Mathematica UX Design Challenge Report

Introduction

Approach Explanation

To better understand user's need and identify usability issues, I start from designing several tasks that I would perform using the program and taking notes on what confuses me or makes me struggled. I also investigated the options provided and the tool bars to imagine what might expect from user's point of view.

I start from basic tasks: change cell types and format the notebook, simple calculations and plots visualizations, search documentations, and preference settings. I then go in and checked every options to see if there's any difficulties I encounter in understanding the option meanings or the method of using options. After noting down the difficulties and the steps taking more than I expected, I analyze the reason of the issues and try to design low-fi prototype to solve the problem. The prototypes are reexamined and designed before I finalize and present them below.

I also explored the desktop version on different systems(MacOS and Windows) and in different language to seek difference between these configurations and find aspects for further improvement.

Usability Issues & Low-fi Prototype

1. As I've always been using Mathematica based web-software(Mathable) for the class I'm mentoring, I believe I'm a pretty experienced entry-level user for Mathematica. I always find I forget what the output is for when I have multiple outputs available for single code/input cell. This always makes me go back to the code and check what I've made as the output, which usually waste me some time by recalling what I've done and reviewing the code. In this case, I proposed the solution to have small caption just below the output with the beginning of the code the output belongs)

```
b = 0.3;
c = 4.2;
Clear[y, ndsy, t, f];
diffeq = y''[t] + b y'[t] + c y[t] == 0;
endtime = 30;
ndsol = NDSolve[{diffeq, y[0] == 1, y'[0] == 1.5}, y[t], {t, 0, endtime}];
ndsy[t_] = y[t] /. ndsol[[1]];
ndsplot = Plot[ndsy[t], {t, 0, endtime}, PlotStyle → {{Thickness[0.01], Red}}, PlotRange → All, AxesLabel → {"t", "y[t]"}, AspectRatio → 1 / GoldenRatio];
diffeq
b = 0.3;
c = 4.2;
startery = 1;
starteryprime = 1.5;
Clear[z];
charequation = z^2 + b z + c == 0;
zsols = Solve[charequation, z];
z1 = z /. zsols[[1]];
z2 = z /. zsols[[2]];
Clear[gensol, K1, K2];
gensol[t_] = K1 E^(z1 t) + K2 E^(z2 t);
ystarteq = gensol[0] == startery;
yprimestarteq = gensol'[0] == starteryprime;
Ksols = Solve[{ystarteq, yprimestarteq}, {K1, K2}];
gensol[t] /. Ksols[[1]];
Clear[yformula];
yformula[t_] = Chop[ComplexExpand[gensol[t] /. Ksols[[1]]]]
Plot[yformula[t], {t, 0, 30}, PlotStyle → {{Thickness[0.01], Red}}, AspectRatio → 1 / GoldenRatio, PlotRange → All, AxesLabel → {"t", "y[t]"}]
```

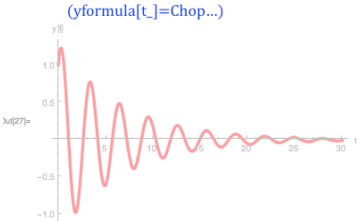
Out[9]= $4.2\,y[t] + 0.3\,y'[t] + y''[t] == 0$

(diffeq)

Out[26]= $(0. + 0.\,i) + 1.\,e^{-0.15\,t}\,\text{Cos}[2.04389\,t] + 0.807283\,e^{-0.15\,t}\,\text{Sin}[2.04389\,t]$

(yformula[t_]=Chop...)

Out[27]=



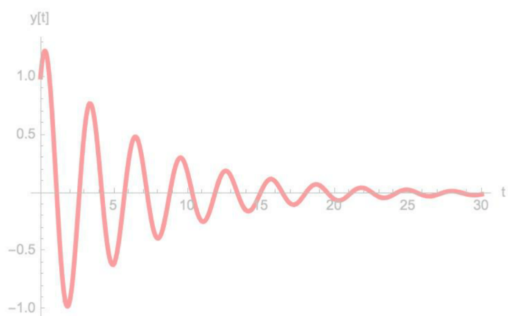
(Plot[yformula[t],...)

In addition, when code and output is being viewed in the notebook. We can also highlight the corresponding code line if the output is being selected/hovered over)

```
gensol[t] /. Ksols[[1]];
Clear[yformula];
|清除
yformula[t_] = Chop[ComplexExpand[gensol[t] /. Ksols[[1]]]]
              |近…  |复展开
Plot[yformula[t], {t, 0, 30}, PlotStyle → {{Thickness[0.01], Red}}, AspectRatio → 1 / GoldenRatio,
|绘图                          |绘图样式       |粗细              |红色   |宽高比        |黄金比例
 PlotRange → All, AxesLabel → {"t", "y[t]"}]
 |绘制范围     |全部  |坐标轴标签
Out[9]= 4.2 y[t] + 0.3 y′[t] + y″[t] == 0

Out[26]= (0. + 0. i) + 1. e^(-0.15 t) Cos[2.04389 t] + 0.807283 e^(-0.15 t) Sin[2.04389 t]
```

Out[27]=



2. Even though I've been relatively experienced in Mathematica functions, some of the features in desktop version are really new, especially the explanation help bar(suggestion bar) under the output. I find this feature really interesting but somewhat confusing and inconvenient. The feature is extremely interesting and useful by giving me suggestions to understand the function, find relate operations that can be performed, adjust the options of the plot for better visualizations, send to Wolfram|Alpha for further explanations, etc. The only issue I have for this is when I'm trying to get some documentations for the functions. The suggestions bars always for the latest output, so I usually need to go back to previous outputs if I need some other explanations about the function:

```
In[32]:= Exp
         |指数形式

Out[32]= Exp
```

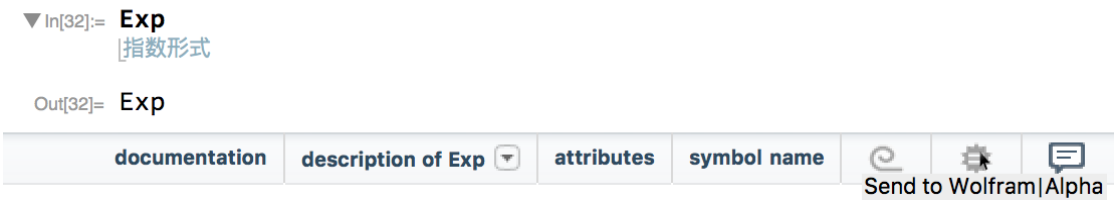

```
Out[32]= Exp

In[34]:= Attributes[Exp]
         |属性       |指数形式

Out[34]= {Listable, NumericFunction, Protected, ReadProtected}
```

In addition, I didn't know what does "roll up input" and "send to Mathematica" icons for until they're available for the output. So I propose fix the suggestion bar for pure function commands like Exp, ComplexExpand, etc. and enable explanation even when the function is not available for the given

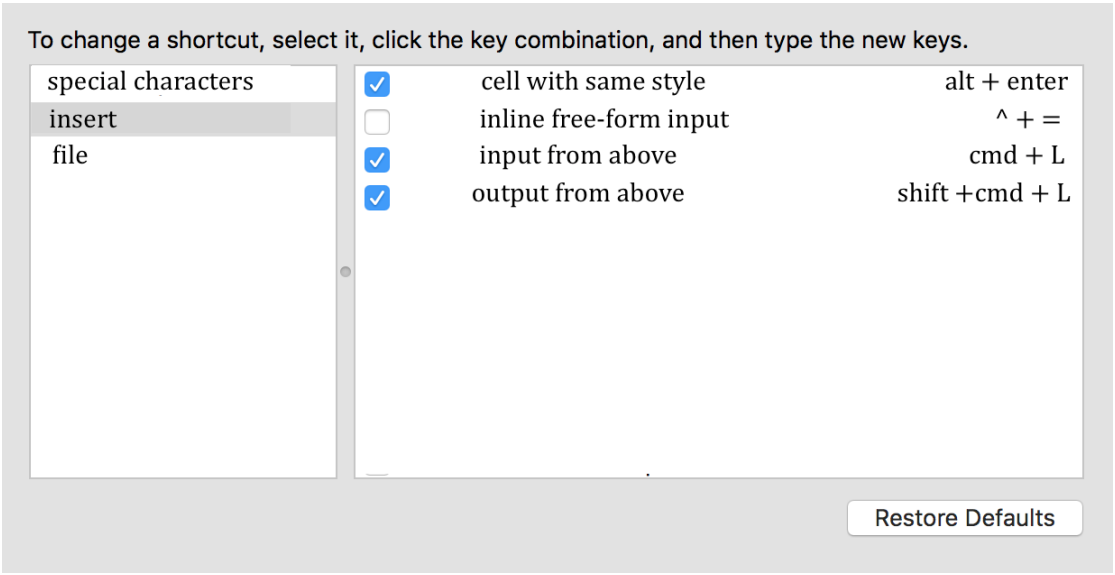
output.



Since Mathematica is for all users, I would also like to understand the software as a first time user. So I also interviewed several people that has never used Mathematica before. Below are several usability issues I find from interviewing them.

3. Although I've been using Mathematica for a long time, there still exist shortcuts I don't know. For example, ctrl+/ in MacOS can create fraction number, ctrl+2 in MacOS can create Sqrt, etc. Additionally, I would also like to customize some shortcuts myself.

Below is a sample preference page for shortcuts, adapting from the interface of shortcuts in MacOS.

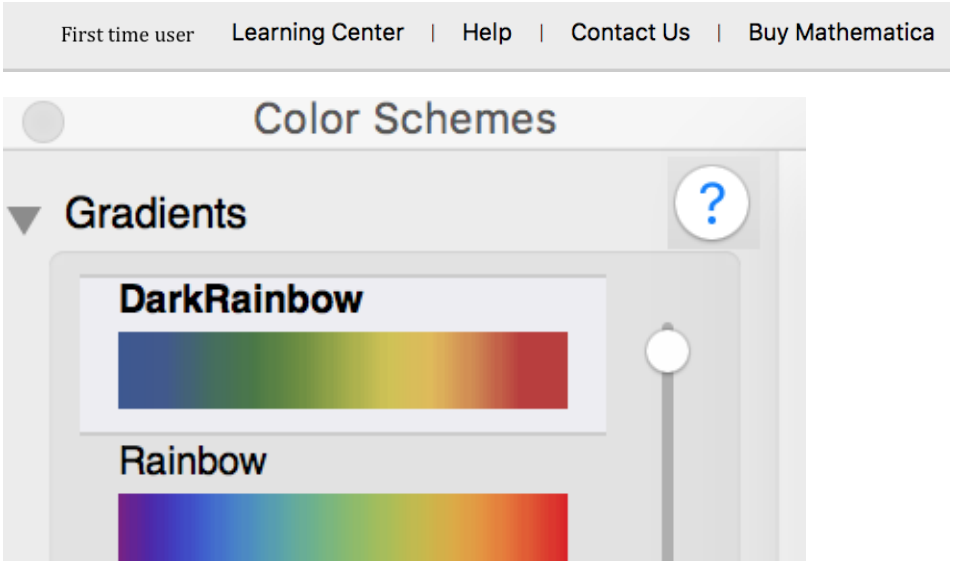


4. A lot of first time users are struggle with the functions, syntax, the difference between cell types, and meaning of the functions. Among 5 people I interviewed, 2 of them spent over 30 minutes to understand the syntax but still cannot successfully define and evaluate functions at certain point, the other 3 people don't understand the output from certain options(Chart Element Schemes, Color Schemes) and cannot successfully Plot functions that satisfy given requirements. This issue is relatively complex than others, so I separate it into 3 different cases.

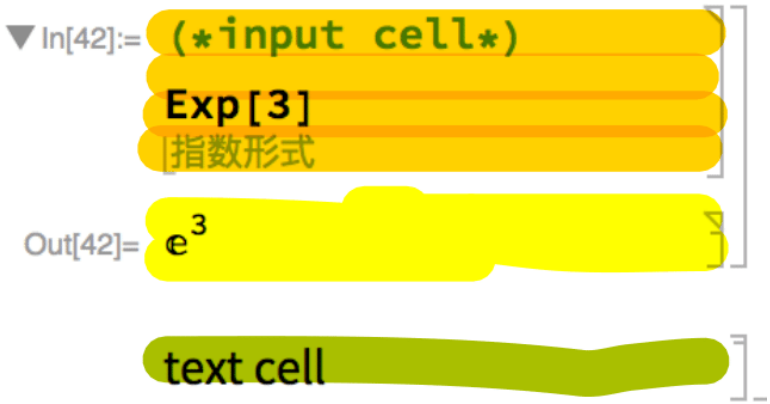
4.1. A lot of issues for first time users happen because of lacking instructions, so providing introduction animations option for them to understand the components(definition of cells, different cell types, etc.) of the program and syntax conventions would be helpful.

4.2. Though the options meaning are clearly suggested by their names, the output of the options are sometimes confusing. For example, the users tend to run the output from “Color Schemes” directly and cannot understand the output. Even with suggestion bars, they still don’t understand what they can do with the function or the output.

Above two issues might not result in errors but the users need to spend more time than expected to understand what they should do. In this case, question mark icon would really help.



4.3. It might be helpful to distinguish different cells and groups by color. During the interview, the first time users seldom understand how the grouping of the cells works.



Conclusion

There still exist some problems in the prototype, user study and iterative designs are needed before implementing the improvement. Other than the issues mentioned above, I do have several other questions about the program while I was studying and testing the functions in Mathematica.

1. When I was testing the comment shortcut function using cmd+m in MacOS, I see that sometimes the cells tend to auto-identify the sentence into segments and only comment our part of the sentence if I use the shortcut at the end of the sentence. As shown below:

```
want to comment out the whole (*sentence*)
```

2. While the documentation is already perfect in categorizing the functions based on the applicable field, I don't understand why "Machine Learning" is colored in orange and placed in from of "Symbolic & Numeric Computation". To me, the orange blocks are some basic syntax information entry-level students may need to use. "Machine Learning", though documented as all other orange blocks, I would not likely to use it unlike I do need to do higher level researches. I do think the users want to have the most used functions at front, and the functions in "Machine Learning" is not used as frequent as "Symbolic & Numeric Computation".
3. Similar thing for the "Screen Environment" option under "Format". The "printout" option doesn't change with respect to my window size, which I totally understand, but what's the setting(margin, paper size, etc.) used for this configuration? Can I customize it? The size of the work after changing to "printout" option is a little too small and makes me uncomfortable in reading and writing, especially when I have code input and output in the notebook.
4. I really love the Windows prompt window after closing the last notebook, would it be possible to have the same thing in MacOS? In the prompt, it only gives the option of starting new notebook, can there be more options(notebook, script, etc.) just like the welcome window?
5. Code captions and the translation in Chinese versions are really good. Sometimes the code space cannot provide enough space for full caption, is it possible to put captions not only at the bottom but also on top in case there's not enough space for captions? Sample show below: