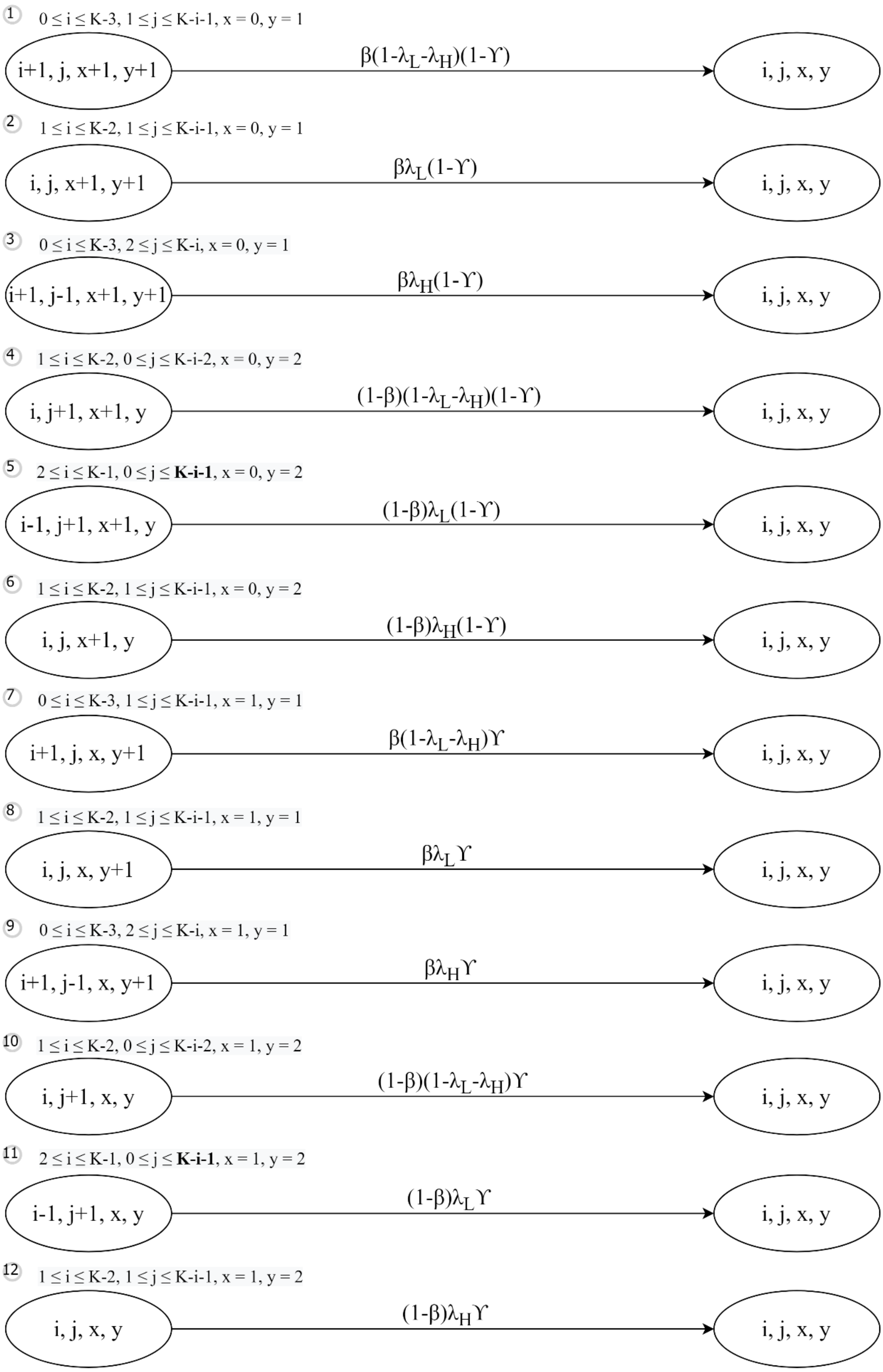


Fig 3. 14: The state diagram for $1 \leq i \leq K-2, ,1 \leq j \leq K-i-1, x=1, y=2$

(b) Priority discipline

(1) $i = 0, j = 0, x = 0, y = 0$

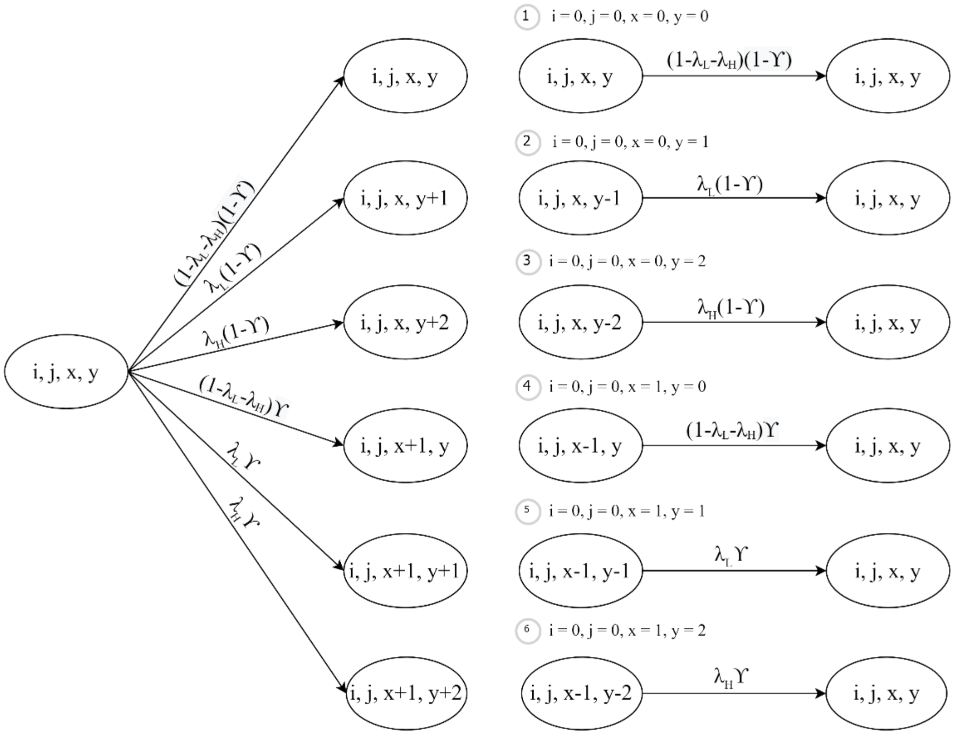


Fig 3. 15: The state diagram for $i = 0, j = 0, x = 0, y = 0$

(2) $0 \leq i \leq K-2, 0 \leq j \leq K-i-2, x = 0, y = 1$ 、2

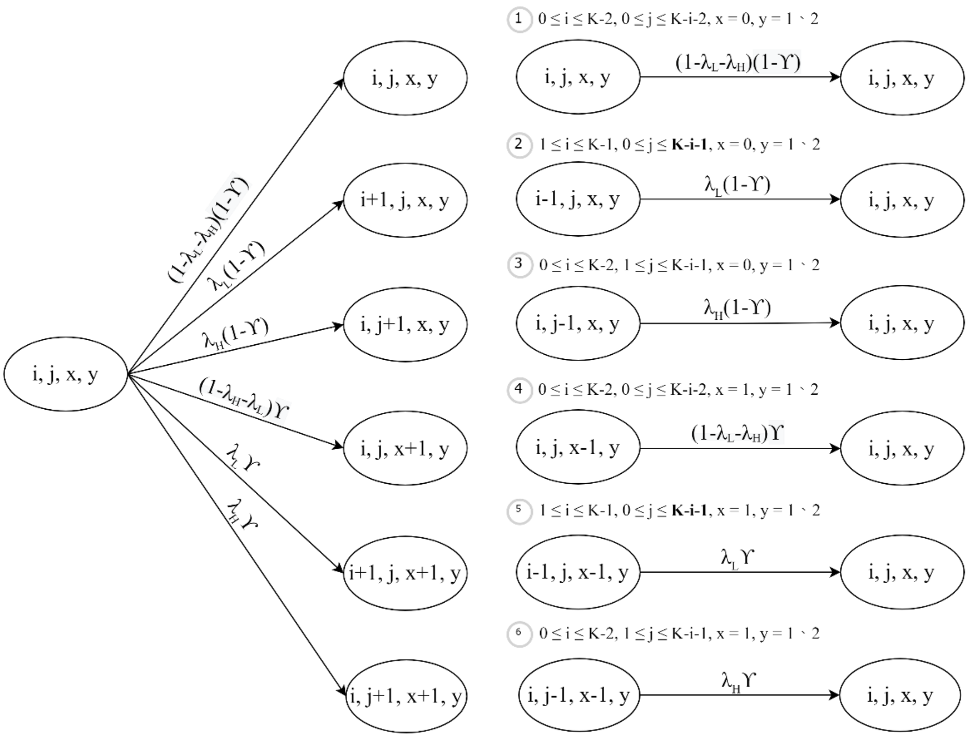


Fig 3. 16: The state diagram for $0 \leq i \leq K-2, 0 \leq j \leq K-i-2, x = 0, y = 1$ 、2

(3) $0 \le i \le K-1, j = K-i-1, x = 0, y = 1$ 、2

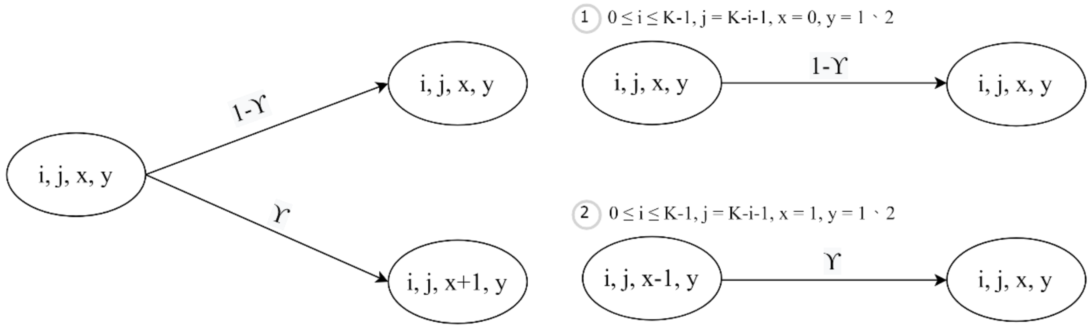


Fig 3. 17: The state diagram for $0 \le i \le K-1, j = K-i-1, x = 0, y = 1$ 、2

(4) $i = 0, j = 0, x = 1, y = 0$

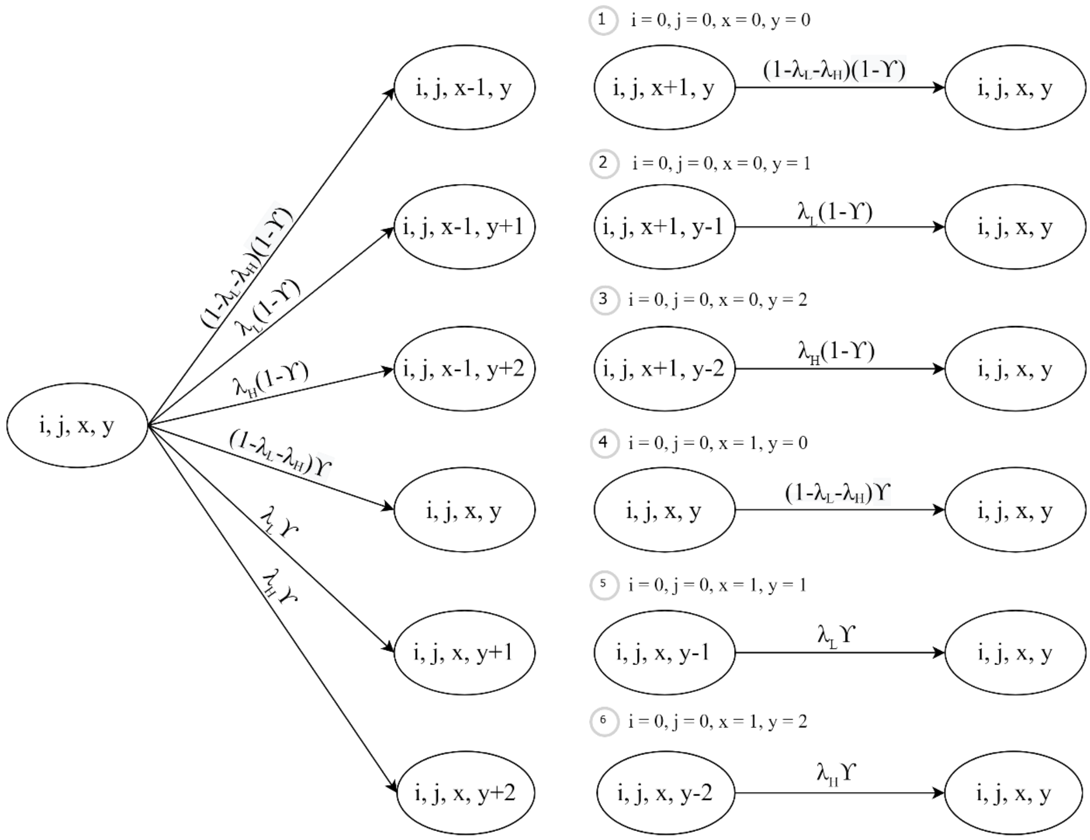


Fig 3. 18: The state diagram for $i = 0, j = 0, x = 1, y = 0$

(5) $i = 0, j = 0, x = 1, y = 1$

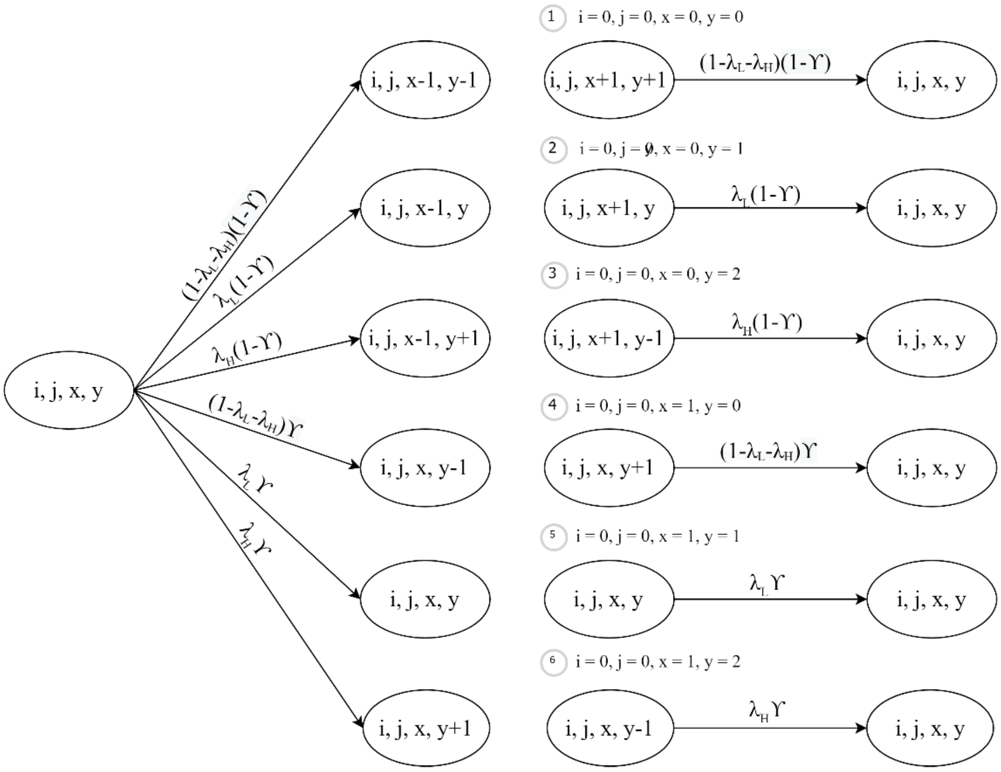


Fig 3. 19: The state diagram for $i = 0, j = 0, x = 1, y = 1$

(6) $i = 0, j = 0, x = 1, y = 2$

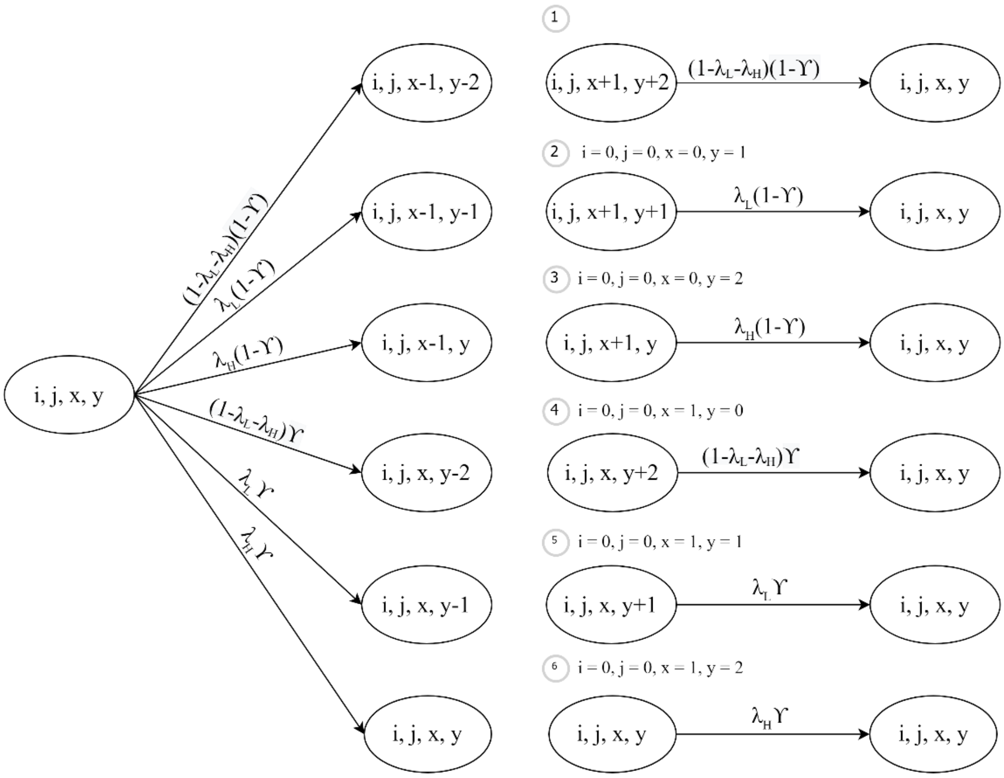


Fig 3. 20: The state diagram for $i = 0, j = 0, x = 1, y = 2$

(7) $i = 0, 1 \leq j \leq K-1, x = 1, y = 1$

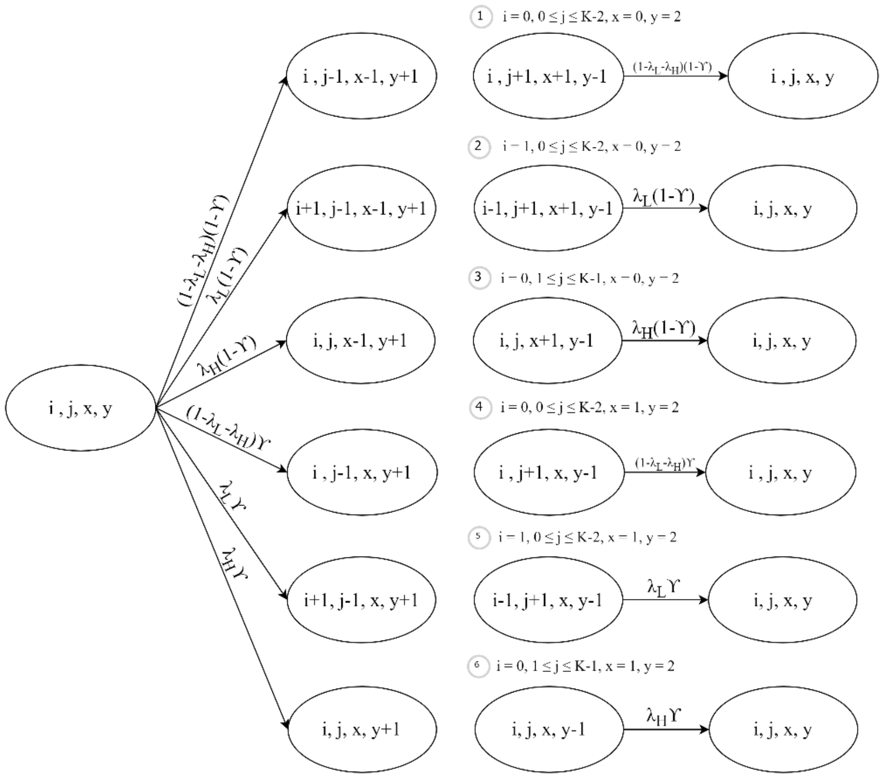


Fig 3. 21: The state diagram for $i = 0, 1 \leq j \leq K-1, x = 1, y = 1$

(8) $i = 0, 1 \leq j \leq K-1, x = 1, y = 2$

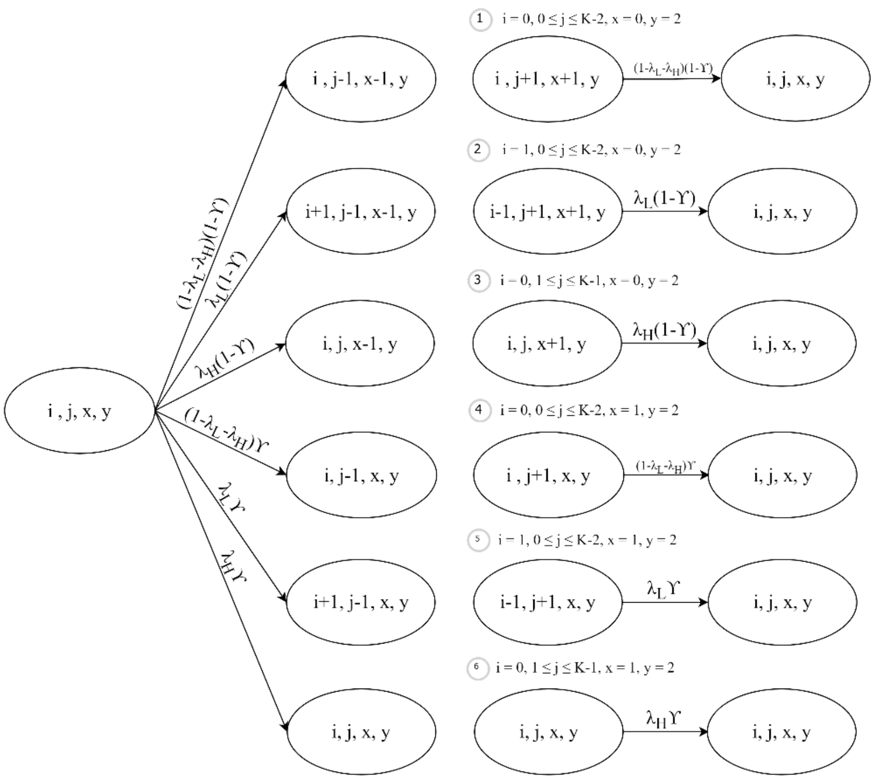


Fig 3. 22: The state diagram for $i = 0, 1 \leq j \leq K-1, x = 1, y = 2$

(9) $1 \leq i \leq K-1, j=0, x=1, y=1$

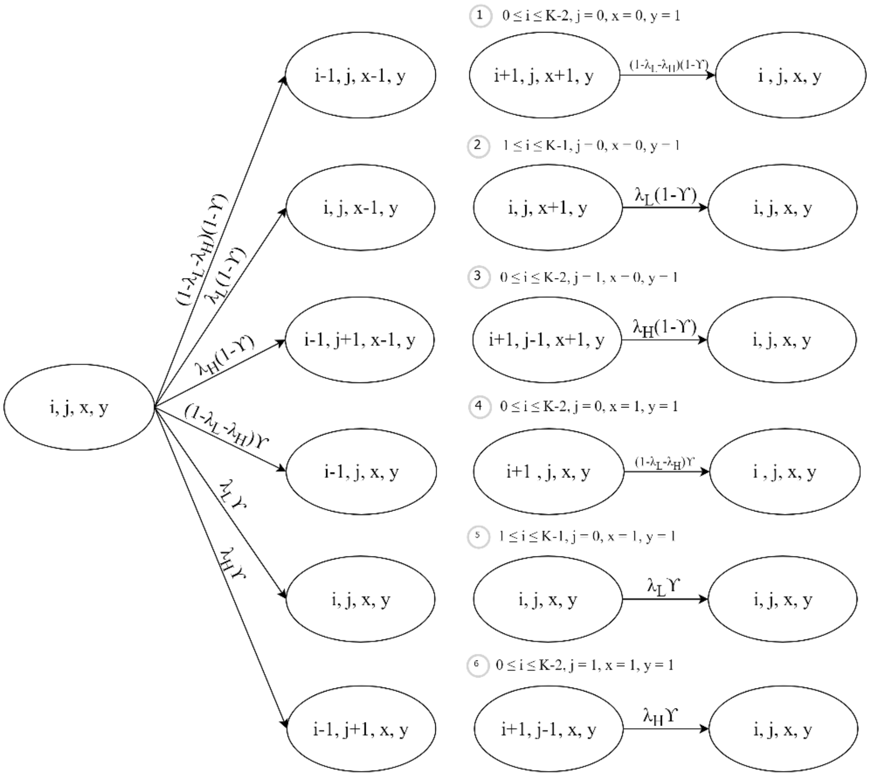


Fig 3. 23: The state diagram for $1 \leq i \leq K-1, j=0, x=1, y=1$

(10) $1 \leq i \leq K-1, j=0, x=1, y=2$

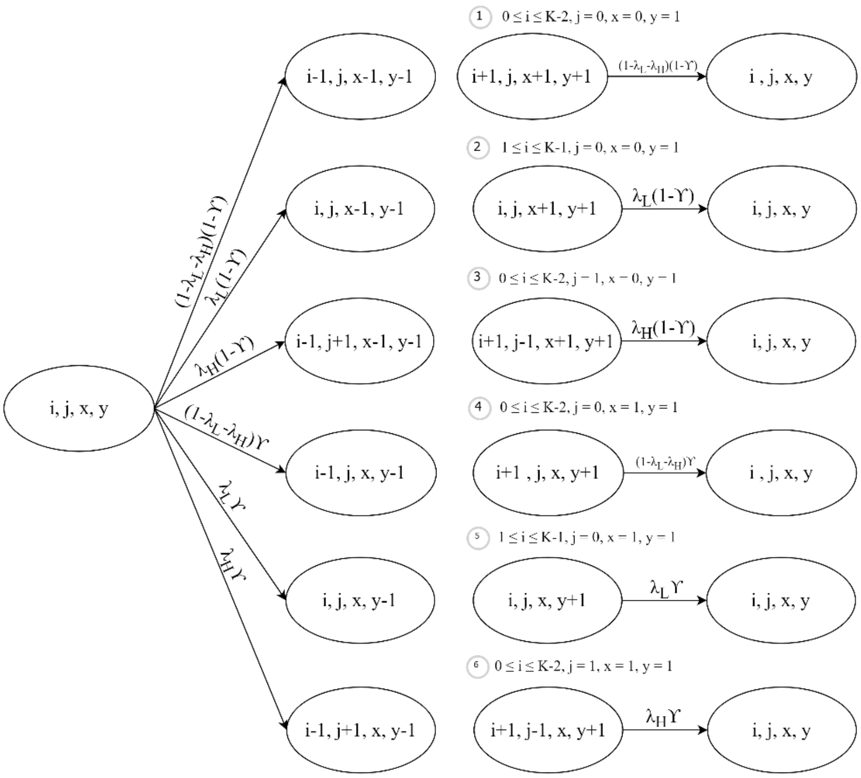
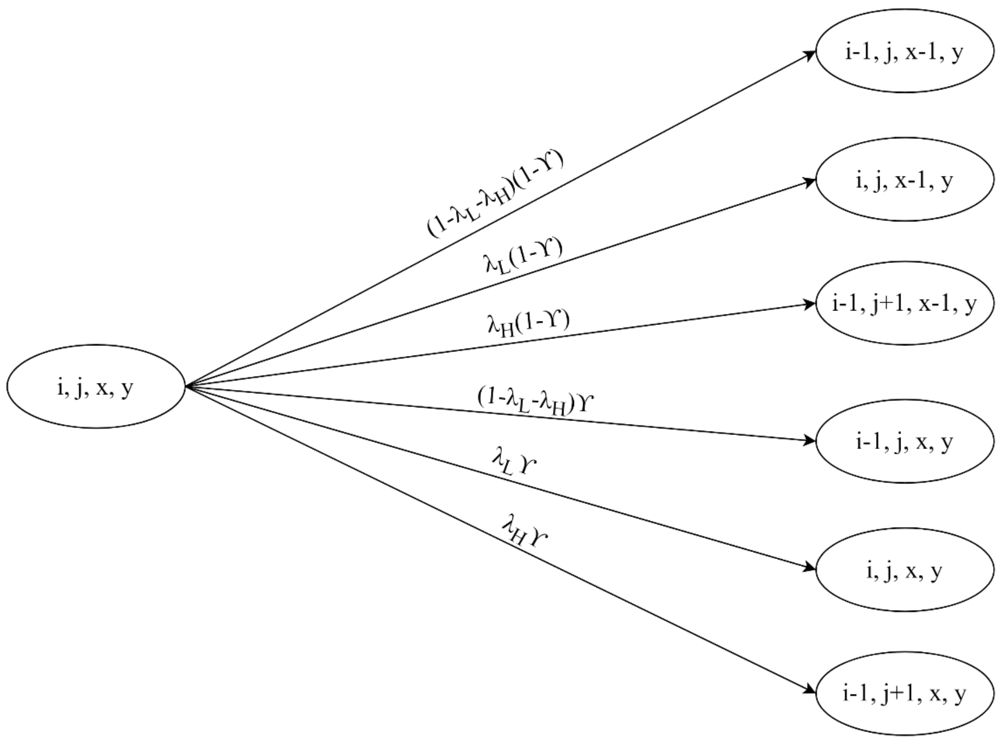


Fig 3. 24: The state diagram for $1 \leq i \leq K-1, j=0, x=1, y=2$

(11) $1 \le i \le K-2, 1 \le j \le K-i-1, x=1, y=1$



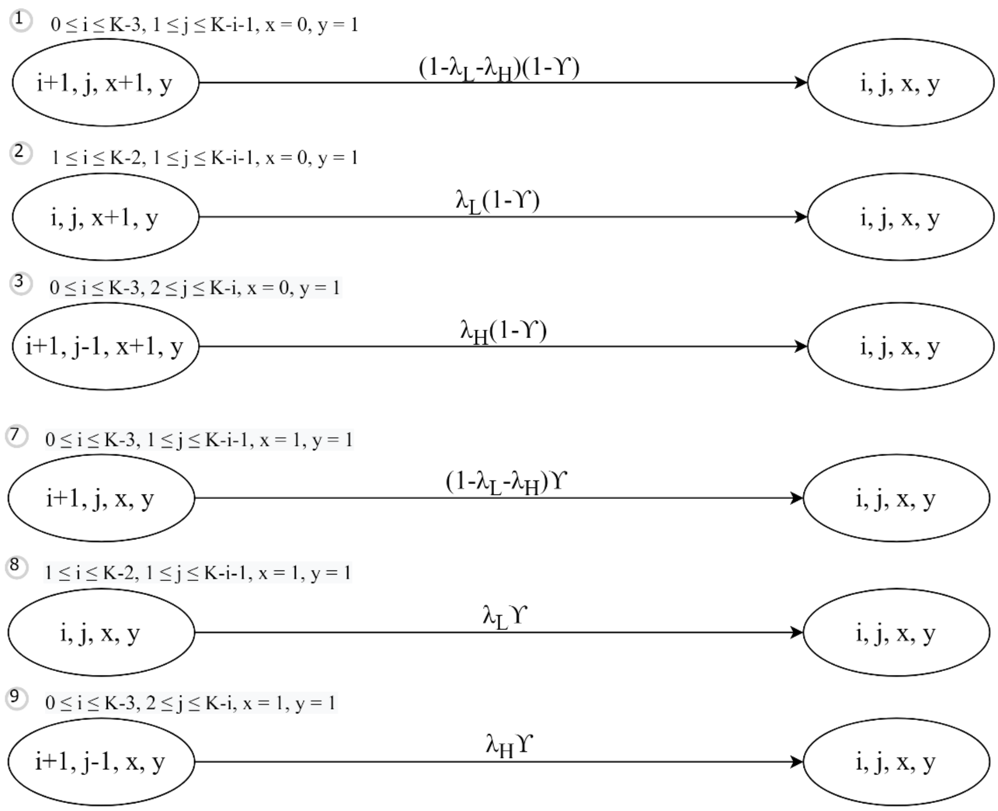


Fig 3. 25: The state diagram for $1 \le i \le K-2, 1 \le j \le K-i-1, x=1, y=1$

(12) $1 \le i \le K-2, 1 \le j \le K-i-1, x = 1, y = 2$

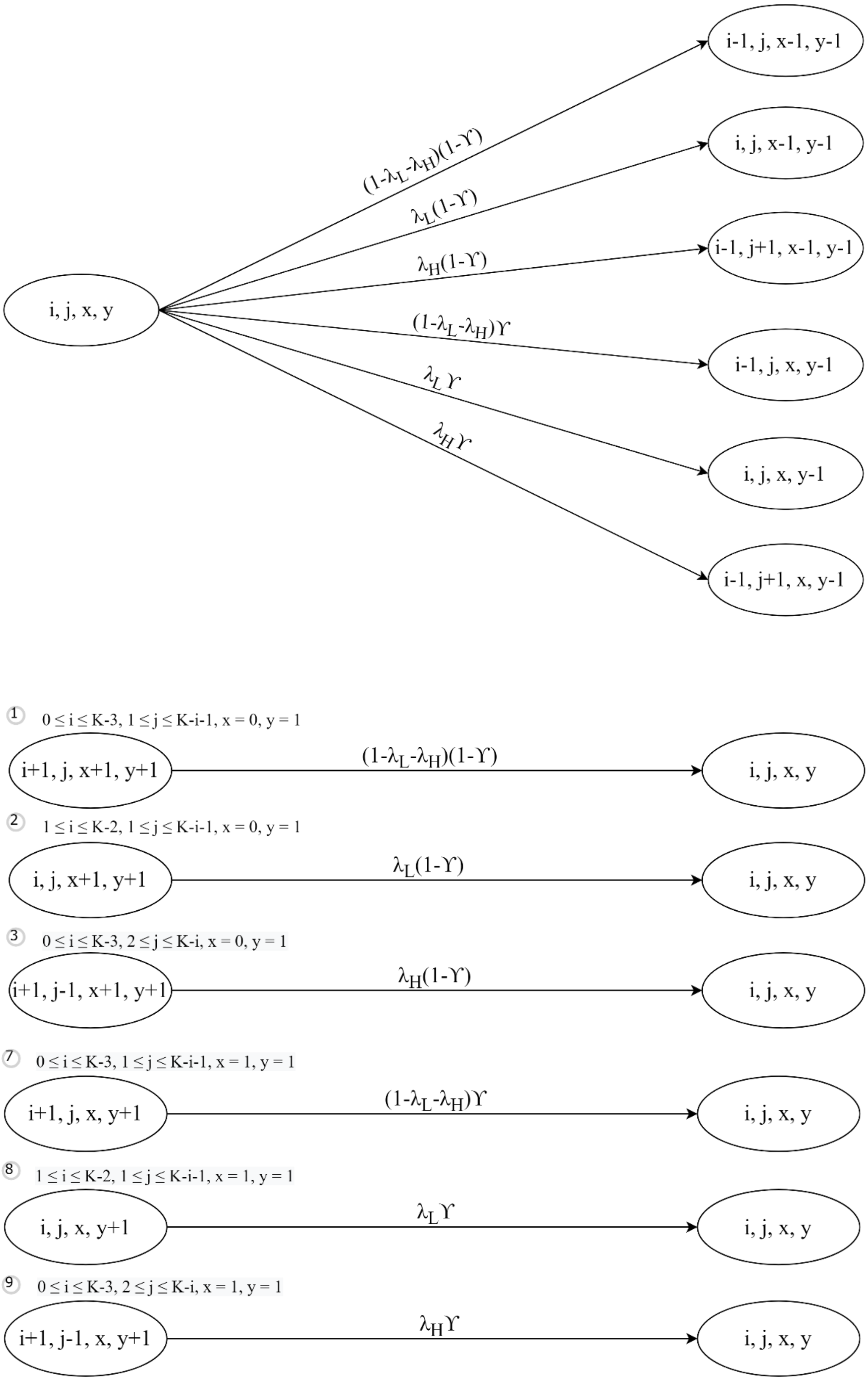


Fig 3. 26: The state diagram for $1 \le i \le K-2, 1 \le j \le K-i-1, x = 1, y = 2$