Part 1: Designing a Game in Extensive Form

These notes show how to design games in extensive form.

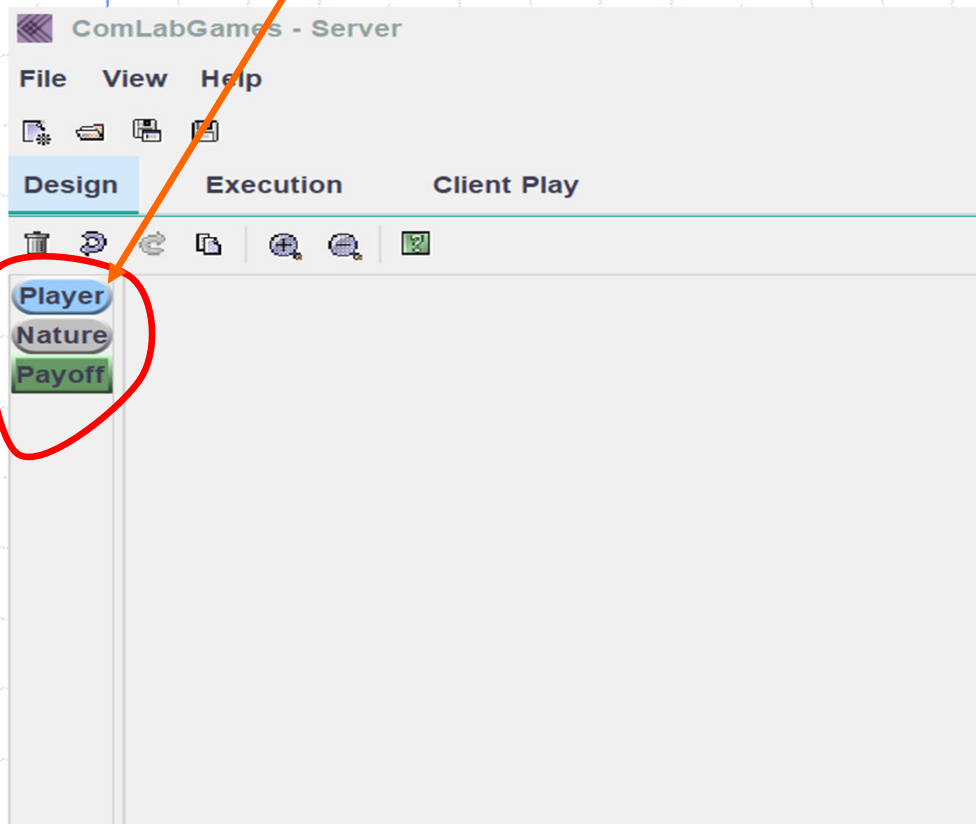# Designing games in extensive form

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.
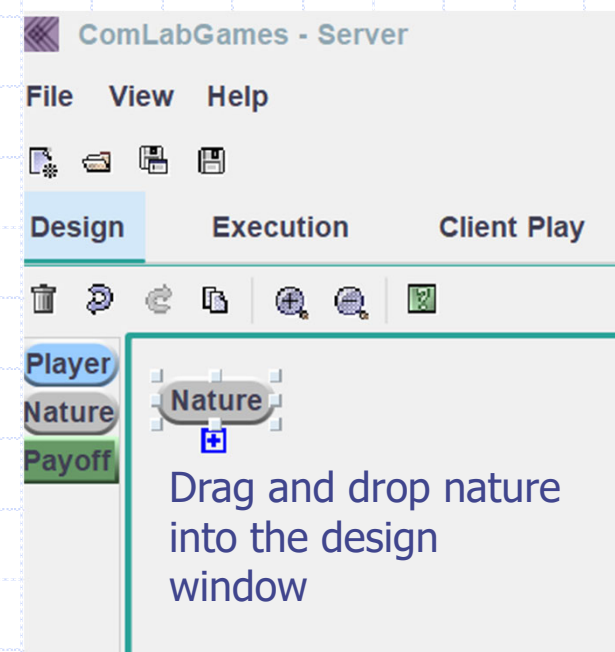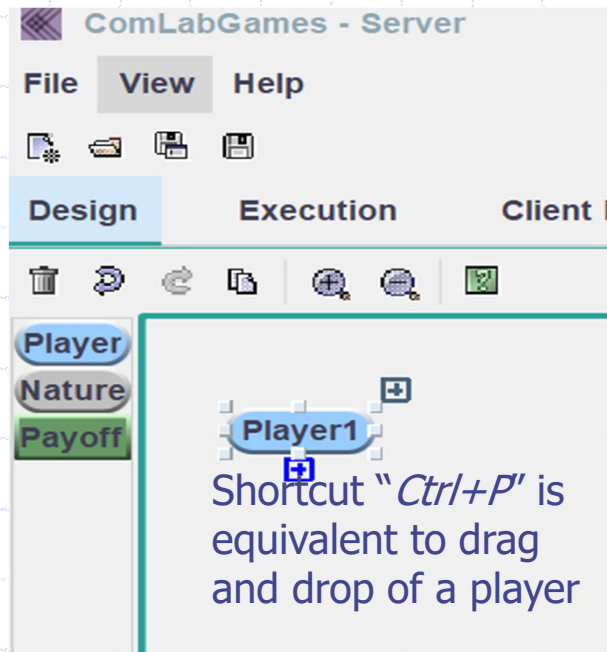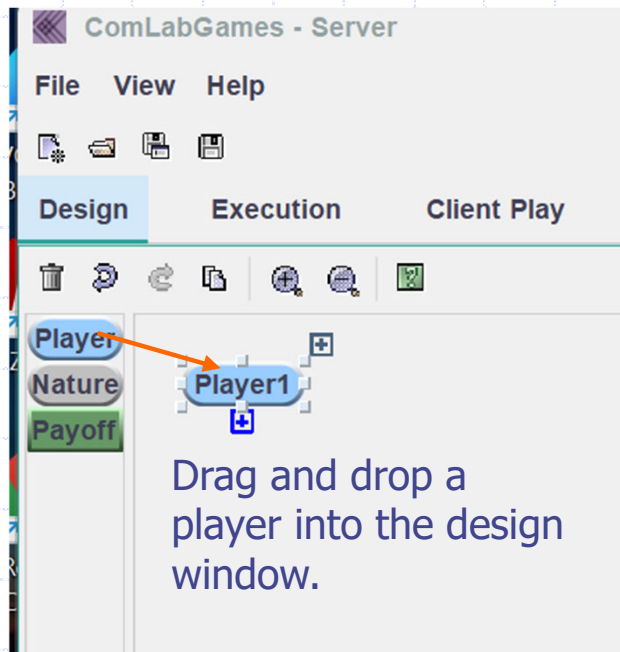2. General rule: select the predecessor and drag another icon into design window or select the predecessor and connect it to the successor icon by connecting ⊞ to the successor node.

Drag and drop a player into the design window.

Shortcut "*Ctrl+P*" is equivalent to drag and drop of a player

Drag and drop nature into the design window

Adding more Player icons into design window

1. Select predecessor icon so it looks like Player1 .
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.

Drag and drop player in the design window. The equivalent move is shortcut "*Ctrl+P*"

A shortcut "*Ctrl+N*" adds a new player.
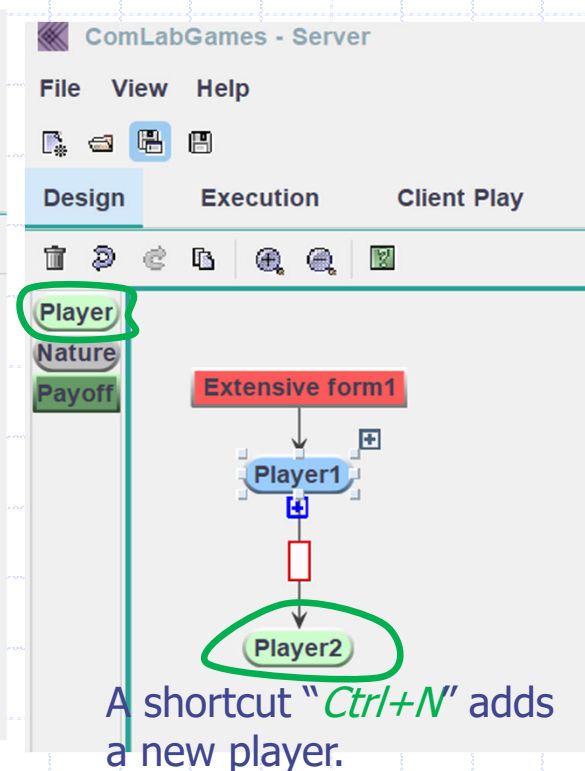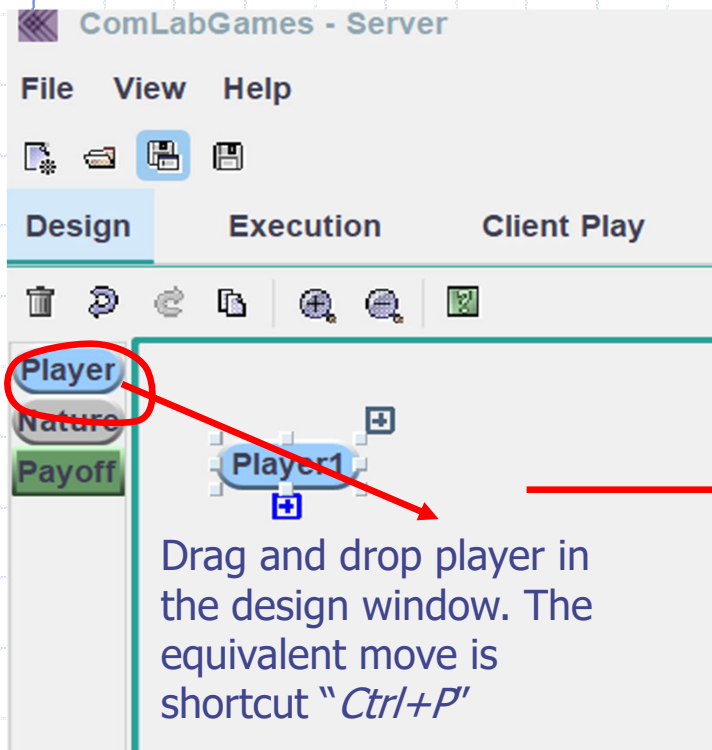
Building the tree

1. Select predecessor node.
2. Drag and drop another (or use shortcut "*Ctrl+P*") Player1 icon and/or Nature into the design window.
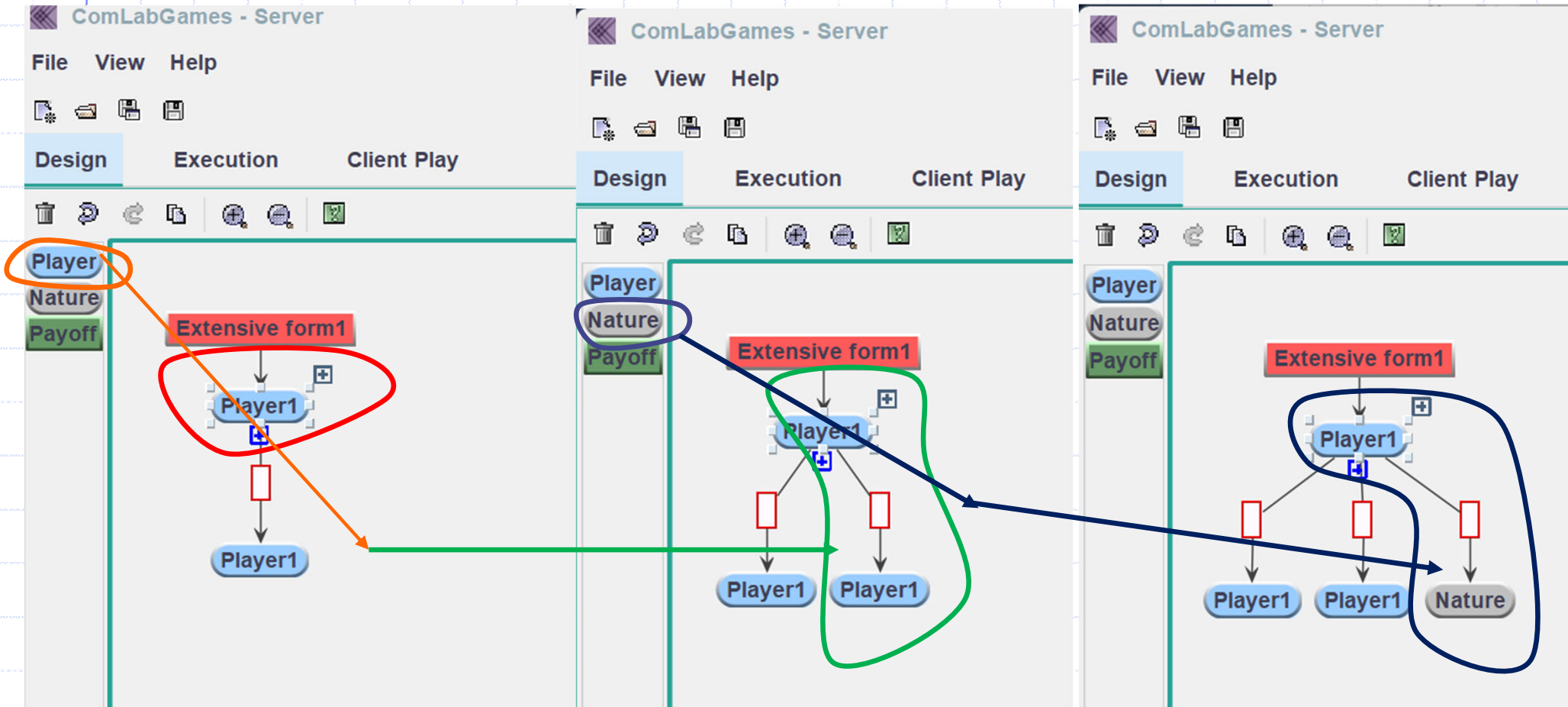
Deleting branches and rearranging tree
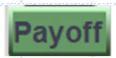
1. Click on the left mouse button, hold it and select area you want to delete or just click on elements you want to delete and click on 🗑 .

2. "Delete? Are you sure?" appears on the screen. Click "yes" to delete.

3. Select Nature , click on 🔲 and drag the mouse to Player1 and connect the icons.
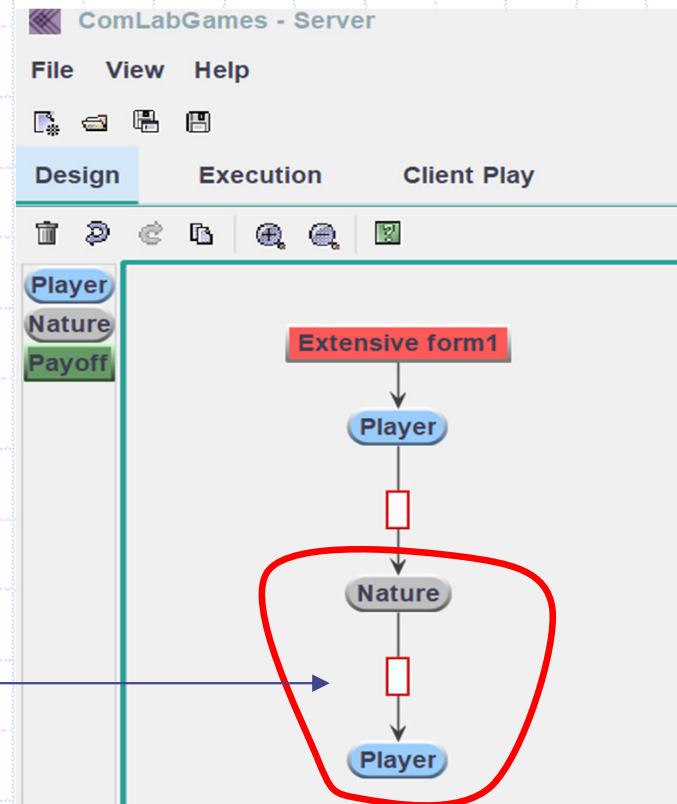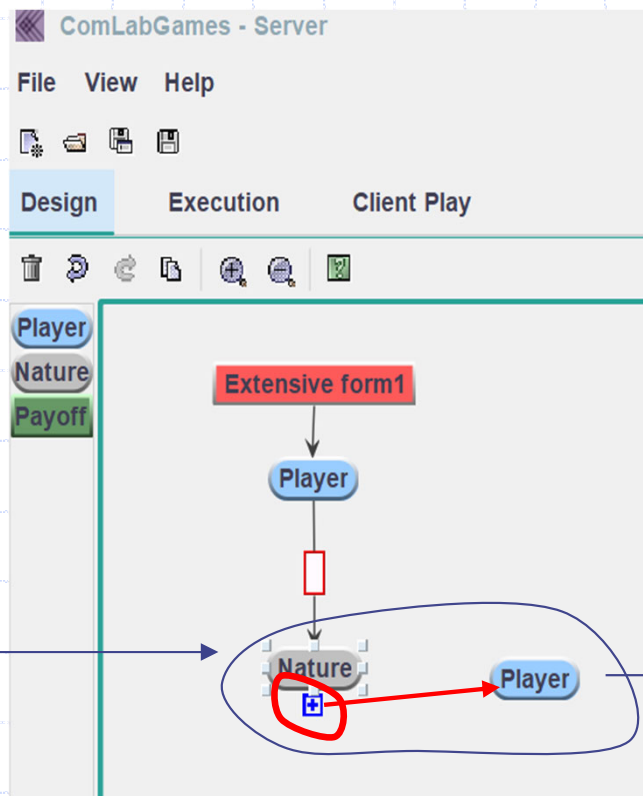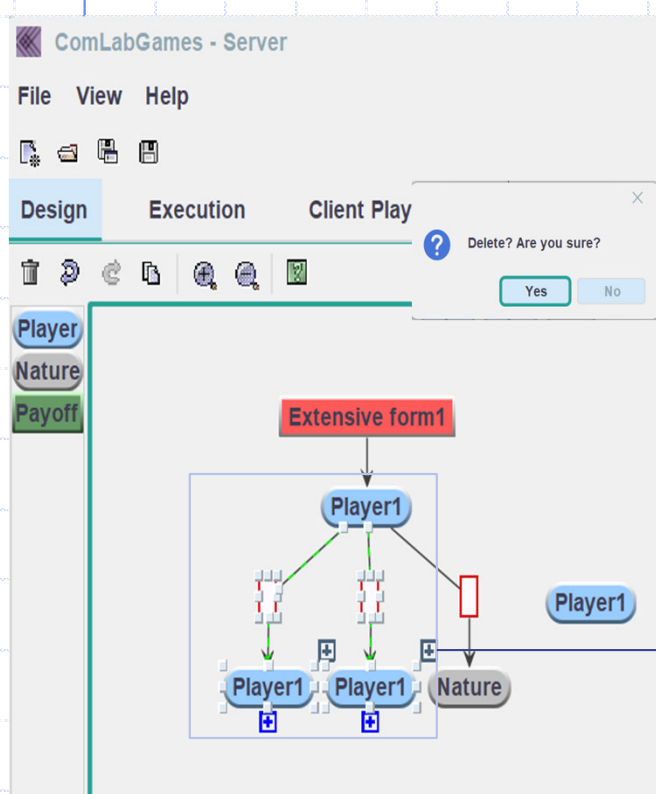
Adding payoffs with drag and drop

1. Select [Player] or [Nature] and drag and drop [Payoff] 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.

Drop payoff on design window or "Ctrl+Y"

Payoff added and assigned # 1

Payoff added and assigned # 2
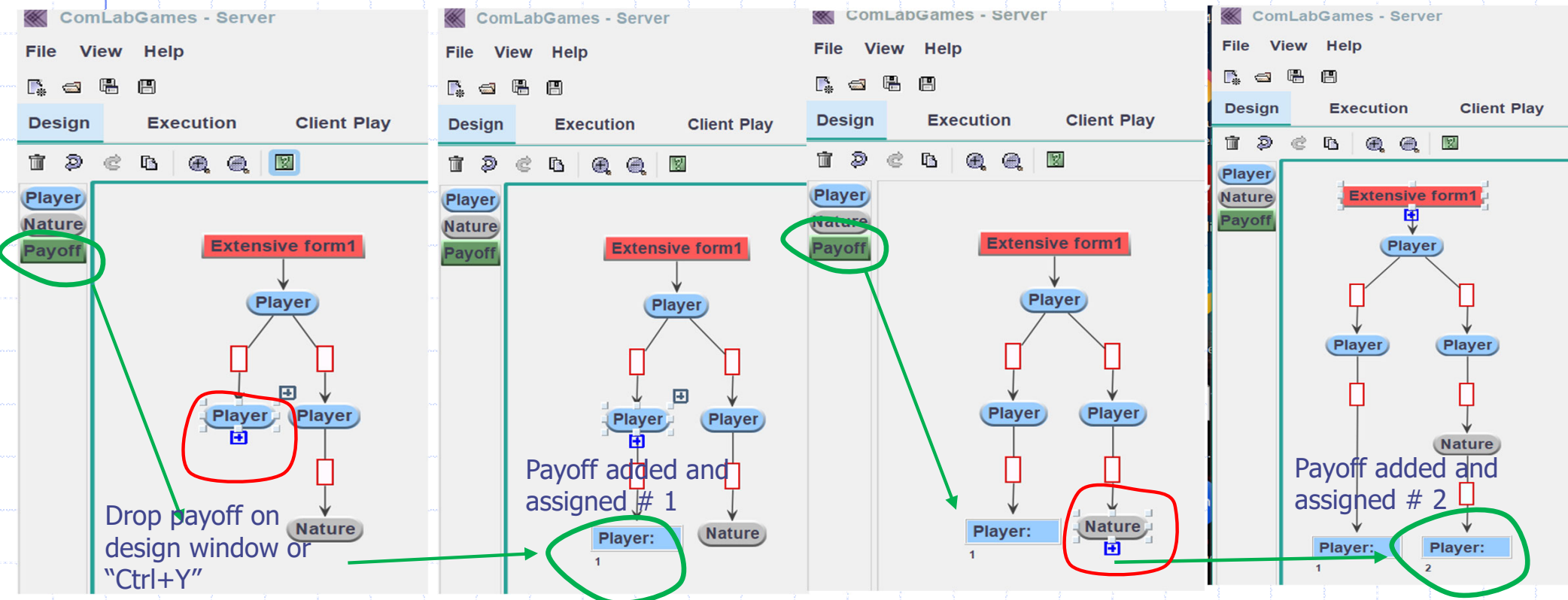
Using shortcuts to build a tree

"*Ctrl+P*": add current player on design window (the same color as the player in the panel on the left)
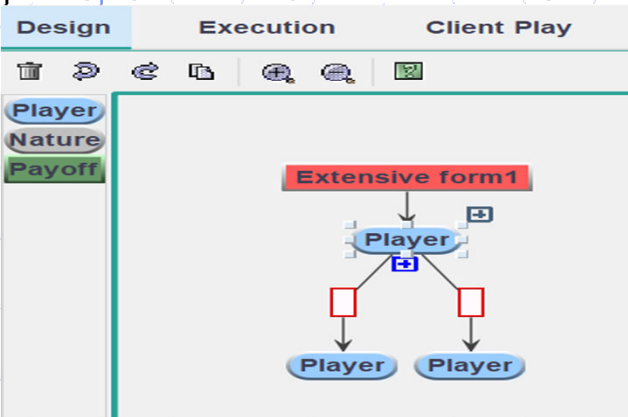
"*Ctrl+N*" to add new players: first **Player1** was added and then **Player2**. The last player on the left panel is **Player2** and it corresponds to the last player added.
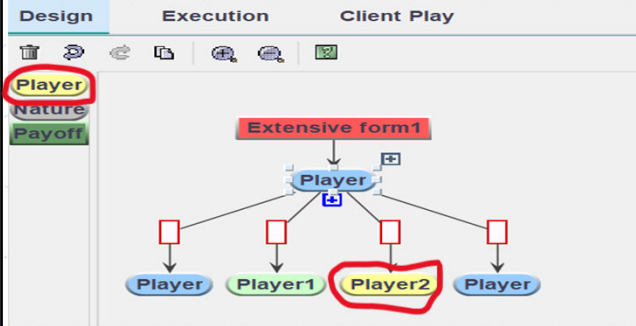
"*Ctrl+S*" to change a selected player. For example, click on **Player** and use "Ctrl +S". The left panel changes to **Player**.
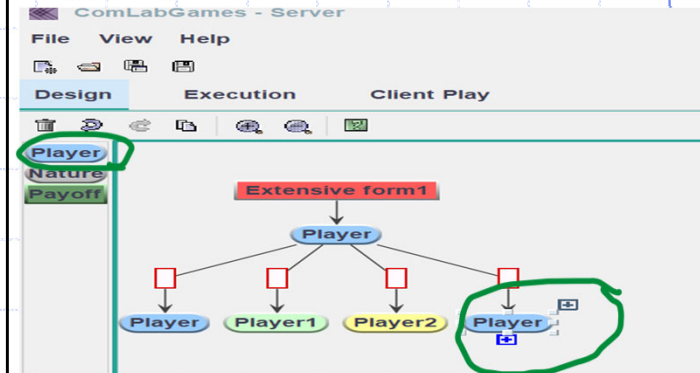
"*Ctrl+Y*" to add a single payoff to a selected player **Player**.
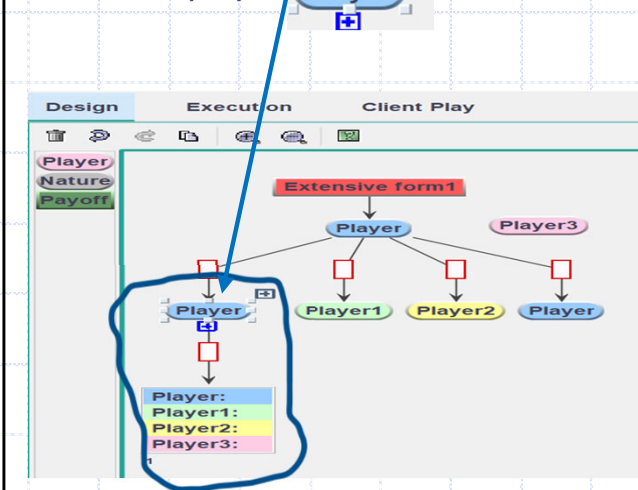
"*Ctrl+F*" to add all the payoffs under tree entry. Note **Player3** is not part of the tree and payoffs were not added to this player.
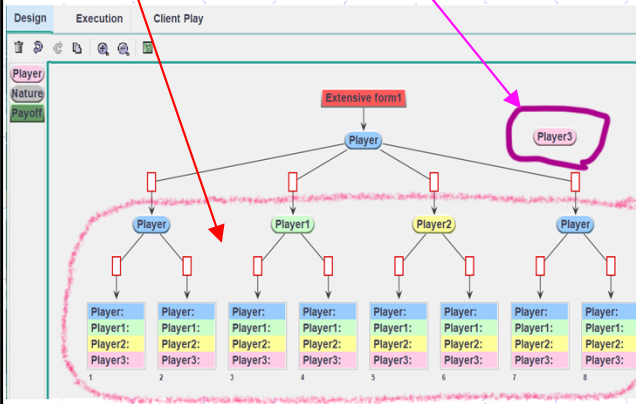
"*Shift+Ctrl+F*" to add payoffs to all players including players who are not connected to a tree like **Player3**
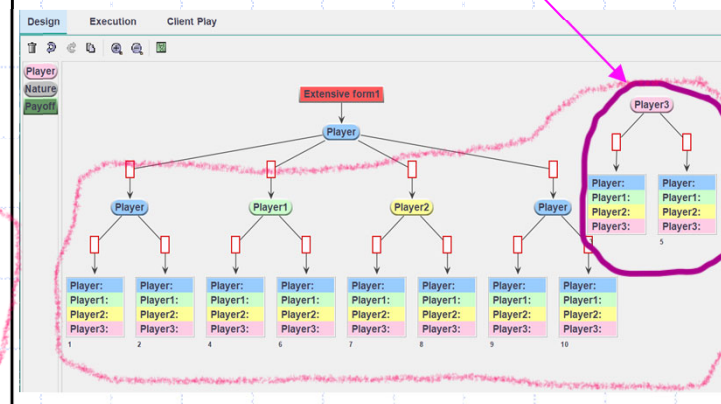
Renaming

Player Nature **Extensive form1**

1. To change a name, double click on the icon and rename it.
2. Player's name is automatically changed in the payoffs.
3. To place a text in a new line, separate text with "\".
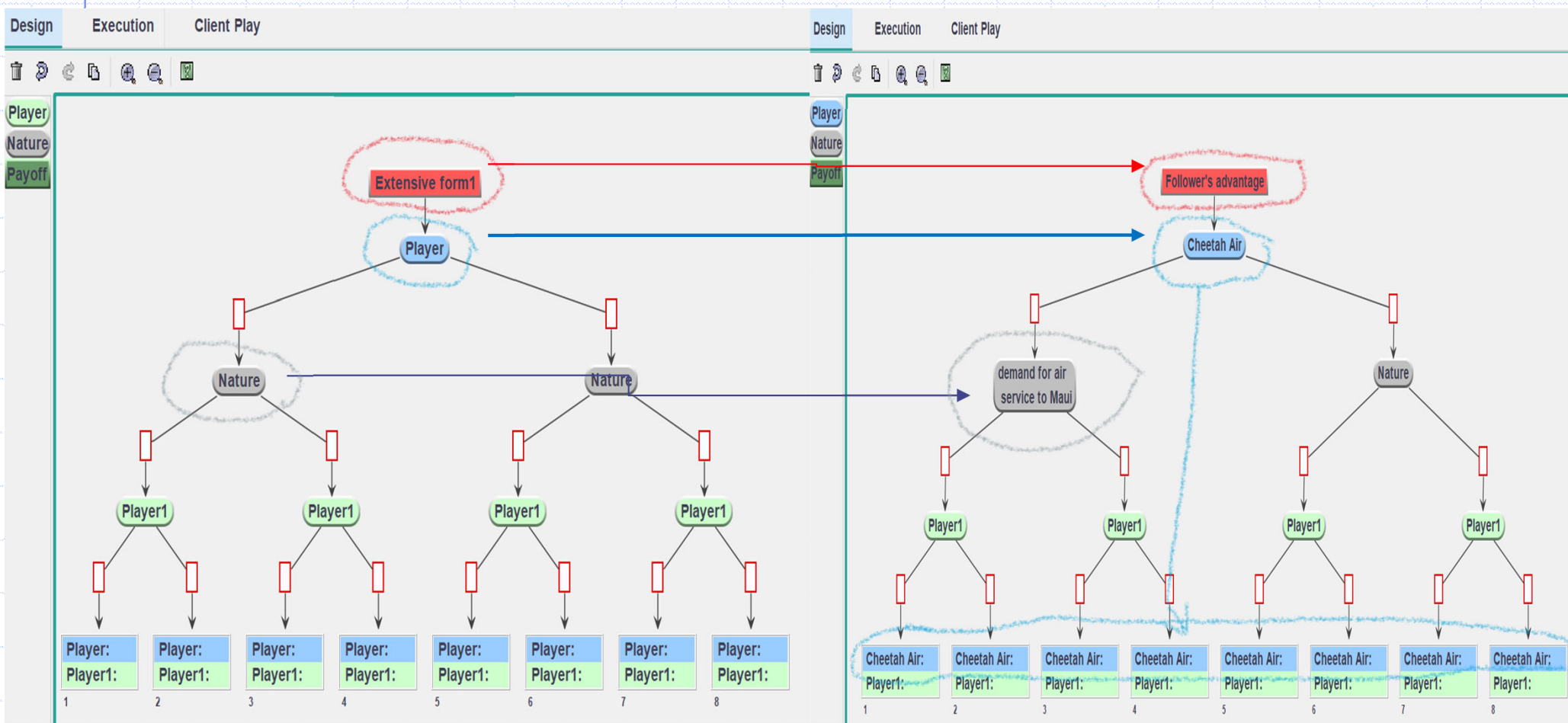
Creating/removing information sets

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 **Eagle Air** node, click on and drag the mouse to the next node.
3. To remove the info set, select corresponding node: **Eagle Air** , and click on . Information set disappears.

Adding information set

Deleting information set

Click on plus and drag the mouse to the next node

Click on plus

Information set disappears
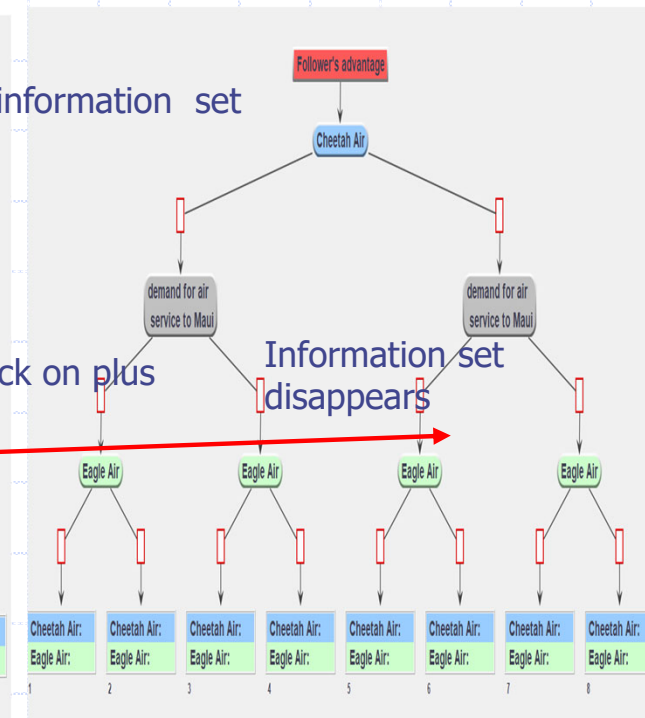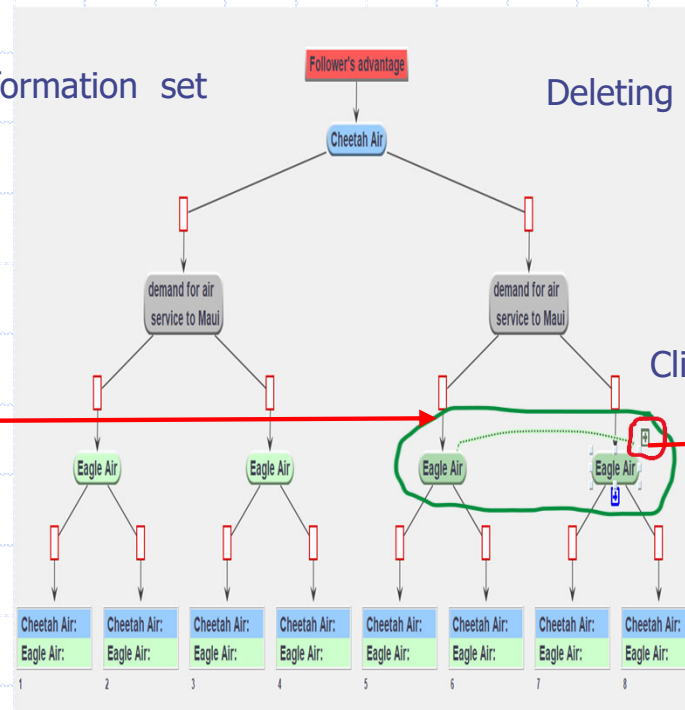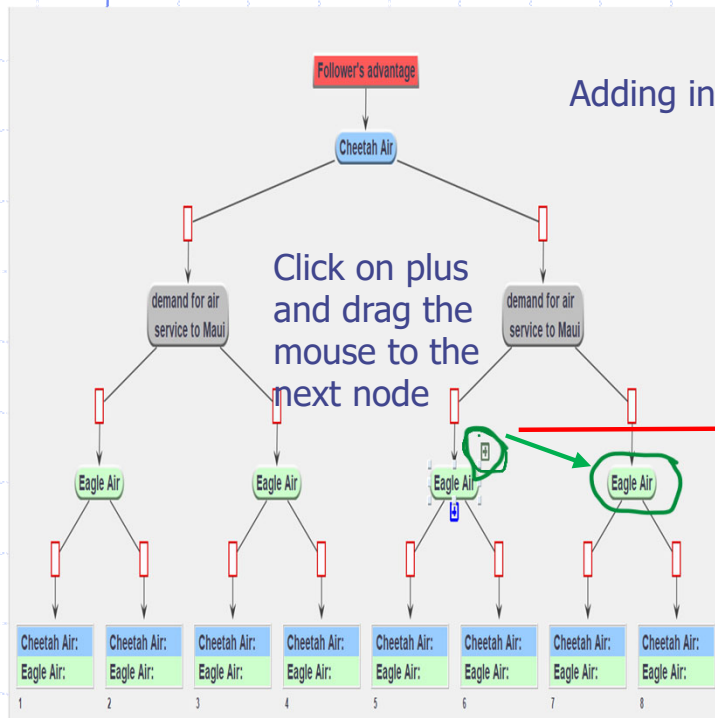
Labeling Player choices

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.

Both choices are labeled automatically with dotted line

All choices are labeled
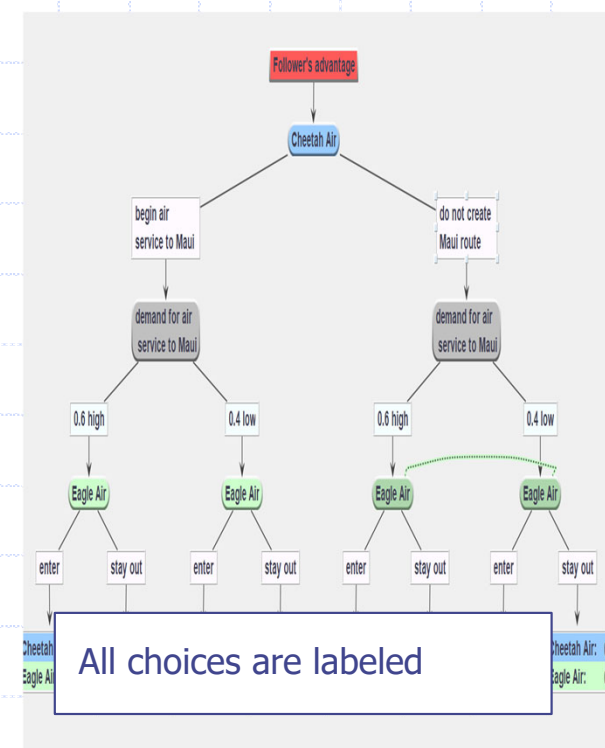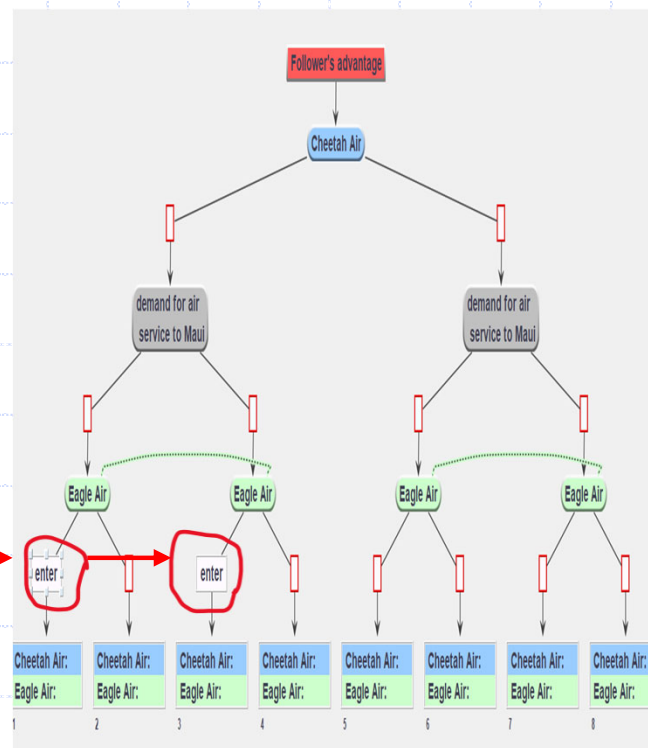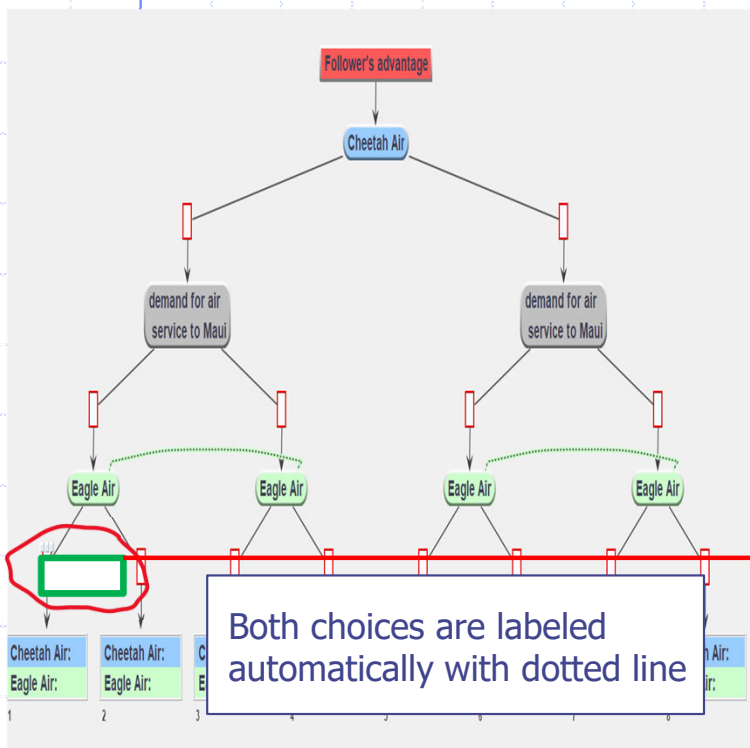
Editing chance probabilities in Nature

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 high

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.

Follower'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 | 6 high | 4 low |

Eagle Air   Eagle Air   Eagle Air   Eagle Air

| enter | stay out | enter | stay out | enter | stay out | enter | stay out |

| Cheetah Air: Eagle Air: | Cheetah Air: Eagle Air: | Cheetah Air: Eagle Air: | Cheetah Air: Eagle Air: | Cheetah Air: Eagle Air: | Cheetah Air: Eagle Air: | Cheetah Air: Eagle Air: | Cheetah Air: Eagle Air: |

1   2   3   4   5   6   7   8

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.
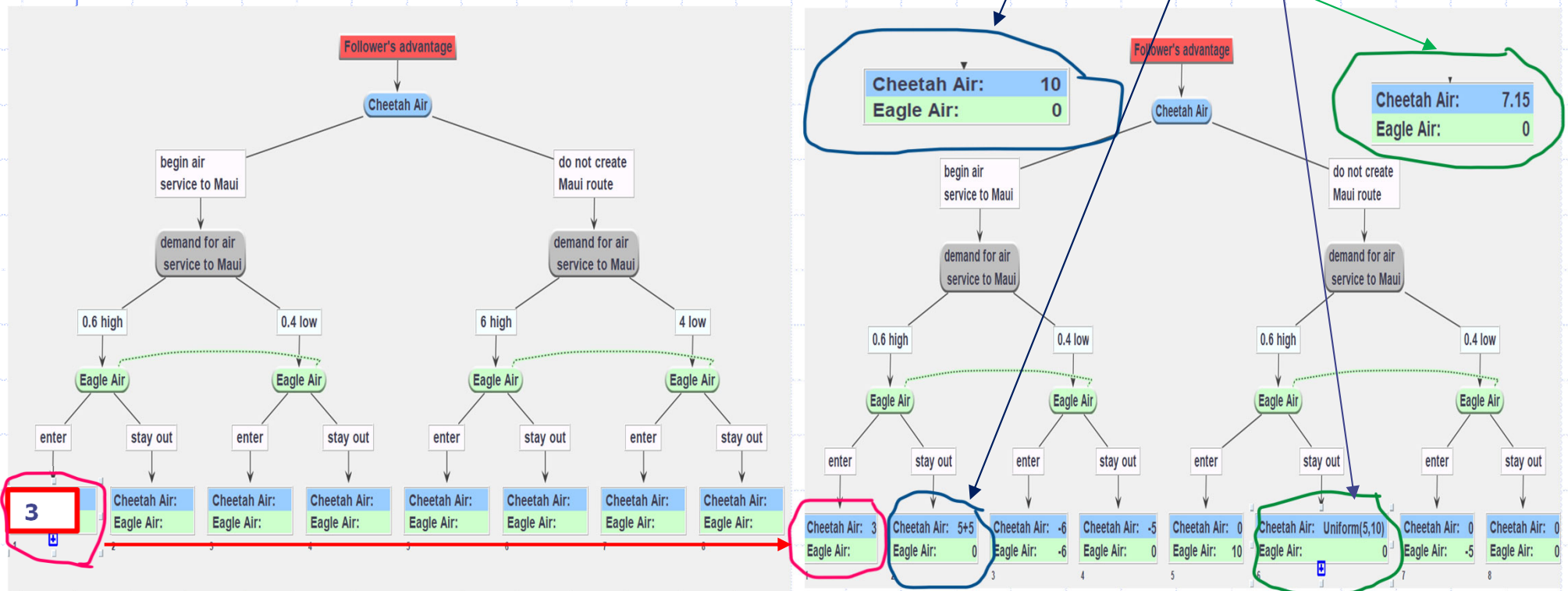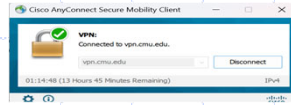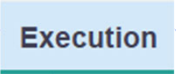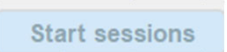
Saving the tree as a file

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

Steps for conducting an experiment

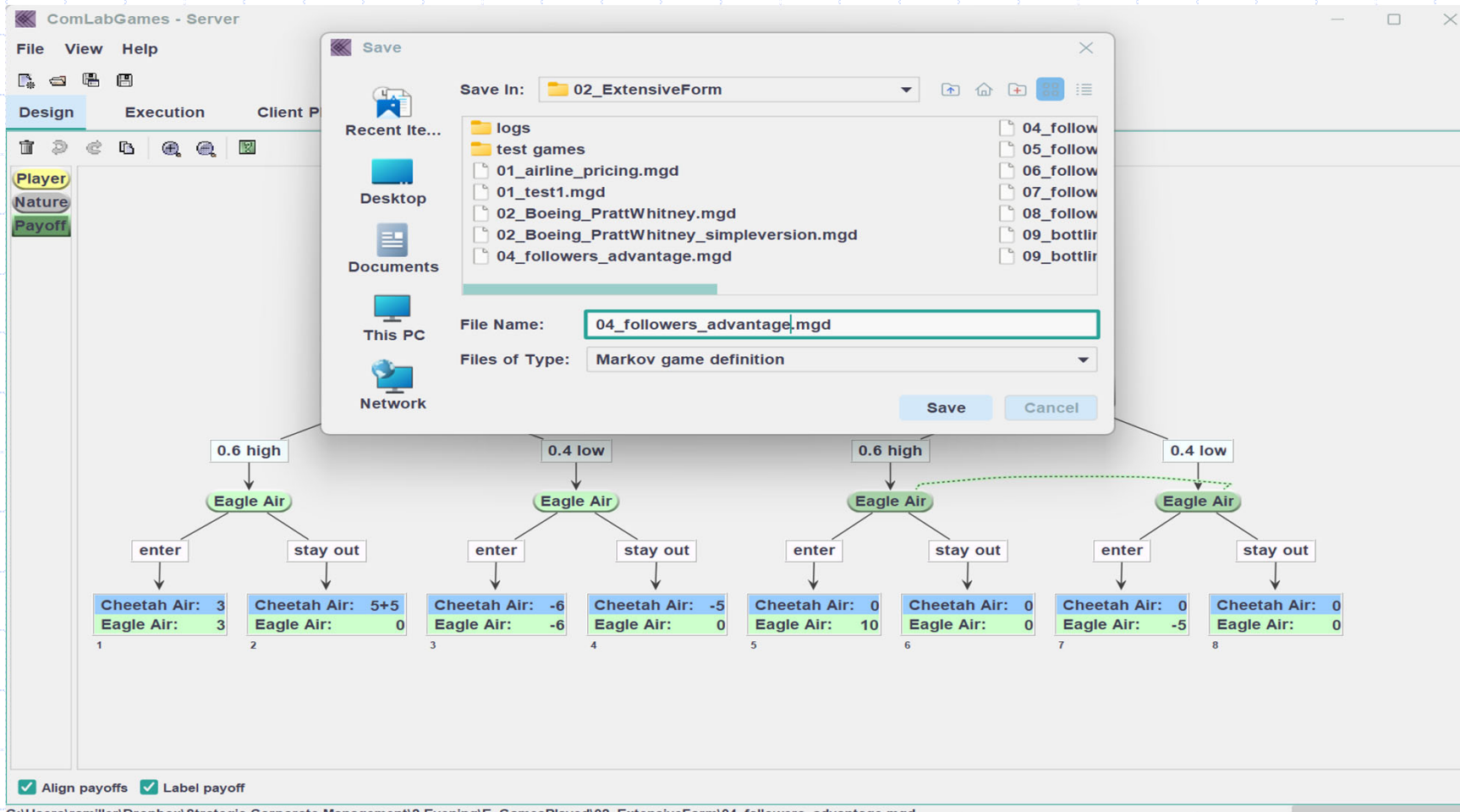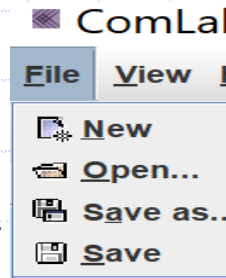1. If you are running experiment from home, make sure you are connected to CMU via VPN: [Cisco AnyConnect Secure Mobility Client] before you open ComLabGames program.
2. Open ComLabGames and open the tree in the design: [Design] window.
3. Select [Execution] tab. Make sure 172…. address is highlighted.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

The name and the location of the loaded game is also shown at the bottom of the screen
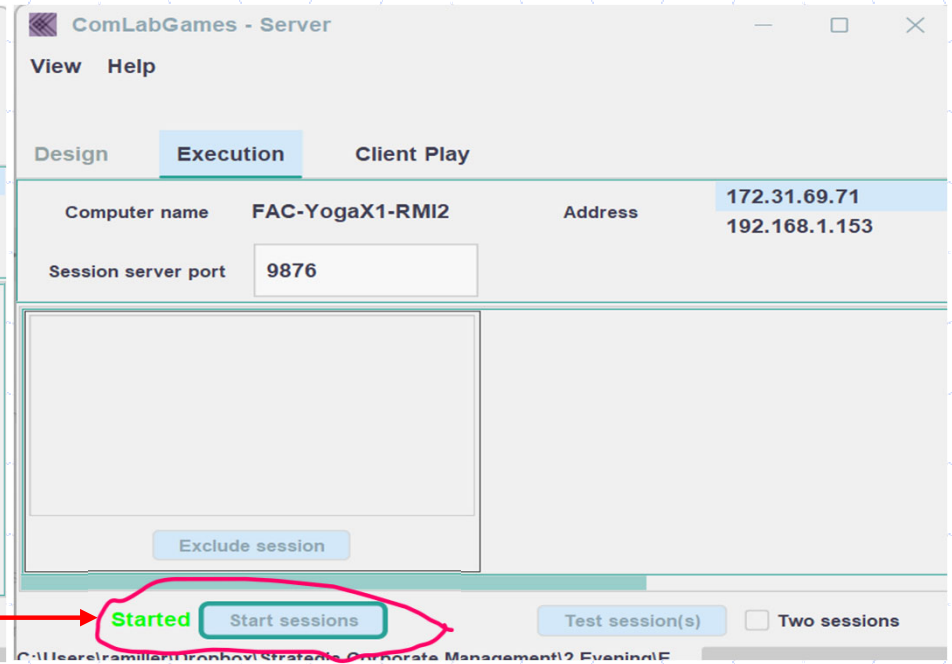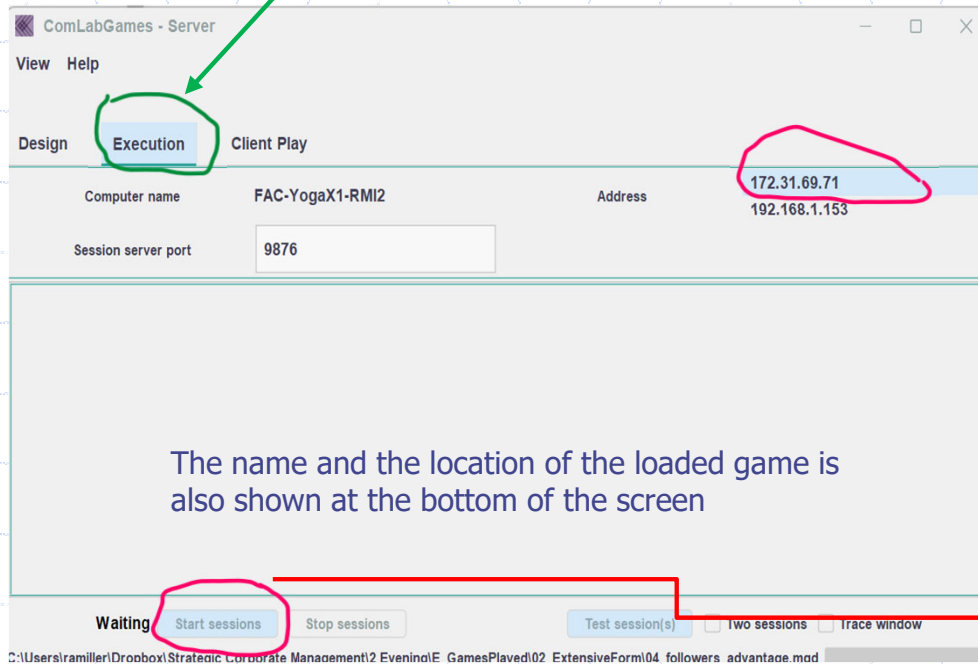
Monitoring the experiment

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.
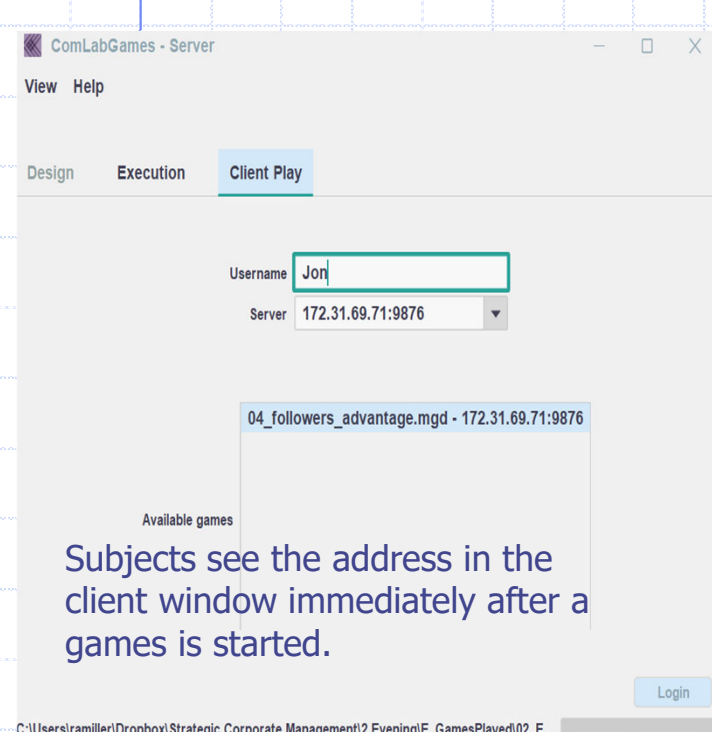
Subjects see the address in the client window immediately after a games is started.

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 📁 logs in the directory where the game was saved is automatically created once you stop running an experiment.
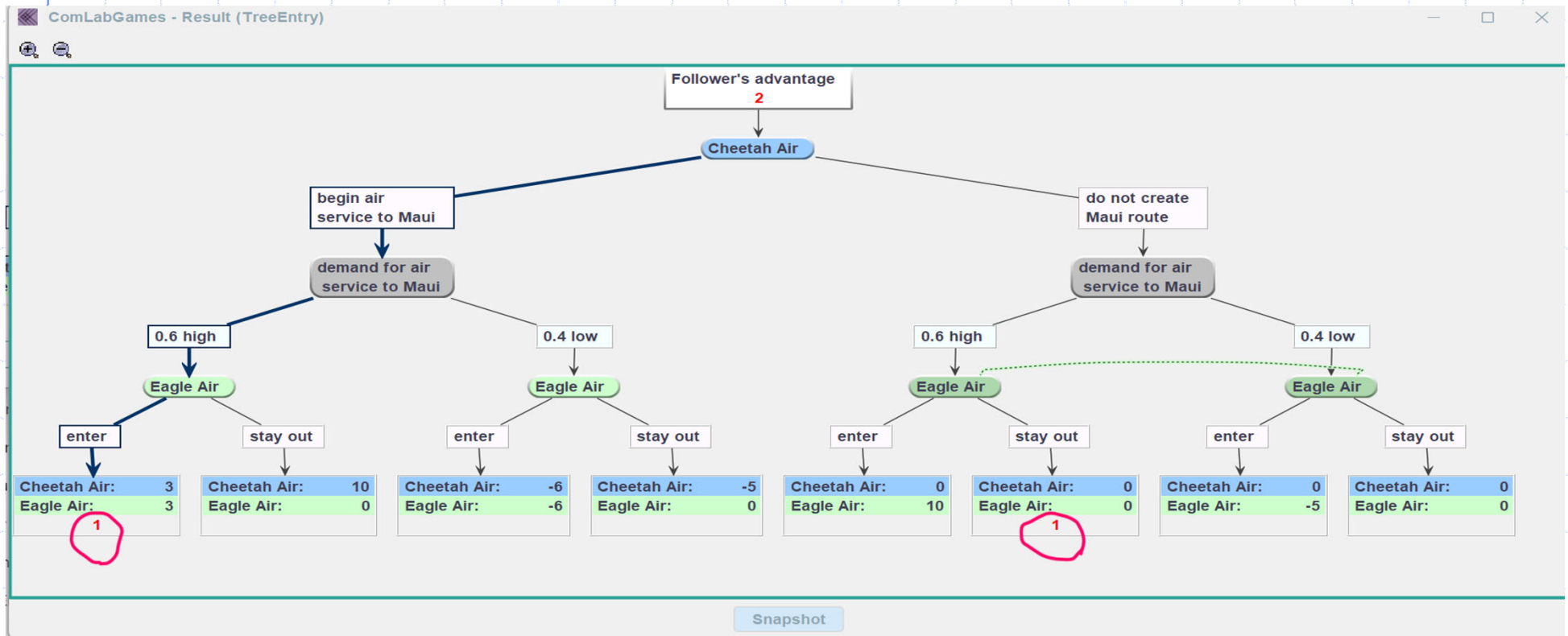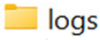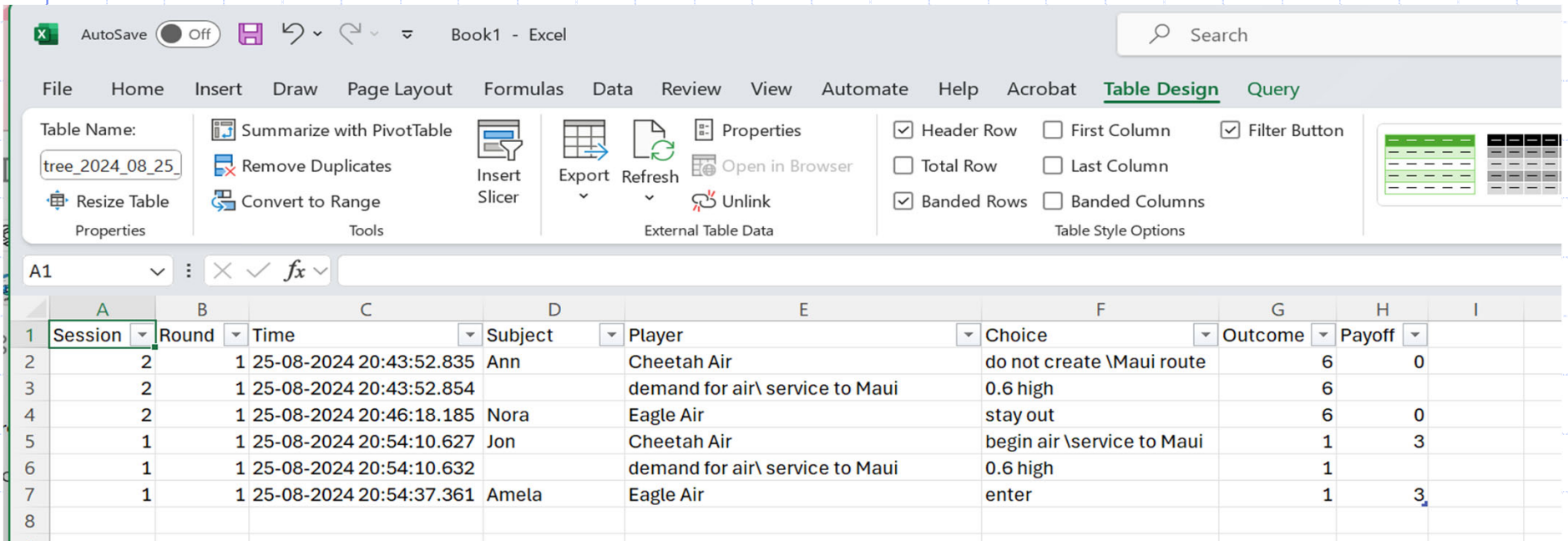2. Output file in *.csv format is saved in 📁 logs .
3. The name of the file has the following name: tree- date-hour- min-sec-name of the game, like: 📊 tree_2024-08-25_20-32-11_04_followers_advantage

	A	B	C	D	E	F	G	H	I
1	Session	Round	Time	Subject	Player	Choice	Outcome	Payoff	
2	2	1	25-08-2024 20:43:52.835	Ann	Cheetah Air	do not create \Maui route	6	0	
3	2	1	25-08-2024 20:43:52.854		demand for air\ service to Maui	0.6 high	6		
4	2	1	25-08-2024 20:46:18.185	Nora	Eagle Air	stay out	6	0	
5	1	1	25-08-2024 20:54:10.627	Jon	Cheetah Air	begin air \service to Maui	1	3	
6	1	1	25-08-2024 20:54:10.632		demand for air\ service to Maui	0.6 high	1		
7	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
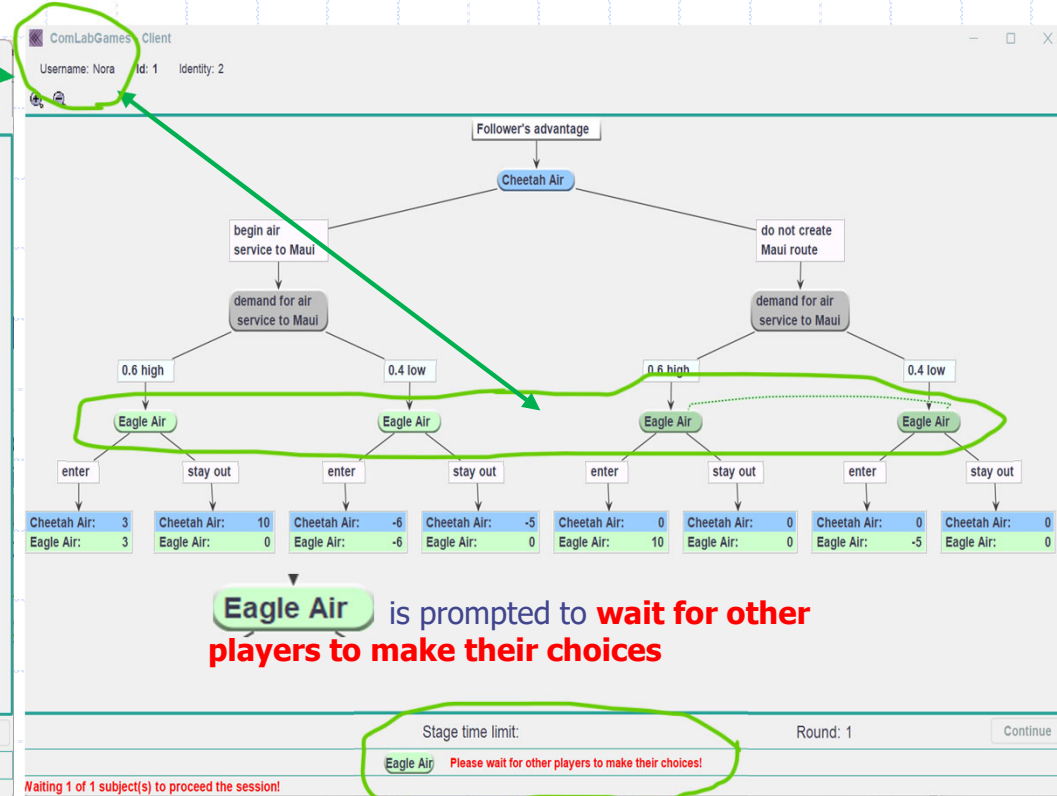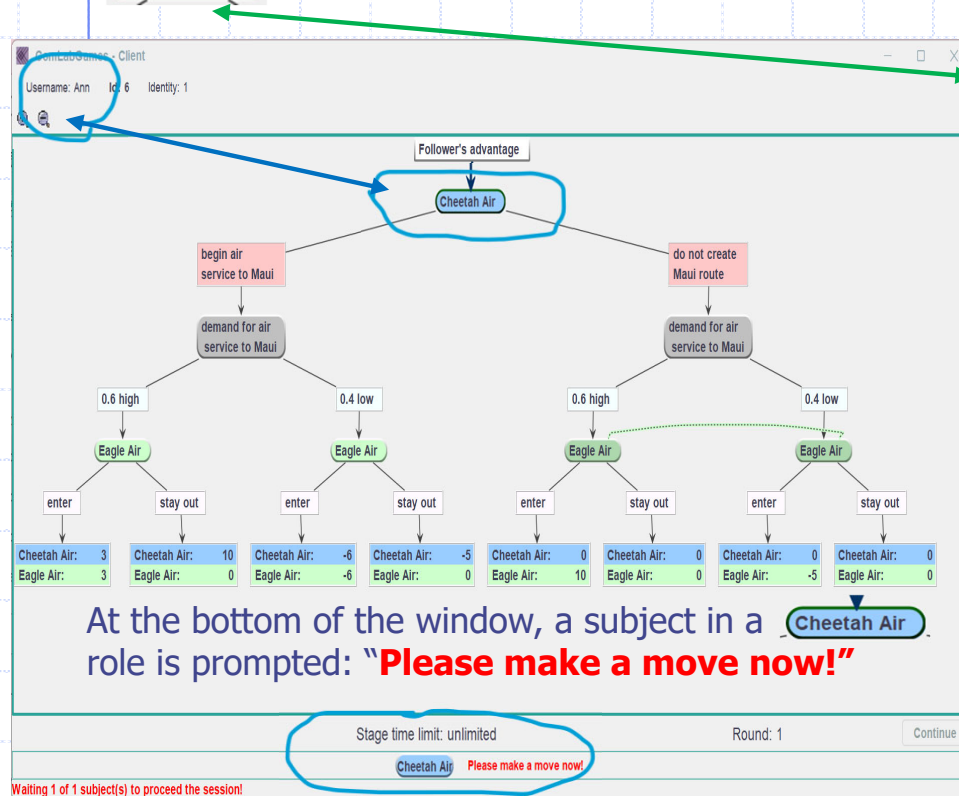- "Subject" records login name
- "Player" records assigned role to a subject.
- "Choice" records the choices subjects selected.
- "Outcome" is a terminal node.

Part 2: Playing Extensive Form Games

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.

At the bottom of the window, a subject in a **Cheetah Air** role is prompted: "**Please make a move now!**"

Eagle Air is prompted to **wait for other players to make their choices**

Selecting a move

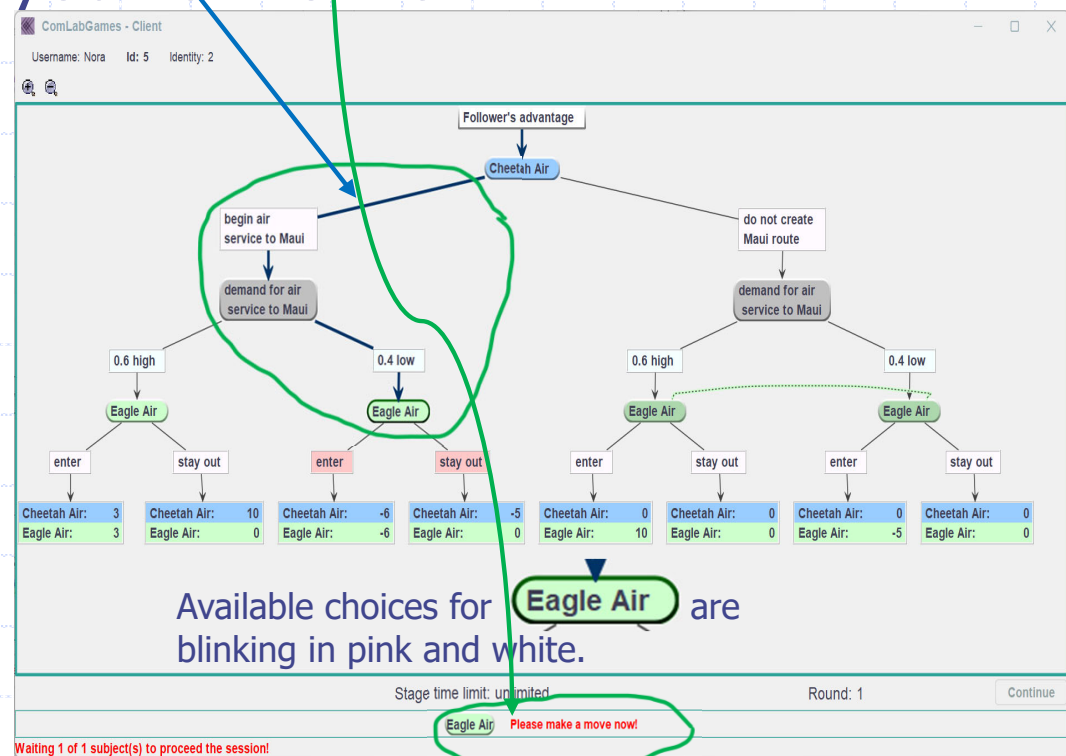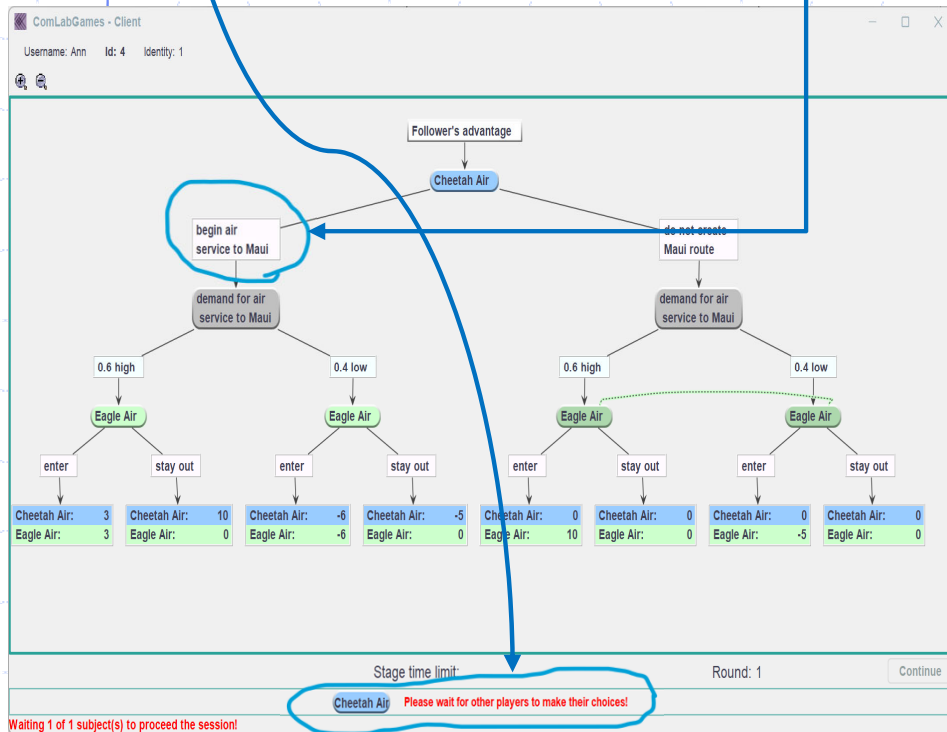1. Moving the mouse between choices without clicking highlights a **green** path to the next decision maker's node or a terminal node.
2. Once selection is made, you cannot cancel it.
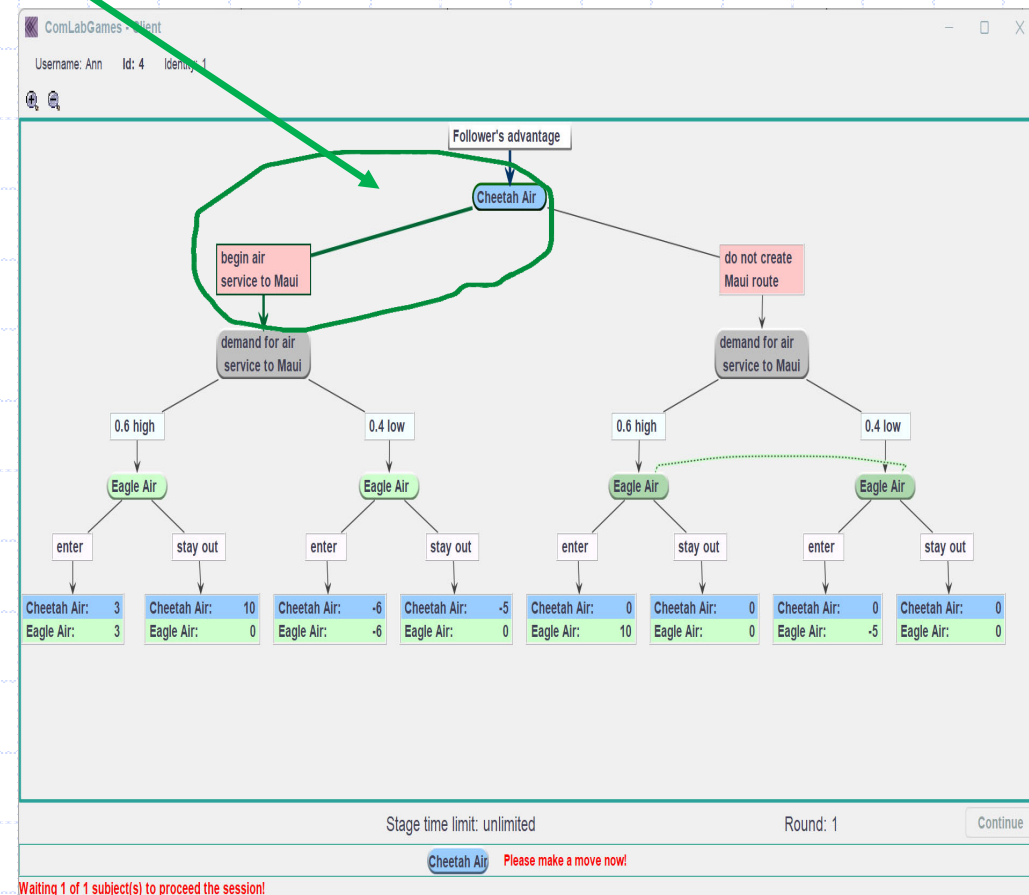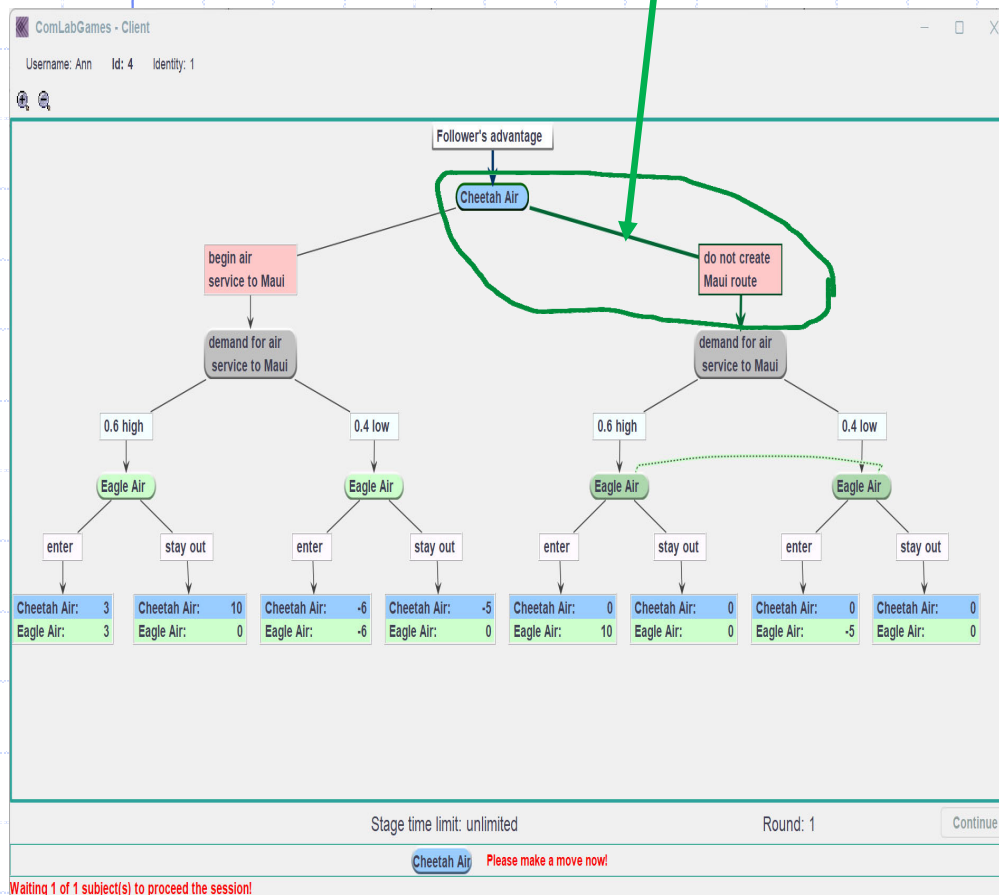
More on move selection

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.

Available choices for [Eagle Air] are blinking in pink and white.

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.
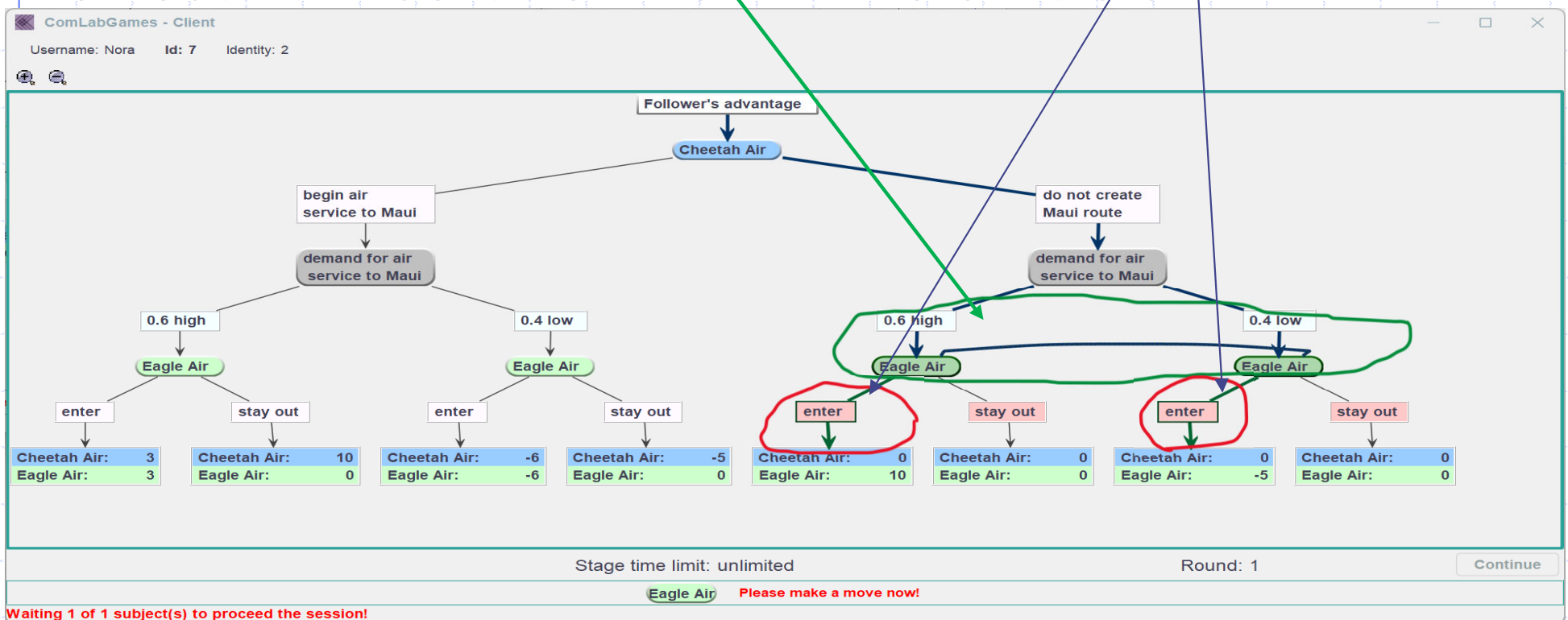
Showing the outcome of the game

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**.