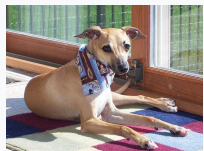
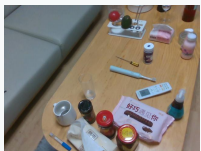


(a) Offline: capability formation and outcome-derived supervision

Expert portfolio



General CPT



Spatial SFT



Video SFT

Qwen3-VL-8B + independent LoRAs

Diagnostics + paired outcomes



$$c_e = P S_e$$

Evidence-null probes; overlapping strengths

Null a_0



+ Typed evidence

Same x , e , prompt and decoding

Learned utility + packet verifier

$$\hat{U}_\phi = B_\phi + G_\phi + \Gamma_\phi - \lambda C$$

Skill

Gain

Match

Cost

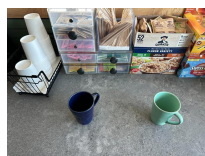
Native scorer / fixed open-ended judge

Router ϕ

Verifier ψ

(b) Online: one proposal, bounded acquisition, one answer

Input



$x = (q, o)$

Descriptor
 h_x, d_x

Joint Route Space

E

General · Spatial · Temporal

K

None · Template · Retrieval

T

Grounding · Depth · OCR

Any budgeted subset, including empty

Acquire once



Knowledge
guide / context



Perceptual
facts

Selected providers
run at most once

Verify / commit



Inspect Ω_{a^*}

Schema / target coverage
Confidence / provenance

Best valid $b \leq a^*$

Keep

Drop

Answer



Fixed expert e^*

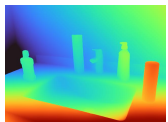
q + original o
+ retained Ω_{b^*}

All packets dropped: original observation, same expert; no online judge or reference

Supplied tool examples



RGB



Rel. depth



Typed evidence packet

• Content

• Coverage

• Confidence

• Ambiguity

• Provenance

• Cost

Post-acquisition subset decision

$$V(b) = \hat{U}_\phi(x, e^*, b) - \lambda[C(a^*) - C(b)] + H_\psi(b)$$

Commit only if $V(b) - V(a_0) > \gamma$; else $b^* = a_0$

Acquired calls stay charged; rejected packets trigger no retry.