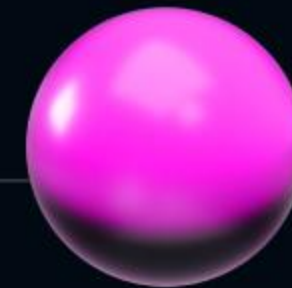


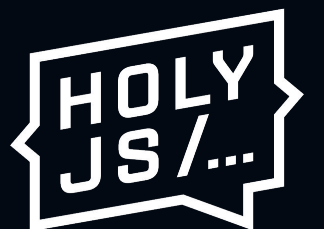
Types in Prototypes



**Viktor
Vershanskiy**

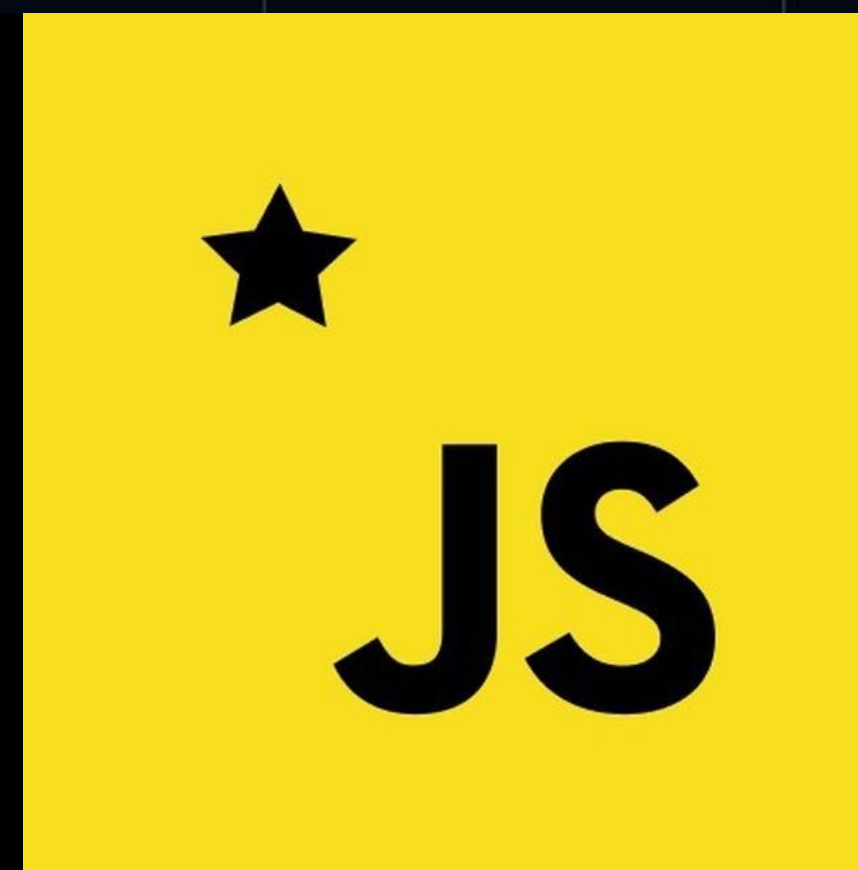
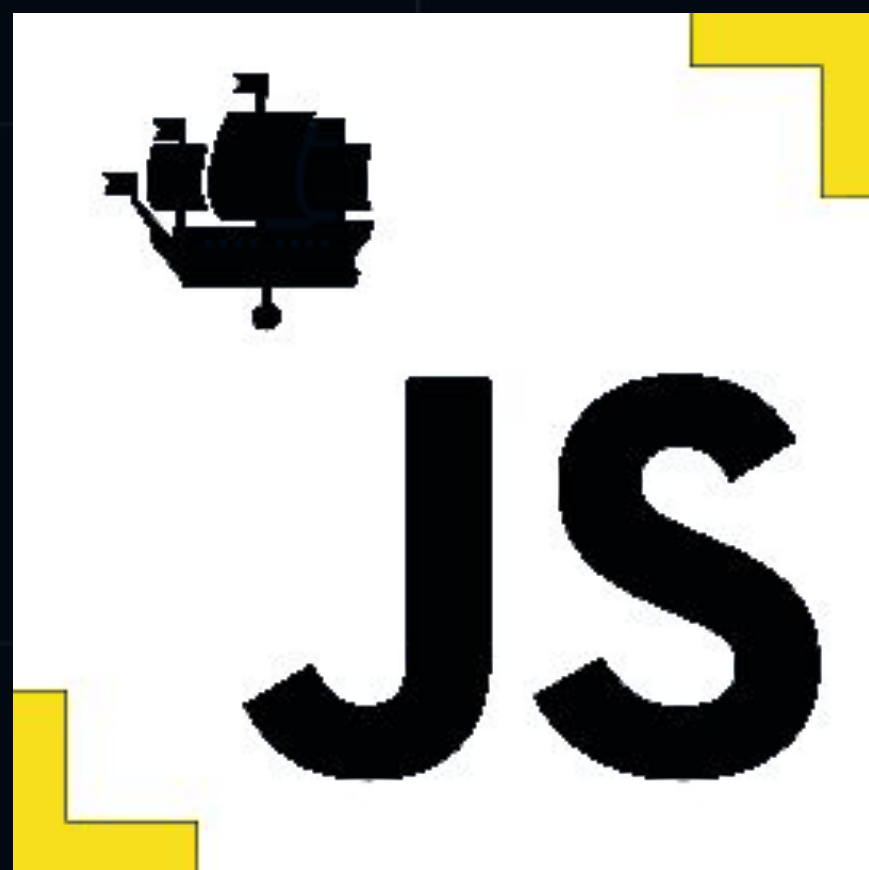


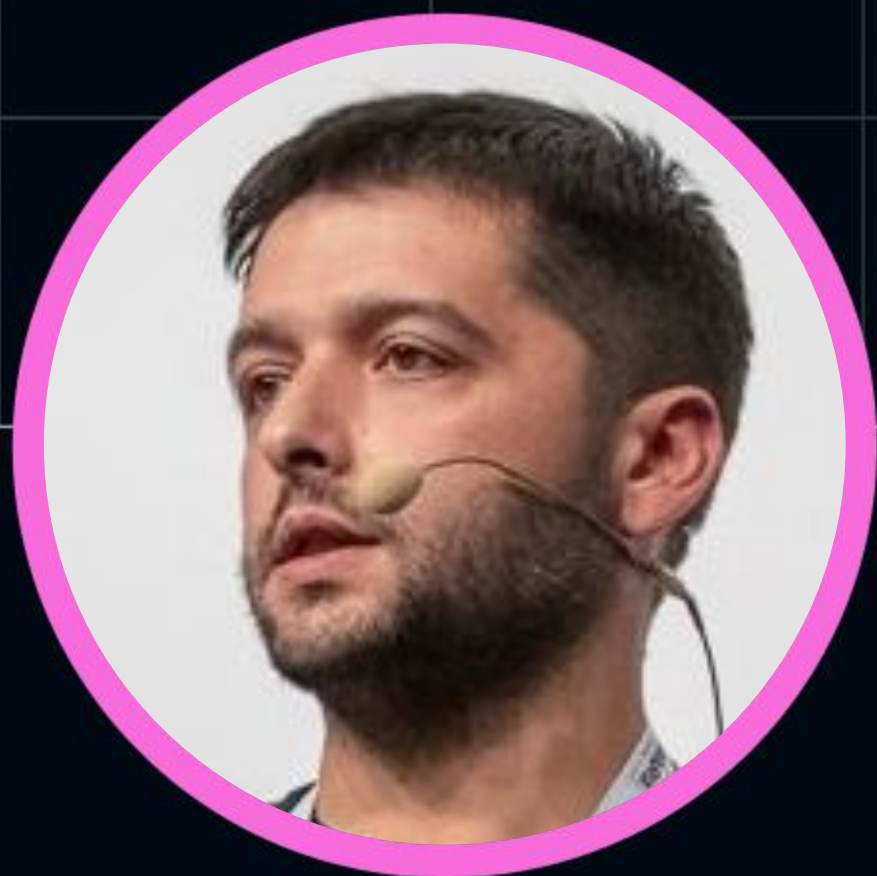
wentout











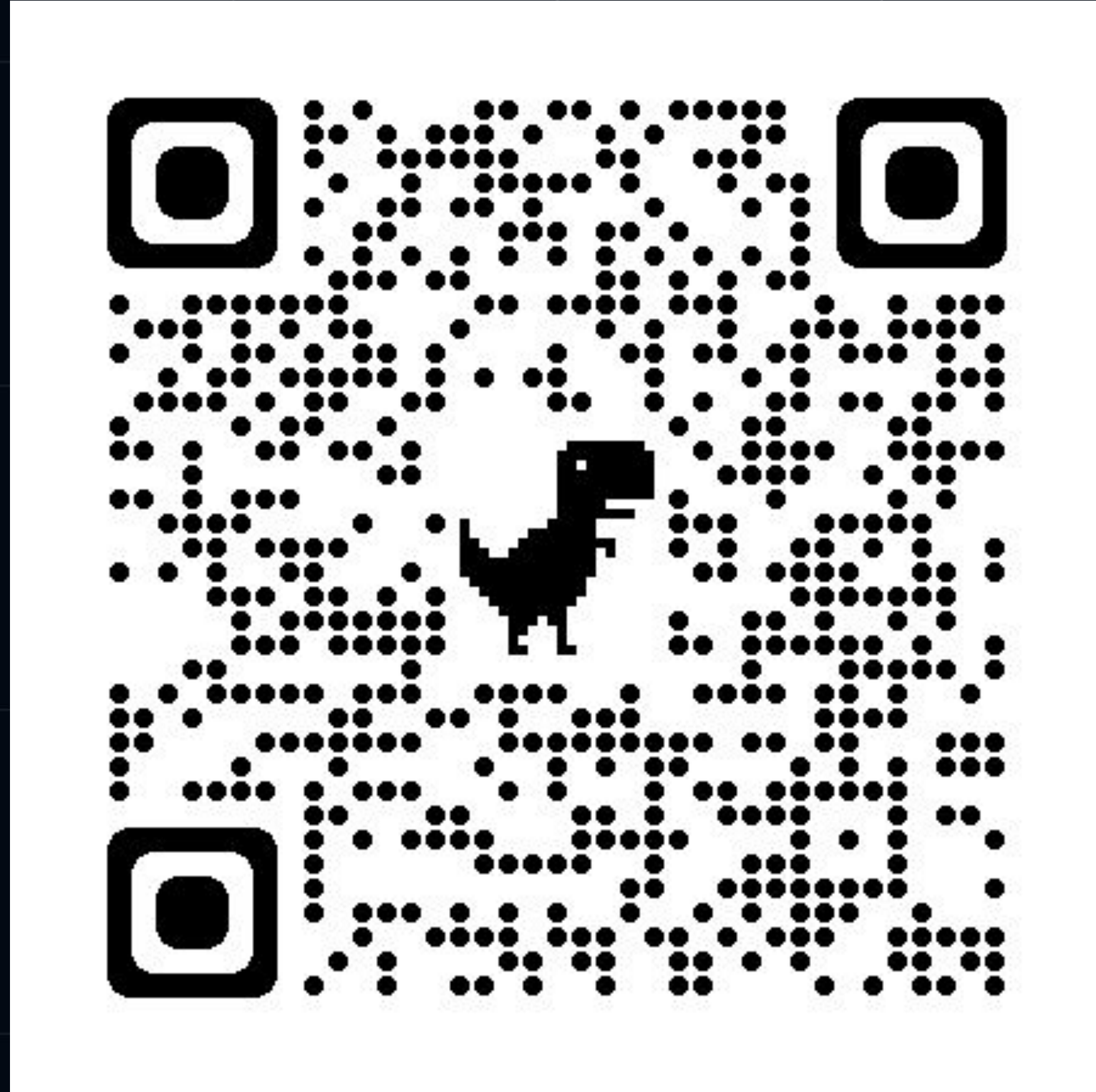
Виктор



wentout

Bio

- JS production at 1999
- Back-End на JS в 2000
- Node.js с 2009
- Diagnostics Group
- BUGs Chrome & v8
- PMI PMBoK + Agile
- PhD in Economy of IT



Outline of the talk

- Known TypeScript of HolyJS talks last 3 yrs
- Previous talks of this Moonshine Spiritual Journey
- Class Based vs Functional Based Constructors
- Time Matters the Difference
- Real three types of Inheritance in JS ~ TS
- Optional Fields Definitions
- Identity as a Single Pattern of Chaining

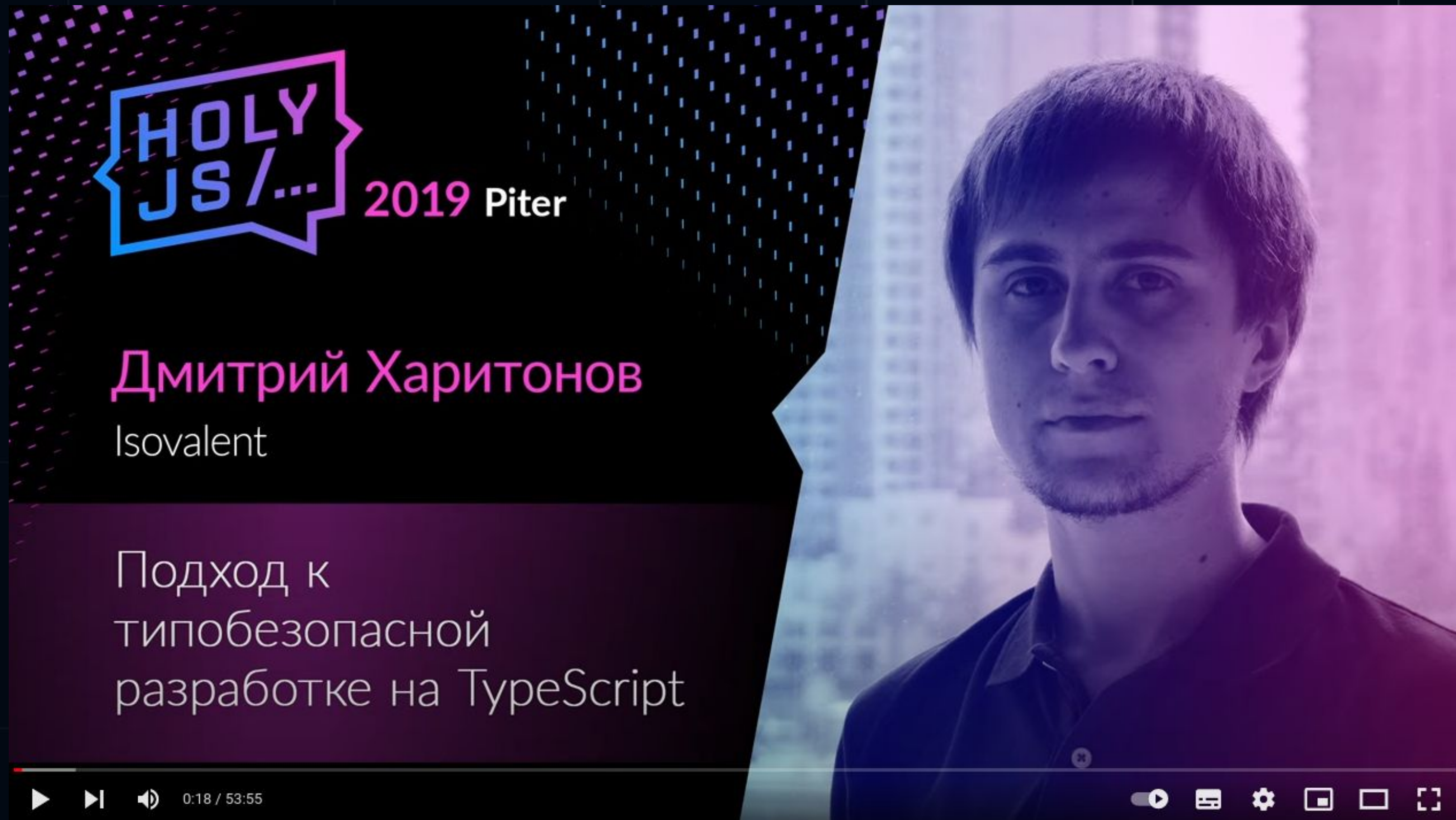




TypeScript on HolyJS



Known TypeScript on HolyJS



Known TypeScript on HolyJS



Рефлексия
в TypeScript



Александр Богачёв
Arrival Ltd

Known TypeScript on HolyJS



Advanced types in TypeScript

Спикеры



Алексей Березин
Joyn GmbH

Приглашенные эксперты



Максим Сысоев
Яндекс

Known TypeScript on HolyJS

Не баг, а фича: разбираем
компромиссы в дизайне языка
TypeScript



Андрей
Старовойт

HolyJS
2022 Spring

Known TypeScript on HolyJS



Дмитрий Пацура
LOWL

Разработка компилятора для
TypeScript на TypeScript на базе LLVM





Moonshine Spiritual



Moonshine Spiritual talks



JS

PiterJS #54



NodeJS SPb

Онлайн митап
10 декабря 19:00 - 20:30

Pro .prototype'ы

Moonshine Spiritual talks



MoscowJS

СОБЫТИЯ

ВИДЕО

ДОКЛАДЧИКИ

ПОДАТЬ ДОКЛАД



Виктор
Вершанский,
DataArt

MoscowJS 50, 11/09/2021

Магия прототипного наследования

- Вы продаёте Прототипы?
- Нет, просто показываю.
- Красивое...

О хтоничности наследования в JS ходят легенды. Обычно объясняют тем, что, мол, можно изменить тип. О том, что можно унаследовать любой объект, вспоминают реже. Но главное остаётся за кадром: это можно делать когда угодно, и потом переделывать. А ведь в этом-то и есть суть динамической типизации: пояснить про магию.

[Слайды](#) [Запись](#)

Moonshine Spiritual talks



Chronotope: await
Eloquent.Errors

Приглашенные эксперты



Дмитрий Махнёв
JetBrains

Спикеры



Виктор Вершанский

Moonshine Spiritual talks



RT

Time Script

incremental computation



Moonshine Spiritual talks



Strict Types in JavaScript

Moonshine Spiritual talks



Multiple inheritance in JavaScript



Class Based

vs

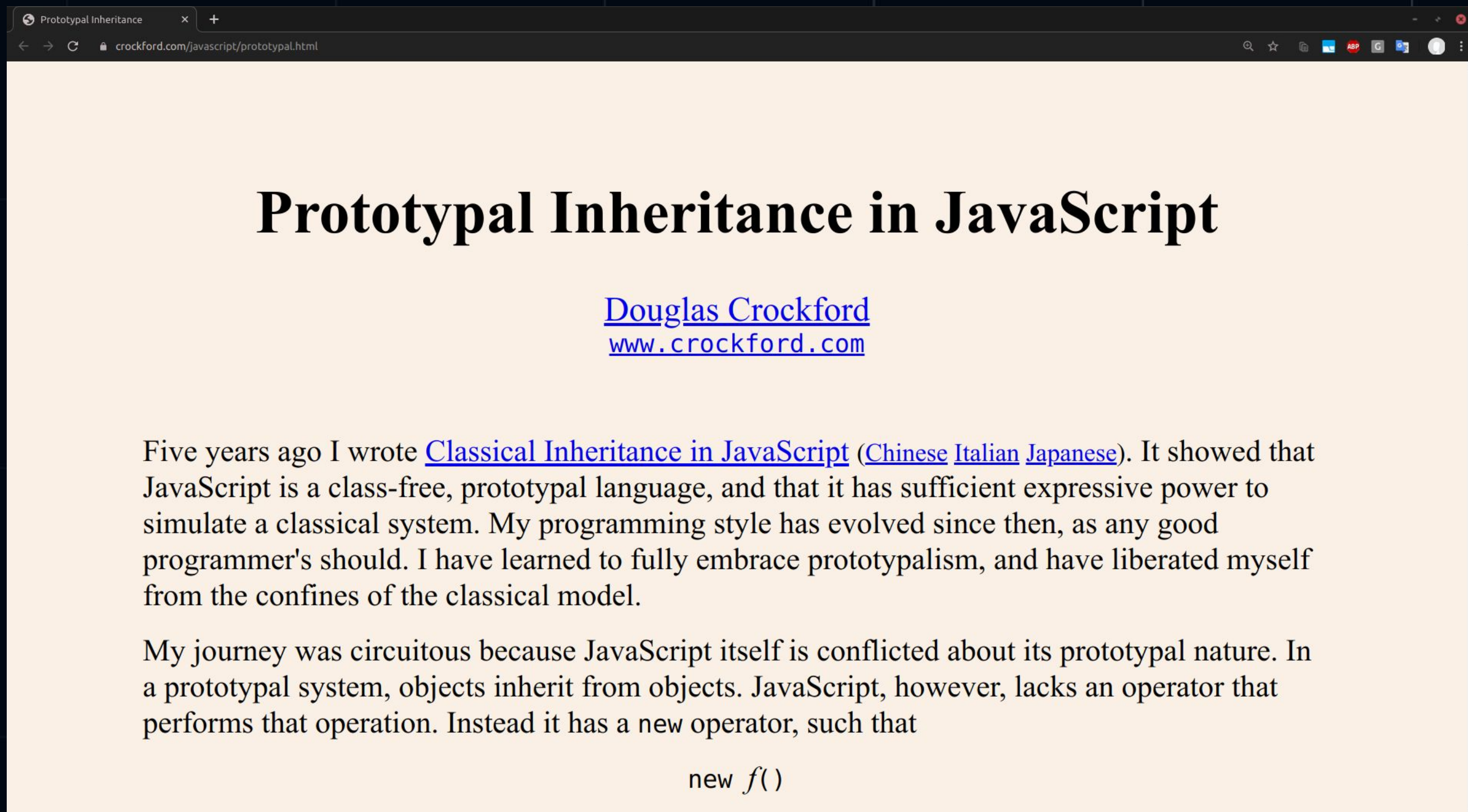
Functional Based



Class vs Function



Class vs Function



Prototypal Inheritance in JavaScript


[Douglas Crockford](#)
www.crockford.com

Five years ago I wrote [Classical Inheritance in JavaScript](#) ([Chinese](#) [Italian](#) [Japanese](#)). It showed that JavaScript is a class-free, prototypal language, and that it has sufficient expressive power to simulate a classical system. My programming style has evolved since then, as any good programmer's should. I have learned to fully embrace prototypalism, and have liberated myself from the confines of the classical model.

My journey was circuitous because JavaScript itself is conflicted about its prototypal nature. In a prototypal system, objects inherit from objects. JavaScript, however, lacks an operator that performs that operation. Instead it has a new operator, such that

`new f()`


Class vs Function




Technologies ▼

References & Guides ▼

Feedback ▼

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Inheritance and the prototype chain

Edit in wiki

Web technology for developers > JavaScript > Inheritance and the prototype chain

English ▼

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▶ Intermediate

▼ Advanced

Inheritance and the prototype chain

Strict mode

JavaScript typed arrays

Memory Management

Concurrency model and Event Loop

References:

▶ Built-in objects

▶ Expressions & operators

JavaScript is a bit confusing for developers experienced in class-based languages (like Java or C++), as it is dynamic and does not provide a `class` implementation per se (the `class` keyword is introduced in ES2015, but is syntactical sugar, JavaScript remains prototype-based).

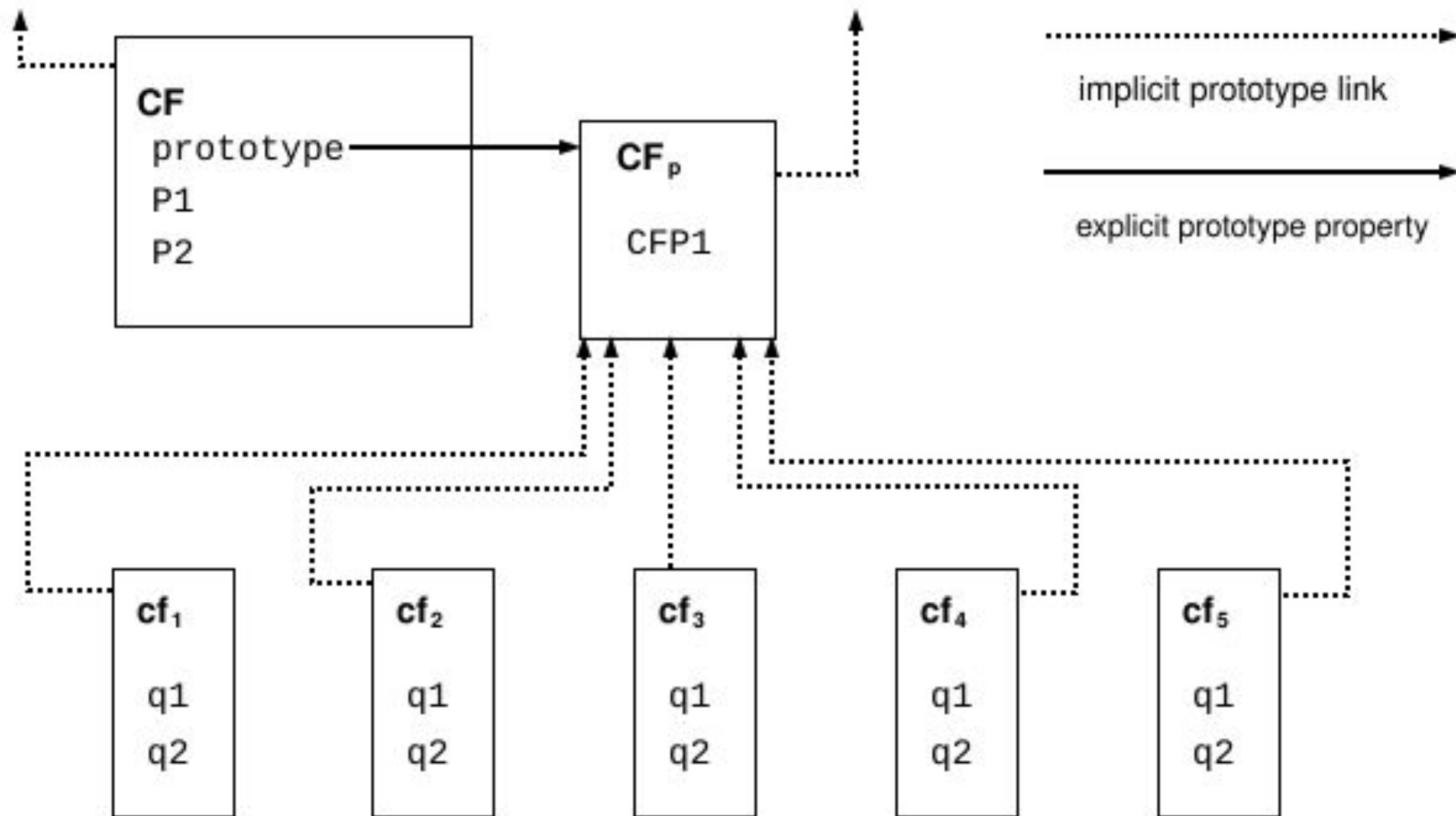
When it comes to inheritance, JavaScript only has one construct: objects. Each object has a private property which holds a link to another object called its **prototype**. That prototype object has a prototype of its own, and so on until an object is reached with `null` as its prototype. By definition, `null` has no prototype, and acts as the final link in this **prototype chain**.

Nearly all objects in JavaScript are instances of `Object` which sits on the top of a prototype chain.

While this confusion is often considered to be one of JavaScript's weaknesses, the prototypal inheritance model itself is, in fact, more powerful than the classic model. It is, for example, fairly trivial to build a classic model on top of a prototypal model.



Inheritance with the prototype chain

Class vs Function



Class vs Function



**BrendanEich** 
@BrendanEich




Replying to [@went_out](#) [@Andre_487](#) and [@jsunderhood](#)


Right, {null, undefined} form an equivalence class for ==.

8:53 AM · May 5, 2020 · [Twitter Web App](#)

2 Retweets

4 Likes



**went.out** [@went_out](#) · May 5

Replying to [@BrendanEich](#) [@Andre_487](#) and [@jsunderhood](#)

It is absolutely Outstanding point!



Class vs Function



BrendanEich ✓

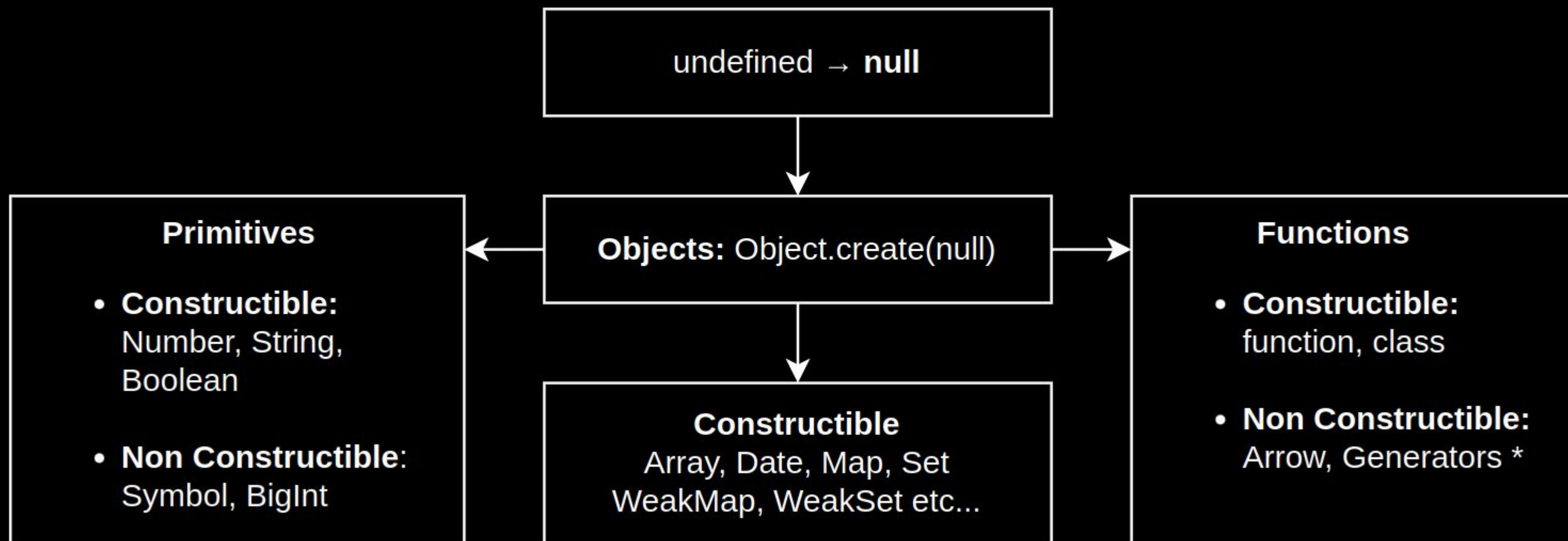
@BrendanEich

Replying to [@BrendanEich](#) [@rauschma](#) and [@IndieScripter](#)

If I didn't have "Make it look like Java" as an order from management, *and* I had more time (hard to unconfound these two causal factors), then I would have preferred a Self-like "everything's an object" approach: no Boolean, Number, String wrappers. No undefined and null. Sigh.

Class vs Function

JavaScript Objects Topology



Class vs Function



Class vs Function

TS class.ts ×



talks > 2023-05-HolyJS > examples > TS class.ts > ...

1

2

3

```
class TheClass {};
```



Class vs Function

TS class.ts



talks > 2023-05-HolyJS > examples > TS class.ts > ...

1

2

3

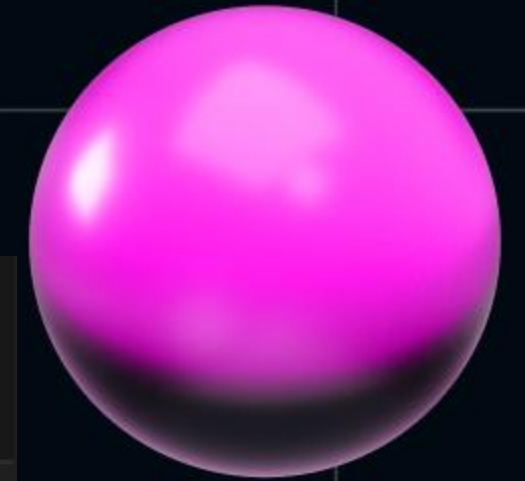
```
class TheClass {
```

4

```
  constructor() {}
```

5

```
};
```



Class vs Function

TS class.ts



talks > 2023-05-HolyJS > examples > TS class.ts > ExtendedClass

```
1
2
3  class · BaseClass · {
4    |→   constructor · ( ) · {}
5  };
6  class · ExtendedClass · extends · BaseClass · {
7  |};
```

Class vs Function

TS class.ts

TS class_extends.ts

JS function.js X



...

talks > 2023-05-HolyJS > examples > JS function.js > ...

```
1  
2  
3 function Construct() {}  
4  
5 const item = new Construct;  
6  
7 console.log(item);
```



Class vs Function

TS class.ts

TS class_extends.ts

JS function.js ●



...

talks > 2023-05-HolyJS > examples > JS function.js > ...

```
1  function Construct() {};  
2  
3  Construct.prototype = { field: 123 };  
4  Construct.prototype.constructor  
5  →    = Construct;  
6  
7  const item = new Construct;  
8  
9  console.log(item);  
10 |
```





time matters

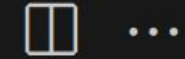


the difference



Time Matters

TS class_extends_new.ts ×



talks > 2023-05-HolyJS > examples > TS class_extends_new.ts > BaseClass > constructor

```
1  class BaseClass {
2    → field: number
3    → constructor() {
4    →   → this.field = 321;
5    → }
6  };
7  class ExtendedClass extends BaseClass {
8    → constructor() {
9    →   → super();
10   →   → this.field = 123;
11   → }
12 };
13
14 const item = new ExtendedClass;
15 console.log(item);
16
```

class_extends_new.ts
123; field = 123;
321; field = 321;
123; field = 123;
321; field = 321;
123; field = 123;
321; field = 321;
123; field = 123;
321; field = 321;

Time Matters

TS function_construct_extended.ts ×

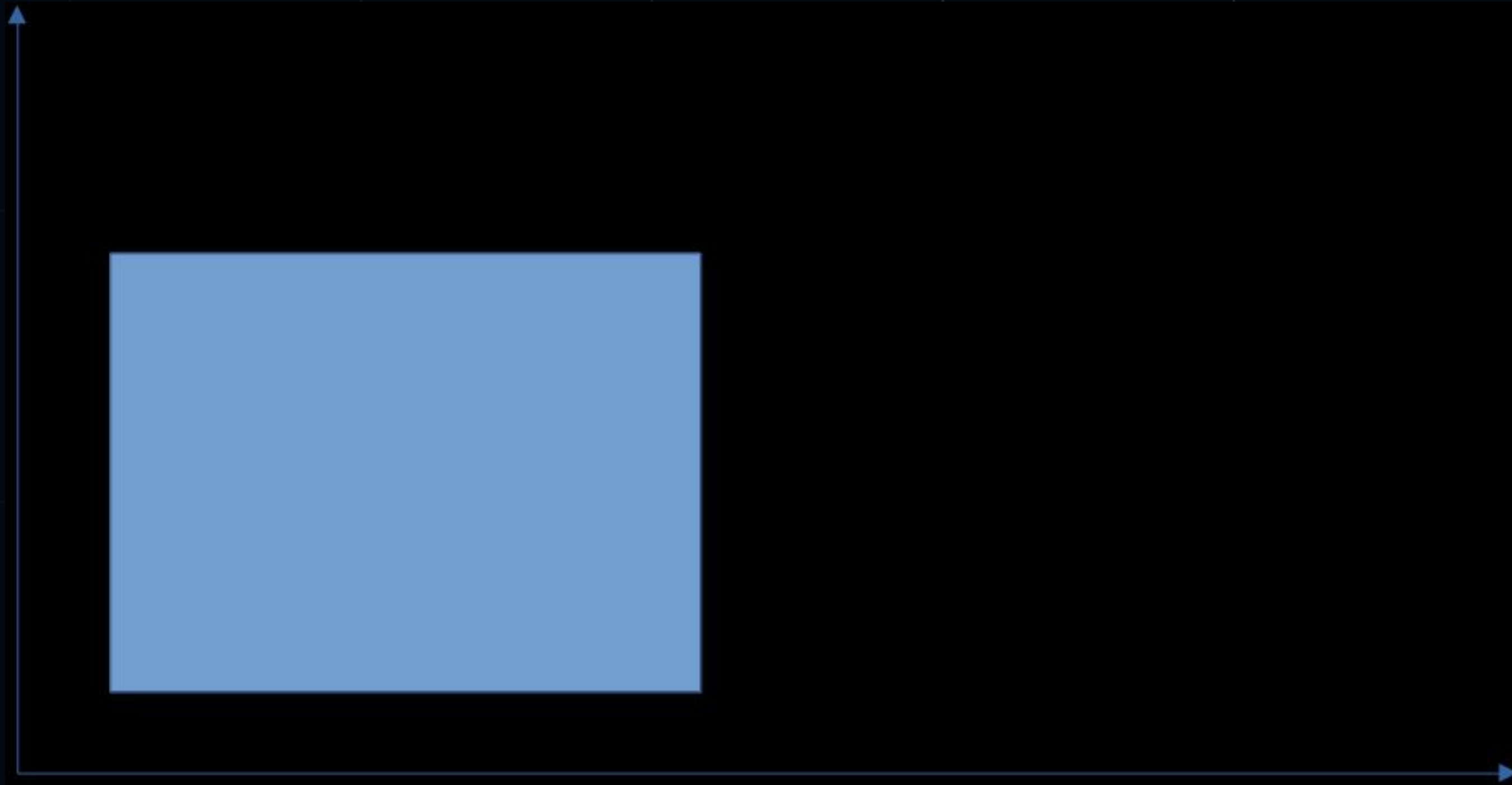


talks > 2023-05-HolyJS > examples > TS function_construct_extended.ts > ...

```
1  function Construct() {};  
2  Construct.prototype = { field: 123 };  
3  Construct.prototype.constructor = Construct;  
4  const item = new Construct;  
5  console.log(item);  
6  
7  function ExtendedConstruct() {};  
8  Object.setPrototypeOf(Construct.prototype, item);  
9  Construct.prototype.field = 321;  
10 const extendedItem = new ExtendedConstruct;  
11  
12 console.log(extendedItem);
```



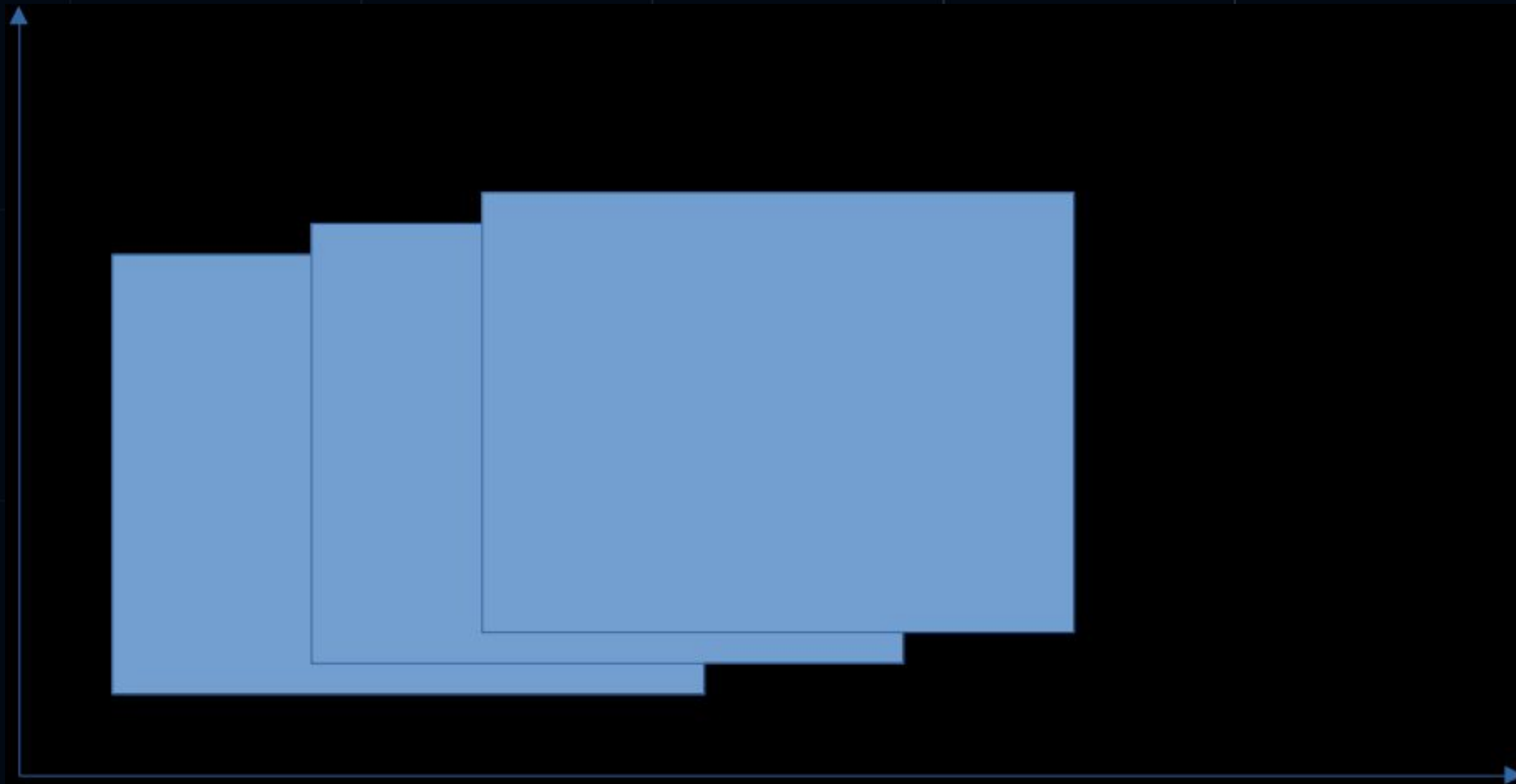
Time Matters



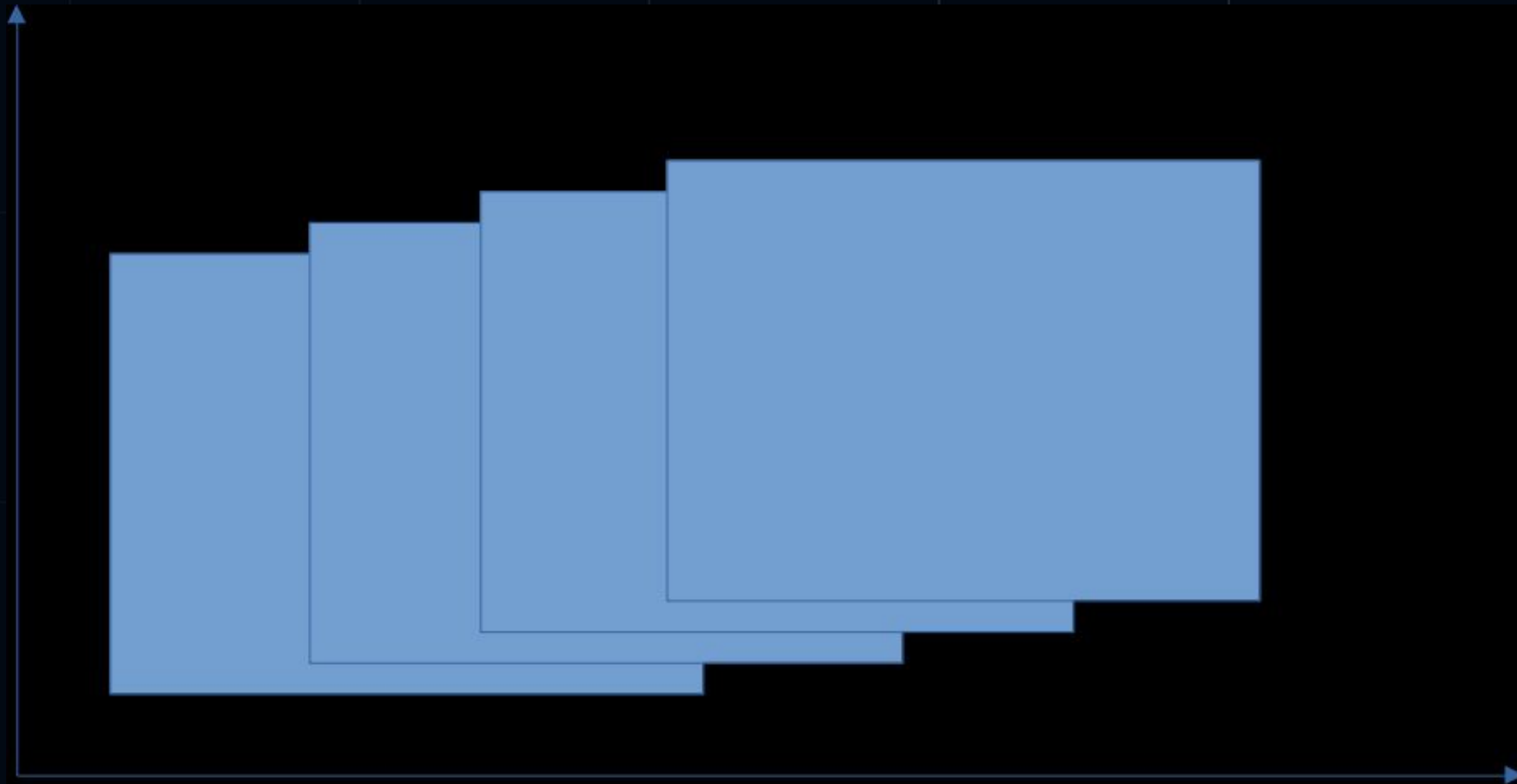
Time Matters



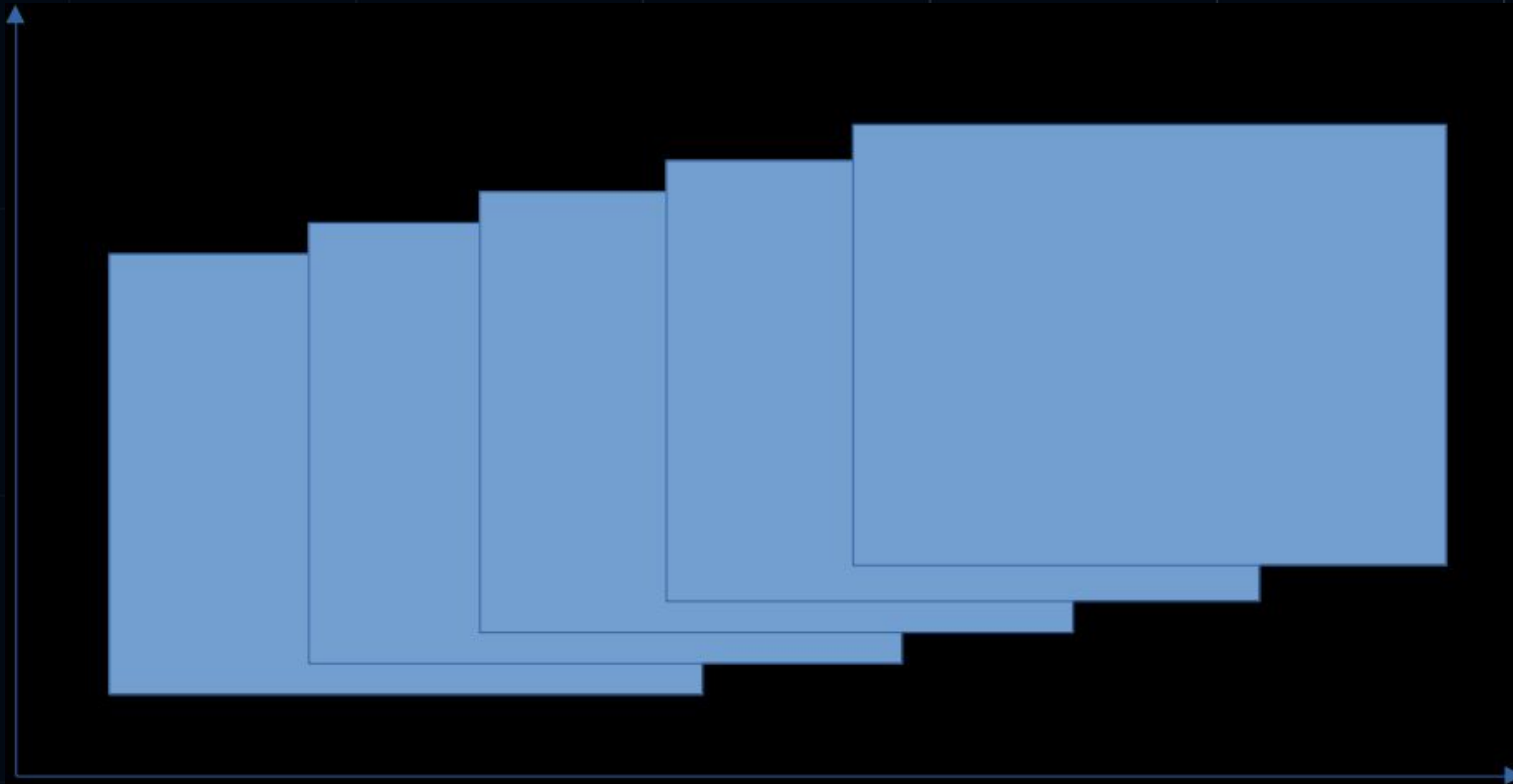
Time Matters



Time Matters



Time Matters



Time Matters

TS function_construct_extended.ts ×

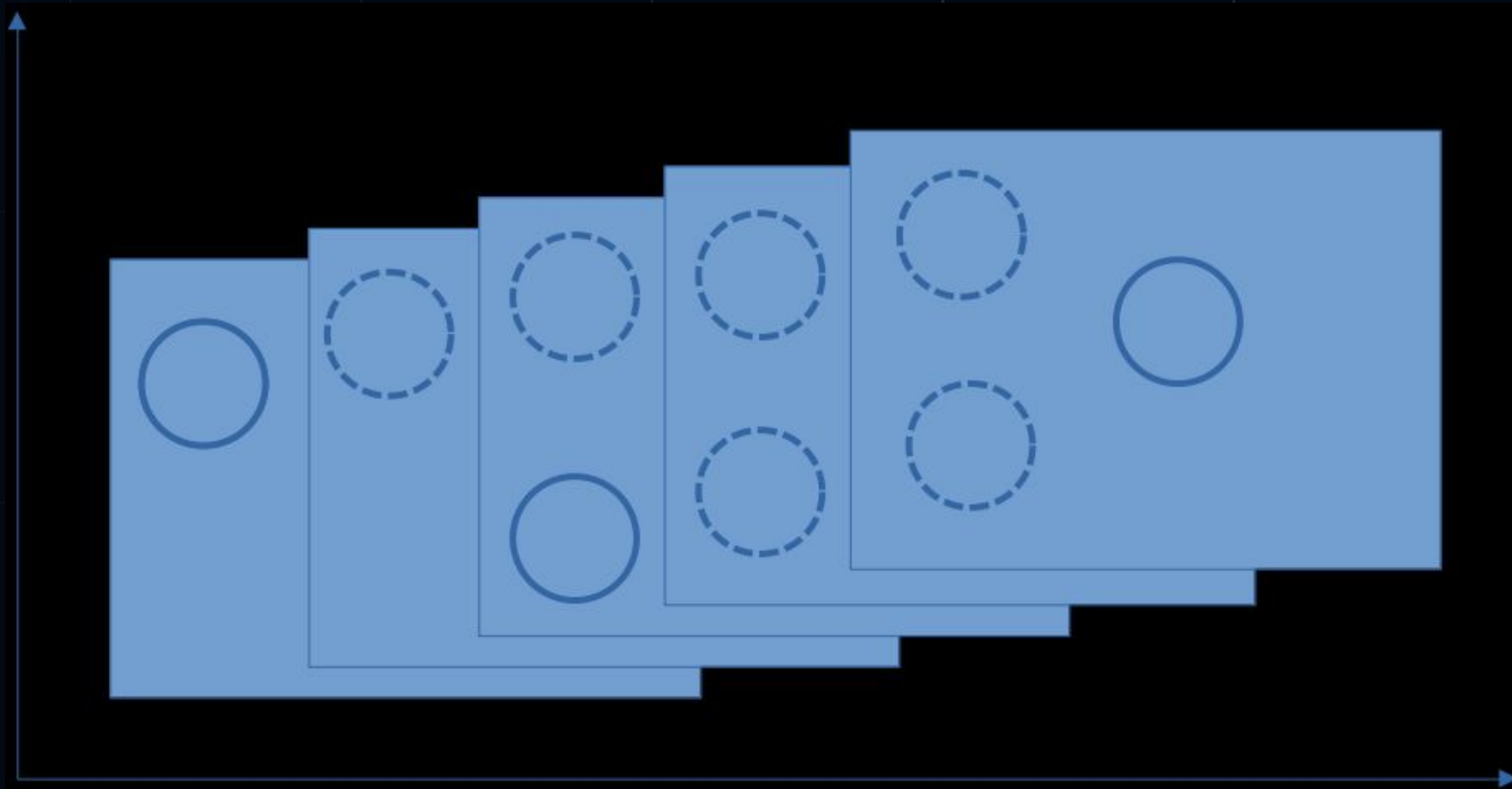


talks > 2023-05-HolyJS > examples > TS function_construct_extended.ts > ...

```
1  function Construct() {};  
2  Construct.prototype = { field: 123 };  
3  Construct.prototype.constructor = Construct;  
4  const item = new Construct;  
5  console.log(item);  
6  
7  function ExtendedConstruct() {};  
8  Object.setPrototypeOf(Construct.prototype, item);  
9  Construct.prototype.field = 321;  
10 const extendedItem = new ExtendedConstruct;  
11  
12 console.log(extendedItem);
```



Time Matters



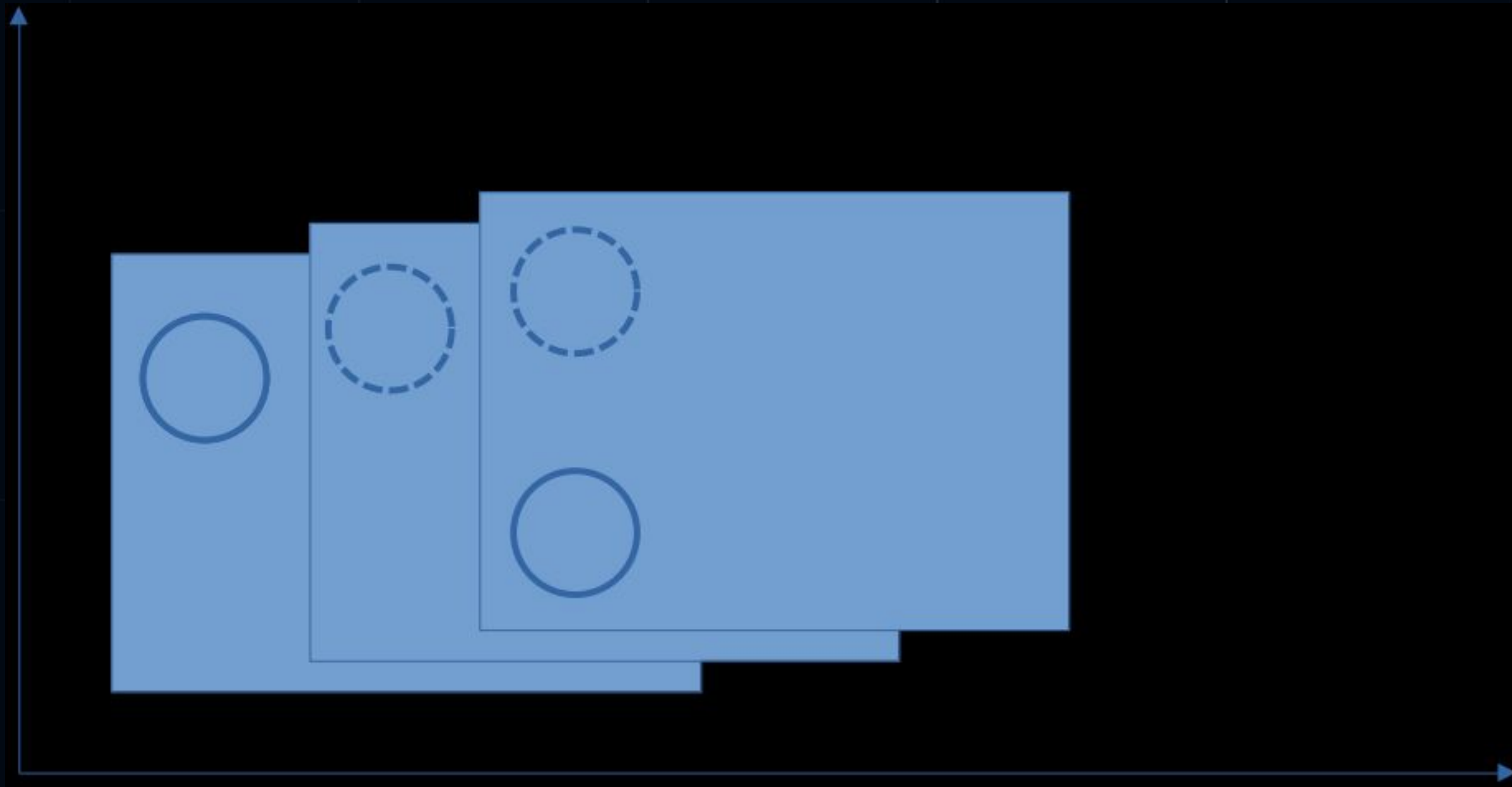
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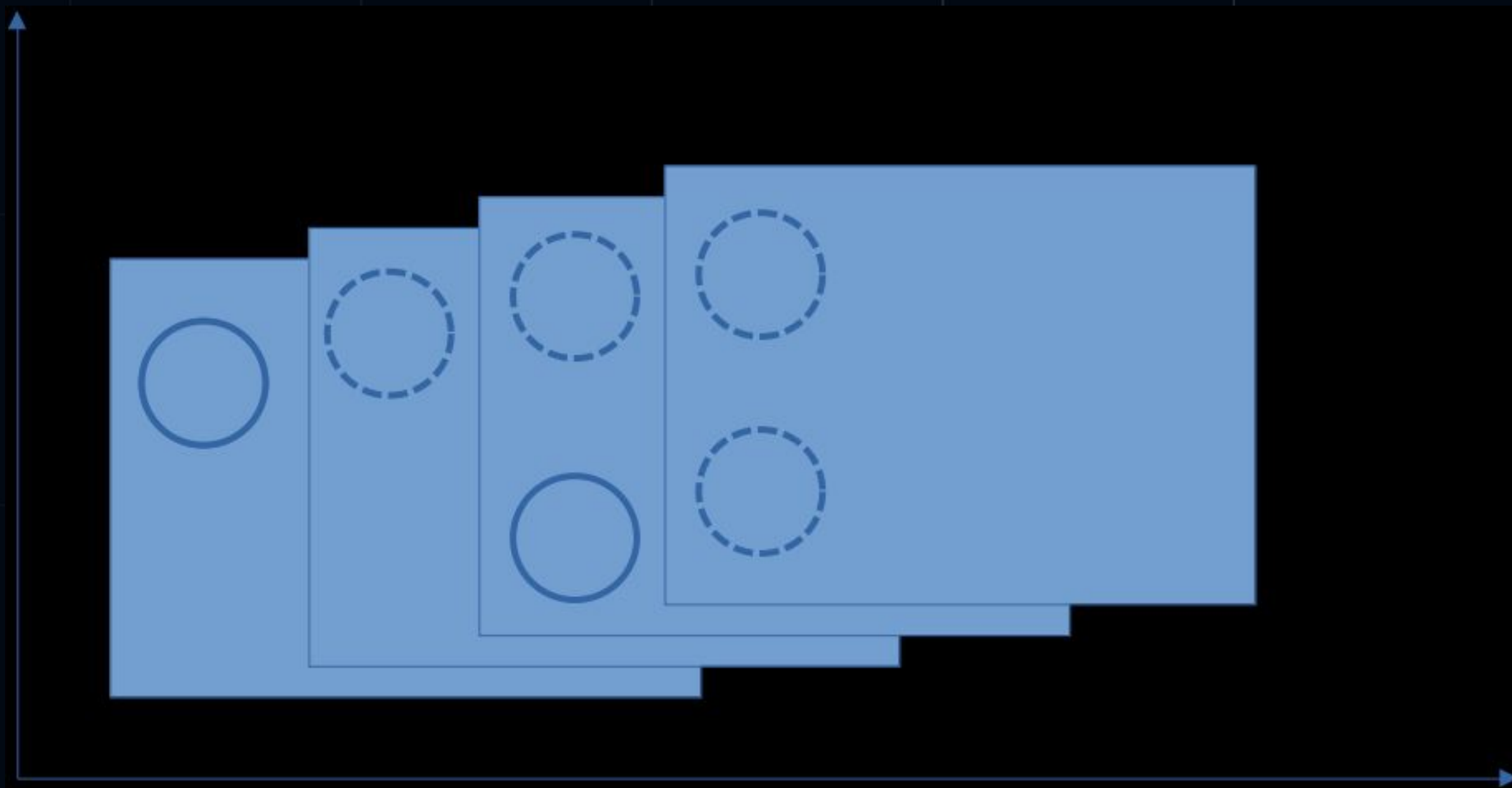
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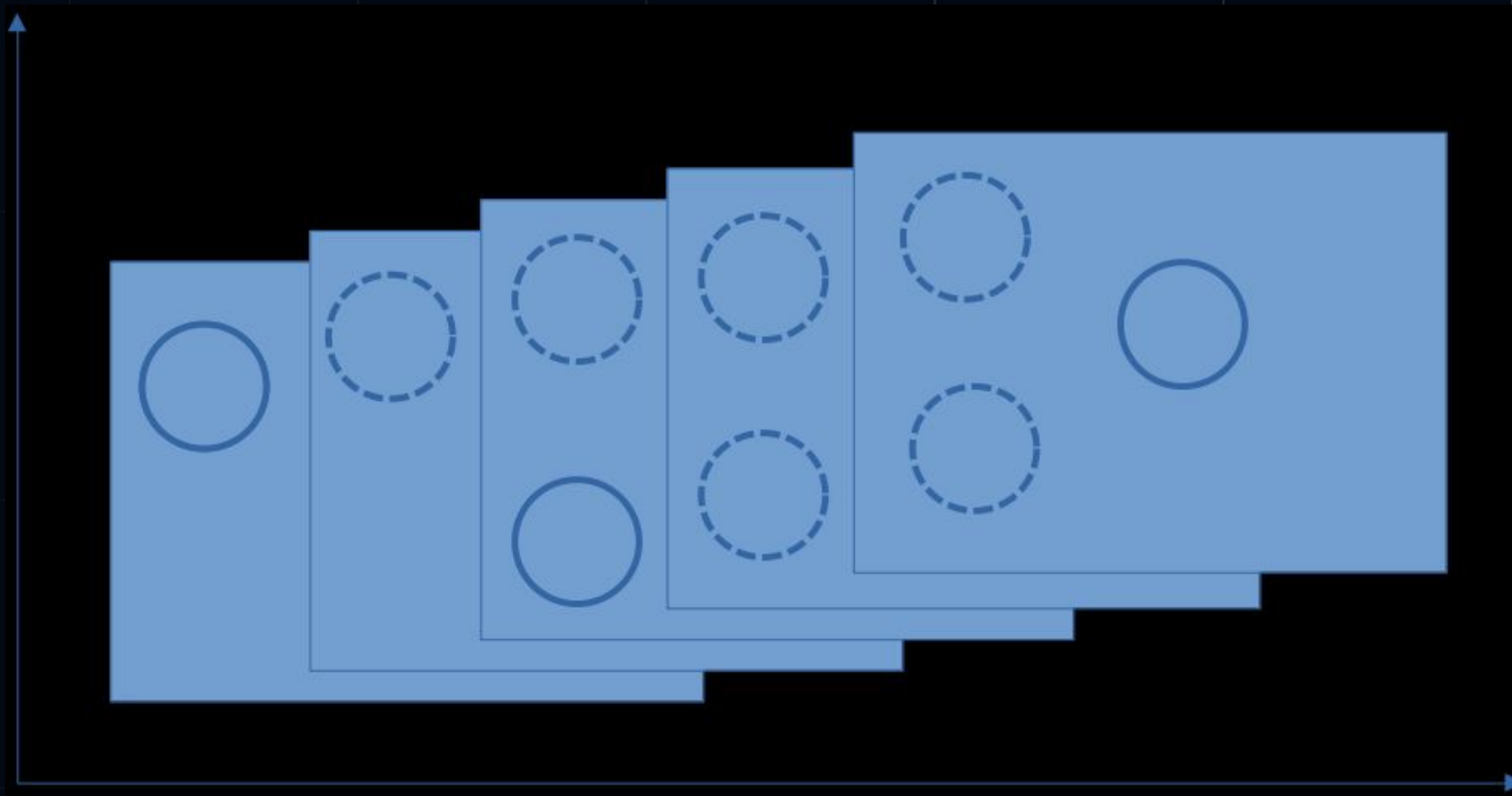
Time Matters



Time Matters



Time Matters



Class vs Function

TS class_extends_new.ts ✕



talks > 2023-05-HolyJS > examples > TS class_extends_new.ts > BaseClass > constructor

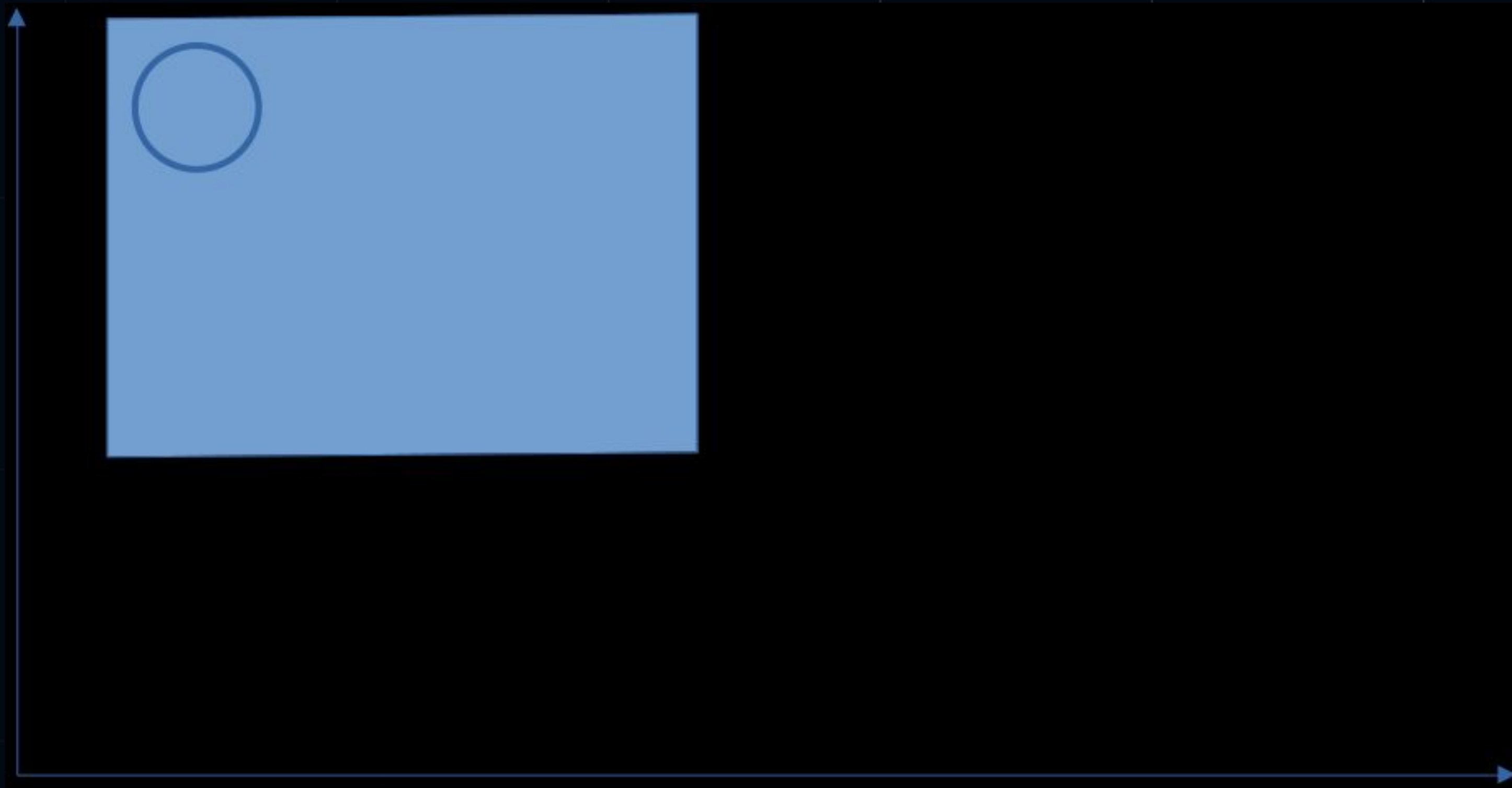
```
1  class BaseClass {
2    → field: number
3    → constructor() {
4    →   → this.field = 321;
5    → }
6  };
7  class ExtendedClass extends BaseClass {
8    → constructor() {
9    →   → super();
10   →   → this.field = 123;
11   → }
12 };
13
14 const item = new ExtendedClass;
15 console.log(item);
16
```

```
class BaseClass {
  field: number;
  constructor() {
    this.field = 321;
  }
}

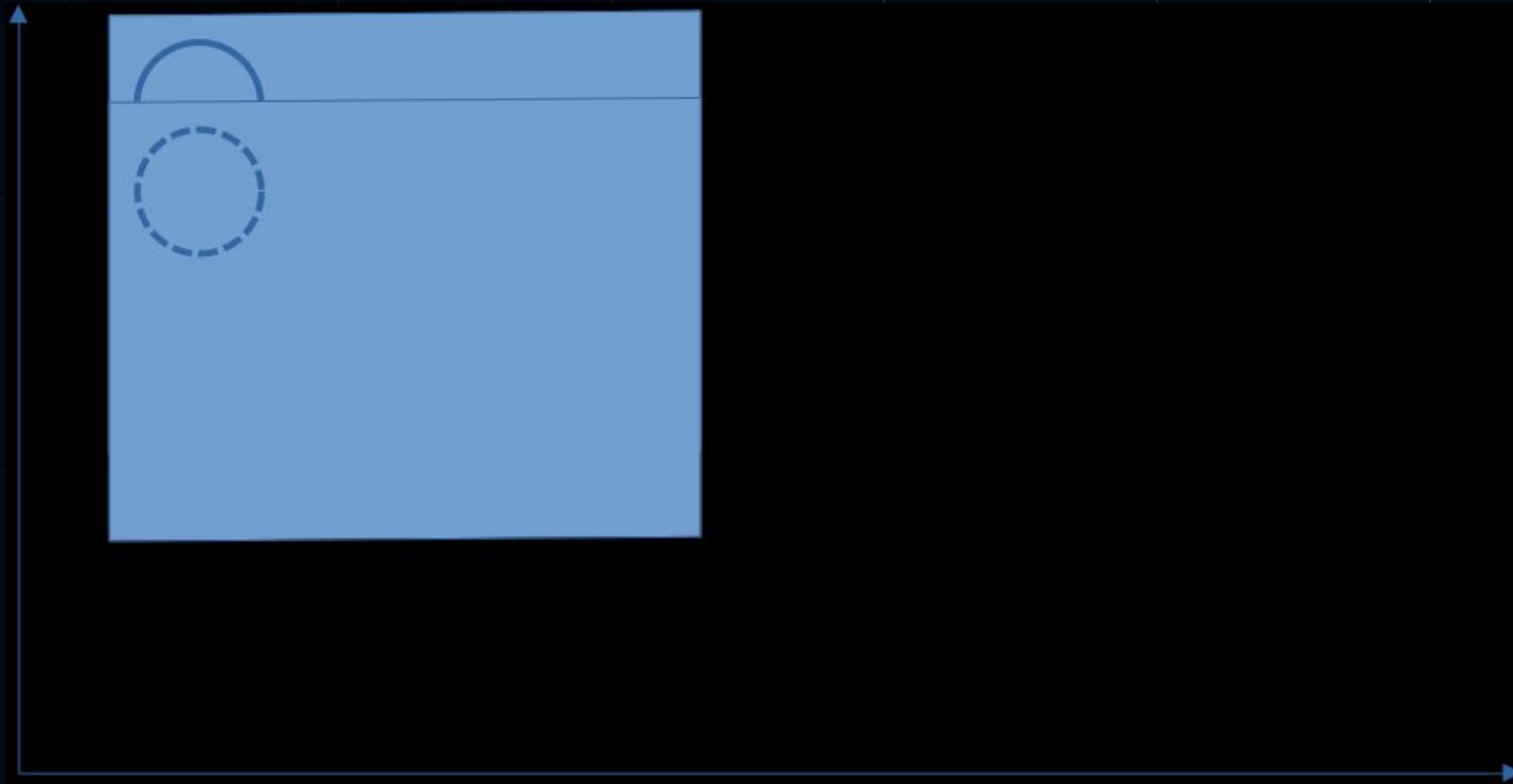
class ExtendedClass extends BaseClass {
  constructor() {
    super();
    this.field = 123;
  }
}

const item = new ExtendedClass;
console.log(item);
```

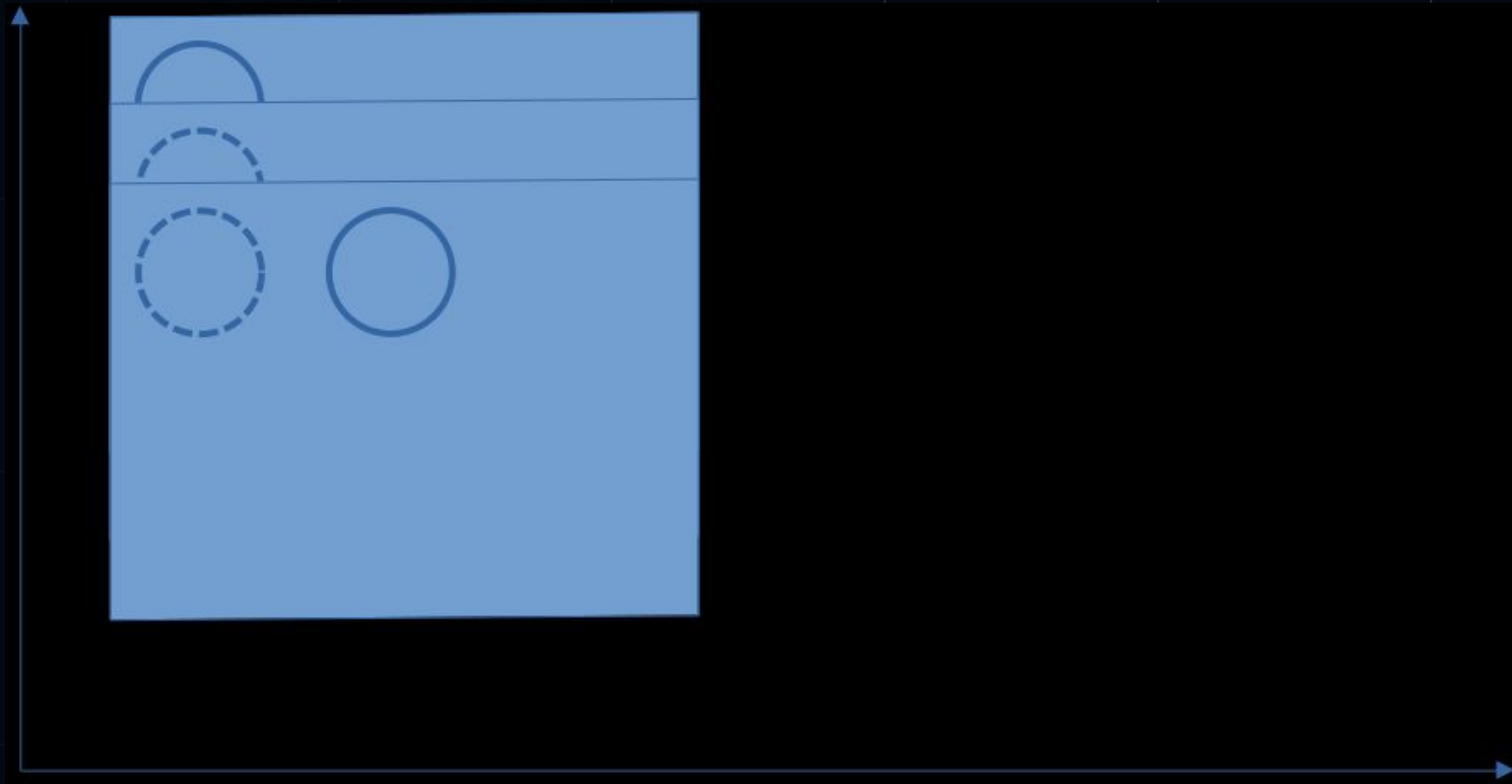

Time Matters



Time Matters



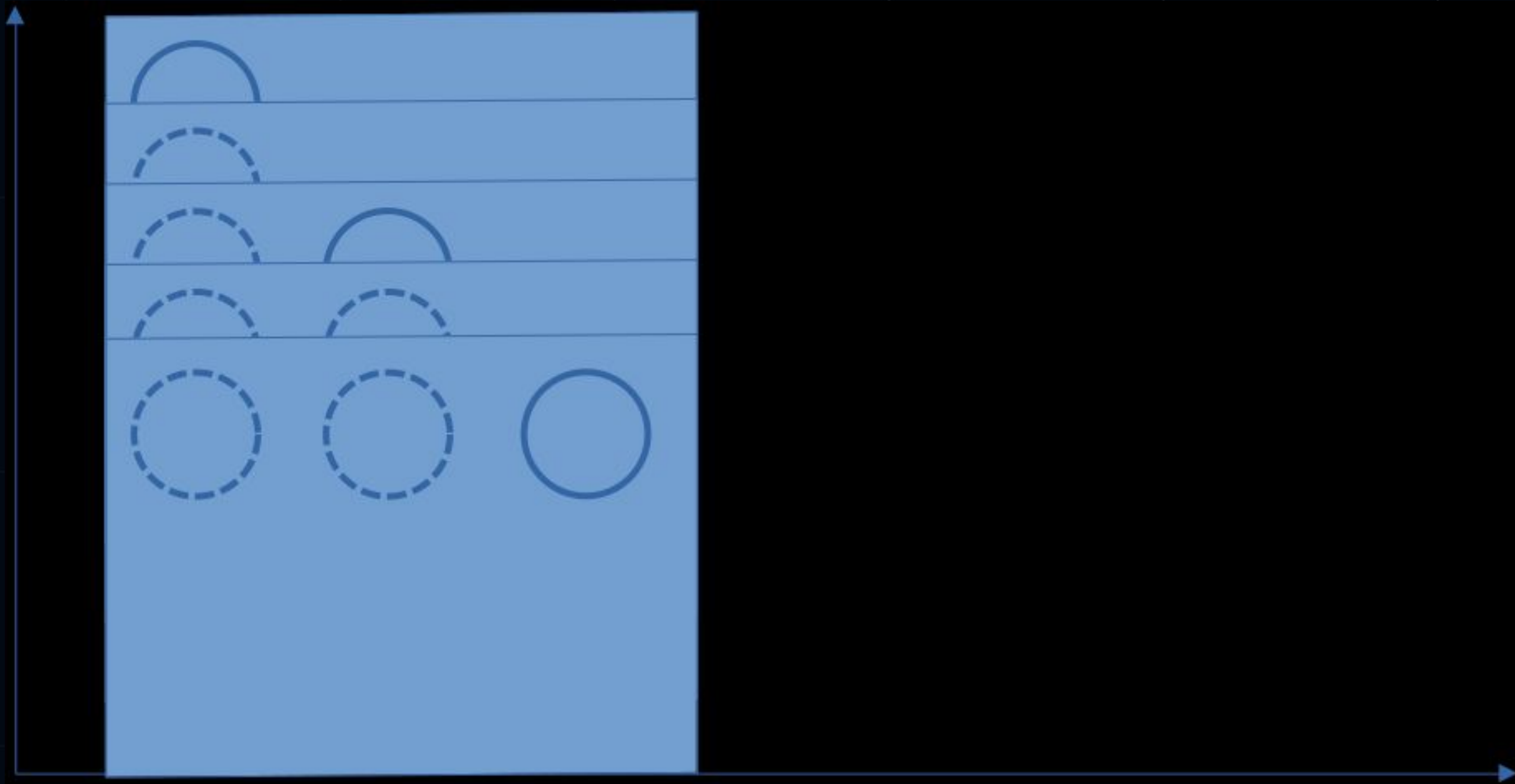
Time Matters



Time Matters



Time Matters



Time Matters

TS class_extends_new.ts ×



talks > 2023-05-HolyJS > examples > TS class_extends_new.ts > BaseClass > constructor

```
1  class BaseClass {
2    → field: number
3    → constructor() {
4    →   → this.field = 321;
5    → }
6  };
7  class ExtendedClass extends BaseClass {
8    → constructor() {
9    →   → super();
10   →   → this.field = 123;
11   → }
12 };
13
14 const item = new ExtendedClass;
15 console.log(item);
16
```

```
class BaseClass {
  field: number;
  constructor() {
    this.field = 321;
  }
}

class ExtendedClass extends BaseClass {
  constructor() {
    super();
    this.field = 123;
  }
}

const item = new ExtendedClass;
console.log(item);
```

Time Matters

TS class_extends_new.ts X



talks > 2023-05-HolyJS > examples > TS class_extends_new.ts > ...

13

14

15 `const item = new ExtendedClass;`

16 `console.log(item);`

17

18 `// number`

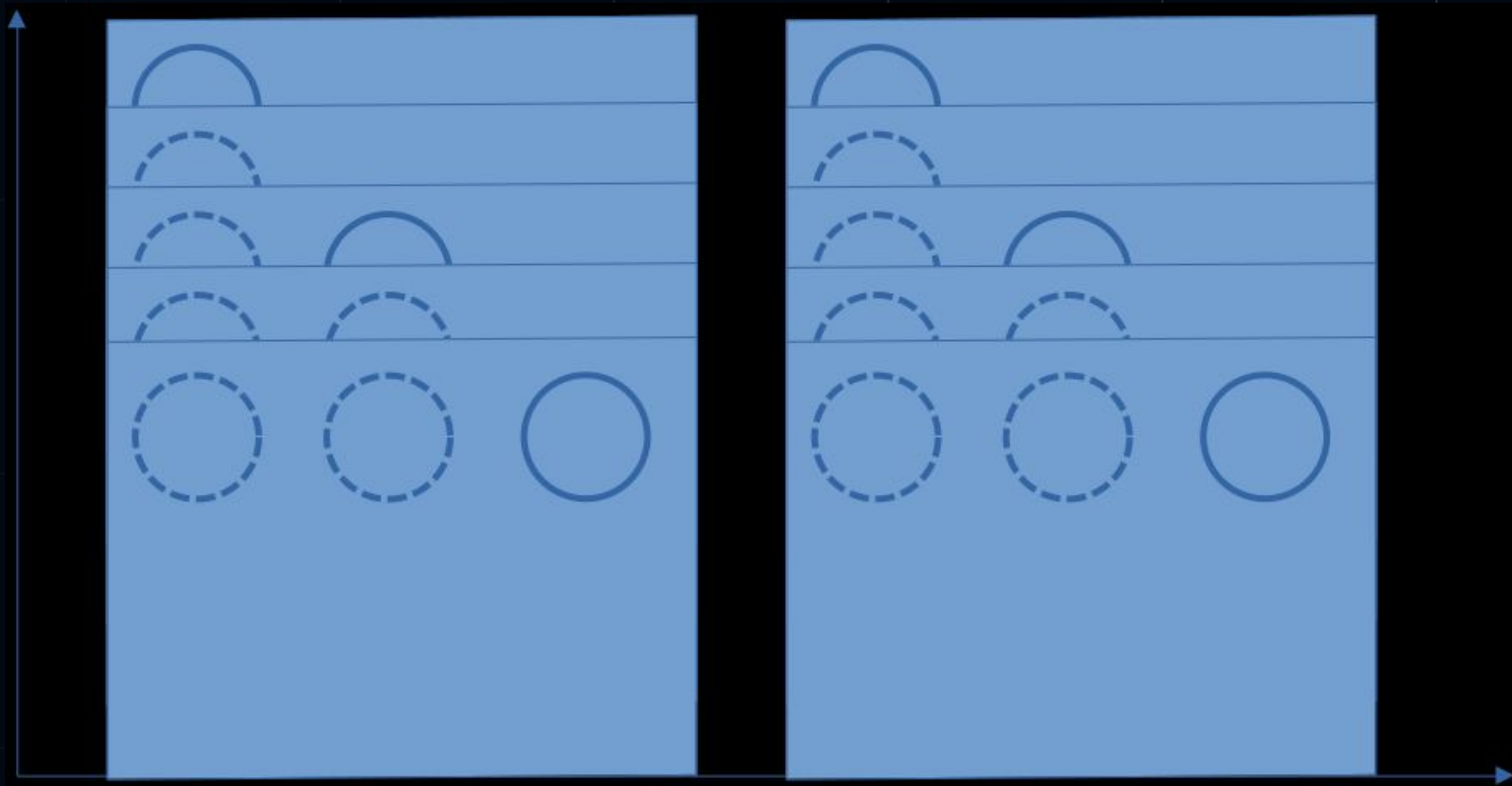
19 `type itemField = typeof item.field;`

20

21

class_extends_new.ts
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Time Matters





Time Matters

TS class_extends_new.ts X



talks > 2023-05-HolyJS > examples > TS class_extends_new.ts > ...

```
6   };
7   class ExtendedClass extends BaseClass {
8     constructor() {
9       super();
10      this.field = 123;
11    }
12  };
13
14      const item: ExtendedClass
15  const item = new ExtendedClass;
16  console.log(item);
17
18  // number
19  type itemField = typeof item.field;
20
21  |
```



Time Matters

TS function_construct_extended.ts ×



talks > 2023-05-HolyJS > examples > TS function_construct_extended.ts > ...

```
1  function Construct() {};  
2  Construct.prototype = { field: 123 };  
3  Construct.prototype.constructor = Construct;  
4  const item = new Construct;  
5  console.log(item);  
6  
7  function ExtendedConstruct() {};  
8  Object.setPrototypeOf(Construct.prototype, item);  
9  Construct.prototype.field = 321;  
10 const extendedItem = new ExtendedConstruct;  
11  
12 console.log(extendedItem);
```



Time Matters



TS function_construct_extended.ts ✕

11

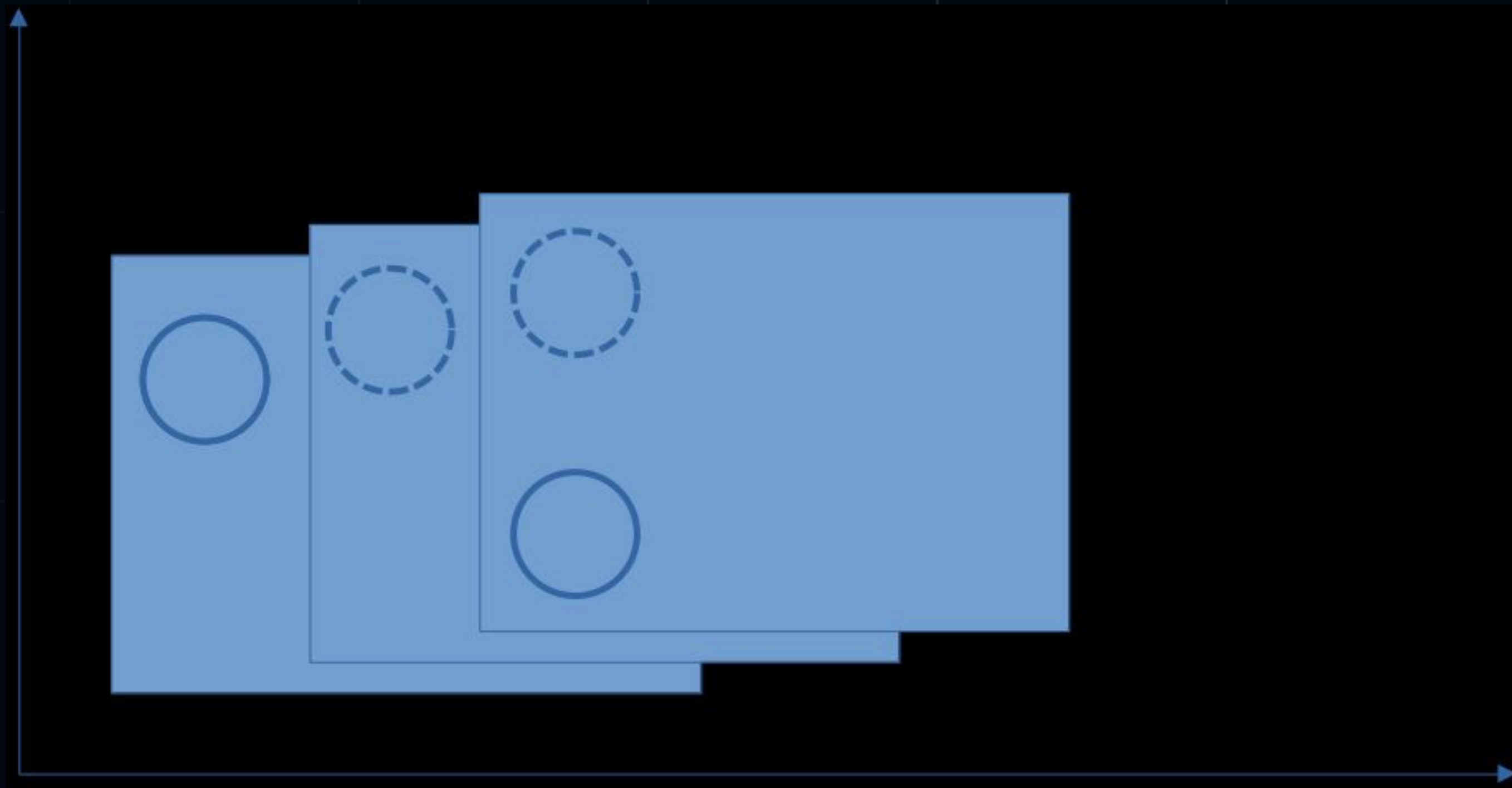
talks > 2023-05-HolyJS > examples > TS function_construct_extended.ts > ...

```

9
10 // any ...
11 Construct.prototype.field = 321;
12
13 |
14 const extendedItem = new ExtendedConstruct;
15 console.log(extendedItem);
16
17 // any ...
18 type extendedItemField = typeof extendedItem.field;

```

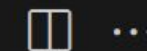
Time Matters





Time Matters

TS function_construct_extended_this_typed.ts ×



talks > 2023-05-HolyJS > examples > TS function_construct_extended_this_typed.ts > [🔗] extendedItemField

```
1 function Construct (this: {field: number}) {};  
2 Construct.prototype = { field: 123 }  
3 Construct.prototype.constructor = Construct;  
4 const item = new Construct;  
5 console.log(item);  
6  
7 function ExtendedConstruct (this: {field: number}) {};  
8 Object.setPrototypeOf(Construct.prototype, item);  
9  
10 // any ...  
11 Construct.prototype.field = 321;  
12  
13  
14 const extendedItem = new ExtendedConstruct;  
15 console.log(extendedItem);  
16  
17 // any ...  
18 type extendedItemField = typeof extendedItem.field;
```

function Construct (this: {field: number}) {}
Construct.prototype = { field: 123 }
Construct.prototype.constructor = Construct;
const item = new Construct;
console.log(item);

function ExtendedConstruct (this: {field: number}) {}
Object.setPrototypeOf(Construct.prototype, item);

// any ...
Construct.prototype.field = 321;

const extendedItem = new ExtendedConstruct;
console.log(extendedItem);

// any ...
type extendedItemField = typeof extendedItem.field;

Time Matters

TS function_construct_extended_this_typed.ts X



talks > 2023-05-HolyJS > examples > TS function_construct_extended_this_typed.ts > [🔗] extendedItemField

```
1 function Construct (this: {field: number}) {};  
2 Construct.prototype = { field: 123 }  
3 Construct.prototype.constructor = Construct;  
4 const item = new Construct;  
5 console.log(item);  
6  
7 function ExtendedConstruct (this: {field: number}) {};  
8 Object.setPrototypeOf(Construct.prototype, item);  
9  
10 // any ...  
11 Construct.prototype.field = 321;  
12  
13  
14 const extendedItem = new ExtendedConstruct;  
15 console.log(extendedItem);  
16  
17 // any ...  
18 type extendedItemField = typeof extendedItem.field;
```

any



types of Inheritance in JS~TS



types of Inheritance

TS RunningObjectProps.ts X



_ProtoTypes > TS RunningObjectProps.ts > ...

```
1  const remapKeys = (  
2    obj: Record<string, number>,  
3    remapMap: Record<string, string>  
4  ) => {  
5    for (const key in remapMap) {  
6      obj[remapMap[key]] = obj[key];  
7      delete obj[key];  
8    }  
9    return obj;  
10 };
```



types of Inheritance

TS RunningObjectProps.ts ●



_ProtoTypes > TS RunningObjectProps.ts > ...

```
15  const remapResult = remapKeys(  
16    { age: 1 },  
17    { age: "newAge" }  
18  );  
19  
20  remapResult.newAge // 1  
21  
22
```



types of Inheritance

TS RunningObjectProps.ts ●



_ProtoTypes > TS RunningObjectProps.ts > ...

19

20 remapResult.newAge // 1

21

22

23 remapResult.age // 1

24

25



types of Inheritance



TS RunningObjectProps.ts ×



talks > 2023-05-HolyJS > examples > TS RunningObjectProps.ts >

19

20 `remapResult.newAge // 1`

21

22

number

23

24 `remapResult.age // 1`

25

26



types of Inheritance

it is not the thing you think about ...

- Primitive to Primitive
- Primitive to Object
- Object to Primitive
- Object to Object



types of Inheritance

it is not the thing you think about ...

- Primitive to Primitive
- Primitive to Object
- Object to Primitive
- Object to Object

DEMO



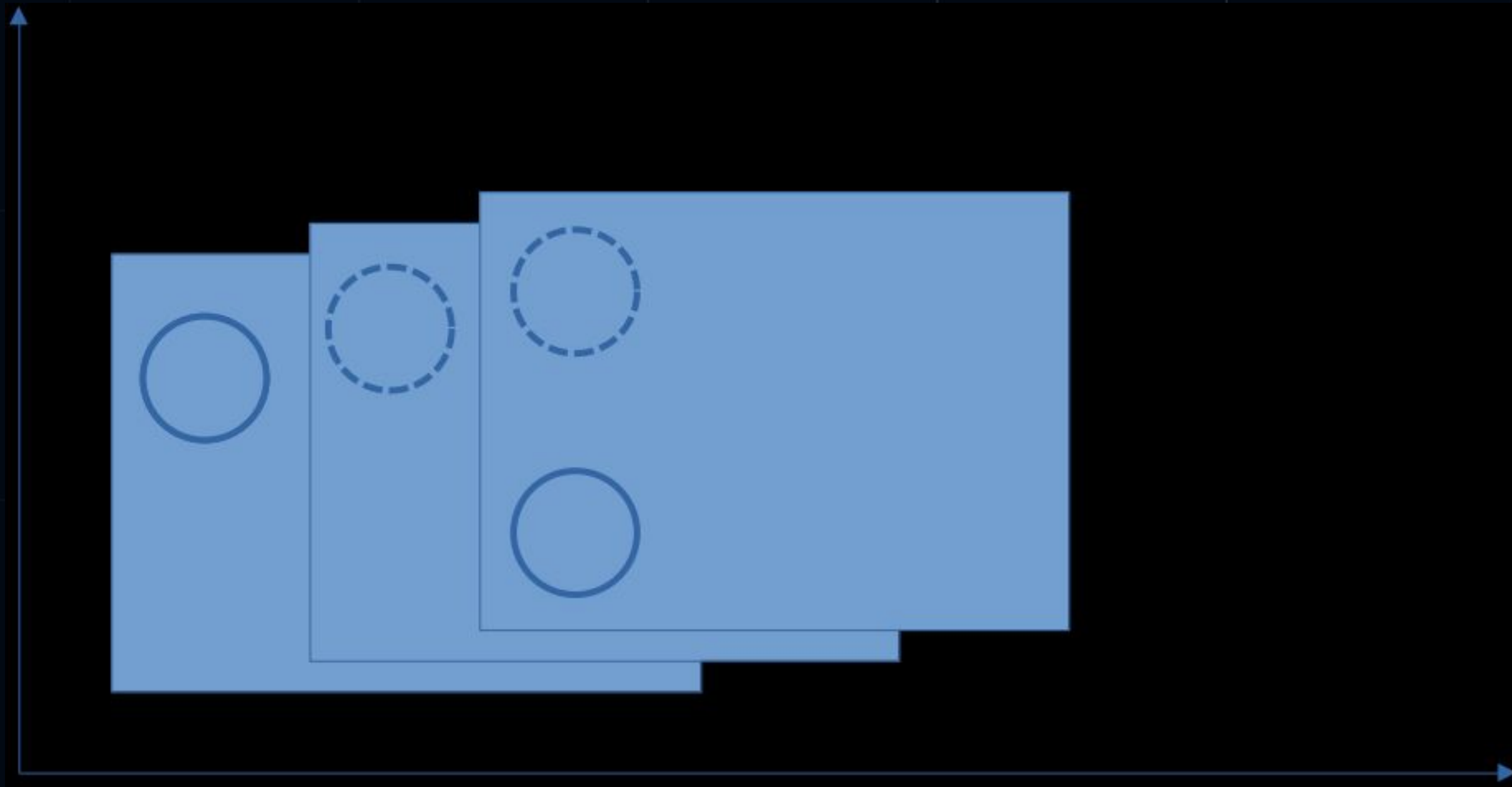


Optional Fields

Definitions



optional fields ...



optional fields ...

again is not the usual thing ...

- get ~ set only fields
- and this might be deep ...
- and mixed with Primitive | Object



optional fields ...

again is not the usual thing ...

- get ~ set only fields
- and this might be deep ...
- and mixed with Primitive | Object

DEMO





Identity of Chaining



identity of chaining

to define constructible something we need

1. to get existing instance type
2. be familiar with future type
3. mix existent and future types



identity of chaining

TS function_construct.ts •



talks > 2023-05-HolyJS > examples > TS function_construct.ts > ...

```
1  function Construct (this: {field: number}): void {};  
2  
3  Construct.prototype = { field: 123 }  
4  Construct.prototype.constructor  
5  →    = Construct;  
6  
7  const item = new Construct;  
8  
9  |          const item: any  
10 console.log(item);  
11
```



identity of chaining

TS function_construct_typed.ts ×



talks > 2023-05-HolyJS > examples > TS function_construct_typed.ts > ...

```
1  function OtherConstruct(this: { field: number }) { }
2
3  const define = function <T>(Cstr: { (this: T): void }) {
4    →   return function(): T {
5    →     →   return new Cstr;
6    →   };
7  };
8
9  const myConstruct = define(OtherConstruct);
10
11      const myConstructedItem: {
12          field: number;
13      }
14  const myConstructedItem = myConstruct();
15
16  console.log(myConstructedItem);
```



identity of chaining

TS mixWithProto.ts X



talks > 2023-05-HolyJS > examples > TS mixWithProto.ts > ...

```
1  type init = {  
2    ... s: number  
3    ... z: number  
4  }  
5  
6  type next = {  
7    ... s?: string  
8    ... m: boolean  
9  }  
10
```

```
type init = {  
  ... s: number  
  ... z: number  
}  
  
type next = {  
  ... s?: string  
  ... m: boolean  
}
```


identity of chaining



TS mixWithProto.ts X



talks > 2023-05-HolyJS > examples > TS mixWithProto.ts > ...

```
10
11
12
13
14 type proto = Pick<
15   → init,
16   → Exclude<
17     → keyof init,
18     → keyof next
19   → >>
```

```
type proto = {
  z: number;
}
```

```
type proto = {
  z: number;
}

type proto = Pick<
  init,
  Exclude<
    keyof init,
    keyof next
  >>
```



identity of chaining

TS mixWithProto.ts X



talks > 2023-05-HolyJS > examples > TS mixWithProto.ts > ...

```
22  type unit = proto & next
23
24  const aggregation: unit = {
25    →  z: 123,
26    →  s: 'x',
27    →  m: true,
28  };
29      type sss = string | undefined
30  type sss = typeof aggregation.s
31
```



identity of chaining

TS function_construct_typed.ts ×



talks > 2023-05-HolyJS > examples > TS function_construct_typed.ts > ...

```
1 function OtherConstruct(this: { field: number }) {}
2 OtherConstruct.prototype = {
3   otherField: true
4 }
5
6 type Proto<P, T> = Pick<P, Exclude<keyof P, keyof T>> & T;
7
8 const define = function<P extends object, T>(Cstr: { (this: T): void }, proto:
9   const MyConstructor = function(): Proto<P, T> {
10     return new Cstr;
11   };
12   Object.setPrototypeOf(MyConstructor, proto);
13   return MyConstructor;
14 };
15
16 const myConstruct = define(OtherConstruct, { otherField: true });
17
18 const myConstructedItem = myConstruct();
19
20 console.log(myConstructedItem);
```

```
function OtherConstruct(this: { field: number }) {}
OtherConstruct.prototype = {
  otherField: true
}
type Proto<P, T> = Pick<P, Exclude<keyof P, keyof T>> & T;
const define = function<P extends object, T>(Cstr: { (this: T): void }, proto:
  const MyConstructor = function(): Proto<P, T> {
    return new Cstr;
  };
  Object.setPrototypeOf(MyConstructor, proto);
  return MyConstructor;
};
const myConstruct = define(OtherConstruct, { otherField: true });
const myConstructedItem = myConstruct();
console.log(myConstructedItem);
```

identity of chaining

DEMO





Ø



special thanks to



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Дмитрий Пацура

Fintier

Микросервисная архитектура



special thanks to



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JUG Ru Group

Артём Кобзарь

Wrike

(не|ну)жная монада Either
на практике и в теории



thank you





to be continued ...

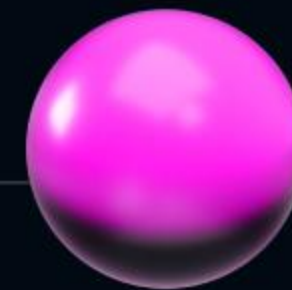


next talk announce

Mnemonic Project



**Viktor
Vershanskiy**



wentout

