Symbol data type JavaScript

Symbol Primitive data type in JavaScript

In JavaScript, `Symbol` is a primitive data type introduced in ES6 (ECMAScript 2015). It is used to create unique identifiers for object properties.

Key points about `Symbol`:

- **Uniqueness:** Each Symbol value is unique and immutable.
- **Used as keys:** Symbols are often used as keys for object properties to avoid name collisions.
- **Primitive:** Like `string`, `number`, `boolean`, etc., `Symbol` is a primitive type, not an object.
- **Cannot be implicitly converted:** Symbols cannot be implicitly converted to strings (e.g., concatenation throws an error).
- **Creation:** Created using the `Symbol()` function.

Syntax:

```javascript
const sym = Symbol(description);
```

- `description` is an optional string to help describe the symbol for debugging purposes.

Example:

```javascript
const sym1 = Symbol('id');
const sym2 = Symbol('id');

console.log(sym1 === sym2);  // false, symbols are always unique

const obj = {
  [sym1]: 'value1',
  [sym2]: 'value2',
};

console.log(obj[sym1]);  // "value1"
console.log(obj[sym2]);  // "value2"
```

Use cases:

- To create unique property keys that won't conflict with other property names.
- To add properties to objects without affecting iterations (like `for...in`) since symbol-keyed properties are not enumerated.

If you want, I can show you how Symbols work with object properties or how to use the global symbol registry (`Symbol.for`). Would you like that?

provide some examples on use cases

Absolutely! Here are some practical use cases of **Symbols** in JavaScript:

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1. Unique Object Property Keys

You want to add properties to an object without risking name collisions with other properties.

```js
const id = Symbol('id');

const user = {
  name: 'Alice',
  [id]: 12345
};

console.log(user.name);    // Alice
console.log(user[id]);     // 12345

// The Symbol key won't show up in normal enumeration:
for (let key in user) {
  console.log(key);       // only logs 'name', not the Symbol key
}
```

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2. Private or Internal Object Properties

Symbols can be used to simulate private properties since they won’t be accessible accidentally.

```js
 const _balance = Symbol('balance');

class BankAccount {
  constructor() {
    this[_balance] = 1000;  // private balance property
  }

  deposit(amount) {
    this[_balance] += amount;
  }

  getBalance() {
    return this[_balance];
  }
}

const account = new BankAccount();
account.deposit(500);

console.log(account.getBalance()); // 1500
console.log(account._balance);     // undefined, no direct access
```

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3. Avoiding Property Name Clashes in Libraries

If you’re building a library and want to add properties to user objects without clashing with existing keys, symbols are great.

```js
```

```
const libProp = Symbol('libProperty');

function addLibraryData(obj) {
  obj[libProp] = 'library specific data';
}

const user = { name: 'Bob' };
addLibraryData(user);

console.log(user[libProp]); // 'library specific data'
```

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4. Using Built-in Symbol Methods (like Symbol.iterator)

Symbols are used to implement protocols, such as iteration:

```js
const myIterable = {
  [Symbol.iterator]: function* () {
    yield 1;
    yield 2;
    yield 3;
  }
};

for (const value of myIterable) {
  console.log(value); // 1, 2, 3
}
```

---

5. Global Symbol Registry (`Symbol.for`)

Symbols created with `Symbol.for` are shared across your entire runtime. Useful for global identifiers.

```js
const globalSym1 = Symbol.for('app.uniqueKey');
const globalSym2 = Symbol.for('app.uniqueKey');
```

```
console.log(globalSym1 === globalSym2); // true, same symbol from registry
```

Want me to explain any of these more or give examples of other built-in symbols?

provide more examples

Sure! Here are **more examples** showing different ways Symbols can be used effectively in JavaScript:

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6. Customizing Object Behavior with Symbol Methods

JavaScript has built-in symbols that let you customize built-in behaviors, like type conversion.

```js
const obj = {
  [Symbol.toPrimitive](hint) {
    if (hint === 'string') {
      return 'Custom string';
    }
    if (hint === 'number') {
      return 42;
    }
    return null;
  }
};

console.log(String(obj));   // "Custom string"
console.log(+obj);          // 42
console.log(obj + '');      // "null"
```

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7. Symbol.hasInstance for Custom instanceof Behavior

You can control how `instanceof` works using `Symbol.hasInstance`.

```js
class EvenNumber {
  static [Symbol.hasInstance](instance) {
    return typeof instance === 'number' && instance % 2 === 0;
  }
}

console.log(2 instanceof EvenNumber);  // true
console.log(3 instanceof EvenNumber);  // false
```

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8. Symbol.species to Control Derived Object Construction

When subclassing built-in classes like `Array`, you can control what constructor is used for methods that return new instances.

```js
class MyArray extends Array {
  static get [Symbol.species]() {
    return Array;
  }
}

const arr = new MyArray(1, 2, 3);
const mapped = arr.map(x => x * 2);

console.log(mapped instanceof MyArray); // false, because species returns Array
console.log(mapped instanceof Array);  // true
```

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9. Symbols for Metadata or Configuration

Attach metadata to an object without affecting normal keys or serialization.

```js
const meta = Symbol('meta');

const user = {
  name: 'Charlie',
  [meta]: { createdAt: Date.now() }
};

console.log(user[meta]); // { createdAt: 1694956800000 }
console.log(JSON.stringify(user)); // {"name":"Charlie"}, symbol key is skipped
```

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10. Symbols in Enums or Constants

You can use symbols for enum-like constants to ensure unique values.

```js
const STATUS = {
  SUCCESS: Symbol('SUCCESS'),
  FAILURE: Symbol('FAILURE'),
  PENDING: Symbol('PENDING')
};

function checkStatus(status) {
  switch(status) {
    case STATUS.SUCCESS:
      console.log('Operation succeeded');
      break;
    case STATUS.FAILURE:
      console.log('Operation failed');
      break;
    case STATUS.PENDING:
      console.log('Operation pending');
      break;
  }
}

checkStatus(STATUS.SUCCESS);  // Operation succeeded
```

If you'd like, I can dig into any of these or show you examples with Symbol-related API methods. Just let me know!

Yes, show me examples with Symbol-related API methods.

Great! Here are some examples demonstrating **Symbol-related API methods** in JavaScript:

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1. `Symbol.for(key)` and `Symbol.keyFor(symbol)`

- `Symbol.for(key)` — Returns a symbol from the global symbol registry associated with the given key, or creates it if it doesn't exist.
- `Symbol.keyFor(symbol)` — Returns the key associated with a symbol in the global symbol registry.

```js
const sym1 = Symbol.for('app.id');
const sym2 = Symbol.for('app.id');

console.log(sym1 === sym2); // true, same symbol from registry

const key = Symbol.keyFor(sym1);
console.log(key); // 'app.id'

// Symbols not in global registry return undefined
const localSym = Symbol('local');
console.log(Symbol.keyFor(localSym)); // undefined
```

---

2. `Object.getOwnPropertySymbols(obj)`

Returns an array of all symbol properties found directly on the given object.

```js
const sym1 = Symbol('a');
const sym2 = Symbol('b');

const obj = {
  [sym1]: 'value1',
  [sym2]: 'value2',
  normalKey: 'value3'
};

const symbols = Object.getOwnPropertySymbols(obj);
console.log(symbols); // [ Symbol(a), Symbol(b) ]

symbols.forEach(sym => {
  console.log(sym, obj[sym]);
});
// Symbol(a) value1
// Symbol(b) value2
```

---

3. `Reflect.ownKeys(obj)`

Returns all property keys (both strings and symbols) of an object.

```js
 const sym1 = Symbol('foo');
const obj = {
  [sym1]: 'bar',
  baz: 42
};

console.log(Reflect.ownKeys(obj)); // ['baz', Symbol(foo)]
```

---

4. `Symbol.hasInstance` (Using it as a method key)

Customizes `instanceof` behavior.

```js
 const evenChecker = {
  [Symbol.hasInstance](value) {
    return typeof value === 'number' && value % 2 === 0;
  }
};

console.log(2 instanceof evenChecker);  // true
console.log(3 instanceof evenChecker);  // false
```

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5. `Symbol.toStringTag`

Allows customization of the default string description of an object used by `Object.prototype.toString`.

```js
const obj = {
  [Symbol.toStringTag]: 'CustomObject'
};

console.log(Object.prototype.toString.call(obj)); // "[object CustomObject]"
```

---

6. `Symbol.iterator`

Defines the default iterator for an object (used in `for...of` loops).

```js
const iterable = {
  data: [10, 20, 30],
  [Symbol.iterator]() {
    let index = 0;
    const data = this.data;
    return {
      next() {
        if (index < data.length) {
          return { value: data[index++], done: false };
        } else {
          return { done: true };
        }
      }
    };
  }
};

for (const value of iterable) {
  console.log(value); // 10, then 20, then 30
}
```

If you'd like, I can go deeper into any of these methods or provide more advanced examples — just say the word!