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Ask questions  
through the app

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AUTO

SCOUT 24

ThoughtWorks®

# DATA SCIENCE, DELIVERED CONTINUOUSLY

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*@cdeger*

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SCOUT24

18

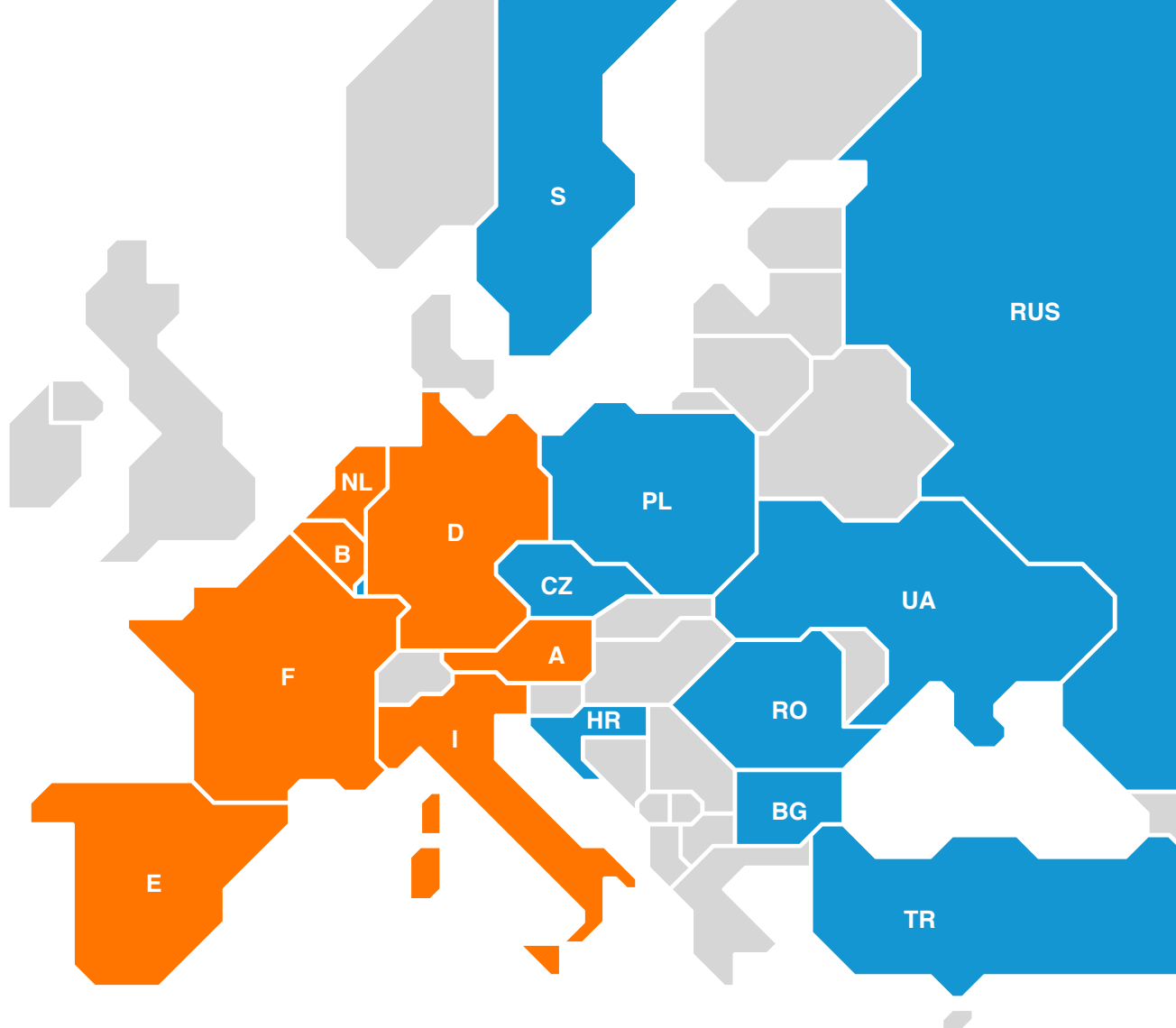
countries

2.4m+

cars & motos

10m+

users per  
month



# The task: A consumer-facing data product

AUTO  
SCOUT24

Suchen

Verkaufen

Informieren

Werkstatt

Mein Konto  
Jetzt anmelden

Fahrzeugbewertung

Finden Sie heraus, wie viel Ihr Auto wert ist.

70 VERKAUFEN

?????€

Marke

Volkswagen

Erstzulassung

2010

Modell

Golf Limousine 5 Türen

Kraftstoff

Diesel

Leistung in kW (PS)

81 (110)

Ausstattungsline

2.0 TDI DPF Trendline

Golf 2.0 TDI DPF

Schaltgetriebe

Sticht: 5

Bauzeitraum: 04/2009 - 03/2010

Kilometerstand (km)

15000

Kostenlos berechnen

# The task: A consumer-facing data product

AUTO  
SCOUT24

Suchen ▾

Verkaufen ▾

Informieren ▾

Werkstatt

Mein Konto ▾  
Jetzt anmelden

🇩🇪 ▾

[< zurück](#)  
Geben Sie weitere Fahrzeugdaten ein.

✓ Volkswagen Golf 2.0 TDI DPF Trendline

Erstzulassung

2010

Aufbau

Limousine, 5 Türen, 5 Sitze

Kraftstoff

Diesel

Leistung in kW (PS)

81 (110)

Kilometerstand

48.000

Ausstattung

☒ = Serienausstattung des gewählten Fahrzeugtyps

Sicherheit

☒ ABS

☒ Beifahrerairbag

☒ Fahrerairbag

☐ Kurvenlicht

☒ Elektronische Lenker

☐ Alarmanlage

☒ ESP

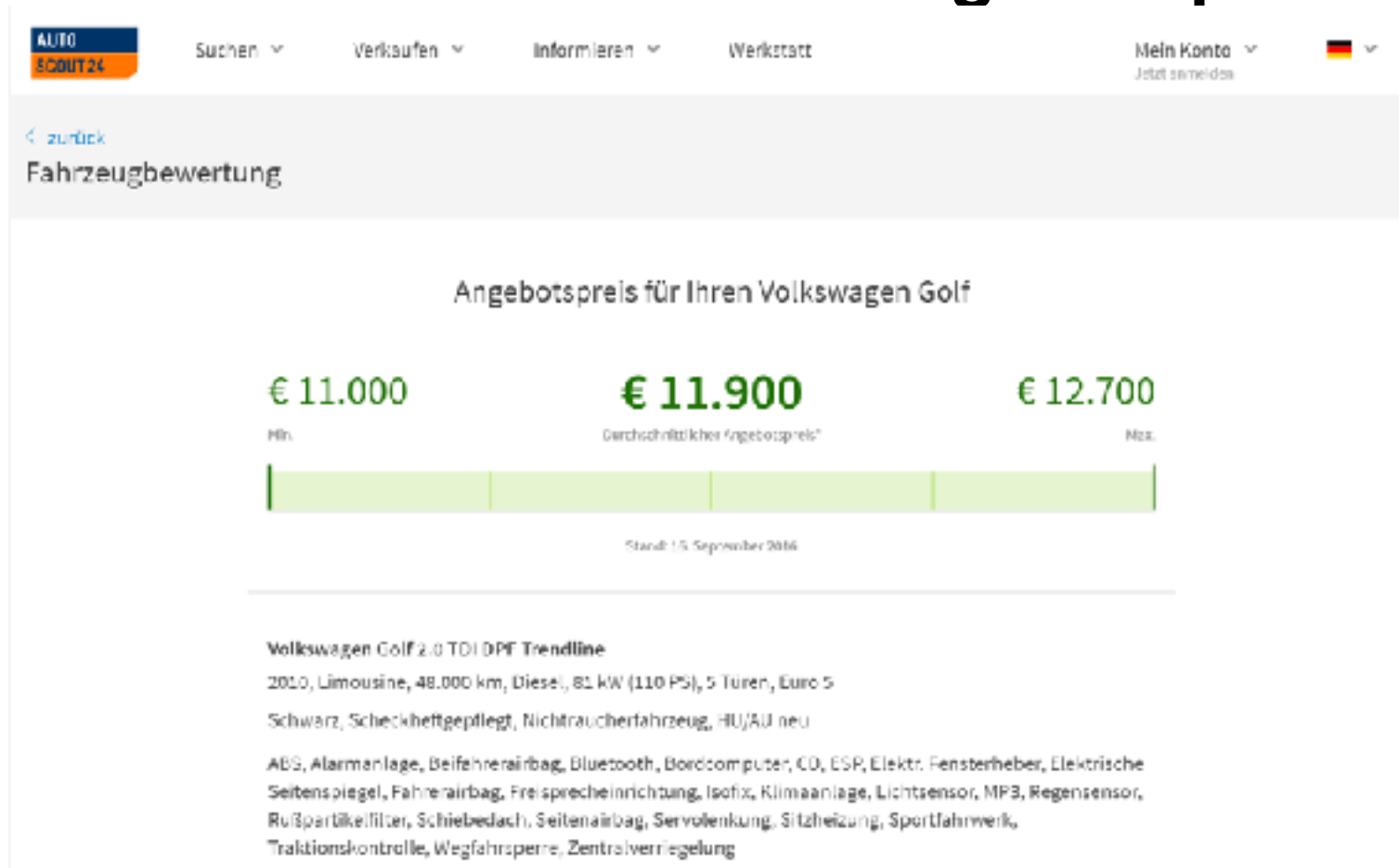
☒ Isofix

☐ Nebelscheinwerfer

☐ Verkehrslichter



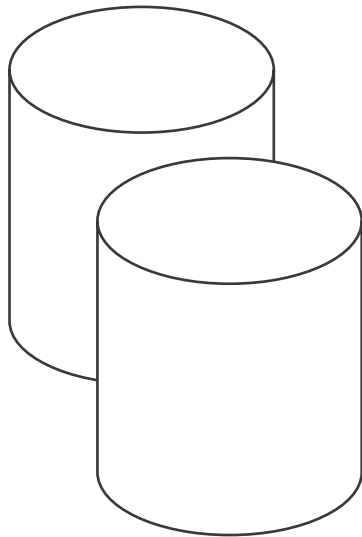
# The task: A consumer-facing data product



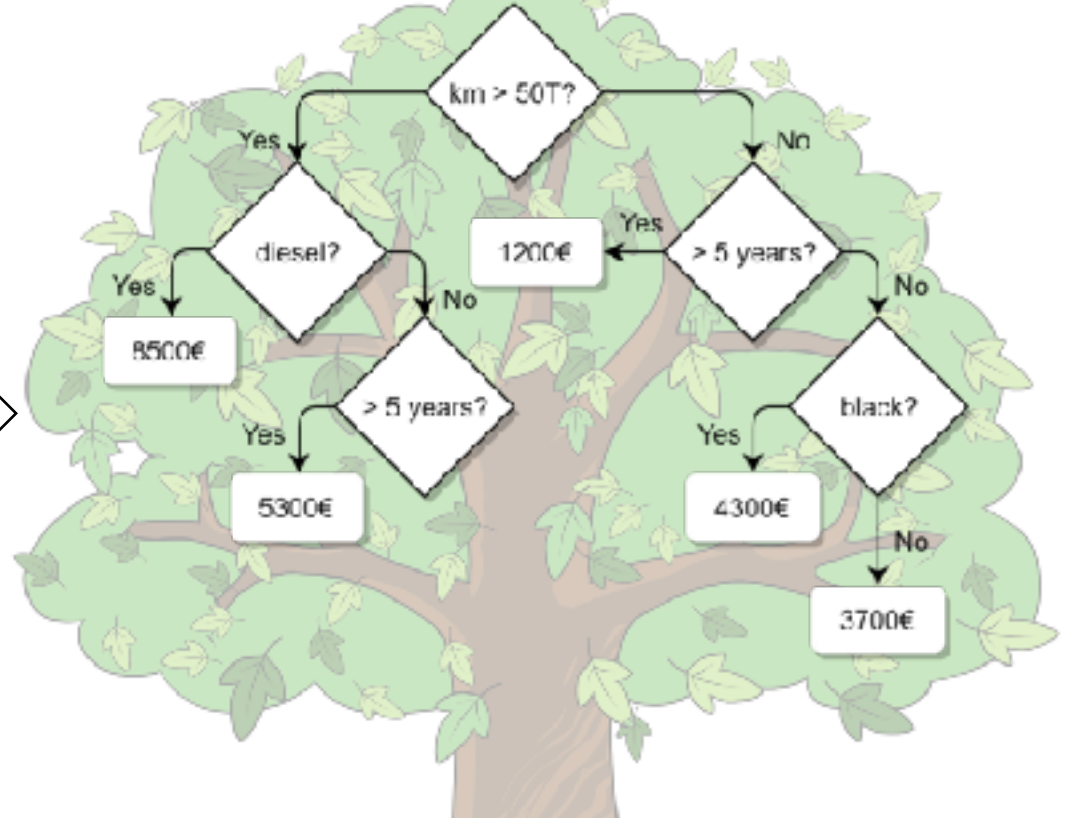


# The prediction model: Random forest

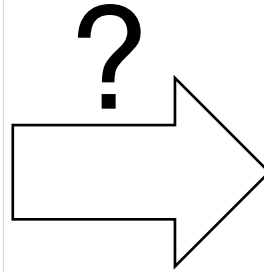
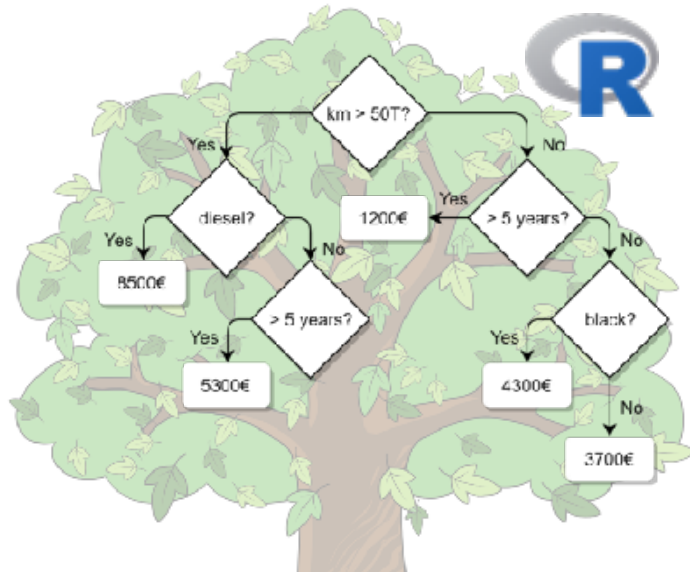
Car listings of  
last two years



Volkswagen Golf

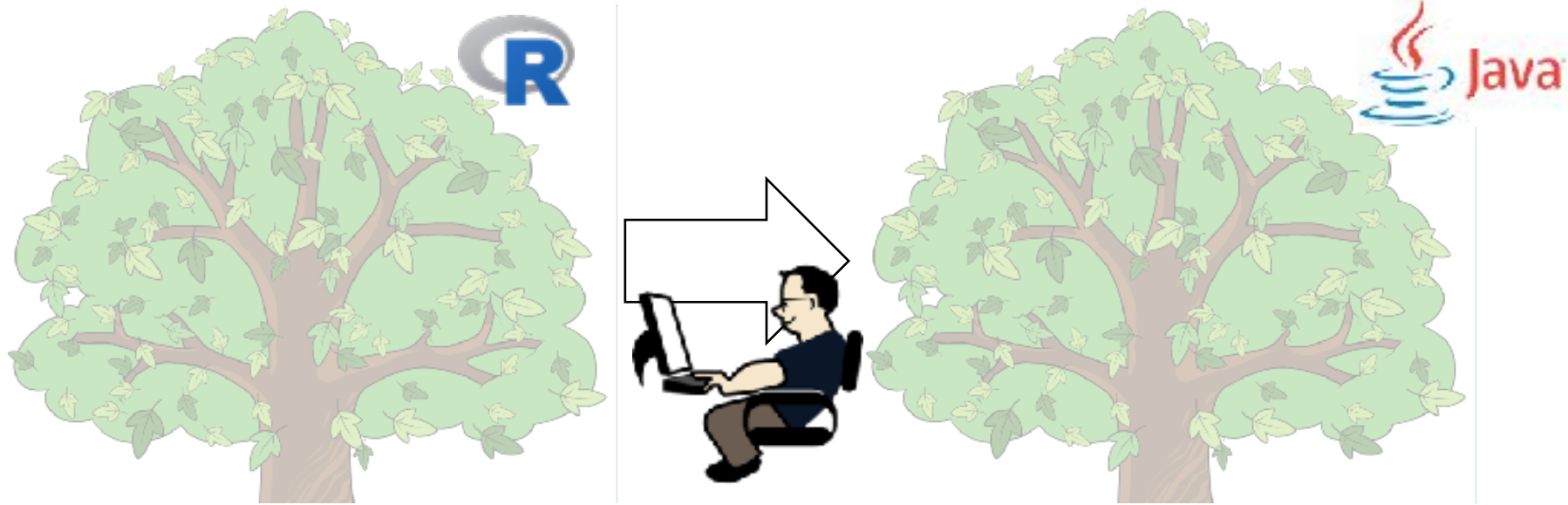


# How to turn an R-based prediction model into a high-performance web application?

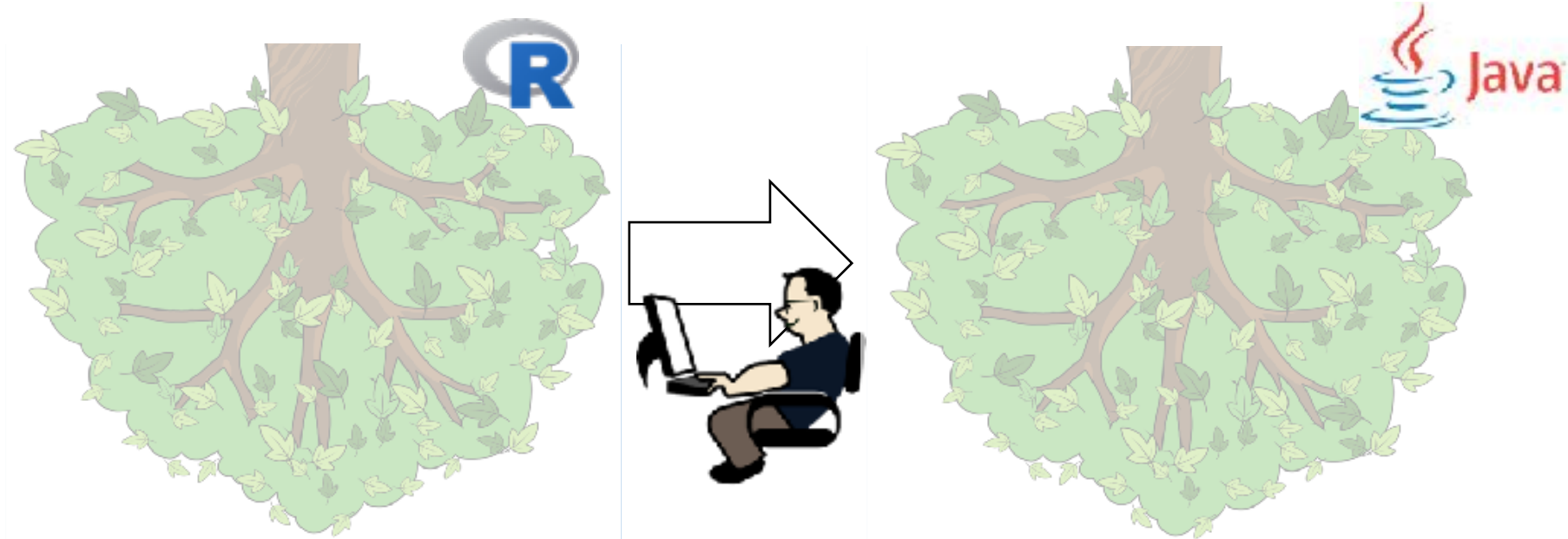


A screenshot of a web application titled "Fahrzeugbewertung" (Car Valuation). The header includes a "Menu" button and a "Preis" button. The main heading is "Fahrzeugbewertung" with the subtitle "Finden Sie heraus, wie viel Ihr Auto wert ist." (Find out how much your car is worth). Below this is a car image with a license plate "HAC 8874" and a price tag "?????€". To the right is a form with the following fields: "Marke" (Brand) with a dropdown menu showing "BMW"; "Kategorie" (Category) with a dropdown menu showing "118"; "Modell" (Model) with a dropdown menu showing "118i Cabrio 2Tür"; "Kraftstoff" (Fuel) with a dropdown menu showing "Benzin"; "Leistung in PS (kW)" (Power in PS (kW)) with a dropdown menu showing "118 (100)"; "Ausstattungsstufe" (Equipment level) with a dropdown menu showing "118i Cabrio Aut."; "Kilometerstand (km)" (Mileage) with a text input field showing "100000". Below the form is an orange button labeled "Kostenlos berechnen" (Calculate for free). At the bottom, there is a text block: "Was bringt Ihnen die Fahrzeugbewertung? Alles, was Sie zur Preisfindung brauchen." (What does the car valuation bring you? Everything you need for finding the price).

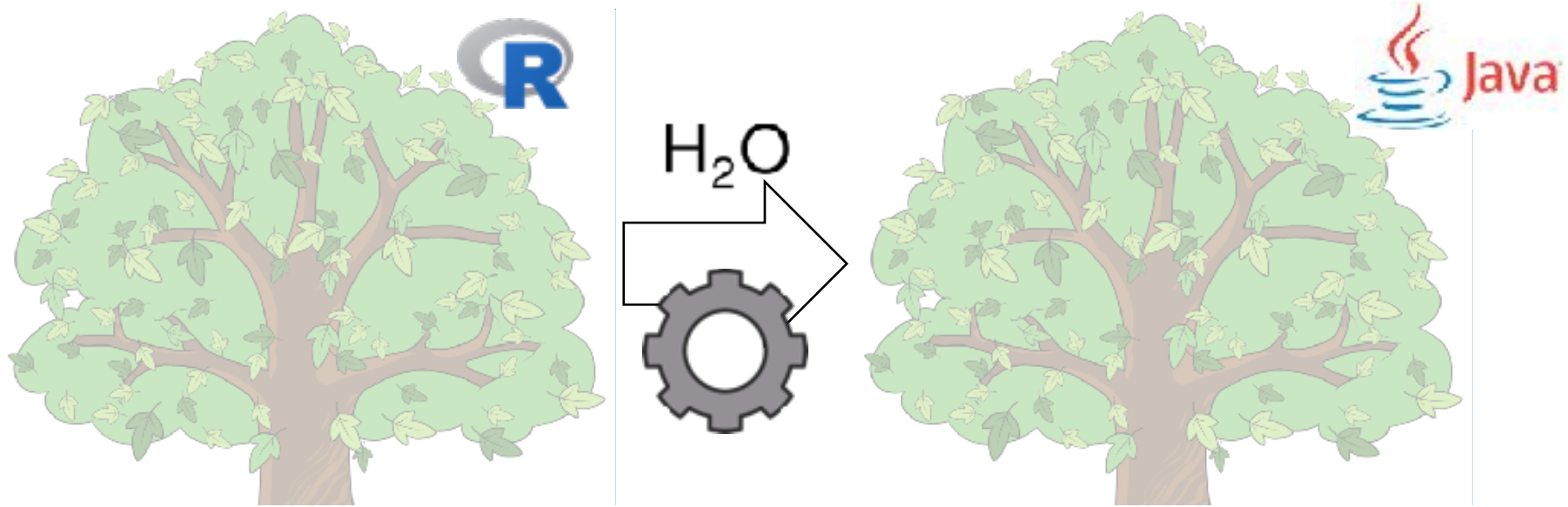
# How to turn an R-based prediction model into a high-performance web application?



# How to turn an R-based prediction model into a high-performance web application?



# How to turn an R-based prediction model into a high-performance web application?



→ **Continuous Delivery!**

# Typical delivery pipeline



Application **code** in  
one repository per  
service.

# Typical delivery pipeline



Application **code** in  
one repository per  
service.

Deployment  
**package** as artifact.



# Typical delivery pipeline

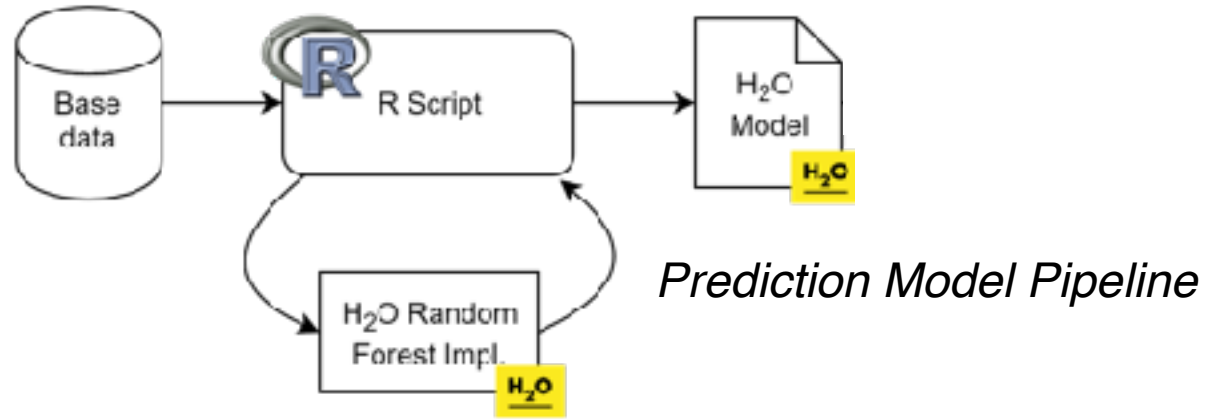


Application **code** in  
one repository per  
service.

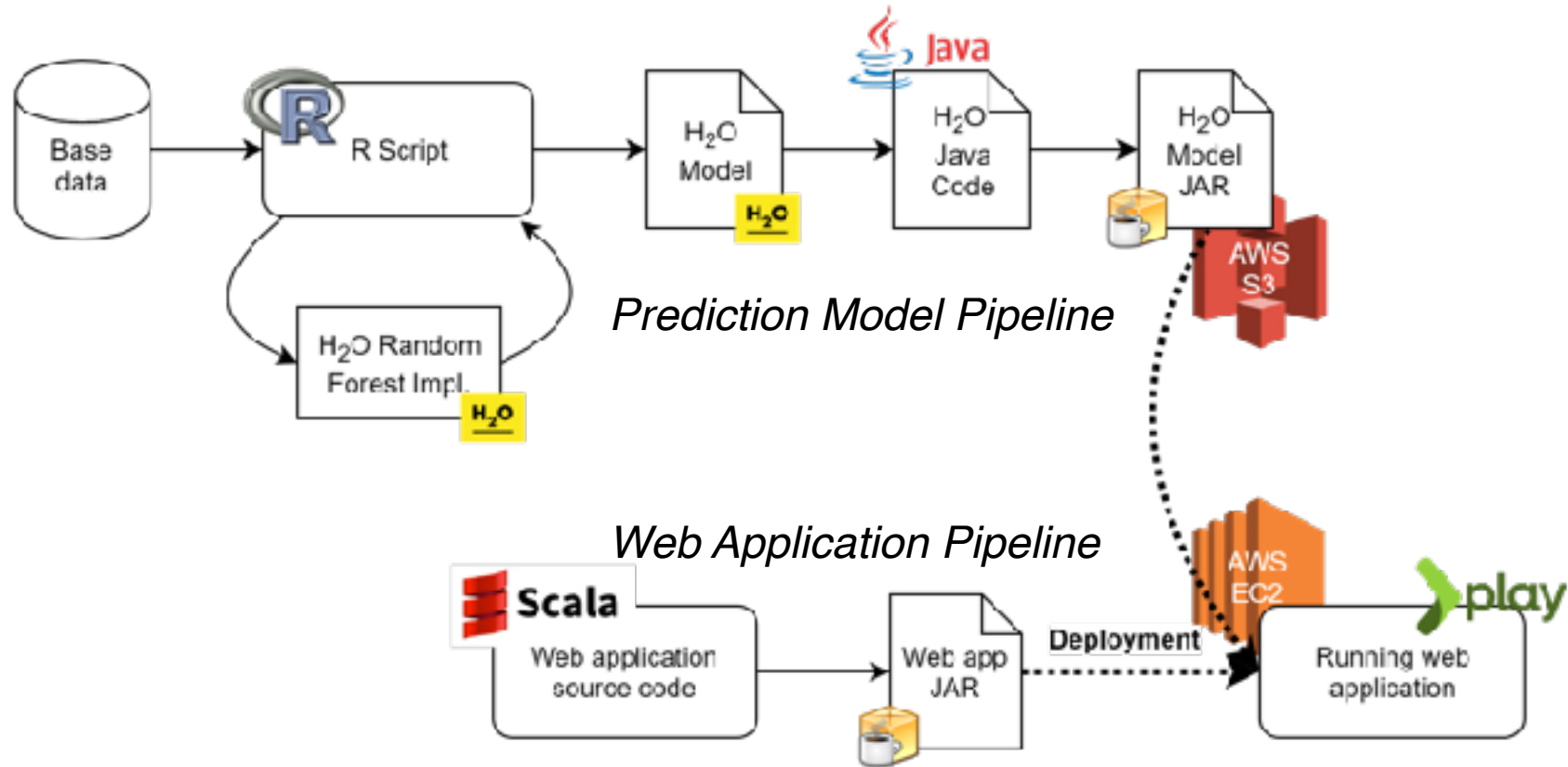
Deployment  
**package** as artifact.

Deliver package to  
**servers**

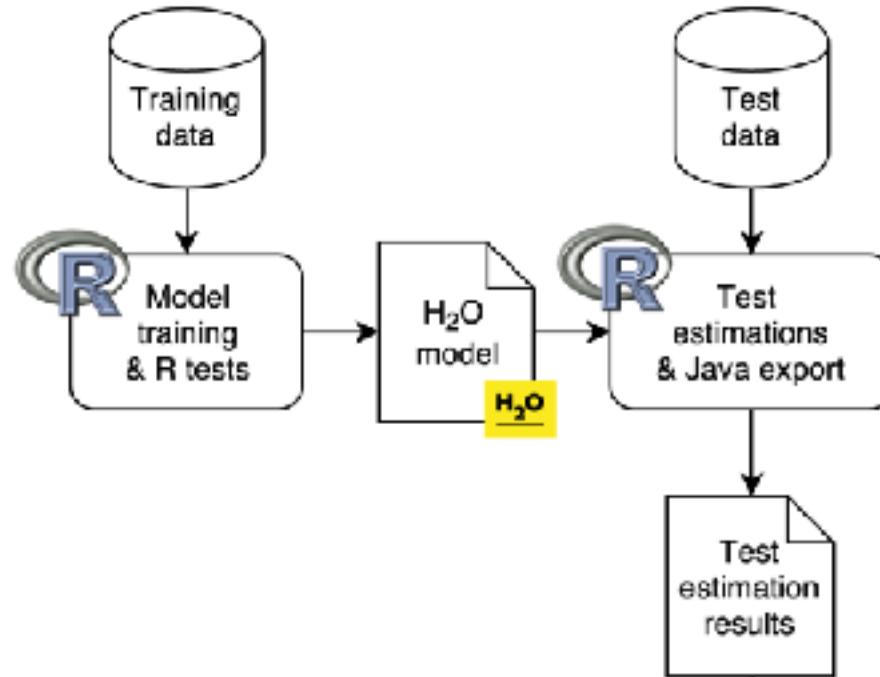
# Continuous delivery pipelines



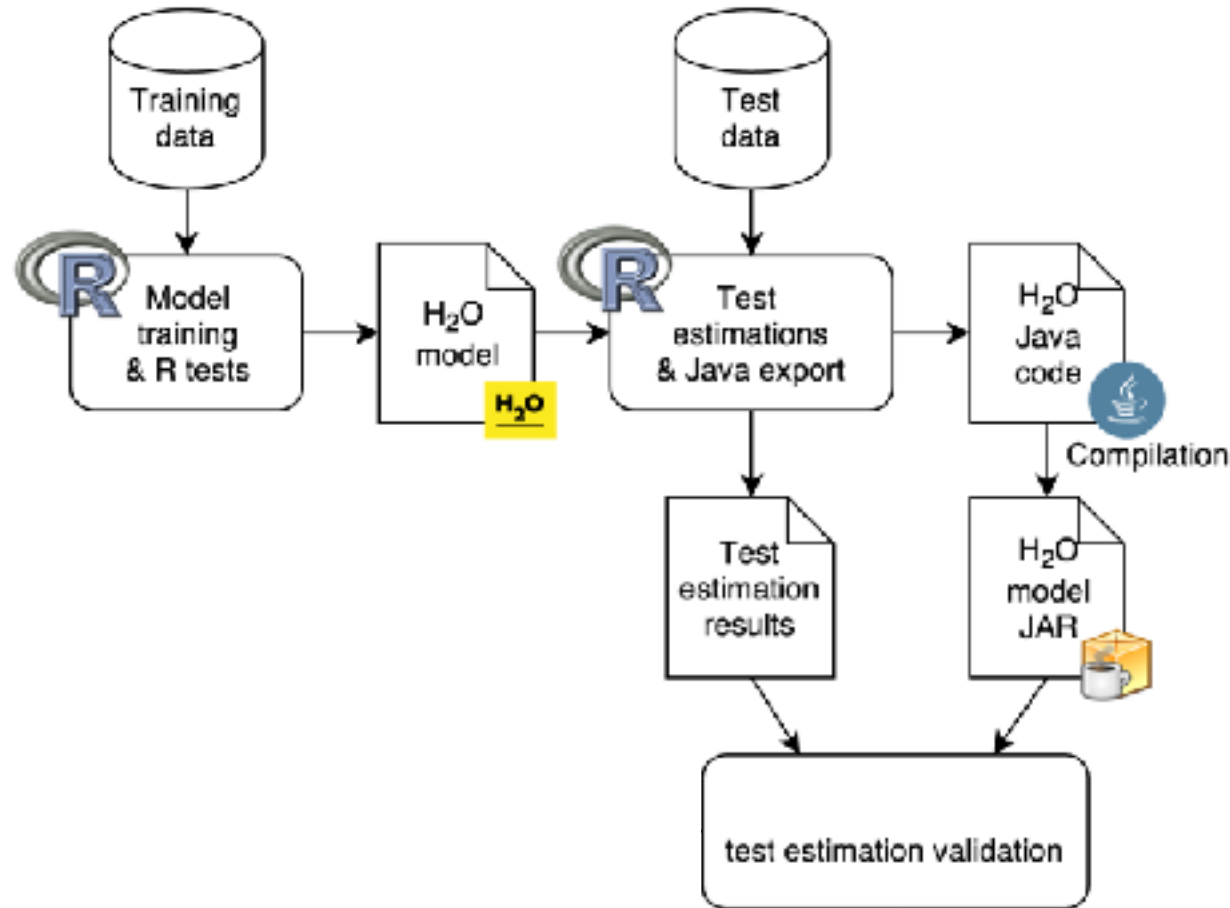
# Continuous delivery pipelines



# The price for CD: Extensive model validation



# The price for CD: Extensive model validation



# Lessons learned

## **Form a cross-functional team of data scientists & software engineers!**

### Software engineers

- ... learn how data scientists work
- ... and understand the quirks of a prediction model

### Data Scientist

- ... learn about unit testing, stable interfaces, git, etc.
- ... get quick feedback about the impact of their work

→ Model and product iterations become much faster!

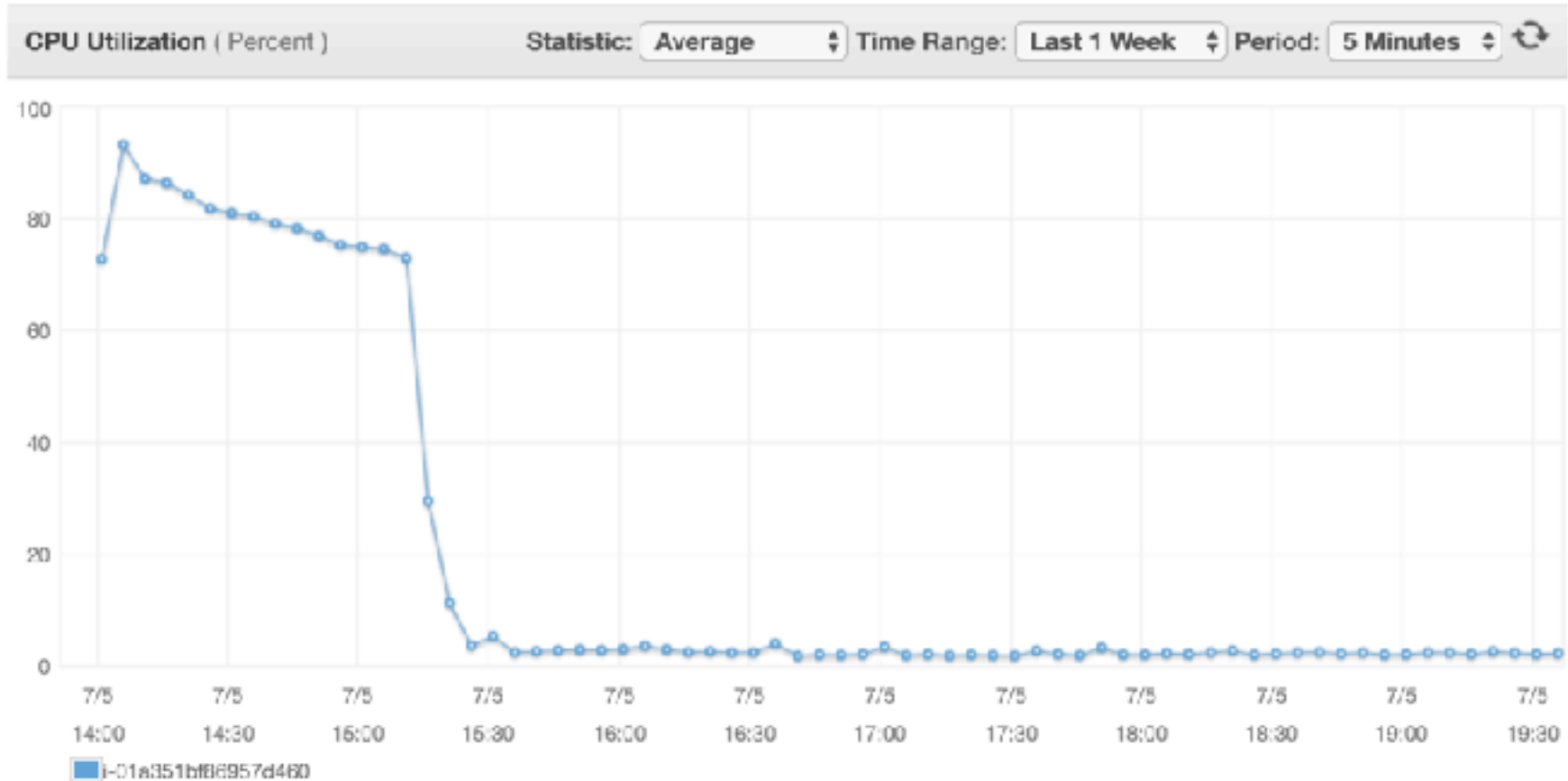
# Lessons learned

## Generating gigabytes of Java code is a challenge for the JVM

- à Use the G1 garbage collector
- à Turn off Tiered Compilation
- Do extensive warm-ups



# Lessons learned – Warm up



# Lessons learned

**The approach of applying Continuous Delivery to Data Science is useful independently of the tech**

- Successfully applied similarly to a Python- and Spark-based project
- Even more useful when quick model evolution is required because of rapidly changing inputs (e.g. user interaction)

# Conclusions

- Continuous Delivery allows us to bring prediction model changes live very quickly.
- Only extensive automated end-to-end tests provide confidence to deploy to production automatically.
- Java code generation allows for very low response times and excellent scalability for high loads but requires plenty of memory.

# Conclusions: Price evaluation everywhere

## Kostenloses Inserat erstellen

💡 Basierend auf Ihren Daten empfehlen wir Ihnen folgenden Preis:

Ändern Sie Ihre Fahrzeugdaten, ändert sich der Preis. [Wie funktioniert das?](#)

**€ 25.584** **Preis übernehmen**

Fahrzeugdaten

✓ Daten vorhanden [Ergänzen](#)

Marke und Modell  
Details

BMW 218 2er Coupe Aut.  
Gebraucht, Coupé, 03/2015, 136 PS (100 kW), Benzin

### Individuelle Verkaufsdaten

Außenfarbe

Gelb

☐ Metallic

Kilometerstand

1275

Fahrgestellnummer (FIN)


17-stellige Nummer

Preis in Euro


# Conclusions: Price evaluation everywhere

**Toyota Aygo** 1.0i 69 PS

Alufelgen, Nebelscheinwerfer, Radio, Bluetooth, ABS, Isofix, Einparkhilfe, Beifahrerairbag

 **€ 9.790,-<sup>2</sup>** GUTES ANGEBOT TOYOTA PLUS


		51 kW (69 PS)
Tageszulassung	1 Fahrzeughalter	Schaltgetriebe
Benzin	4,1 l/100 km (komb) <sup>1</sup>	95 g CO2/km (komb) <sup>1</sup>

 1.0i 69 PS + Weitere Fahrzeuge anzeigen

# Conclusions: Price evaluation everywhere

**Toyota Aygo** 51 kW (69 PS)

Alufelgen, Nebelscheinwerfer, Radio, Bluetooth, ABS, Isofix, Einparkhilfe, Beifahrerairbag



€ 9.790,-<sup>2</sup> **GUTES ANGEBOT** TOYOTA PLUS

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1/15 300

TEST 5 Sterne 5 Sterne 5 Sterne 5 Sterne

[+ Weitere Fahrzeuge anzeigen](#)


**DIESES ANGEBOT**

**€ 9.790,-**



# Conclusions: Price evaluation everywhere

**Toyota Aygo** Alufelgen, Nebelscheinwerfer, Radio, Bluetooth, ABS, Isofix, Einparkhilfe, Beifahrerairbag



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1/15 300

4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

+ Weitere Fahrzeuge anzeigen



## AutoScout24 Preisbewertung Was ist das?

☐ **TOP ANGEBOT**  
[ ][ ][ ][ ][ ]

☒ **GUTES ANGEBOT**  
[ ][ ][ ][ ][ ]

☐ **FAIRES ANGEBOT**  
[ ][ ][ ][ ][ ]

☐ **ETWAS TEUER**  
[ ][ ][ ][ ][ ]

☐ **TEUER**  
[ ][ ][ ][ ][ ]



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# THANK YOU

## *QUESTIONS?*

*Arif Wider & Christian Deger*

*@arifwider*

*@cdeger*

Please

**Remember to  
rate this session**

Thank you!

