

Developing and Distributing Custom Visuals



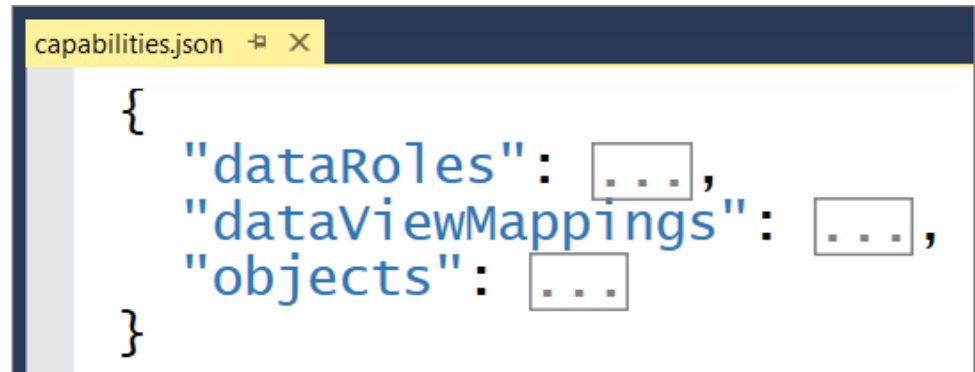
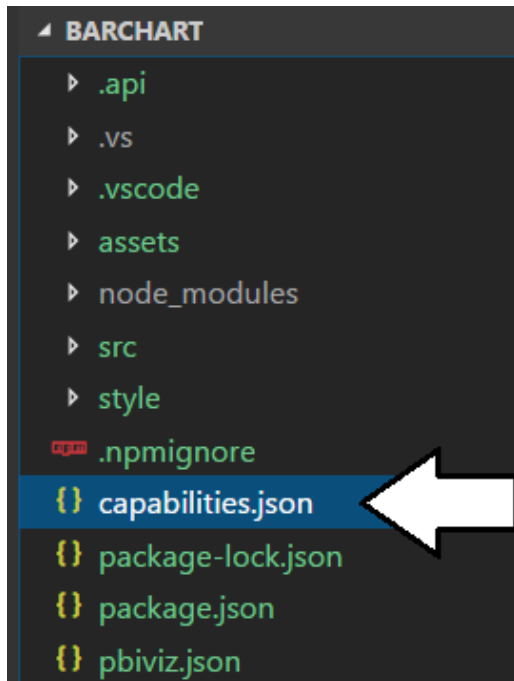
Agenda

- Defining Data Roles and Data Mappings
- Extending a Visual with Custom Properties
- Designing Custom Visuals using a View Model
- Advanced Custom Visual Design Features
- Packaging and Deploying Custom Visuals



Visual Capabilities

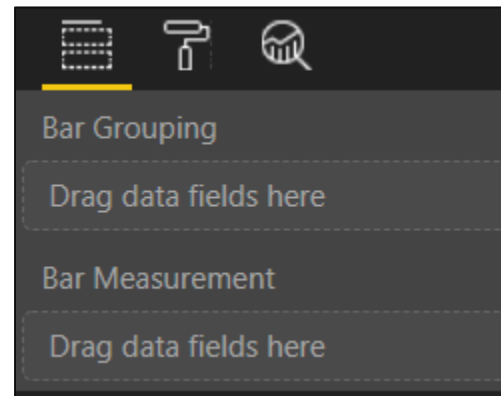
- Visual capabilities defined inside **capabilities.json**
 - **dataRoles** defines the field wells displayed on Fields pane
 - **dataViewMappings** defines the type of DataView used by visual
 - **objects** defines custom properties for visual



Data Roles

- DataRoles define how fields are associated with visual
 - Each dataRole is display as field well in the Field pane
 - dataRoles can be defined with conditions and data mappings

```
"dataRoles": [  
  {  
    "displayName": "Bar Grouping",  
    "name": "myCategory",  
    "kind": "Grouping"  
  },  
  {  
    "displayName": "Bar Measurement",  
    "name": "myMeasure",  
    "kind": "Measure"  
  }  
]
```



Data Mapping Modes

- Power BI visual API provides several mapping modes

- Single
- Table
- Categorical
- Matrix
- Tree

Single Mapping

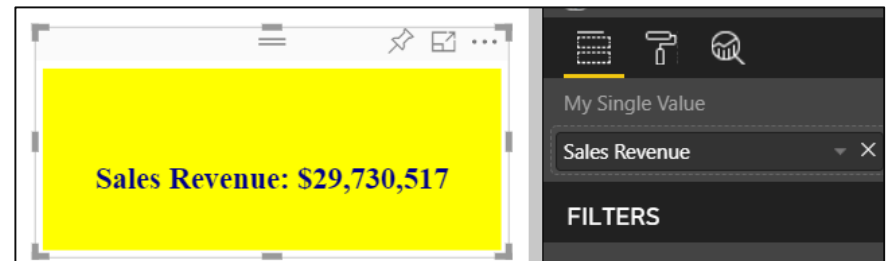


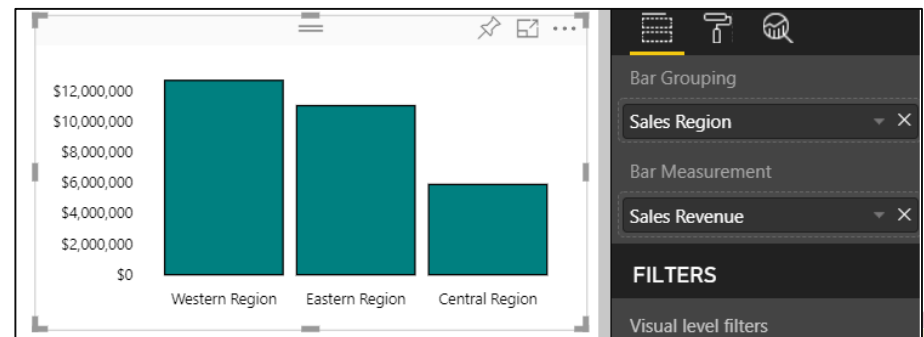
Table Mapping

A Power BI visual in Table Mapping mode. The visual is a table with three columns: "Sales Region", "Sales Revenue", and "Units Sold". The data is as follows:

Sales Region	Sales Revenue	Units Sold
Western Region	\$12,733,888	1,598,125
Central Region	\$5,915,449	994,680
Eastern Region	\$11,081,180	1,959,240

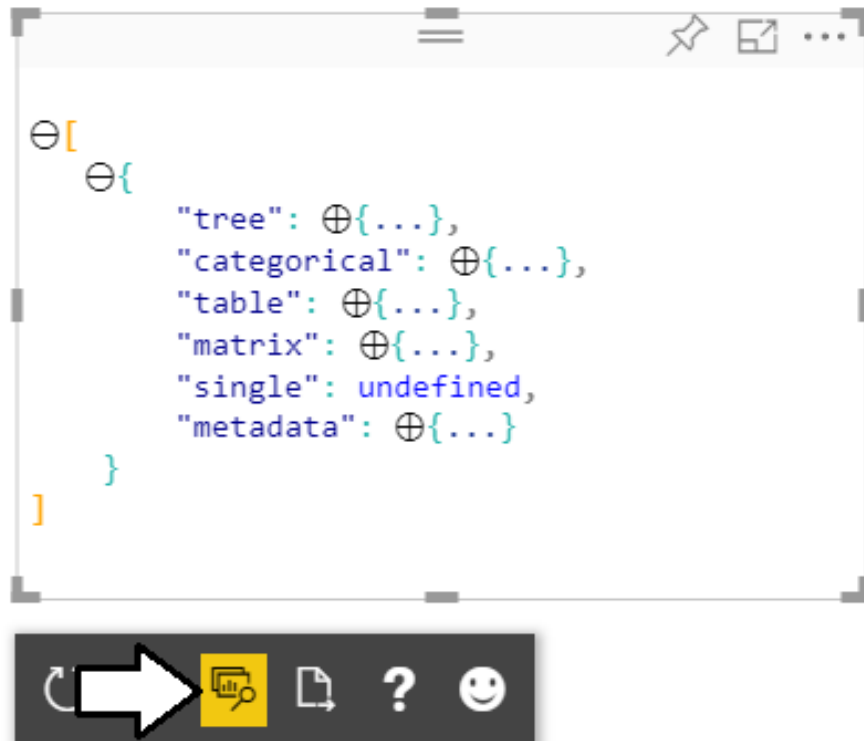
The right-hand pane shows the configuration: "Values" is selected, and "Sales Region", "Sales Revenue", and "Units Sold" are the chosen fields. The "FILTERS" pane is empty.

Categorical Mapping



Developer Visual DataView

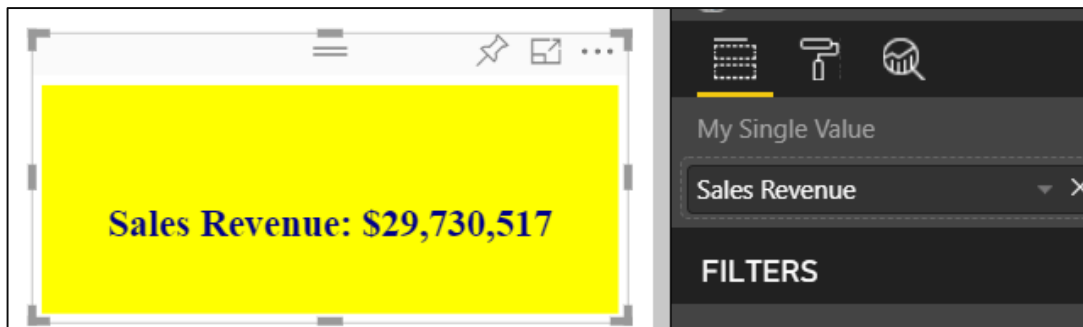
- Developer visual supports DataView mode
 - Allows you to see and explore data mapping
 - Allows you to see metadata for custom properties



Single Mapping Example: oneBigNumber

- dataRole can use dataViewMapping mode of single
 - For visuals like Card which only display single value
 - Condition can define that a dataRole requires exactly one measure

```
"dataRoles": [  
  {  
    "displayName": "My single value",  
    "name": "myvalue",  
    "kind": "Measure"  
  }  
],  
"dataViewMappings": [  
  {  
    "conditions": [ { "myvalue": { "min": 1, "max": 1 } } ],  
    "single": { "role": "myvalue" }  
  }  
]
```



Programming in Single Mapping Mode

- Single mapping easy to access through visuals API
 - DataView object provides single.value property
 - value property defined as PrimitiveValue { bool | number | string }
 - PrimitiveValue must be explicitly cast
 - Other measure properties available through column metadata

```
"tree": ⊕{...},
"categorical": ⊕{...},
"table": ⊕{...},
"matrix": ⊕{...},
"single": ⊖{
  "column": ⊕{...},
  "value": 29730517.14
},
"metadata": ⊖{
  "columns": ⊖[
    ⊖{
      "roles": ⊕{...},
      "type": ⊕{...},
      "format": "\\$#,0;(\\$#,0);\\$#,0",
      "displayName": "Sales Revenue",
      "queryName": "Sales.Sales Revenue",
      "expr": ⊕{...},
      "index": 0,
      "isMeasure": true
    }
  ]
}
```

```
public update(options: VisualUpdateOptions) {
  // get DataView object
  this.dataView = options.dataViews[0];

  // get single value
  var value: number = <number>this.dataView.single.value;

  // get metadata to discover field name and format string
  var column: DataViewMetadataColumn = this.dataView.metadata.columns[0];
  var valueName: string = column.displayName
  var valueFormat: string = column.format;
```

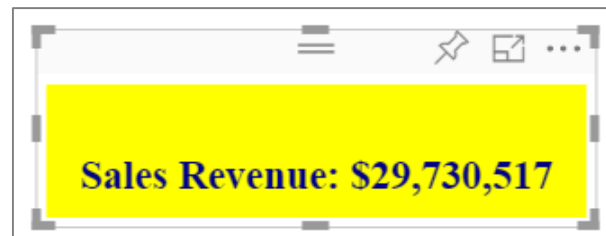


Using the Power BI Formatting Utilities

- Used to format values using Power BI formatting strings
 - Requires installing powerbi-visuals-utils-formattingutils package

```
var value: number = <number>this.dataView.single.value;  
var column: DataViewMetadataColumn = this.dataView.metadata.columns[0];  
var valueName: string = column.displayName  
var valueFormat: string = column.format;  
  
var valueFormatterFactory = powerbi.extensibility.utils.formatting.valueFormatter;  
var valueFormatter = valueFormatterFactory.create({  
    format: valueFormat,  
    formatSingleValues: true  
});  
  
var valueString: string = valueFormatter.format(value);
```

```
"column": {  
  "roles": [...],  
  "type": [...],  
  "format": "\\$#,0;(\\$#,0);\\$#,0",  
  "displayName": "Sales Revenue",  
  "queryName": "Sales.Sales Revenue",  
}
```



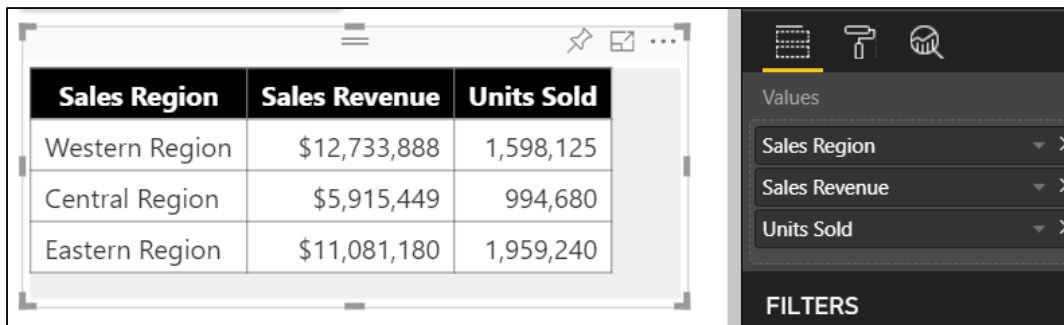
```
"column": {  
  "roles": [...],  
  "type": [...],  
  "format": "#,0",  
  "displayName": "Units Sold",  
  "queryName": "Sales.Units Sold",  
}
```



Table Mapping Example: Snazzy Table

- dataRole can use dataViewMapping mode of table
 - For visuals which display rows & columns for ordered set of fields
 - condition can define number of fields that can be added

```
"dataRoles": [  
  {  
    "displayName": "values",  
    "name": "values",  
    "kind": "GroupingOrMeasure"  
  }  
],  
"dataViewMappings": [  
  {  
    "conditions": [ { "values": { "min": 1, "max": 5 } } ],  
    "table": { "rows": { "for": { "in": "values" } } }  
  }  
]
```



The screenshot displays a Power BI report interface. On the left, a table visual is shown with three columns: Sales Region, Sales Revenue, and Units Sold. The table contains three rows of data. On the right, the filter pane is visible, showing the 'Values' section with three filters applied: Sales Region, Sales Revenue, and Units Sold. The filter pane also includes a 'FILTERS' section at the bottom.

Sales Region	Sales Revenue	Units Sold
Western Region	\$12,733,888	1,598,125
Central Region	\$5,915,449	994,680
Eastern Region	\$11,081,180	1,959,240



Programming in Table Mapping Mode

- Table mapping data accessible through visuals API
 - DataView object provides table property
 - table property provides columns property and rows property

```
"table": ⊕{  
  "columns": ⊕[  
    ⊕{  
      "roles": ⊕{...},  
      "type": ⊕{...},  
      "format": undefined,  
      "displayName": "Sales Region",  
      "queryName": "Customers.Sales Region",  
      "expr": ⊕{...},  
      "index": 0,  
      "identityExprs": ⊕[ ... ]  
    },  
    ⊕{...},  
    ⊕{...}  
  ],  
  "identity": ⊕[ ... ],  
  "identityFields": ⊕[ ... ],  
  "rows": ⊕[  
    ⊕[  
      "Western Region",  
      12733888.2,  
      1598125
```

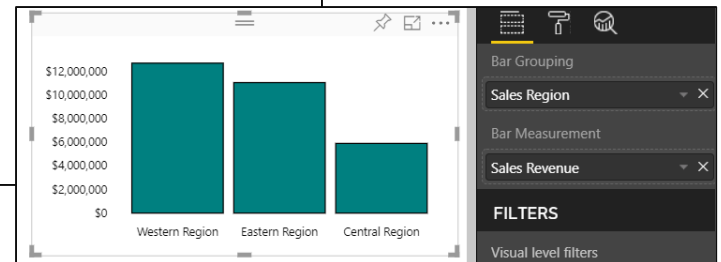
```
public update(options: VisualUpdateOptions) {  
    var dataView: DataView = options.dataViews[0];  
    var table: DataViewTable = dataView.table;  
    var columns: DataViewMetadataColumn[] = table.columns;  
    var rows: DataViewTableRow[] = table.rows;
```



Categorical Mapping Example: Barchart

- dataRole can use dataViewMapping mode of categorical
 - This is the most common type of data mapping
 - For visuals which divide data into groups for analysis
 - Groups defined as columns and values defined as measures

```
"dataRoles": [
  { "displayName": "Bar Grouping", "name": "myCategory", "kind": "Grouping" },
  { "displayName": "Bar Measurement", "name": "myMeasure", "kind": "Measure" }
],
"dataViewMappings": [
  {
    "conditions": [ { "myCategory": { "max": 1 }, "myMeasure": { "max": 1 } } ],
    "categorical": {
      "categories": {
        "for": { "in": "myCategory" },
        "dataReductionAlgorithm": { "top": {} }
      },
      "values": {
        "select": [ { "bind": { "to": "myMeasure" } } ]
      }
    }
  }
]
```



Agenda

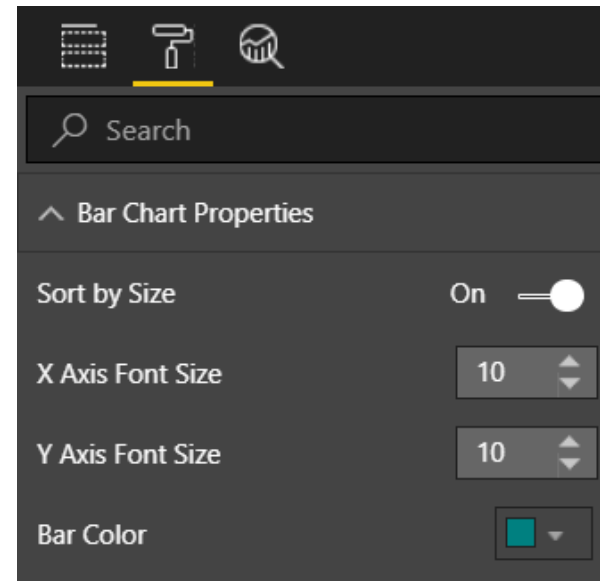
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Extending Visuals with Custom Properties

- Custom properties defined using **objects**
 - You can define one or more objects in **capabilities.json**
 - Each object defined with name, display name and properties
 - object properties automatically persistent inside visual metadata
 - properties can be seen and modified by user in Format pane
 - Custom properties require extra code to initialize Format pane

```
"objects": {  
  "barchartProperties": {  
    "displayName": "Bar Chart Properties",  
    "properties": {  
      "sortBySize": {  
        "displayName": "Sort by Size",  
        "type": { "bool": true }  
      },  
      "xAxisFontSize": {  
        "displayName": "X Axis Font Size",  
        "type": { "integer": true }  
      },  
      "yAxisFontSize": {  
        "displayName": "Y Axis Font Size",  
        "type": { "integer": true }  
      },  
      "barColor": {  
        "displayName": "Bar Color",  
        "type": { "fill": { "solid": { "color": true } } }  
      }  
    }  
  }  
}
```



DataViewObjectParser and VisualSettings

- Power BI visual utilities provide DataViewObjectParser
 - Abstracts away tricky code to initialize and read property values

```
TS settings.ts •
module powerbi.extensibility.visual {

  import DataViewObjectsParser = powerbi.extensibility.utils.dataview.DataViewObjectsParser;

  export class VisualSettings extends DataViewObjectsParser {
    public barchartProperties: BarchartProperties = new BarchartProperties();
  }

  export class BarchartProperties {
    sortBySize: boolean = true;
    xAxisFontSize: number = 10;
    yAxisFontSize: number = 10;
    barColor: Fill = { "solid": { "color": "teal" } };
  }
}
```



Mapping Object Properties to VisualSettings

- VisualSettings class must map to named objectnamed
 - VisualSetting class contains named field that maps to object name
 - Named field based on custom class with mapped properties
 - Object & property names must match what's in capabilities.json

```
"objects": {  
  "barchartProperties": {  
    "displayName": "Bar Chart Properties",  
    "properties": {  
      "sortBySize": {  
        "displayName": "Sort by Size",  
        "type": { "bool": true }  
      },  
      "xAxisFontSize": {  
        "displayName": "X Axis Font Size",  
        "type": { "integer": true }  
      },  
      "yAxisFontSize": {  
        "displayName": "Y Axis Font Size",  
        "type": { "integer": true }  
      },  
      "barColor": {  
        "displayName": "Bar Color",  
        "type": { "fill": { "solid": { "color": "#FFFFFF" } } }  
      }  
    }  
  }  
}
```

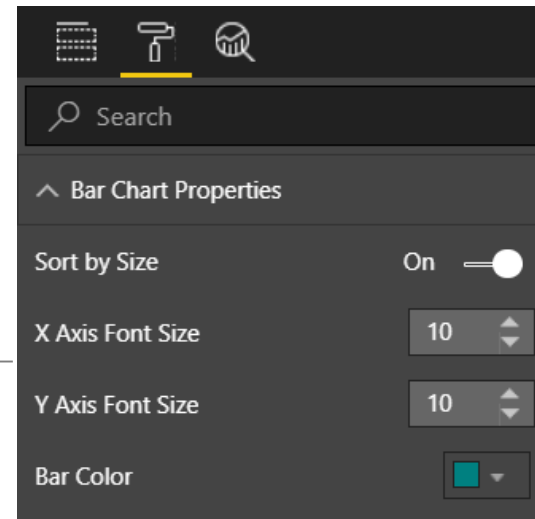
```
export class VisualSettings extends DataModel {  
  public barchartProperties: BarchartProperties;  
}  
  
export class BarchartProperties {  
  sortBySize: boolean = true;  
  xAxisFontSize: number = 10;  
  yAxisFontSize: number = 10;  
  barColor: Fill = { "solid": { "color": "#FFFFFF" } }  
}
```



Initializing Objects in the Format Pane

- Visual must initialize properties in Format pane
 - Visual must implement enumerateObjectInstances
 - VisualSettings makes this relatively easy
 - Extra code required to make property appear as spinner

```
public enumerateObjectInstances(options: EnumerateVisualObjectInstancesOptions): VisualObjectInstanceEnumeration {  
    // register object properties  
    var visualObjects: VisualObjectInstanceEnumerationObject =  
        <VisualObjectInstanceEnumerationObject>VisualSettings  
            .enumerateObjectInstances(this.settings, options);  
  
    // configure spinners for integers properties  
    visualObjects.instances[0].validValues = {  
        xAxisFontSize: { numberRange: { min: 10, max: 36 } },  
        yAxisFontSize: { numberRange: { min: 10, max: 36 } },  
    };  
  
    // return visual object collection  
    return visualObjects;  
}
```



Retrieving Property Values

- Property values persisted into visual metadata
 - Properties not persisted while they still retain default values

```
"tree": ⊕{...},
"categorical": ⊕{...},
"table": ⊕{...},
"matrix": ⊕{...},
"single": undefined,
"metadata": ⊖{
  "columns": ⊕[ ... ],
  "objects": ⊖{
    "barchartProperties": ⊖{
      "sortBySize": false,
      "xAxisFontSize": 14
    }
  }
}
```

- Property values retrieved using VisualSettings object

```
public update(options: VisualUpdateOptions) {
  if (options.dataViews[0]) {
    // create VisualSettings object
    this.settings = VisualSettings.parse(options.dataViews[0]) as VisualSettings;

    // retrieve property values
    var sortBySize: boolean = this.settings.barchartProperties.sortBySize
    var xAxisFontSize: number = this.settings.barchartProperties.xAxisFontSize;
```



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Designing with View Model

- Best practice involves creating view model for each visual
 - View model defines data required for rendering
 - createViewModel method gets data to generate view model
 - update method calls createViewModel to get view model

```
export interface BarchartDataPoint {  
  Category: string;  
  Value: number;  
}  
  
export interface BarchartViewModel {  
  IsValid: boolean;  
  DataPoints?: BarchartDataPoint[];  
  Format?: string;  
  SortBySize?: boolean;  
  XAxisFontSize?: number;  
  YAxisFontSize?: number;  
  BarColor?: string;  
}
```





DEMO

Examining the View Model in the Barchart Visual

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smartieBarChart Demo

- Advanced Visual Features
 - Support for Visual Highlighting
 - Selection Manager
 - TooltipsServiceWrapper

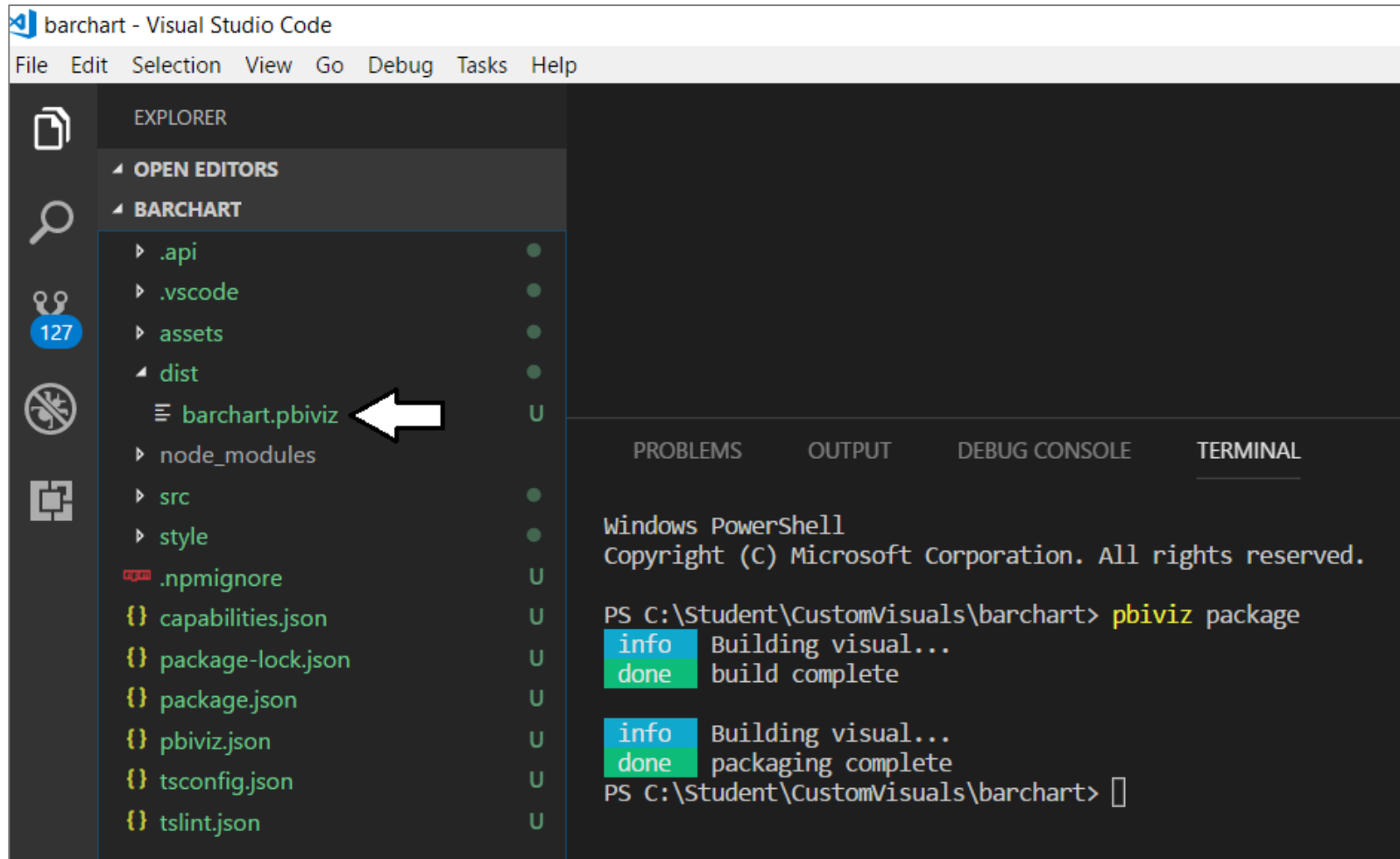


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Packaging and Deploying Custom Visuals



Summary

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