

the same population-genetic abstractions (Table 1), increasing realism



Grounding
how much real data?

Exact model

Wright-Fisher simulator (NumPy)

closed forms · bitwise-reproducible

immigration-drift equilibrium:
 $g \approx 0.05$ retains $\geq 95\%$ diversity;
observation floor $1 - e^{-mp}$

Trained networks

RNN · MLP · VAE on a synthetic oracle;
convolutional VAE on MNIST

sign-level tests · exact oracles

collapse & rescue in every
architecture; MNIST: dry 30 → 1 modes,
10% grounding holds 30/30;
estimator-bias learning kernel

Language models

LoRA specialists on Qwen 0.5B & 7B;
exact-match verifier

seed-replicated signs

not tested at this tier

Recombination
blend or merge?

blending conservation law
(first-order cancellation);
union-operator gain; Fisher-Muller

merge rescues two forgetting
specialists ($\approx 0.50 \rightarrow 0.955$)

merged specialists beat every parent
(5 seeds at 0.5B; 7B); routing vs
averaging; the headroom rule

Entangled skills
who merges with whom?

NK landscapes: outbreeding
depression; directed sex restores
the gain; mate-pool breadth optimum

not tested at this tier

bred-and-screened offspring beat
the blind blend in every seed
(hard, unsaturated tasks)

The composed society
can the loop sustain itself?

four-arm ablation: grounding, sex,
diversity each removed
→ three distinct failures

not tested at this tier

open — the stated gap

Speciation & prediction
when does merging fail?

BDM incompatibility model:
isolation cliff; quadratic snowball

barrier decomposition under
permutation+rescaling; conflict
sweep $0.97 \rightarrow 0.03$; emergent null

convention conflict → hybrid
breakdown; duration null; pre-merge
predictive test (13 cond. × 3 seeds)