CALIBRATING THE SIMBIOSYS TUMORSCOPE FOR THE FIGHT ON CANCER: A SCENARIO ANALYSIS ENGINE FOR DETERMINING OPTIMAL THERAPY CHOICE

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EXECUTIVE SUMMARY
Use of the most toxic drugs in a “scorched earth strategy” is common in the treatment of breast cancer, even though less toxic drugs have only single-digit lower rates of success. To address this issue, the TumorScope software was calibrated to accurately predict the response of breast cancer to the various drugs commonly used for treatment. Calibration resulted in high correlation between predicted and actual outcomes for nearly 200 patients spanning all types of breast cancer. More pertinent to treatment planning, TumorScope was able to improve the accuracy of identifying patient/drug combinations that will achieve pathological complete response (PCR) after treatment by two to three times that of the current state-of-the-art method. PCR is the strongest predictor of long-term survival for breast cancer patients and the desired outcome for all drug-based therapies. Physicians can thus use the computational analysis of different therapies produced by TumorScope to weigh likelihood of therapy success versus drug toxicity.

RESEARCH CHALLENGE
Despite significant advances in cancer treatment in both the number and efficacy of therapies, success rates of any individual therapy remain low. This is especially true in breast cancer where, while overall five-year survival rates tend to be greater than 70%, the efficacy rates of any individual therapy range from 20% to 80%. Critically missing is a way for physicians to distinguish which therapy will be most effective for each patient, whether none of the available therapies will work. As a consequence, many patients are prescribed a therapy, often at high physical, mental, and monetary cost, that is either too extreme or completely ineffective.

As with every predictive model, TumorScope had its limits, and calibration data, indicating a good model fit. Pertinent to treatment planning, TumorScope improved the accuracy of identifying patient/drug combinations that achieve pathological complete response (PCR) by two to three times that of the current state-of-the-art method. Since PCR is the strongest predictor of long-term survival for breast cancer patients, physicians can use TumorScope to identify which therapies will achieve PCR (if any), and potentially deescalate therapy when less toxic drugs are predicted to give rise to the same extent of response as more toxic alternatives.

WHY BLUE WATERS
The Blue Waters system has been critical for the calibration of the TumorScope prediction engine. Calibration required simulating the response of hundreds of patients to various therapies while varying a number of parameters. Even with the fast time-to-solution of the predictive engine (one prediction per hour), a calibration process of this scale would have required months to years of computer time to complete. By leveraging the large number of GPUs available on Blue Waters to perform thousands of simulations of the approximately 200 patients undergoing different treatments, with different parameters.

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