

Developing and Distributing Custom Visuals



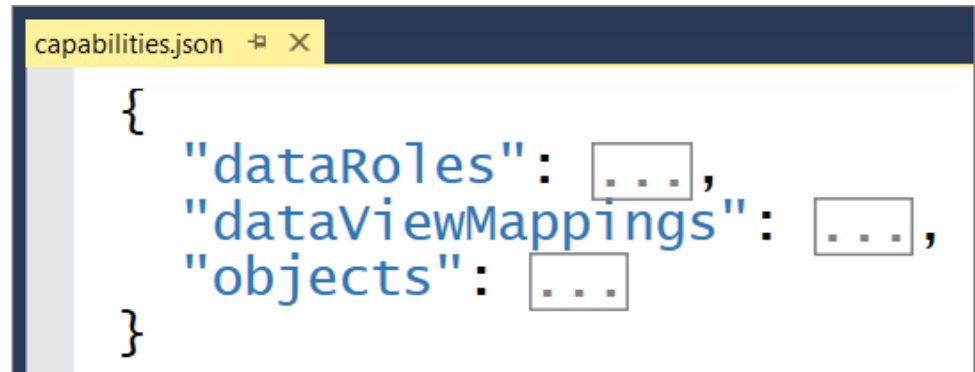
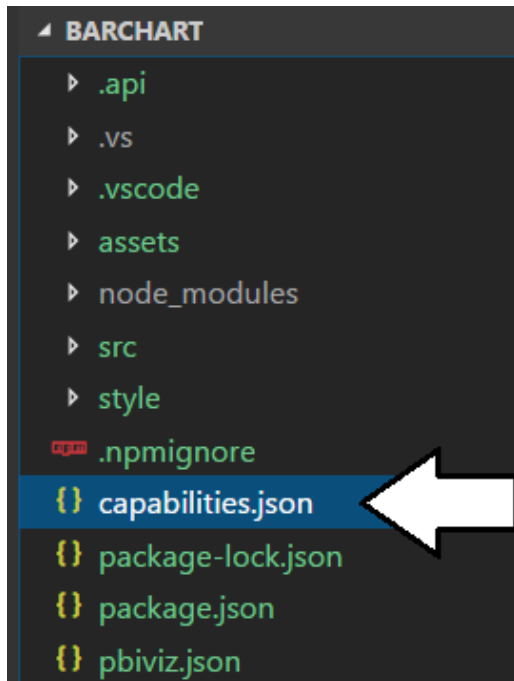
Agenda

- 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

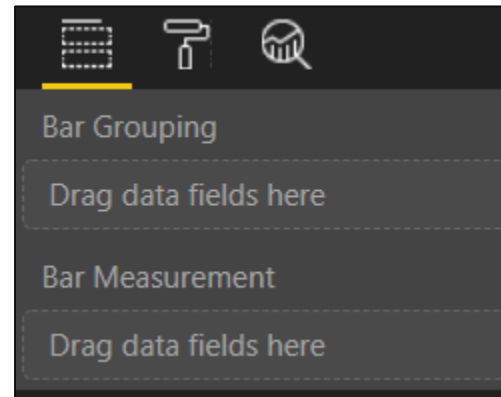
- Visual capabilities defined inside **capabilities.json**
 - **dataRoles** defines the field wells displayed on Fields pane
 - **dataViewMappings** defines the type of DataView used by visual
 - **objects** defines custom properties for visual



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

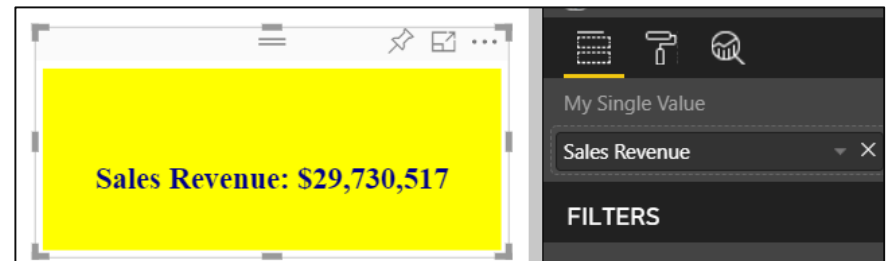
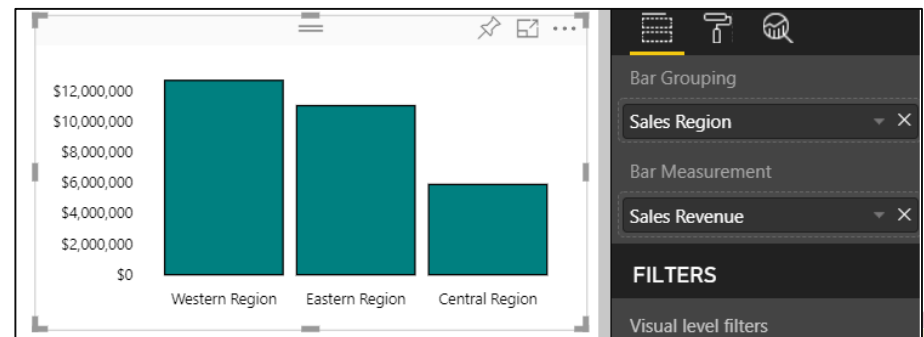


Table Mapping

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

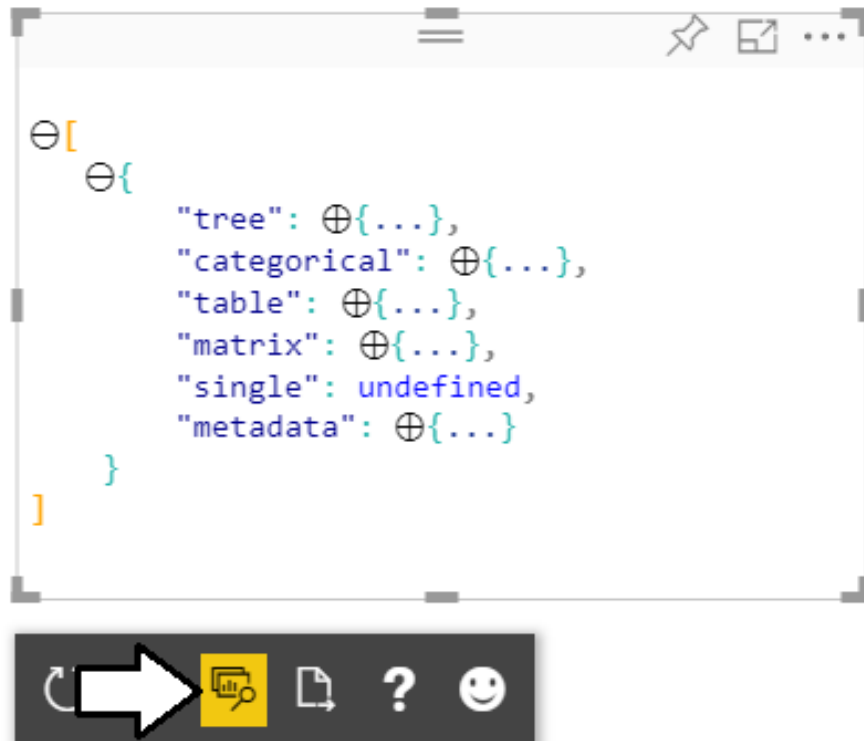
Sales Region	Sales Revenue	Units Sold
Western Region	\$12,733,888	1,598,125
Central Region	\$5,915,449	994,680
Eastern Region	\$11,081,180	1,959,240

Categorical Mapping



Developer Visual DataView

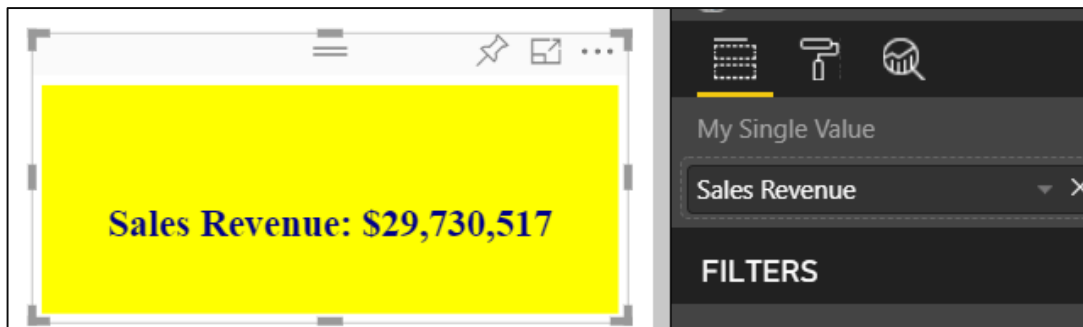
- Developer visual supports DataView mode
 - Allows you to see and explore data mapping
 - Allows you to see metadata for custom properties



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 PrimitivesValue { bool | number | string }
 - PrimitivesValue 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

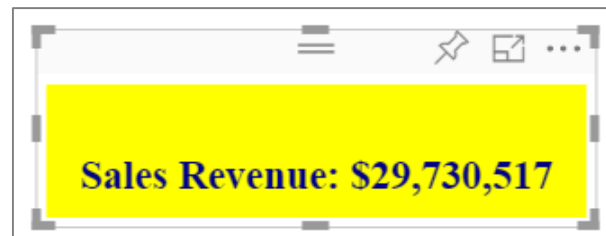
- Used to format values using Power BI formatting strings
 - Requires installing powerbi-visuals-utils-formattingutils package

```
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",
```



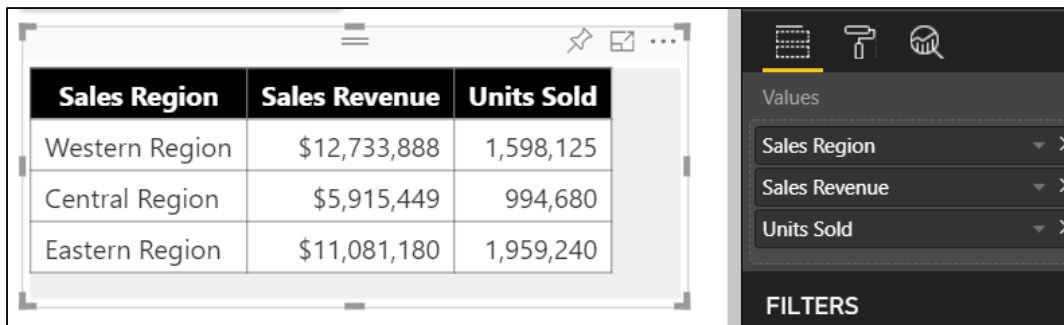
```
"column": {
  "roles": [...],
  "type": [...],
  "format": "#,0",
  "displayName": "Units Sold",
  "queryName": "Sales.Units Sold",
```



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' field set 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
```

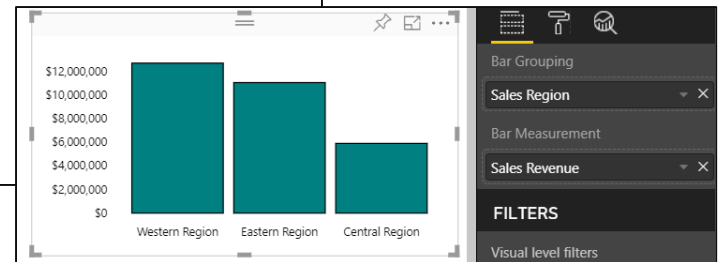
```
public update(options: VisualUpdateOptions) {  
    var dataView: DataView = options.dataViews[0];  
    var table: DataViewTable = dataView.table;  
    var columns: DataViewMetadataColumn[] = table.columns;  
    var rows: DataViewTableRow[] = table.rows;
```



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

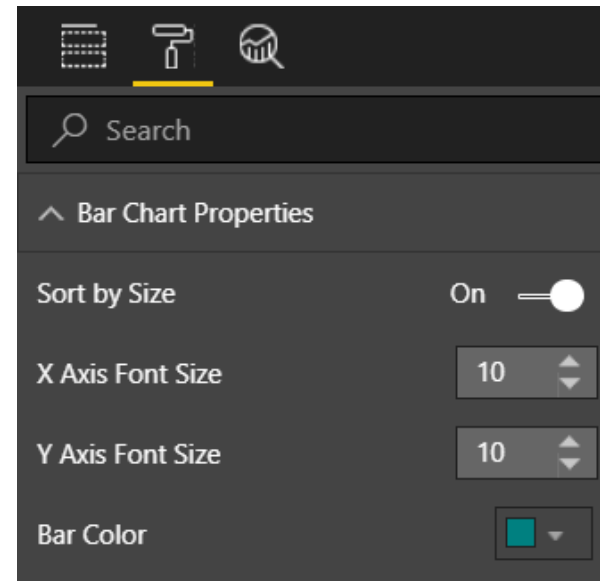
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Extending Visuals with Custom Properties

- 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" } } }  
      }  
    }  
  }  
}
```

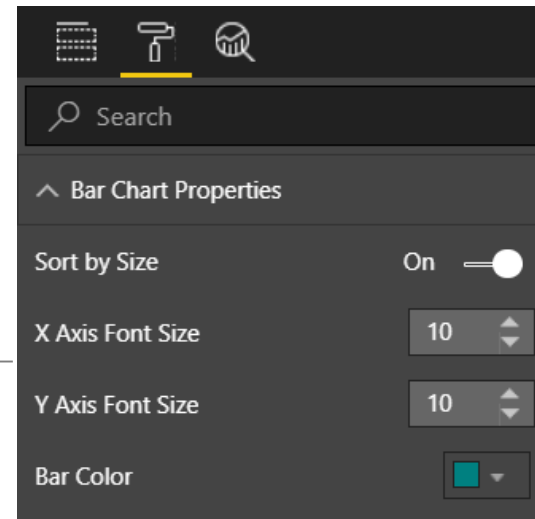
```
export class VisualSettings extends DataModel {  
  public barchartProperties: BarchartProperties;  
}  
  
export class BarchartProperties {  
  sortBySize: boolean = true;  
  xAxisFontSize: number = 10;  
  yAxisFontSize: number = 10;  
  barColor: Fill = { "solid": { "color": "#FFFFFF" } }  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



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

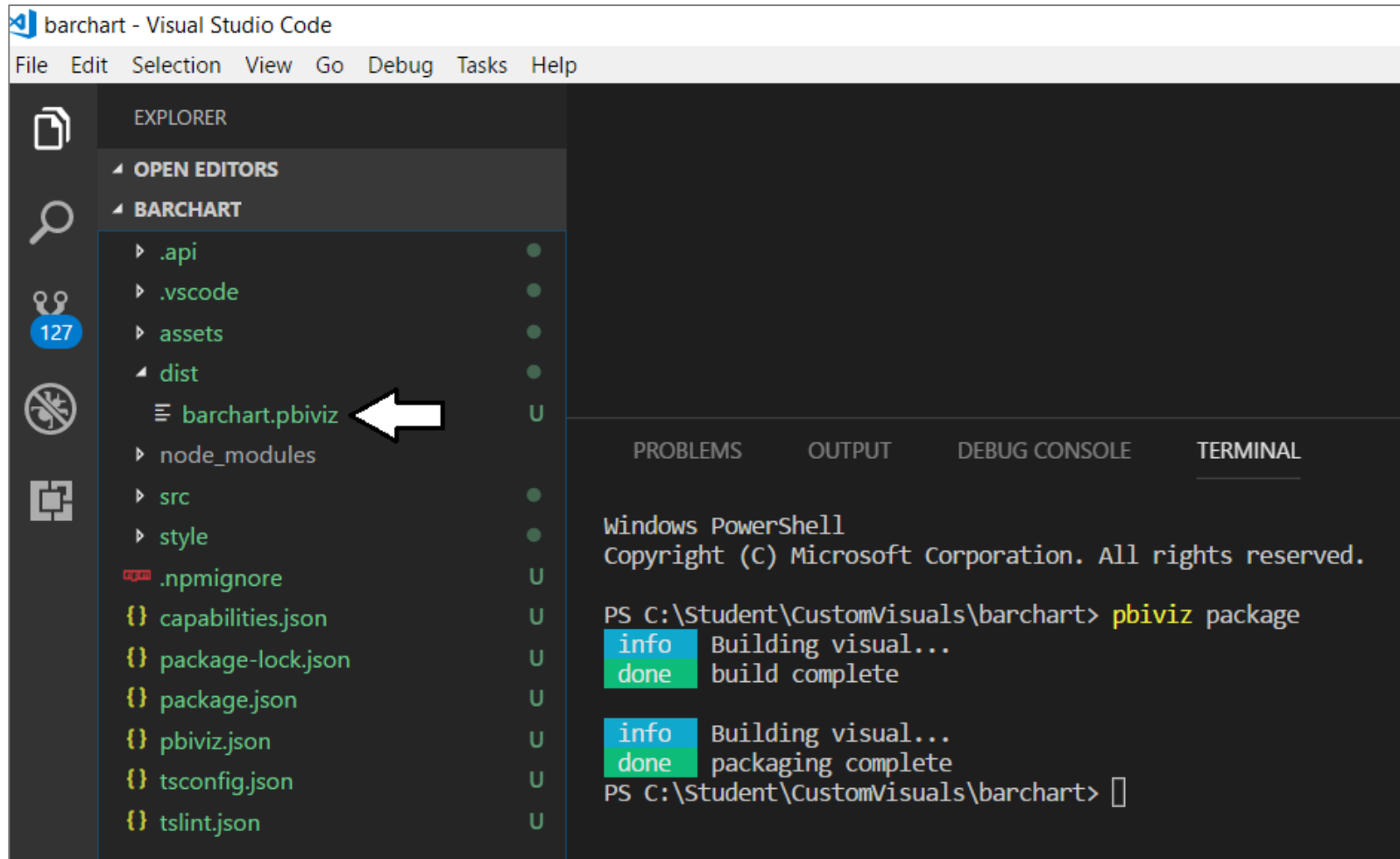


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Packaging and Deploying Custom Visuals



Summary

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