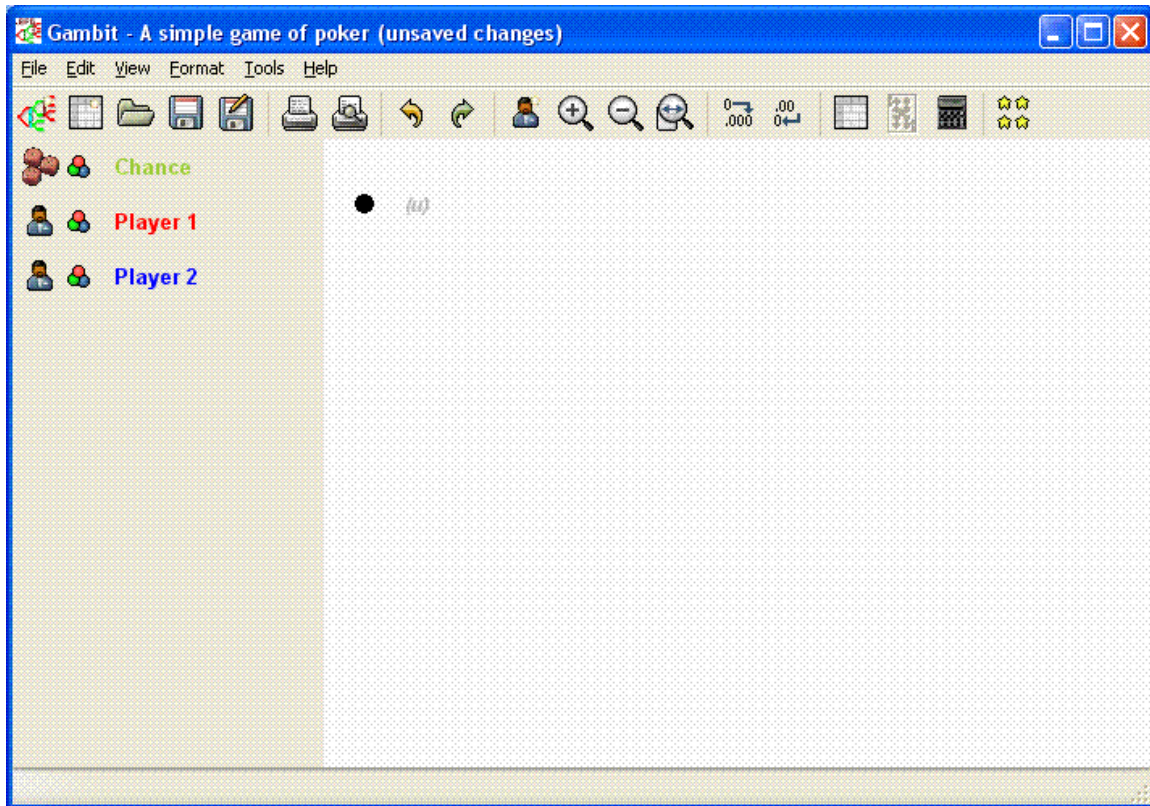


Gambit Tutorial

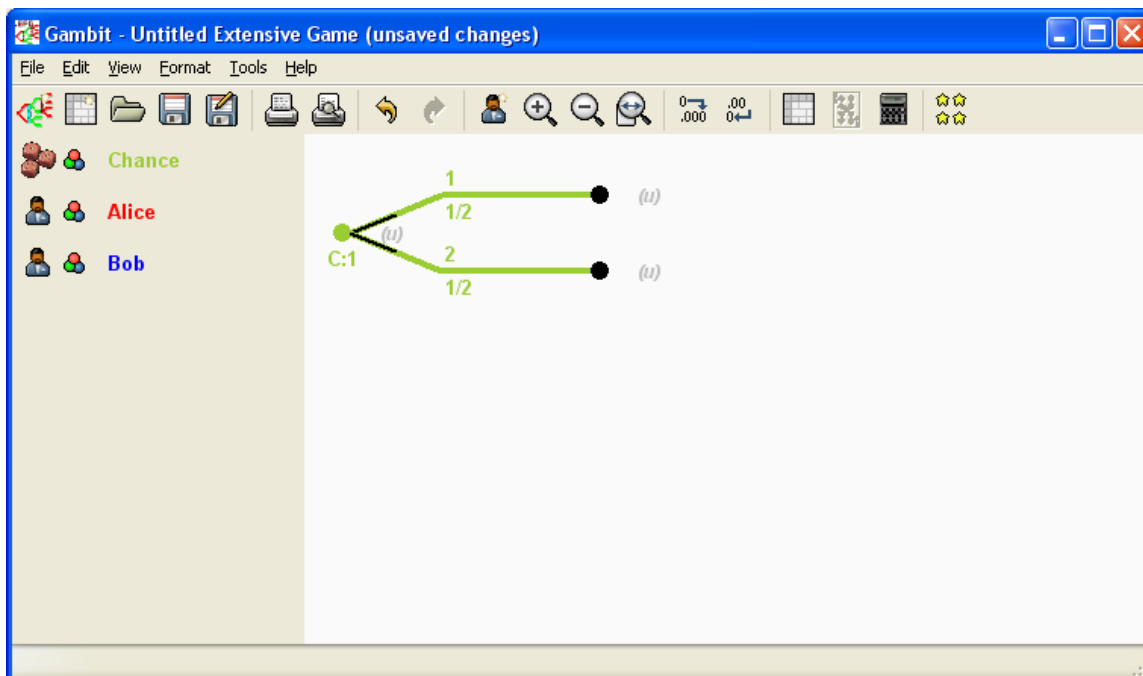
This follows the tutorial at <http://gambit.sourceforge.net/doc/tutorials/poker.pdf>, which has a few out-of-date features. You can follow the online tutorial but refer to this document for features that have been updated. There is generally enough information in this tutorial for you to duplicate the steps taken, but the online tutorial is animated.

This simple game of poker illustrates how to build and analyze an extensive form game, using a one-card poker game as an example. It is between Alice and Bob. After bringing up Gambit, give our game a descriptive title. Do Edit → Game then, for Title, type, e.g., “A simple game of poker;” then click OK. (Don’t worry about Comment.)

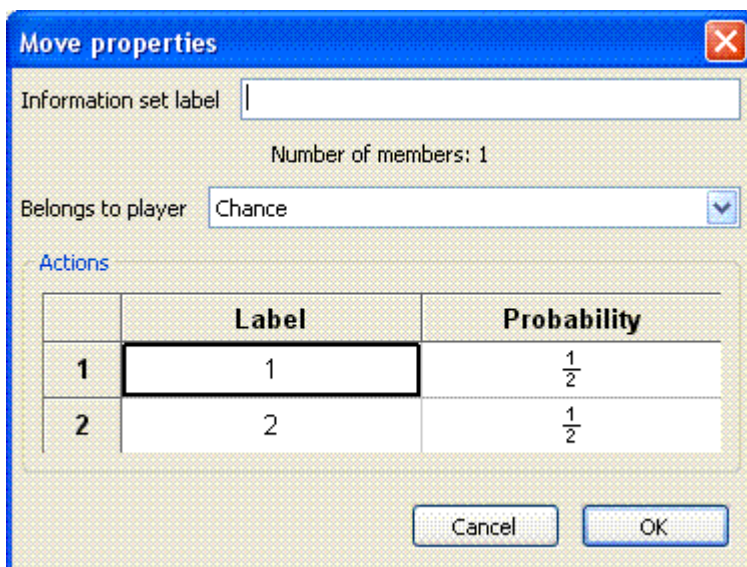


Click on “Player 1” on left side and change the name to “Alice.” (You can change color by clicking on icon next to name.) Then click on “Player 2” on left side and change the name to “Bob:”

To build a game tree, we begin with Alice drawing a card. There are two types of cards, high and low, and they’re equally likely. We first want a chance(nature) move. Click on the dice icon on the left, next to “Chance”, drag it to the root of the tree (the dot in the big panel). This creates a chance move with two actions. The “C:1” under the root indicates that this is move number 1 for the Chance player. The $\frac{1}{2}$ under each branch indicates that the actions are equally likely

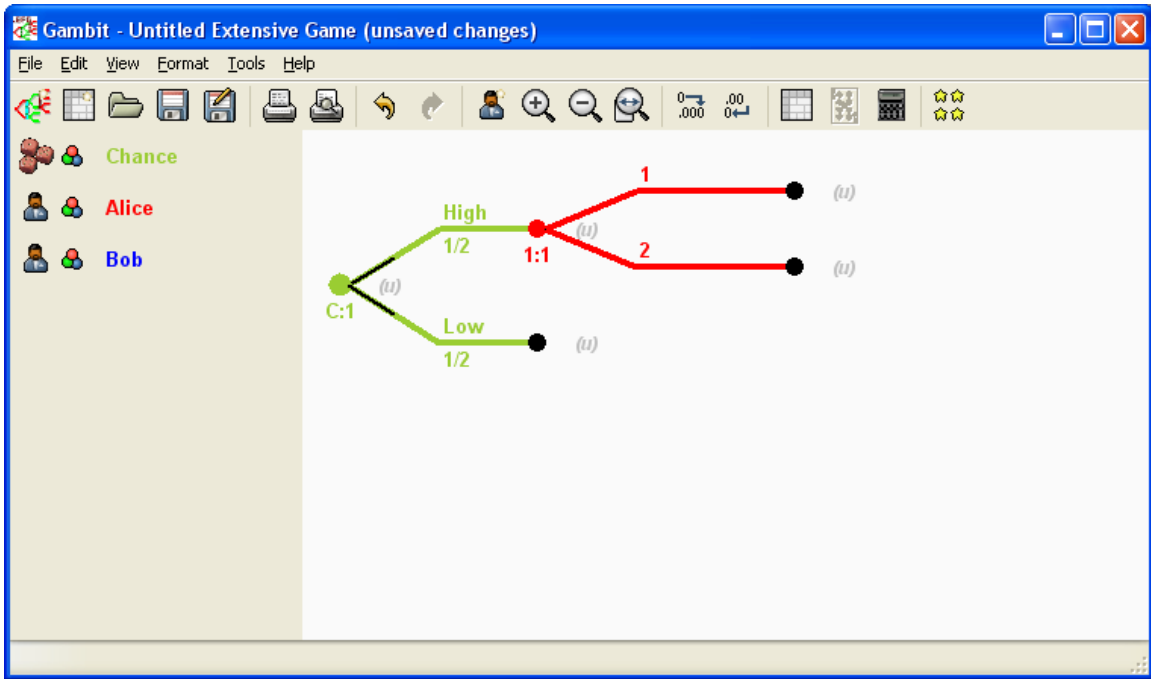


Gambit gives the actions default names “1” and “2.” Double click on branch label “1” or “2” (they give the same result) to pop up a window.



There are two action rows (one for each branch) with columns “Label” and “Probability.” Change the label for action 1 from “1” to “High” and the label for action 2 from “1” to “Low.” Then click OK.

After Alice gets her card, she may raise or fold. Proceed as with the Chance move except drag the Alice icon to the node at the end of the top branch.



We get two new branches out from this node. Double click on the label on either to pop up the following window. Two actions are shown. Replace “1” with “Raise” and “2” with “Fold.” If Alice folds, the game ends. If she raises, Bob has a move. He can meet or pass; in either case, the game ends. Add Bob’s move and action labels.

Move properties ✖

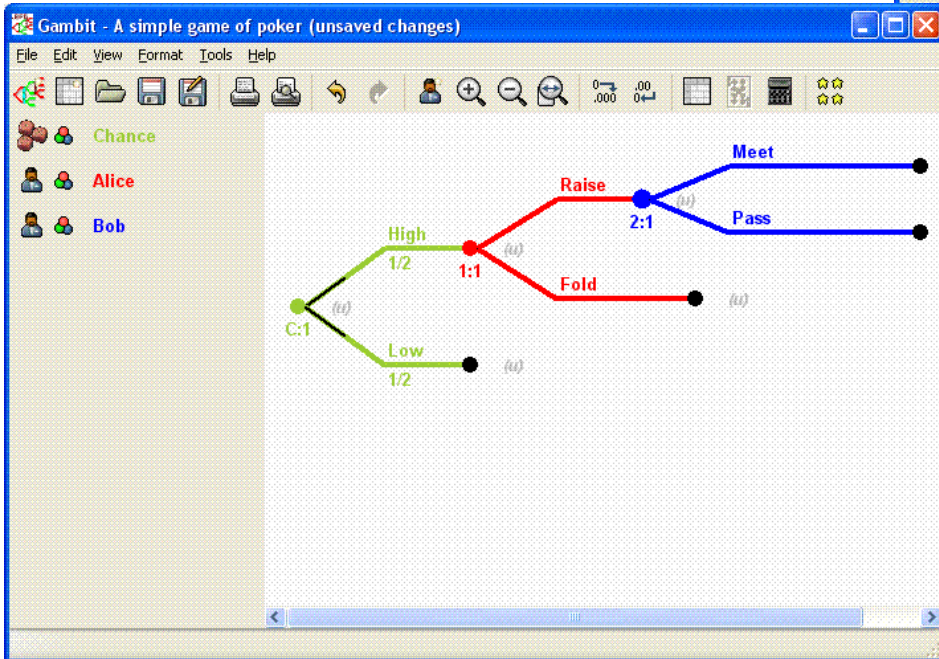
Information set label:

Number of members: 1

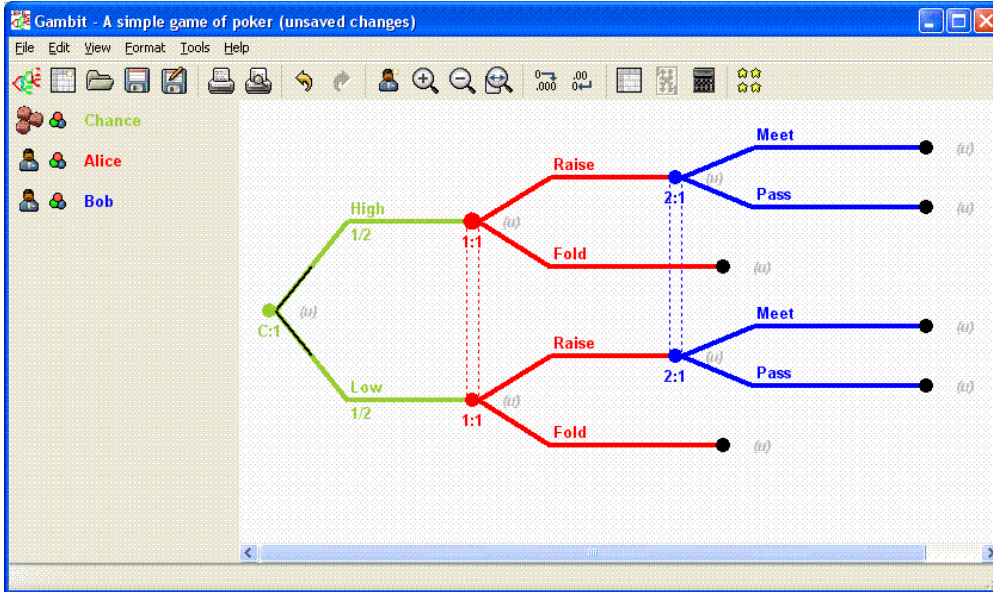
Belongs to player: 1: Alice ▼

Actions

	Label
1	<input style="width: 80%;" type="text" value="1"/>
2	<input style="width: 80%;" type="text" value="2"/>



We've drawn only the interaction when Alice draws a high card. The same rules apply when she draws a low card. So copy the tree that follows drawing a high card to the node at the end of the "Low" branch. Hold down the control key and drag the node at the end of the "High" move to the node at the end of the "Low" move

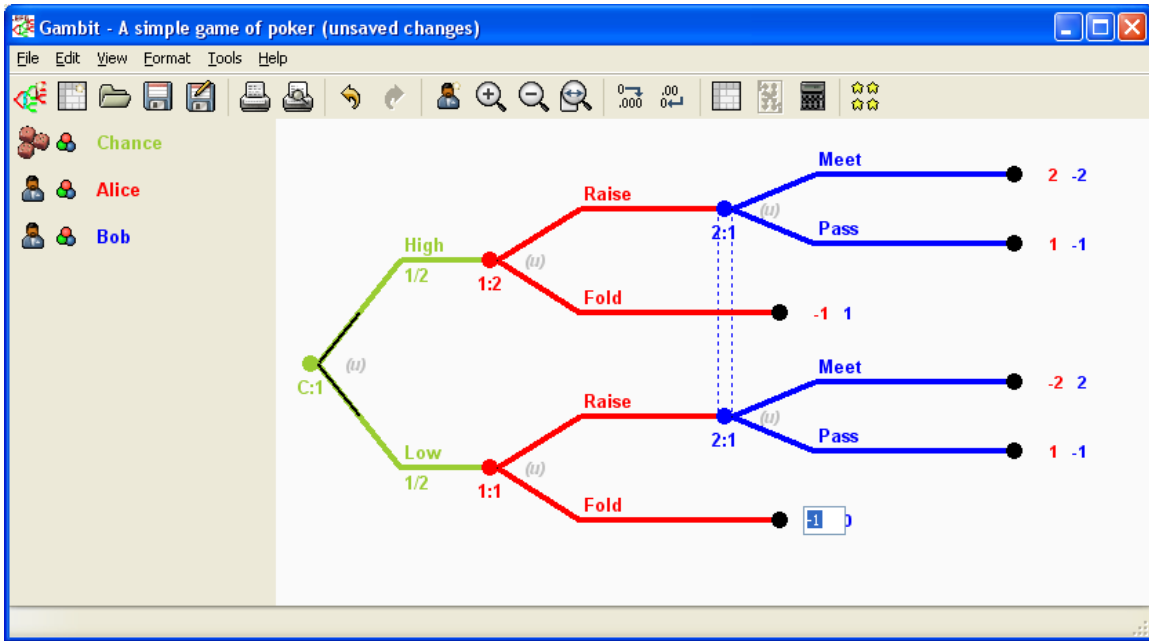


When nodes are copied, they stay in the same information set as their originals. (They're indistinguishable.) In our game, Alice does observe the card she draws, but Bob doesn't. So Alice's two moves should be in separate information sets. Right click on the root of the tree (representing Chance's choice). In the menu, click "Reveal" to pop up a the following window. Click the "Bob" check box to uncheck it. The tree is now complete (See the next screenshot.)

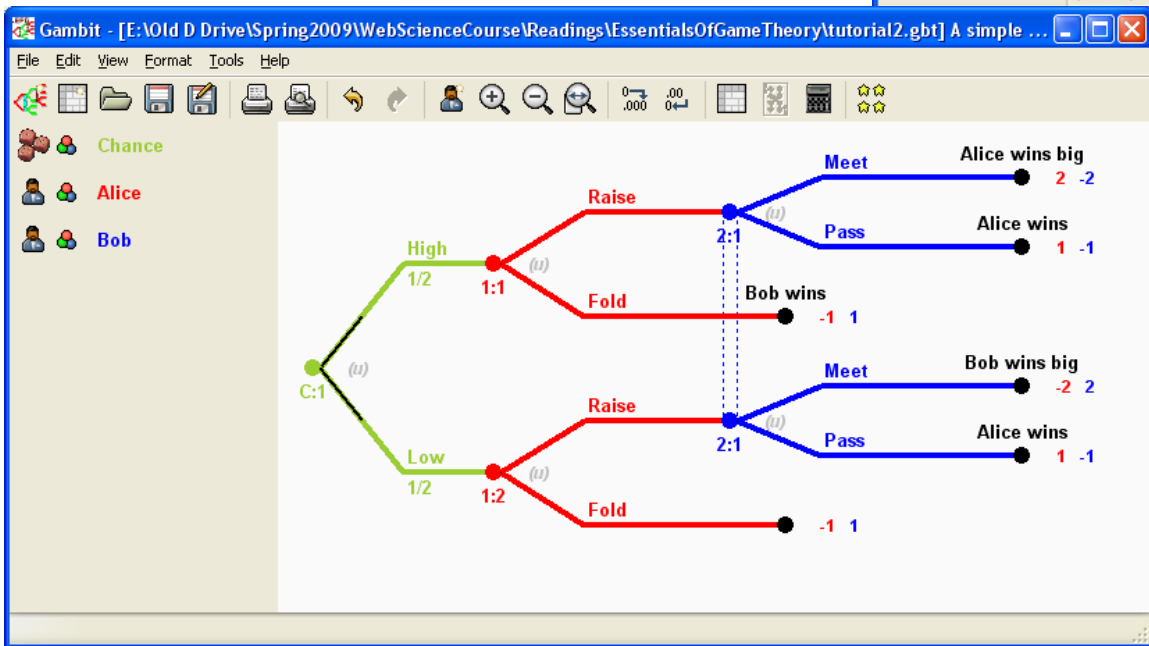
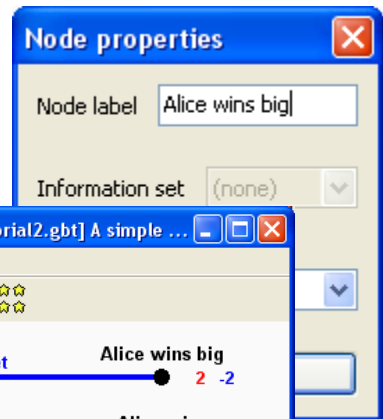


It remains to handle the payoffs. At the beginning, each player places \$1 in the pot. With actions Raise and Meet, the player puts another \$1 in the pot. With actions Fold and Pass, the player forfeits the pot to the other. If Alice raises and Bob meets, the result depends on Alice's card. If she has a high card, she wins the pot, otherwise Bob does.

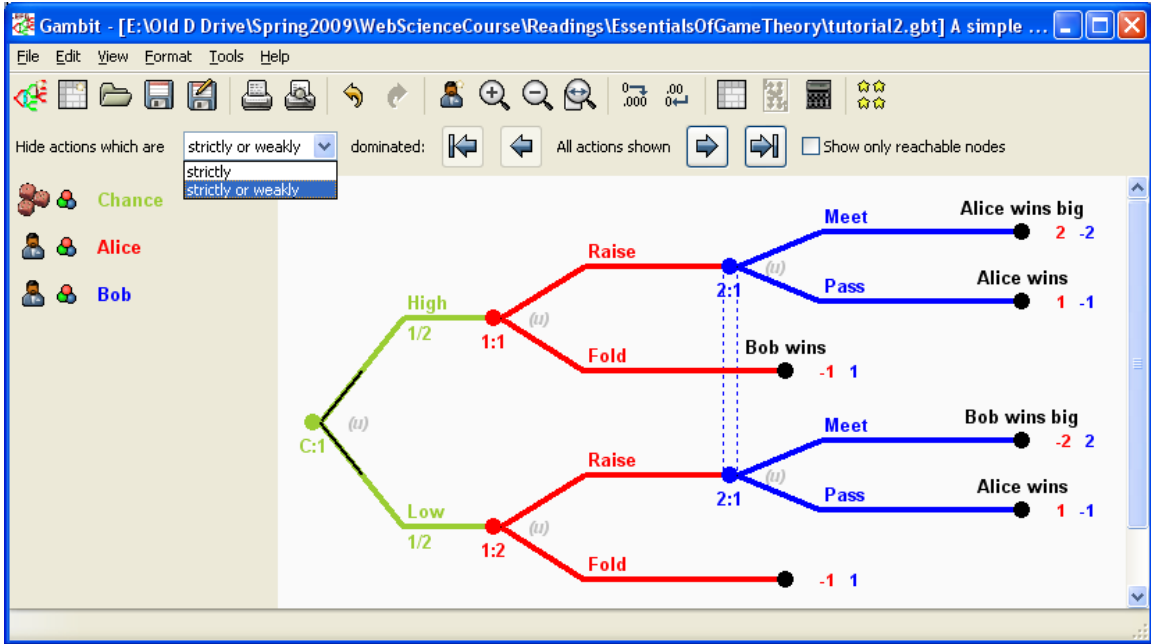
To the right of each leaf is a "(u)" in light gray. Double clicking it creates two payoff boxes, left for player 1 (Alice), right for player 2 (Bob), both with the default payoff, 0. Initially, the left box is open as a text box. Type the payoff for player 1 and hit Enter. Double click the right payoff box and type the payoff for player 2 and then hit Enter. Do the same for all payoff nodes. To change a payoff value, double click the box, type in the new value, and hit Enter.



To add a name to a payoff node, double click it to open a window. In the “Node label” field, type in the name. We use the names “Alice wins big” (once), “Bob wins big” (once), “Alice wins” (twice), and “Bob wins” (twice).



Now see whether any of the actions are dominated. To open a new row of tools Click Tools → Dominance



From the “Hide actions which are ... dominated” drop-down menu, select “strictly or weakly.” The arrow buttons let you step through the levels of elimination (right arrow down, left arrow up). Clicking the right arrow once is supposed to remove the branch where Alice folds. When I try this, Gambit crashes.

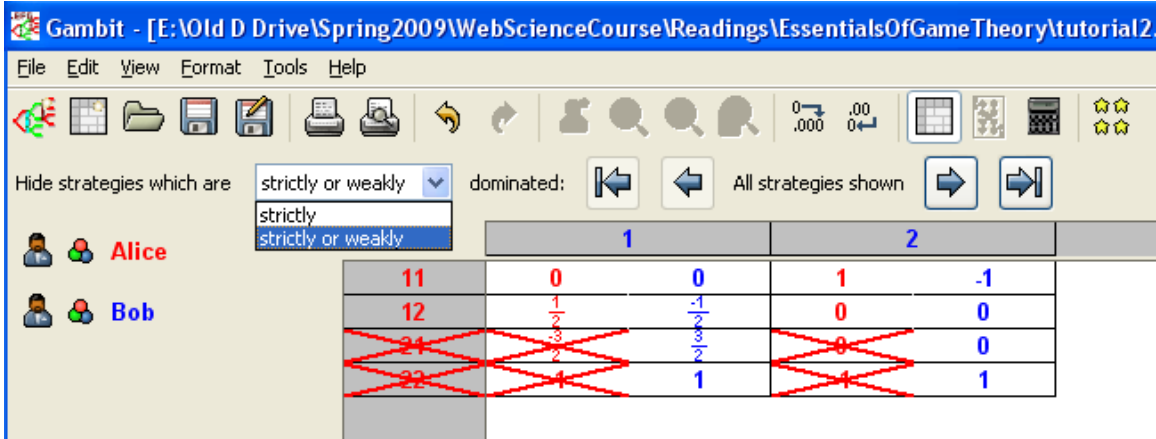
Be sure to save your model: File → Save. This gives a window for browsing to a folder and supplying the model name (extension .gbt). In any case, click Tools → Dominance again to turn off dominance analysis.

To view the game in strategic form, click the fourth tool button from the right. This shows a grid with first row and column shaded. Use this button to toggle between strategic and extensive forms.

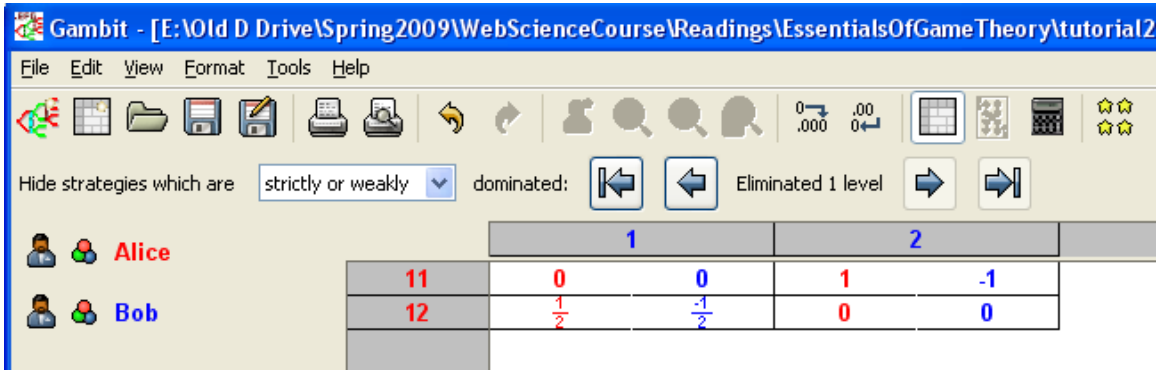
	1	2
11	0	0
12	$\frac{1}{2}$	$-\frac{1}{2}$
21	$-\frac{3}{2}$	$\frac{3}{2}$
22	-1	1

Gambit summarizes strategies. For Alice, each strategy lists the actions she takes at each of her information sets. E.g., 12 corresponds to her taking her second action (fold) at her first information set and her first action (raise) at her second information set.

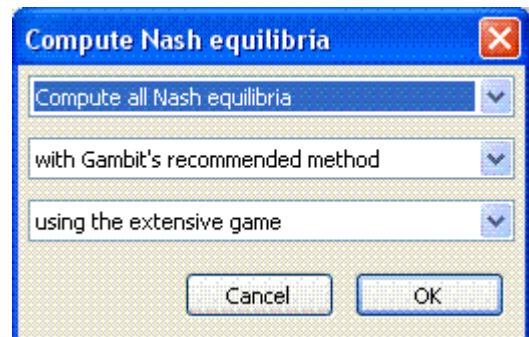
Do dominance analysis now. We have the same toolbar as with the extensive form.

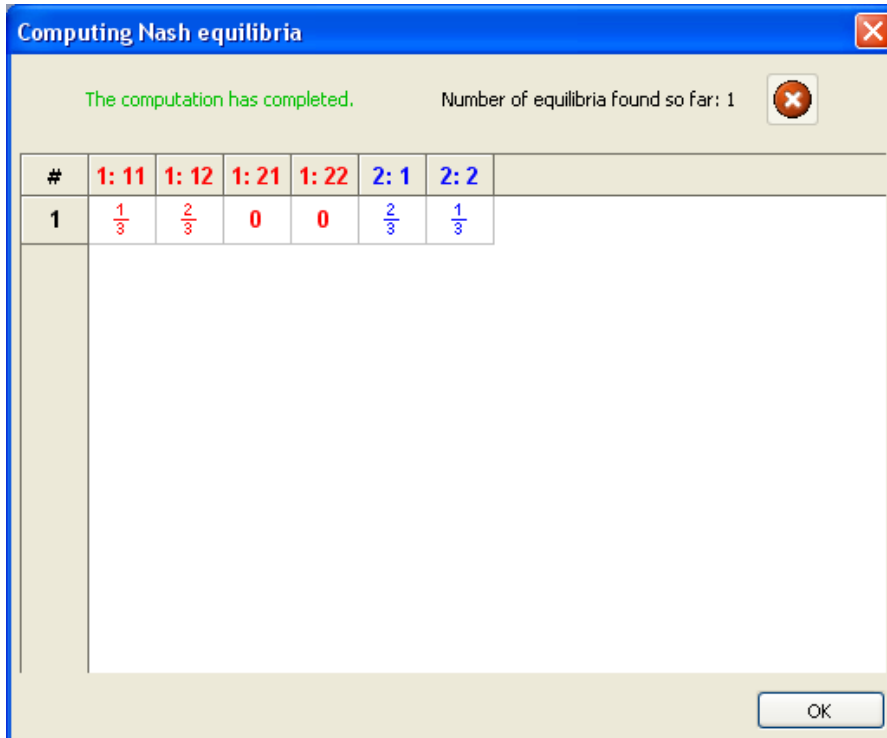


It crosses out what is dominated after any number of steps. We see that any strategy having Alice fold when she has a high card is dominated. To clean this up, click the right arrow so that only two strategies remain for Alice.



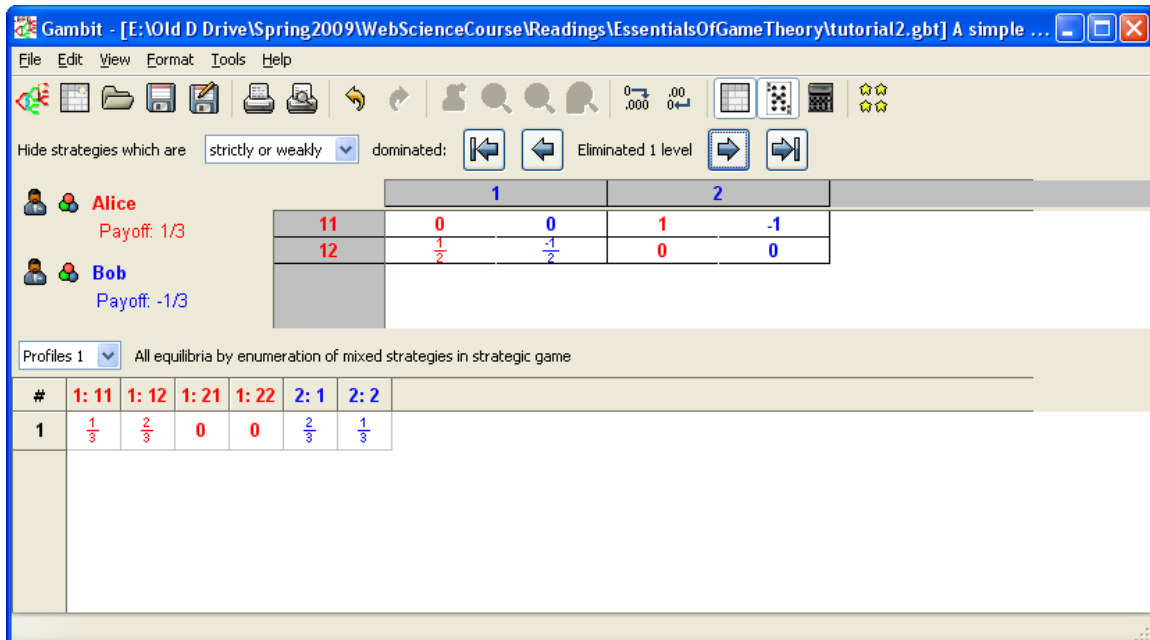
The algorithms for finding Nash equilibria are available either via the Tools tab or by clicking the second tool button from the right. This pops up a window for you to select from several ways to find Nash equilibria. At this stage, just take the defaults. It pops up a window with the Nash equilibria



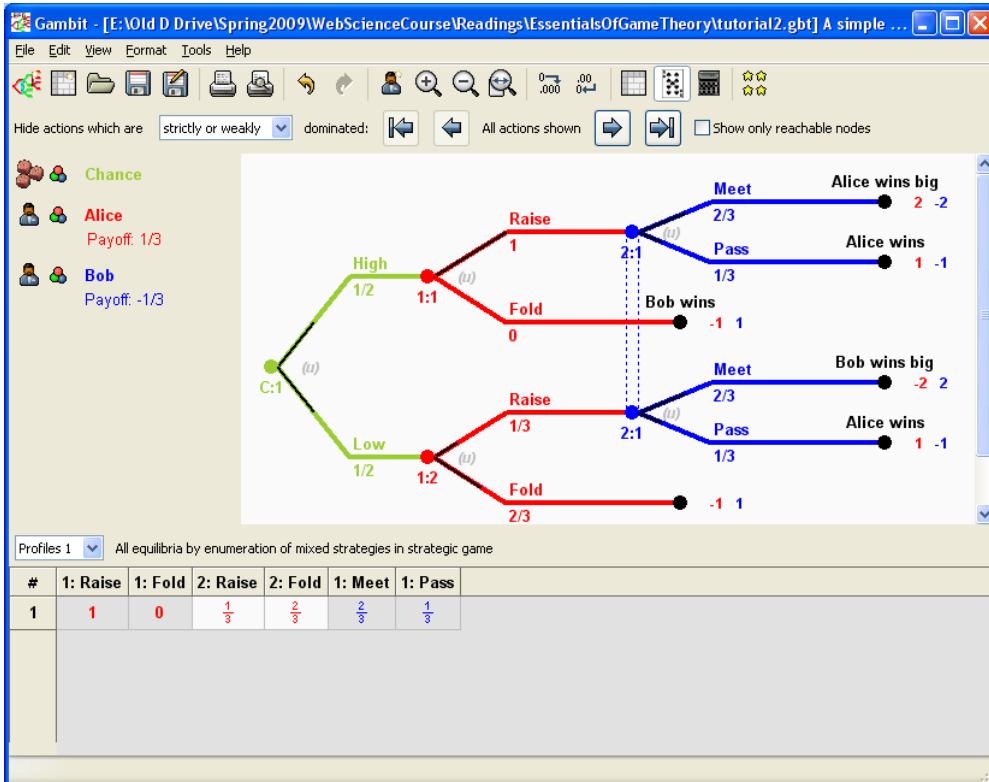


Here it finds one. In the column labels, the number before the colon is the player number, and the number after the colon is that player's strategy. We see that, in this equilibrium, Alice never folds with a high card and folds with probability $\frac{2}{3}$ with a low card while Bob meets with probability $\frac{2}{3}$.

When the window showing the Nash equilibrium is dismissed, this equilibrium is shown in the main window, below the dominance pain. We also see that Alice's expected payoff in this equilibrium is $\frac{1}{3}$ while Bob's is $\frac{2}{3}$.

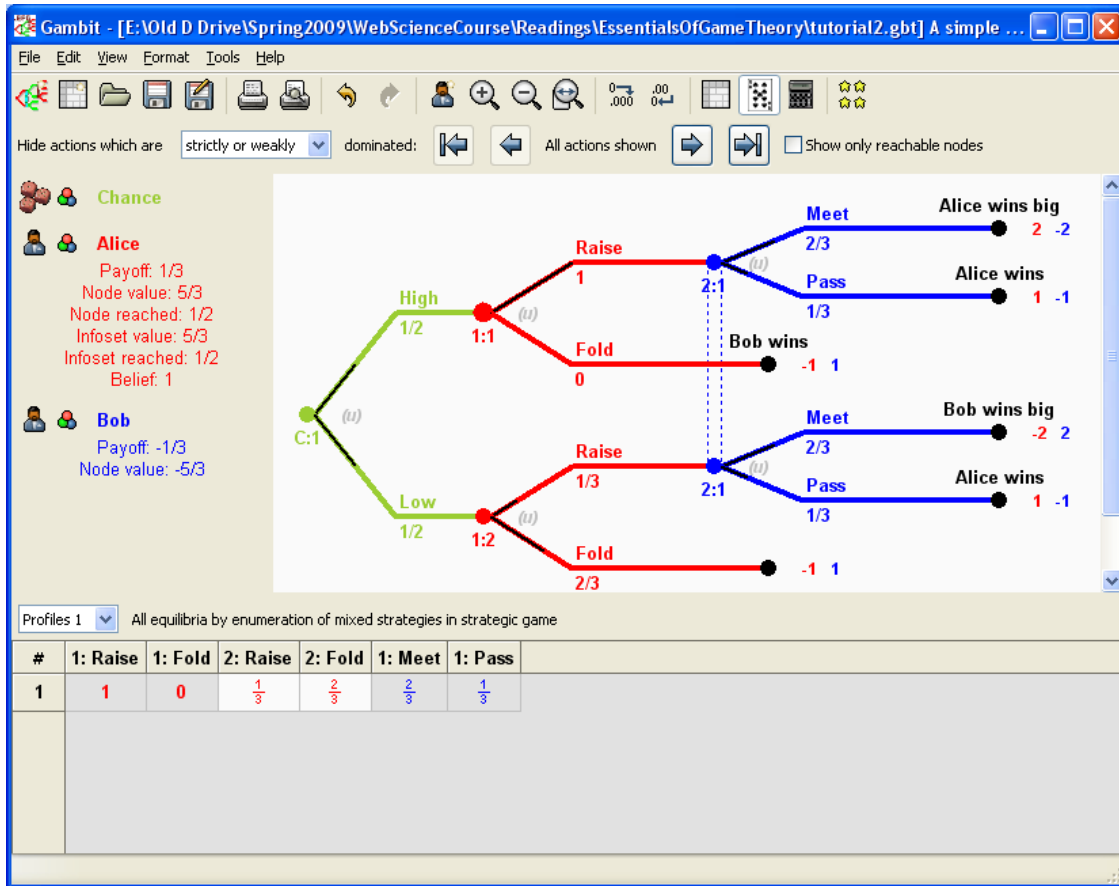


We convert back to the extensive form by toggling the fourth icon from the right. You can drag the border between the upper and lower panel to see the entire tree. The first leg of each link is darkened to show its probability in the equilibrium. The numbers below the links are these probabilities.

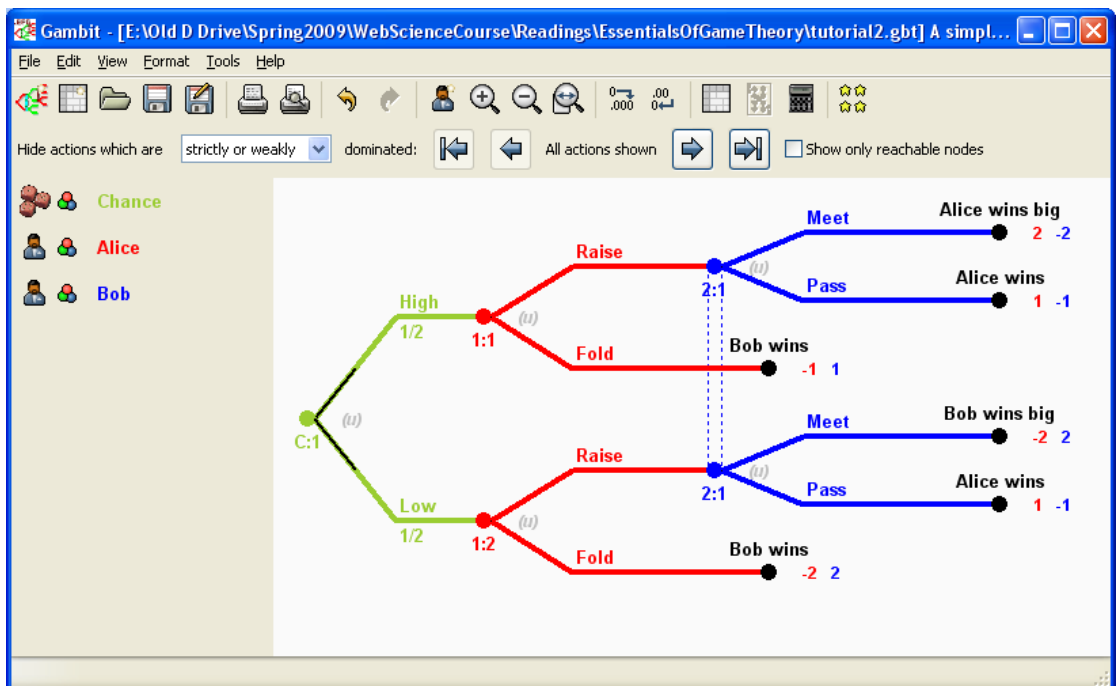


You can click on a node to get information on it. The following screenshot shows the result of clicking on the node that results from a High action by Chance, where it is Alice's turn to play. "Node value" is Alice's expected payoff once this node is reached, and "Node reached" is the probability that this node is reached. The information on the infoset is similar. (Note that this node is the only member of its infoset.)

Gambit Tutorial



You can also change values and run the analysis again. In the following, we change the payoffs when Alice folds with a low card.



In this case, there are two equilibria.

The screenshot shows the Gambit software interface. The main window displays a normal form game matrix for a two-player game between Alice and Bob. The matrix is as follows:

	1	2
11	0	0
12	0	0
21	0	0
22	0	0

Below the matrix, the equilibrium profiles are listed:

#	1: 11	1: 12	1: 21	1: 22	2: 1	2: 2
1	$\frac{1}{3}$	$\frac{2}{3}$	0	0	1	0
2	1	0	0	0	1	0

In the extensive form, now that there are two equilibria to choose from, we can click on a row for a given equilibrium to see the information on that equilibrium (e.g., the probabilities that the various actions will be taken) in the upper panel.