Callbacks in Dash

BUILDING DASHBOARDS WITH DASH AND PLOTLY

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What are callbacks?

- Functionality triggered by interaction
    - A user interacts with an element
        - -> A Python function is triggered
            - --> Something is changed
- Why? Enhances interactivity

Callbacks in Dash

- Start with the **decorator** function
  - Uses `from dash.dependencies import Input, Output`
- Output: Where to send the function return
  - `component_id` : Identify the component
  - `component_property` : What will be changed
- Input: What triggers the callback
  - `component_property` : What to use in triggered function

```
@app.callback(
    Output(component_id='my_plot',
           component_property='figure'),
    Input(component_id='my_input',
           component_property='value')
)
def some_function(data):
    # Subset Data
    # Recreate Figure
    return fig
```

Dropdowns in Dash

```
dcc.Dropdown(id='title_dd',
             options=[{'label':'Title 1',
                       'value':'Title 1'},
                      {'label':'Title 2',
                       'value':'Title 2'}]),
```

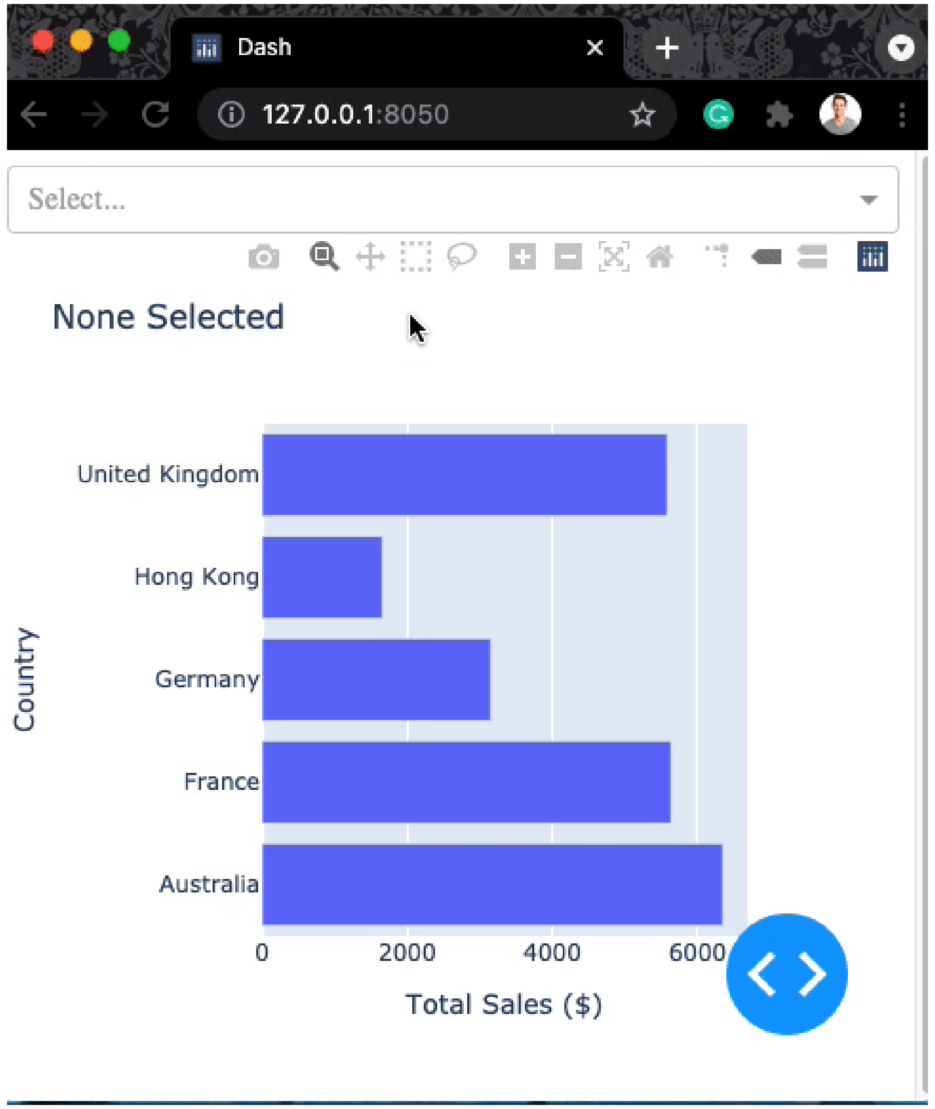
- List of label-value dictionaries

A dropdown callback

```
app.layout = html.Div(children=[
  dcc.Dropdown(id='title_dd',
      options=[{'label':'Title 1',
                'value':'Title 1'},
               {'label':'Title 2',
                'value':'Title 2'}]),
  dcc.Graph(id='my_graph')])
@app.callback(
    Output(component_id='my_graph',
           component_property='figure'),
    Input(component_id='title_dd',
           component_property='value')
)
```

```
#@app.callback()
def update_plot(selection):
    title = "None Selected"
    if selection:
        title = selection
    bar_fig = px.bar(
      data_frame=ecom_sales,
      title=f'{title}',
      x='Total Sales ($)', y='Country')
  return bar_fig
```

Our first dropdown



Dropdown as a filter

- Common use case - dropdown filters the plot DataFrame

```
#@app.callback()
def update_plot(input_country):
    country = 'All Countries'
    sales = ecom_sales.copy(deep=True)
    if input_country:
        country = input_country
        sales = sales[sales['Country'] == input_country]
    bar_fig = px.bar(
        data_frame=sales, title=f"Sales in {country}",
        x='Total Sales ($)', y='Country')
    return bar_fig
```

Let's practice!

Interactive components

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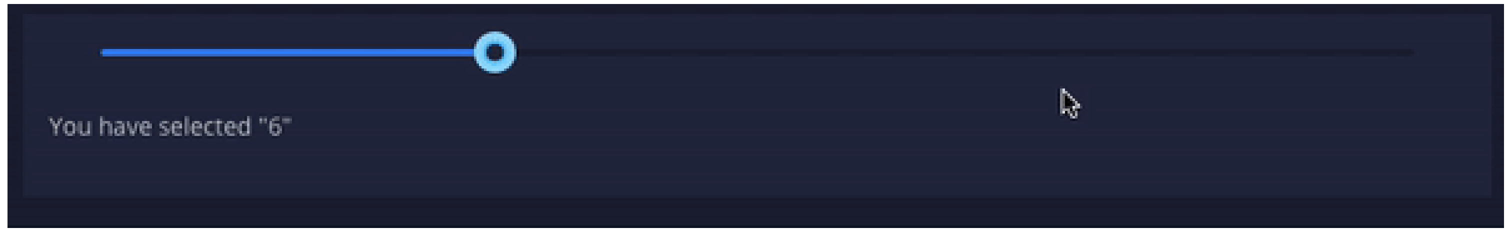
Enhancing Interactivity

- Some useful interactive components:
  - `dcc.Checklist()` = Checkboxes
  - `dcc.RadioItems()` = Radio buttons
  - `dcc.Slider()` / `dcc.RangeSlider()` = Slider selectors
  - `dcc.DatePickerSingle()` / `dcc.DatePickerRange()` = Similar to sliders but for dates

Sliders

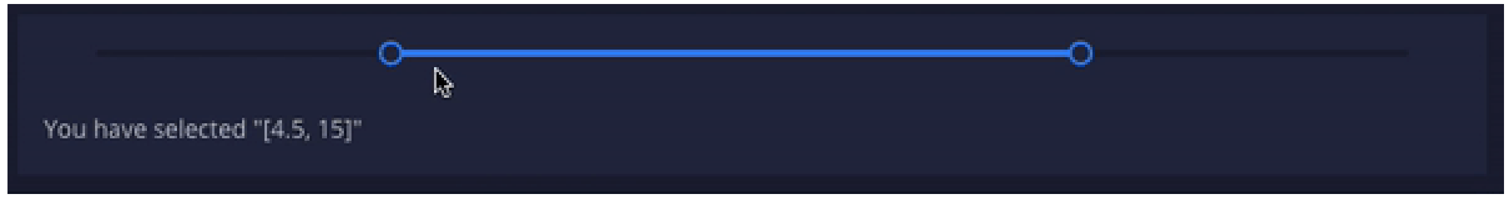
- Slider: drag and move for a single value
- Range Slider: drag and move for two values
- Reminder: Can link to callback
  - Update plots or components

A slider:



You have selected "6"

A range slider:



You have selected "[4.5, 15]"

Sliders in Dash

```
dcc.Slider(
    min=10,
    max=50,
    value=45,
    step=5,
    vertical=False
)
```

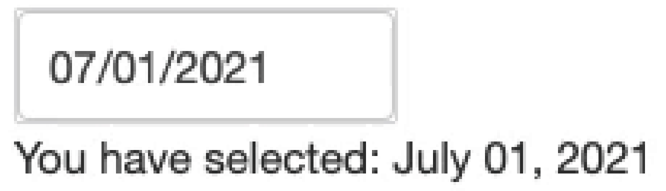
Key arguments:

- `min` / `max` : Bounds of slider
- `value` : Starting selection
- `step` : Increment for each notch
- `vertical` : To make horizontal or vertical

Date pickers in Dash

`DatePickerSingle` : Select a single date

```
dcc.DatePickerSingle(
  date=date(2021, 7, 1),
  initial_visible_month=datetime.now(),
)
```



07/01/2021

You have selected: July 01, 2021

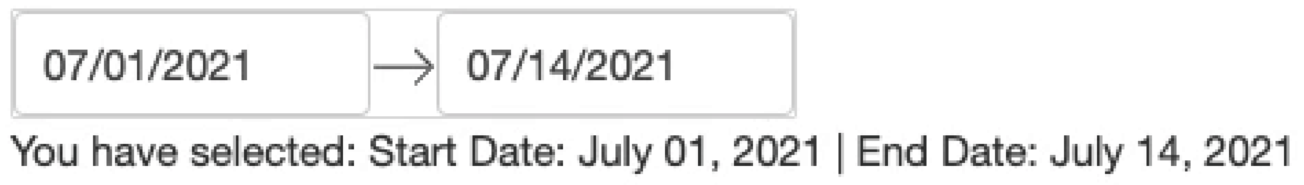
- `date` = starting selection
- `initial_visible_month` = month shown in popup
- Optionally limit `min_date_allowed` and `max_date_allowed`

Date Range Picker

- Similar to `DatePickerSingle`

```
dcc.DatePickerRange(
initial_visible_month=datetime.now(),
start_date=date(2021, 7, 1),
end_date=date(2021, 7, 14),
)
```

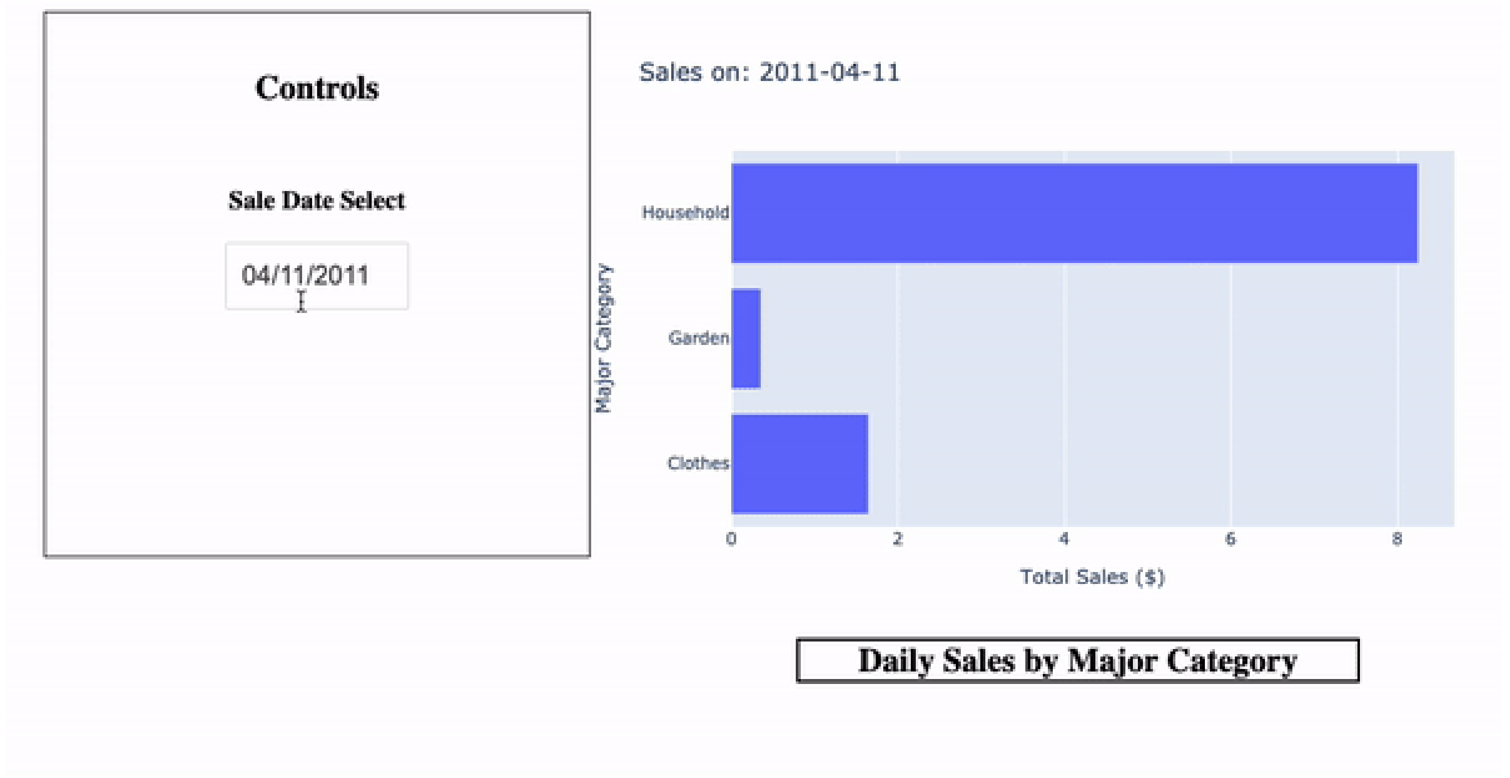
- Set an initial `start_date` and `end_date`



You have selected: Start Date: July 01, 2021 | End Date: July 14, 2021

Updating plots

```
# dcc.DatePickerSingle(id='sale_date')
# dcc.Graph(id='sales_cat')
@app.callback(
    Output(component_id='sales_cat',
           component_property='figure'),
    Input(component_id='sale_date',
           component_property='date'))
def update_plot(input_date):
    sales = ecom_sales.copy(deep=True)
    if input_date:
        sales = sales[sales['InvoiceDate'] == input_date]
    # Create fig
    return fig
```



Let's practice!

BUILDING DASHBOARDS WITH DASH AND PLOTLY

Reusable Dash components

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DRY Code

- DRY = Don't Repeat Yourself (or refactoring)
  - Remove unnecessary code
- In Python: Often using functions

DRY Code example

```
sales_country = ecom_sales\
   .groupby('Country')['OrderValue']\
   .sum()\
   .reset_index(name='Total Sales ($)')\
   .sort_values('Total Sales ($)',
                ascending=False)
sales_ma_cat = ecom_sales\
   .groupby('Major Category')['OrderValue']\
   .sum()\
   .reset_index(name='Total Sales ($)')\
   .sort_values('Total Sales ($)',
                 ascending=False)
```

Refactored:

```
def sales_by(col):
    df = ecom_sales\
    .groupby(col)['OrderValue']\
    .sum()\
    .reset_index(name='Total Sales ($)')\
    .sort_values('Total Sales ($)',
                 ascending=False)
    return df
# Call many times
sales_country = sales_by('Country')
sales_ma_cat = sales_by('Major Category')
sales_mi_cat = sales_by('Minor Category')
```

DRY in Dash

- In Dash: use functions to refactor code
- Use cases (using functions):
  - Re-using HTML (or any) component
  - Adding consistent styling (CSS can be fiddly!)
  - Ease of updating code

Re-using components

E.g., Heavily styled logo;

```
def create_logo():
```

```
  logo=html.Img(src=logo_link, style={
 'margin':'30px 0px 0px 0px',
 'padding':'50px 50px',
 'border':'3px dotted lightblue',
 'background-color':'rgb(230,131,247)'
  })
```

```
  return logo
```

```
app.layout = html.Div([
  create_logo(),
  html.Div(),
  # More components
  create_logo(),
  dcc.Graph(id='my_graph')
  create_logo()
]
```

The logo is inserted 3 times!

Generating a component list

Before:

```
app.layout = html.Div([
  html.Img(src=logo_link),
  html.Br(),
  html.Br(),
  html.H1("Sales breakdowns"),
  html.Br(),
  html.Br(),
  html.Br(),
  html.Div(children=[
    html.Div(children=[
```

After:

```
def make_break(num_breaks):
    br_list = [html.Br()] * num_breaks
    return br_list
app.layout = html.Div([
  html.Img(src=logo_link),
  *make_break(2),
  html.H1("Sales breakdowns"),
  *make_break(3),
  html.Div(children=[
    html.Div(children=[
```

Reusing styling

- Have some common styling we want added
- Python dictionary `.update()` used (warning: unique keys!)

```python
d1 = {'Country':'Australia'}
d2 = {'City':'Sydney'}
d1.update(d2)
print(d1)
```

```
{'Country':'Australia', 'City':'Sydney'}
```

Styling functions in Dash

Set up the function:

```
def style_c():
  corp_style={
    'margin':'0 auto',
    'border':'2px solid black',
    'display':'inline-block',
  }
  return corp_style
```

Call in Dash layout:

```
app.layout = html.Div([
 html.Img(src=logo_link,
 style=style_c()),
 dcc.DatePickerSingle(
 style={'width':'200px'}.update(style_c())
  )
])
```

Let's practice!

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User inputs in Dash components

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Why user input?

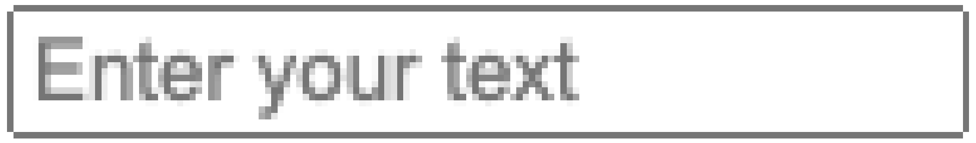
Some useful applications of user inputs:

- Filtering across a large number range (`number` inputs)
  - Consider a dropdown with 2000 'year' values!
- Filtering based on text-matching (`search` or `text` inputs)
- Creating a login (`password` and `email` / `text` input)
  - Beyond this course

User input in Dash

A user input is a `dash_core_components` `Input` type (`dcc.Input`)

- An `id` is required for callback usage
- The `type` will default to text (more on this later!)
- The `placeholder` appears faded in the input box



```
dcc.Input(
    id='my_input',
    type='text',
    placeholder="Enter your text")
```

Using the input

Similar to previous input work:

- Input becomes a Python variable
- Used with the callback
  - Typically to **filter** a DataFrame
- For example (right):
  - `df` subset using input

```
#@app.callback()
def update_plot(my_input):
    df = data.copy(deep=True)
    df = df[df['column'] == my_input]
    fig = px.scatter(data_frame=df)
    return fig
```

User input types

Dash offers useful input types:

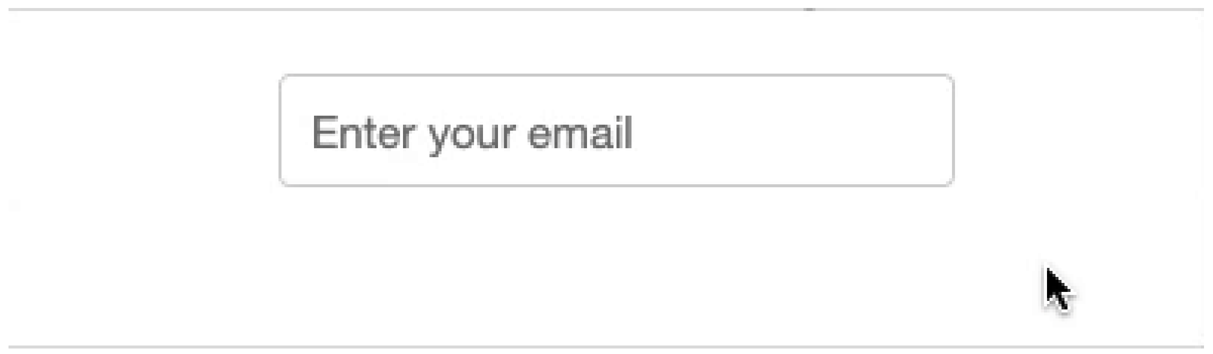
- Some are straightforward: `'text'` , `'number'` , `'password'` , `'email'`
- Some are more specialized:
    - `'range'` produces a range slider
    - `'tel'` and `'url'` are for telephone numbers and website urls
- Some are advanced
    - `'search'` and `'hidden'` involve advanced browser interaction

Restricting user input

The `type` argument automatically sets some limitations.

- E.g., an `email` type requires **something@something.com** format

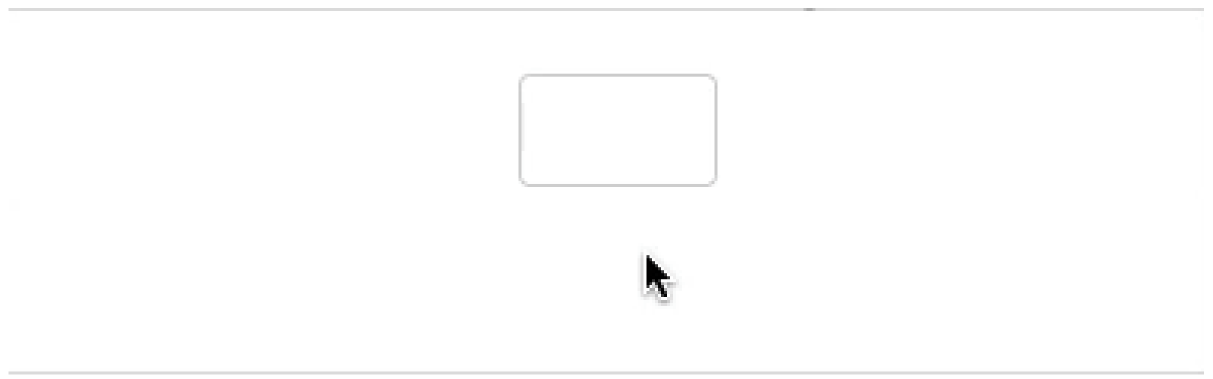
```
dcc.Input(
    id='my_input',
    type='email',
    placeholder="Enter your email")
```



Additional restrictions

Additional arguments for specific types help control input

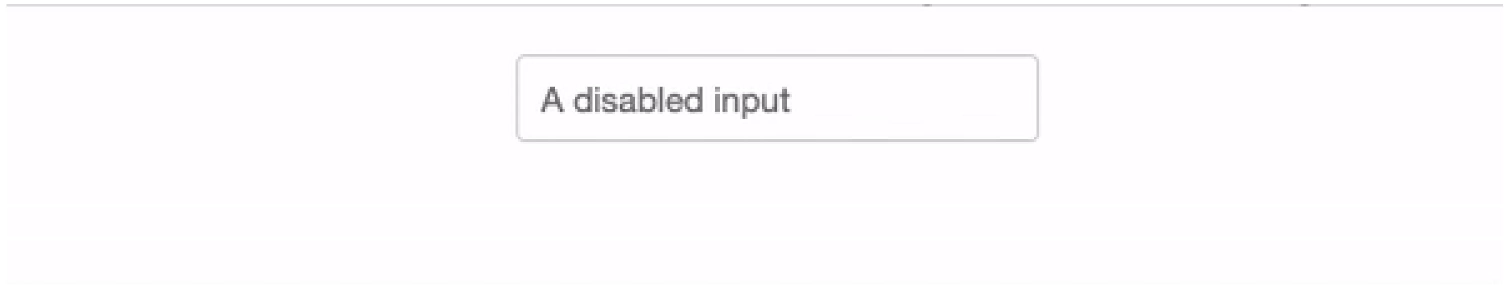
- E.g., a `number` type only allows numbers
  - Additionally: `min` and `max` set numerical limit
  - `minLength` / `maxLength` for `text` inputs
- E.g., a `text` type also has `pattern` for regex validation



```
dcc.Input(
    id='my_input',
    type='number',
    max=250)
```

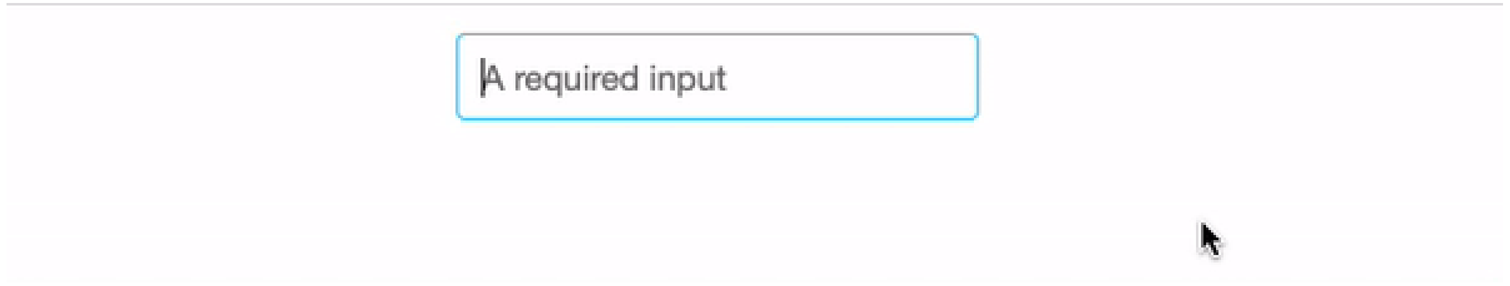
Toggling an input

We can turn off an input programmatically with `disabled`



```
dcc.Input(id='my_input', disabled=True)
```

Or we can force its usage with `required`



(Both are True/False arguments of `dcc.Input()`)

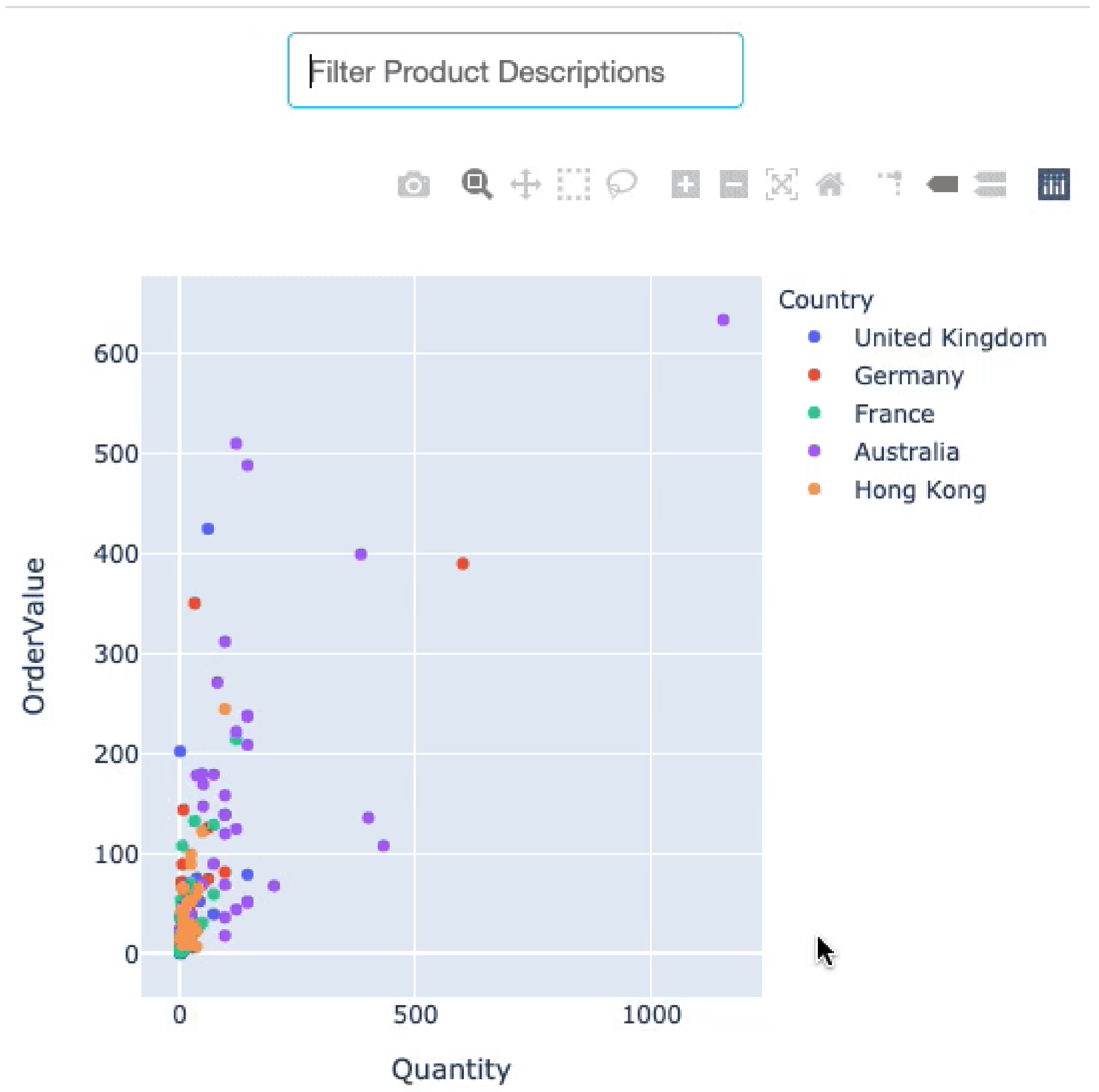
```
dcc.Input(id='my_input', required=True)
```

When to update

A vital argument is `debounce` : Determines callback trigger (on unfocus or 'Enter') versus as-you-type

- Here `debounce` is `False` (callback as you type)
  - Filtering for `R` , `Re` , `Red` , `Redd` in turn

```
dcc.Input(id='my_input', type='text',
          debounce=False)
```



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