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We can dream of the days in which scientific discoveries take place in fully automated ways, but the reality is far from this dream because of fundamental challenges in semantics, language processing, motor control, and sensory stream processing. At the same time, informatics offers tools that far exceed human capabilities in systematic information evaluation, a core aspect of scientific discovery. It is likely that the best approaches ahead will explore new hybrid or mixed initiative approaches in which we find new ways for intelligent systems to supplement the weaknesses of human cognition rather than try to compete in processing domains that are strengths of human information processing.

Social computing presents many new hybrid human-machine opportunities for scientific discovery that we are just beginning to recognize and explore. Here I name a few instances that are connected to work currently going on in my lab related to the study of peer review. Human peer review is currently the state of the art for evaluation of training or fellowship applicants, grant proposals, conference papers, and journal articles—critical elements of scientific discovery at the macro level from beginning to end. Currently we use only very basic mathematics from thousands of years ago as reasoning tools, only very basic early Internet functionality for information circulation, and the most primitive spreadsheets as information display techniques.

1) Can we use modern statistics and information processing to develop more reliable summaries of human judgments? The massive datasets already in hand on peer review provides highly useful training sets for computational approaches.
2) Can we use natural language processing techniques to encourage higher quality reviewing? There are a number of common dysfunctions in the content of peer reviews that reduce their reliability, validity, and impact. These common dysfunctions could be automatically detected during the review submission process and thereby potentially corrected before it is too late.
3) Can we use Semantic web and statistical techniques to improve efficiency of assigning reviewers to documents? We likely can do better than relying on databases of keywords in assigning reviewers to documents, and we likely can take advantage of past outcome data to influence this process as well.
4) Can we provide feedback recipients with tools for evaluating, prioritizing, and planning from the feedback they receive? The peer review process is not just about selection but also about feedback; scientific discoveries are fundamentally social this way. Yet recipients often struggle in understanding the feedback and integrating the feedback into next steps. Evaluation and planning tools could improve this post-feedback process.
5) Can we use modern statistics and information processing to develop better metrics for evaluating the efficiency, processing quality, and outcome success of particular peer review systems? The larger the scale of the system, the greater the likely role of visual analytics in support system evaluation.

Related Work

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