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# Performance Tuning

[angular-architects.io](https://angular-architects.io)

## Turbo Button



# Quick Wins

Bundling

Minification

enableProdMode()

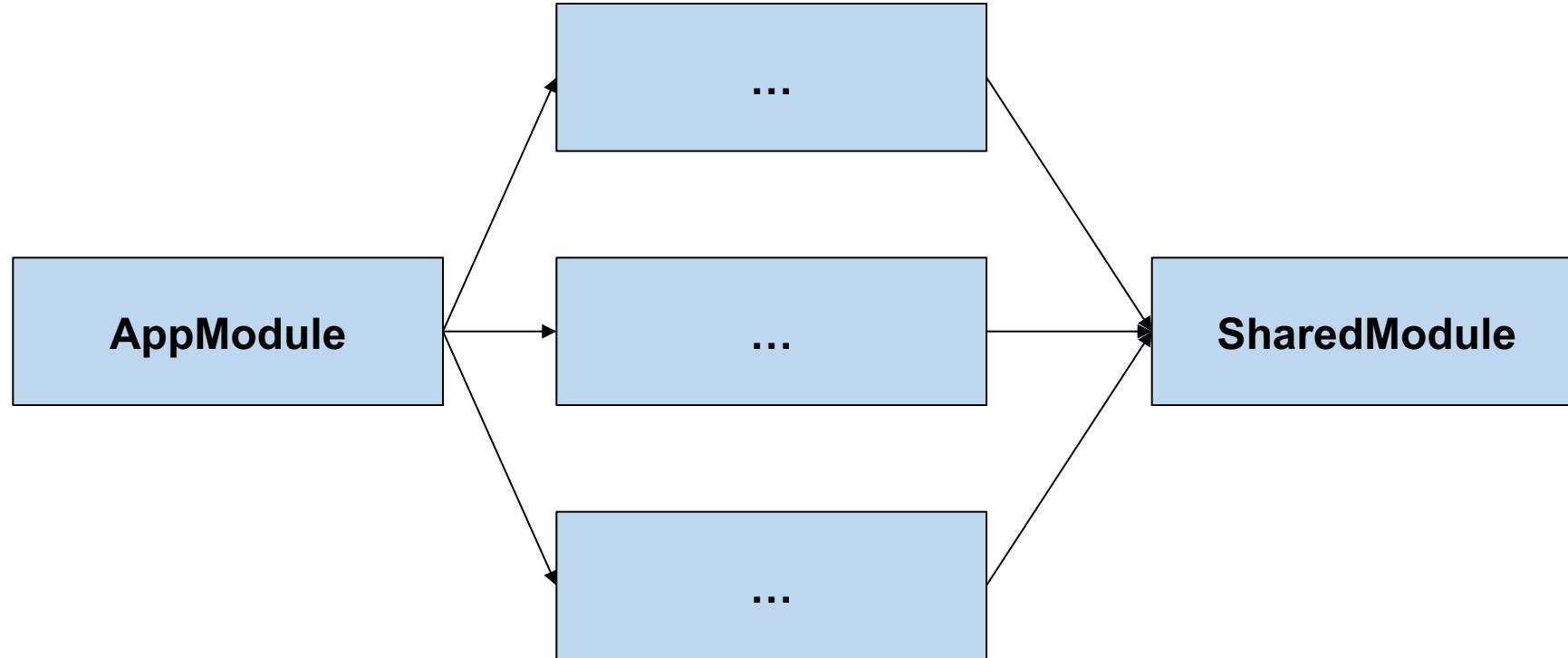
# Contents

- Lazy Loading and Preloading
- Performance for Data Binding with OnPush
- AOT and Tree Shaking

# Lazy Loading



# Module Structure

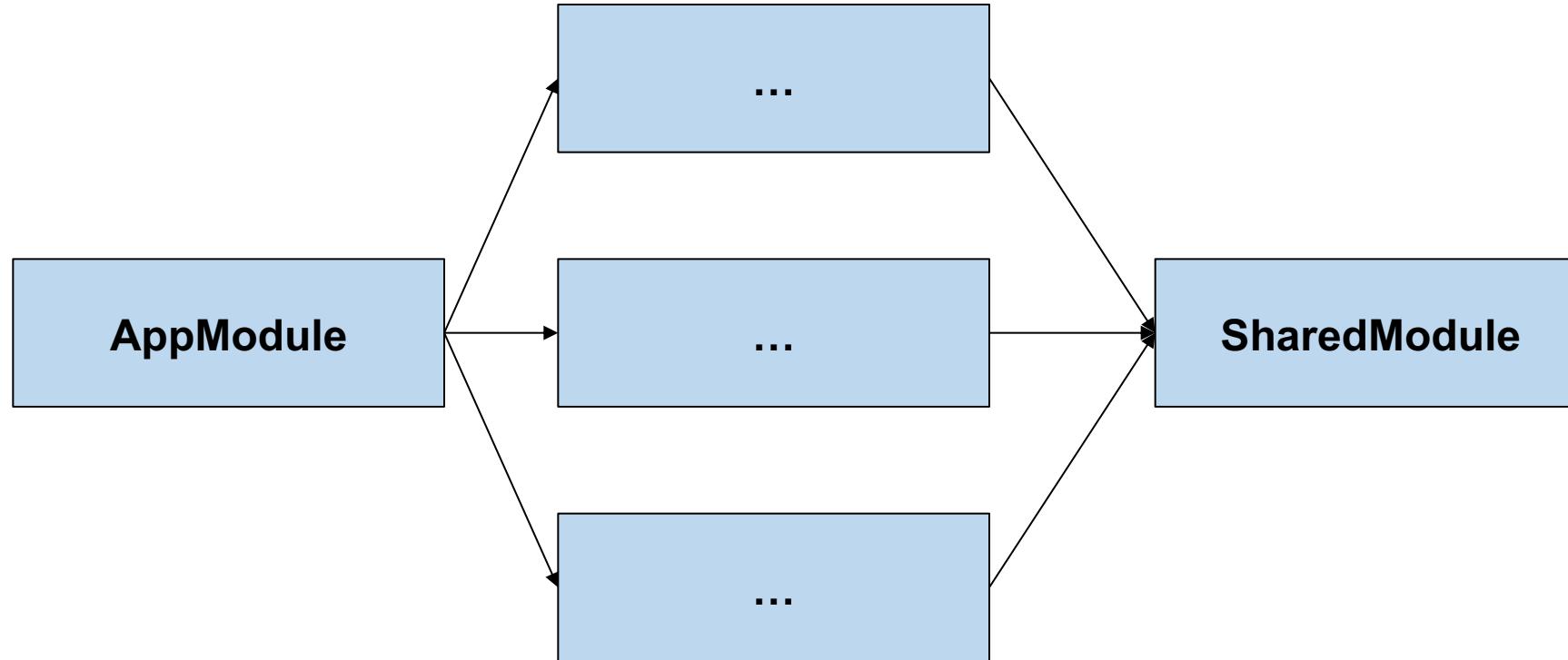


**Root Module**

**Feature Modules**

**Shared Module**

# Lazy Loading



**Root Module**

**Feature Modules**

**Shared Module**

# Root Module with Lazy Loading

```
const APP_ROUTE_CONFIG: Routes = [
  {
    path: 'home',
    component: HomeComponent
  },
  {
    path: 'flights',
    loadChildren: () => import('./flight-booking/flight-booking.module')
      .then(m => m.FlightBookingModule)
  }
];
```

# Routes for "lazy" Module

```
const FLIGHT_ROUTES = [
  {
    path: '',
    component: FlightBookingComponent,
    [...]
  },
  [...]
}
```

# Routes for "lazy" Module

```
const FLIGHT_ROUTES =      [
  {
    path: 'subroute',
    component: FlightBookingComponent,
    [...]
  },
  [...]
}
```

flight-booking/ subroute

Triggers Lazy Loading w/ loadChildren

# Lazy Loading

- Lazy Loading means: Loading it later
- Better startup performance
- Delay during execution for loading on demand

# Preloading



# Idea

- Module that might be needed later are loaded after the application started
- When module is needed it is available immediately

# Activate Preloading

```
...
imports: [
  [...]
  RouterModule.forRoot(
    ROUTE_CONFIG,
    { preloadingStrategy: PreloadAllModules });
]
...
```



# Performance- Tuning with OnPush

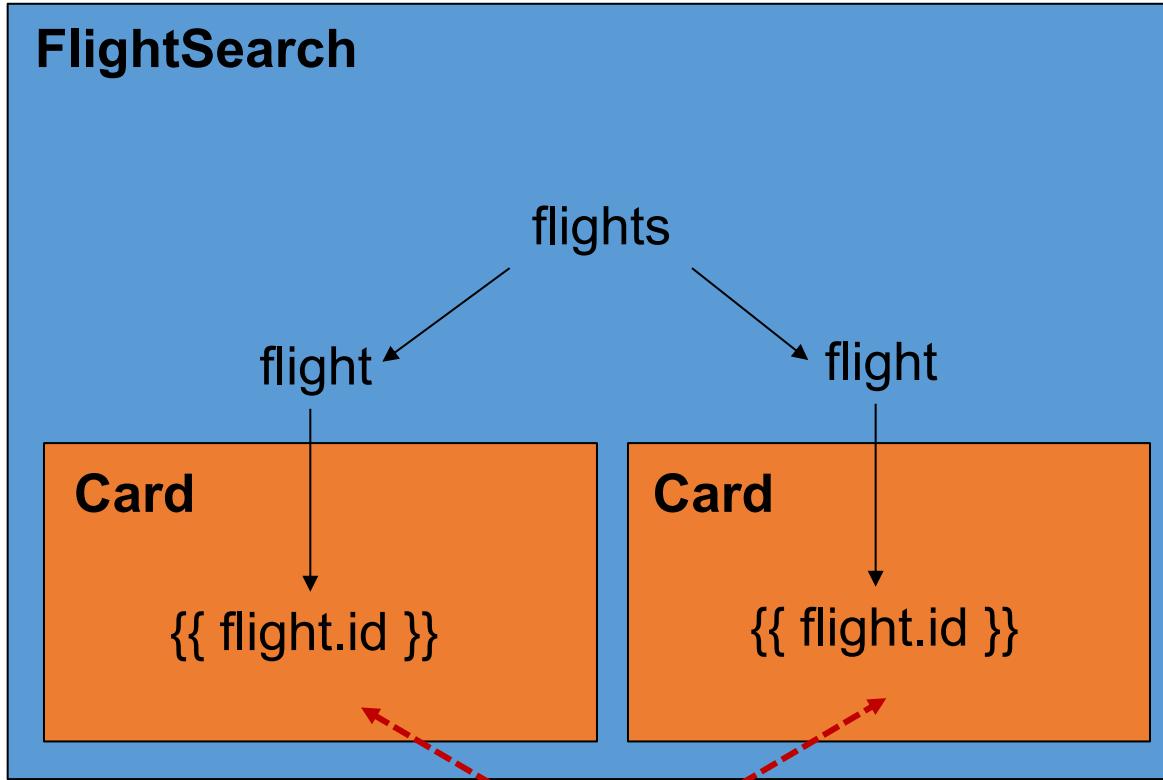
# DEMO



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# OnPush



Angular just checks when “notified”



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# "Notify" about change?

- Change bound data (@Input)
  - OnPush: Angular just compares the object reference!
  - e. g. oldFlight === newFlight
- Raise event within the component
- Notify a bound observable
  - {{ flights\$ | async }}
- Trigger it manually
  - Don't do this at home ;-)
  - At least: Try to avoid this

# Activate OnPush

```
@Component({
  [...]
  changeDetection: ChangeDetectionStrategy.OnPush
})
export class FlightCard {
  [...]
  @Input() flight;
}
```

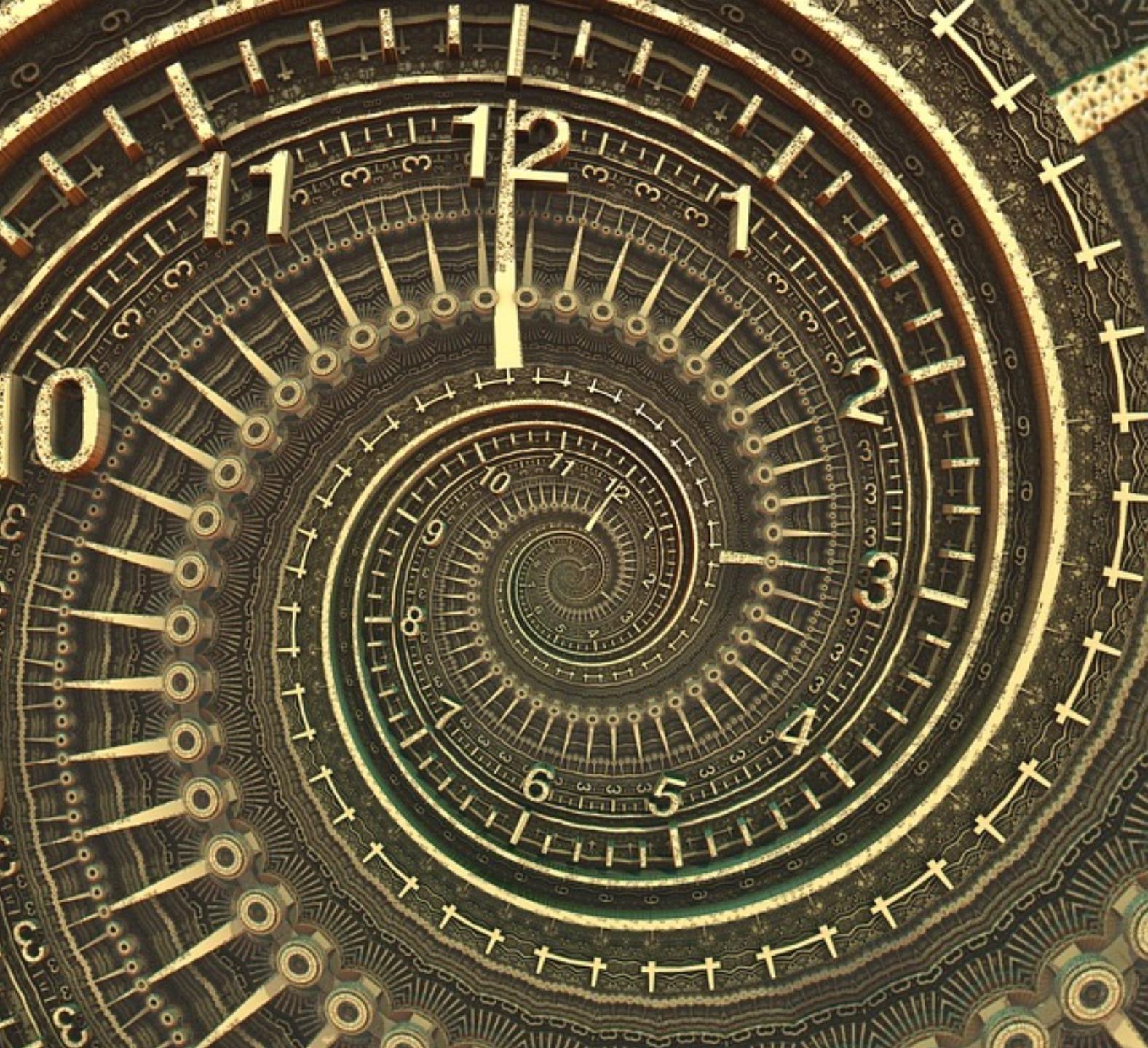
# DEMO



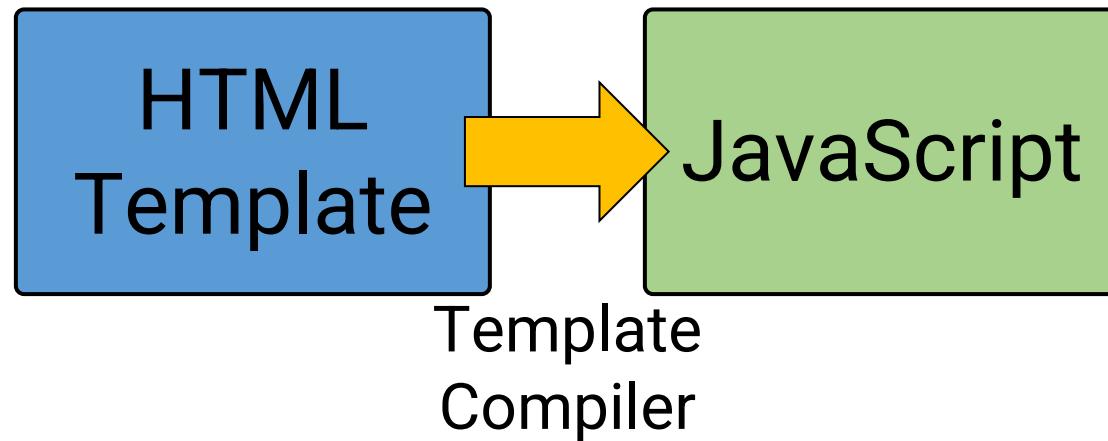
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# Ahead of Time (AOT) Compilation



# Angular Compiler



# Approaches

- JIT: Just in Time, at runtime
- AOT: Ahead of Time, during build

# Advantages of AOT

- Better Startup-Performance
- Smaller Bundles: You don't need to include the compiler!
- Tools can easier analyse the code
  - Remove unneeded parts of frameworks
  - Tree Shaking

# Angular CLI

- ng build --prod
- @ngtools/webpack with AngularCompilerPlugin
- Can be used without CLI too

# Production Mode without AOT (no lazy loading)

FLIGHT42 Flight42

HOME Flight Search Passenger Search

FLIGHT BOOKING

## Flight Search

Elements Console Sources Network **Performance** Memory Application Security Audits Augury > ... X

Screenshots  Memory

1000 ms 2000 ms 3000 ms 4000 ms 5000 ms 6000 ms 7000 ms

FPS CPU NET

1000 ms 2000 ms 3000 ms 4000 ms 5000 ms 6000 ms 7000 ms

Network Frames 2234.0 ms

Summary Bottom-Up Call Tree Event Log

Range: 0 – 6.93 s

16:30 DEU 30.01.2018 4

# Production Mode with AOT (no lazy loading)

FLIGHT42 Flight42

HOME Flight Search Passenger Search

FLIGHT BOOKING

## Flight Search

Elements Console Sources Network **Performance** Memory Application Security Audits Augury > :: X

Screenshots Memory

500 ms 1000 ms 1500 ms 2000 ms 2500 ms 3000 ms 3500 ms 4000 ms 4500 ms

FPS CPU NET

200 ms 400 ms 600 ms 800 ms 1000 ms 1200 ms 1400 ms

Network main.js 280.7 ms Frames 571.9 ms 81.5 ms

Summary Bottom-Up Call Tree Event Log

Range: 0 – 1.43 s

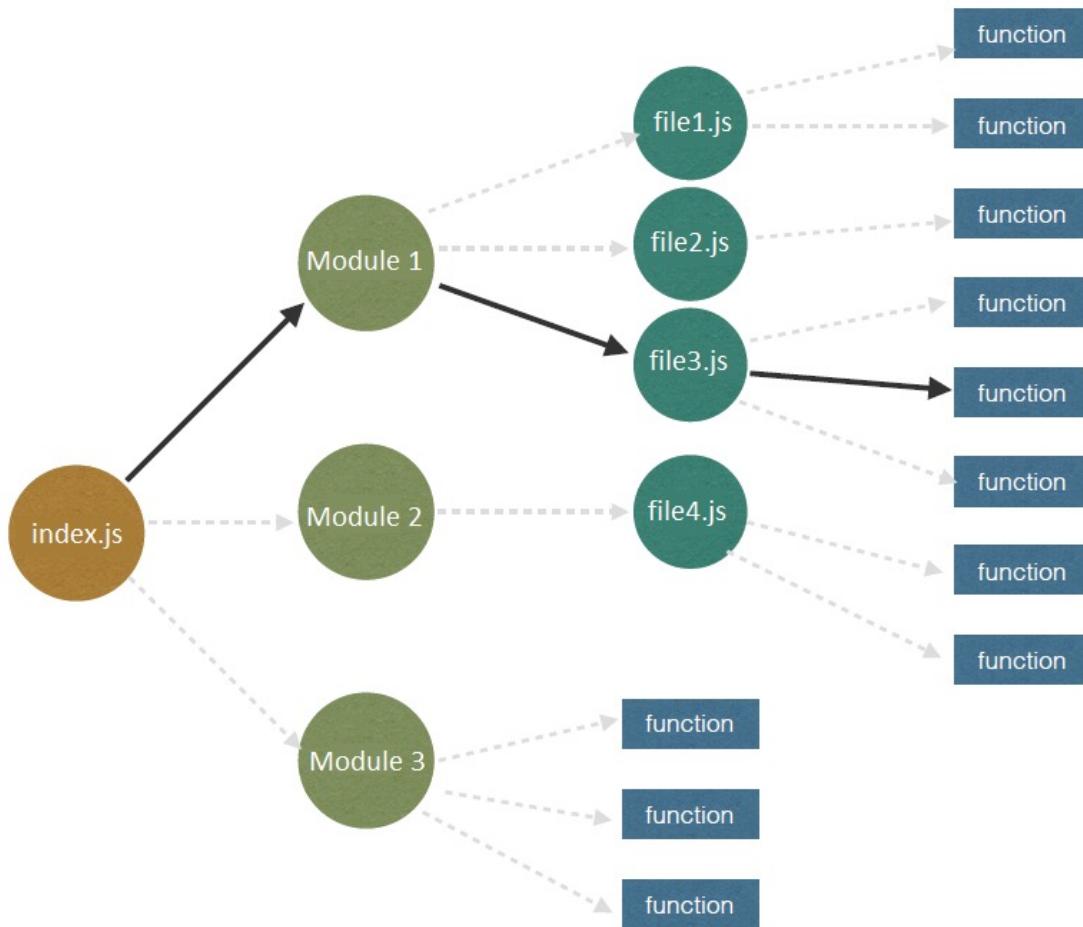
16:27 30.01.2018 4

# Ivy makes AOT the default 😊

- Ivy also does a lot of under the hood optimization
- No breaking changes, nothing to do from our side 😊
- Angular ViewEngine itself was not tree-shakable
- Angular Ivy is tree-shakable 😊
- Default since NG 10, for libs default since NG 12

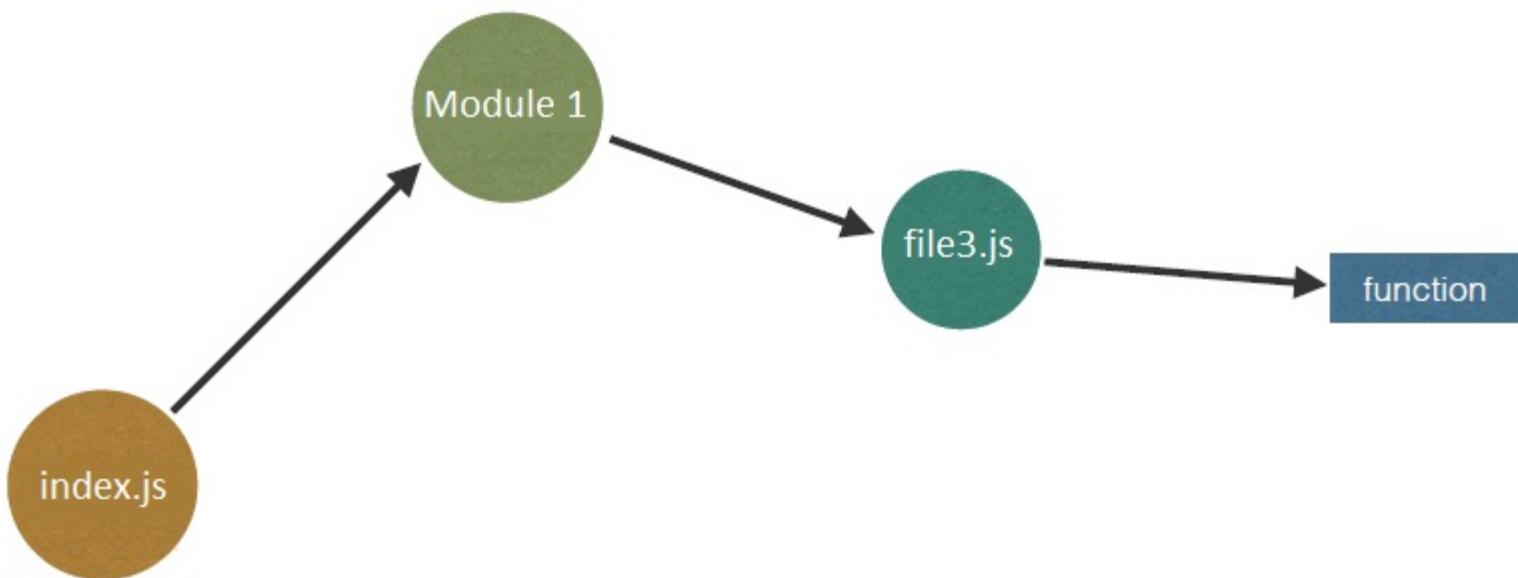
# Tree Shaking

Before Tree Shaking



# Tree Shaking

After Tree Shaking



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# Webpack Bundle Analyzer

## Bundles without AOT and Tree Shaking

vendor.978ac3ef762178ef4aa8.bundle.js

node\_modules

**JIT Compiler**

@angular

platform-browser-dynamic

esm5

platform-browser-dynamic.js  
+ 1 modulescore  
esm5

core.js

router.js +  
23 modules

common.js http.js

common  
esm5forms.js +  
2 modulesplatform-browser esm5 http  
esm5 http.jsplatform-browser-dynamic  
esm5main.ts  
+ 68  
modules

polyfills.7c4efb87d4ba5dbbc58c.bundle.js

node\_modules

zone.js

dist

zone.js

core.js

modules



# Demo

# Conclusion

Quick Wins

Lazy Loading  
and  
Preloading

OnPush w/  
Immutables and  
Observables

AOT and Tree  
Shaking



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# For performance deep dive

Watch this (starting at 8:30):

[https://drive.google.com/file/d/15fmyedJPYSOIv\\_0YvFtg26XGS8tZpZ03/view](https://drive.google.com/file/d/15fmyedJPYSOIv_0YvFtg26XGS8tZpZ03/view)

Repo: <https://github.com/jeffbcross/victor-videos/>