CS 105

Introduction to Scientific Computing

Topic #19 – GUIs

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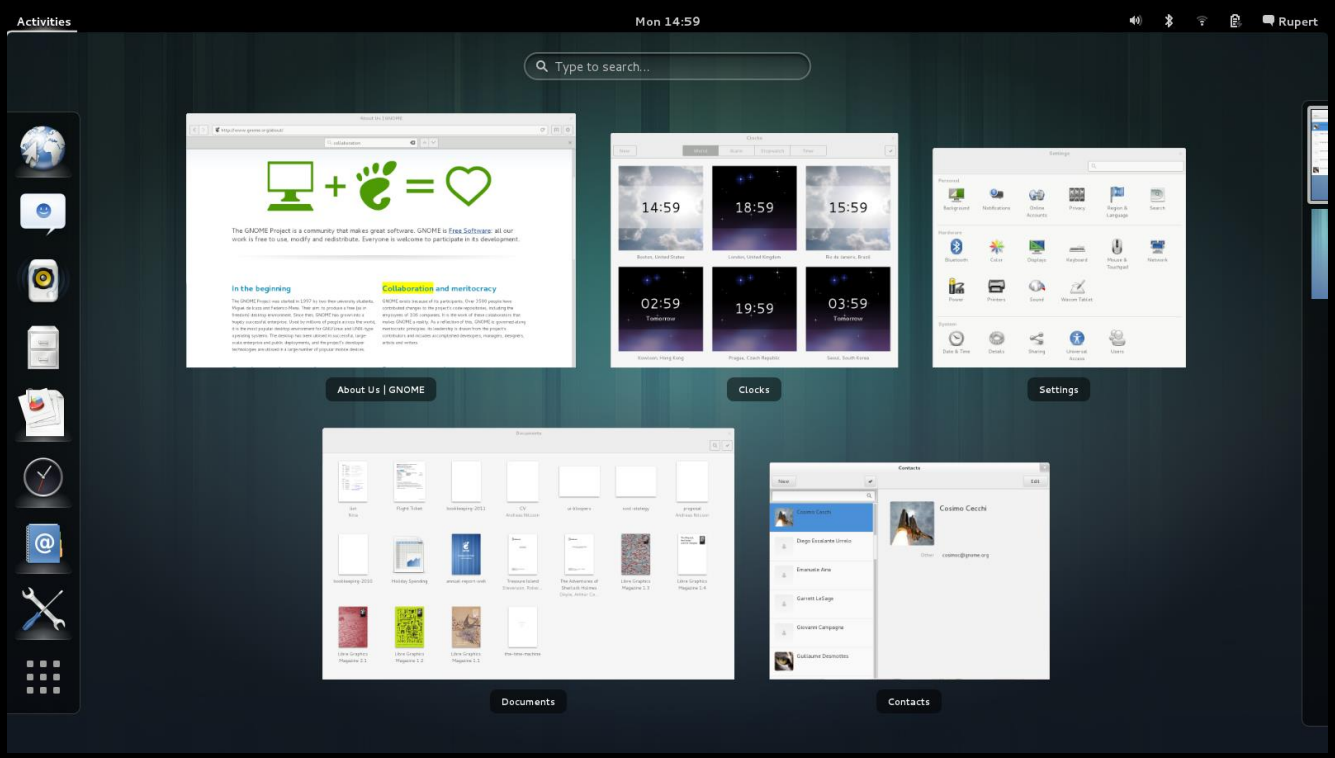
TOPICS

1. What are GUIs?
2. Making simple GUIs in MATLAB

READING

- None

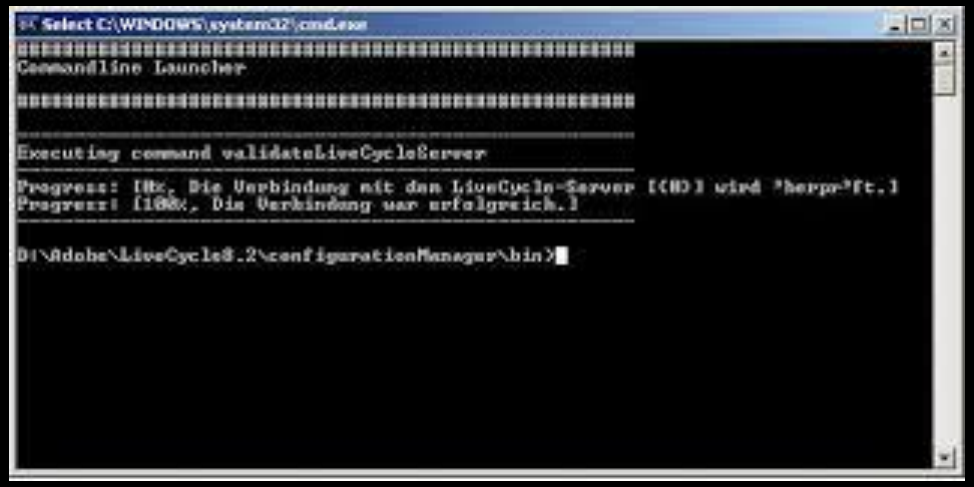
CS 105 - GRAPHICAL USER INTERFACES



GRAPHICAL USER INTERFACE

- In the 70s/80s there was a shift from using a *command line* interface to a graphical one
- This interface is called a **G**raphical **U**ser **I**nterface (or GUI)

GUI VS CLI



GRAPHICAL USER INTERFACE

- This was largely in response to more people using computers and wanting interaction with them to be more *natural*.
- Note: Still in teaching CS we focus on writing programs that using the command line
  - Graphical User Interface is just "bells and whistles"

BASICS CONCEPTS IN GUI PROGRAMMING

- We first add *elements* to a *window*
- The elements include things like
  - Buttons
  - Labels
  - Drop-Down boxes
  - Text fields
  - Text areas
  - Drawing areas
  - Etc..
- The elements also have *properties* that we can change

ELEMENT CALLBACKS

- Many elements are meant to be interacted with.
- We call these interactions ***events*** and include things like
  - Mouse down
  - Mouse clicked
  - Key Typed
  - Mouse released
  - Value Changed
- What we do when an event occurs is defined in a ***callback function***
  - Callback functions are *bound* to elements

GUI LAYOUT IN MATLAB

- In Matlab we make a window by creating a *figure*
  f = figure
- This figure can have additional properties
  - Visible
  - Position
- Generally speaking we can set properties either while making the object, or afterwards
- Example:
  - f = figure('Visible','off','Position',[360,500,450,285])
  - set(f,'Visible','on');

GUI LAYOUT IN MATLAB

- We need to be able to add elements to this figure
  elementname = uicontrol('Style',type,'String',label,'Position',position,'Callback', callbackfunction)
  - Style = 'checkbox','edit','frame','listbox','popupmenu','pushbutton','radiobutton','slider','text','togglebutton'
  - String = Label or list box and pop-up menu items
  - Position = Location of object
  - Callback = Callback function to run when something happens to the element

GUI LAYOUT

- htext = uicontrol('Style','text','String','Select Data','Position',[325,90,60,15])
- We can also make it so that elements resize automatically
  - set([f,htext],'Units','normalized');
- We can assign the frame a name
  - set(f,'Name','Simple GUI');
- We can make it visible
  - set(f,'Visible','on');

MATLAB GET AND SET COMMANDS

- MATLAB has the commands *get* and *set* that allow for getting and setting of properties of "things"
- These things include figures and user interface controls
- We specify a triplet:
  - Object (or array of objects) to get/set
  - Property string
  - Value

BASIC GUI EXAMPLE

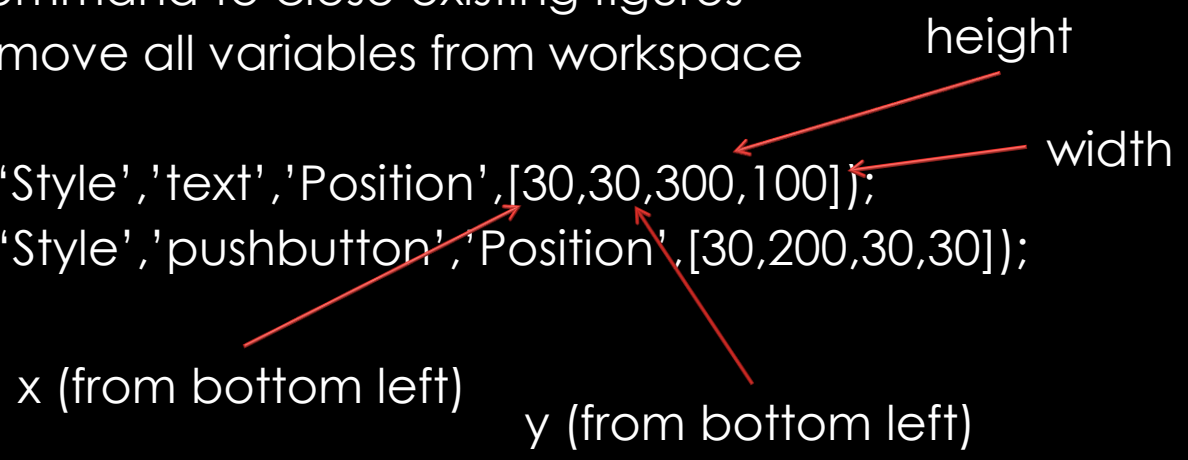
- Let's make a simple GUI with a text field and a push button.
- When we push the button it will display in the text field 'Hello'

BASIC GUI EXAMPLE

- %create a figure to put things in
  - f = figure;
- %add a text field
  - tf = uicontrol('Style','text');
- %add a pushbutton
  - b = uicontrol('Style','pushbutton');

BASIC GUI EXAMPLE

- By default all the uicontrol objects get put at the same place!
- Lets change the position of these things
  - close all; %command to close existing figures
  - clear all; %remove all variables from workspace
  - f = figure;
  - tf = uicontrol('Style','text','Position',[30,30,300,100]);
  - b = uicontrol('Style','pushbutton','Position',[30,200,30,30]);



BASIC GUI EXAMPLE

- Let's add some text onto these components
  - tf = uicontrol('Style','text','Position',[30,30,300,100],'String','Click The button!');
- Or just set the text field's property
  - set(tf,'String','Click the Button!!');
- Let's center the text field and make it ½ the width and 1/3 the height of the figure
  - figdims = get(f,'Position);
  - w = figdims(3);
  - h = figdims(4);
  - set(tf,'Position',[w/2 – (w/2)/2 ,h-h/4,w/2,h/4]);

BASIC GUI EXAMPLE

- Finally lets create a function that sets the text on our textfield to be 'Hello World' and have this be the callback for the push button
  - The function has 2 parameters, returns nothing, and can be called whatever we want
- function buttonCallback(item,data)
  set(tf,'String','Hello World');
  end
- Since this function must be able to "see" the variable tf it must defined in the same script as where we create our control objects
  - Furthermore, this "script" must actually be a function (no parameters) in order to have a function inside of it ☹

GUI1

- function GUI1
  - f = figure;
  - figuredims = get(f,'Position');
  - tf = uicontrol('Style','text','String','Click the Button!','Position', [figuredims(3)/4, figuredims(4)-figuredims(3)/3, figuredims(3)/2, figuredims(4)/3]);
  - b = uicontrol('Style','pushbutton','String','Click Me','Position', [figuredims(3)/2 – 200/2, 0, 200, 100],'Callback',@buttonCall);
  - function buttonCall(x,y)
    set(tf,'String','Hello World');
    end

end

GUI1

- Lets change the callback function so each time you click it it *appends* 'Hello World' to the existing text

- ```
  function buttonCall(x,y)
          ct = get(tf,'String');
          set(tf,'String',[ct ' Hello World']);
  end
  ```
  ```

GUI2

- Lets allow the user to type into a *edit field* and when a button is clicked it either:
  - If the value in the edit field is numeric, it converts its factorial and displays it in the edit field
  - Otherwise it displays "Error: Non Numeric Data" in the text field