Character Strategy Formulas and Logical Representations

This document outlines the simplified formulas and logical representations for each of the six legendary strategies implemented in the Applied Probability and Automation Framework. These representations aim to distill the core decision-making principles of each character into a concise, actionable form, much like a battle plan for a seasoned strategist.

1. Takeshi Kovacs - The Aggressive Berserker

Takeshi's strategy is characterized by aggressive, high-risk, high-reward plays, adapting rapidly to perceived opportunities. His core logic can be represented as a dynamic betting function that scales with perceived advantage and a rapid decision-making process.

Simplified Formula:

$ \text{BetSize} = \text{BaseBet} \times (1 + \alpha \times \text{PerceivedAdvantage}) \times \text{AggressionFactor} $

$ \text{Decision} = \text{ClickHighestEVCell} \text{ if } \text{PerceivedAdvantage} > \text{Threshold} \text{ else } \text{CashOut} $

Logical Representation:

```
IF (PerceivedAdvantage > AggressionThreshold) THEN
    Bet = BaseBet * (1 + DynamicBetMultiplier * PerceivedAdvantage)
    Action = ClickHighestExpectedValueCell
ELSE IF (CurrentProfit > WinTarget OR CurrentLoss > StopLoss) THEN
    Action = CashOut
ELSE
    Action = ClickNextHighestExpectedValueCell
END IF
```

Key Parameters:
- BaseBet: Initial bet amount.
- α: Sensitivity to perceived advantage (Aggression Factor).
- $\text{PerceivedAdvantage}$: A calculated metric based on board state, remaining mines, and potential payouts. Higher values indicate more favorable conditions.

- $\text{AggressionThreshold}$: The minimum perceived advantage required to initiate an aggressive play.
- WinTarget: The profit level at which Takeshi will consider cashing out.
- StopLoss: The loss level at which Takeshi will consider cashing out.

Takeshi's strategy is akin to a berserker charging into battle: high risk for high reward, but with a keen eye for opportunities and a quick retreat when conditions turn dire. His strength lies in exploiting fleeting advantages with decisive action, embodying the Envoy Intuition to adapt on the fly.

2. Lelouch vi Britannia - The Strategic Mastermind

Lelouch's strategy is a sophisticated blend of calculated planning, psychological manipulation, and optimal timing. His core logic involves evaluating long-term game states, predicting opponent (or game system) responses, and executing moves that maximize strategic advantage, often with a hidden objective.

Simplified Formula:

$ \text{Decision} = \text{argmax}_{a \in \text{Actions}} (\text{ExpectedValue}(a) + \beta \times \text{StrategicImpact}(a) + \gamma \times \text{PsychologicalAdvantage}(a)) $

$ \text{StrategicImpact}(a) = \text{FutureGameStates}(a) \times \text{OpponentResponsePrediction}(a) $

Logical Representation:

```
 IF (LongTermStrategicGoalAchievable) THEN
    Action = ExecuteOptimalMoveForStrategicGoal
ELSE IF (OpponentBehaviorPredictable) THEN
    Action = ExploitPredictedOpponentWeakness
ELSE IF (PsychologicalAdvantagePossible) THEN
    Action = ExecutePsychologicalManipulationMove
ELSE
    Action = DefaultOptimalExpectedValueMove
END IF
```

Key Parameters:
- $\text{ExpectedValue}(a)$: The immediate statistical expected value of action a.
- $\text{StrategicImpact}(a)$: A measure of how action a influences future game states and opponent responses.
- $\text{PsychologicalAdvantage}(a)$: A metric quantifying the psychological pressure or misdirection created by action a.

- β, γ: Weights determining the importance of strategic impact and psychological advantage relative to immediate expected value.
- $\text{LongTermStrategicGoalAchievable}$: A boolean indicating if a predefined long-term objective is within reach.
- $\text{OpponentBehaviorPredictable}$: A boolean indicating if the game system's (or an opponent's) response patterns are discernible.

Lelouch operates like a grand chess master, always thinking several steps ahead. His strategy isn't just about immediate gains, but about shaping the entire battlefield to his advantage, using his Geass to subtly influence outcomes and achieve his ultimate objectives.

3. Kazuya Kinoshita - The Conservative Survivor

Kazuya's strategy is fundamentally risk-averse, prioritizing capital preservation and consistent, albeit modest, gains. His logic is driven by strict adherence to safety protocols and a deep understanding of potential pitfalls, ensuring long-term survival even in volatile environments.

Simplified Formula:

$ \text{Decision} = \text{argmax}_{a \in \text{SafeActions}} (\text{ExpectedValue}(a)) \text{ if } \text{RiskLevel} < \text{MaxTolerableRisk} \text{ else } \text{CashOut} $

$ \text{SafeActions} = \{ a \mid \text{ProbabilityOfLoss}(a) < \text{RiskThreshold} \} $

Logical Representation:

```
IF (CurrentLoss >= StopLoss OR CurrentProfit >= WinTarget) THEN
    Action = CashOut
ELSE IF (BoardState.HasHighRiskCells OR ProbabilityOfLoss(NextClick) >= MaxTolerableRisk) THEN
    Action = CashOut
ELSE
    Action = ClickSafestCellWithPositiveExpectedValue
END IF
```

Key Parameters:
- MaxTolerableRisk: The maximum acceptable probability of loss for any given action.
- $\text{ProbabilityOfLoss}(a)$: The calculated probability of losing the current round if action a is taken.
- SafeActions: A subset of all possible actions that meet the defined risk criteria.

- StopLoss: The maximum allowable cumulative loss before cashing out.
- WinTarget: The desired cumulative profit before cashing out.
- $\text{BoardState.HasHighRiskCells}$: A boolean indicating if the current board configuration presents unusually high-risk areas.

Kazuya navigates the game like a cautious explorer, always checking for traps and prioritizing a safe return over a risky treasure. His Rental Wisdom guides him to avoid unnecessary exposure, ensuring he lives to play another day, even if it means missing out on some high-stakes opportunities.

4. Senku Ishigami - The Analytical Scientist

Senku's strategy is purely data-driven and scientific, focusing on maximizing expected value through rigorous probability calculations and systematic optimization. His approach is characterized by continuous learning and refinement based on empirical evidence.

Simplified Formula:

$ \text{Decision} = \text{argmax}_{a \in \text{Actions}} (\text{ExpectedValue}(a | \text{BoardState}, \text{HistoricalData})) $

$ \text{ExpectedValue}(a | \text{BoardState}, \text{HistoricalData}) = \sum_{s' \in \text{NextStates}} P(s' | a, \text{BoardState}) \times \text{Value}(s') $

Logical Representation:

```
WHILE (GameInProgress) DO
   CollectAllAvailableData(BoardState, RevealedCells, HistoricalOutcomes)
   CalculateProbabilities(RemainingMines, UnrevealedCells)
   FOR EACH UnrevealedCell DO
      CalculateExpectedValue(Cell, Probabilities, Payouts)
   END FOR
   Action = ClickCellWithHighestExpectedValue
   IF (NoPositiveExpectedValueCells) THEN
      Action = CashOut
   END IF
END WHILE
```

Key Parameters:
- $\text{ExpectedValue}(a | \text{BoardState}, \text{HistoricalData})$: The calculated expected value of taking action a, conditioned on the current board state and all available historical data.
- $P(s' | a, \text{BoardState})$: The probability of transitioning to state s' given action

a and the current board state.
- $\text{Value}(s')$: The value of the next state s', typically representing the potential future profit.
- RemainingMines: The number of mines yet to be found on the board.
- UnrevealedCells: The cells on the board that have not yet been clicked.

Senku approaches the game as a grand experiment, meticulously gathering data and applying scientific principles to uncover the optimal path. His Science Kingdom ability allows him to systematically analyze every variable, ensuring that every decision is backed by irrefutable logic and empirical evidence.

5. Rintaro Okabe - The Mad Scientist

Okabe's strategy is a complex, multi-layered approach that combines game theory, psychological manipulation, and an uncanny ability to perceive and exploit subtle shifts in probability, akin to his 'Reading Steiner' ability to observe worldline changes. His decisions are not just about immediate expected value, but about influencing the overall flow of the game and predicting future states based on subtle cues.

Simplified Formula:

$ \text{Decision} = \text{argmax}_{a \in \text{Actions}} (\text{GameTheoryEV}(a) + \delta \times \text{WorldlineConvergence}(a) + \epsilon \times \text{PsychologicalPressure}(a)) $

$ \text{WorldlineConvergence}(a) = \text{ProbabilityOfDesiredFutureState}(a) \times \text{ImpactOnFutureState}(a) $

Logical Representation:

```
 IF (OpponentBehaviorDetectedAsBluff) THEN
    Action = ExploitBluffWithAggressiveCounter
 ELSE IF (WorldlineConvergenceToDesiredOutcomeLikely) THEN
    Action = ReinforceConvergencePath
 ELSE IF (LabMemberConsensusReachedOnOptimalPlay) THEN
    Action = ExecuteConsensusPlay
 ELSE IF (PsychologicalAdvantageOpportunity) THEN
    Action = ApplyPsychologicalPressure
 ELSE
    Action = DefaultGameTheoryOptimalMove
 END IF
```

Key Parameters:
- $\text{GameTheoryEV}(a)$: The expected value of action a derived from game-

theoretic models (e.g., Nash Equilibrium).
- $\text{WorldlineConvergence}(a)$: A metric representing how much action a pushes the game towards a desired future state or outcome, considering multiple probabilistic paths.
- $\text{PsychologicalPressure}(a)$: A measure of how action a might induce errors or predictable responses from an opponent (or the game system).
- δ, ϵ: Weights determining the importance of worldline convergence and psychological pressure.
- $\text{OpponentBehaviorDetectedAsBluff}$: A boolean indicating if the system detects a high probability of a bluff from the opponent.
- $\text{LabMemberConsensusReachedOnOptimalPlay}$: A simulated consensus from a group of diverse strategies (like his lab members) on the best course of action.

Okabe's strategy is a chaotic yet brilliant dance between scientific rigor and intuitive leaps, always seeking to manipulate the 'worldline' of the game to his advantage. His decisions are often counter-intuitive but lead to unexpected victories, embodying the unpredictable genius of a true mad scientist.

6. Hybrid Strategy - The Ultimate Fusion

The Hybrid strategy is a dynamic, adaptive approach that intelligently blends the strengths of Senku (analytical rigor) and Lelouch (strategic mastery) based on real-time game conditions and performance metrics. It aims to achieve optimal balance between immediate expected value maximization and long-term strategic positioning.

Simplified Formula:

$ \text{Decision} = \text{Blend}(\text{SenkuStrategy}(S), \text{LelouchStrategy}(S), \text{Weight}(S)) $

$ \text{Weight}(S) = \text{Sigmoid}(\text{PerformanceMetric}(S) - \text{Threshold}) $

Logical Representation:

```
  IF (CurrentGamePhase == 'Early' OR BoardComplexity == 'Low') THEN
    Action = SenkuStrategy.ClickHighestExpectedValueCell
  ELSE IF (CurrentGamePhase == 'Late' OR OpponentBehaviorDetected) THEN
    Action = LelouchStrategy.ExecuteStrategicMove
  ELSE
    // Dynamic blending based on performance and context
    SenkuWeight = CalculateSenkuWeight(PerformanceMetrics, RiskTolerance)
    LelouchWeight = 1 - SenkuWeight
    Action = WeightedAverageDecision(SenkuStrategy.Decision,
```

```
LelouchStrategy.Decision, SenkuWeight, LelouchWeight)
```
END IF

Key Parameters:
- $\text{SenkuStrategy}(S)$: The decision output from Senku's analytical strategy given state S.
- $\text{LelouchStrategy}(S)$: The decision output from Lelouch's strategic strategy given state S.
- $\text{Weight}(S)$: A dynamically calculated weight (between 0 and 1) that determines the blend ratio between Senku's and Lelouch's strategies. This weight is often derived from a sigmoid function applied to a performance metric or a contextual factor.
- $\text{PerformanceMetric}(S)$: A real-time metric reflecting the current effectiveness or suitability of a strategy given the game state (e.g., recent win rate, risk exposure, or deviation from expected profit).
- Threshold: A value used in the sigmoid function to determine the crossover point for blending.
- CurrentGamePhase: Categorization of the game's progress (e.g., 'Early', 'Mid', 'Late').
- BoardComplexity: A measure of the current board's difficulty or uncertainty.
- $\text{OpponentBehaviorDetected}$: A boolean indicating if the system has identified specific opponent patterns that might require a strategic response.

The Hybrid strategy is the ultimate fusion, adapting its core identity based on the ebb and flow of the game. It's like a multi-class character in an RPG, seamlessly switching between a powerful mage (Lelouch) and a brilliant scientist (Senku) to optimize for any situation, ensuring both tactical superiority and long-term stability.