May 3rd, 12:00 AM - 12:00 AM

Migrating Behavior Search's User Interface from Swing to JavaFX

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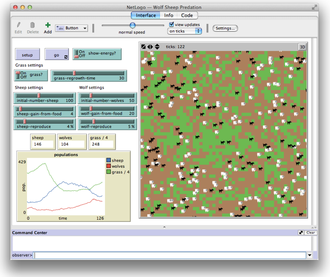
I. Introduction

Agent-Based Models (ABMs) and NetLogo

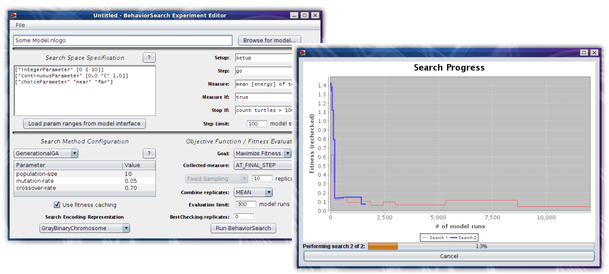
- Agent-based modeling is a computer modeling technique that focuses on modeling the rules of individuals ("agents") and simulating the interactions between these individuals.
- ABMs are widely used to simulate behavior in many fields including archaeology, biology, economics, and social science.
- NetLogo is an agent-based modeling language and integrated modeling environment. It is a popular platform for building and running ABMs. (See: http://ccl.northwestern.edu/netlogo/)



A sample predator-prey model in NetLogo

BehaviorSearch

- BehaviorSearch is a tool to help automate the exploration and analysis of ABMs. (See: http://www.behaviorsearch.org/)
- This software interfaces with the NetLogo platform and allows the client to search for combinations of model parameter settings that will result in a specified target behavior



A screenshot of the BehaviorSearch software before this project

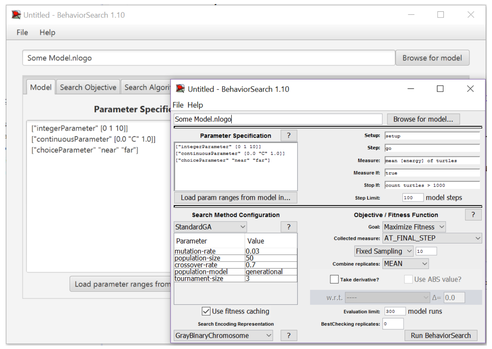
II. Motivation

Java Swing Graphical User Interface (GUI)

- Earlier versions of BehaviorSearch used the Swing GUI library
- With Swing, all of the graphical components and controlling methods get embedded in the same code, which makes the code long and hard to debug
- The GUI style looked and felt dated (e.g. like Windows 2000)
- Application didn't scale well to modern high-resolution screens
- Did not support displaying charts inherently (BehaviorSearch used the third-party JFreeChart library for this)
- All of the input forms were packed into one cluttered window

JavaFX Graphical User Interface (GUI)

- JavaFX fixes many of the problems with Swing
- It separates the graphical component details into a separate .fxml file that is easy to read and change
- It also provides SceneBuilder, which allows developers to easily modify .fxml with real-time preview using drag and drop
- Programs can be styled with CSS3, allowing easy changes of style
- Supports chart components (no third party library required)
- Organizes input forms into tabs for a less cluttered display



*Comparison of before and after new GUI (Java FX is bigger)**

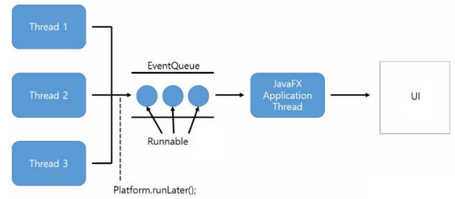
*screenshot taken on 2160 x 1440 HD monitor

III. Challenges

Multithreading in JavaFX

- When dealing with time-consuming computational tasks, like what BehaviorSearch does to analyze models, it is important to do those tasks in a parallel worker thread, so that the GUI stays responsive.
- Java Swing had a specialized solution for this, a `SwingWorker` class does all the computation in the background
- JavaFX doesn't have similar class to SwingWorker

Solution: Create the new thread manually, create a task worker that implements the `Runnable` interface, and then use `Platform.runLater()` to update the GUI.



Multithreading using `Platform.runLater();` *in JavaFx*
Image Credit: Palpit Source: http://palpit.tistory.com/773

Utilizing Multiple Scenes

- Scenes in JavaFX are not easy to get access to, since they are created automatically by the `FXMLLoader`. This makes it hard to pass data from one scene to another scene.

Solution: Get the `Controller` object from the `FXMLLoader`, then pass parameters into the controller using an `ini` method.

Example:

```
RunOptionDialogController runController;
runController = loader.getController();
runController.ini(runOptions, this);
```

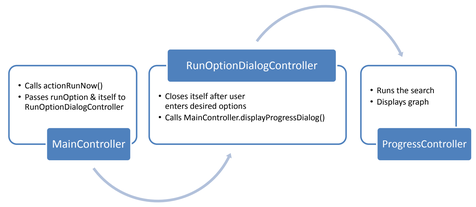


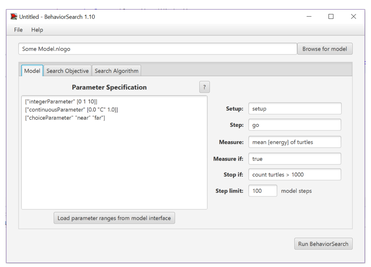
Table Functionality in JavaFX

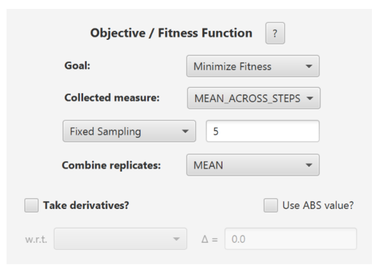
- The default table in JavaFX required users to hit ENTER to commit each value they entered. This was not a natural behavior for the table in this software and could confuse users.

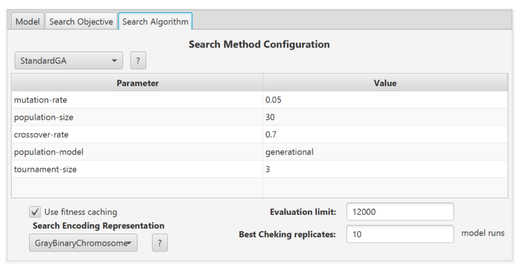
Solution: Design a custom subclass of the `TableCell` class that is named `AcceptOnExitTableCell` (class outline shown at right), which overrides the default table behavior such that user's entries are stored regardless of whether they hit ENTER.

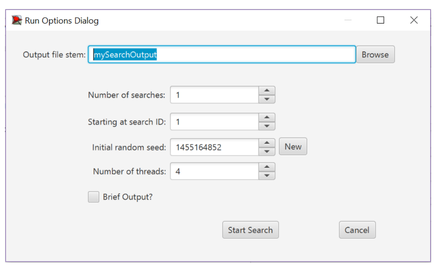
```
AcceptOnExitTableCell<S, T>
  + forTableColumn() <S> : Callback<TableColumn<S, String>, TableCell<S, String>>
  + forTableColumn(StringConverter<T>) <S, T> : Callback<TableColumn<S, T>, TableCell<S, T>>
  - textField : TextField
  - escapePressed : boolean
  - tablePos : TablePosition<S, ?>
  + AcceptOnExitTableCell()
  + AcceptOnExitTableCell(StringConverter<T>)
  - converter : ObjectProperty<StringConverter<T>>
  + converterProperty() : ObjectProperty<StringConverter<T>>
  + setConverter(StringConverter<T>) : void
  + getConverter() : StringConverter<T>
  + startEdit() : void
  + commitEdit(T) : void
  + cancelEdit() : void
  + updateItem(T, boolean) : void
  - getTextField() : TextField
  - getItemText() : String
  - updateItem() : void
  - startEdit(TextField) : void
```

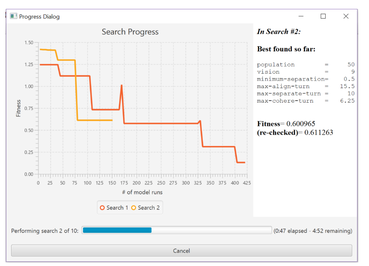
IV. Results (Improved UI with JavaFX)











This software development project was completed over the course of 12 months. The final GUI was composed of 440 lines of XML code, 1345 lines of Java code, and 163 lines of Java comments, spread across 9 source files.