

## Gambit Tutorial: Games in Strategic Form

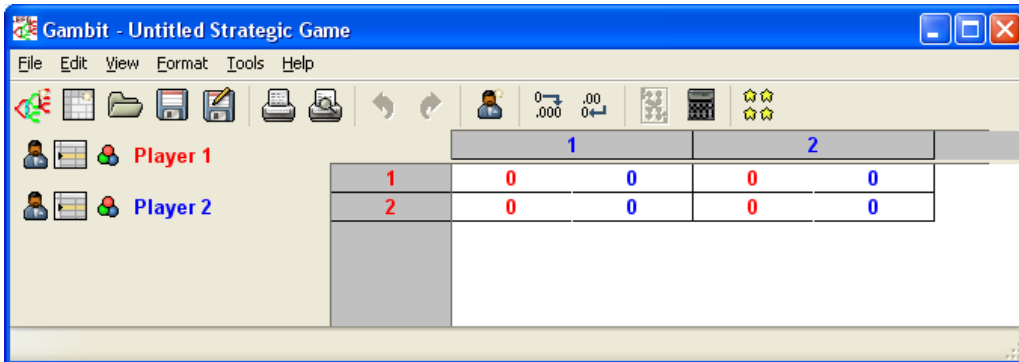
This tutorial complements the earlier Gambit tutorial in that it focuses solely on the representation of games in strategic (or normal) form. Since the earlier tutorial in fact covered strategic-form representation except for initial definition of a game, this tutorial concentrates on that aspect. All the material covered here is presented in the document *Gambit: Software Tools for Game Theory* by McKelvey, McLennan, and Turocy, available online at

<http://gambit.sourceforge.net/doc/gambit-0.2007.01.30/gambit/>

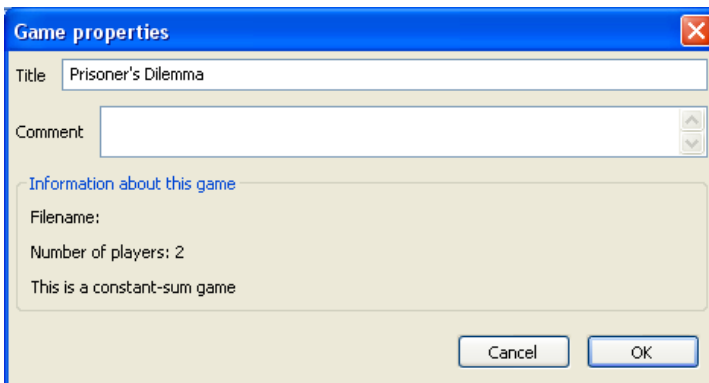
The most relevant section is 2.4 (“Strategic games”). This document is succinct and easy to read, and it has a reasonable number of straightforward examples. You are encouraged to refer to it.

Most of this tutorial uses the Prisoner’s Dilemma as an example. The material on finding dominated strategies and Nash equilibria overlaps with the earlier tutorial. This tutorial also shows how to reconfigure the strategic form presentation of a game with both players’ strategy options either as row labels or as column labels, in hierarchical fashion. And it shows how to add strategies to the strategic form as well as how to add a third player, which results in a hierarchy of strategies in either the rows or the columns. Players beyond a third can be added, resulting in more deeply nested strategy hierarchies.

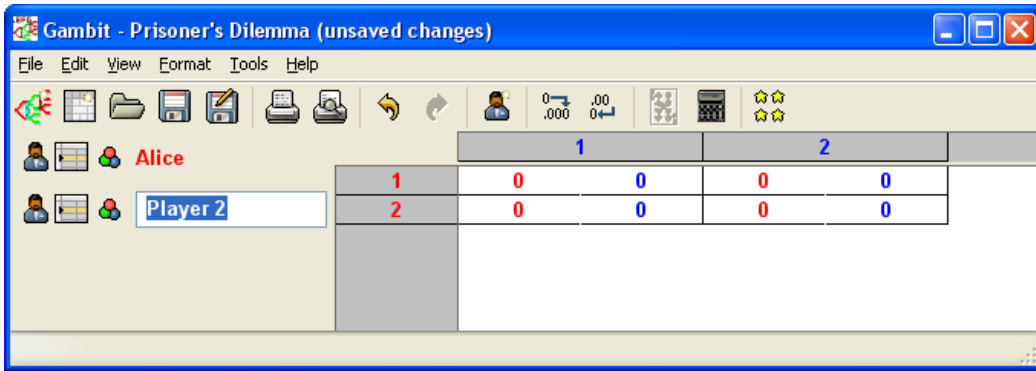
To start, open Gambit and select File → New → Strategic game, which results in the following window.



To name the game, select Edit → Game, and type “Prisoner’s Dilemma” in the Title field of the window that pops up, as shown below.

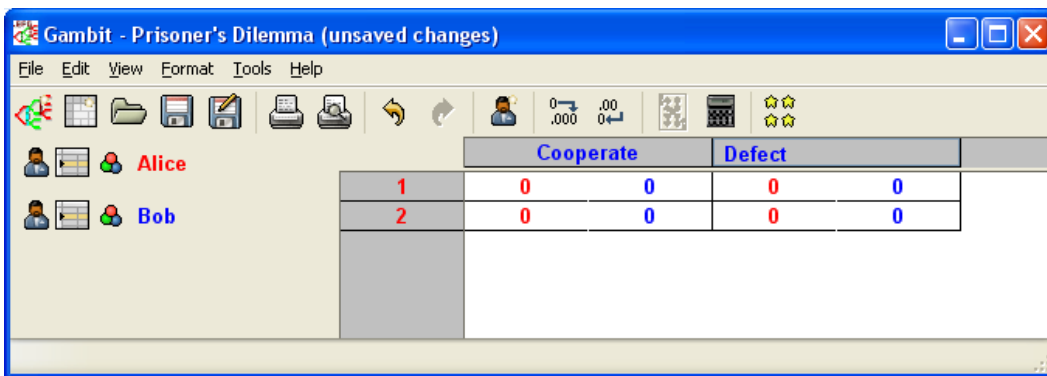


Next, click Player 1 on left. Type in “Alice” then Enter.



And click Player 2 on left. Type in "Bob" then Enter

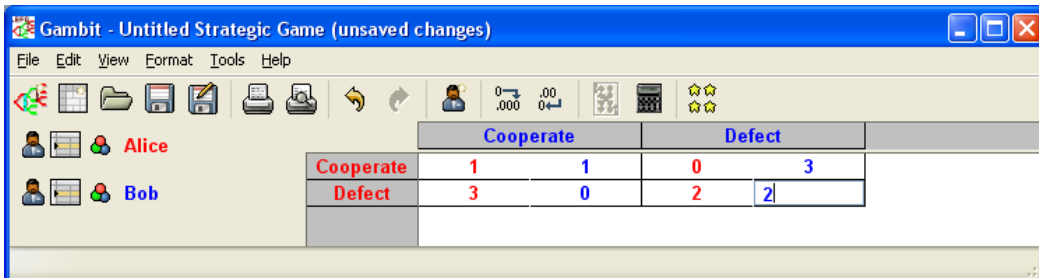
To name the strategies, first click on the column labels. Change "1" to "Cooperate" and "2" to "Defect"



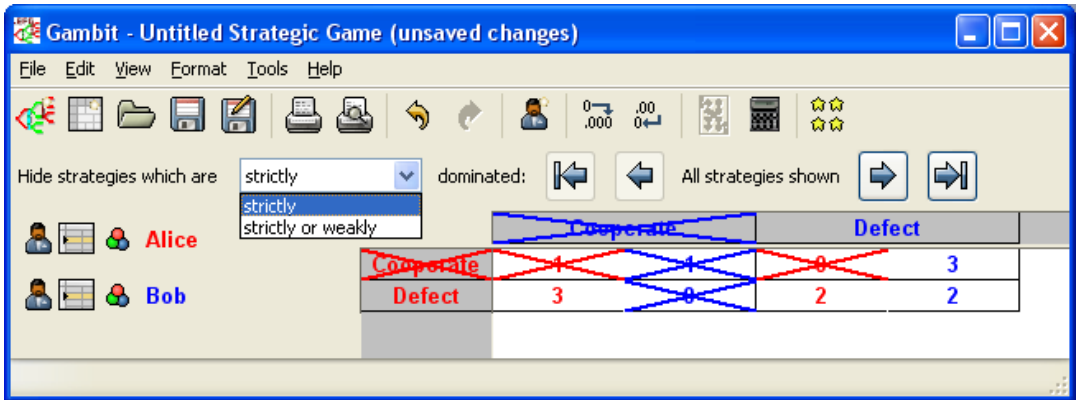
Change the row labels similarly

At any point, save your work to file by selecting File → Save (or clicking the fourth tool icon from the left). This brings up the usual file browser.

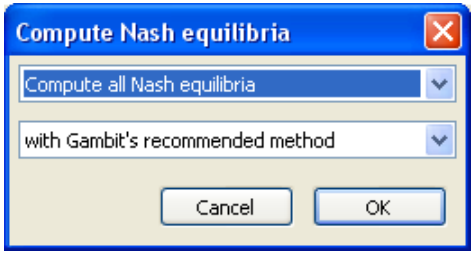
The payoffs initially are all 0. Change them to be as in the following screenshot. Click on a payoff, type the new value, and hit Enter. You can move from one to the next with the Tab key. At the end of the first row, it wraps around to the beginning of the next row.



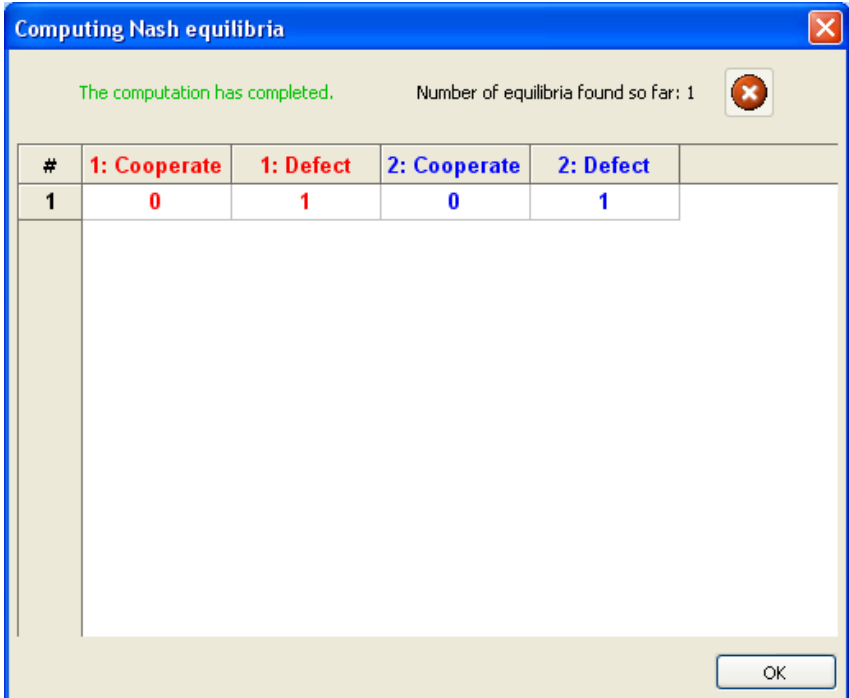
For strict dominance analysis, select Tools -> Dominance -> strictly.



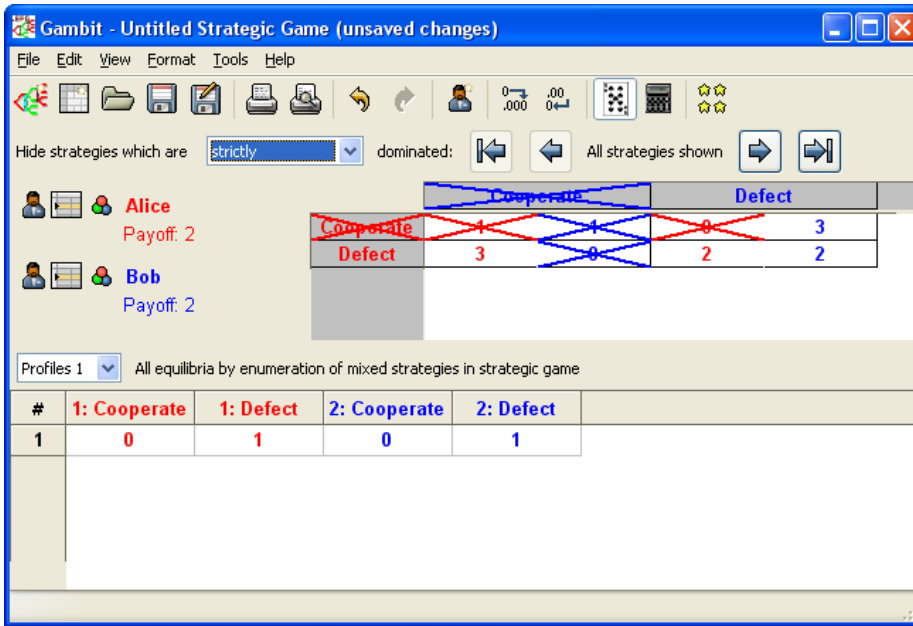
Click the → to eliminate from view all but one payoff. Click ← to restore the view.  
 To find the Nash equilibria, select Tools -> Equilibrium (or click the second tool icon from the right). Accept the defaults in the window that pops up.



This pops up a window with Nash equilibria (here just one).



When this pop-up window is dismissed, the main window is split into two panels, the lower with the information on the Nash equilibrium. This shows the expected payoffs for the players in the equilibrium next to their names.




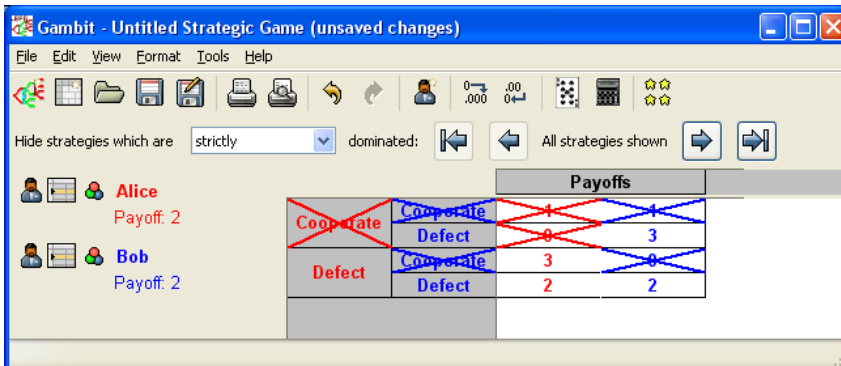
If there are more than one equilibrium, select one by clicking on its row in the lower panel. You can drag the border between the two panels and also adjust the overall height of the window.

You can change payoffs and recomputed dominance and equilibria.

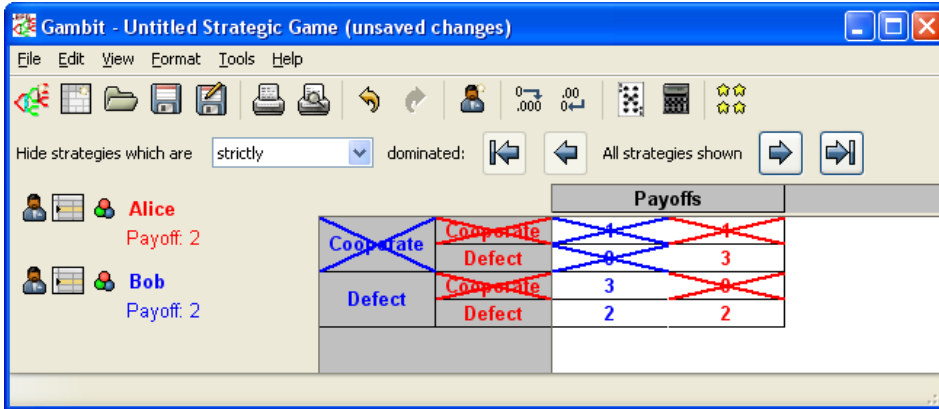
To save an image of the game as, say, a .JPEG file, select File → Export → JPEG: The image shows only the matrix with column and row labels (but no player names). To print a similar image, select File -> Print (or Print preview to preview the image to be printed). The same can be achieved by clicking the sixth (seventh) tool icon from the left.

To dismiss the bottom panel (with the Nash equilibrium information), Click the third tool icon from the right

The assignment of players to row and column roles is fully customizable. To change the assignment of a player, drag the person icon  to the left of the player's name to either of the areas in the payoff table displaying the strategy labels. For example, dragging the player icon from the left of Bob's name and dropping it on the right side of Alice's strategy label column changes the display of the game. Here, the strategies are shown in a hierarchical format, enumerating the outcomes of the game first by Alice's (red) strategy choice, then by Bob's (blue) strategy choice.




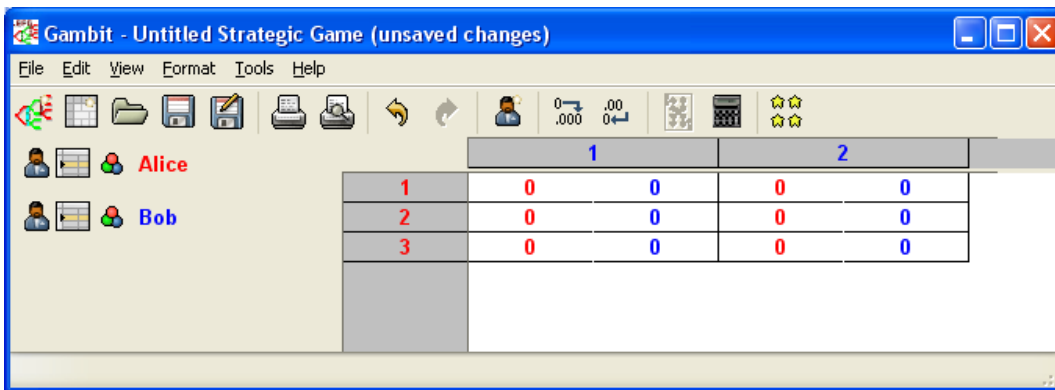
Alternatively, the game can be displayed by listing the outcomes with Bob's strategy choice first, then Alice's. Drag Bob's player icon and drop it on the left side of Alice's strategy choices.




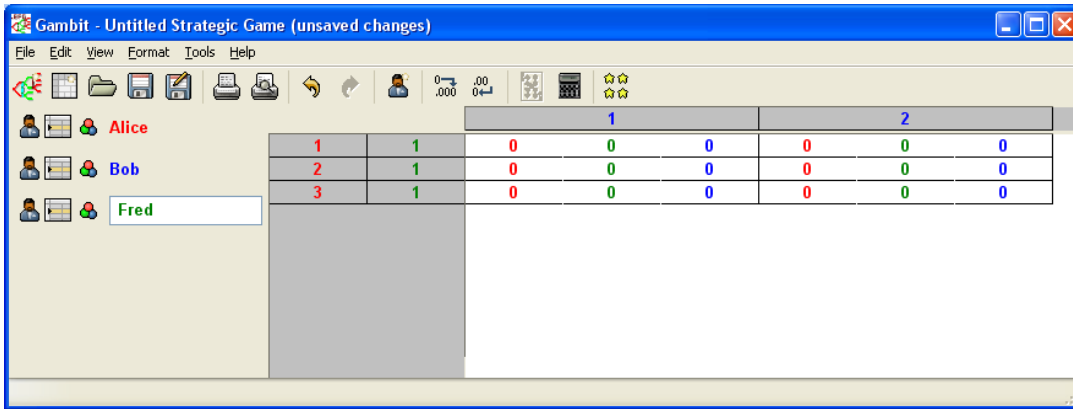
The same dragging operation can be used to assign players to the columns. Assigning multiple players to the columns gives the same hierarchical presentation of those players' strategies. Dropping a player above another player's strategy labels assigns him to a higher level of the column player hierarchy; dropping a player below another player's strategy labels assigns him to a lower level of the column player hierarchy. As the assignment of players in the row and column hierarchies changes, the ordering of the payoffs in each cell of the table also changes. In all cases, the color-coding of the entries identifies the player to whom each payoff corresponds.

For the remainder of this tutorial, we work with arbitrary examples of games since we illustrate features not exhibited by the Prisoner's Dilemma.

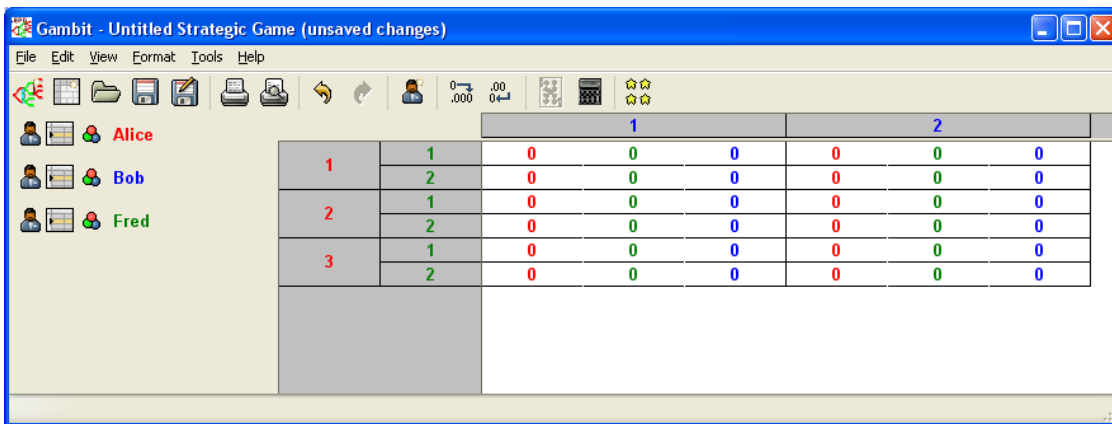
To add a new action, click the new strategy icon  to the left of the player's name. In the new game we are now developing, we change the players' names but keep the default numeric names for strategies. Clicking the new strategy icon for Alice automatically adds a row for strategy 3.



To add an additional player to the game, select Edit→ Add player or click the corresponding toolbar icon . The newly created player has one strategy, by default labeled 1.



Now add a second strategy for Fred (clicking his new strategy icon).



Now change the payoffs as required by the problem, and you can find which strategies are dominated and the Nash equilibria as before.

