Large Population Models

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As we navigate complex challenges in public health, urban planning, and social welfare, policymakers need innovative tools to make data-driven decisions and optimize outcomes. Large Population Models (LPMs) offer a new approach to understand and predict the behavior of complex systems, enabling governments to design more effective and targeted policies.

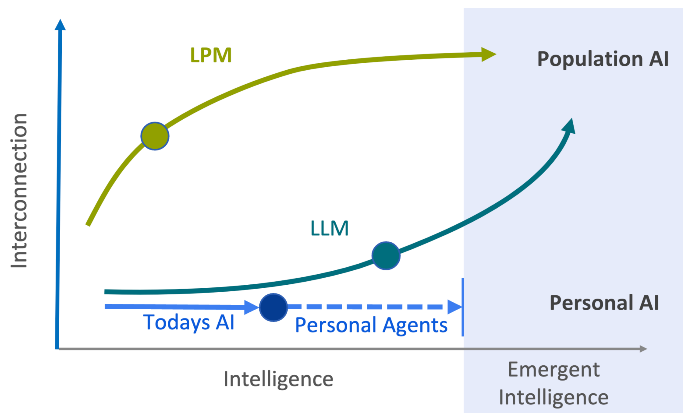

Fig: Large Population Models (LPMs) enable us to tackle complex societal challenges through a deeper understanding of the intricate web of connections and behaviors that shape our world. Large Language Models (LLMs) are the route for Personal AI, focusing on maximizing individual intelligence. In contrast, LPMs pave the path to Population AI by capturing interaction complexity.

Many challenges we face today - from the spread of a pandemic to housing crises in our cities - are not the result of a single person's actions, but rather the complex interplay of countless individuals making decisions and interacting with each other over time. While most of current AI research has focused on capturing our multi-sensory nature - via large models for language, speech, vision - it has often overlooked the importance of this interaction complexity in shaping real-world outcomes.

LPMs aim to capture these dynamic interactions among millions of agents, instead of focusing solely on individual agency. LPMs can help us understand how these complex systems, like cities or societies evolve over time. This can advance evidence-based policymaking, helping design targeted interventions, optimize resource allocation, and evaluate the impact of policies in real-time.

Fig: LPMs are being deployed for decision making in diverse ecosystems

Imagine using an LPM to simulate the spread of COVID-19 in London, a city of 8.3 million people. As individuals interact, LPM simulates the spread of disease, taking into account individual demographics' and mobility behavior. Agents' behavior evolves over time - driven by their sensory observations (eg: see the news) and experiences (eg: received stimulus, lose job). LPMs capture these feedback loops between behavior and disease, at million-scale, to help design effective policies. Crucially, LPMs reveal how population-level outcomes may diverge from individual preferences, informing tough decisions like prioritizing test speed over accuracy or staggering vaccine rollouts. Modeling these country-scale dynamics can be prohibitive. Our research makes this computation tractable - via novel methods[1] and software platforms[2]. LPMs can simulate **country-scale ecosystems for a few thousand dollars**, on commodity hardware.

LPMs **don't just live in a simulated world**. They engage with the real-world by integrating data from decentralized protocols, such as contact tracing applications that provide real-time insights into population behavior and enable adaptive policymaking[3]. The rise of digital public infrastructure, such as India's UPI, ONDC, presents another exciting avenue for LPMs. As UPI/ONDC generate vast amounts of data on economic activities and consumer behavior, LPMs can sit on top of this digital infrastructure to capture impact of supply chain disruptions, natural disasters, economic crises through dynamic simulations of market dynamics. Here, data privacy and security is critical. Our research enables LPMs to analyze suchdata and design policies without compromising data privacy and security of any consumer, household or business.

The potential applications of LPMs are vast. In public health, LPMs can help optimize vaccine distribution, predict disease outbreaks, and evaluate the impact of health policies. In urban planning, LPMs can simulate traffic patterns, energy consumption, and the effects of infrastructure projects on city dynamics. In social welfare, LPMs can model the impact of various schemes on poverty alleviation, education, and social mobility.

[1] https://web.media.mit.edu/~ayushc/motivation.pdf
[2] https://github.com/AgentTorch/AgentTorch
[3] https://web.media.mit.edu/~ayushc/decabm.pdf