Big Data to Knowledge
Think Tank: Game Developers and Biomedical Researchers

Executive Summary

The Big Data to Knowledge (BD2K) initiative sponsored a day-and-a-half meeting on December 8 -9, 2014 that brought together game developers and biomedical big data researchers with the goal of investigating the potential for game technologies and games to enhance biomedical research. While advances in computation have greatly accelerated biomedical research, many components of biomedical research still require human eyes and intuition to iteratively solve puzzles, recognize patterns, and form strategies. Game technologies and approaches can be used to create effective and engaging environments for performing such tasks, and games have been successfully used in the biomedical space to crowdsource data analysis to the public, resulting in innovative solutions and scientific breakthroughs. But games and game methods have enormous additional potential to provide innovative solutions to a broader range of biomedical research hurdles including data pipelining & integration, visualization & publishing, peer-to-peer sharing & engagement, and other elements vital to the digital research enterprise beyond data analysis.

Because game developers and biomedical researchers represent communities that rarely if ever interact and are therefore unfamiliar with each other's professional language, methodologies, and strategic thinking, the think tank involved an unconventional format designed to introduce the participants and their methods to each other. Following brief introductory remarks and introductions, the participants rotated through a series of rapid, small group conversations analogous to "speed dating," in which two biomedical researchers and two game developers explored possible applications of game solutions to specific research problems. Based on the outcome of the these discussions, the second day of the think tank focused on the data processing and research development methods of the two communities, the various ways in which game methods could facilitate biomedical research.

The think tank participants highlighted several areas of immediate potential for game technologies to enhance research — including data visualization, multi-user collaborative data sharing environments, methods for distributed computing and crowdsourcing, text parsing and meta-data application, and model testing. The think tank participants also discussed the barriers to and complexities of implementing these strategies and technologies in the biomedical space. The participants agreed that it was not simply the technologies themselves but **rather the strategic thinking and approach taken by game developers as they consider their user-community's needs, interests and abilities that were critical to employing these methods in the biomedical space**. Therefore, a key recommendation made by the group was to create opportunities for partnerships between game developers and biomedical

researchers to rapidly and effectively bring these approaches to bear on critical biomedical big data research questions. They outlined the following recommendations:

1. Research games or research enabled by game technologies can be developed now, but in parallel additional information in some areas would be helpful, for example:

    *   Gaining a greater understanding of how each community processes data and uses tools within their typical workflows.
    *   Open-ended games or other innovative game play to explore open-ended research questions and games that help identify new research questions constitute a new area of great interest to both groups that needs further investigation.
    *   Determining which research projects and methods readily lend themselves to game technologies and games and which do not, and correspondingly, which types of games are most appropriate to which specific types of research projects, including when crowdsourcing is appropriate and when it is not.
    *   Identifying particular player audiences based on their interests in specific kinds of game play (e.g., open world exploration, puzzle solving, language analysis, categorization, etc.).
    *   Identifying game deployment vectors to reach new and current players of research games.
    *   Identification of case studies of successful research games would lend credibility and create a valuable resource for the NIH, other federal agencies, and the public.

2. Collaboration between game developers and biomedical researchers is critical to the success of these approaches; the participants identified the following barriers and opportunities related to collaboration:

    *   Translation between biomedical researchers and game developers of their respective bodies of knowledge.
    *   The perception and respectability of using game technology and "games" as a science research method — including government, academic, and public perception.
    *   Access not only to data, but to actual experimentation resources, such as via cloud labs.
    *   Alignment of incentive structures for biomedical researchers and game developers is critical to engagement of both groups and the success of projects.

3. Opportunities for creating partnerships and enhancing learning for both groups could include:

    *   Interdisciplinary short-courses, hackathons, bootcamps and other training opportunities.
    *   Focus sessions at both life-sciences and game development conferences.
    *   Funding for interdisciplinary research teams and for applying games methods to biomedical research, including the support of early exploratory/feasibility projects as well as for sustaining longer-term collaborative projects.
    *   Establishing and building collaboration platforms tailored to the research games field.
    *   Encouragement of publishing and dissemination of research games results and outcomes.
    *   Publicly supporting and announcing notable research games to the public.