Term: M1-RAIA

Semester: 1

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Artificial Intelligence - Part 1

LAB MANUAL

Institut Supérieur des Études Technologiques de Bizerte

Available at https://github.com/a-mhamdi/isetbz/

Honor code

The University of North Carolina at Chapel Hill
Department of Physics and Astronomy
http://physics.unc.edu/undergraduate-program/labs/general-info/

"During this course, you will be working with one or more partners with whom you may discuss any points concerning laboratory work. However, you must write your lab report, in your own words.

Lab reports that contain identical language are not acceptable, so do not copy your lab partner's writing.

If there is a problem with your data, include an explanation in your report. Recognition of a mistake and a well-reasoned explanation is more important than having high-quality data, and will be rewarded accordingly by your instructor. A lab report containing data that is inconsistent with the original data sheet will be considered a violation of the Honor Code.

Falsification of data or plagiarism of a report will result in prosecution of the offender(s) under the University Honor Code.

On your first lab report you must write out the entire honor pledge:

The work presented in this report is my own, and the data was obtained by my lab partner and me during the lab period.

On future reports, you may simply write "*Laboratory Honor Pledge*" and sign your name."

Contents

In order to activate the virtual environment and launch **Jupyter Notebook**, we recommend you to proceed as follow

① Press simultaneously the keys  &  on the keyboard. This will open the dialog box **Run**;

② Then enter **cmd** in the command line and confirm with  key on the keyboard;

③ Type the instruction **mljl.bat** in the console prompt line;

④ Finally press the  key.

Leave the system console active.

A. Mhamdi

1 | *Julia* Onramp

Student's name	. . . . .	. . . . .	. . . . .
	. . . . .	. . . . .	. . . . .
	. . . . .	. . . . .	. . . . .
Score /20	. . . . .	. . . . .	. . . . .

Detailed Credits

Anticipation *(4 points)*	. . . . .	. . . . .	. . . . .
Management *(2 points)*	. . . . .	. . . . .	. . . . .
Testing *(7 points)*	. . . . .	. . . . .	. . . . .
Data Logging *(3 points)*	. . . . .	. . . . .	. . . . .
Interpretation *(4 points)*	. . . . .	. . . . .	. . . . .

Goals

★ Learn the essentials of *Julia* on commonly used features & workflows.

The notebook is available at `https://github.com/a-mhamdi/cosnip/` → *Julia* → *julia-onramp.ipynb*

2 | Tipping Problem

Student's name	. . . . .	. . . . .	. . . . .
	. . . . .	. . . . .	. . . . .
	. . . . .	. . . . .	. . . . .
Score /20	. . . . .	. . . . .	. . . . .

Detailed Credits

Anticipation *(4 points)*	. . . . .	. . . . .	. . . . .
Management *(2 points)*	. . . . .	. . . . .	. . . . .
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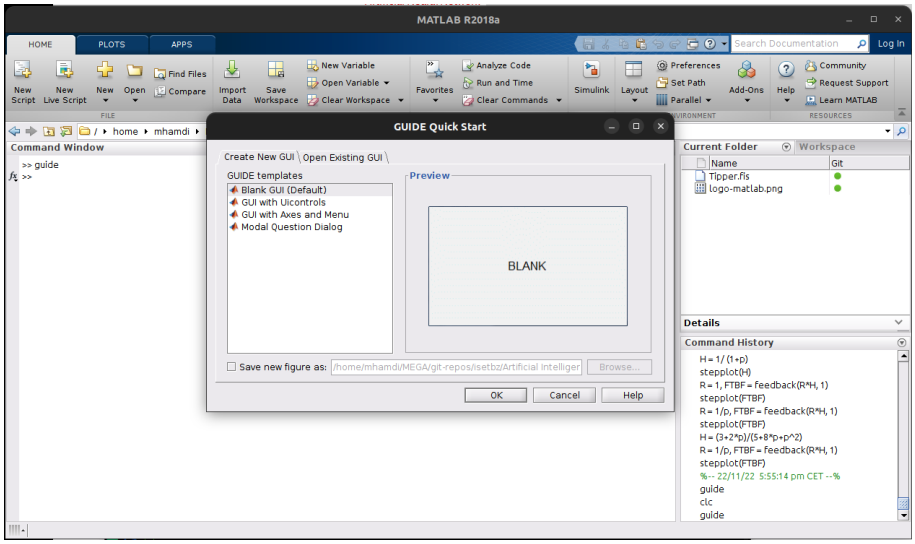
Data Logging *(3 points)*	. . . . .	. . . . .	. . . . .
Interpretation *(4 points)*	. . . . .	. . . . .	. . . . .

Goals

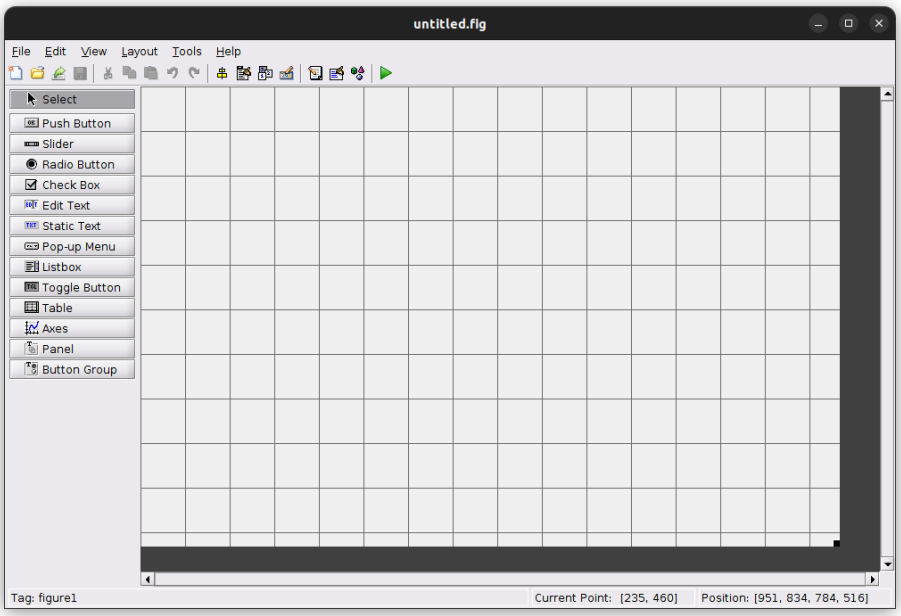
★ Construct algorithms to help decide in given ambiguous situation.

The code is available at `https://github.com/a-mhamdi/isetbz/` → *Artificial Intelligence* → *Codes* → *Matlab* → *Tipper.**

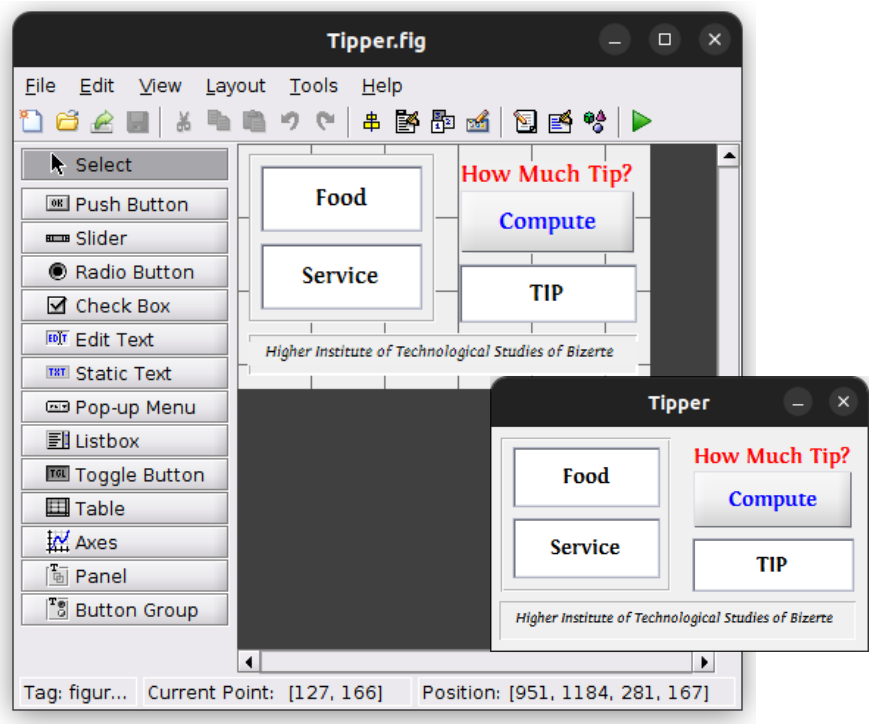
GUIDE from within the command window



GUIDE's wizard to create GUI



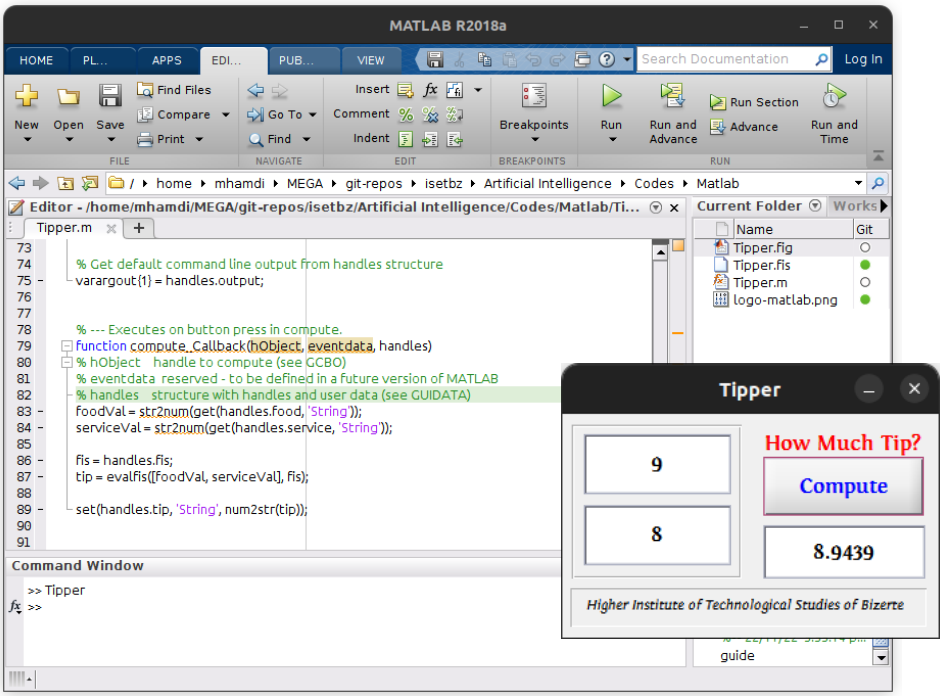
Final GUI design



It is preferable to load the fuzzy inference system, denoted here after by *fis*, in the opening function of the gui.

```
% --- Executes just before Tipper is made visible.
function Tipper_OpeningFcn(hObject, eventdata, handles, varargin)
% This function has no output args, see OutputFcn.
% hObject    handle to figure
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
% varargin   command line arguments to Tipper (see VARARGIN)
fis =readfis('Tipper.fis');
handles.fis = fis;

% Choose default command line output for Tipper
handles.output = hObject;

% Update handles structure
guidata(hObject, handles);

% UIWAIT makes Tipper wait for user response (see UIRESUME)
% uiwait(handles.figure1);
```

```
% --- Executes on button press in compute.
function compute_Callback(hObject, eventdata, handles)
% hObject    handle to compute (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
foodVal = str2num(get(handles.food, 'String'));
serviceVal = str2num(get(handles.service, 'String'));

fis = handles.fis;
tip = evalfis([foodVal, serviceVal], fis);

set(handles.tip, 'String', num2str(tip));
```



The code is available at https://github.com/a-mhamdi/isetbz/ → *Artificial Intelligence* → *Codes* → *Julia* → *tipper.jl*

```
using Fuzzy
using Plots

score = range(0, 10, length=100)

food = Dict(
```

```
^^I    "Rancid" => TrapezoidalMF(0, 0, 2, 4),
^^I    "Delicious" => TrapezoidalMF(6, 8, 10, 10)
^^I    )
food_chart = chart_prepare(food, score)

service = Dict(
^^I    "Poor" => TrapezoidalMF(0, 0, 2, 4),
^^I    "Good" => TrapezoidalMF(3, 4, 6, 7),
^^I    "Excellent" => TrapezoidalMF(6, 8, 10, 10)
^^I    )
service_chart = chart_prepare(service, score)

tip = Dict(
^^I   "Cheap" => TrapezoidalMF(0, 0, 1, 3),
^^I   "Average" => TrapezoidalMF(2, 4, 6, 8),
^^I   "Generous" => TrapezoidalMF(7, 9, 10, 10)
^^I    )
tip_chart = chart_prepare(tip, score)

rule_1 = Rule(["Rancid", "Poor"], "Cheap", "MAX")
rule_2 = Rule(["", "Good"], "Average", "MAX")
rule_3 = Rule(["Delicious", "Excellent"], "Generous", "MAX")

rules = [rule_1, rule_2, rule_3]

#= GRAPHS =#
p1 = plot(score, food_chart["values"], ylabel="Food", label=food_chart[
 ↪"names"], legend=:bottomright)

p2 = plot(score, service_chart["values"], ylabel="Service",␣
 ↪label=service_chart["names"], legend=:bottomright)

p3 = plot(score, tip_chart["values"], xlabel="Score", ylabel="Tip",␣
 ↪label=tip_chart["names"], legend=:bottomright)

graphs = plot(p1, p2, p3, layout=(3, 1), lw=2)
savefig(graphs, "./images/mf-graphs.pdf")

# FUZZY INFERENCE SYSTEM: MAMDANI
fis = FISMamdani([food, service], tip, rules)
eval_fis(fis, [9., 8.])
```

3 | Slection Process - Case of RAIA

Student's name	. . . . .	. . . . .	. . . . .
	. . . . .	. . . . .	. . . . .
	. . . . .	. . . . .	. . . . .
Score /20	. . . . .	. . . . .	. . . . .

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Goals

★ Design a fuzzy system to pick the most adequate candidates out of the applicants to the master program **RAIA**.

The notebook is available at `https://github.com/a-mhamdi/cosnip/` ⟶ *Julia* ⟶ *fuzzy* ⟶ *selection-process.jl*

The overall scope of this manual is to introduce **Artificial Intelligence (AI)** , through some numeric simulations, to the students enrolled at the master's program **RAIA**.

The topics discussed in this manuscript are as follow:

① Getting started with *Julia*

Get familiar with *Pluto* Notebook.

② Fuzzification, inference system & defuzzification

Membership functions; COG.

③ System control using fuzzy logic

④ How to build an ANN

⑤ Structure & design of a CNN

Julia; REPL; *Pluto*; *Fuzzy*; *Flux*; CUDA; *Matlab*; artificial intelligence; system control; fuzzy; inference; ann; cnn.