2831, which relates to electrical circuitry innovations; (3) art unit 3685, which relates to cryptography in financial transactions; and (4) art unit 3689, which relates to incentive programs and electronic shopping. Art units 2431 and 3685 were selected because these art units share similar technologies (i.e., cryptography); however, art unit 3685 is considered a business method art unit. Even though their technologies are similar, art unit 2431 has an allowance rate of 82.3 percent, whereas art unit 3685 has an allowance rate of 24.8 percent. Further, art units 2831 and 3689 were selected to illustrate a stark contrast in allowance rates—art unit 2831 has an overall allowance rate of 85 percent, whereas art unit 3689 has an overall allowance rate of 7.8 percent.

A visual representation of the decision tree is shown in figure 1. Decision nodes are represented as squares. Chance nodes are represented as circles. Edge nodes are represented as triangles. Some nodes may never be encountered in a particular trajectory through the decision tree. For example, it is possible that a first-action allowance is issued, in which case no decision nodes will be reached. Nonetheless, the more complete representation allows for calculations of expected values associated with various decisions to identify strategic decisions.

However, as previously mentioned, we have modified the traditional decision tree framework: we do not identify specific and general decisions to be made at various decision points; rather, we identify a condition for making a particular decision. Particularly, at each decision node, we identify a particular threshold that can be used as a guiding principle for making a prosecution decision: If a potential patent is worth at least the threshold to an applicant, we suggest that the applicant should proceed with prosecution.

Table 1 and figure 2 identify these thresholds for various points in prosecution and for each of the four art units considered in our analysis.

As an illustration: If a patent application is classified into art unit 3689 (which has been reported as having the lowest art unit allowance rate) and if a patent for the application’s technology has a potential value of $40,000, our proposed game theory prosecution approach would be to abandon the application after the first office action because the patent valuation is below the threshold value. The expected applicant payoff of this decision would be to save or not expend the costs of responding to the first office action, given the statistical expectation that the examiner will not allow the application.

In our approach, thresholds will be higher in instances where probabilities of securing a patent are lower. Figure 3 shows the probability of receiving a next-action allowance upon filing an amendment in response to various office actions in prosecution. As indicated (by comparing figures 2 and 3), the art units having the highest thresholds for continuing prosecution are associated with the lowest probabilities of receiving allowances. For example, the business method art units 3685 and 3689 are associated with lower allowance prospects and higher thresholds as compared to the other art units 2431 and 2831.

Interestingly, the thresholds for the non-business-method art units do not exceed the estimated filing costs (which we estimate as being $13,360 for attorney and government fees) across all rounds of prosecution. Thus, if a rational decision maker determined that the filing costs were justifiable for the potential patent, the decision maker would also determine that it would make sense to proceed with prosecution. These strategies may be advantageous due to the relatively high allowance rates of the art units. For example, the probabilities of receiving an allowance after responding to a fourth office
action in art units 2431 and 2831 were 47.5 percent and 50.4 percent, respectively, while the cost of responding to a fourth office action added a mere $4,900. Thus, a game theory analysis would indicate that responding would be advantageous (over abandoning the application) if a potential patent value was worth more than approximately $9,800 (which is less than the estimated filing costs).

Table 1 also identifies what type of prosecution strategy is recommended in instances where prosecution is to be continued in response to various prosecution events. In the two non-business-method art units, the recommended approach is consistently to continue engaging with the examiner instead of appealing rejections to the PTAB. This is a result of the relatively high cost of appealing and the decent prospects of continuing normal prosecution. For example, when an applicant responds to any of the first through fourth office actions with an amendment, the likelihood that the examiner’s next action is to issue an allowance is above 50 percent for art unit 2831. Meanwhile, the likelihood of an appeal resulting in an immediate allowance is slightly lower at 46 percent.

Meanwhile, the recommended approach for the business method art units is to appeal rejections at the earliest opportunity (when prosecution is to be continued). This is a result of the relatively low allowance prospects associated with amendment approaches relative to appeals for these art units. For example, when an applicant responds to any of the first through fourth office actions with an amendment, the likelihood that the examiner’s next action is to issue an allowance is above 50 percent for art unit 2831. Meanwhile, the likelihood of an appeal resulting in an immediate allowance is 12 percent.

Analysis
As described above, game theory analytics can be leveraged to drive optimal decision-making in the multiplayer context of patent prosecution. The applicant, as a player, files a patent application and makes subsequent filing decisions in response to rejection decisions by the examiner, as another player, or in response to appeal decisions by the PTAB, as yet another player. Understanding the statistical payoffs or rewards involved from an applicant’s perspective throughout patent prosecution can facilitate optimal decision-making.

Once a patent application is assigned to an art unit, the probabilities of the chance occurrences can be defined by the big data statistics of the art unit or of the examiner assigned to the application. Further, throughout the trajectory of the prosecution cycle, we propose that the traditional decision tree analysis can be modified by transforming the decision nodes into condition nodes—where a particular decision (continuing prosecution) is the statistically advisable decision if a potential value of a patent meets or exceeds a calculated threshold value. If the estimated value of a potential patent is worth at least the defined threshold, then it is estimated that the applicant will gain the best payoff by continuing to engage the examiner. However, if the estimated value of the potential patent is below the defined threshold, then it is estimated that the applicant’s best payoff will be achieved by abandoning the application (and saving subsequent prosecution costs).

For the business method art units (particularly art unit 3689), unless patent protection of the corresponding technology would be highly valuable, the data indicates that a sound strategy may be quickly abandoning the application after receiving a first office action. Payoff, in this instance, may be potential costs saved by not responding to the outstanding office action, which may be substantial. For example, in art unit 3689, across all of the applications that were abandoned within this art unit across the last two years, roughly one-third of these applications (resulting in no patent value) had more than one final office action. This means that roughly a quarter of the patent applications assigned to art unit 3689 reached at least the fourth office action in the decision tree. Presuming that the applicants in those cases filed a response to each office action, the applicants paid out $15,200, using our estimated filing costs above. However, in cases where the value of the patent application was less than the threshold value of the relevant decision node, applicants using the game theory approach may have optimized their payoff by abandoning the application and saving the filing costs associated with each response. The optimal payoff gained by abandoning an application is especially true for the extreme example of art unit 3689, which notoriously has the lowest allowance rate.

In contrast, for non-business-method art units (e.g., art unit 2831), the data indicates that, of the various options available...