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# Four development stages of collective intelligence

**Key words:** Collective intelligence; Meta-synthesis of wisdom; Incompatibility; Labor division; Cooperative behavior; Collective intelligence emergence; Large language model

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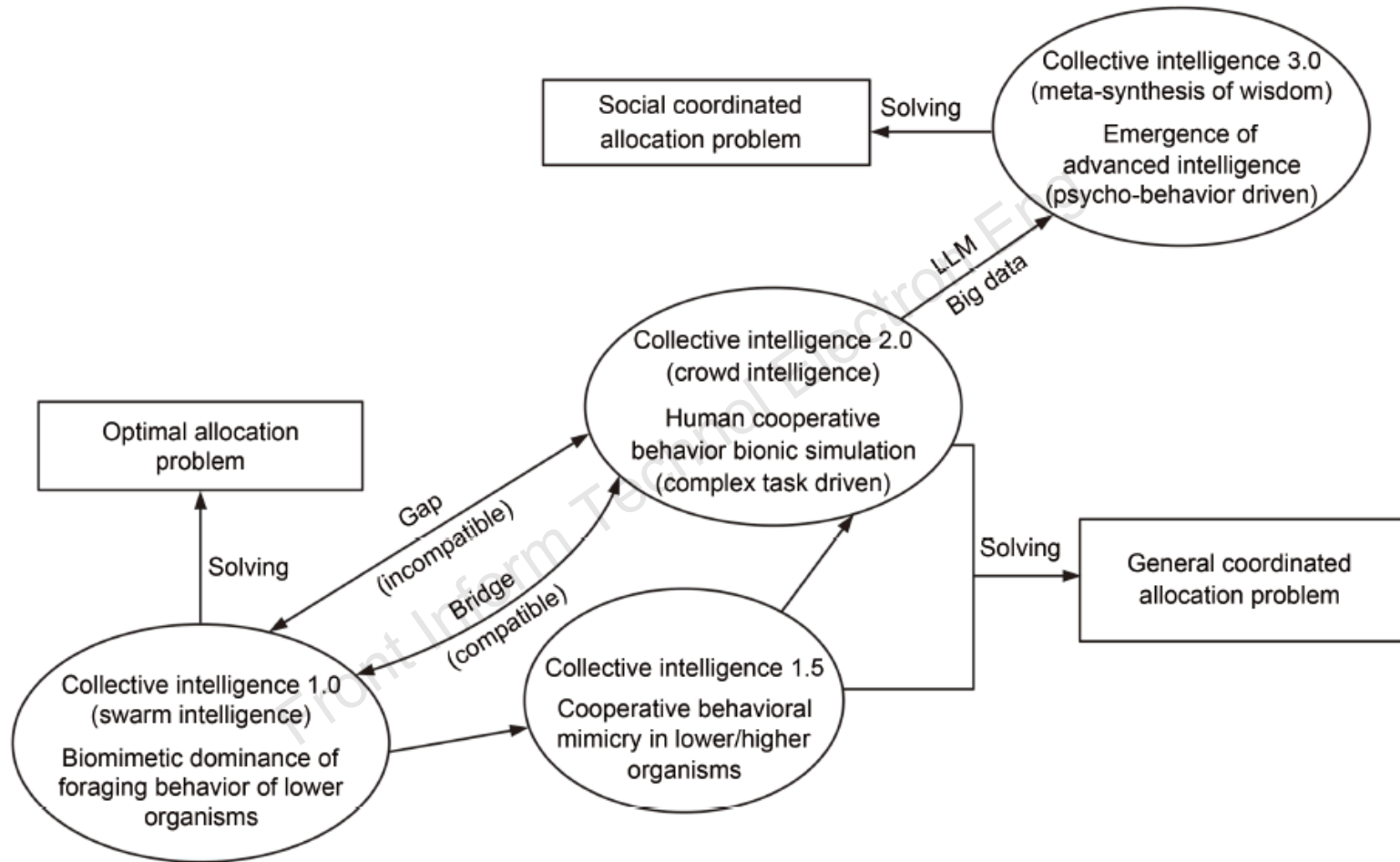
# Motivation

- There is currently a distinction between CI 1.0 (swarm intelligence) and CI 2.0 (crowd intelligence), including two different development stages. Swarm intelligence is biocentric, while crowd intelligence is human-centric. It is obvious that there is a fundamental difference between these two and they are not compatible.
- When CI 2.0 was proposed, it highlighted the guiding role of Qian's academic idea of a meta-synthesis seminar hall system, but the relationship between these two is unclear.

# Main idea

- In view that an incompatibility exists between CI 1.0 and CI 2.0, CI 1.5 is introduced to build a bridge between the above two stages, which is based on bio-collaborative behavioral mimicry. CI 1.5 is the transition from CI 1.0 to CI 2.0, which contributes to the compatibility of the two stages.
- A new interpretation of the meta-synthesis of wisdom proposed by Qian Xuesen is given. The meta-synthesis of wisdom, as an improvement of crowd intelligence, is an advanced stage of bionic intelligence, i.e., CI 3.0.
- As a result, four development stages (CI 1.0, CI 1.5, CI 2.0, and CI 3.0) are proposed.

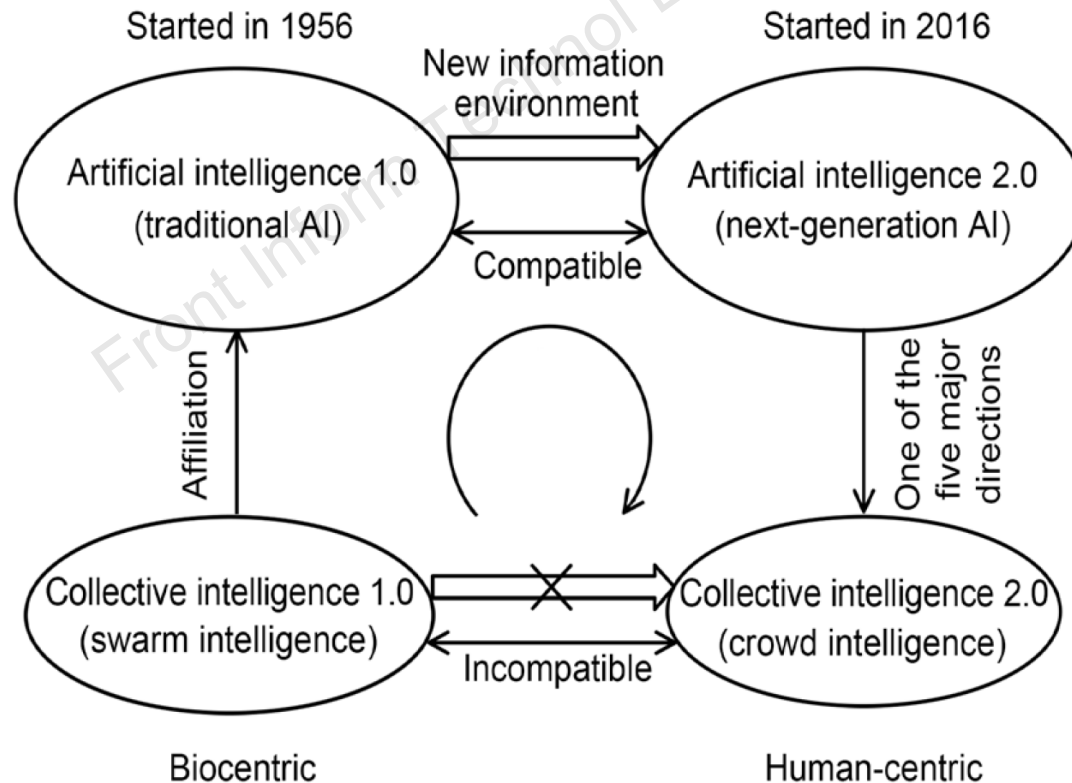
# Framework



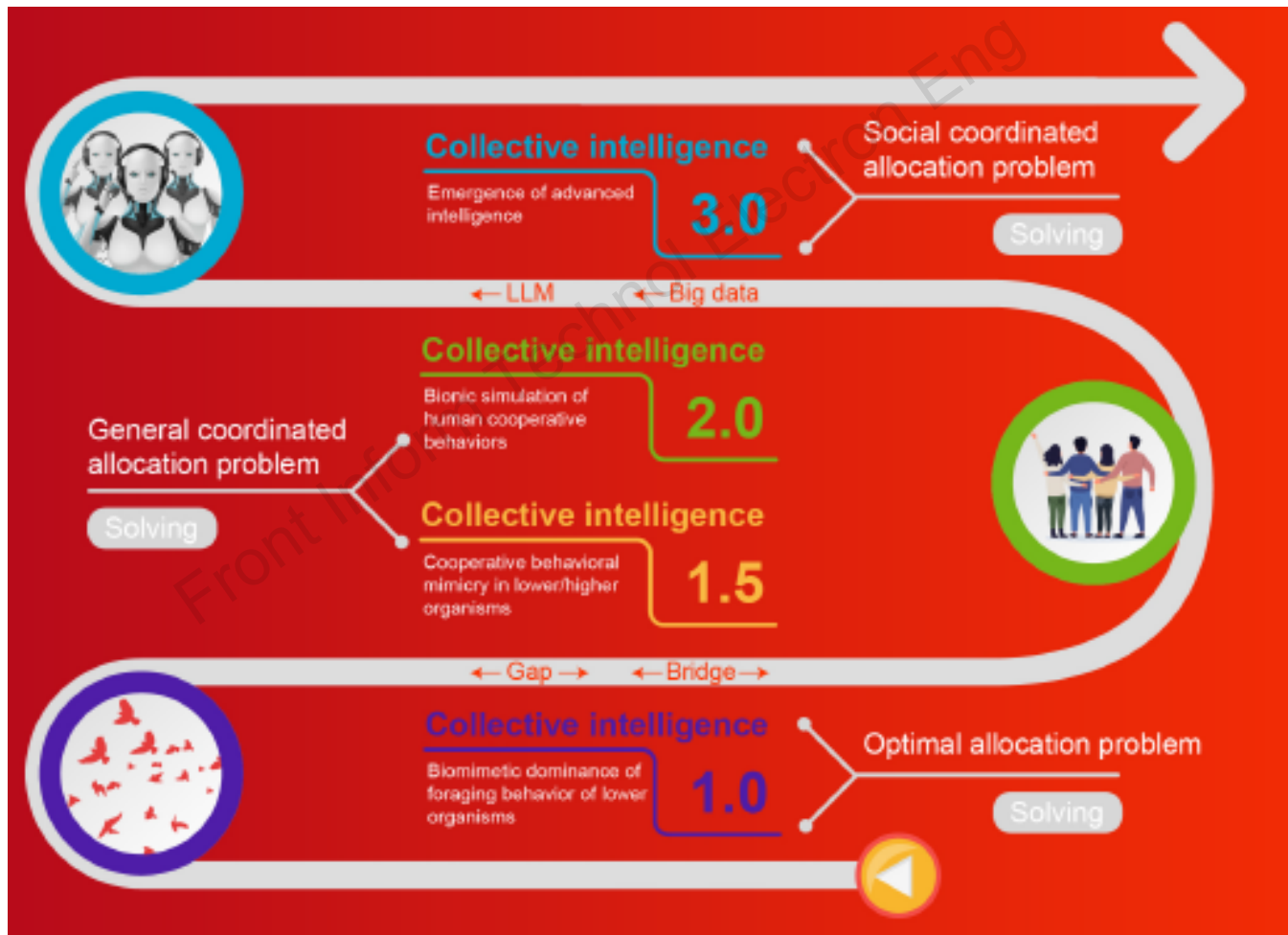
The overall framework of four development stages of collective intelligence. These four different stages develop progressively and with reasonable compatibility. In addition, there are differences between CI 2.0 and CI 3.0. CI 2.0 solves general coordinated-based allocation problems. CI 3.0 addresses distribution problems mainly in terms of social systems, which are more complex.

# Method

It can be seen that swarm intelligence is a component of traditional AI. In response to the impact of the new information environment, AI 1.0 develops to AI 2.0 (new generation AI) stage, which is a natural promotion process. But the natural promotion path directly from CI 1.0 to CI 2.0 does not exist (as shown by the hollow arrow with a fork). The promotion from CI 1.0 to CI 2.0 is generated indirectly through the path of CI 1.0→AI 1.0→AI 2.0→CI 2.0 (as shown by the clockwise arrow).



# Results



# Conclusions

1. The incompatibility of CI 1.0 and CI 2.0 is discovered, and the transition stage is further proposed, i.e., CI 1.5. With the connecting role of CI 1.5, the incompatibility between CI 1.0 and CI 2.0 is effectively dissolved.
2. We point out the limitations and clarify the main direction of CI 1.5. Through the analysis of retrospective origin, we propose a new perspective to study the hunting behavior of higher organisms based on the cooperative behavior mimicry of higher organisms.
3. A correlation between the meta-synthesis of wisdom (CI 3.0) and crowd intelligence (CI 2.0) is proposed. The analysis shows that the dual-wheel drive of LLMs and big data with deep uncertainty is an evolutionary path from CI 2.0 to CI 3.0.



Renbin XIAO received his PhD degree in systems engineering from Huazhong University of Science and Technology (HUST), Wuhan, in 1993. Currently, he is a full professor at the School of Artificial Intelligence and Automation, HUST, Wuhan. His research interests include collective intelligence, massive personalized customization, and innovation design of complex products.