


# Session 2.6

## Designing Games in Extensive Form








These notes show how to design games in extensive form.


# Designing games in extensive form

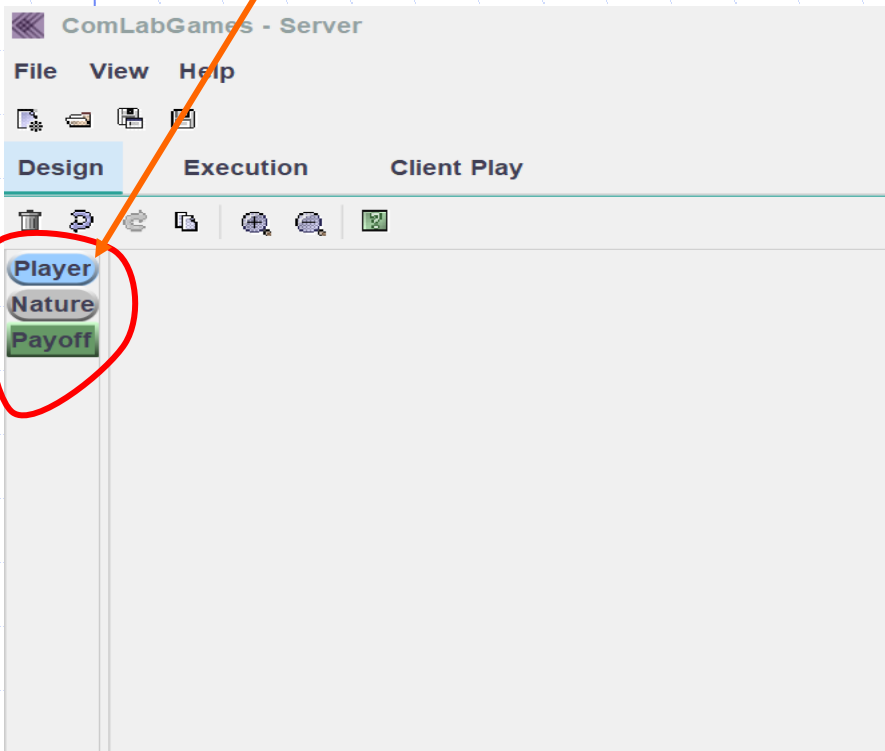
1. If you just downloaded *ComLabGames* software for the first time:
  - a. select "*Extensive Form Game*" from the game type Dialog.
  - b. Otherwise, click on  ("New") and select "*Extensive Form Game*" from the game type Dialog to open design window for extensive form game.



# Elements in Design window


1. Basic: **Player**, **Nature** and **Payoff**.
2. Additional:  (shortcuts),   (zoom in, zoom out or CTRL+ mouse button),  (duplicate),   (undo, redo) and  (delete).

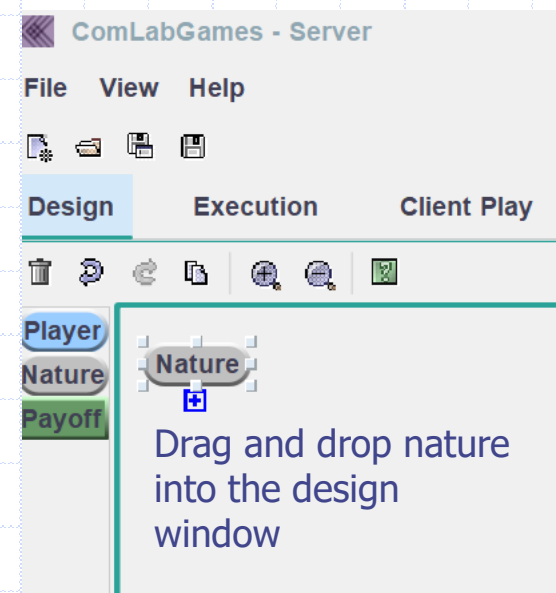
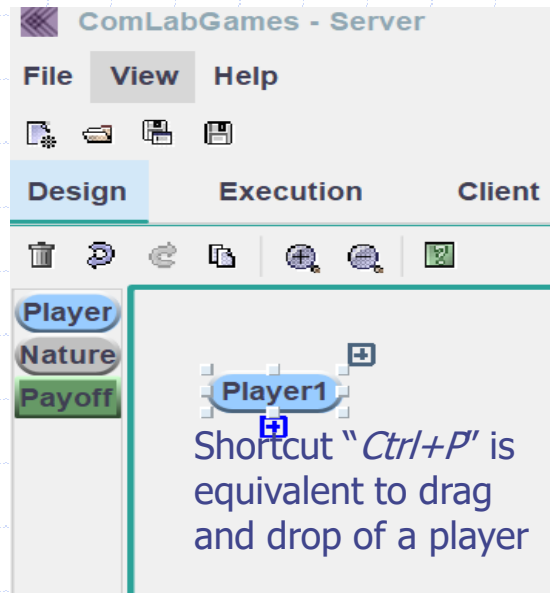
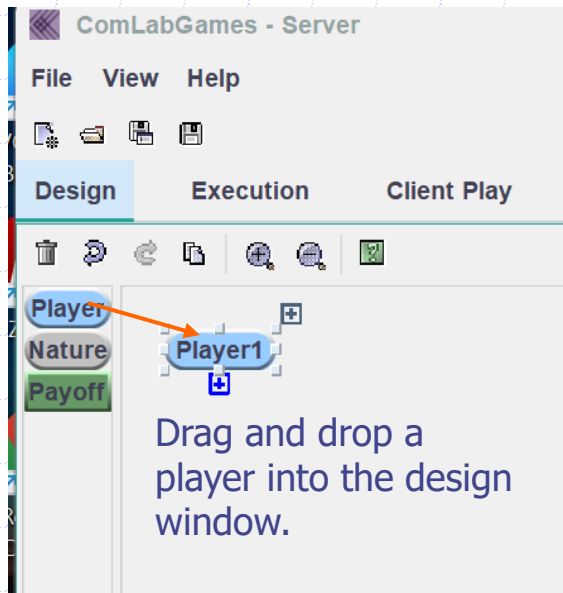
Click on  to see the description of each command in keyboard shortcuts.




Shortcut	Description
Ctrl + P	Add current Player
Ctrl + N	Add new Player
Ctrl + S	Select Player
Ctrl + Y	Add Payoff to Player
Ctrl + F	Add Payoff to all Players under Tree Entry
Shift + Ctrl + F	Add Payoff to all Players
Ctrl + E	Edit element
Ctrl + R	Remove element

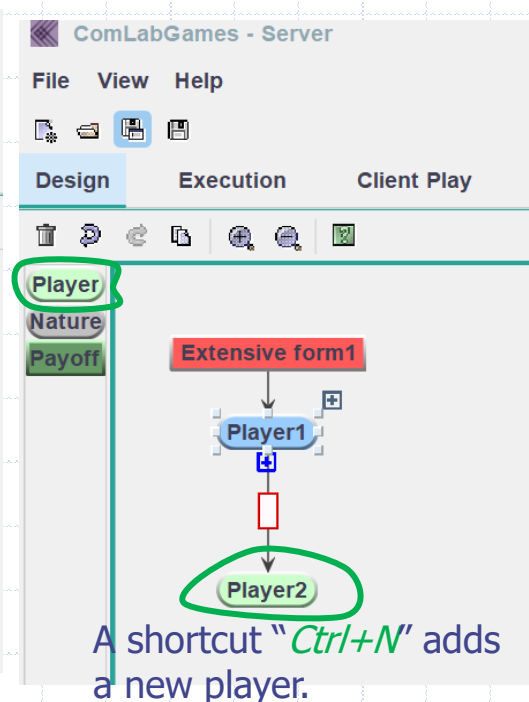
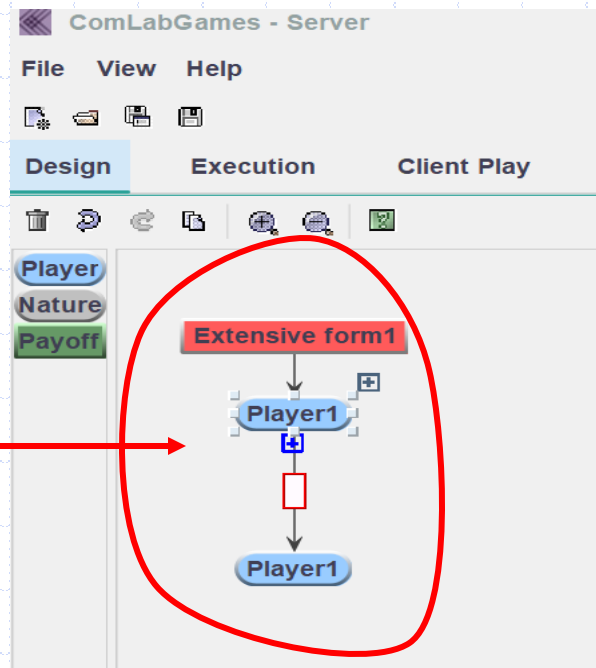
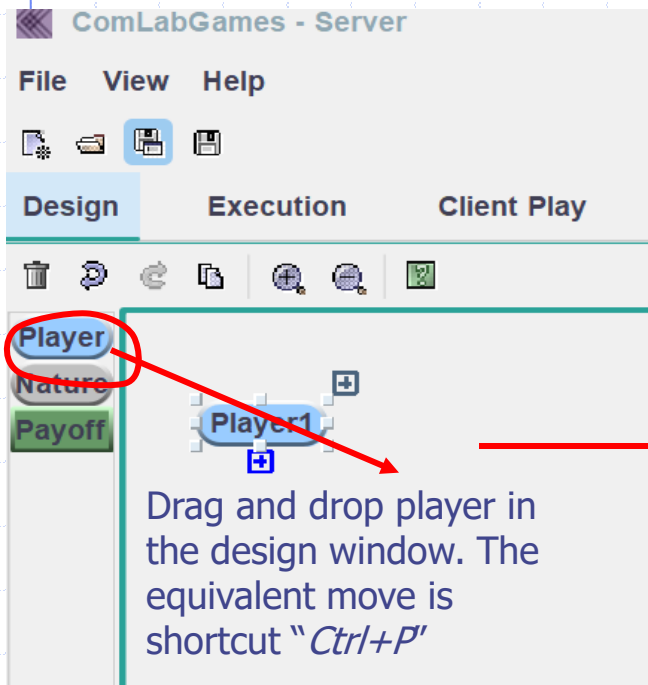
# Basic steps in designing a game tree

1. To draw a tree, drag and drop a **Player** or **Nature** into the design window or use shortcuts to start the game.
2. General rule: select the predecessor and drag another icon into design window or select the predecessor and connect it to the successor icon by connecting  to the successor node.



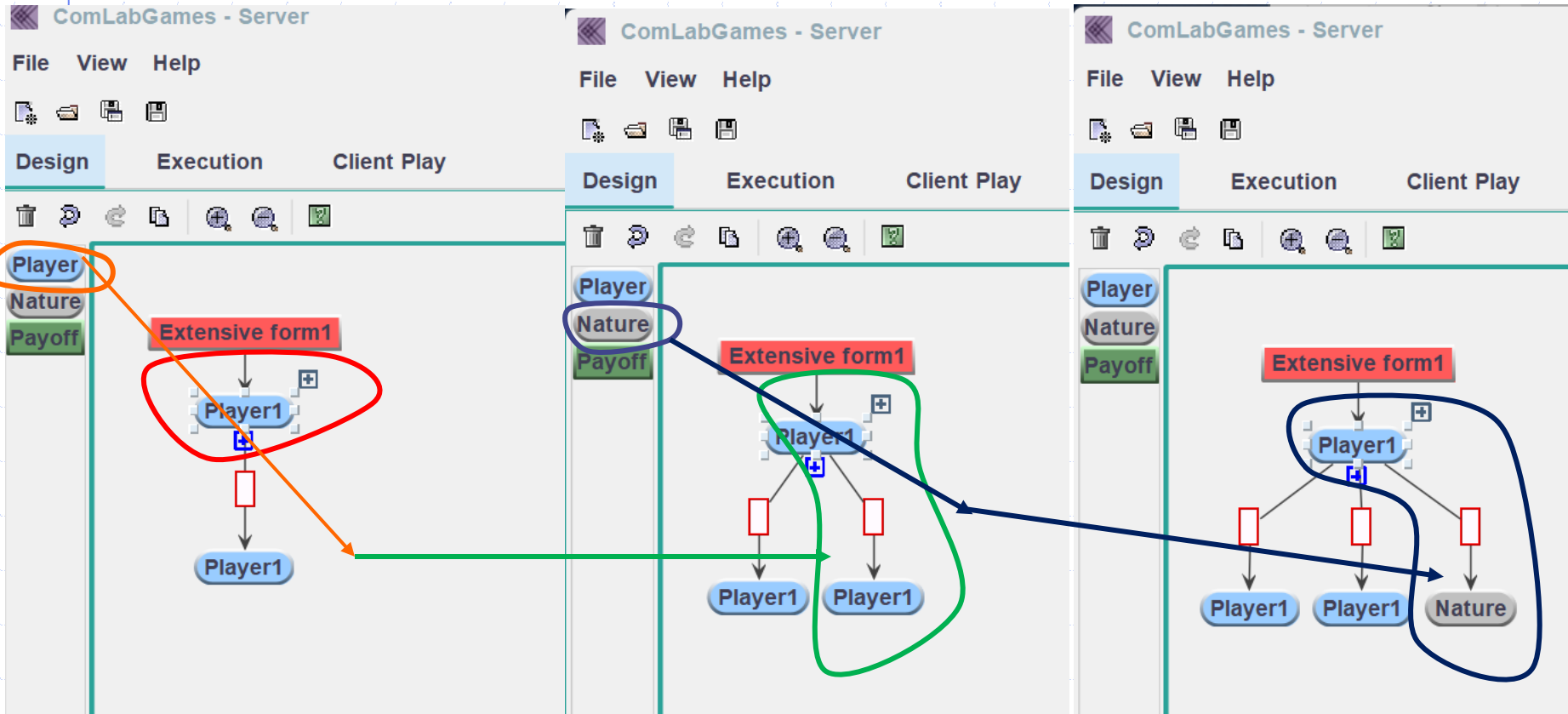
# Adding more **Player** icons into design window

1. Select predecessor icon so it looks like .
2. Drag and drop a **Player** icon into design window or use "*CTRL+P*" to add a current (**Player**) player.
3. If you use "*CTRL+N*" a new (**Player2**) player will be added.
4. Player nodes connect automatically.





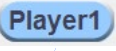


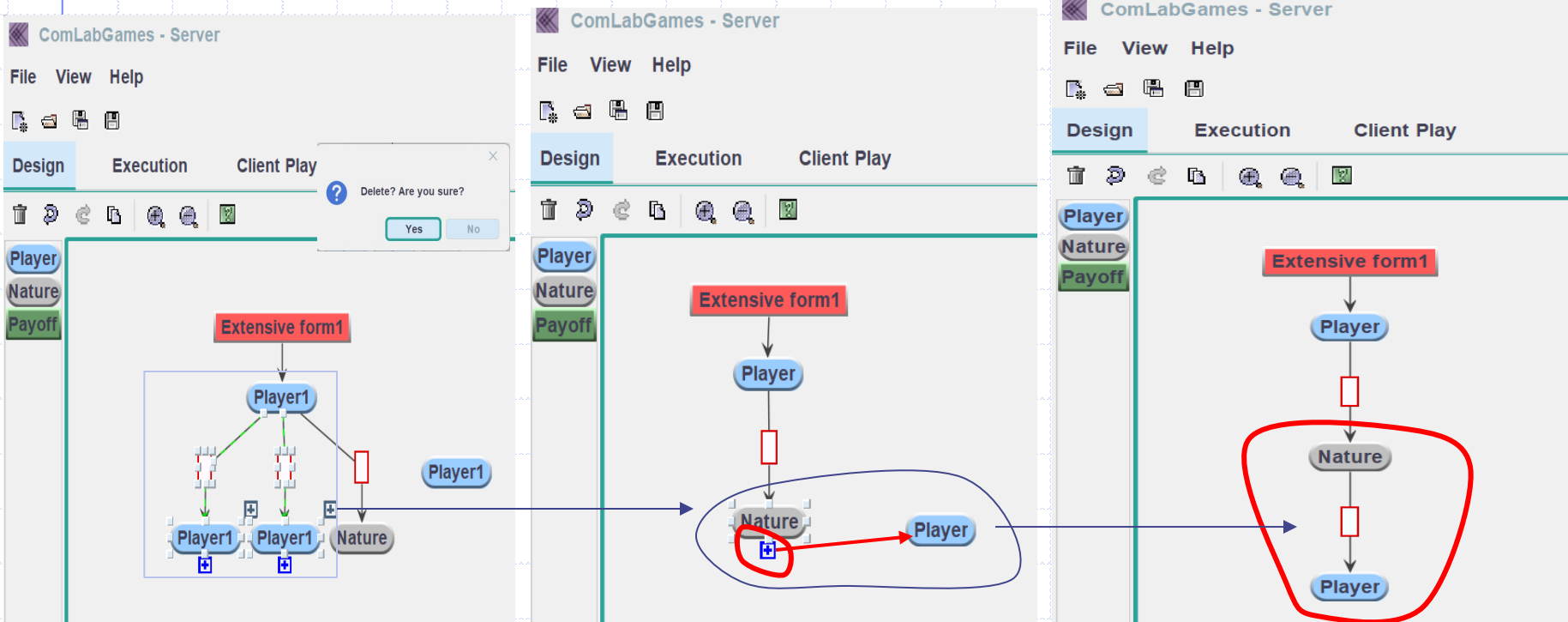
# Building the tree

1. Select predecessor node.
2. Drag and drop another (or use shortcut "*Ctrl+P*") **Player1** icon and/or **Nature** into the design window.



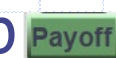


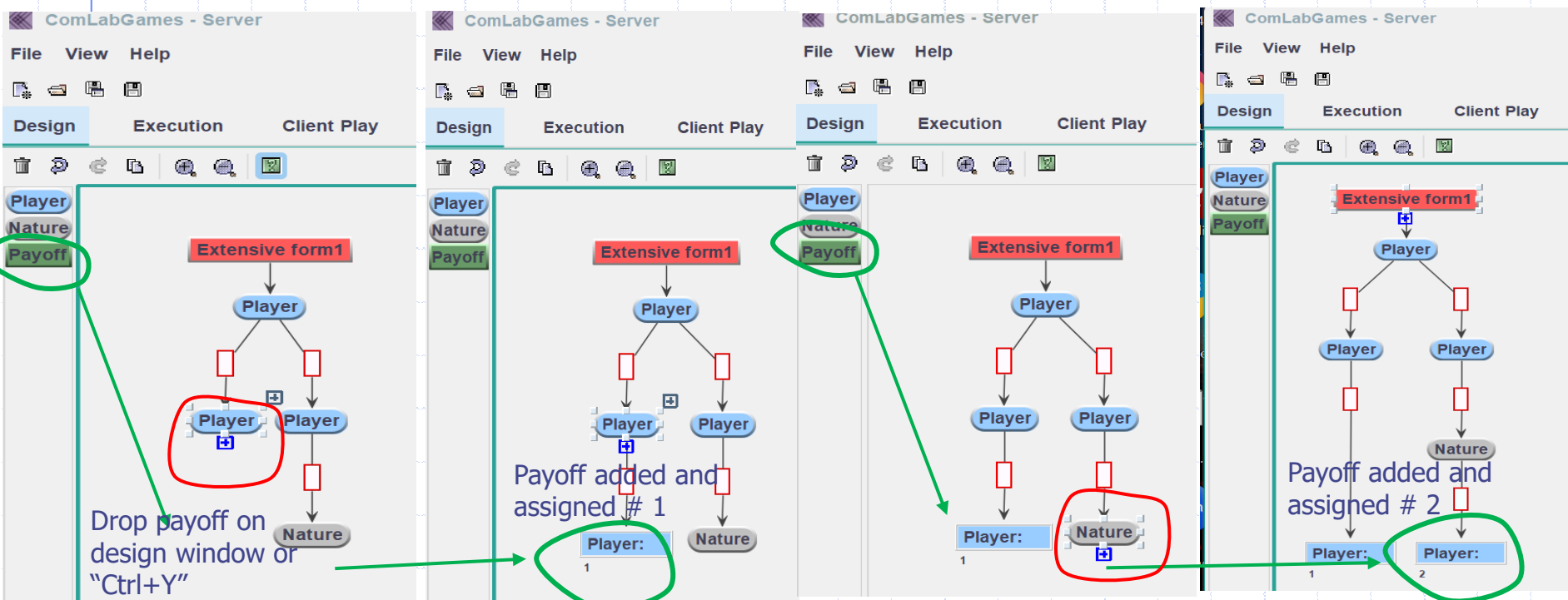
# Deleting branches and rearranging tree

1. Click on the left mouse button, hold it and select area you want to delete or just click on elements you want to delete and click on  .
2.  appears on the screen. Click "yes" to delete.
3. Select  , click on  and drag the mouse to  and connect the icons.



# Adding payoffs with drag and drop

1. Select  or  and drag and drop  icon on the design window or use shortcut "*Ctrl+Y*".
2. Each payoff node is assigned a number in the ascending order.
3. Only payoffs icons are numbered in the design window.

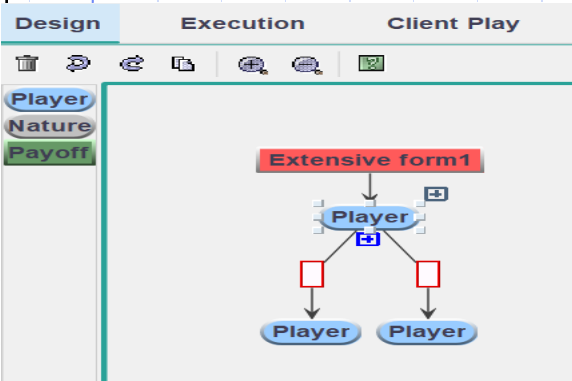


The image displays four sequential screenshots of the ComLabGames - Server software interface, illustrating the process of adding and numbering payoffs to an extensive form game tree.

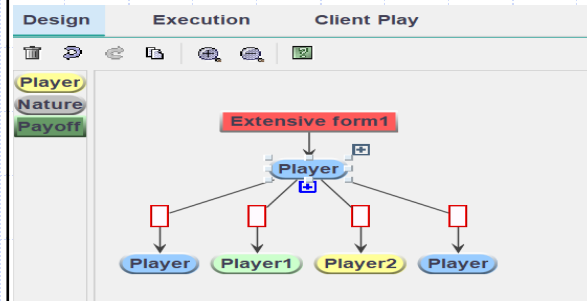
- First Screenshot:** Shows the software interface with the "Design" tab selected. The "Player" and "Nature" icons are visible in the left toolbar. A green circle highlights the "Payoff" icon. A red circle highlights a "Player" node in the game tree. A text box at the bottom left says "Drop payoff on design window or 'Ctrl+Y'".
- Second Screenshot:** Shows the "Player" node selected in the tree. A "Player:" payoff node with the number "1" is added below it. A text box says "Payoff added and assigned # 1".
- Third Screenshot:** Shows the "Nature" node selected in the tree. A "Nature:" payoff node with the number "1" is added below it. A text box says "Payoff added and assigned # 2".
- Fourth Screenshot:** Shows the final state with two payoff nodes: "Player:" (1) and "Nature:" (2). The "Nature:" node is circled in red.

# Using shortcuts to build a tree

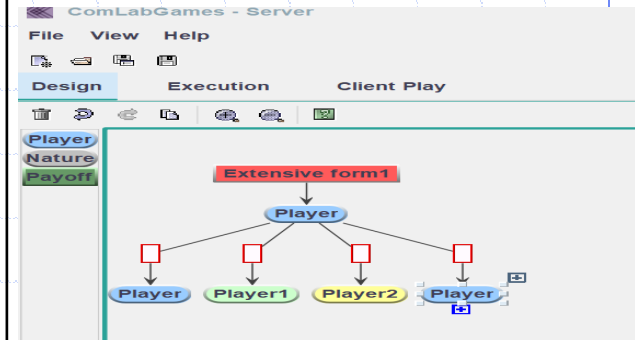
"**Ctrl+P**": add current player on design window (the same color as the player in the panel on the left)



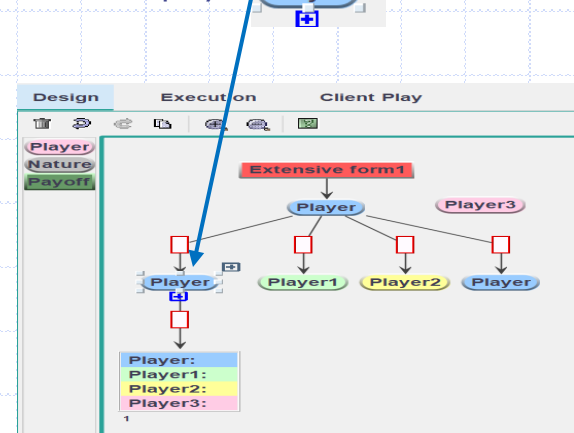
"**Ctrl+N**" to add new players: first **Player1** was added and then **Player2**. The last player on the left panel is **Player2** and it corresponds to the last player added.



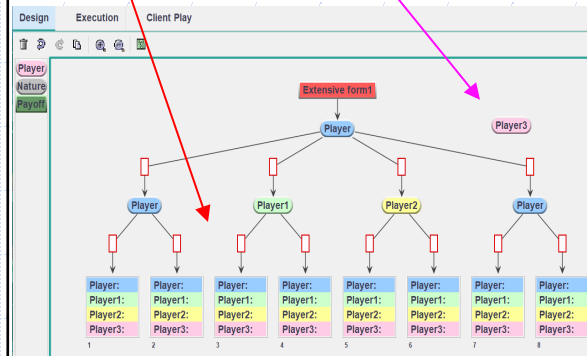
"**Ctrl+S**" to change a selected player. For example, click on **Player** and use "**Ctrl+S**". The left panel changes to **Player**.



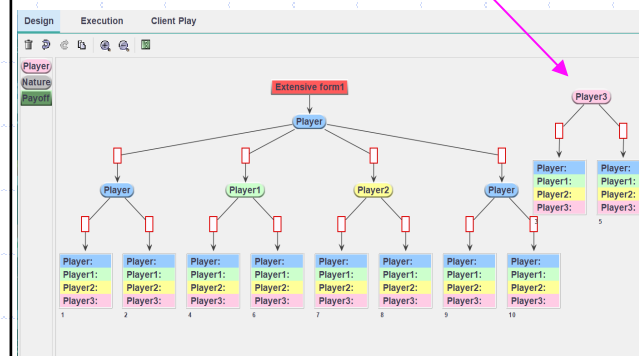
"**Ctrl+Y**" to add a single payoff to a selected player.



"**Ctrl+F**" to add all the payoffs under tree entry. Note **Player3** is not part of the tree and payoffs were not added to this player.







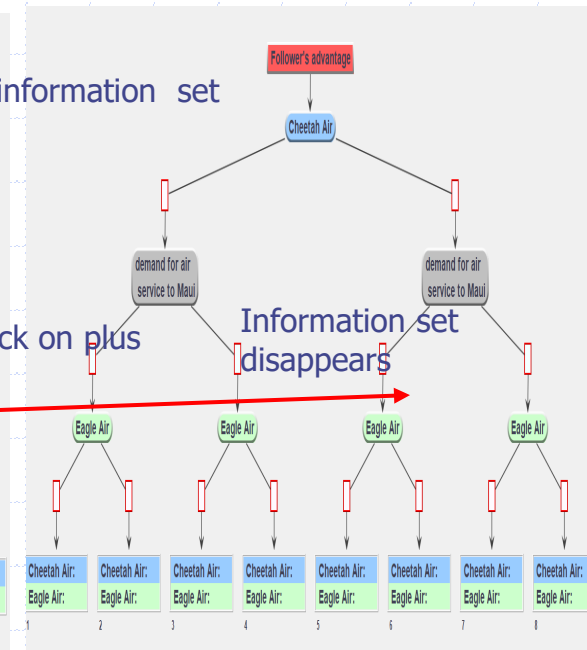
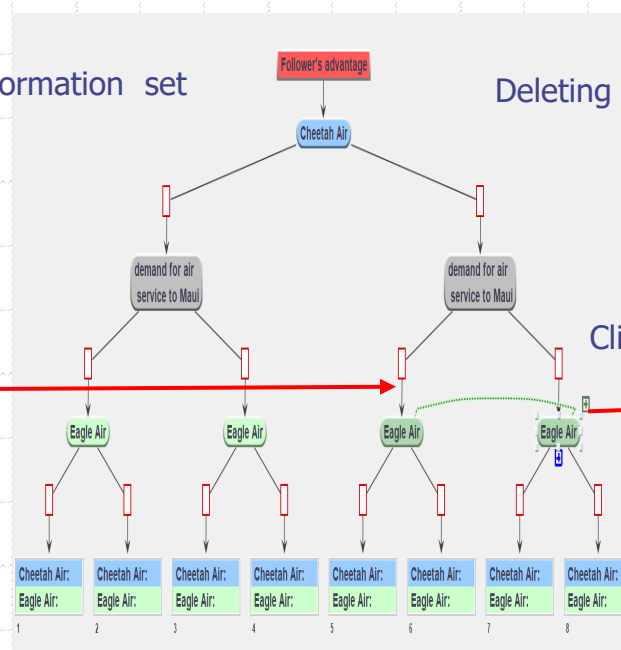
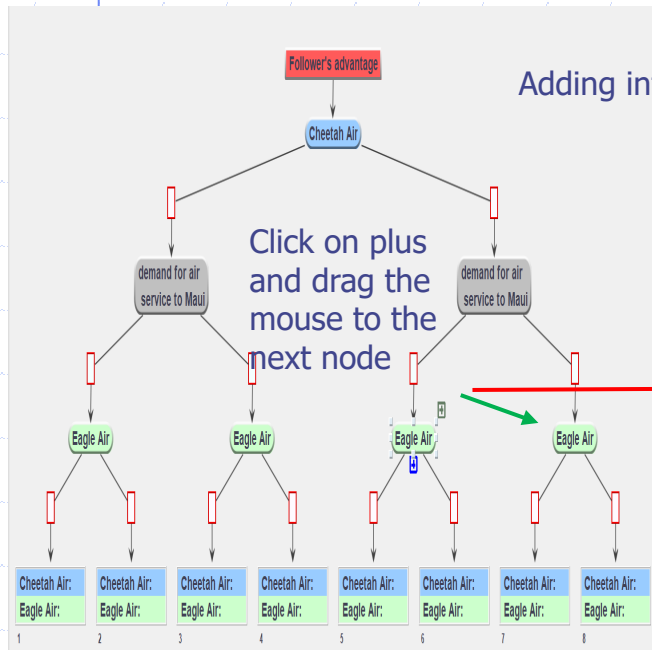
"**Shift+Ctrl+F**" to add payoffs to all players including players who are not connected to a tree like **Player3**.





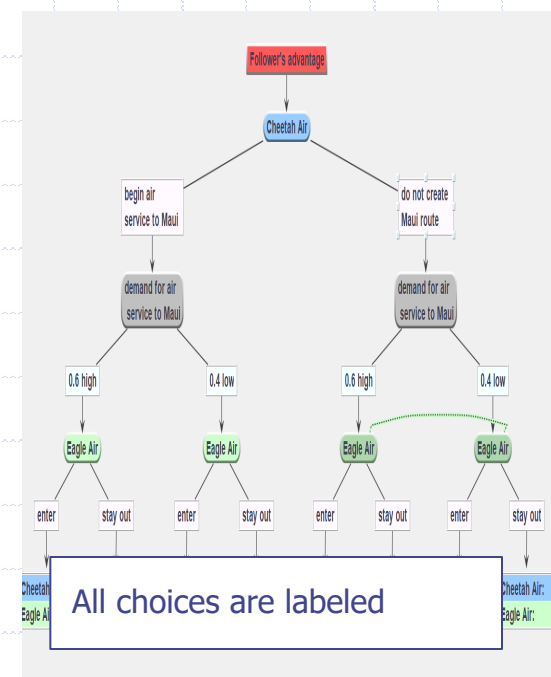
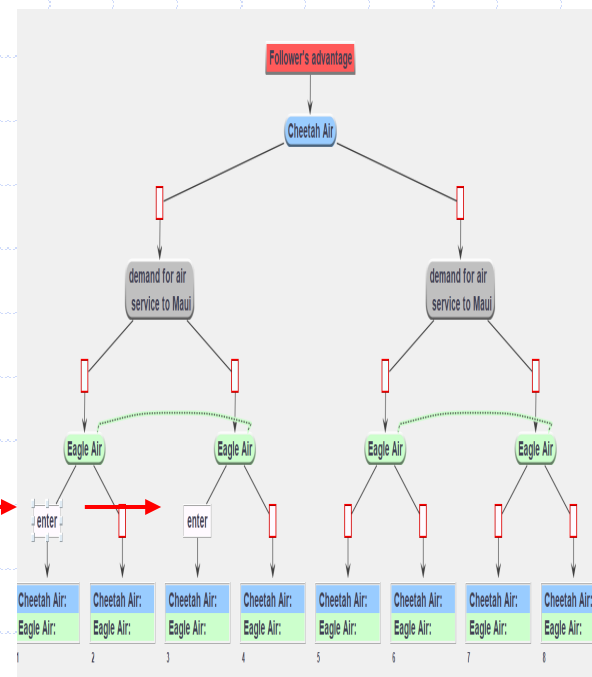
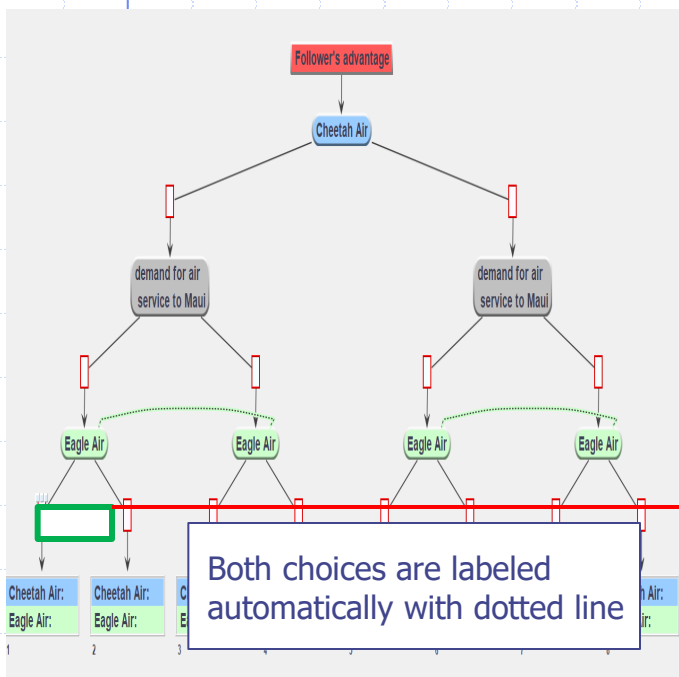
# Creating/removing information sets

1. Recommended to add information set before labeling choices.  
The choice's text is automatically copied to the choice corresponding to the node in the same information set.
2. To add an information set, select a  node, click on  and drag the mouse to the next node.
3. To remove the info set, select corresponding node: , and click on . Information set disappears.




# Labeling Player choices

1. Double click on a choice and write a label.
2. When a dotted line connects two player nodes, the same text appears in the corresponding choice.
3. If dotted line is not drawn, the text must be repeated.
4. You can copy a text from any document and paste it into a choice.

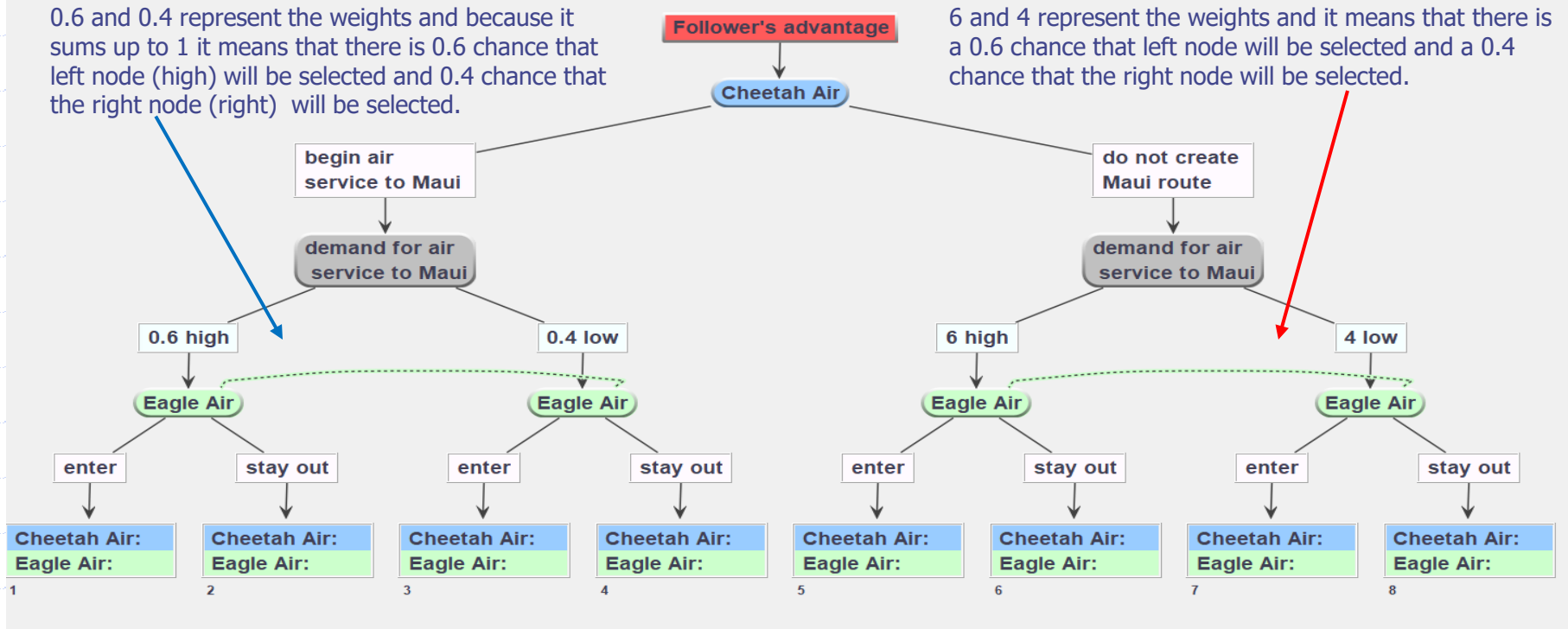


# Editing chance probabilities in

1. Only whole numbers or decimal numbers can be written as weights.
2. When the weights are accompanied with labels there must be at least one empty space between the number and the label, just like: 

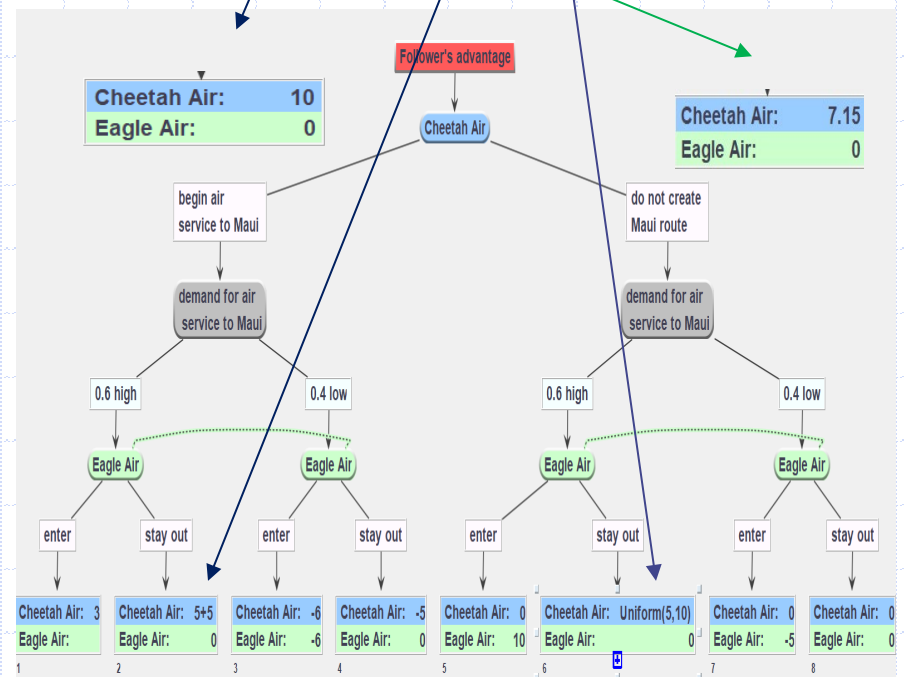
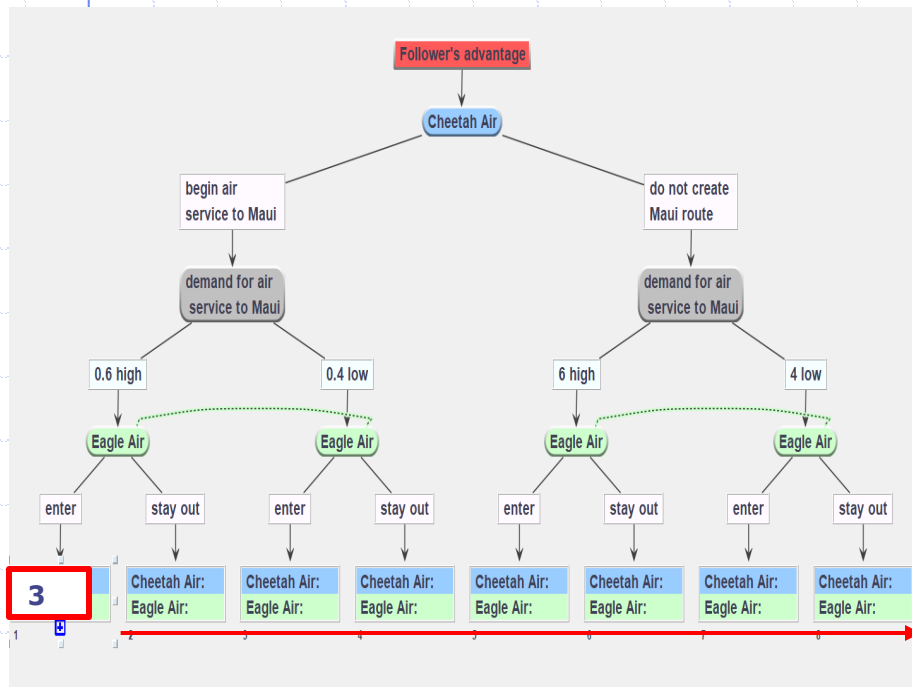
0.6 and 0.4 represent the weights and because it sums up to 1 it means that there is 0.6 chance that left node (high) will be selected and 0.4 chance that the right node (right) will be selected.

6 and 4 represent the weights and it means that there is a 0.6 chance that left node will be selected and a 0.4 chance that the right node will be selected.



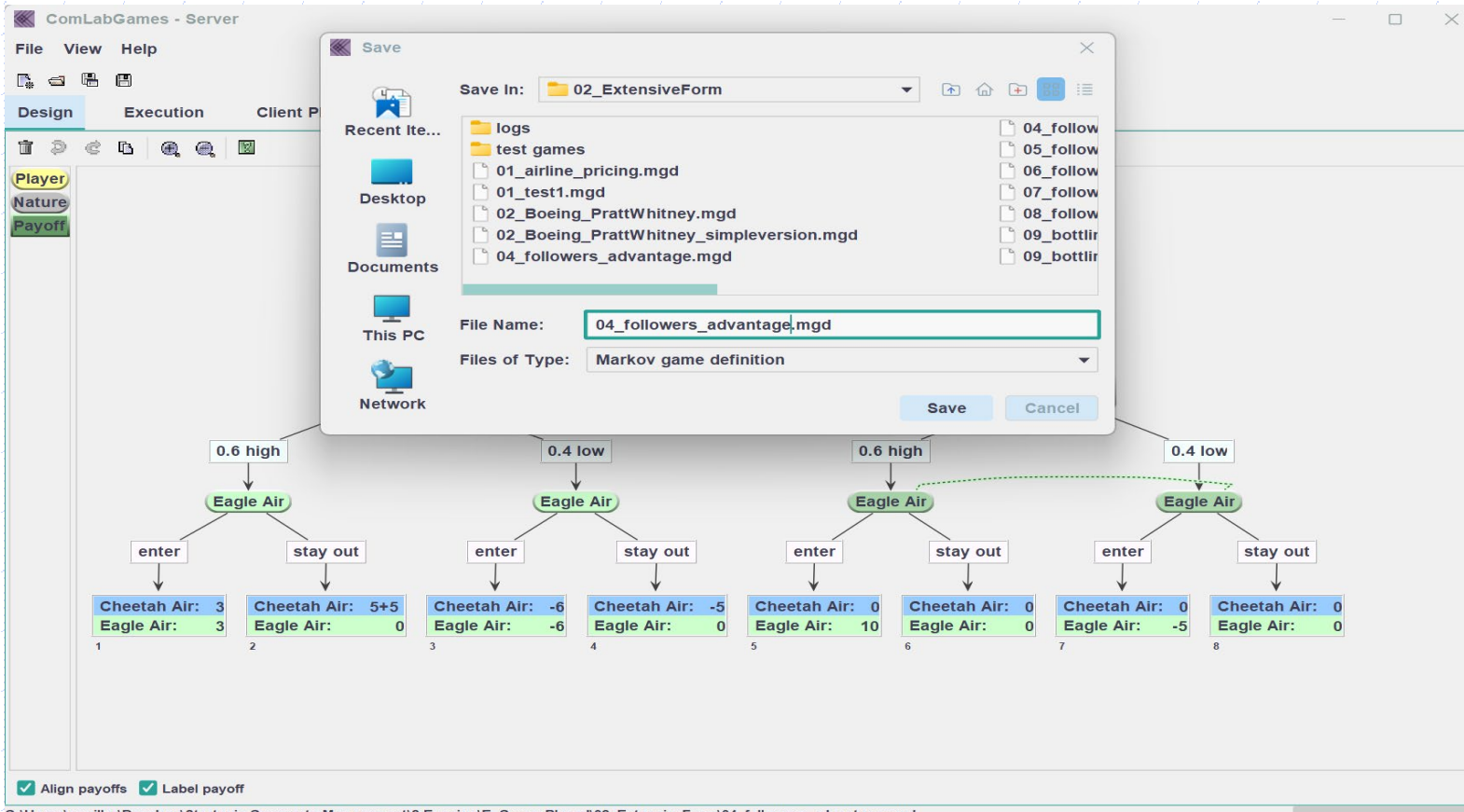
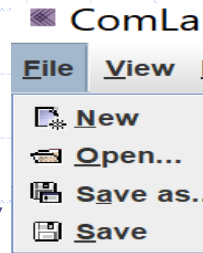
# Editing payoffs

1. Double click on the appropriate payoff and write a number.
2. Payoffs can be expressed with mathematical formula, a draw from a distribution. Moderator will see the formula and subjects will see actual draws or results of a mathematical operation.



# Saving the tree as a file

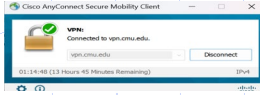
Click on File and "Save as" to save the file. The program automatically adds suffix "mgd".

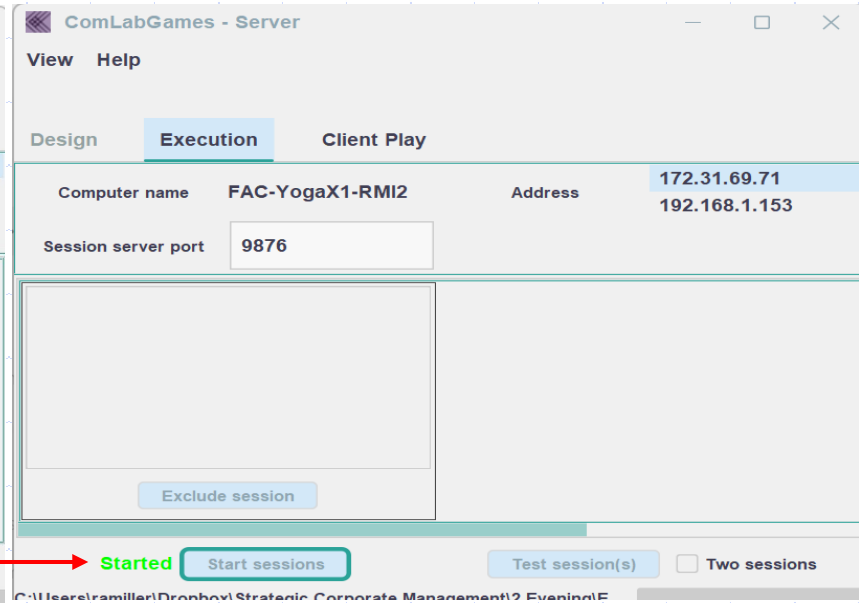
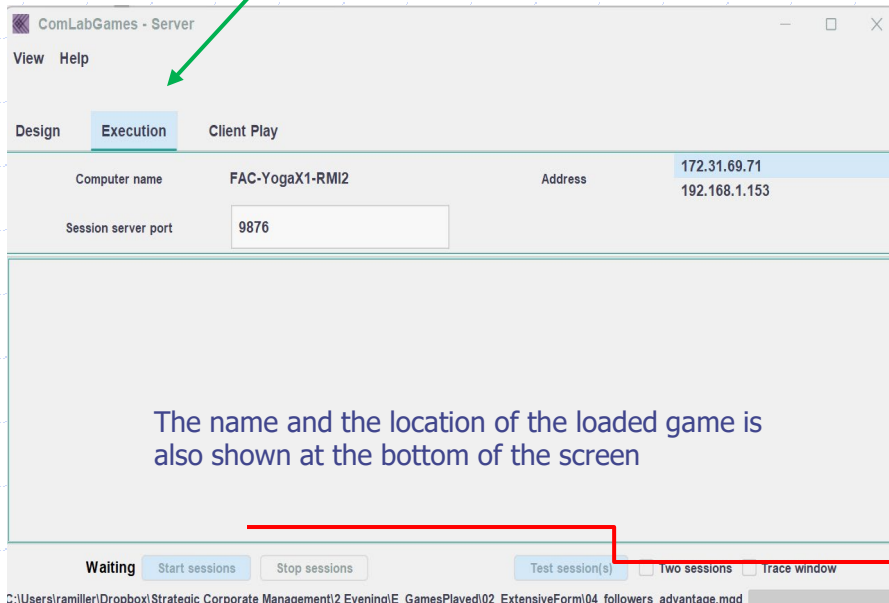


The screenshot displays the ComLabGames - Server application interface. A 'Save' dialog box is open, showing the file path '02\_ExtensiveForm' and a list of files. The 'File Name' field contains '04\_followers\_advantage.mgd' and the 'Files of Type' is set to 'Markov game definition'. The background shows a game tree with four nodes, each representing a decision point for 'Eagle Air' with probabilities of 0.6 high and 0.4 low. The tree branches into 'enter' and 'stay out' actions, leading to terminal payoffs for 'Cheetah Air' and 'Eagle Air'.

Node	Probability	Action	Cheetah Air	Eagle Air
1	0.6 high	enter	3	3
2	0.4 low	stay out	5+5	0
3	0.6 high	enter	-6	-6
4	0.4 low	stay out	-5	0
5	0.6 high	enter	0	10
6	0.4 low	stay out	0	0
7	0.6 high	enter	0	-5
8	0.4 low	stay out	0	0

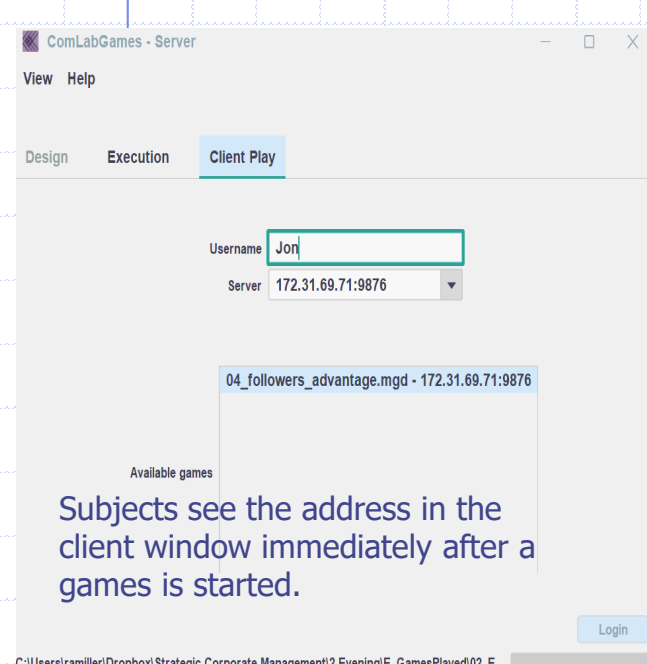
# Steps for conducting an experiment

1. If you are running experiment from home, make sure you are connected to CMU via VPN:  before you open ComLabGames program.
2. Open ComLabGames and open the tree in the design: **Design** window.
3. Select **Execution** tab. Make sure 172.... address is highlighted.
4. Click on **Start sessions**.



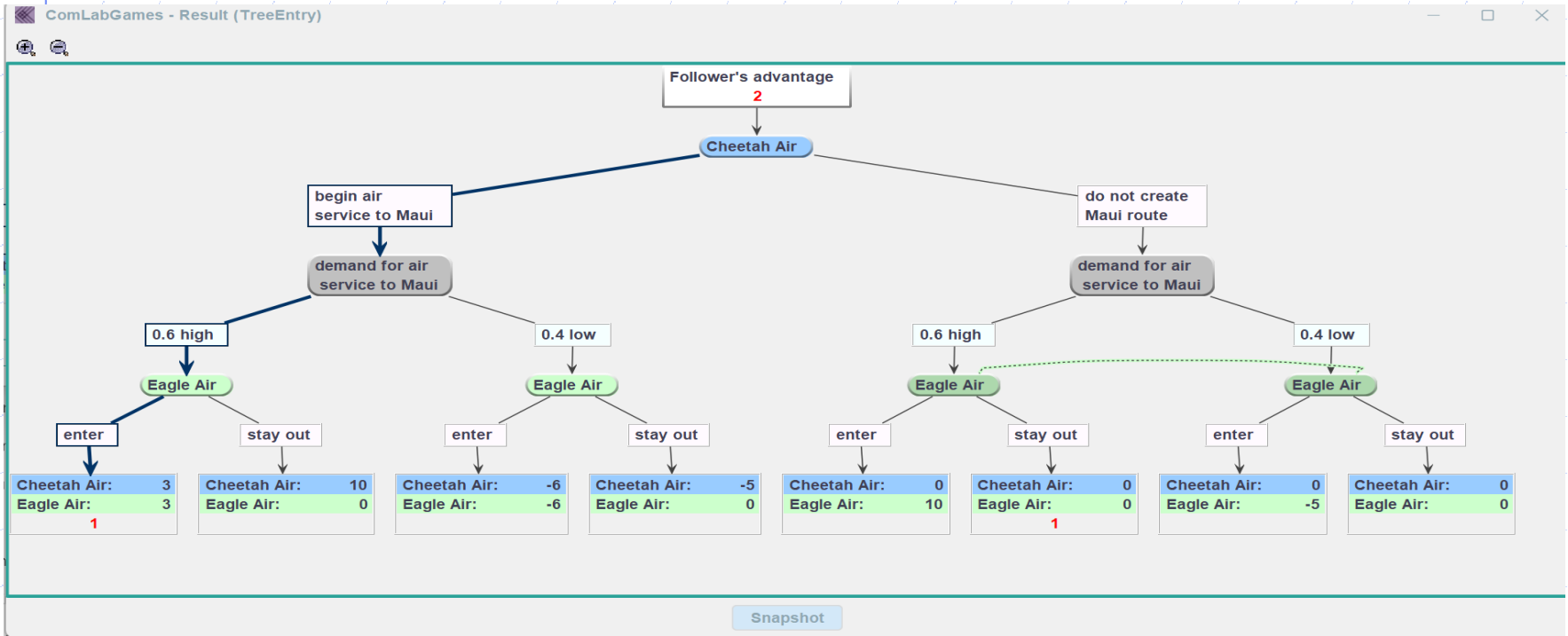
# Monitoring the experiment

1. Address 172.... will appear in Client Play" window when you start a session.
2. Pairing of subjects is shown in execution window. A subject whose turn is to decide is colored in red.
3. Subject who is waiting is colored in blue.






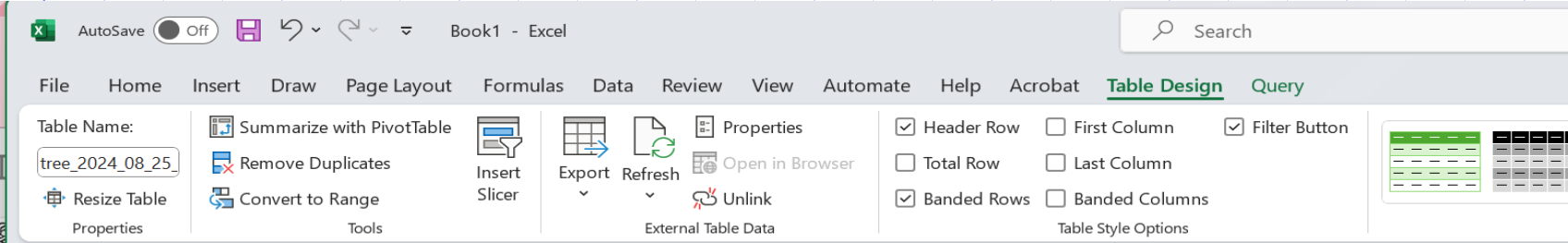
# Result window

1. Once subjects selected decisions the path and the frequency of each terminal node is shown in Result (TreeEntry)
2. Click on "SnapShot" to save the tree representation of the results. It will be automatically saved in the game directory.



# Output file

1. Subdirectory  in the directory where the game was saved is automatically created once you stop running an experiment.
2. Output file in \*.csv format is saved in .
3. The name of the file has the following name: tree- date- hour- min-sec-name of the game, like:  tree\_2024-08-25\_20-32-11\_04\_followers\_advantage



Session	Round	Time	Subject	Player	Choice	Outcome	Payoff
1	2	1 25-08-2024 20:43:52.835	Ann	Cheetah Air	do not create \Maui route	6	0
2	2	1 25-08-2024 20:43:52.854		demand for air\ service to Maui	0.6 high	6	
3	2	1 25-08-2024 20:46:18.185	Nora	Eagle Air	stay out	6	0
4	1	1 25-08-2024 20:54:10.627	Jon	Cheetah Air	begin air \service to Maui	1	3
5	1	1 25-08-2024 20:54:10.632		demand for air\ service to Maui	0.6 high	1	
6	1	1 25-08-2024 20:54:37.361	Amela	Eagle Air	enter	1	3

- "Session #" shows subjects who were assigned to play together.

- "Time" represents the time of a decision by each player/nature move

- "Subject" records login name

- "Player" records assigned role to a subject.

- "Choice" records the choices subjects selected.

- "Outcome" is a terminal node.

## Part 2:

# Playing Games in Extensive Form

These notes explain the mechanics of playing a extensive form game (as a client). These instructions apply to the games you play in class, and those you play within your team.

# Playing an extensive form game

1. After all the subjects login to the game (in our example two subjects), the node **Cheetah Air** of the subject whose turn it is to move is circled in blue and his possible choices are blinking between pink and white.
2. It is not subject Nora's turn to move. That is why any node **Eagle Air** is not circled in blue.

ComLabGames - Client  
Username: Ann Id: 6 Identity: 1

Followers's advantage

**Cheetah Air**

begin air service to Maui  
do not create Maui route

demand for air service to Maui

0.6 high 0.4 low

Eagle Air

enter stay out

Cheetah Air: 3 Eagle Air: 3	Cheetah Air: 10 Eagle Air: 0	Cheetah Air: -6 Eagle Air: -6	Cheetah Air: -5 Eagle Air: 0	Cheetah Air: 0 Eagle Air: 10	Cheetah Air: 0 Eagle Air: 0	Cheetah Air: 0 Eagle Air: -5	Cheetah Air: 0 Eagle Air: 0
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At the bottom of the window, a subject in a **Cheetah Air** role is prompted: **"Please make a move now!"**

Stage time limit: unlimited Round: 1 Continue

**Cheetah Air** Please make a move now!

Waiting 1 of 1 subject(s) to proceed the session!

ComLabGames - Client  
Username: Nora Id: 1 Identity: 2

Followers's advantage

**Eagle Air**

begin air service to Maui  
do not create Maui route

demand for air service to Maui

0.6 high 0.4 low

Eagle Air

enter stay out

Cheetah Air: 3 Eagle Air: 3	Cheetah Air: 10 Eagle Air: 0	Cheetah Air: -6 Eagle Air: -6	Cheetah Air: -5 Eagle Air: 0	Cheetah Air: 0 Eagle Air: 10	Cheetah Air: 0 Eagle Air: 0	Cheetah Air: 0 Eagle Air: -5	Cheetah Air: 0 Eagle Air: 0
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**Eagle Air** is prompted to **wait for other players to make their choices**

Stage time limit: Round: 1 Continue

**Eagle Air** Please wait for other players to make their choices!

Waiting 1 of 1 subject(s) to proceed the session!

# Selecting a move

1. Moving the mouse between choices without clicking highlights a **green** path to the next decision maker's node or a terminal node.
2. Once selection is made, you cannot cancel it.

ComLabGames - Client  
Username: Ann Id: 4 Identity: 1

Followers's advantage

Cheetah Air

begin air service to Maui

do not create Maui route

demand for air service to Maui

demand for air service to Maui

0.6 high

0.4 low

Eagle Air

Eagle Air

enter

stay out

enter

stay out

enter

stay out

enter

stay out

Cheetah Air: 3	Cheetah Air: 10	Cheetah Air: -6	Cheetah Air: -5	Cheetah Air: 0	Cheetah Air: 0	Cheetah Air: 0	Cheetah Air: 0
Eagle Air: 3	Eagle Air: 0	Eagle Air: -6	Eagle Air: 0	Eagle Air: 10	Eagle Air: 0	Eagle Air: -5	Eagle Air: 0

Stage time limit: unlimited Round: 1 Continue

Cheetah Air Please make a move now!

Waiting 1 of 1 subject(s) to proceed the session!

ComLabGames - Client  
Username: Ann Id: 4 Identity: 1

Followers's advantage

Cheetah Air

begin air service to Maui

do not create Maui route

demand for air service to Maui

demand for air service to Maui

0.6 high

0.4 low

Eagle Air

Eagle Air

enter

stay out

enter

stay out

enter

stay out

enter

stay out

Cheetah Air: 3	Cheetah Air: 10	Cheetah Air: -6	Cheetah Air: -5	Cheetah Air: 0	Cheetah Air: 0	Cheetah Air: 0	Cheetah Air: 0
Eagle Air: 3	Eagle Air: 0	Eagle Air: -6	Eagle Air: 0	Eagle Air: 10	Eagle Air: 0	Eagle Air: -5	Eagle Air: 0

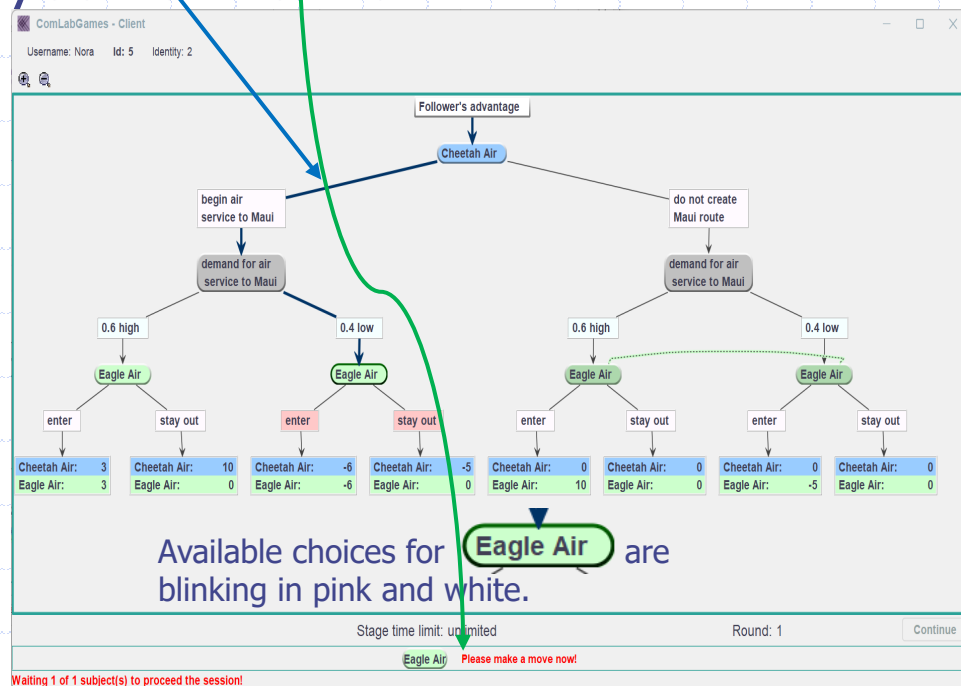
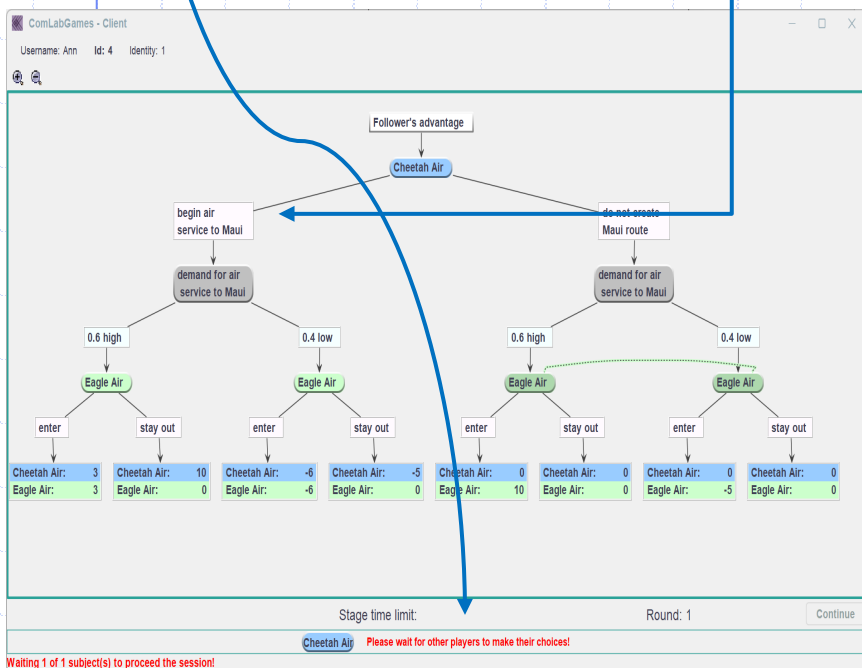
Stage time limit: unlimited Round: 1 Continue

Cheetah Air Please make a move now!

Waiting 1 of 1 subject(s) to proceed the session!

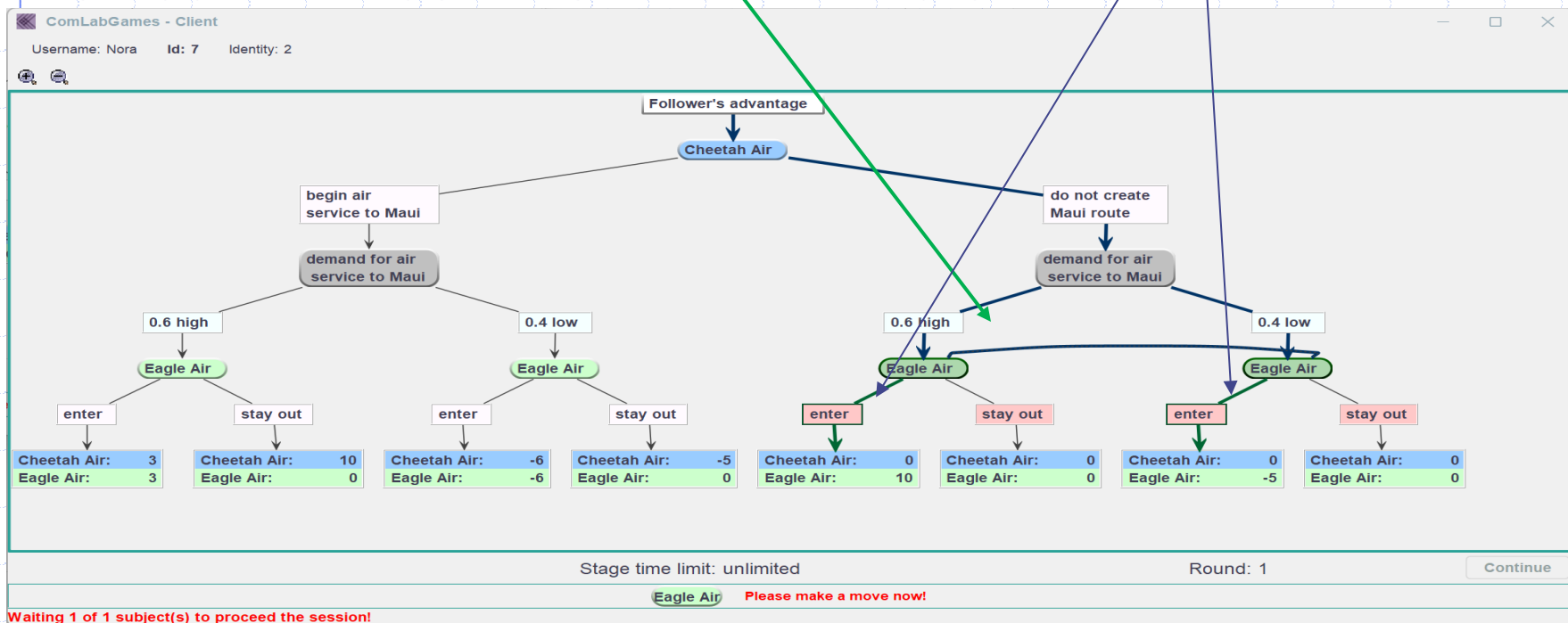
# More on move selection

1. Click on a choice to select it. Choice **begin air service to Maui** was selected.
2. **Cheetah Air** is prompted to wait.
3. **Eagle Air** node is circled in **blue** after **Cheetah Air** made a decision and the path that led to her node is highlighted in blue. She is prompted to make a decision.
4. Once a selection is made, you cannot cancel it.



# Dotted lines and decision making

1. The player, **Eagle Air** whose decision nodes are connected with dotted lines are both highlighted in blue.
2. She does not know what nature selected.
3. Moving the mouse between choices without clicking highlights the player's alternatives.
4. **Eagle Air** has two "enter" choices highlighted in *green* because she does not know the nature's draw.



# Showing the outcome of the game

1. Once a terminal node is reached the *payoffs* are highlighted.
2. The path from the start of the tree to the terminal node is highlighted in blue.
3. The outcome counter is displayed in *red*.

