What is the optimal division of labor between machines and humans?

In 1951, Paul Fitts created a list that categorized eleven tasks as being performed better by either humans (Humans are better (HABA)) or machines (Machines are better at (MABA)). Fitts list became the starting point of research on function allocation in human computing systems. Over the decades, some of the categorization has become obsolete, for example, Fitts classified that humans were better at storing large amounts of information for longer periods; over time, however, machines have exceeded humans at capacity of storage. Crouser (2009), "in the 1950s humans were indeed better at storing large amounts of information, today's machines far exceed the capacity previously imagined". Drawing a parallel to current advancement in machines, it means that the optimal division of labor will also change as computers or humans become more advanced.

Humans and computers have varying strengths at different tasks. If a task is easy for both humans and computers, then there is a reduced need for collaboration between the two. However, we find that most computational tasks are a combination of smaller tasks some of which are better done by humans and the rest by computers. An example of a task that is easy for both humans and computers is preforming addition on single-digit numbers. Examples of tasks that are easy for a human but difficult for a computer are natural language processing and image labelling. Examples of tasks that are easy for computers but difficult for humans are sorting large amounts of data and perfect recall.

To compare pure human computation, pure computer computation, and human-computer collaboration, I will use an example of a task that can be completed in any of the three methods. Given a photo with ten people, pull up information on each.

Using pure human computation, it would be easy to recognize the ten people from the photo and label them by their names. However, sifting through millions of papers to find information on the ten people would be tedious and take up a lot of time. The combined operations would have a runtime of O(n^2).

Using pure computer computation, it would be difficult to label the ten people from the photo. Since computers have relational databases and can use binary search, it would be easy for the computer to find information on the ten once it has labelled them by name. The combined operations would also have a runtime of O(n^2).

Using human-computer collaboration, humans could easily label the ten people and then the computer could easily pull up information of each from a database. The combined operations would have a runtime of O(nlogn).

From the above example, we can see that there is performance optimization by having humans carry out tasks that are easy to humans and having computers carry out tasks that are easy for computers. As mentioned earlier, the categorization of these tasks will change over time as both humans and computers get better at different tasks.

References

Crouser, R. J., Ottley, A., & Chang, R. (2009). Balancing Human and Machine Contributions in Human Computation Systems. In Liu, Y., Evolvable systems: from biology to hardware. Berlin, Heidelberg.

Winter, J. C., & Dodou, D. (2011, August 25). Why the Fitts list has persisted throughout the history of function allocation. Retrieved from https://link.springer.com/article/10.1007/s10111-011-0188-1