

Flutter

Kasper Lund, Google





Generated code for inner loop of f

V8 version 2.5.9.2

V8 version 3.5.10.15 (unoptimized)

```
L01: cmp esp, 0x0299e084  
je L2  
mov eax,[eax+0x17]  
mov [esp+0x14],eax  
mov [esp+0x10],eax  
push ecx  
push edx  
push edi  
push rbp  
call 0x43323740 // opcode: CALL_1C  
mov eax,[esp+0x10]  
mov eax,[esp+0x14]  
and eax,0xf0  
and eax,0x2  
jne L2  
cmp max, 0x1e20  
jne L3  
add max,max  
mov max,[esp+0x14]  
mov edx,[esp+0x10]  
pop rbp  
L3:  
L3: ...  
L3: ...
```

Instructions for computing
 $j + 1$

```
LD1: push [eax+0x13]  
mov max,edi+0x1429  
call 0x43323740 // opcode: CALL_1C  
mov eax,[esp+0x10]  
mov edx,[esp+0x14]  
push rbp  
jne L3  
L3:  
L3: and eax,0x2  
jne L3  
test al,al  
je L3  
L3:  
L3: mov [esp+0x10],eax  
pop edx,[eax+0x1429]  
jne L4  
L4:  
L4: pop rbp  
jne max-0x10  
mov max,edx+0x1429  
pop edx  
pop eax,[esp+0x14]  
or eax,ecx  
test cl,cl  
tne L3  
pop edx,max  
jne L3  
L3:  
L3: ...
```

Google

TODO

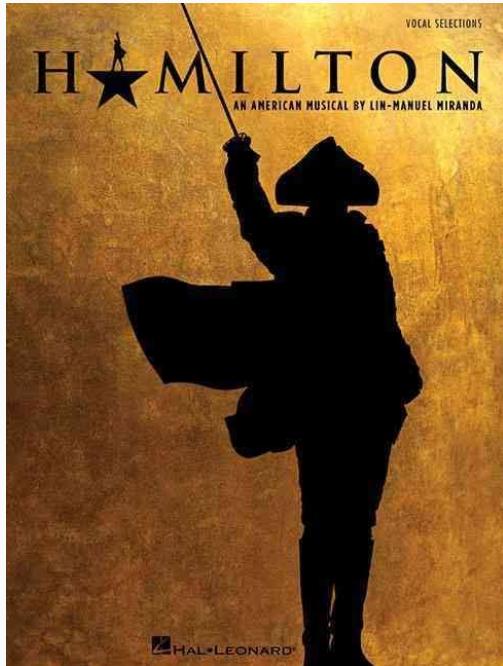
- make the web slightly better
- bring joy to mobile developers

The best way to build for
mobile?

We need to talk about American politics...







The Founding Father Alexander Hamilton's
life is now a hip-hop musical...



JASMINE
CEPHAS JONES

RENÉE ELISE
GOLDSBERRY

PHILLIPA
SOO

CAST MEMBERS OF HAMILTON

Hamilton!

So you have have one really popular show.

What more do you need?



HAMILTON



When do you need it?

Now.

Hurry up and build two great apps!

- We need a super productive framework and developer environment
- We need a platform that supports custom UIs really well
- We need a high-performance solution that supports beautiful apps

Flutter



<http://flutter.io/>

Mobile SDKs

	Compiled to native	Interpreted (JavaScript)
MVC/MVVM	iOS SDK Android SDK	
Reactive		

Mobile SDKs

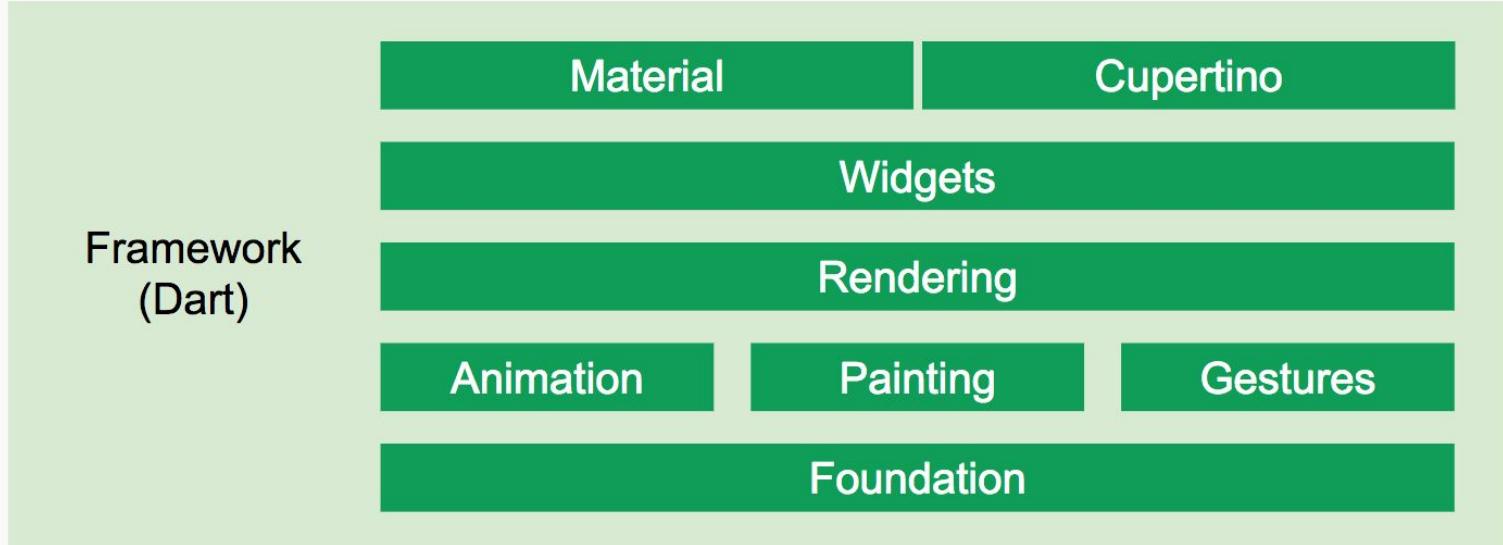
	Compiled to native	Interpreted (JavaScript)
MVC/MVVM	iOS SDK Android SDK	Titanium, Cordova, PhoneGap, Ionic, ...
Reactive		

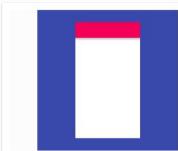
Mobile SDKs

	Compiled to native	Interpreted (JavaScript)
MVC/MVVM	iOS SDK Android SDK	Titanium, Cordova, PhoneGap, Ionic, ...
Reactive		React Native

Mobile SDKs

	Compiled to native	Interpreted (JavaScript)
MVC/MVVM	iOS SDK Android SDK	Titanium, Cordova, PhoneGap, Ionic, ...
Reactive	Flutter	React Native



**AppBar**

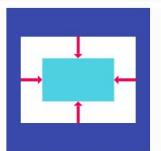
A material design app bar. An app bar consists of a toolbar and potentially other widgets, such as a TabBar and a FlexibleSpaceBar.

[Documentation](#)**AspectRatio**

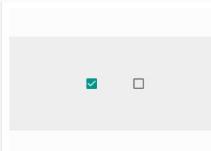
A widget that attempts to size the child with a specific aspect ratio.

[Documentation](#)**AssetBundle**

Asset bundles contain resources, such as images and strings, that can be used by an application. Access to these resources is asynchronous so that the...

[Documentation](#)**Center**

A widget that centers its child within itself.

[Documentation](#)**Checkbox**

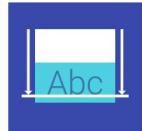
Checkboxes allow the user to select multiple options from a set. The Checkbox widget implements this component.

[Documentation](#)**Chip**

A material design chip. Chips represent complex entities in small blocks, such as a contact.

[Documentation](#)**BackdropFilter**

A widget that applies a filter to the existing painted content and then paints child. This effect is relatively expensive, especially if the filter is non-local, such as a blur.

[Documentation](#)**Baseline**

A widget that positions its child according to the child's baseline.

[Documentation](#)**BottomNavigationBar**

Bottom navigation bars make it easy to explore and switch between top-level views in a single tap. The BottomNavigationBar widget...

[Documentation](#)**ClipOval**

A widget that clips its child using an oval.

[Documentation](#)**ClipPath**

A widget that clips its child using a path.

[Documentation](#)**ClipRect**

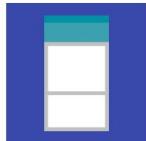
A widget that clips its child using a rectangle.

[Documentation](#)**BottomSheet**

Bottom sheets slide up from the bottom of the screen to reveal more content. You can call showBottomSheet() to implement a persistent bottom sheet o...

[Documentation](#)**ButtonBar**

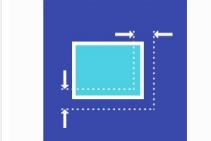
A horizontal arrangement of buttons.

[Documentation](#)**Card**

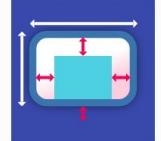
A material design card. A card has slightly rounded corners and a shadow.

[Documentation](#)**Column**

Layout a list of child widgets in the vertical direction.

[Documentation](#)**ConstrainedBox**

A widget that imposes additional constraints on its child.

[Documentation](#)**Container**

A convenience widget that combines common painting, positioning, and sizing widgets.

[Documentation](#)

Flutter comes with lots of Material Design widgets...

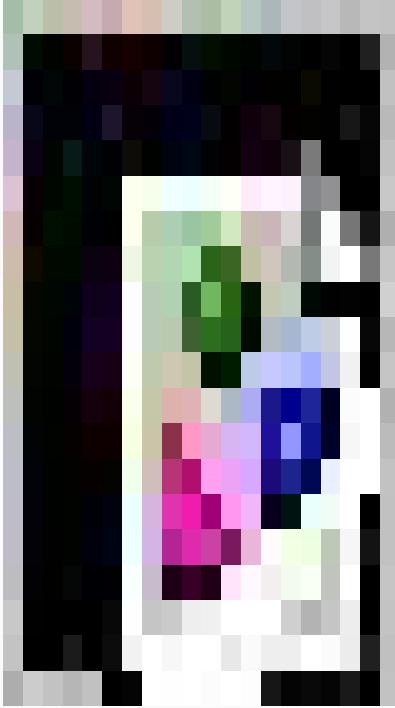
Let us see it live...



```
$ flutter devices  
emulator-5554 • android-x64 (7.1.1)  
$ flutter run -d emulator-5554
```

“What I really like about Flutter, is their beautiful set of Material Design widgets.”

<https://medium.com/@aubykhan/how-i-built-a-cross-platform-connected-app-in-7-days-93728a987424>



Custom UIs are really quite popular

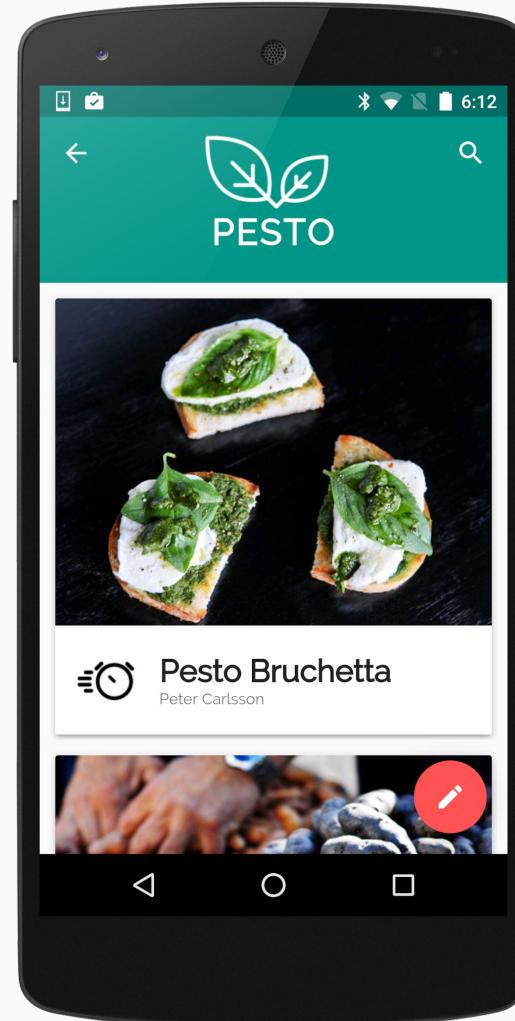
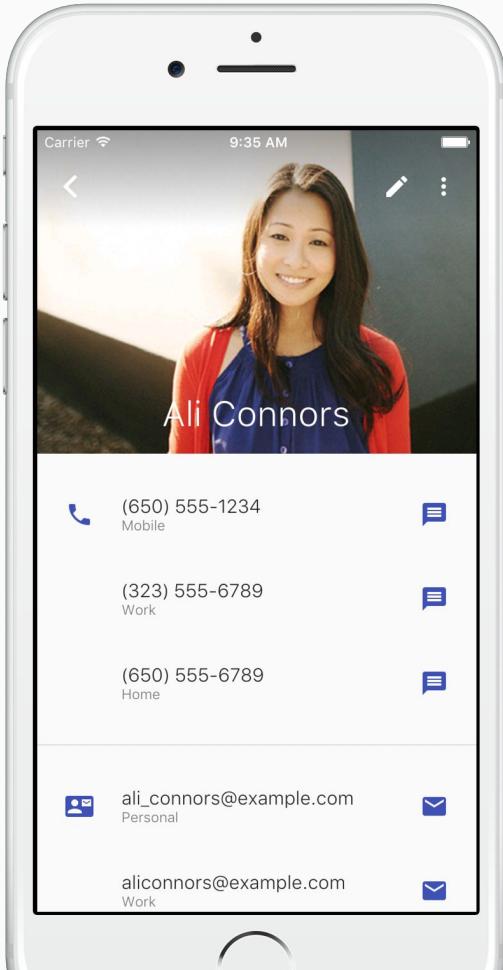
Traditionally

Doing custom is hard

Doing custom twice is painful



Flutter supports custom UIs extremely well because of the platform layering



Doing custom is **easy**

Doing custom twice is **not needed**

“Running at 60 fps, user interfaces created with Flutter perform far better than those created with other cross-platform development frameworks.”

<https://code.tutsplus.com/tutorials/developing-an-android-app-with-flutter--cms-28270>

Dart



Dart is the tech stack of choice for
Google's largest business

Home

My ads

Allow & block ads

Performance reports

Optimization

Settings

Help

Send feedback

Estimated earnings

Today

£0.00

34%

8 days



Balance

£22.81

Last payment
£64.61

Per

Last 7 days

3.3

-492

Clicks

1

-2 (-6)

Impressions

1

-2 (-6)

VIEW REPORT

Yesterday

Countries

Last 28 days vs previous 28 days

United States

£4.73 +£3.21 (+211%)



Desktop

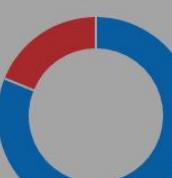
£3.71

High-end mobile devices

£0.05

Tablets

£0.02



● CPM bids

● Active View CPM

£0.

£0.

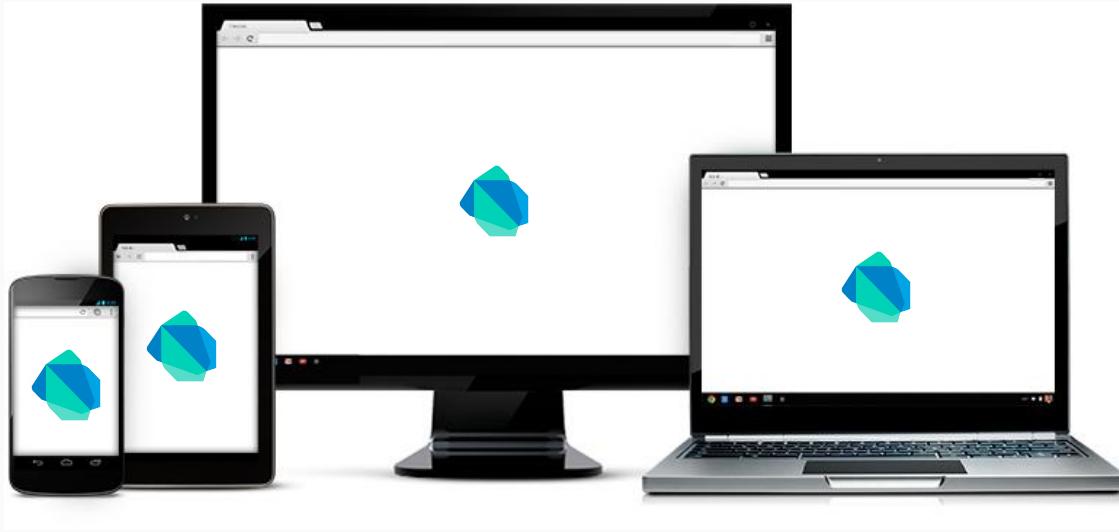
£0.

£0.

£0.

£0.

 Back to previous AdSense



Dart translates to JavaScript and
runs in all modern browsers

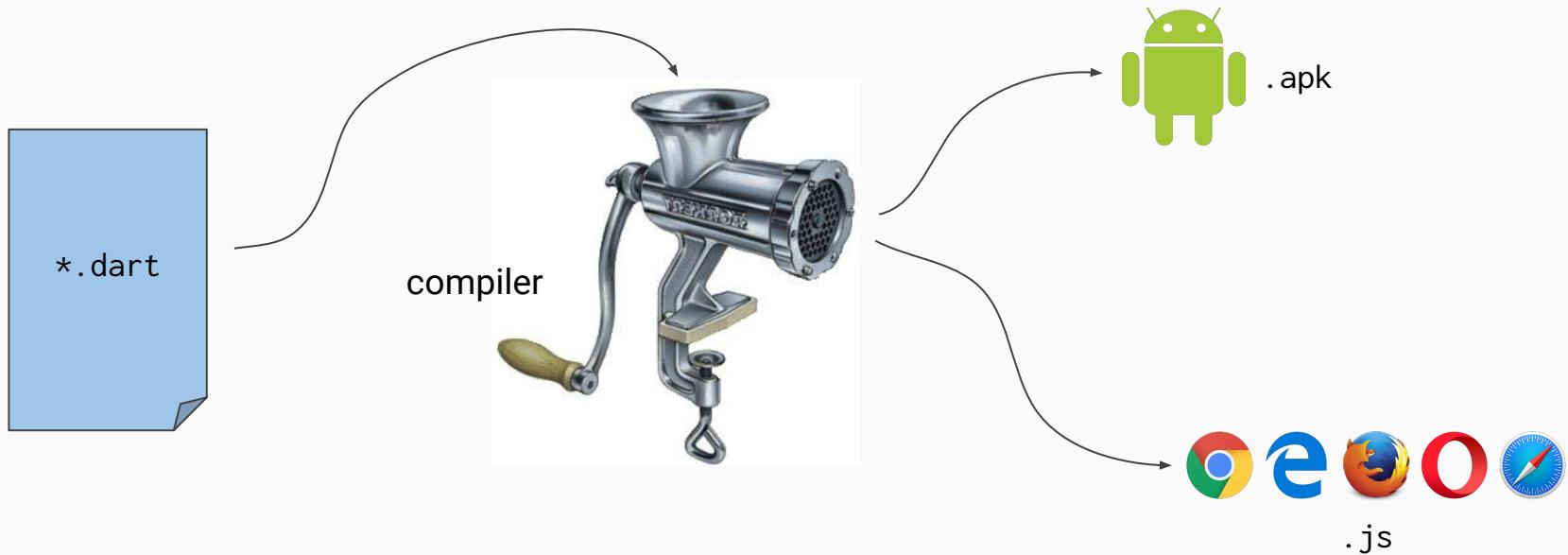
```
main() {  
    var person = new Person("Kasper");  
    print("Hello $person");  
}  
  
class Person {
```

```
    String name;  
    Person(this.name);  
    toString() => name;  
}
```

The Dart language

- Unsurprising and object-oriented
- Class-based single inheritance
- Familiar syntax with lexical scoping
- Sound type system **NEW!**

Ahead-of-time compilation



Dart compiles to native machine code

```
...  
ldr r1, [sp]  
ldr d0, [r1, #3]  
vcmpd d0, d0  
vmstat  
bvs L0  
vcvtid s2, d0  
vmovrs r0, s2  
adds r0, r0, r0  
bvs L1  
vcvtdi d1, s2  
vcmpd d0, d1  
vmstat  
bxeq lr  
L0:  
ldr r0, [r1, #3]  
ldr r1, [r1, #7]  
eor r0, r0, r1  
...
```



“The UI is butter smooth ... I have never seen such a smooth Android app.”

Pascal Welsch, Speaker at Droidcon Berlin

... but making sausages is quite involved!



Pay as you go: Just-in-time compilation



- Compile the application as it executes
- Avoid paying the compilation cost up front
- Only compile the parts actually executed

Stand back while I hack this thing...

The screenshot shows the IntelliJ IDEA interface with a Dart file named `main.dart` open. The code defines a `DemoApp` class extending `StatelessWidget`, which builds a `MaterialApp` with a `HomePage` as the home screen. The `HomePage` class extends `StatefulWidget` and its state is `HomePageState`. The `HomePageState` class contains a counter variable and an `incrementCounter` method that increments the counter. The `Widget build` method of `HomePage` returns a `Scaffold` with an `AppBar` containing the title "Demo!!" and a `body` containing a centered `Column`. The IDE's bottom bar shows the console output: "Performing full restart...", "Restarted app in 1,125ms.", and "Application finished." The status bar at the bottom indicates "Frameworks Detected: Android framework is detected. // Configure (yesterday 11:59 AM)".



“Coding with Flutter the past week has brought back the joy of mobile development for me.”

<https://traversoft.com/blog/2017/08/08/conference-app-flutter/>



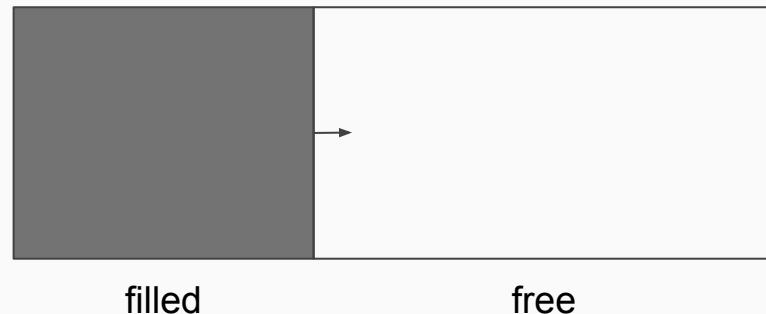
Constructing widget trees in Flutter
appear expensive – is it?

Excited!

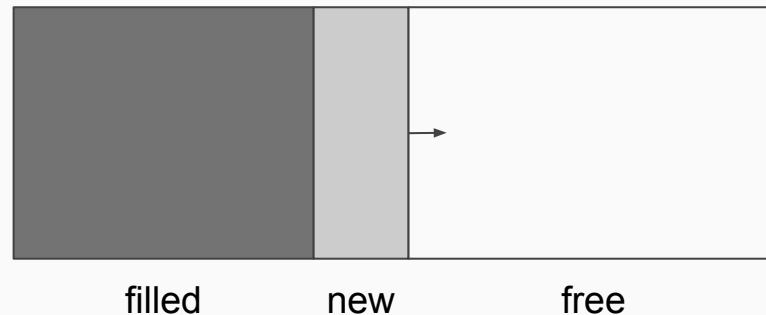


No!

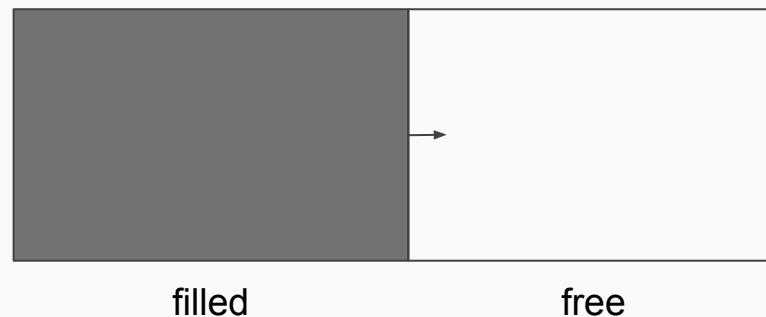
Free space is contiguous



Allocate by bumping a single pointer ...



... and initializing the allocated space



Lock free
Simple
Fast

Concerned?



How much do we have to pay for
collecting the garbage?

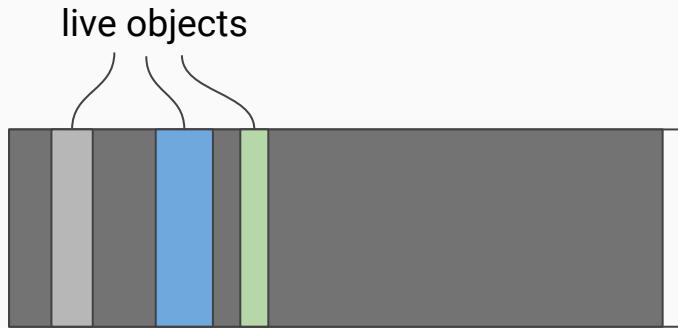
conservative

Idea: treat everything that looks like a pointer as such

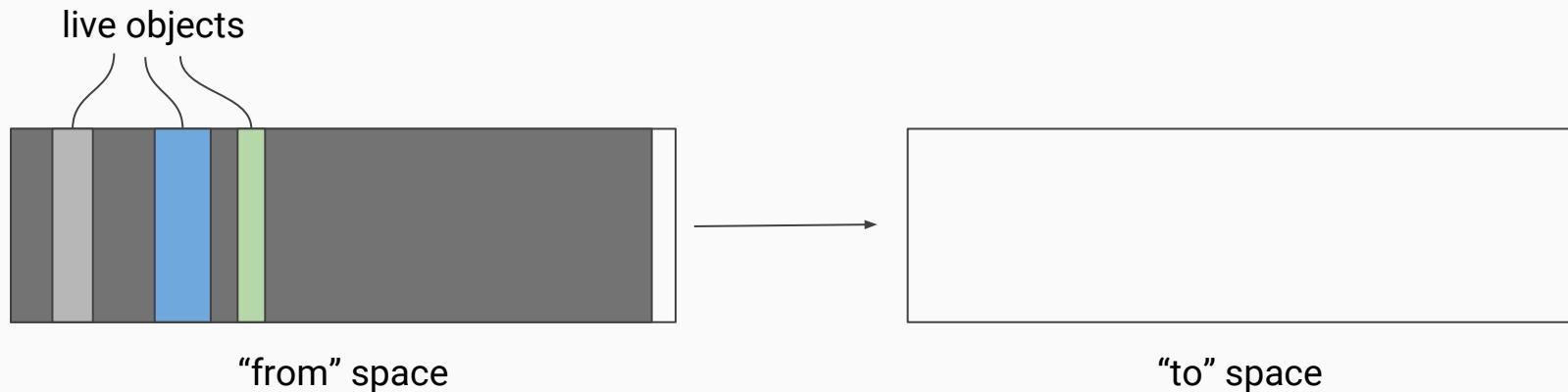
- can't distinguish ints from pointers
- can't update pointers, because they might be ints



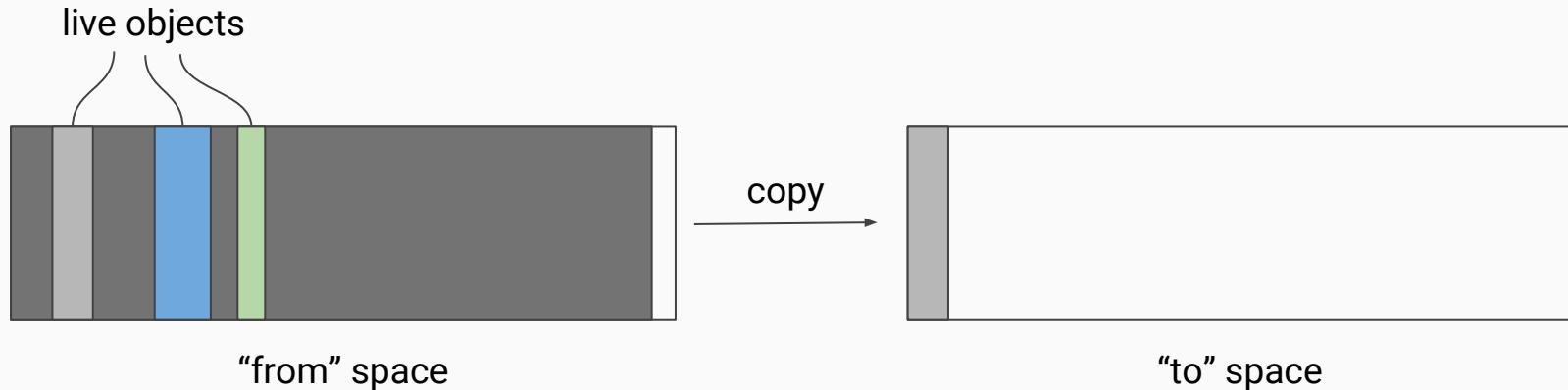
Semi-space collector



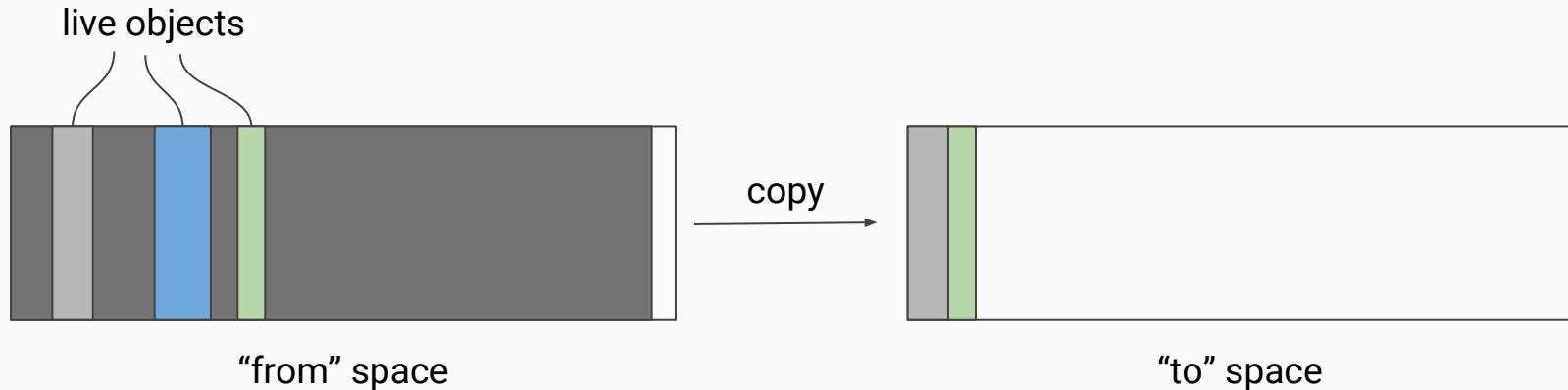
Semi-space collector



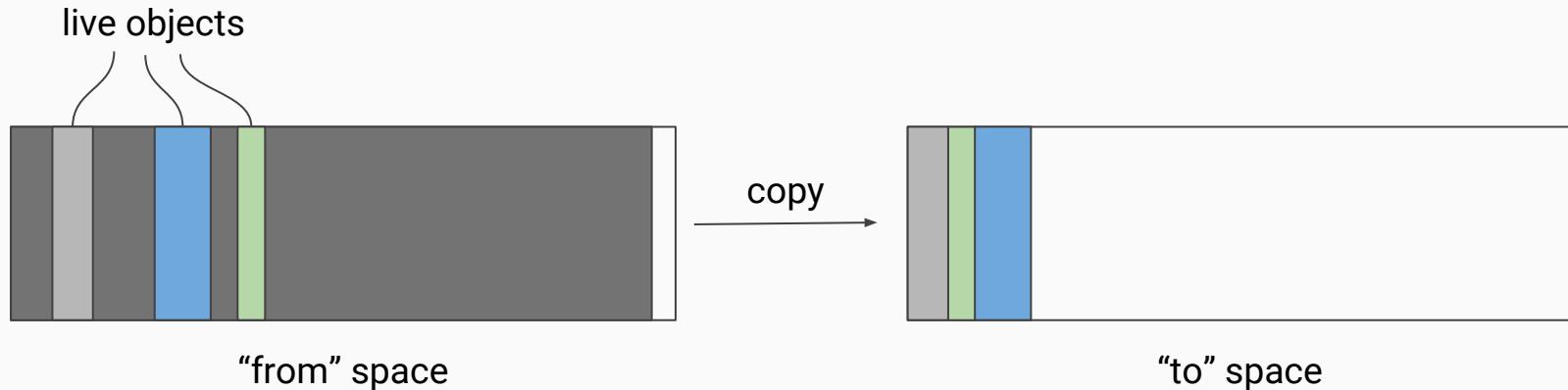
Semi-space collector



Semi-space collector



Semi-space collector

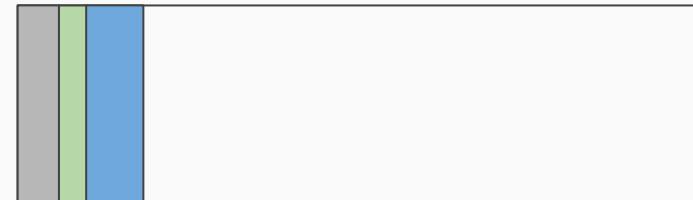


Semi-space collector



“from” space

live objects



“to” space

Semi-space collector



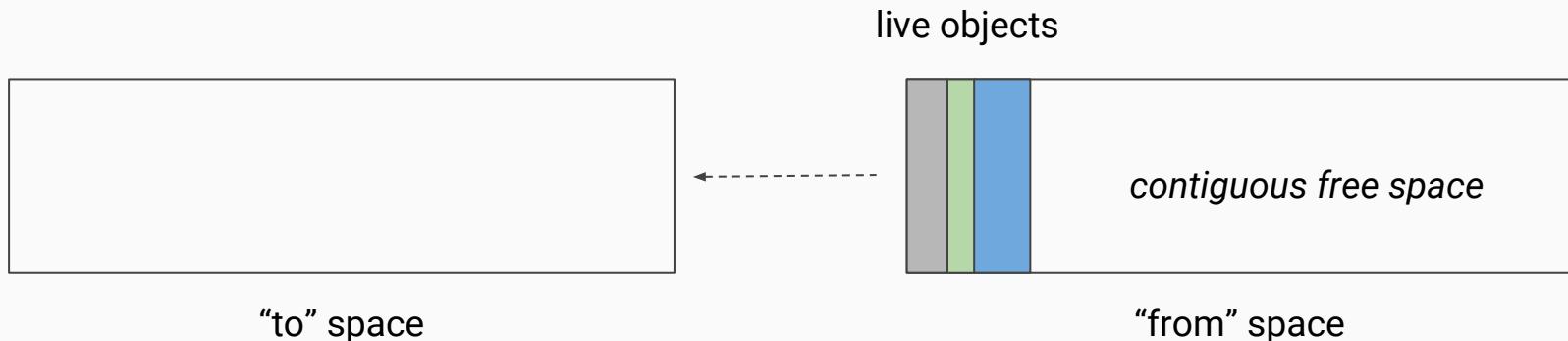
“from” space

live objects



“to” space

Semi-space collector

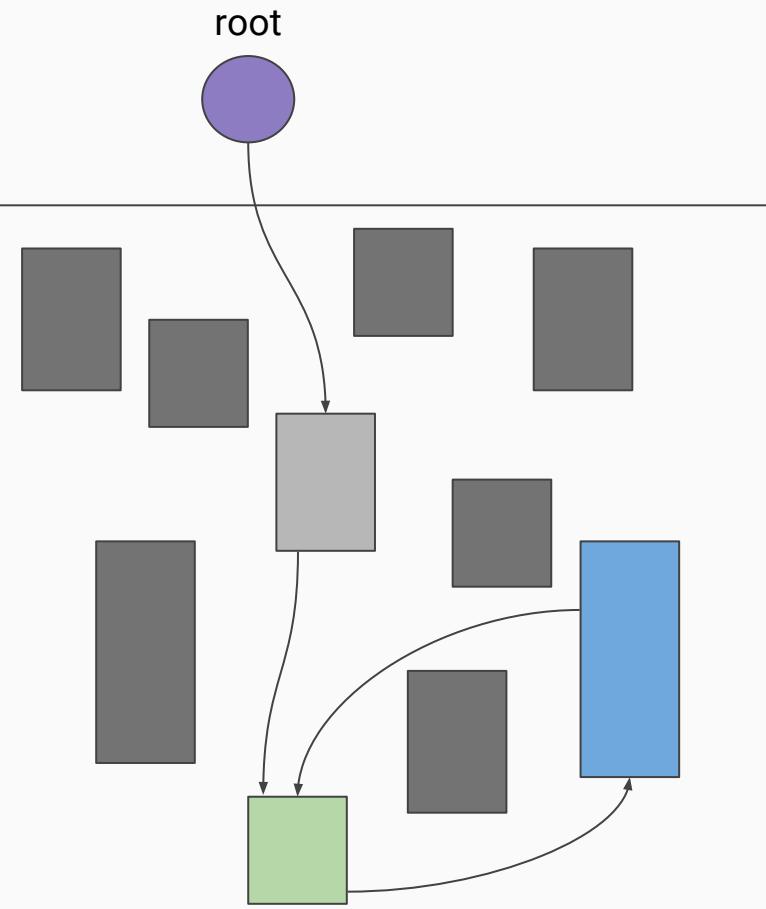


conservative

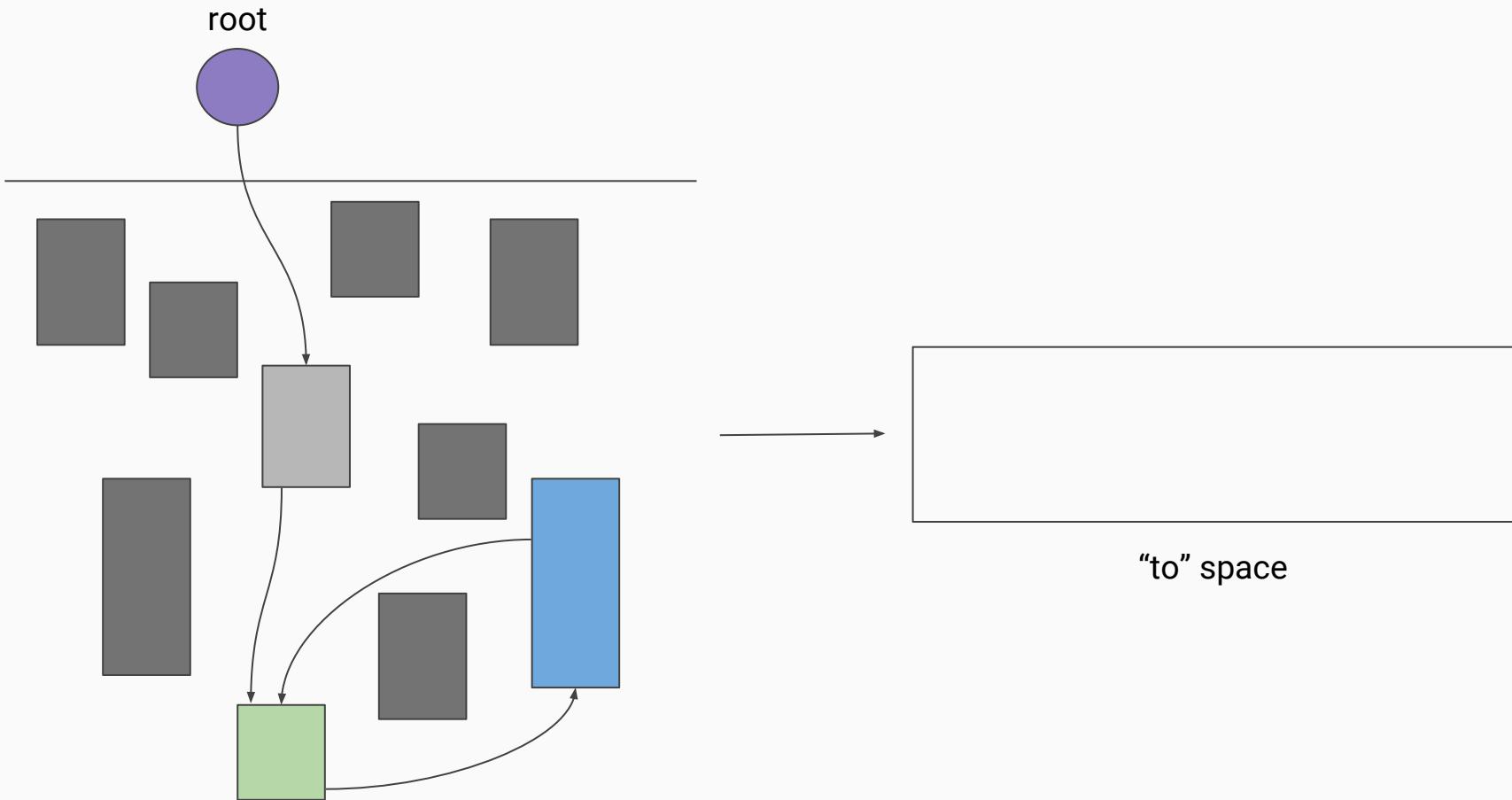


Idea: allow moving objects and compacting

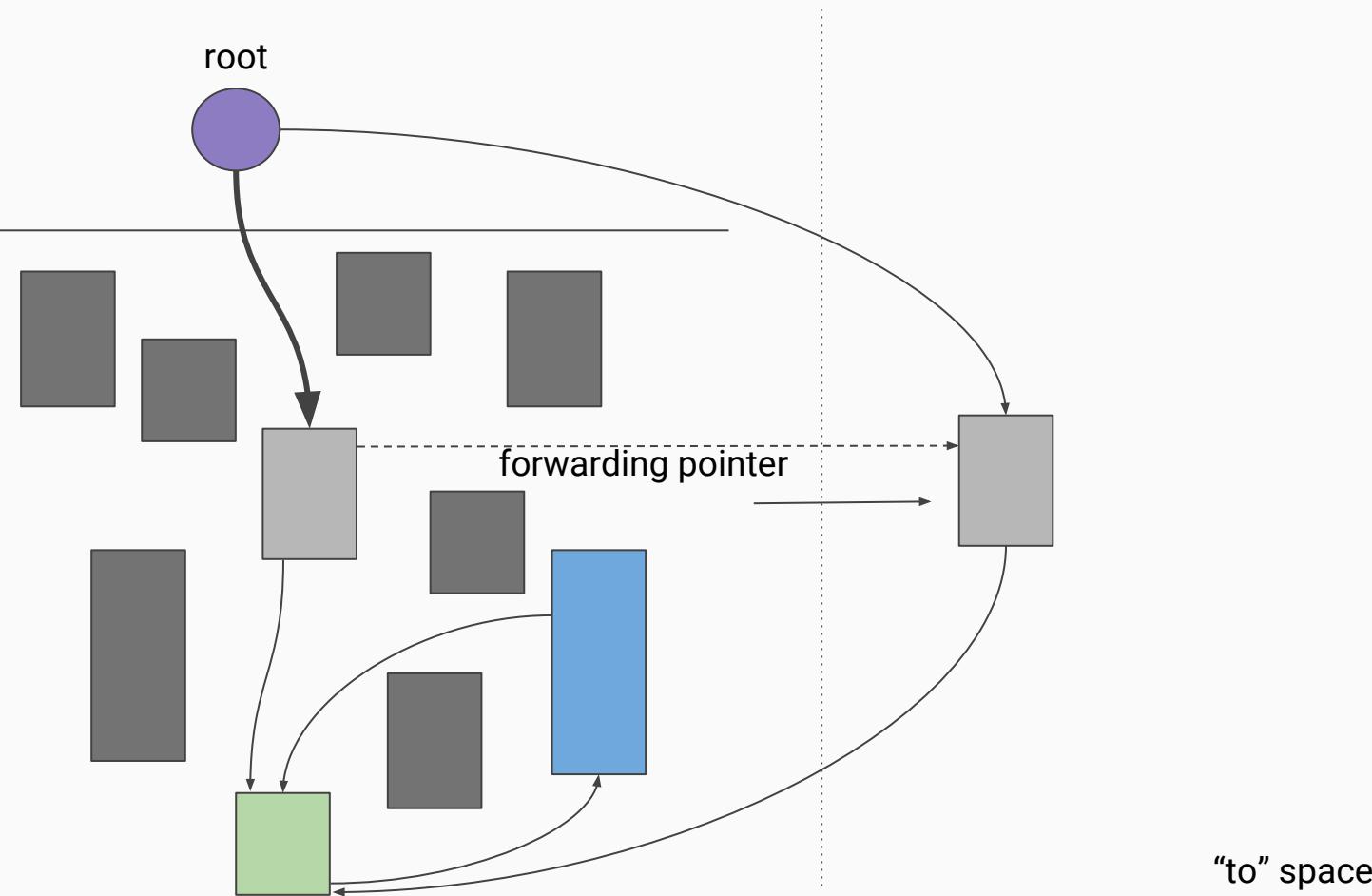
- enables really fast allocations
- enables really fast garbage collections



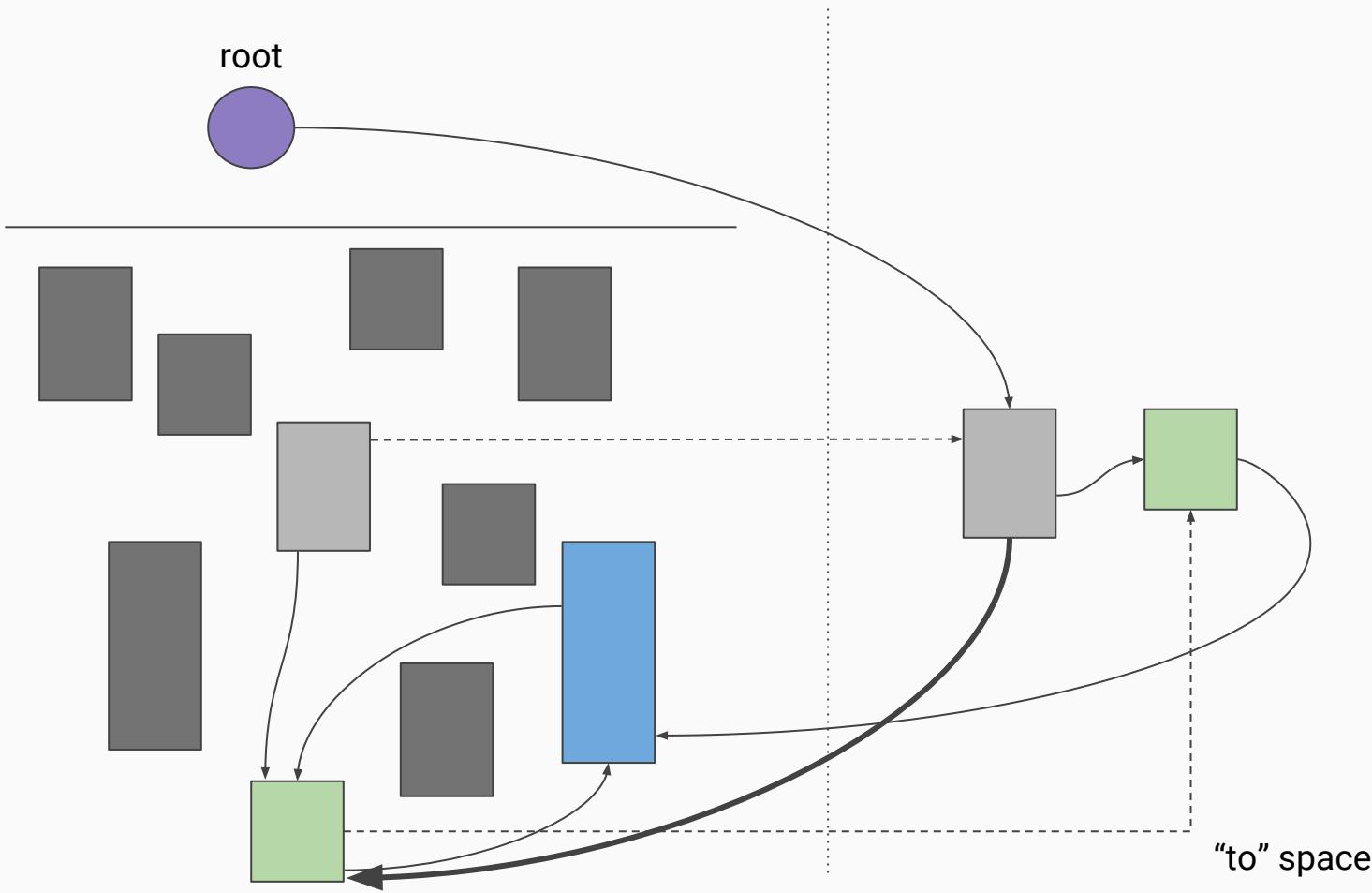
Live and dead objects in the object soup (usually called the *heap*)



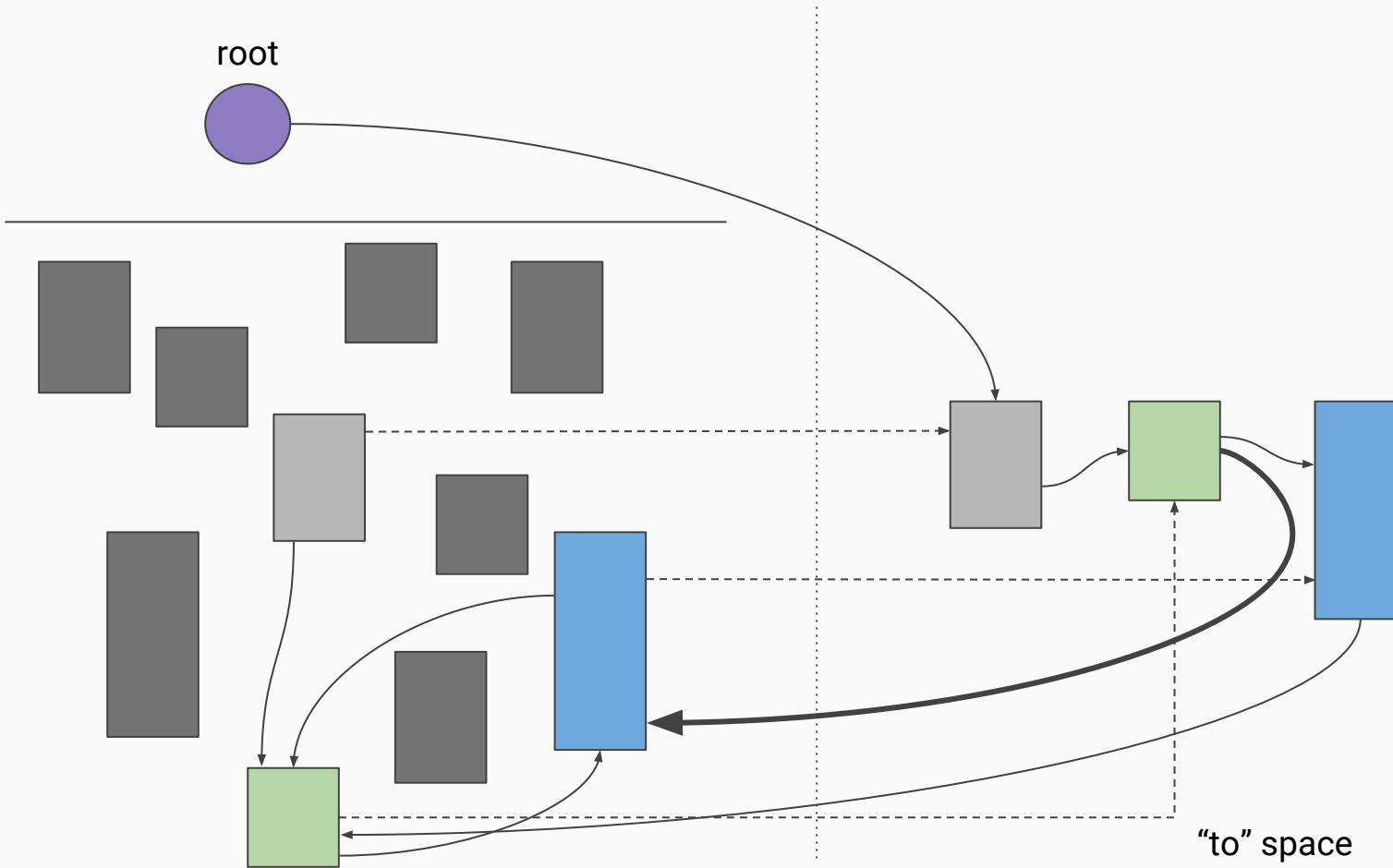
Live and dead objects in the object soup (usually called the *heap*)



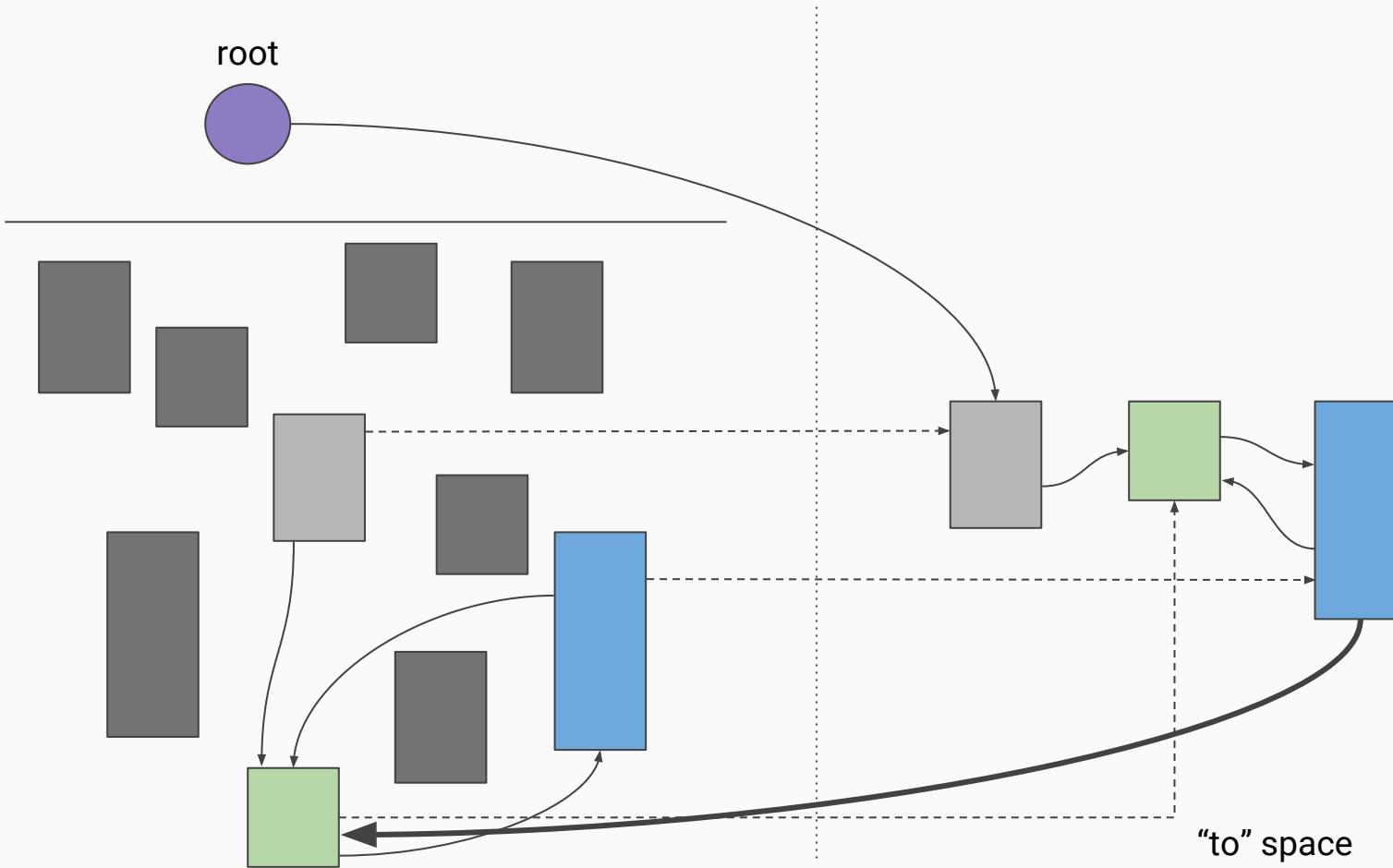
Let's start at the root



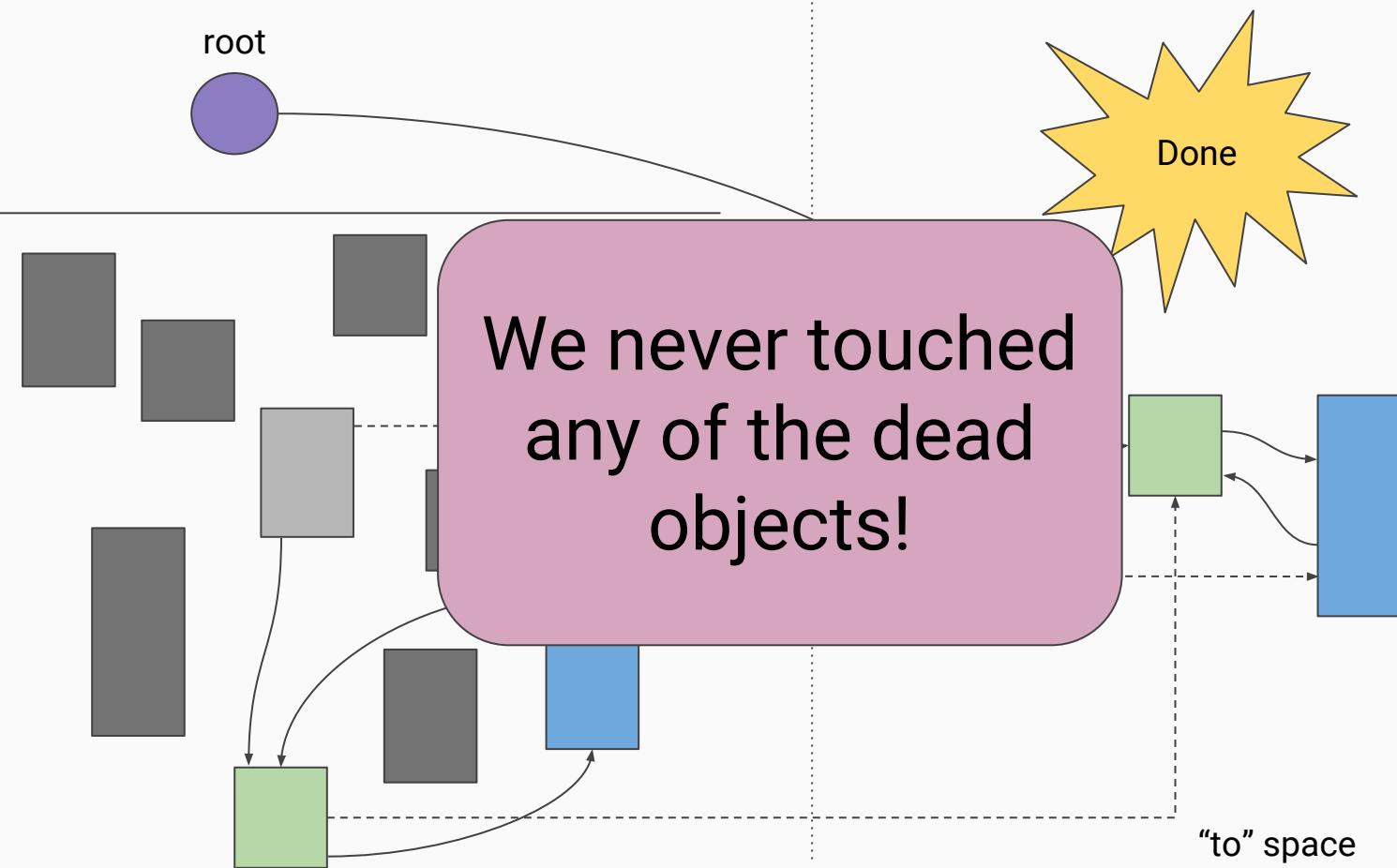
When done with the roots, we scan through “to” space



We continue scanning through “to” space ...



... as long as we're making progress (copying over objects)



... and we're done!

Now I should really tell you
about generational garbage
collection...



Flutter's widget construction pattern is
super well supported by Dart!

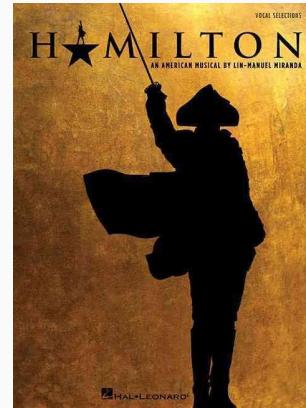
Dart allows deploying **fast** machine code

Dart enables **hot reload** in development

Dart deals **efficiently** with tons of widgets

Now back to Hamilton...

After a short three months...



One simple codebase, two great apps
(Android and iOS)

Hamilton - The Official App

By Hamilton Uptown LLC

This app is only available on the App Store for iOS devices.

 Free

Description
Introducing Hamilton — The Official App. Fans' access to all things Hamilton: An American Musical.

[HelloHelloHello!](#)

[Hamilton Uptown LLC Web Site](#) • [Hamilton - The Official App Support](#) • [...More](#)

What's New in Version 1.2
[Edit your profile](#) • [Change your password](#)

iPhone Screenshots



Compatibility: Requires iOS 8.0 or later. Compatible with iPhone 5s, iPhone 6, iPhone 6 Plus, iPhone 6s, iPhone 6s Plus, iPhone SE, Phone 7, iPhone 7 Plus, iPad Air, iPad Air Wi-Fi + Cellular, iPad mini 2, iPad mini 2 Wi-Fi + Cellular, iPad Air 2, iPad Air 2 Wi-Fi + Cellular, iPad mini 3, iPad mini 3 Wi-Fi + Cellular, iPad mini 4, iPad mini 4 Wi-Fi + Cellular, 12.9-inch iPad Pro, 9.7-inch iPad Pro Wi-Fi + Cellular, 9.7-inch iPad Pro 9.7-inch iPad Pro Wi-Fi + Cellular, iPad (5th generation), iPad Wi-Fi + Cellular (5th generation), 12.9-inch iPad Pro (2nd generation), 12.9-inch iPad Pro Wi-Fi + Cellular (2nd generation), 10.5-inch iPad Pro 10.5-inch iPad Pro Wi-Fi + Cellular, and iPod touch (6th generation).

Google

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 Hamilton — The Official App

Hamilton Uptown LLC Entertainment ★★★★★ 947 [Install](#)

PEGI 3

This app is compatible with some of your devices.

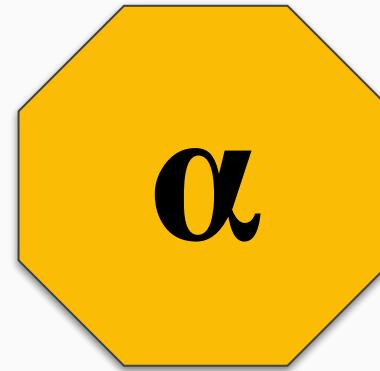
LOTTERY
Enter the official Hamilton lottery for Los Angeles (other cities coming soon!).

STICKERS
Share fun show-related stickers with your friends and family.

Introducing Hamilton — The Official App. Fans' access to all things Hamilton: An American Musical.

Flutter makes it easy and fast to build beautiful mobile apps.

Flutter is a new mobile app SDK to help developers and designers build modern mobile apps for iOS and Android.



Flutter is available as an open-source, alpha release.

Flutter is used by Google and others in production.

Thank you!

<https://flutter.io/>