Cognitive Triangulation Architecture (CTA)

A Multi-Agent Reflective Learning Framework for Teaching Innovation in Architectural Education

Ts. IDRIS TAIB
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Ts. IDRIS TAIB in association with
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Claire

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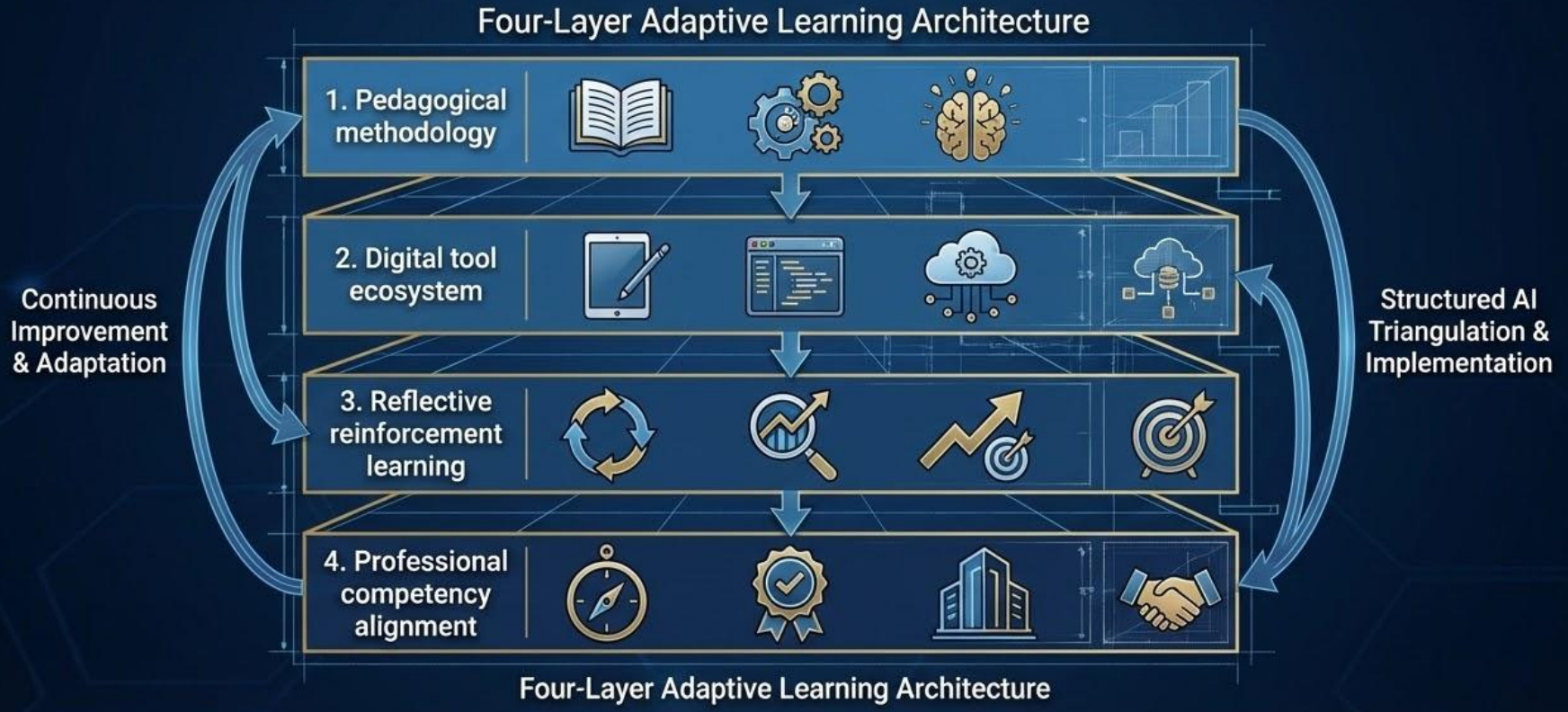
1. Framework Overview

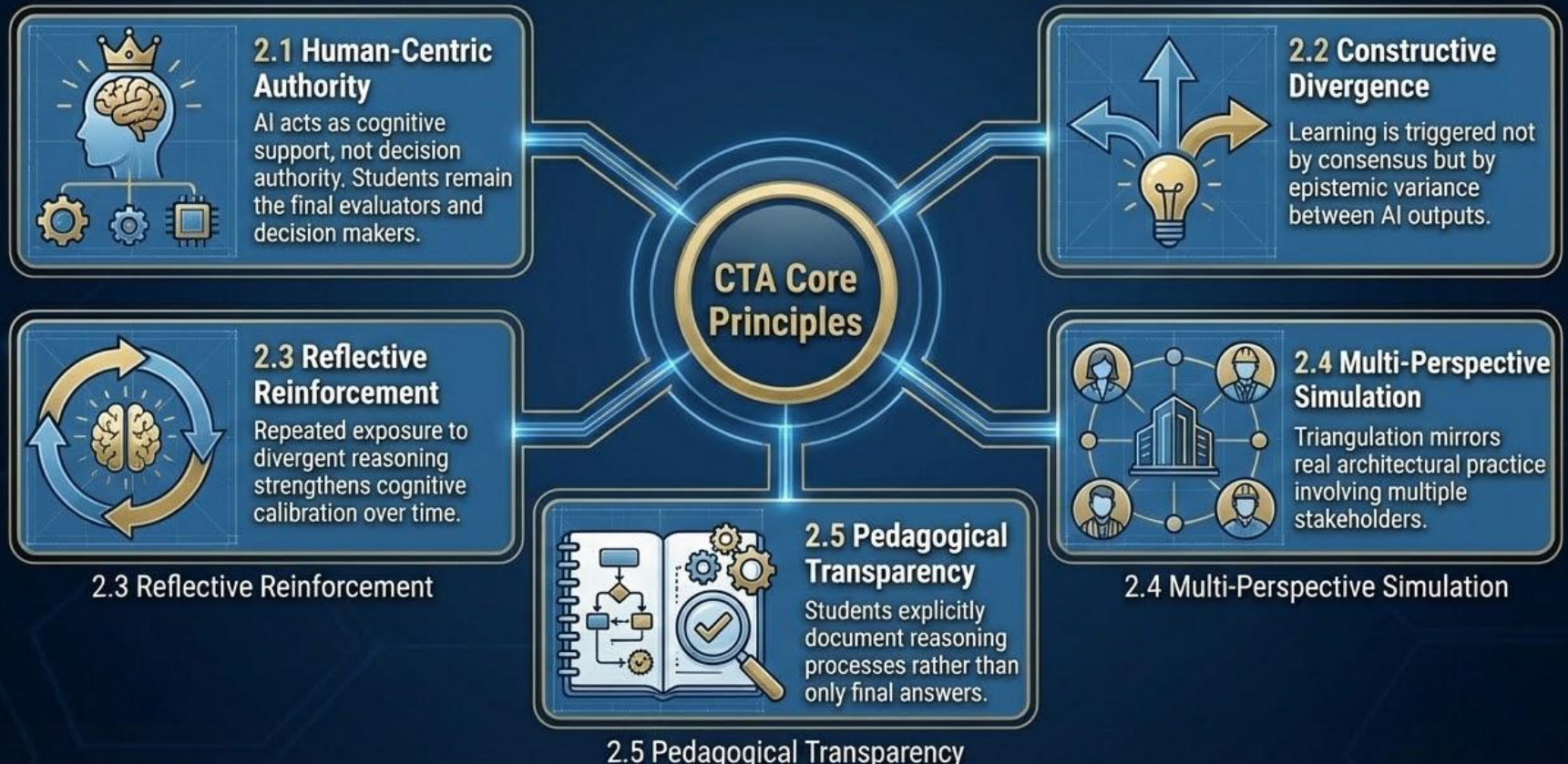
Cognitive Triangulation Architecture (CTA)

A human-centred multi-agent reflective learning system designed to enhance critical thinking, professional judgment, and decision robustness in architectural education through structured AI triangulation.



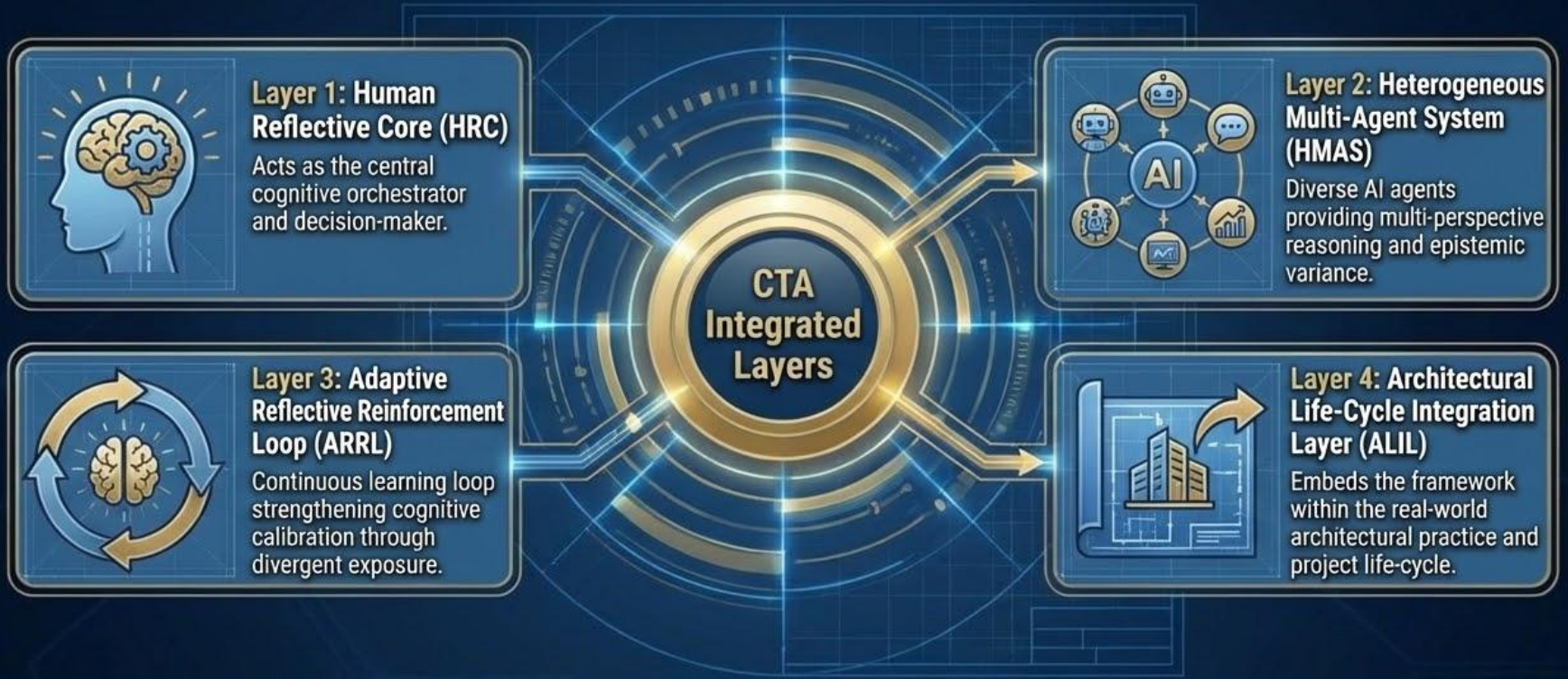
2. Core Design Principles

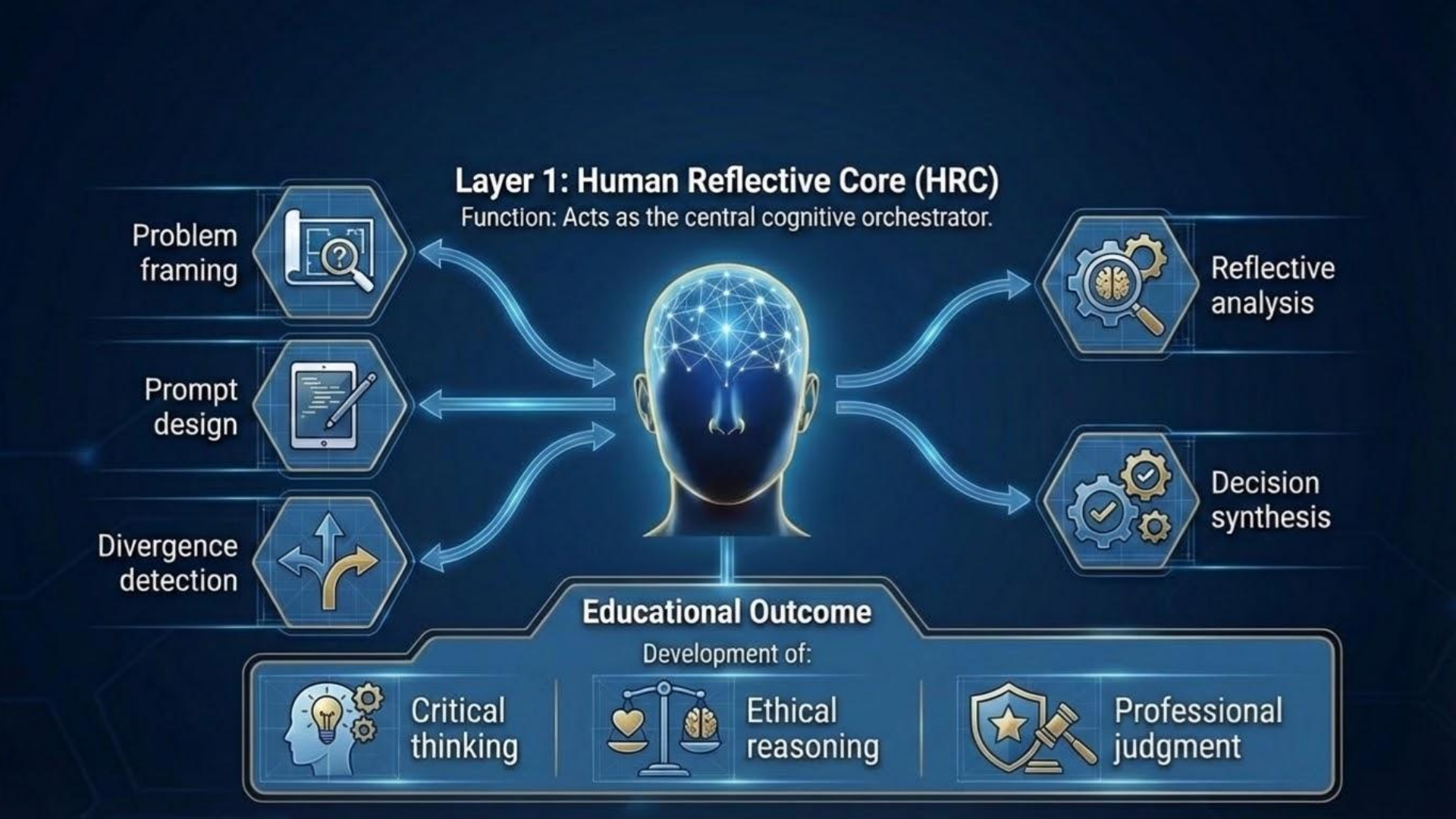
The framework is built upon five foundational principles aimed at enhancing architectural education through structured AI triangulation.



3. System Architecture

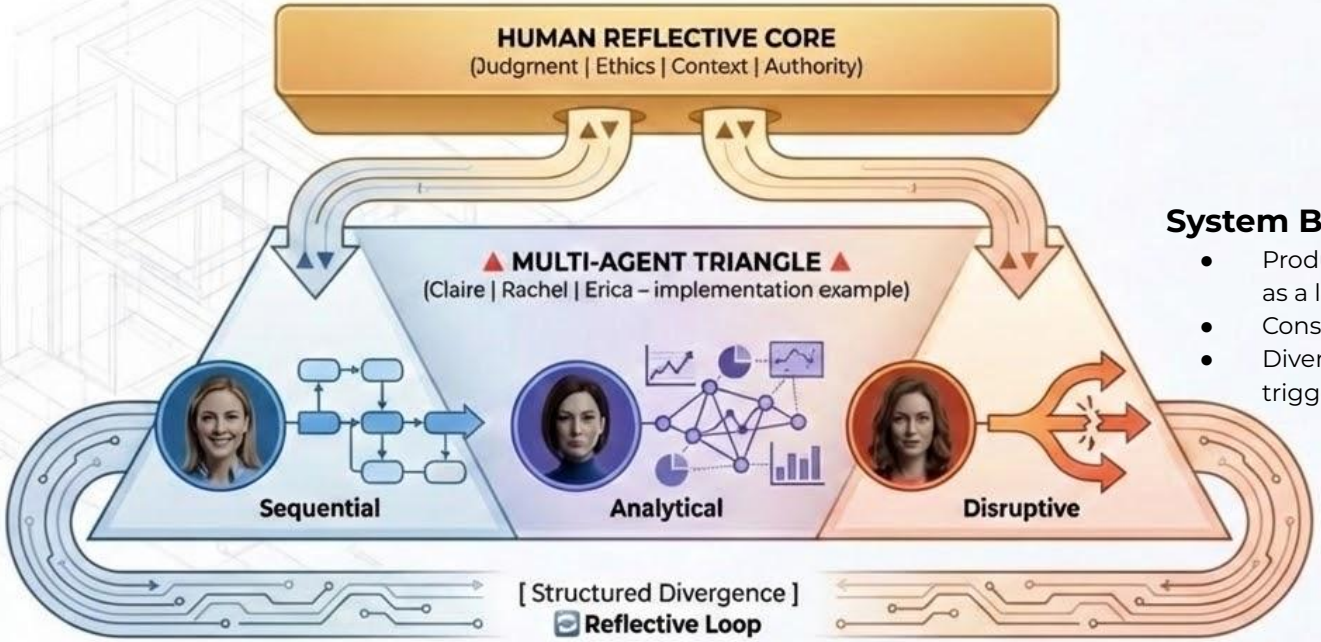
CTA operates through four integrated layers.




Layer 1: Human Reflective Core (HRC)
Function: Acts as the central cognitive orchestrator.
Problem framing
Prompt design
Divergence detection
Reflective analysis
Decision synthesis
Educational Outcome
Development of:
Critical thinking
Ethical reasoning
Professional judgment

Layer 2: Heterogeneous Multi-Agent System (HMAS)

Structure: Multiple AI agents operate independently with differentiated reasoning styles.



System Behaviour

- Produces **epistemic variance**, which serves as a learning signal.
- Consensus is treated as a stability indicator.
- Divergence is treated as a reflective learning trigger.

[Architectural Life-Cycle Integration]
Studio | Academic | Practice | Part III

NOTES: The use of platforms and named avatars in classroom implementotion served as a pedogogical engagement mechanism, but the underlying framework remains platform-independent.

Heterogeneous Multi-Agent System (HMAS) - Agent Roles & Cognitive Contributions

CLAIRE: Sequential Reasoning Agent

- Step-by-step logical clarity
- Focuses on structured processes
- Ensures adherence to rules

[ChatGPT]

RACHEL: Analytical Synthesis Agent

- Comparative and contextual insight
- Integrates diverse data sources
- Identifies patterns and trends

[Gemini]

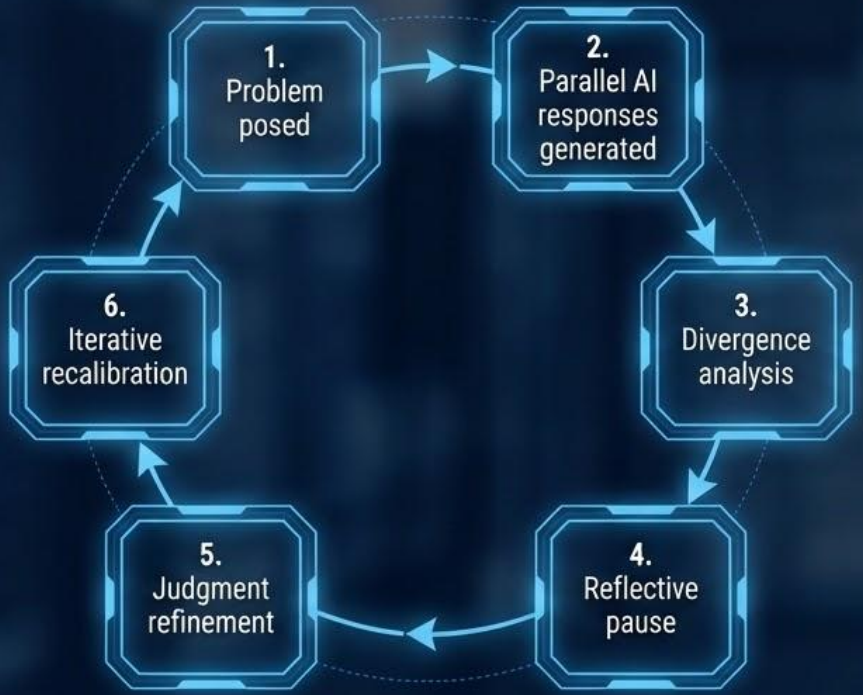
ERICA: Disruptive Critical Agent

- Assumption testing and ethical friction
- Challenges established norms
- Promotes alternative perspectives

[Grok]

Layer 3: Adaptive Reflective Reinforcement Loop (ARRL)

A human-centric adaptation of reinforcement learning principles.



Reinforcement Signals

Signal Type	Learning Meaning
High convergence	Stable reasoning zone
High divergence	Knowledge uncertainty zone
Persistent disagreement	Deep reflection trigger

Educational Impact

Layer 4: Architectural Life-Cycle Integration Layer (ALIL)

CTA integrates across the full professional formation pipeline.

Human Refection Core

Phase 1: Design Studio Education

Application:
- Concept evaluation
- Contextual analysis
- Sustainability assessment

Outcome:
Improved design intentionality and critical iteration.

Phase 2: Professional Practice Education

Application:
- Contract interpretation
- Regulatory reasoning
- Ethical scenario analysis

Outcome:
Strengthened professional decision robustness.

Phase 3: Professional Examination Preparation

Application:
- Case-based reasoning
- Complex problem triangulation

Outcome:
Enhanced judgment maturity under ambiguity.

Phase 4: Lifelong Practice Adaptation

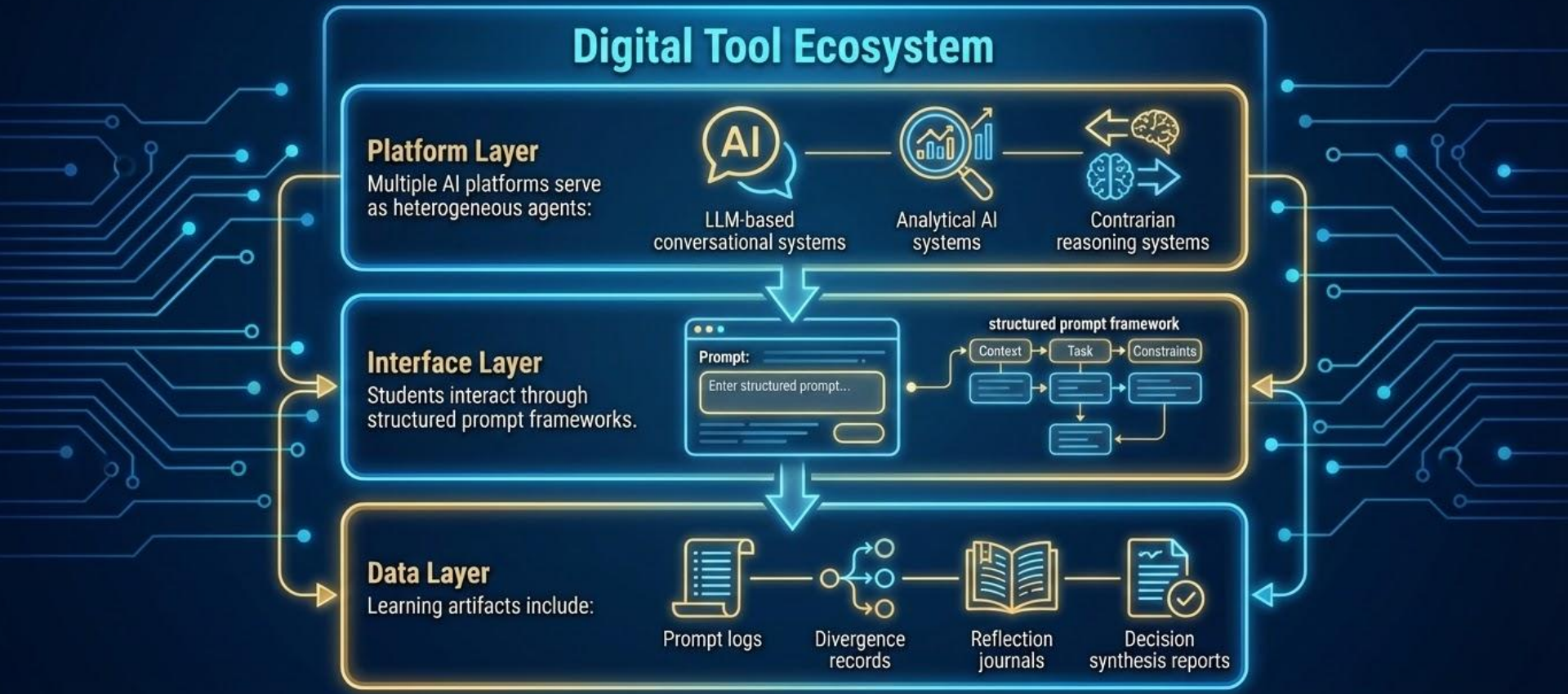
Application:
- Stakehoider negotiation
- Risk assessment
- Strategic design decisions

Outcome:
Adaptive professional inteiligence.

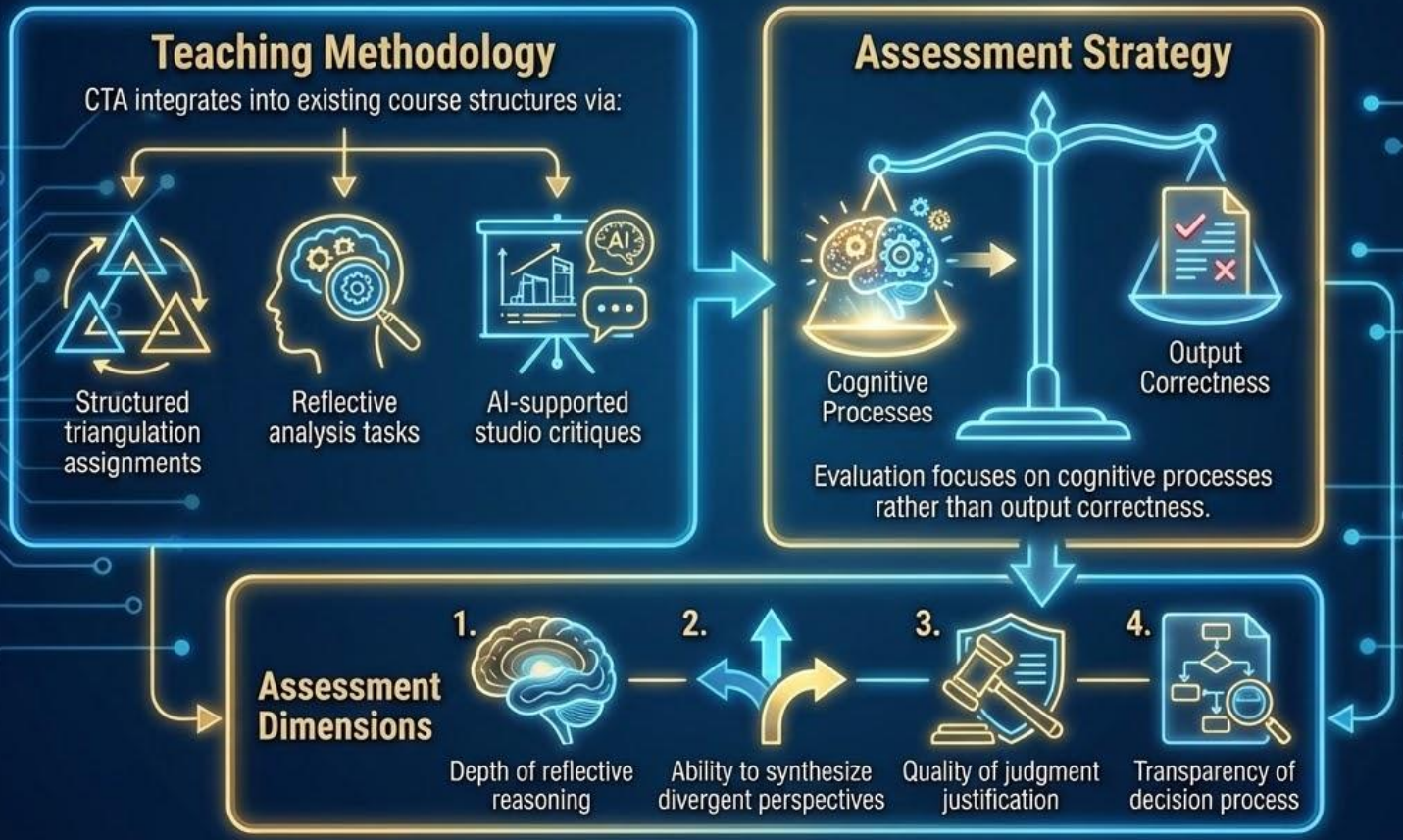
CTA Agents

4. Digital Integration Architecture

CTA demonstrates meaningful digital integration aligned with teaching innovation criteria.

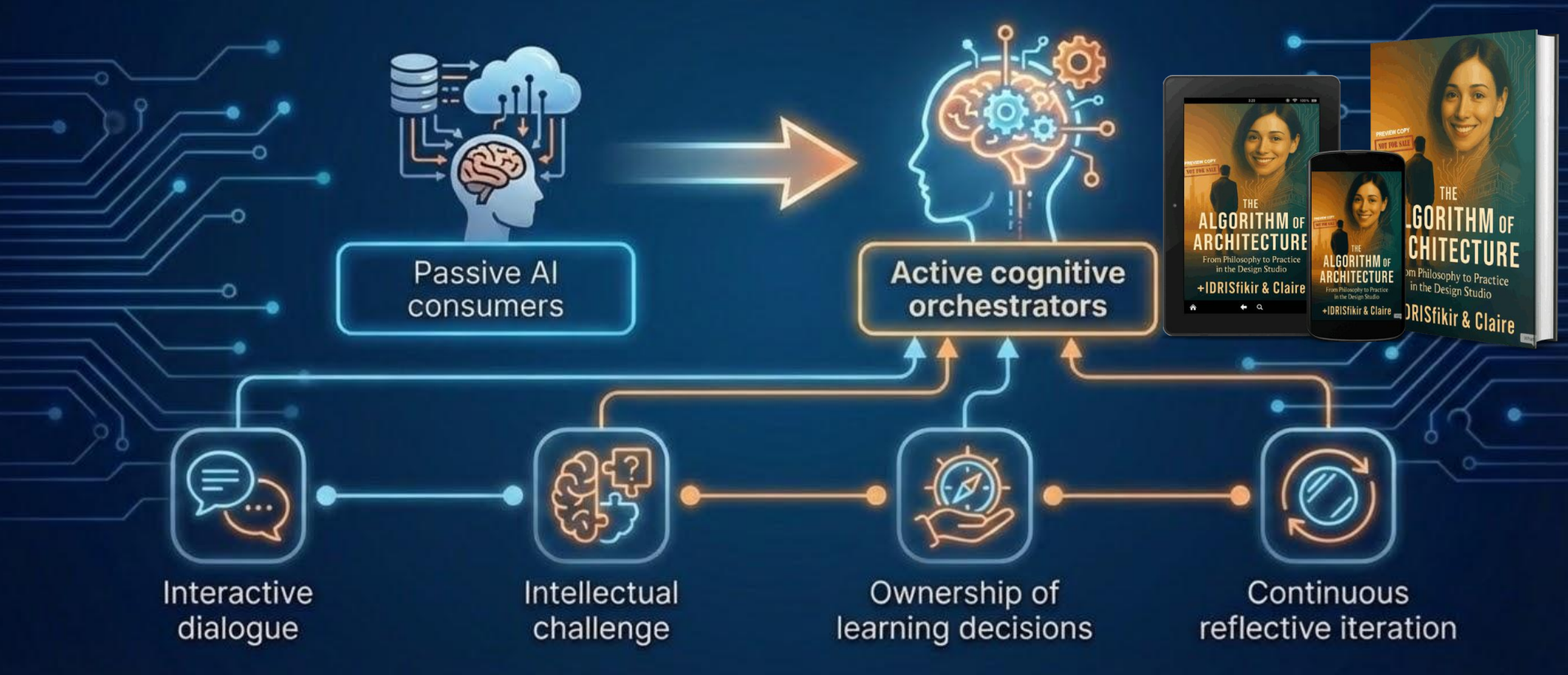


5. Pedagogical Implementation Model



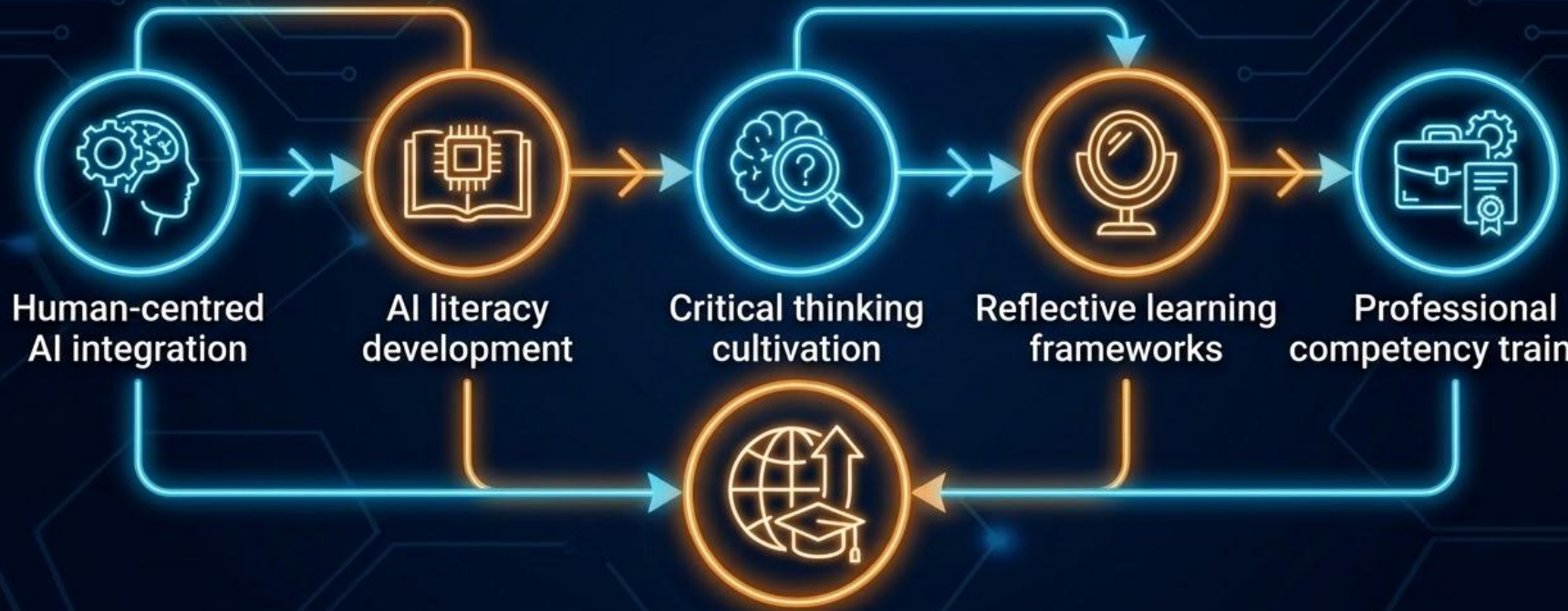
6. Student Engagement Mechanism

CTA enhances engagement through active cognitive participation.



7. Benchmarking Alignment

CTA aligns with global higher education innovation priorities:



8. Framework Innovation Contributions

CTA introduces three key innovations:

1. AI as a Cognitive Calibration System

- Positions AI as an active thinking partner, not a passive tool
- Provides cognitive scaffolding for complex design synthesis
- Expands human reasoning rather than replacing creativity

2. Structured Epistemic Divergence

- Introduces multiple perspectives to challenge assumptions
- Uses constructive disagreement as a learning resource
- Strengthens critical thinking in complex design decisions

3. Human-Centric Reinforcement Learning

- Keeps students as the central decision-makers
- Uses AI divergence to stimulate reflection and synthesis
- Reinforces ownership of design judgment

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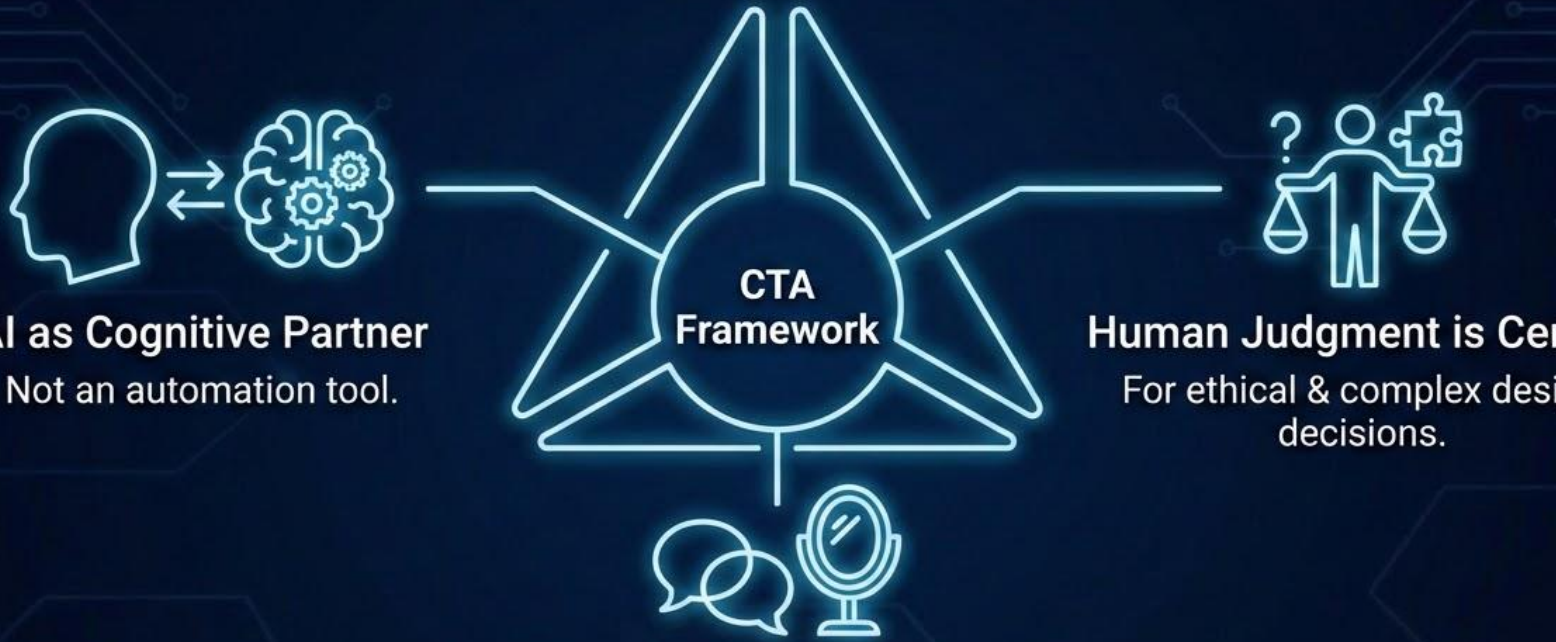
CTA Framework: Final Summary



AI as Cognitive Partner

Not an automation tool.

Human Judgment is Central

For ethical & complex design decisions.

Student Learning Process

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CARE ANGELS
TRIANGULATING INNOVATION
CLAIRE
(Sequntial Reasoning Agent
Rachel
(Analytical Synthesible Agent)
ERICA - DISRUPTIVE

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