UOIF: Proof-Driven Recompute of $\Psi(x)$ with Stepwise Confidence and Live Verification

UOIF Working Note

August 08, 2025

1 Model and Proof Logic

We evaluate

$$\Psi(x) \;=\; \underbrace{\left[\alpha\, S(x) + (1-\alpha)\, N(x)\right]}_{\text{Hybrid linearity}} \cdot \underbrace{\exp\!\big(-[\lambda_1 R_a + \lambda_2 R_v]\big)}_{\text{Exponential boundedness}} \cdot \underbrace{P(H \mid E, \beta)}_{\text{Bayesian calibration}} \quad , \quad \lambda_1{=}0.85,\ \lambda_2{=}0.15,\ S(x){=}0.60.$$

Deductive derivations.

- Hybrid linearity: $O(\alpha) = \alpha\, S(x) + (1-\alpha)\, N(x)$ is affine; $\partial O/\partial\alpha = S(x) - N(x) < 0$ when $N(x) > S(x)$.
- Exponential boundedness: $R_a, R_v \geq 0 \Rightarrow$ Penalty $:= \exp(-[\lambda_1 R_a + \lambda_2 R_v]) \in (0, 1]$.
- Bayesian posterior: $P(H \mid E, \beta) = \min\{\beta\, P(H \mid E), 1\}$ caps uplift at certainty.

2 Verification (Real-Time: Aug 08, 2025)

Official 2025 results live: year info, country, individual, statistics.
Problems page pending: no 2025 problems/shortlist content observed.

3 IMO 2025 Results (Canonical Live): Stepwise with Confidence

Sources. Official results + DeepMind 2025 + Evan 2025 + AoPS. Confidence: 0.98.

Step. Choose $\alpha \in \{0.12, 0.15\}$, $N(x){=}0.97$, $\beta{=}1.15$. Hybrid $O(\alpha) = \alpha \cdot 0.60 + (1-\alpha) \cdot 0.97 = 0.97 - 0.37\alpha$; thus $O(0.12){=}0.9256$, $O(0.15){=}0.9145$. Confidence: 0.96.

Penalty (canonical-eased). $R_a{=}0.12, R_v{=}0.04 \Rightarrow$ Penalty $= \exp(-[0.85 \cdot 0.12 + 0.15 \cdot 0.04]) = \exp(-0.108) \approx 0.8977$. Confidence: 0.85.

Posterior (capped). With $P(H \mid E) \in [0.85, 0.90]$, $\beta{=}1.15$, set $P(H \mid E, \beta) = 1.0$. Confidence: 0.88.

Value. $\alpha{=}0.12 \Rightarrow \Psi(x) \approx 0.9256 \times 0.8977 \times 1.0 = \mathbf{0.831}$; $\alpha{=}0.15 \Rightarrow \Psi(x) \approx 0.9145 \times 0.8977 \times 1.0 = \mathbf{0.821}$.

Label: Primitive/Empirically Grounded (results primitives). Confidence: 0.90.

Sensitivity. $\dfrac{\partial \Psi(x)}{\partial \alpha} = (S(x) - N(x)) \cdot \text{Penalty} \cdot P(H \mid E, \beta) < 0$. Confidence: 0.92.

4 IMO 2025 Problems (Pending Canonical): Stepwise with Confidence

Sources. Evan 2025 + AoPS + DeepMind 2025 (expert interpretive). Confidence: 0.88.

Step. Example midpoint α=0.17, $N(x)$=0.89, β=1.05. Hybrid $O = 0.17 \cdot 0.60 + 0.83 \cdot 0.89 = 0.8407$. Confidence: 0.85.

Penalty (stricter). R_a=0.25, R_v=0.10 $\Rightarrow$ Penalty $= \exp(-[0.85 \cdot 0.25 + 0.15 \cdot 0.10]) = \exp(-0.2275) \approx 0.797$. Confidence: 0.80.

Posterior. $P(H \mid E, \beta) = 0.90 \times 1.05 = 0.945$. Confidence: 0.85.

Value. $\Psi(x) \approx 0.8407 \times 0.797 \times 0.945 \approx \mathbf{0.633}$. Range over $\alpha \in [0.15, 0.20]$, $N(x) \in [0.88, 0.90]$: **0.621**–**0.643**.

Label: Interpretive/Contextual. Confidence: 0.85.

5 IMO 2024 (DeepMind P1/P2/P4): Stepwise with Confidence

Sources. DeepMind 2024 solution pages + Evan + established archives/mirrors. Confidence: 0.90.

Step. $N(x)$=0.96, $\alpha \in \{0.10, 0.15\}$, β=1.05. Hybrid $O(\alpha) = 0.96 - 0.36\alpha$: $O(0.10)$=0.9240, $O(0.15)$=0.9060. Confidence: 0.88.

Penalty. R_a=0.10, R_v=0.05 $\Rightarrow$ Penalty $= \exp(-[0.85 \cdot 0.10 + 0.15 \cdot 0.05]) = \exp(-0.0925) \approx 0.9117$. Confidence: 0.85.

Posterior. $P(H \mid E, \beta) = 0.90 \times 1.05 = 0.945$. Confidence: 0.85.

Value. α=0.10 $\Rightarrow \Psi(x) \approx 0.9240 \times 0.9117 \times 0.945 = \mathbf{0.796}$; α=0.15 $\Rightarrow$ **0.781**.

Label: Primitive/Empirically Grounded. Confidence: 0.88.

6 Keystone Reflections

- $\Psi(x)$ **as evidential synthesizer**: prioritizes canonical artifacts, damps overconfidence via $\exp(\cdot)$, and calibrates expert uplift through a capped posterior; monotone in α when $N > S$.
- **AI-driven mathematics**: enables transparent promotion (2025 results) while preserving caution for pending primitives (2025 problems).

7 Condensed Citations

Official IMO 2025 (results): year info, country, individual, statistics.
DeepMind 2025: blog, solutions PDF.
DeepMind 2024: blog, solutions index.
Evan Chen 2025: notes. AoPS 2025: P1–P6 thread IDs as in prior exchanges.