MODULE *APS_Scheduler*

EXTENDS *Naturals*, *FiniteSets*

$$
\begin{aligned}
&APSConfigType(maxBatch,\ maxPipeline,\ maxTimeout) \triangleq \\
&\quad [\\
&\qquad batchSize : 1 \,..\, maxBatch, \\
&\qquad pipelineDepth : 1 \,..\, maxPipeline, \\
&\qquad timeout : 1 \,..\, maxTimeout \\
&\quad]
\end{aligned}
$$

$$
\begin{aligned}
&ConfigSatisfiesNetwork(cfg,\ networkCondition) \triangleq \\
&\quad \text{IF } networkCondition = \text{“Unstable”} \\
&\quad \text{THEN } \land\ cfg.timeout \geq 2 \\
&\qquad\qquad \land\ cfg.batchSize \leq 2 \\
&\qquad\qquad \land\ cfg.pipelineDepth \leq 2 \\
&\quad \text{ELSE } \land\ cfg.timeout \geq 1 \\
&\qquad\qquad \land\ cfg.batchSize \geq 1 \\
&\qquad\qquad \land\ cfg.pipelineDepth \geq 1
\end{aligned}
$$

$$
\begin{aligned}
&LatencyScore(cfg,\ networkCondition) \triangleq \\
&\quad \text{IF } networkCondition = \text{“Unstable”} \\
&\quad \text{THEN } (2 * cfg.timeout) + cfg.batchSize + cfg.pipelineDepth \\
&\quad \text{ELSE } cfg.timeout + cfg.batchSize
\end{aligned}
$$

$$
ThroughputScore(cfg) \triangleq cfg.batchSize * cfg.pipelineDepth
$$

$$
\begin{aligned}
&PerformanceScore(cfg,\ networkCondition) \triangleq \\
&\quad (2 * LatencyScore(cfg,\ networkCondition)) - ThroughputScore(cfg)
\end{aligned}
$$

$$
\begin{aligned}
&ChooseBetterConfig(current,\ candidate,\ networkCondition) \triangleq \\
&\quad \text{IF } PerformanceScore(candidate,\ networkCondition) \leq PerformanceScore(current,\ networkCondition) \\
&\quad \text{THEN } candidate \\
&\quad \text{ELSE } current
\end{aligned}
$$

$$
\begin{aligned}
&RefineTimeout(timeout,\ networkCondition,\ maxTimeout) \triangleq \\
&\quad \text{IF } networkCondition = \text{“Unstable”} \\
&\quad \text{THEN IF } timeout < maxTimeout \text{ THEN } timeout + 1 \text{ ELSE } maxTimeout \\
&\quad \text{ELSE } 1
\end{aligned}
$$

$$
\begin{aligned}
&AdvanceSchedulerState(state) \triangleq \\
&\quad \text{IF } state = \text{“Monitor”} \text{ THEN “Sample”} \\
&\quad \text{ELSE IF } state = \text{“Sample”} \text{ THEN “Estimate”} \\
&\quad \text{ELSE IF } state = \text{“Estimate”} \text{ THEN “Explore”} \\
&\quad \text{ELSE IF } state = \text{“Explore”} \text{ THEN “Deploy”} \\
&\quad \text{ELSE “Monitor”}
\end{aligned}
$$