
Hybrid Intelligence and the Future of Work

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Computational and algorithmic advances in machine learning methods including deep neural networks have led to a new wave of excitement for Artificial Intelligence (AI). The performance of automated approaches on perception tasks such as objection recognition and speech recognition is approaching human level abilities. However, AI systems still have limitations in carrying out complex activities that come natural to humans; machines are far from carrying out a natural dialog with humans or accomplishing a task like trip planning. They also make mistakes that can be upsetting or harmful for users.

Despite shortcomings of AI systems, they are deployed in critical domains including medical diagnosis and self-driving cars. The reason these systems work in such critical domains is that they are not artificial intelligence systems, they are hybrid intelligence systems. These systems are designed as human in the loop. For example, current self-driving cars require a human driver paying continuous attention, watching the actions of the autonomous system and correcting it when the system makes a mistake. The data collected from this human in the loop interaction is used to further improve the autonomous system creating a symbiotic relationship.

Advances in human computation platforms can help to extend the benefits of hybrid intelligence to any AI system. Combining artificial intelligence with human

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intelligence can help to create reliable systems that are not bounded by the limitations of current AI systems today. Human computation platforms like Amazon Mechanical Turk provide on demand access to human intelligence in a scalable way so that human intelligence can be used as a resource in the *training, evaluation* and *execution* of AI systems.

Human computation is already an important resource in the training of AI systems. The size and quality of human annotations is a key to the performance of machine learning algorithms. This type of training happens offline and is common for perception machine learning tasks like object recognition. Researchers have also shown that crowdsourcing can be used to collect data for the training of more complex tasks such as teaching a robot to move around a maze [4]. Platforms that can coordinate multiple workers hired through crowdsourcing are used for collecting data for interactive tasks like dialogs [3, 2].

Crowd platforms can be instrumental for the high coverage evaluation of multi-turn interactive systems, such as dialog systems, which cannot be evaluated with offline data sets. AI systems can be paired with humans through crowdsourcing to enable testing these systems with a large and diverse set of subjects. These crowd powered testbeds can be shared among researchers to create testbeds for evaluating AI readiness and for tracking progress in the field. Crowd evaluations can lead to new insights about what humans care about and their sensitivities, which may lead to the design of metrics for simulating human evaluation.

Advances in real-time crowdsourcing has reduced the latency of accessing the crowd below a second [1]. With platforms that enable real-time human access, human intelligence can be a resource through the execution of AI

systems working as components and verifiers of AI systems to improve performance.

Hybrid Intelligence systems offer new application areas for microtasking. The demand on human intelligence is likely to increase as hybrid systems spread to more application areas. This increased demand can be a partial solution to concerns over unemployment as more human tasks get automated with advancements in AI. There exists an opportunity to create crowdsourcing platforms that produce value for both AI systems and humans, but this depends on overcoming problems that arise even today such as worker rights, benefits, identity. Hybrid systems also introduce ethical issues on ownership and responsibility for failures and mistakes of AI systems. There is a substantial promise and a number of important challenges ahead towards realizing the potential of hybrid intelligence of humans and machines.

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