

**DCGI**

DEPARTMENT OF COMPUTER GRAPHICS AND INTERACTION

# PLATFORM-AWARE RICH FORM GENERATION FOR ADAPTIVE SYSTEMS THROUGH CODE- INSPECTION

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Faculty of Electrical Engineering

# MOTIVATION

# MOTIVATION

Shipping and Billing Info

Shipping Address

First Name  
Last Name  
Address  
Zip Code  
Phone Number

Billing Address

My shipping address is the same as my billing address.

First Name  
Last Name  
Address  
Zip Code  
Phone Number

Card Number  
MM/YY

Card ID Number  
Three digit number on back of card

Continue

Your Cart Shipping/Billing Review

Software602  
Form Signer

## TIMESHEET

Name: \_\_\_\_\_ Organization Unit: \_\_\_\_\_

Project Name: \_\_\_\_\_ Hours: \_\_\_\_\_

Date: 18.6.2013

Select Form Action:

Sign and Submit Save Form Close Form

OfficeTime

New Session New Expense

Timesheet Projects Categories Reports

Active sessions

Sanford Online 00h 22m

Today \$154.23 / 03h 49m



# MOTIVATION

A web form titled "Shipping and Billing Info" with two columns: "Shipping Address" and "Billing Address". Each column contains input fields for First Name, Last Name, Address, Zip Code, and Phone Number. There is a checkbox for "My shipping address is the same as my billing address." Below the forms are fields for Card Number and Card ID Number, with a "Continue" button at the bottom.

A web form titled "Software602 Form Signer TIMESHEET". It includes fields for Name, Organization Unit, Project Name, and Hours. The date is set to "18.6.2013". At the bottom, there are three buttons: "Sign and Submit", "Save Form", and "Close Form".

A mobile app interface for "OfficeTime" showing a menu with options: "New Session", "New Expense", "Timesheet", "Projects", "Categories", and "Reports". It also displays "Active sessions" with a summary for "Sanford Online" showing "00h 22m" and a total of "\$154.23 / 03h 49m".

A collection of mobile app interfaces including a "Bank of Montreal Mobile Banking" app with "Sign In" and "Find Us" buttons, a "Bakerloo" app with a list of services, and a "WATANYA" app with "send", "view files", and "revision history" buttons.



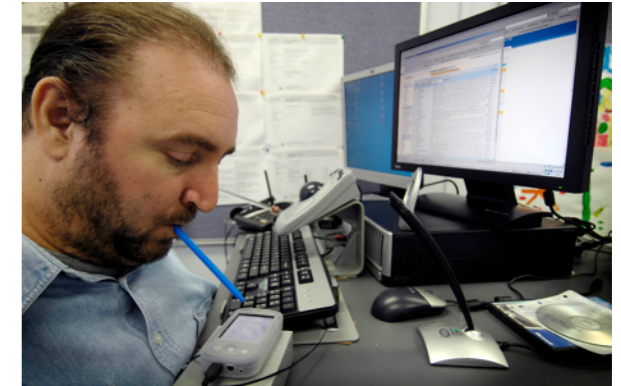
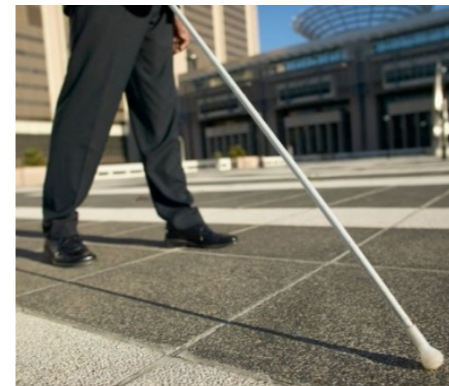
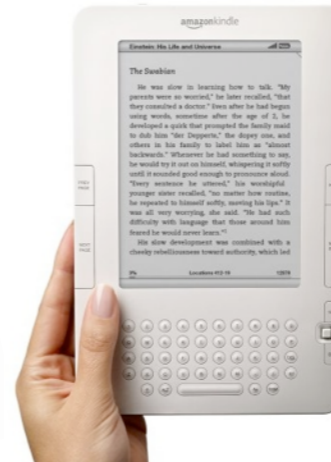
# MOTIVATION

A web form titled "Shipping and Billing Info" with two columns: "Shipping Address" and "Billing Address". Each column contains fields for First Name, Last Name, Address, Zip Code, and Phone Number. There are also fields for Card Number and MM/YYYY. A "Continue" button is at the bottom right. A red banner at the bottom says "Three digit number on back of card".

A web form titled "TIMESHEET" from Software602 Form Signer. It has fields for Name, Organization Unit, Project Name, and Hours. The date is set to 18.6.2013. At the bottom, there are three buttons: "Sign and Submit", "Save Form", and "Close Form".

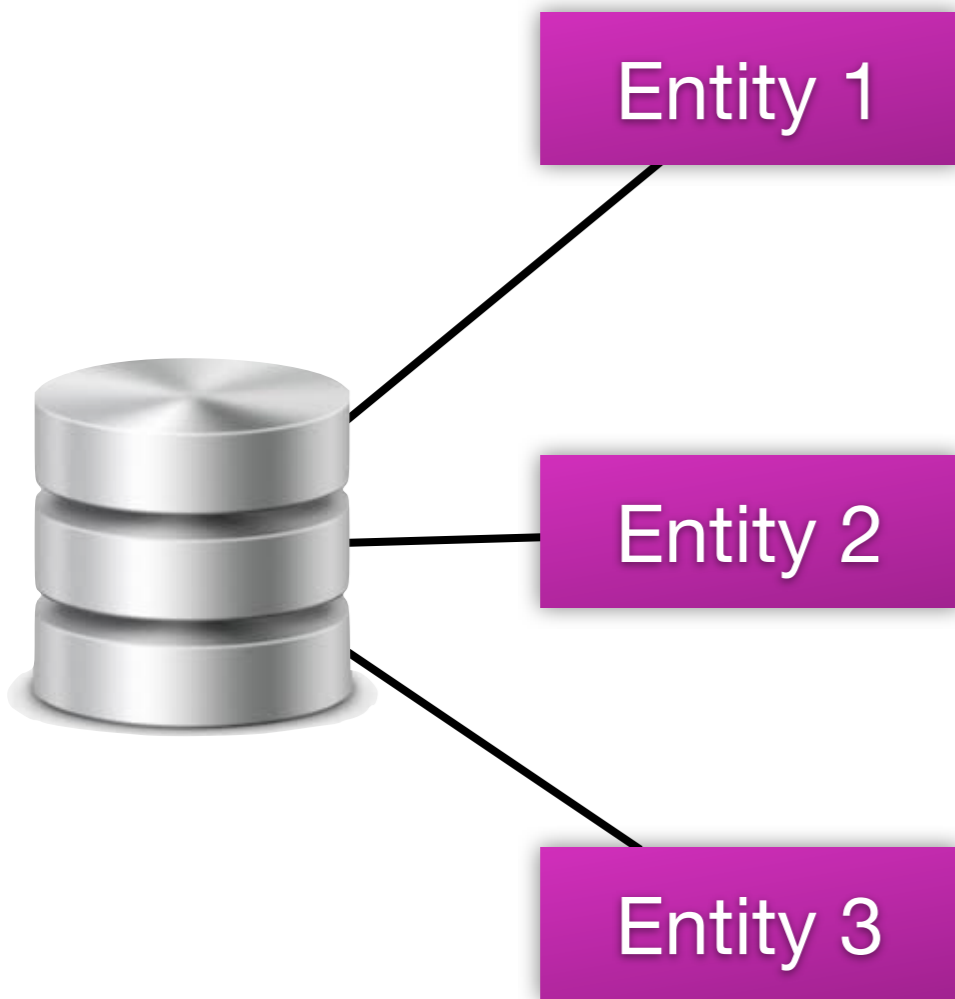
A mobile app interface for "OfficeTime". It shows a menu with options: "New Session", "New Expense", "Timesheet", "Projects", "Categories", and "Reports". Below the menu, it displays "Active sessions" with a session for "Sanford Online" running for 00h 22m. The total time is 03h 49m.

A collection of mobile banking app interfaces. One shows a list of services: Bakerloo, Central, Circle, District, Hammer...nd City, Jubilee, and Metropolitan. Another shows a "Mobile Banking" screen with "Sign In" and "Find Us" buttons. A third shows a "send" button and "view files" and "revision history" options.

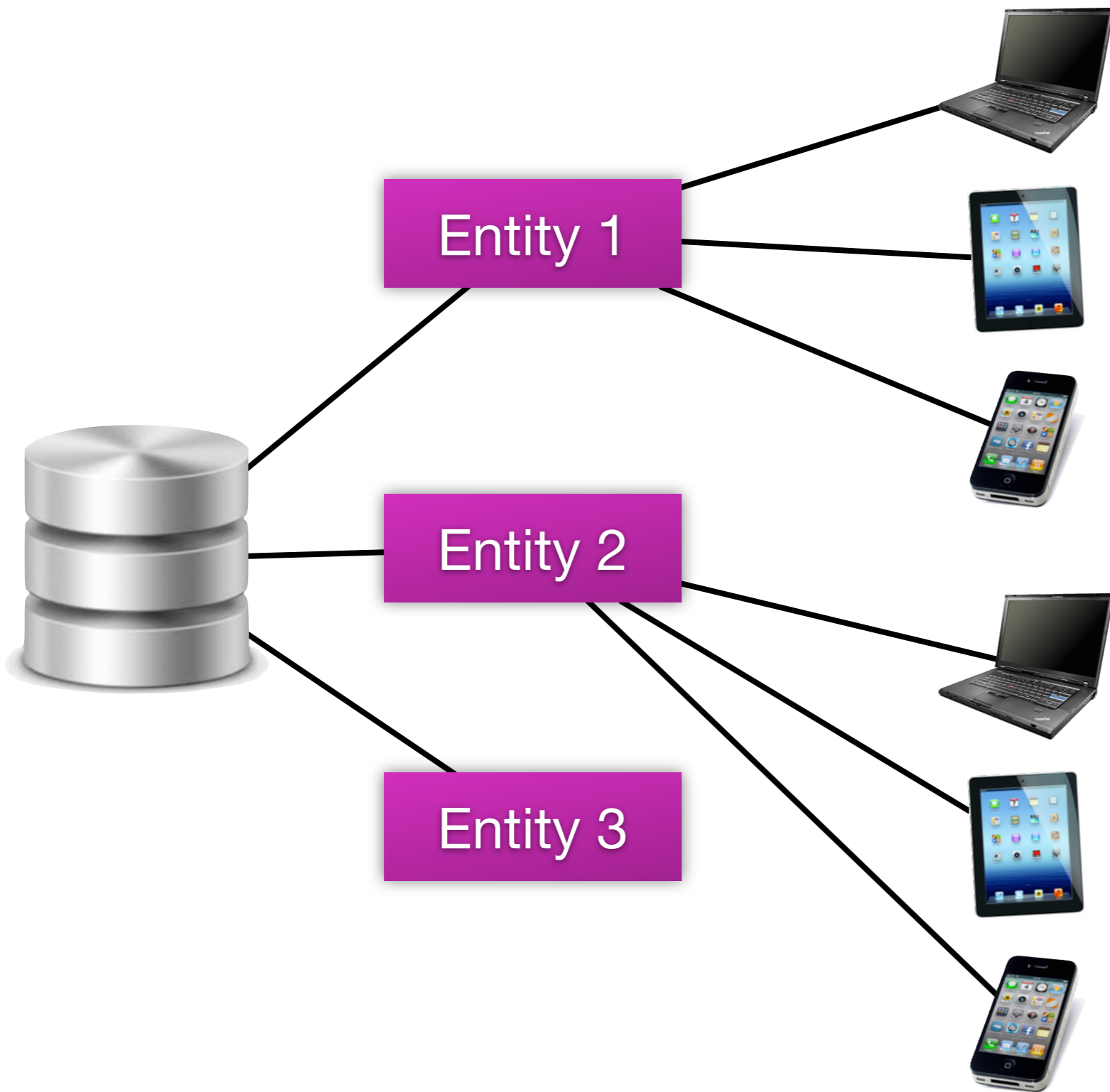


# MOTIVATION | CONT.

# MOTIVATION | CONT.

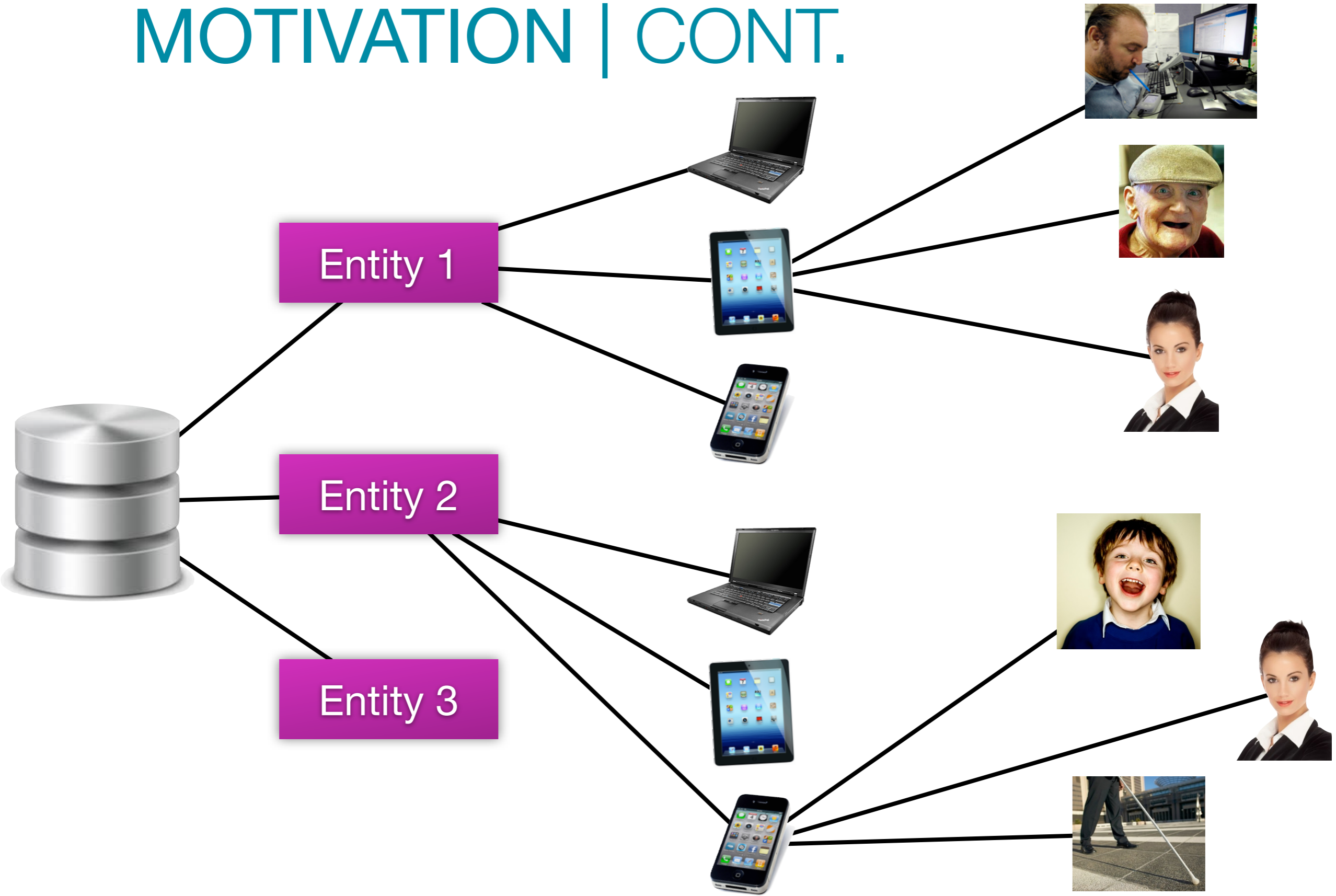


# MOTIVATION | CONT.





# MOTIVATION | CONT.



# MOTIVATION

# MOTIVATION

## Problems

# MOTIVATION

Problems

Information  
restatement

Data  
Entity

```
@Table(name = "person_info")
public class PersonInfo extends EntityObject {

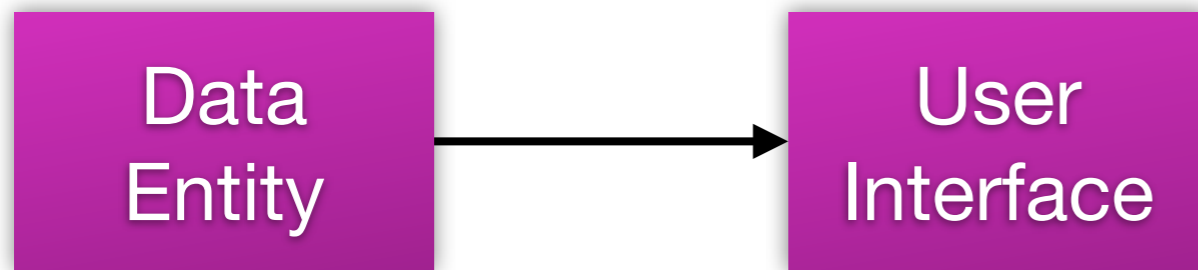
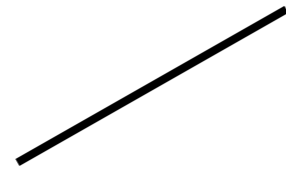
    /*fields*/
    @Column(name = "first_name", nullable = false)
    public String getFirstName() {return this.firstName;}

    @Column(name = "last_name")
    public String getLastName() {return this.lastName;}
}
```

# MOTIVATION

Problems

Information  
restatement



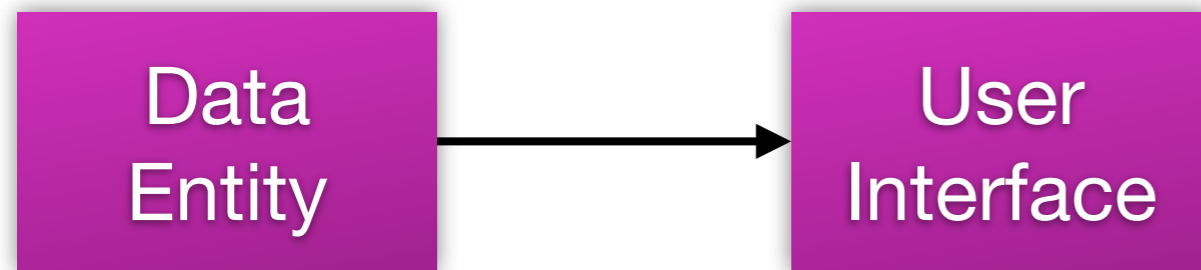
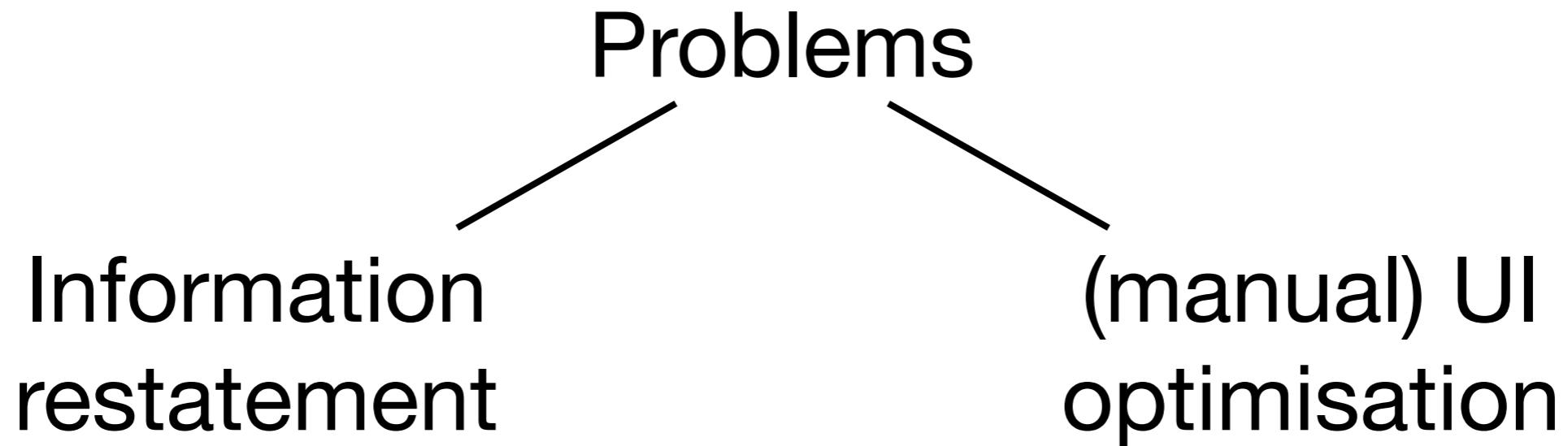
```
@Table(name = "person_info")
public class PersonInfo extends EntityObject {

    /*fields*/
    @Column(name = "first_name", nullable = false)
    public String getFirstName() {return this.firstName;}

    @Column(name = "last_name")
    public String getLastName() {return this.lastName;}
}
```



# MOTIVATION



```
@Table(name = "person_info")
public class PersonInfo extends EntityObject {

    /*fields*/
    @Column(name = "first_name", nullable = false)
    public String getFirstName() {return this.firstName;}

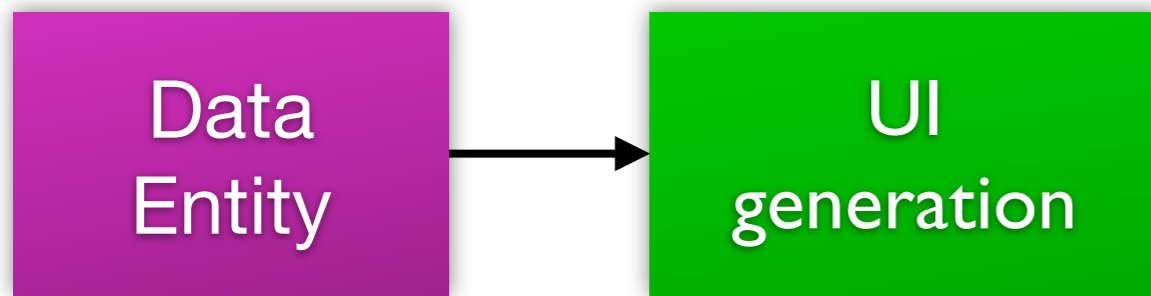
    @Column(name = "last_name")
    public String getLastName() {return this.lastName;}
}
```

iOS



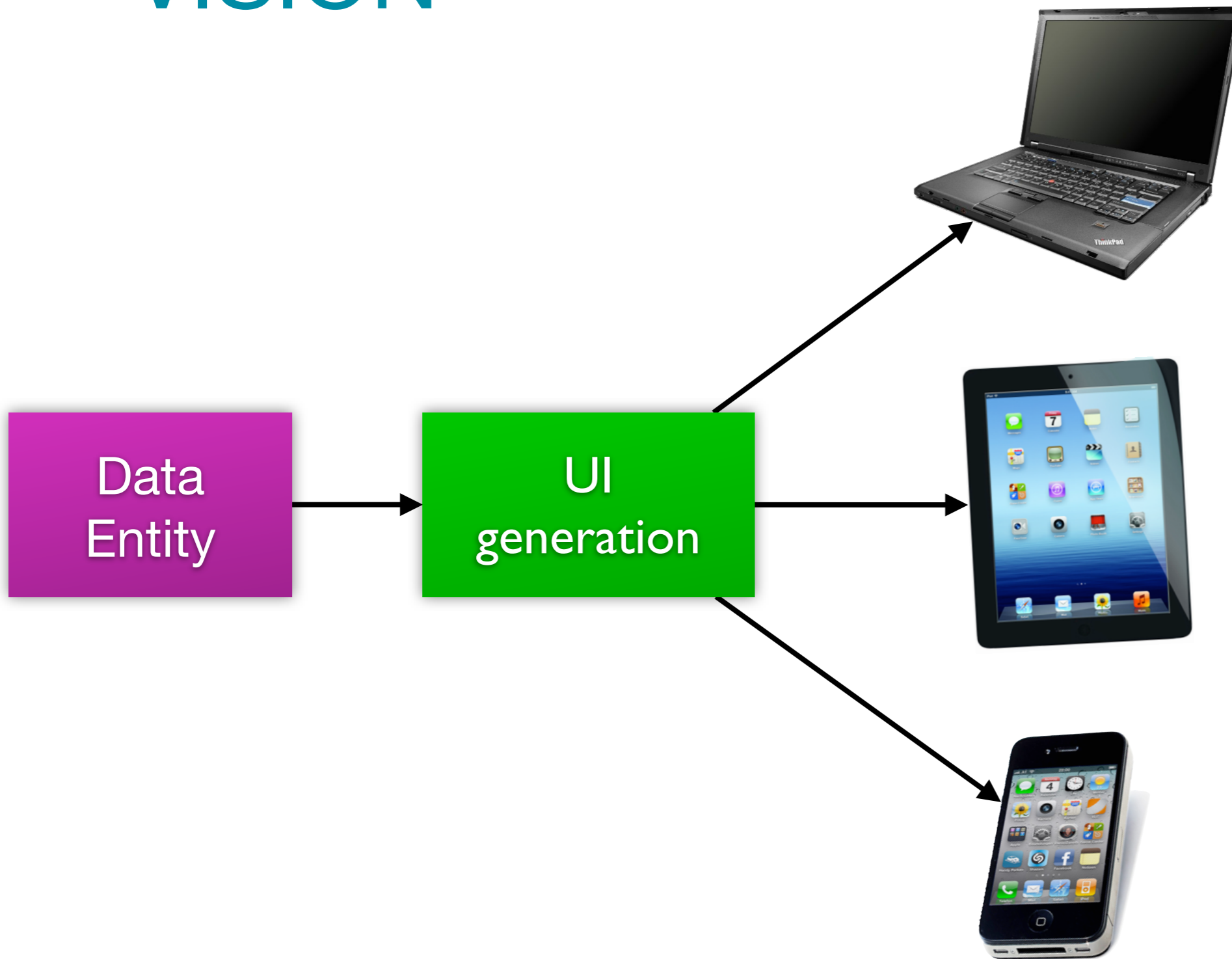
# VISION

# VISION

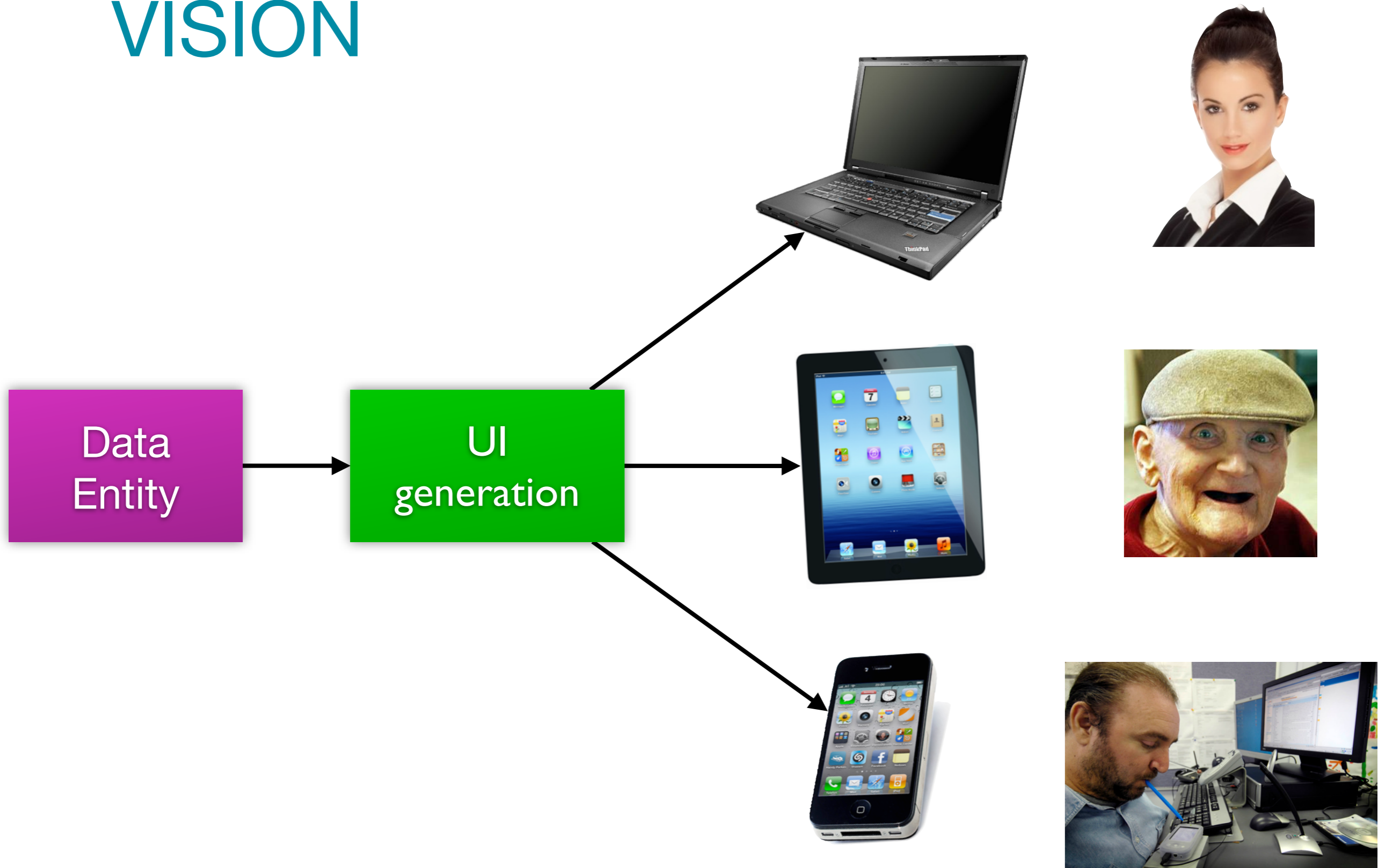




# VISION



# VISION



# UI GENERATION | STAGES



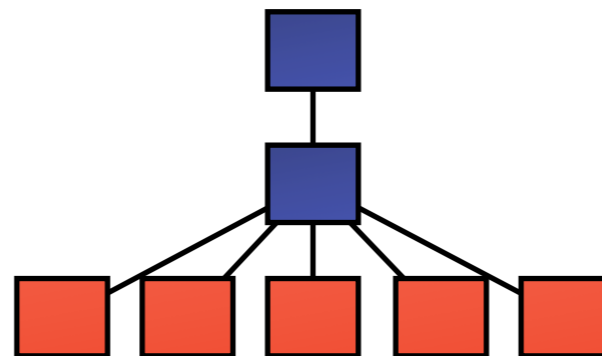
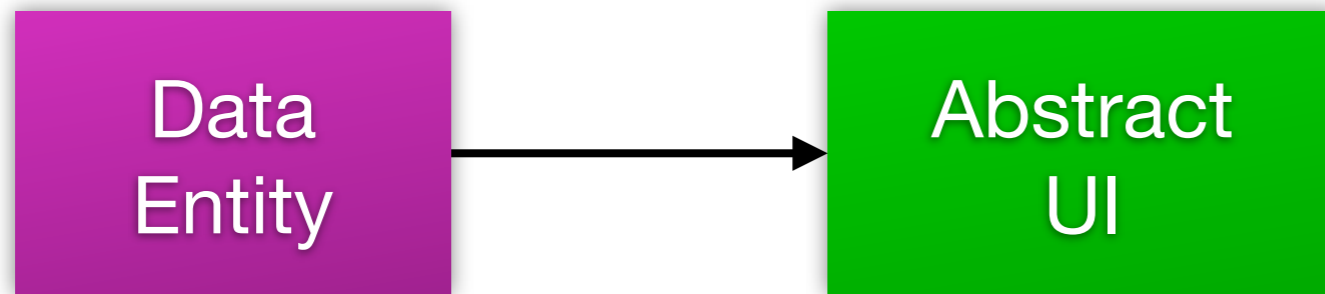
Data  
Entity

# UI GENERATION | STAGES

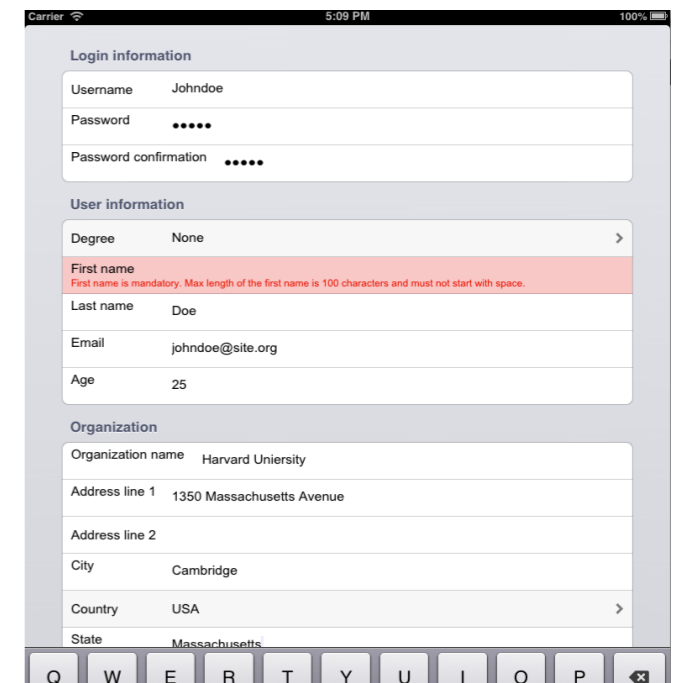
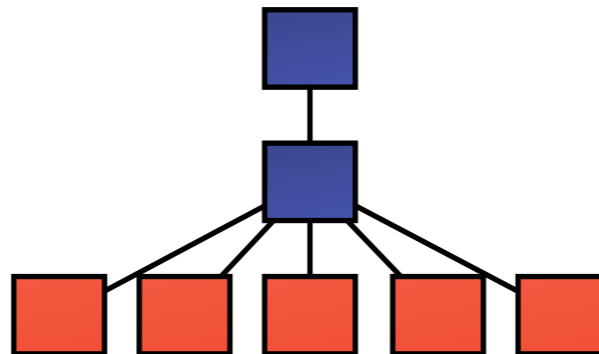
Data  
Entity



# UI GENERATION | STAGES

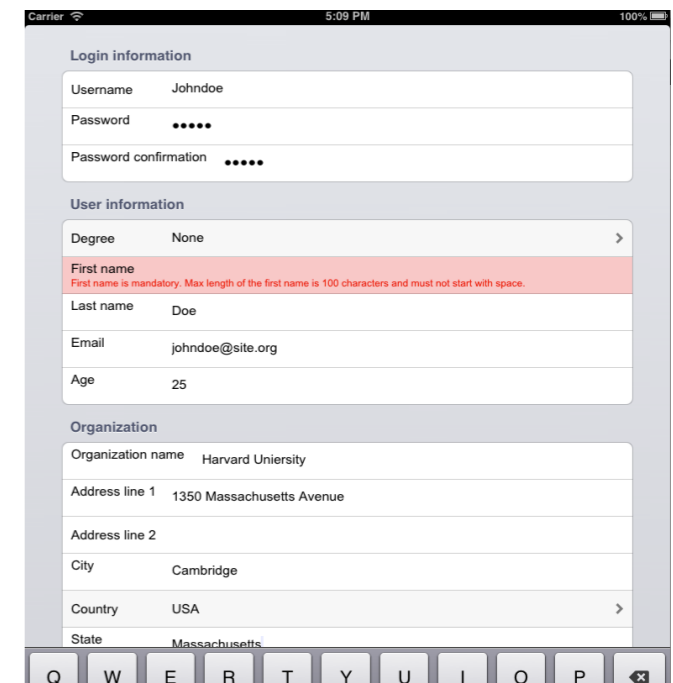
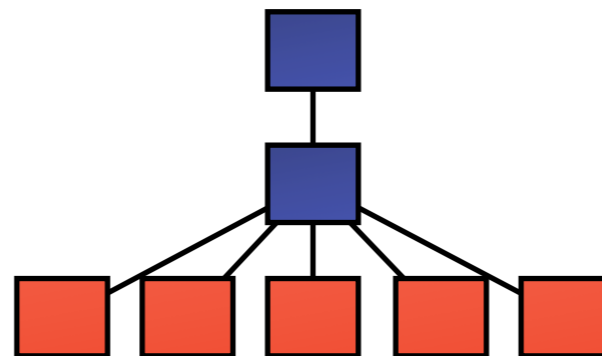
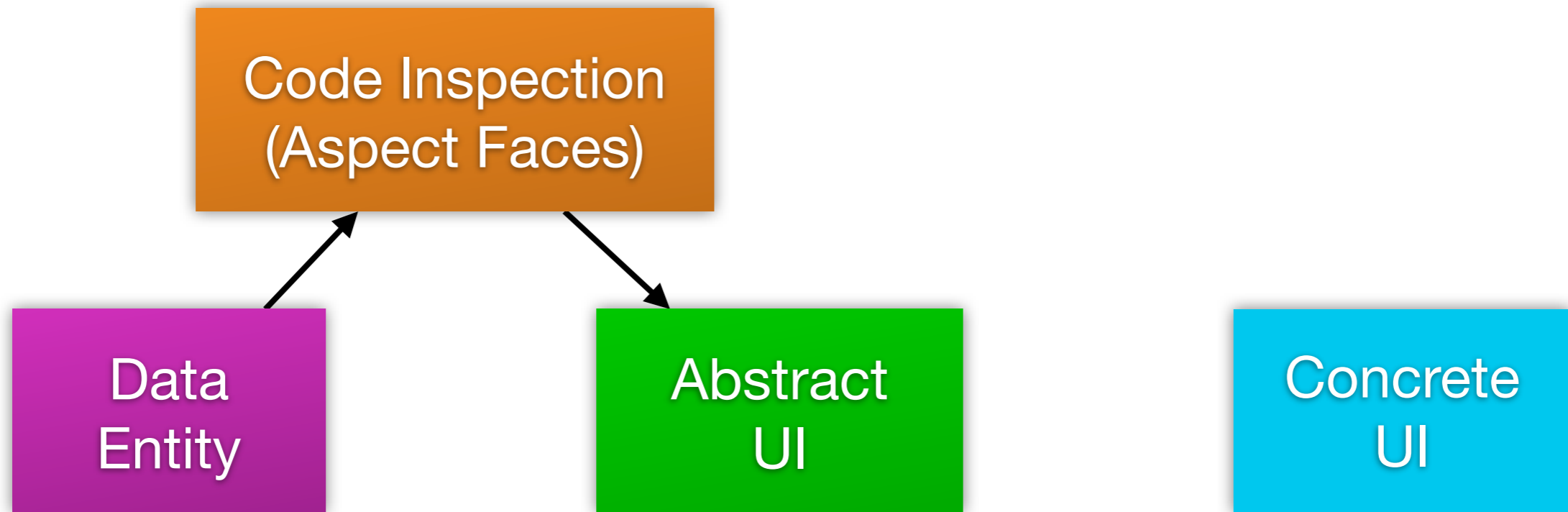


# UI GENERATION | STAGES



# UI GENERATION | STAGES

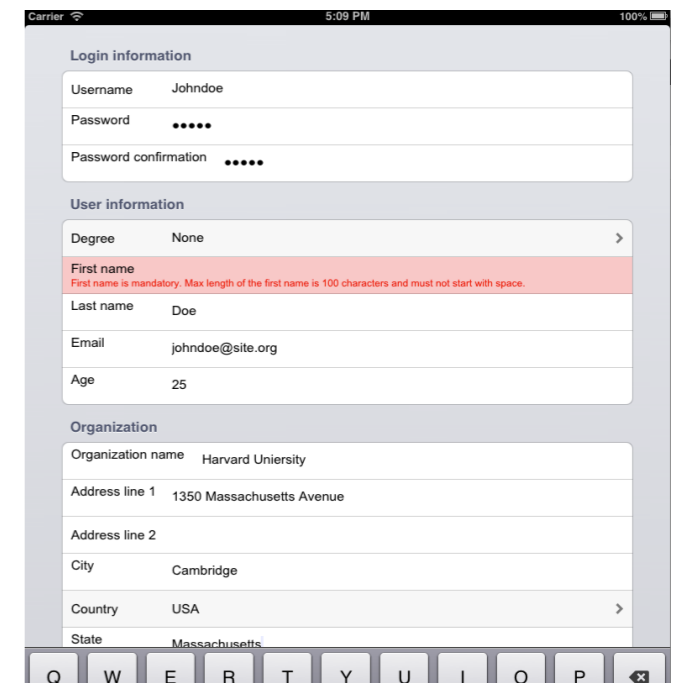
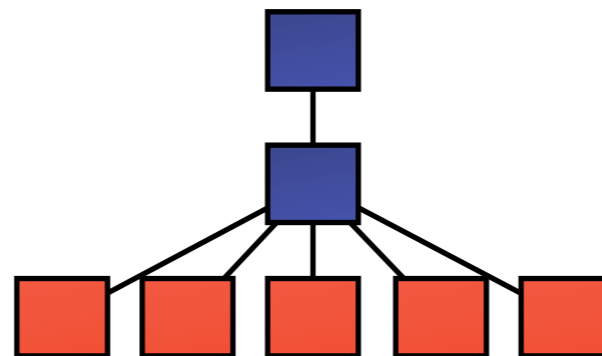
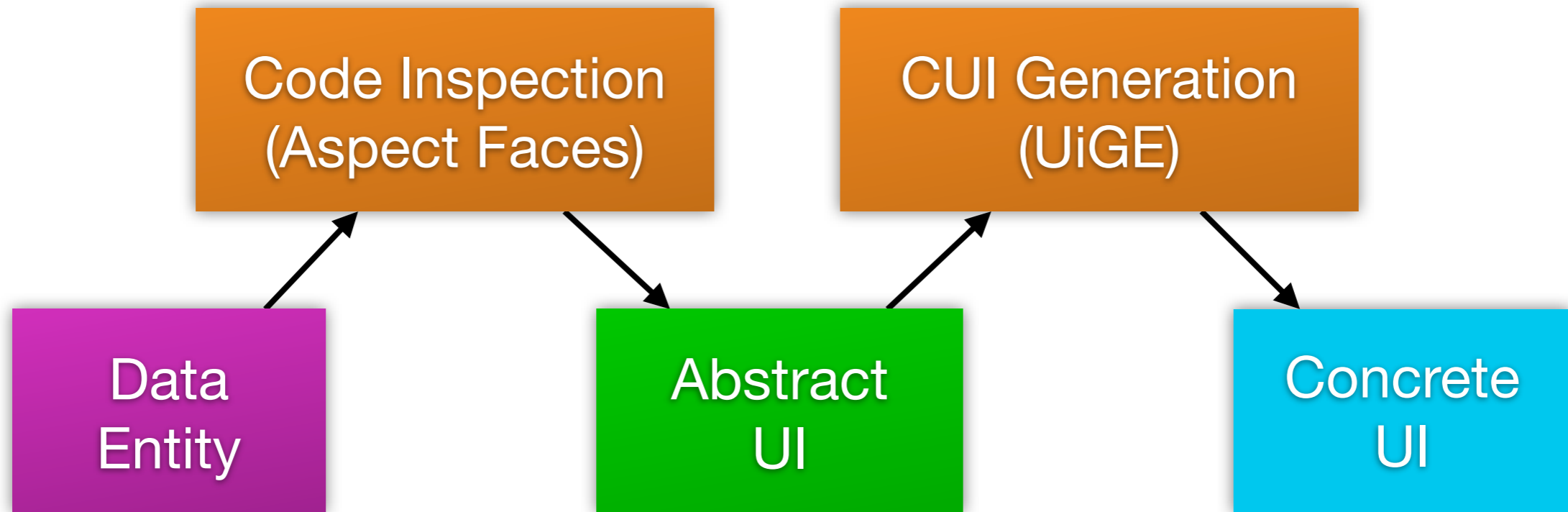
[Cerny 2011]



# UI GENERATION | STAGES

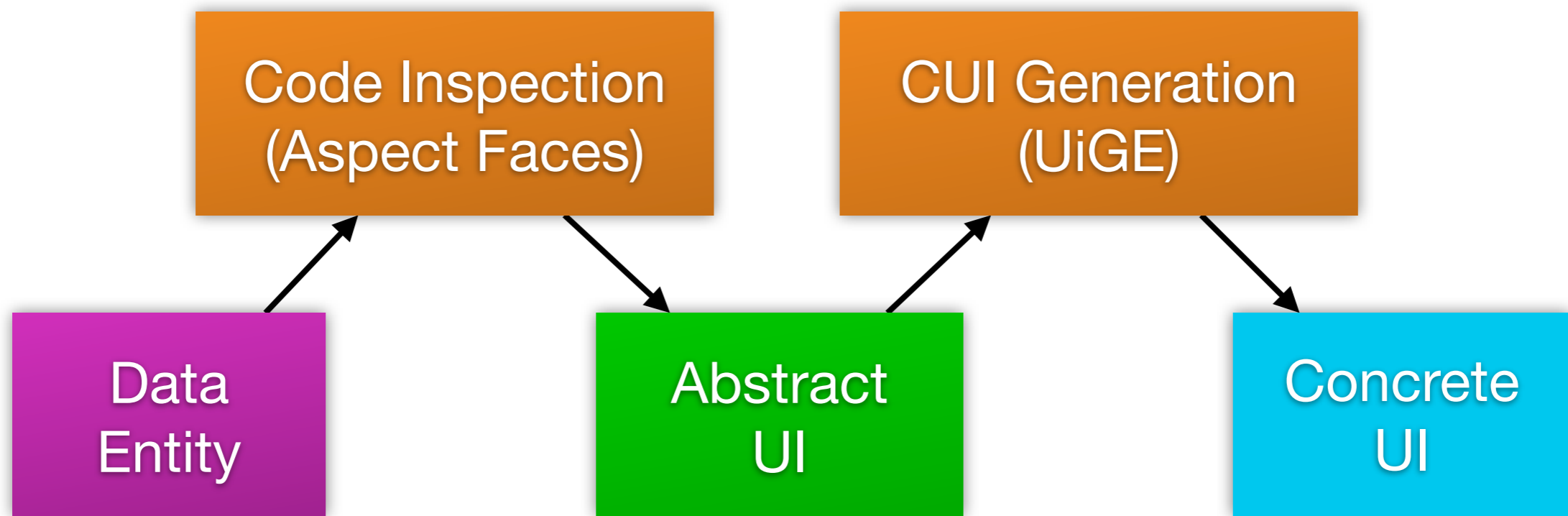
[Cerny 2011]

[Macik 2012]

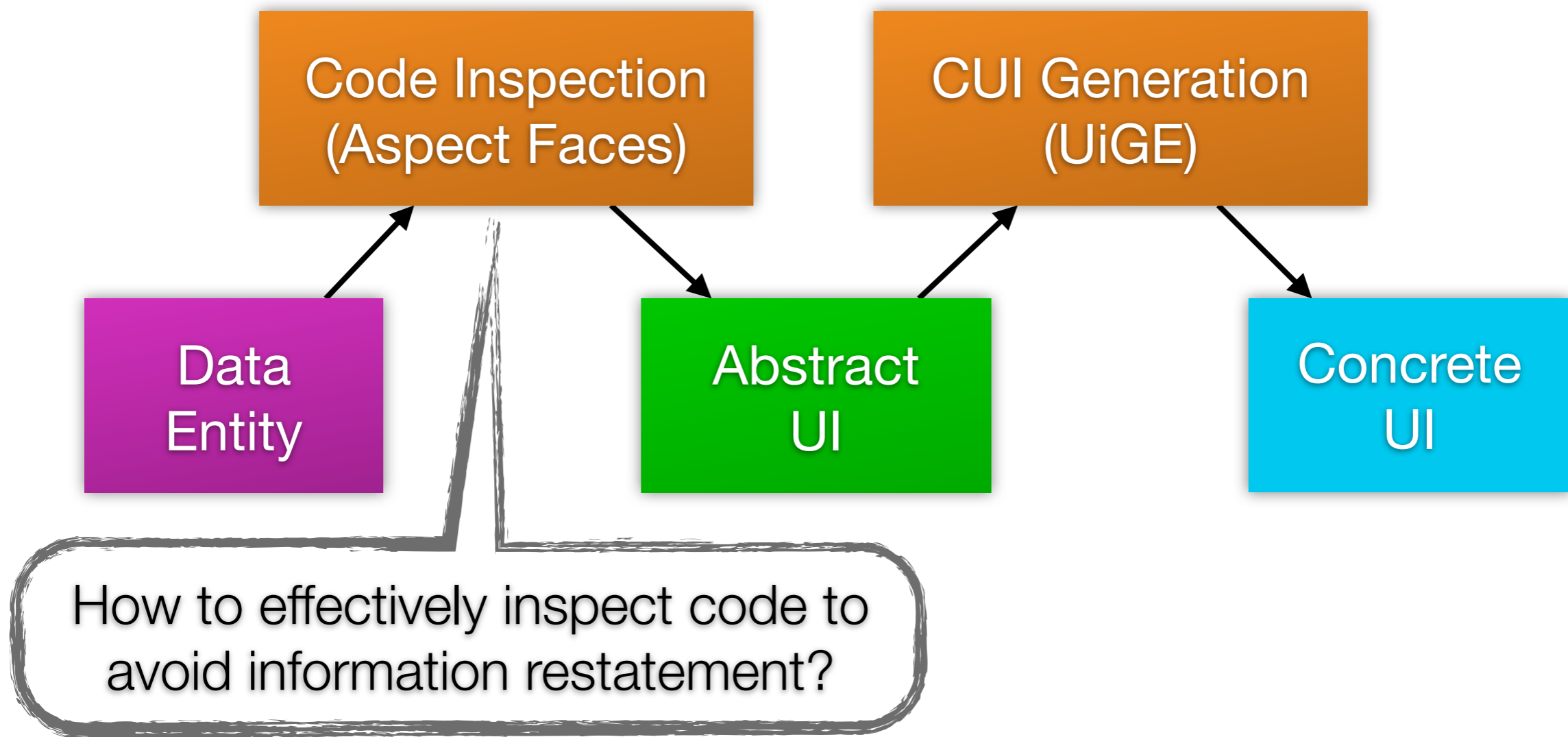




# UI GENERATION | STAGES



# UI GENERATION | STAGES



# UI GENERATION | STAGES

How to reflect user's needs and preferences?

Code Inspection  
(Aspect Faces)

CUI Generation  
(UiGE)

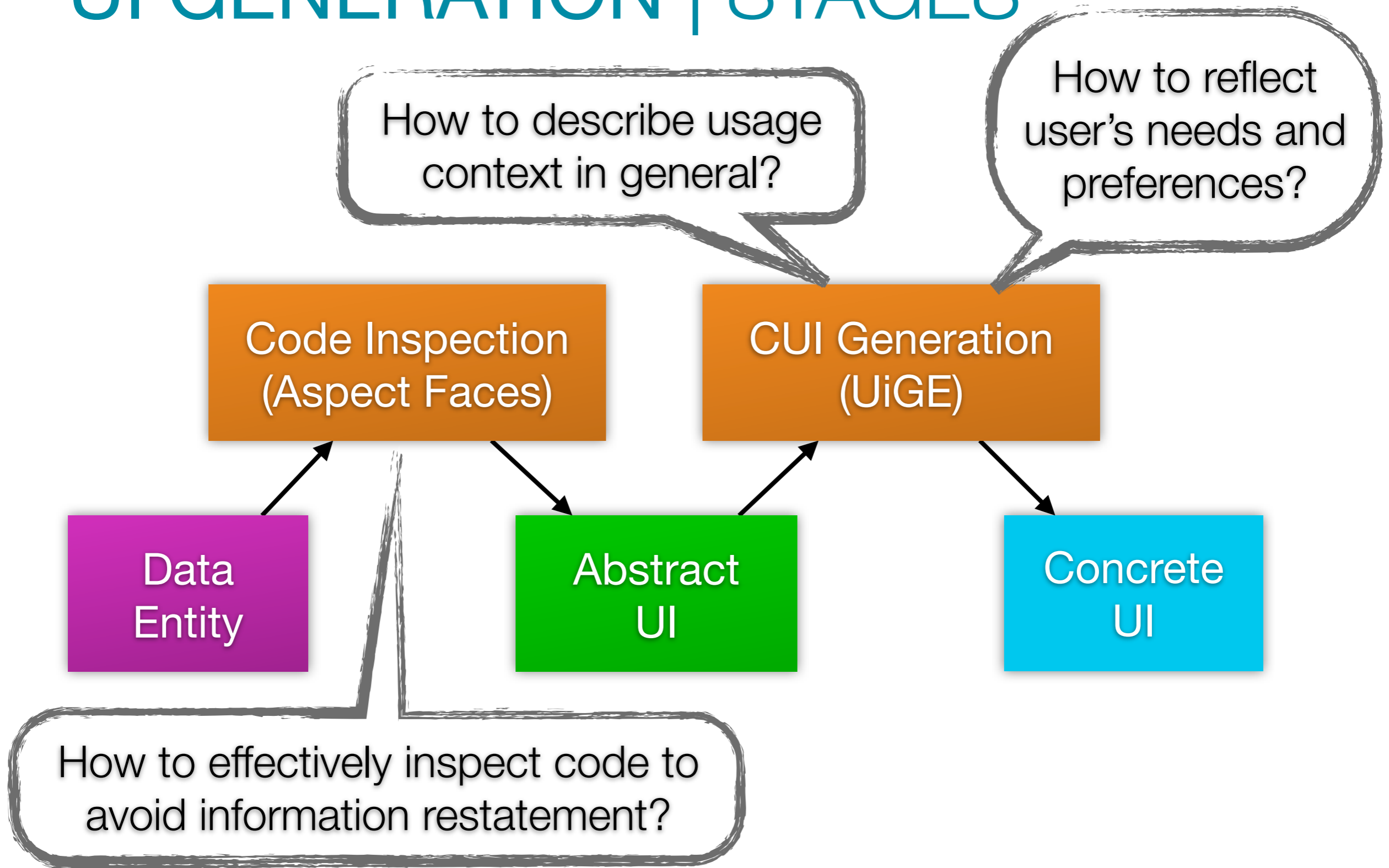
Data  
Entity

Abstract  
UI

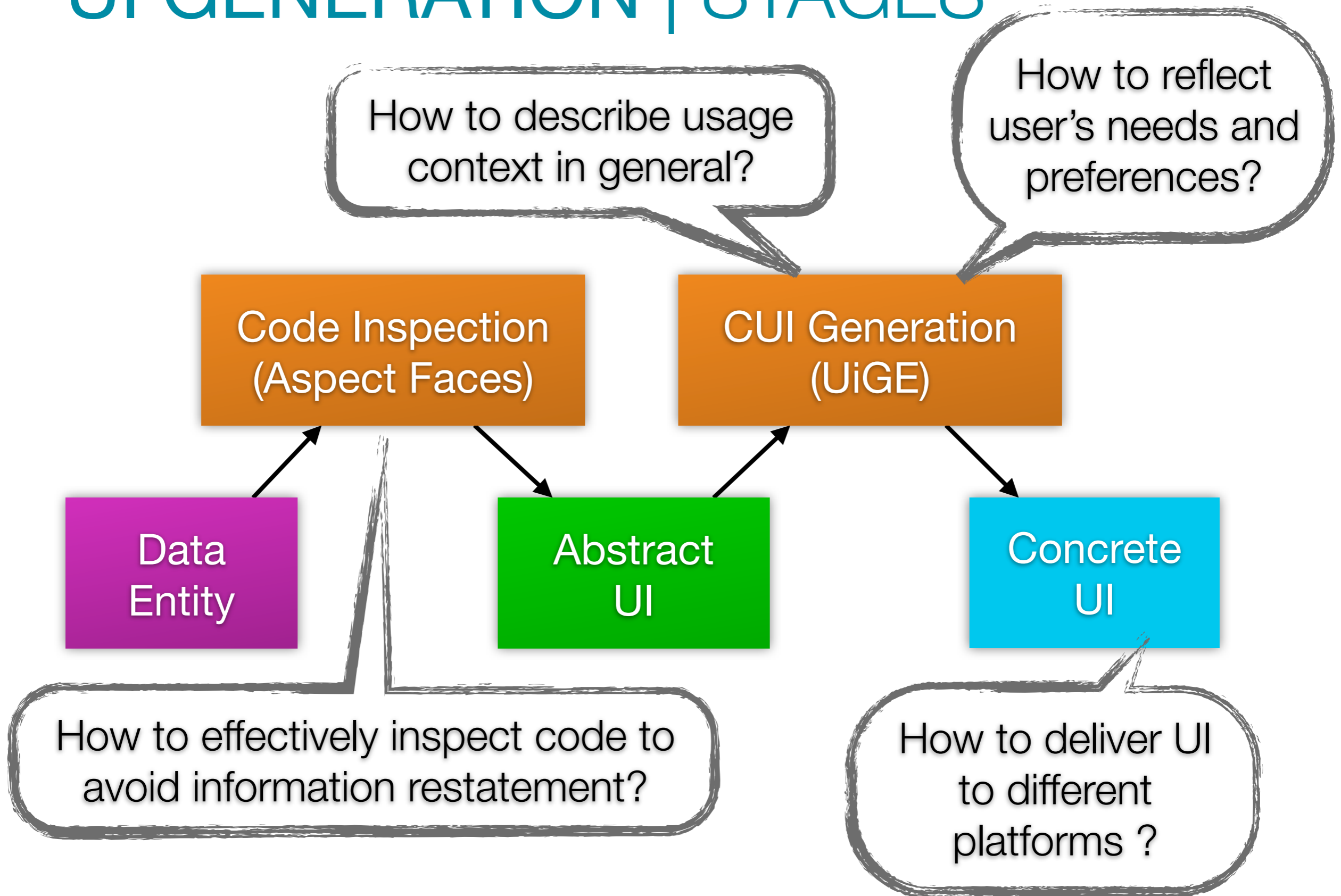
Concrete  
UI

How to effectively inspect code to avoid information restatement?

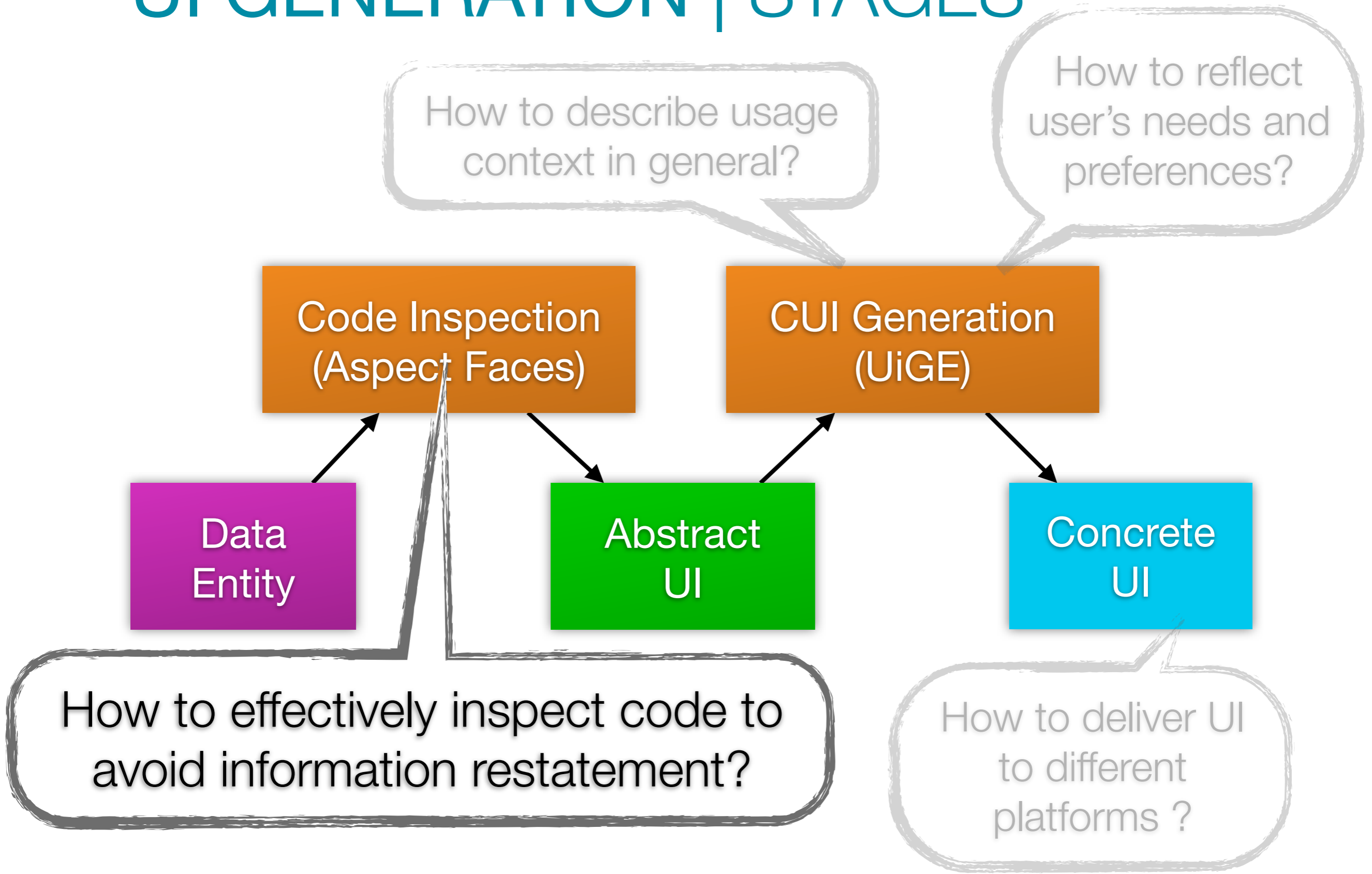
# UI GENERATION | STAGES



# UI GENERATION | STAGES



# UI GENERATION | STAGES



# CODE INSPECTION | ASPECT FACES

# CODE INSPECTION | ASPECT FACES



JPA  
Entity



# CODE INSPECTION | ASPECT FACES

JPA  
Entity

Extension  
marks

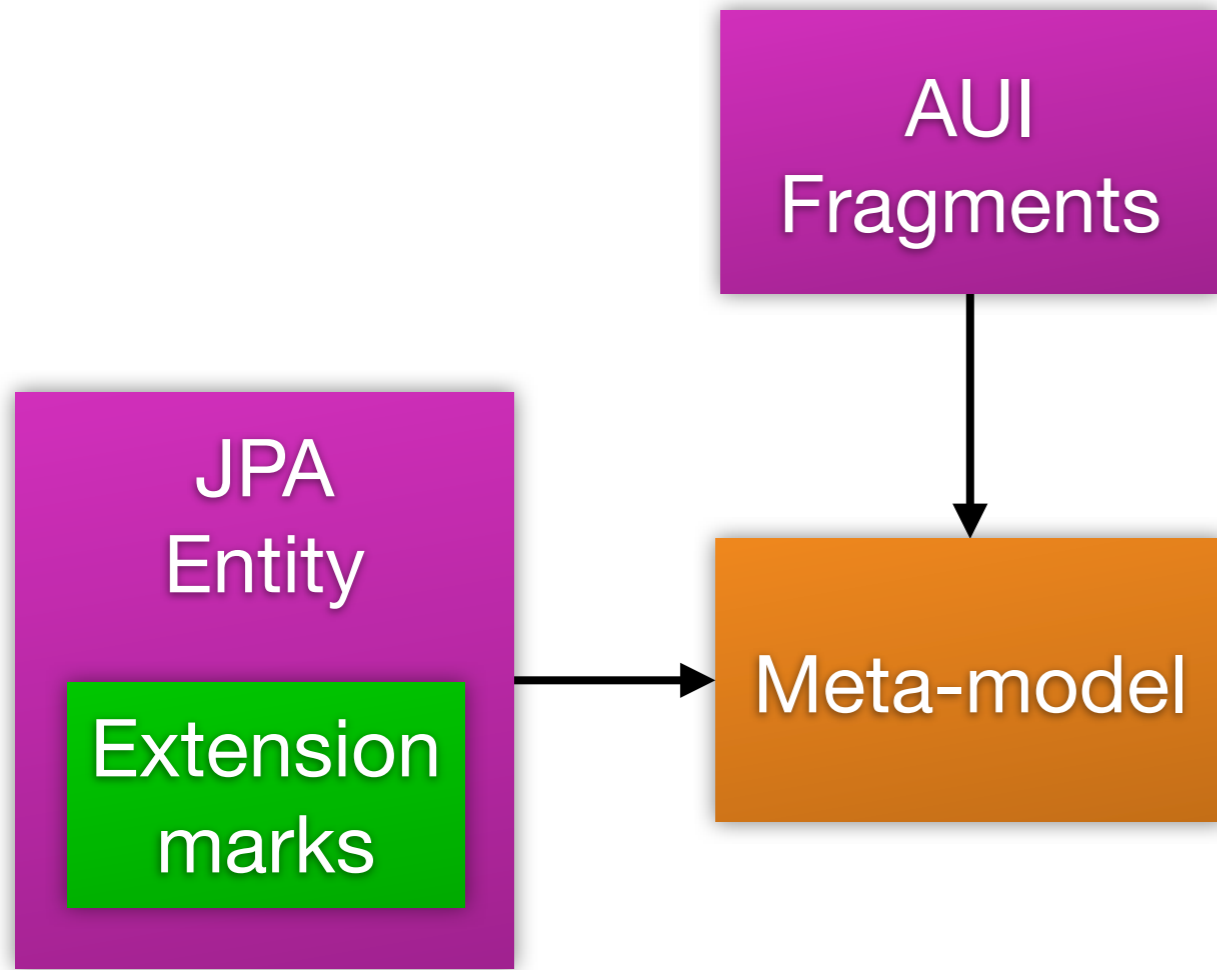
# CODE INSPECTION | ASPECT FACES

AUI  
Fragments

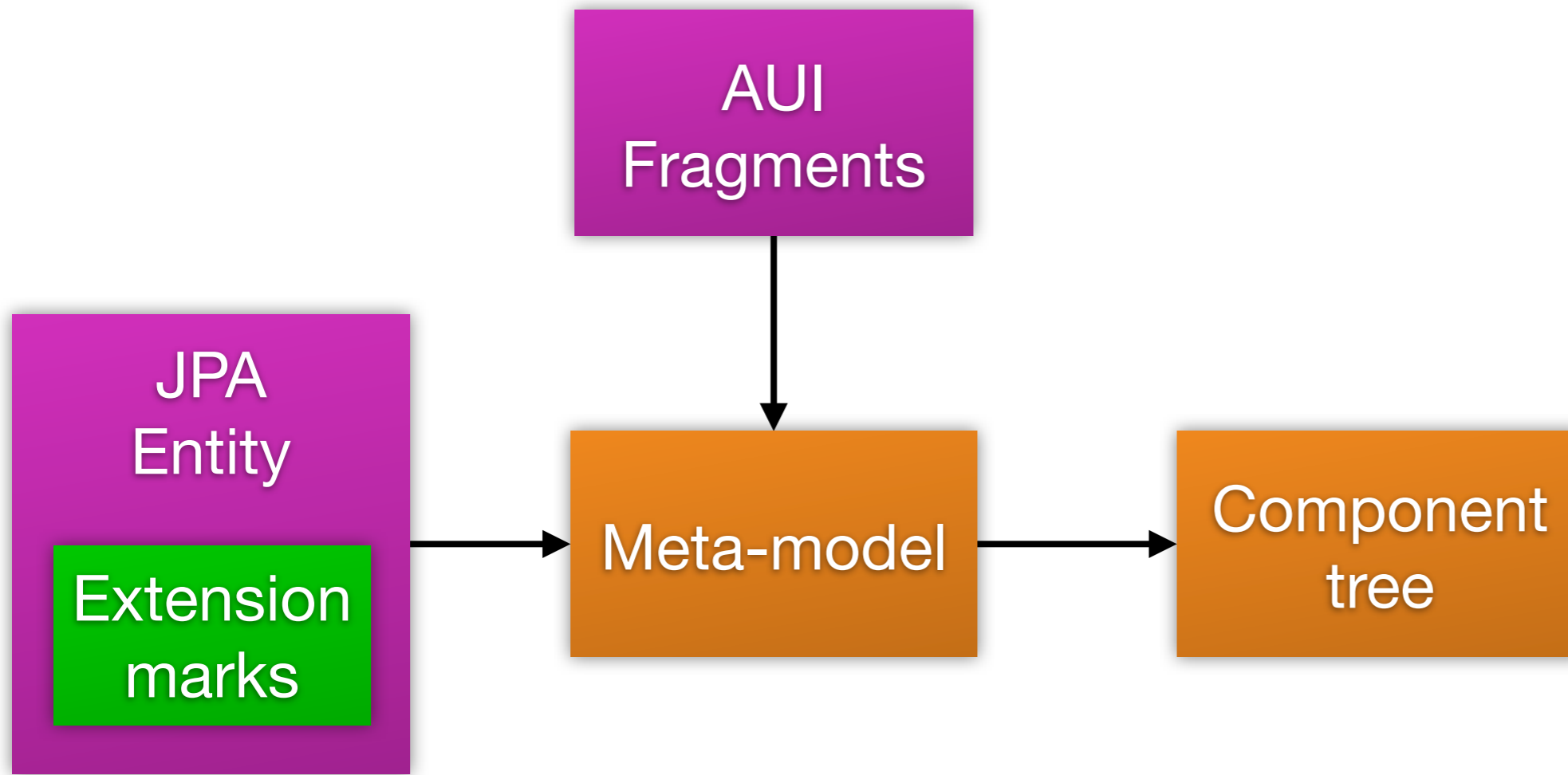
JPA  
Entity

Extension  
marks

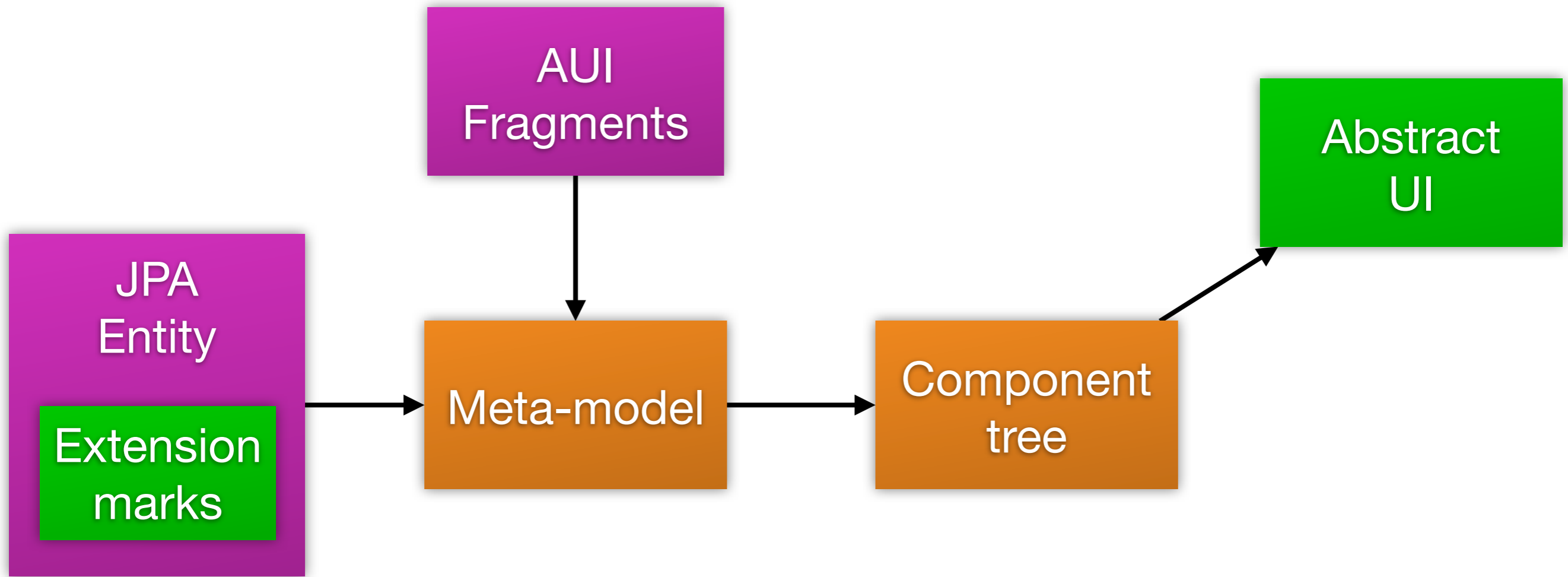
# CODE INSPECTION | ASPECT FACES



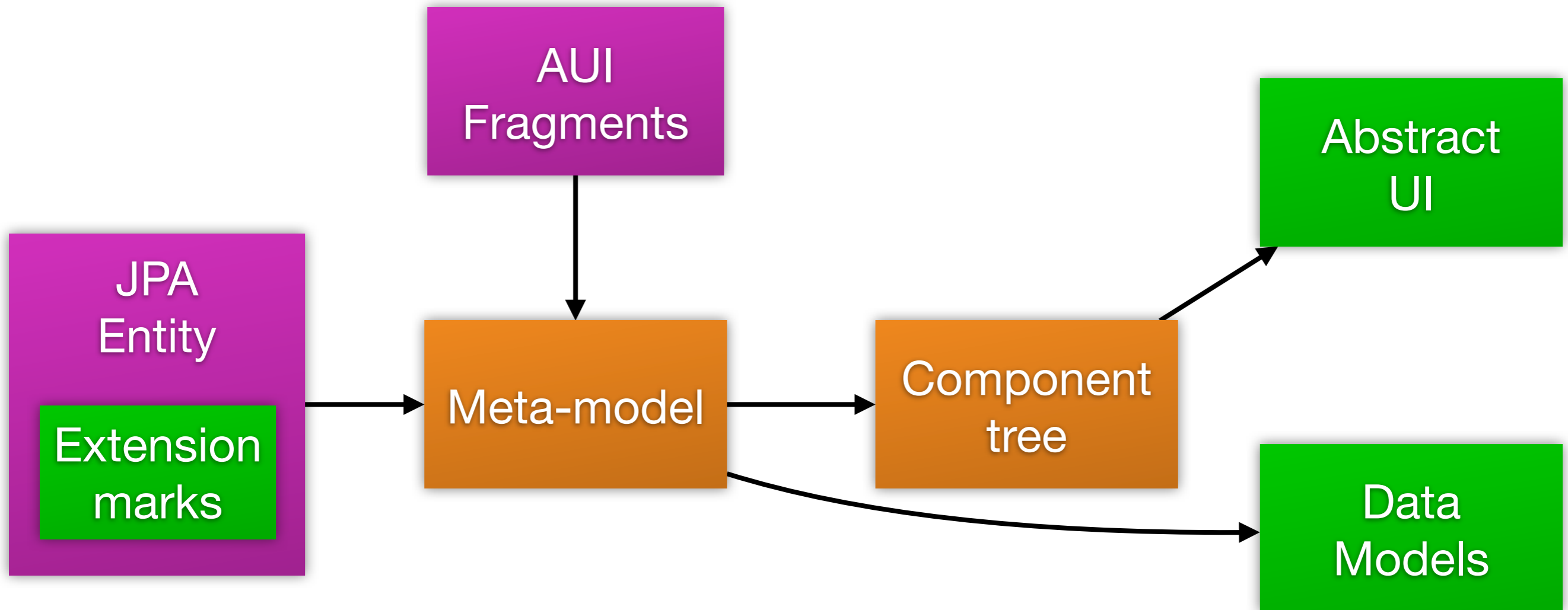
# CODE INSPECTION | ASPECT FACES



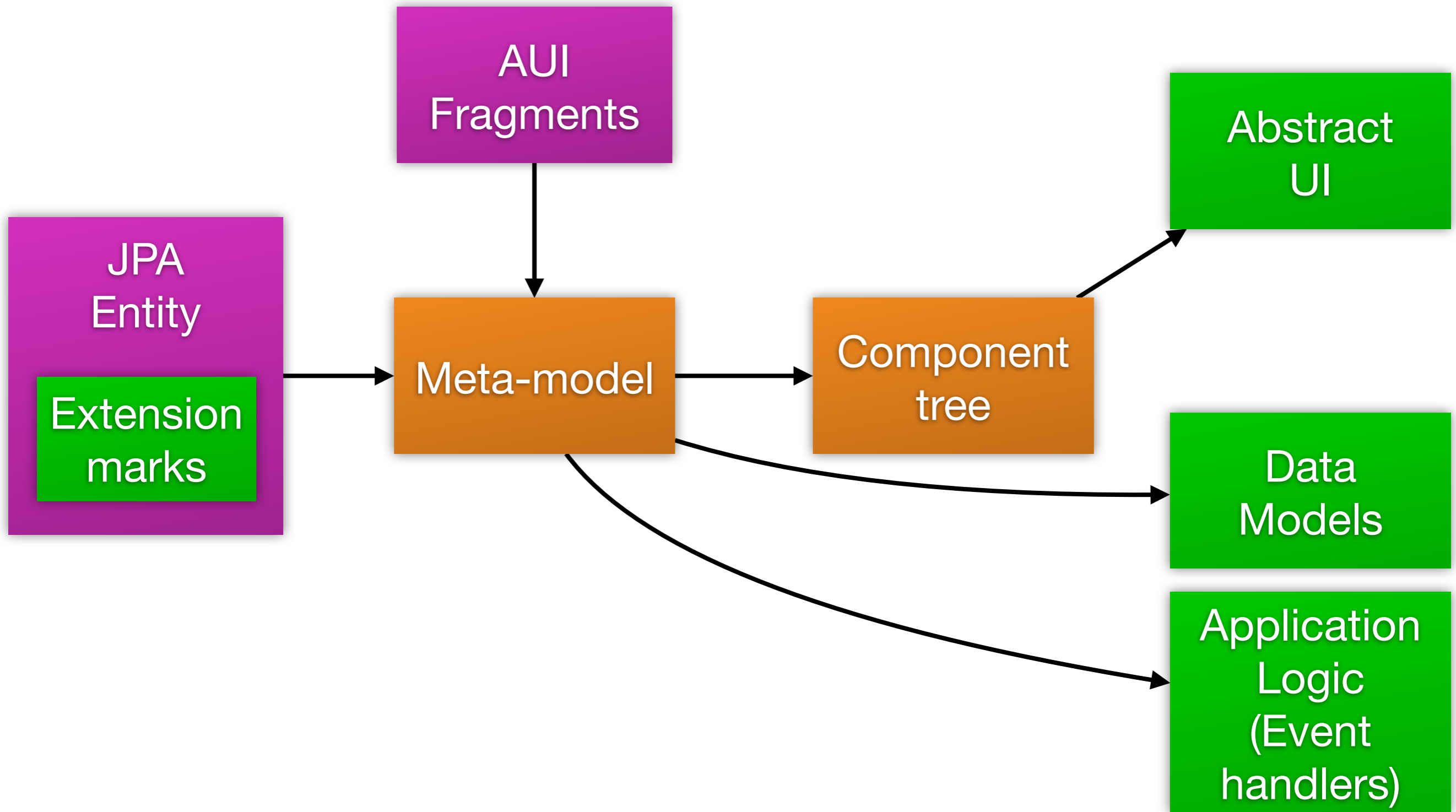
# CODE INSPECTION | ASPECT FACES



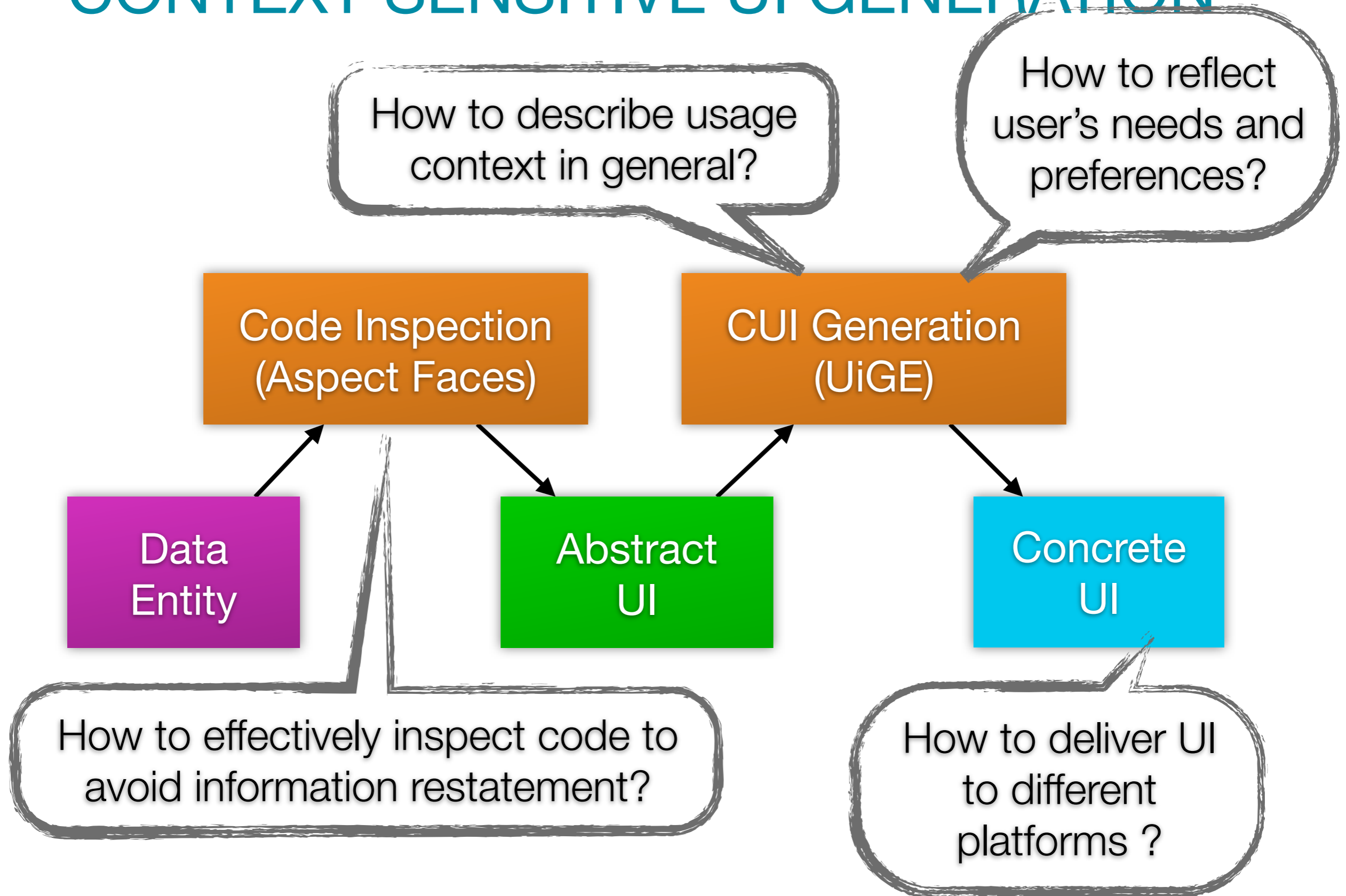
# CODE INSPECTION | ASPECT FACES



# CODE INSPECTION | ASPECT FACES

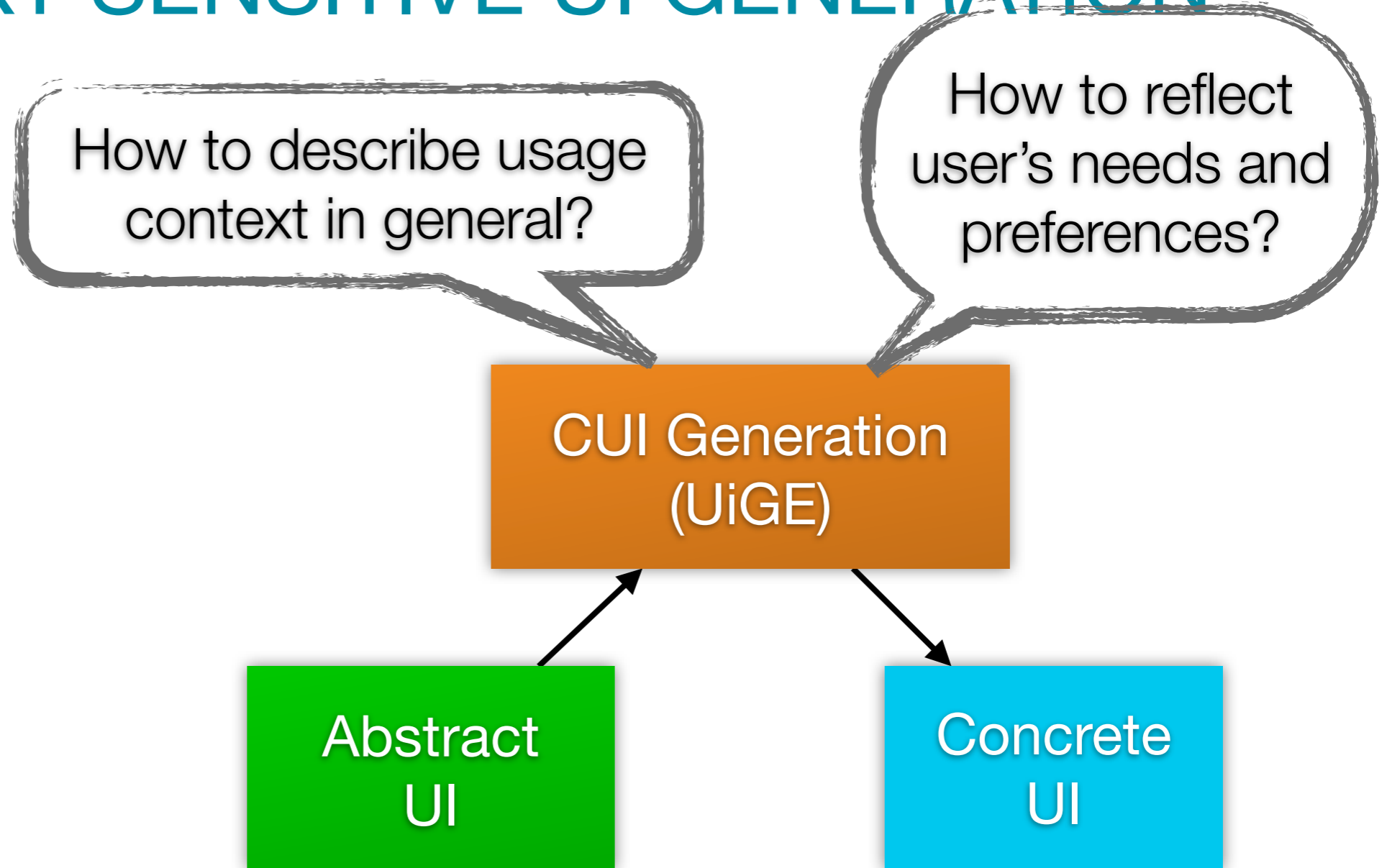


# CONTEXT SENSITIVE UI GENERATION





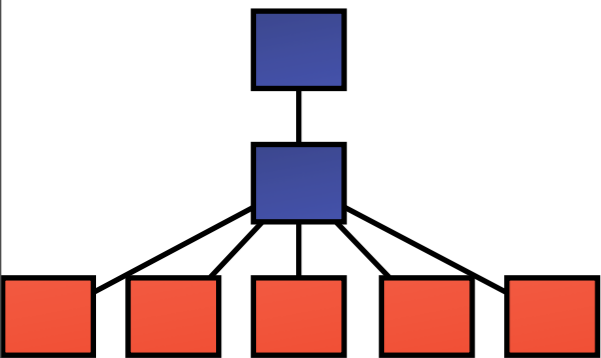
# CONTEXT SENSITIVE UI GENERATION



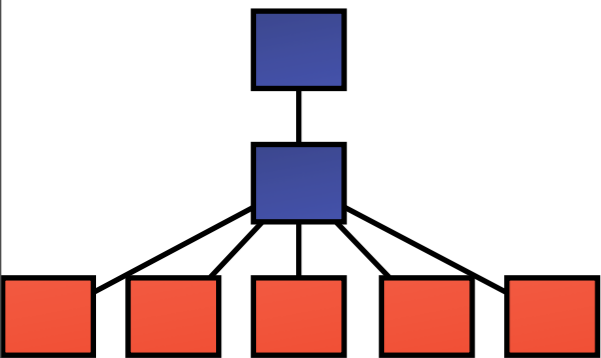
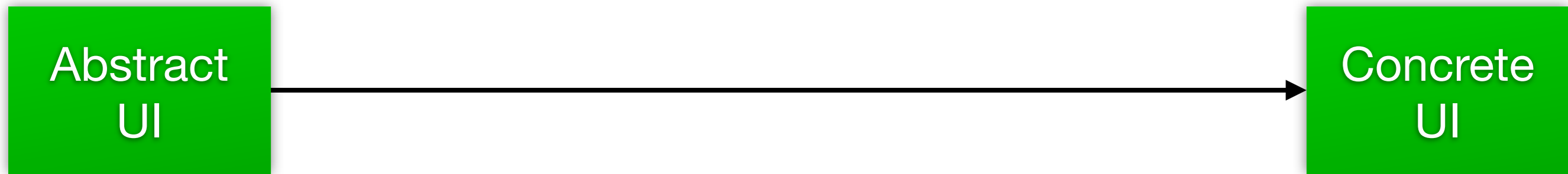
# UI GENERATION | UiGE

# UI GENERATION | UiGE

Abstract  
UI

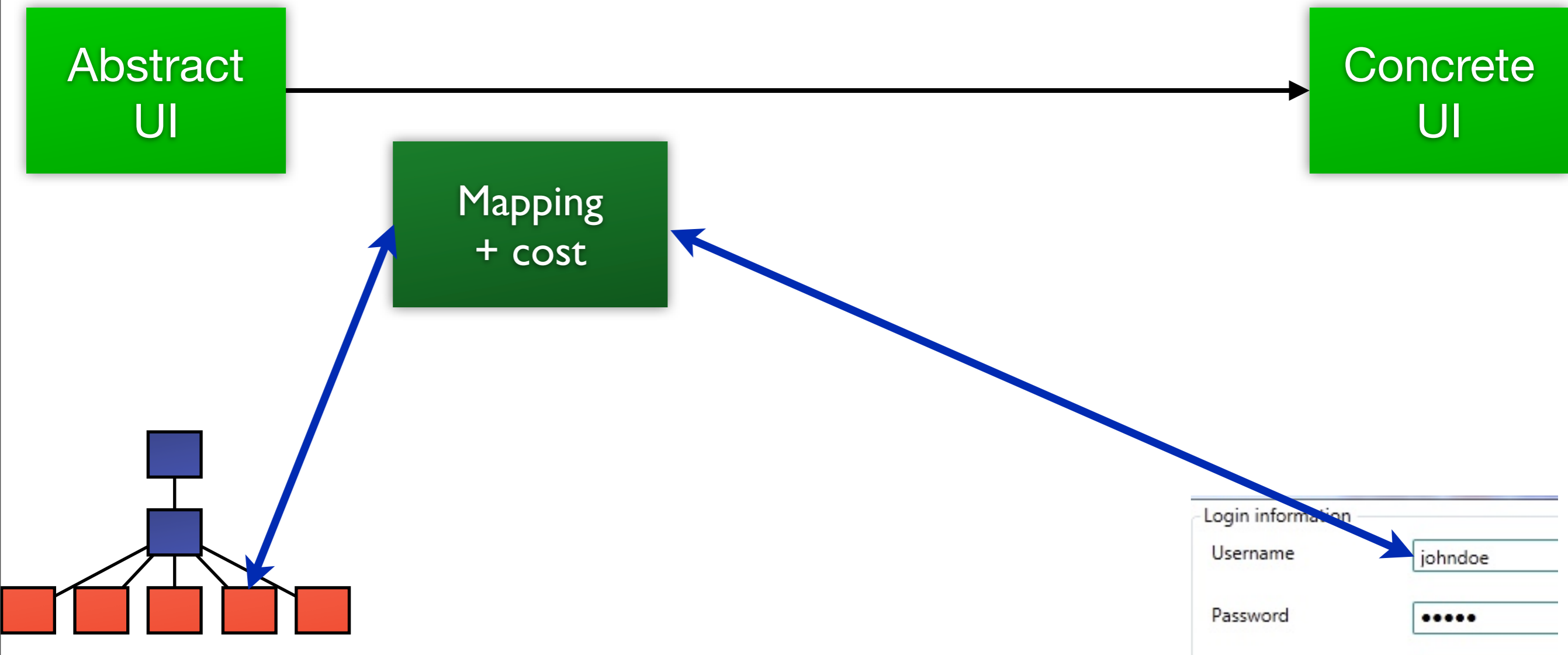


# UI GENERATION | UiGE

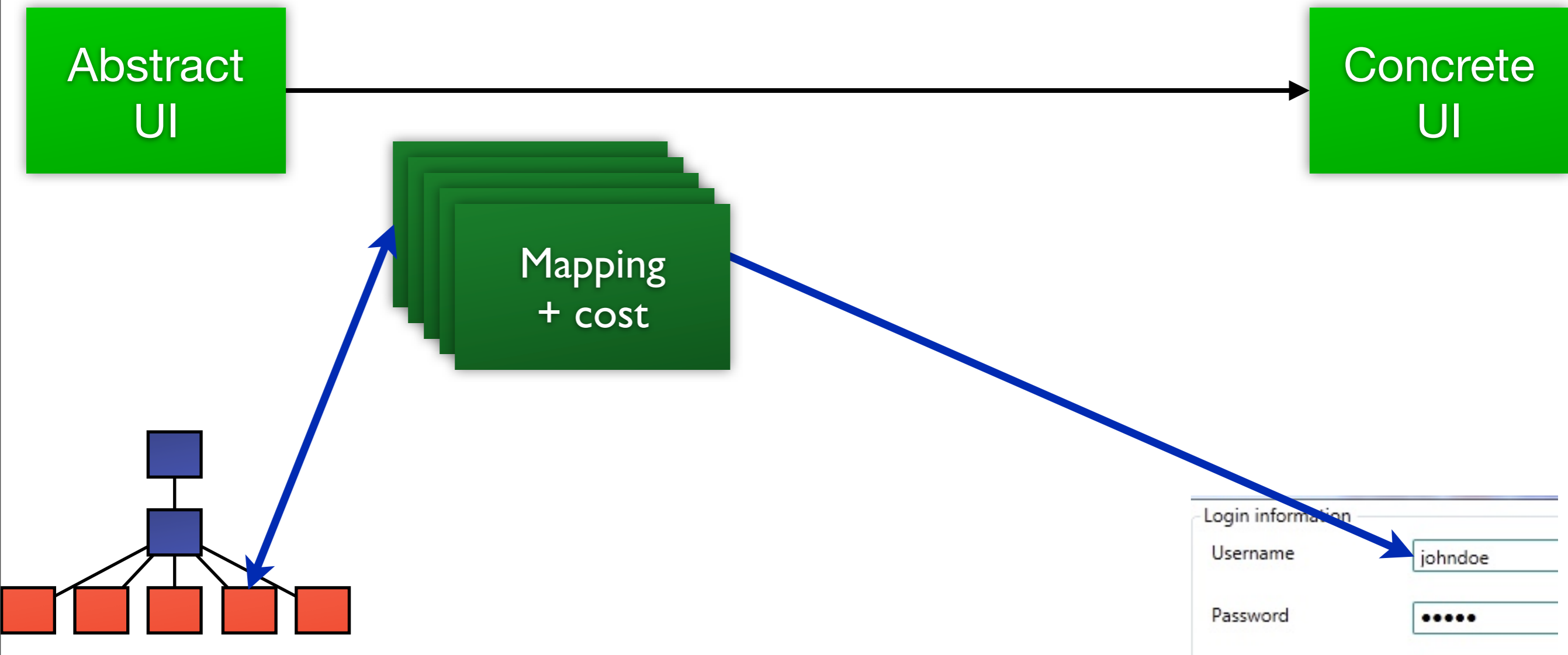


A screenshot of a login form titled "Login information". It contains two input fields: "Username" with the text "johndoe" and "Password" with masked characters (dots).

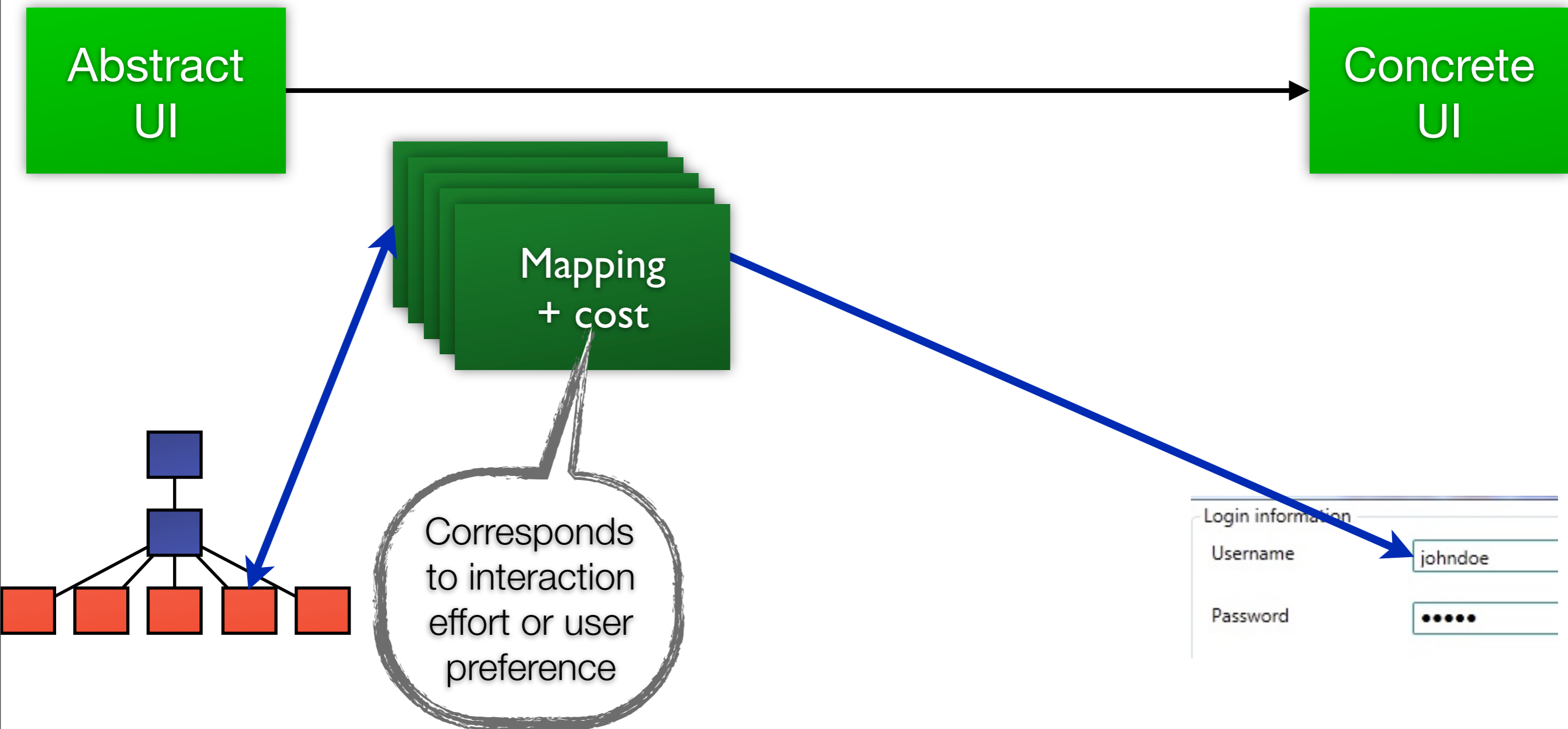
# UI GENERATION | UiGE



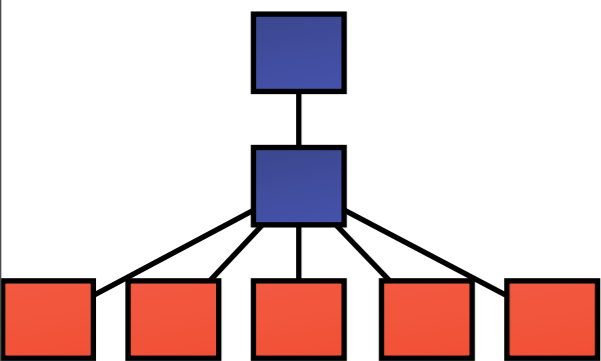
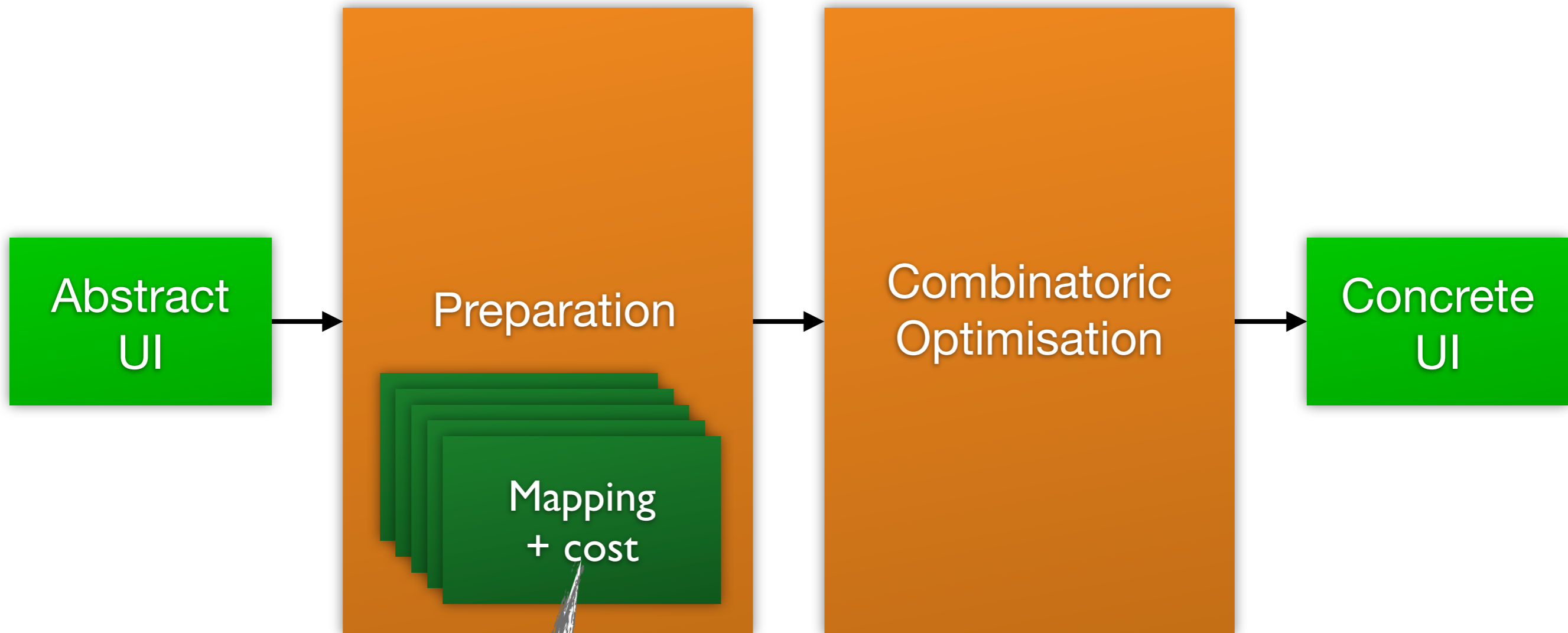
# UI GENERATION | UiGE



# UI GENERATION | UiGE



# UI GENERATION | UiGE

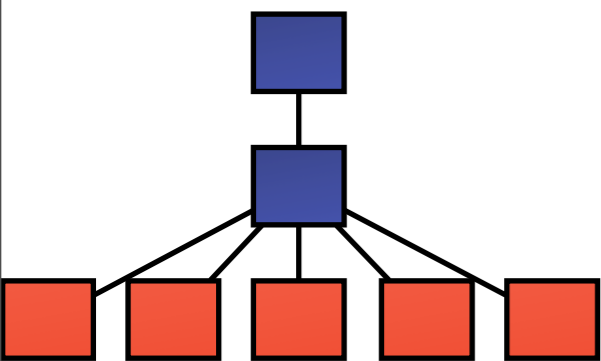
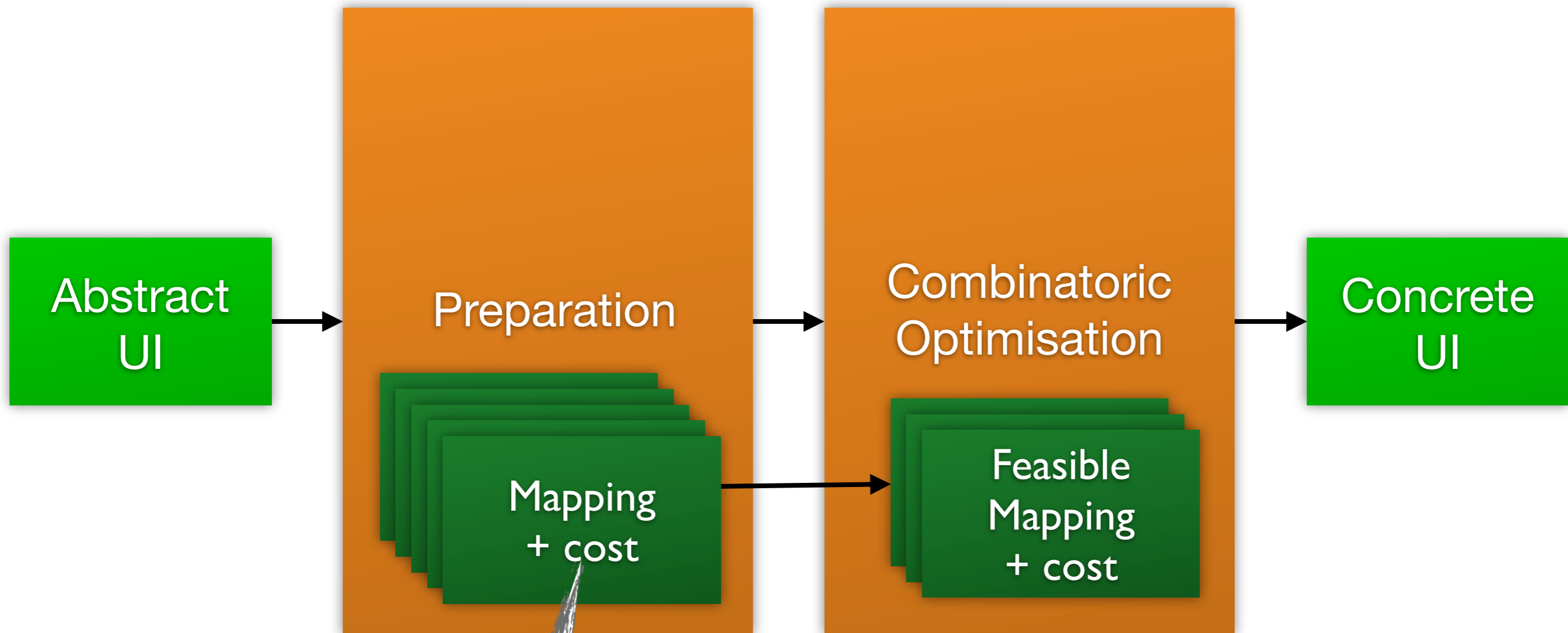


Corresponds to interaction effort or user preference

Login information	
Username	<input type="text" value="johndoe"/>
Password	<input type="password" value="•••••"/>



# UI GENERATION | UiGE



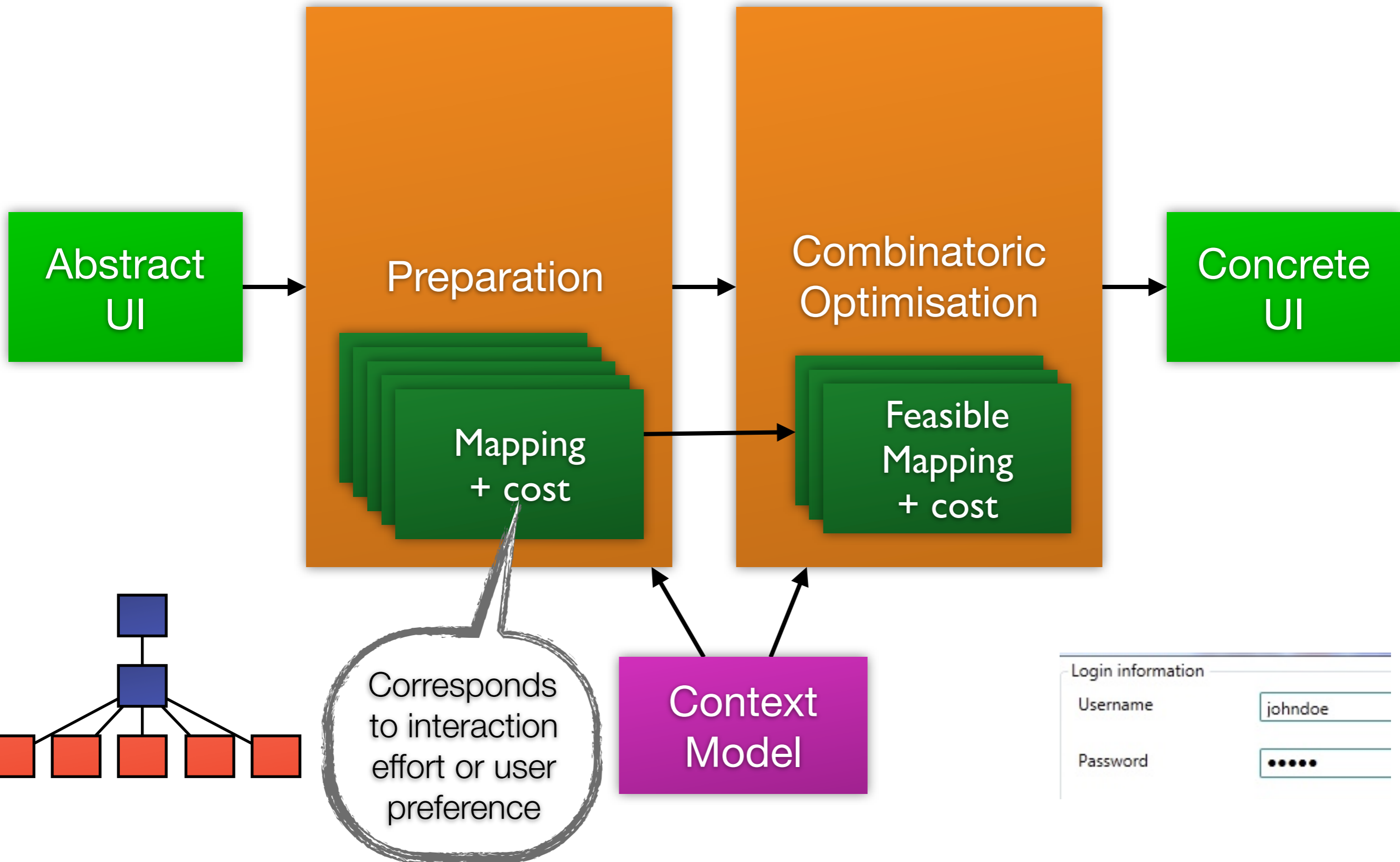
Corresponds to interaction effort or user preference

Login information

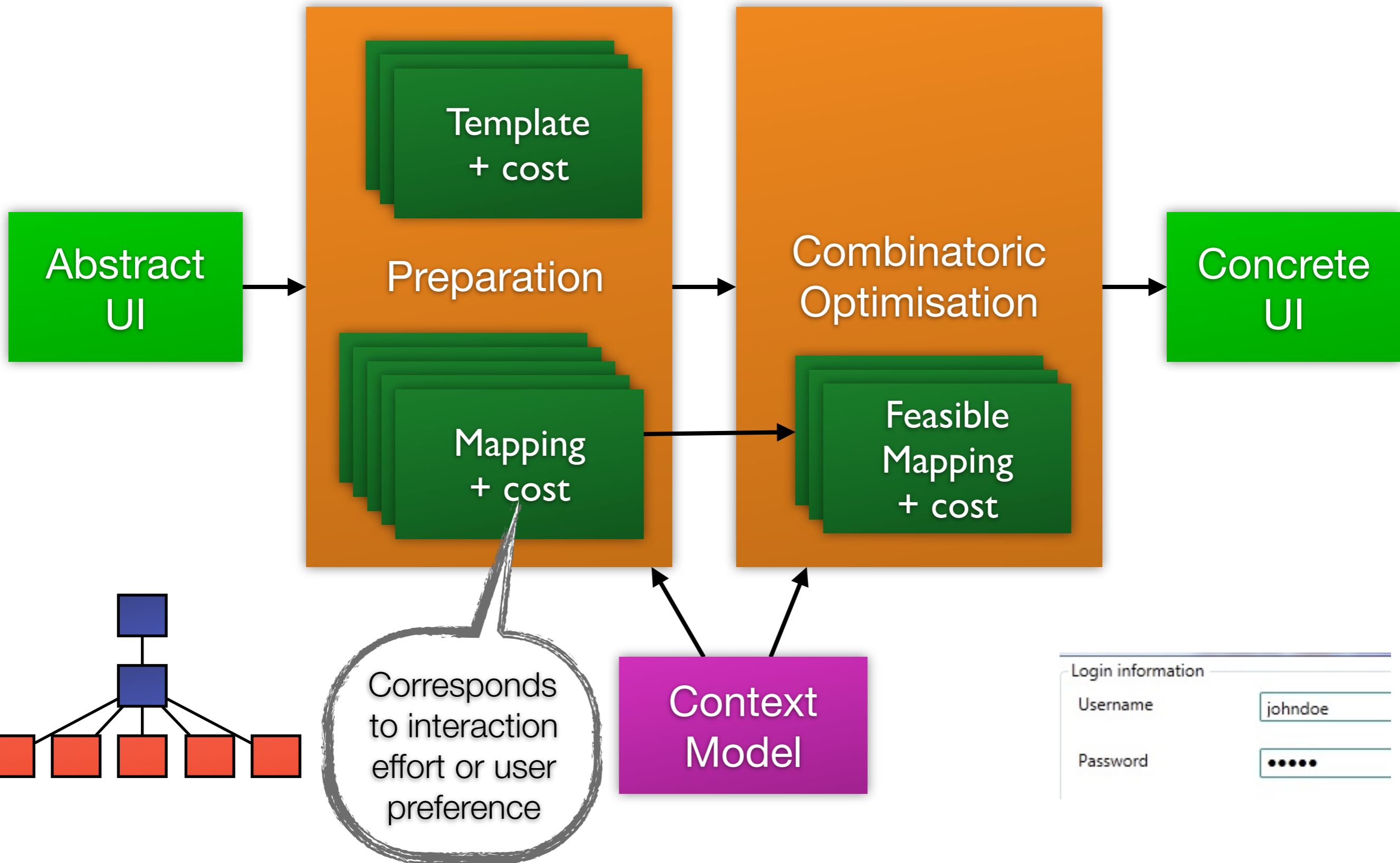
Username

Password

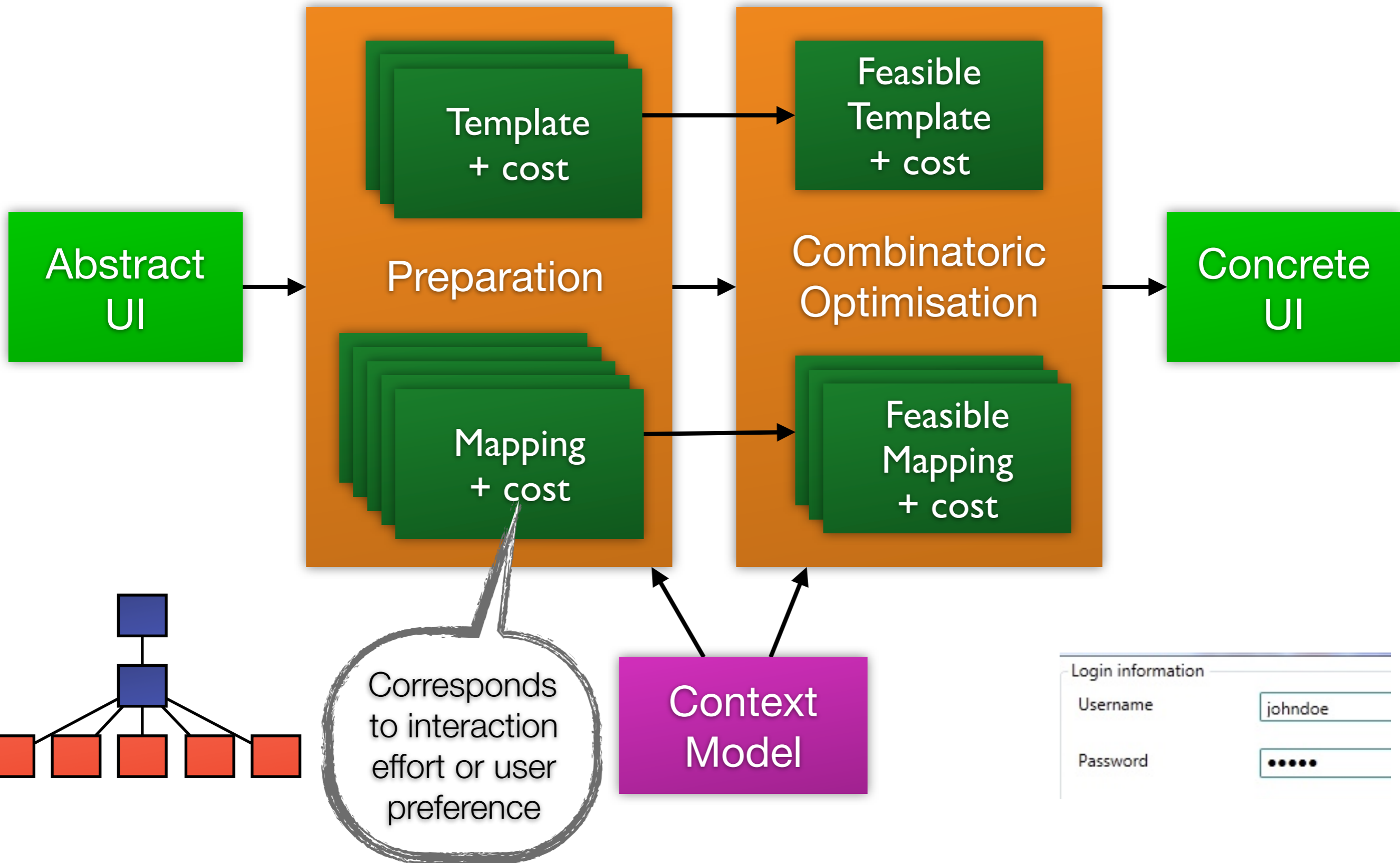
# UI GENERATION | UiGE



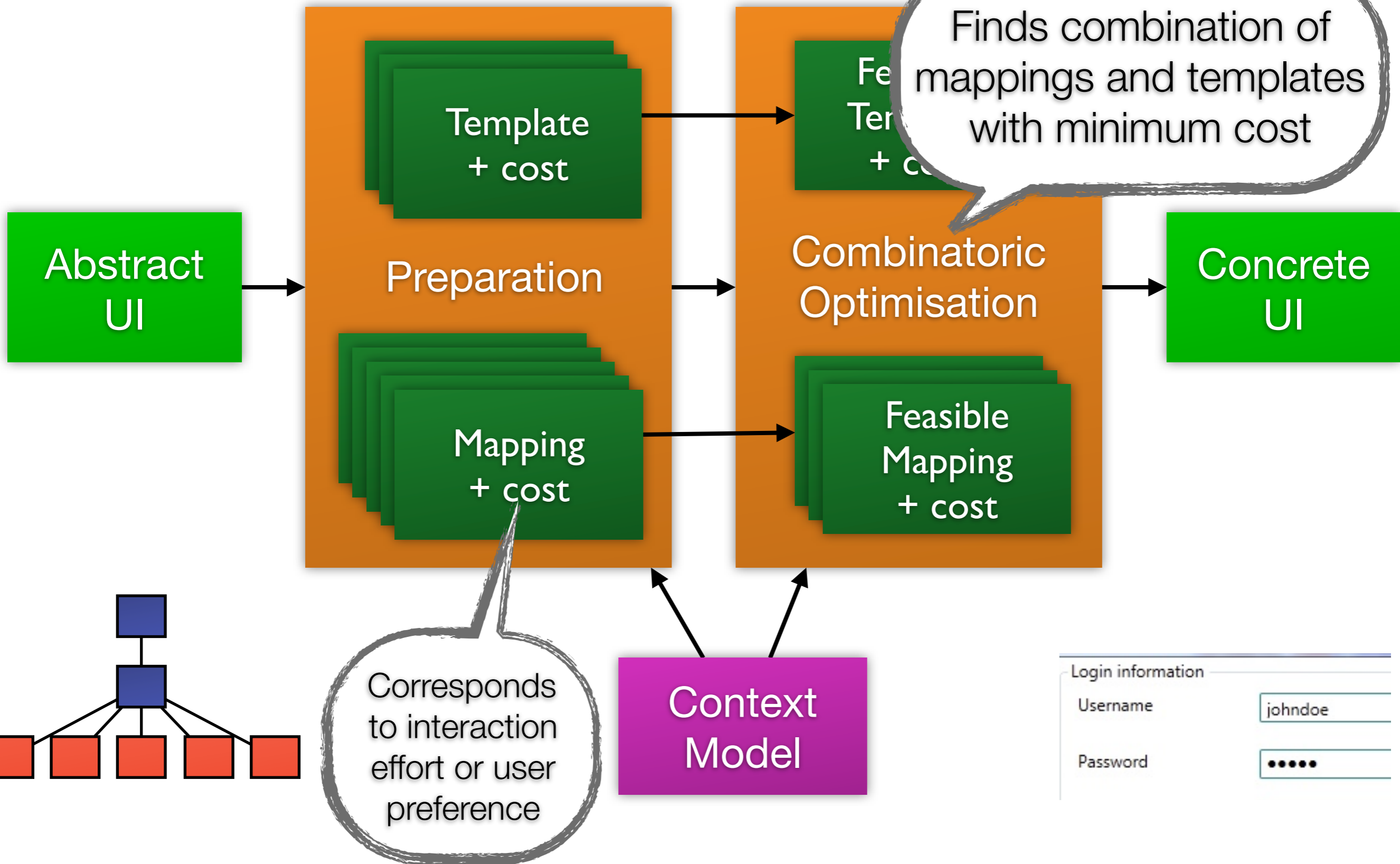
# UI GENERATION | UiGE



# UI GENERATION | UiGE



# UI GENERATION | UiGE



# CONTEXT MODEL | PRINCIPLE

# CONTEXT MODEL | PRINCIPLE

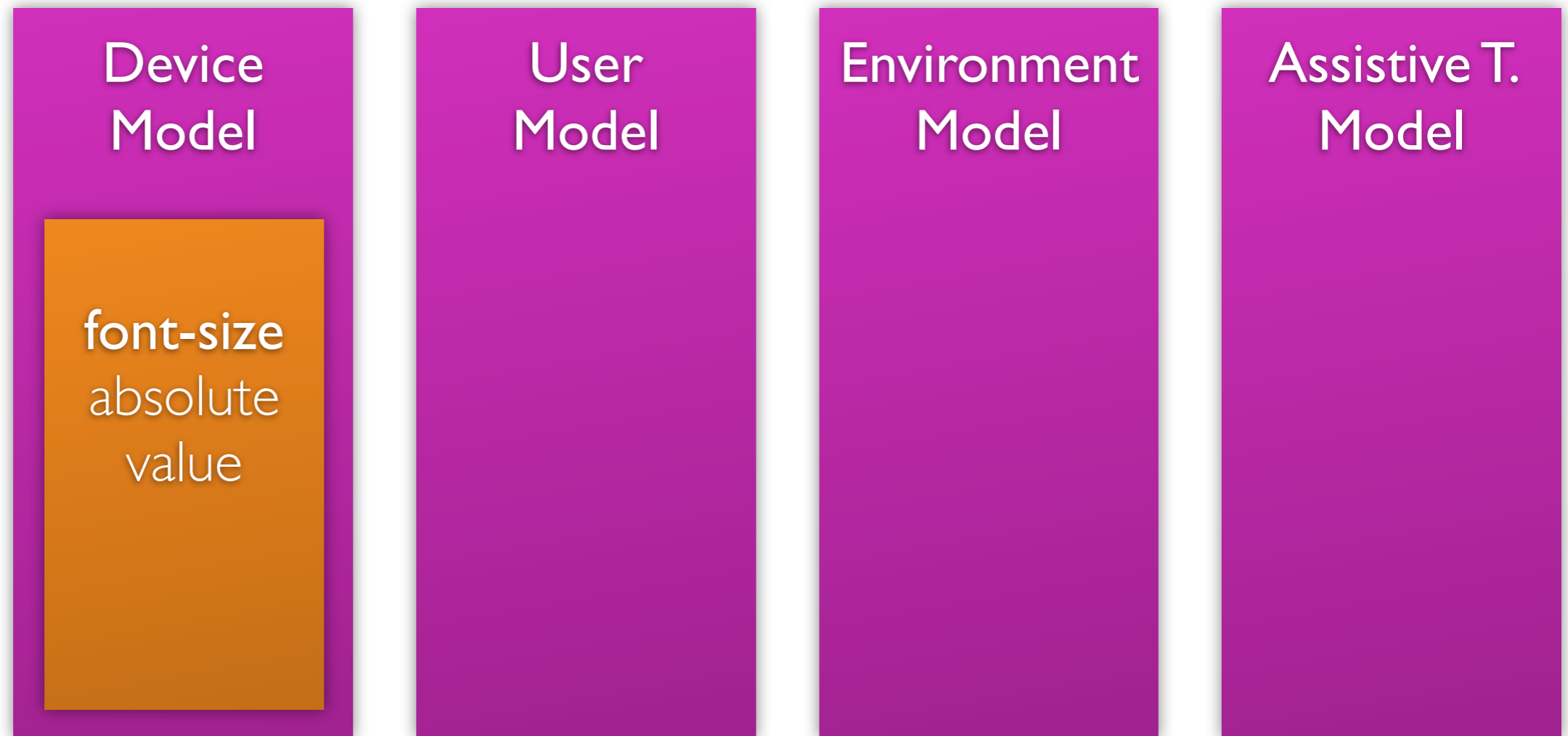
Device  
Model

User  
Model

Environment  
Model

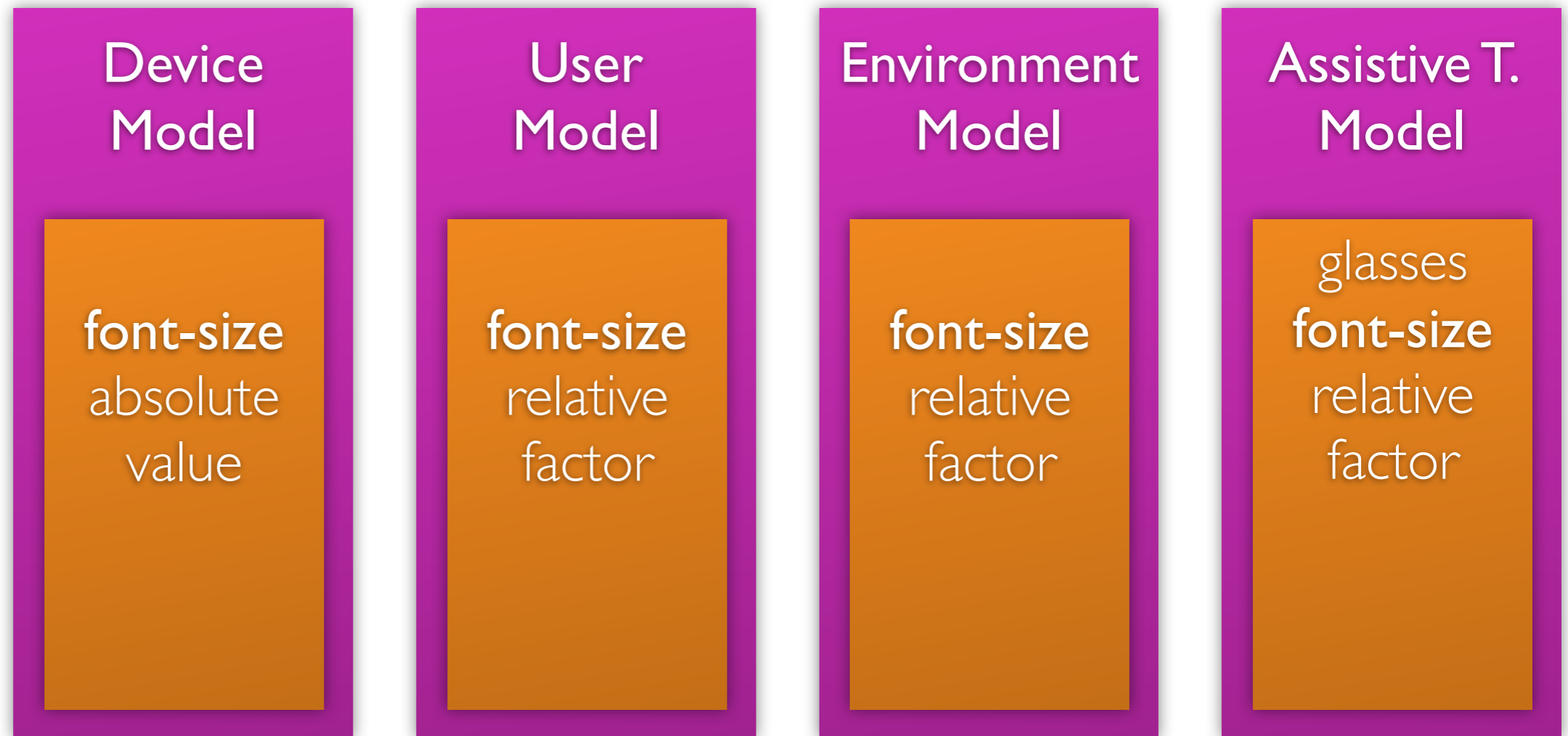
Assistive T.  
Model

# CONTEXT MODEL | PRINCIPLE

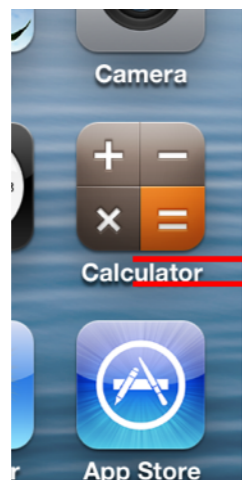




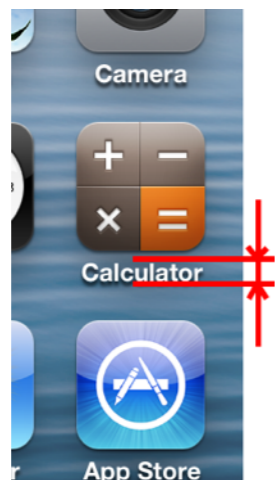
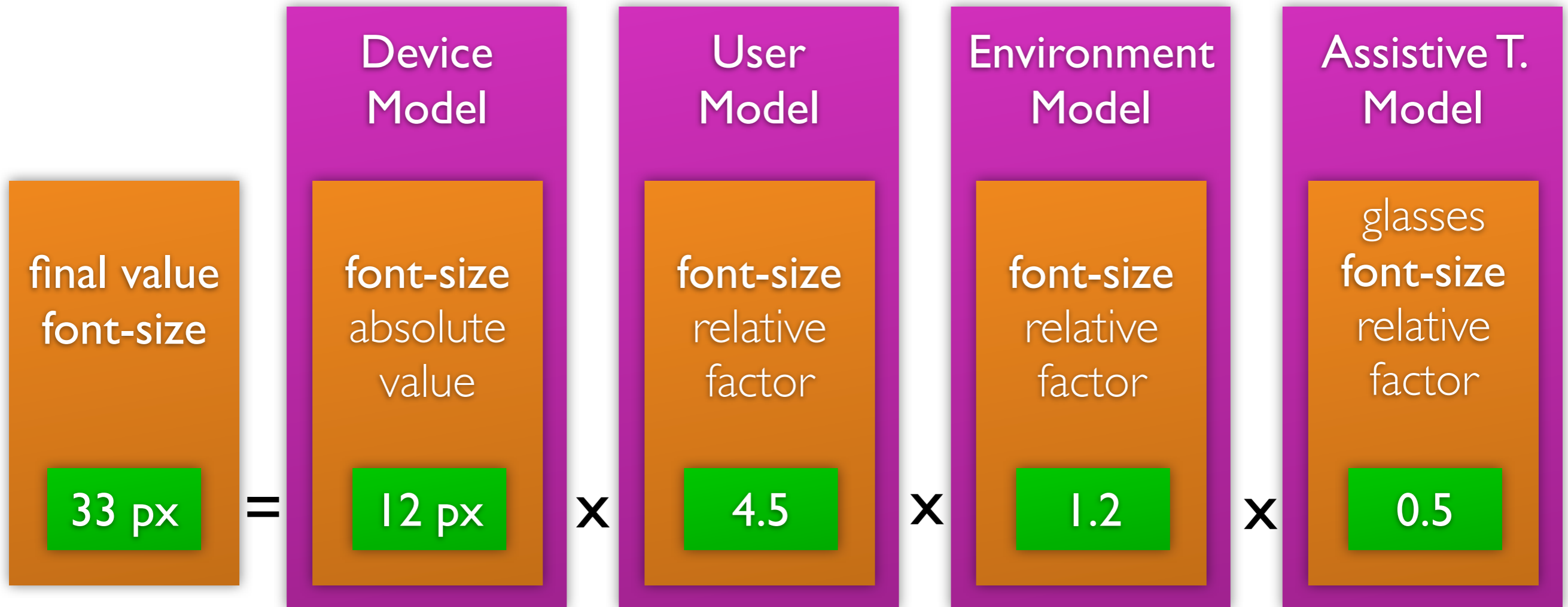
# CONTEXT MODEL | PRINCIPLE



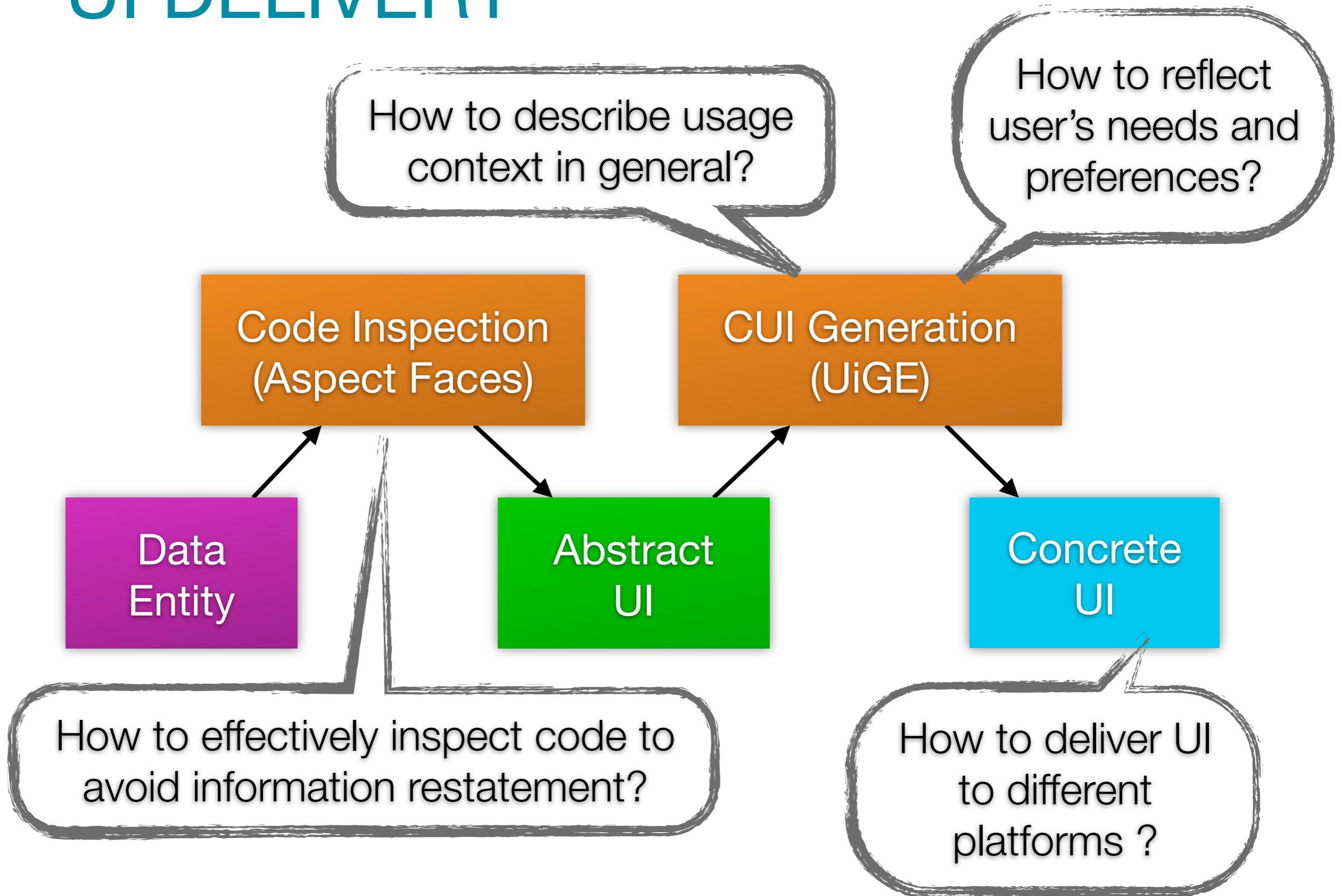
# CONTEXT MODEL | PRINCIPLE



# CONTEXT MODEL | PRINCIPLE



# UI DELIVERY



# UI DELIVERY

How to reflect  
user's needs and  
preferences?

CUI Generation  
(UiGE)

Concrete  
UI

How to deliver UI  
to different  
platforms ?

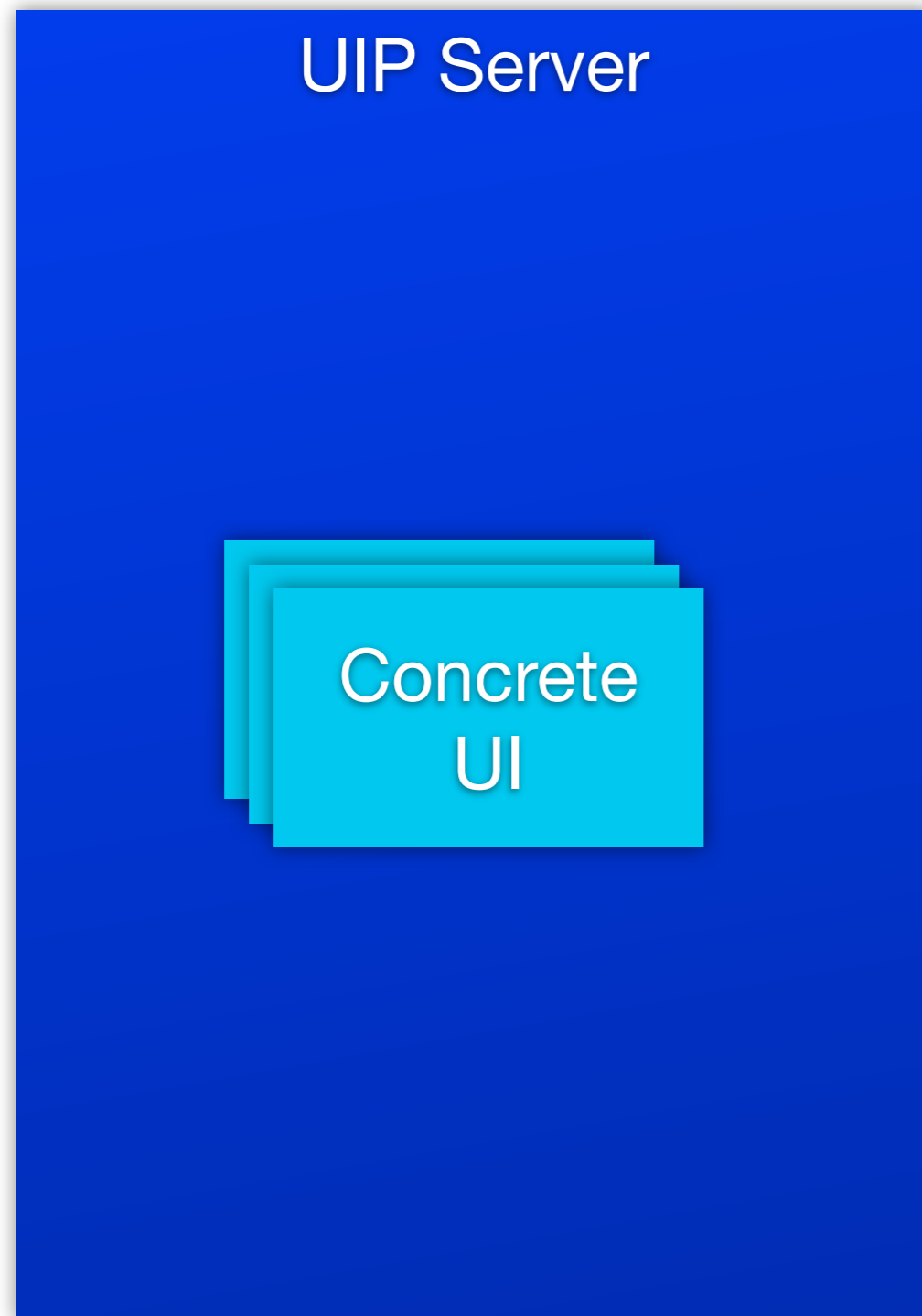
# UIP | USER INTERFACE DELIVERY

Concrete  
UI

# UIP | USER INTERFACE DELIVERY

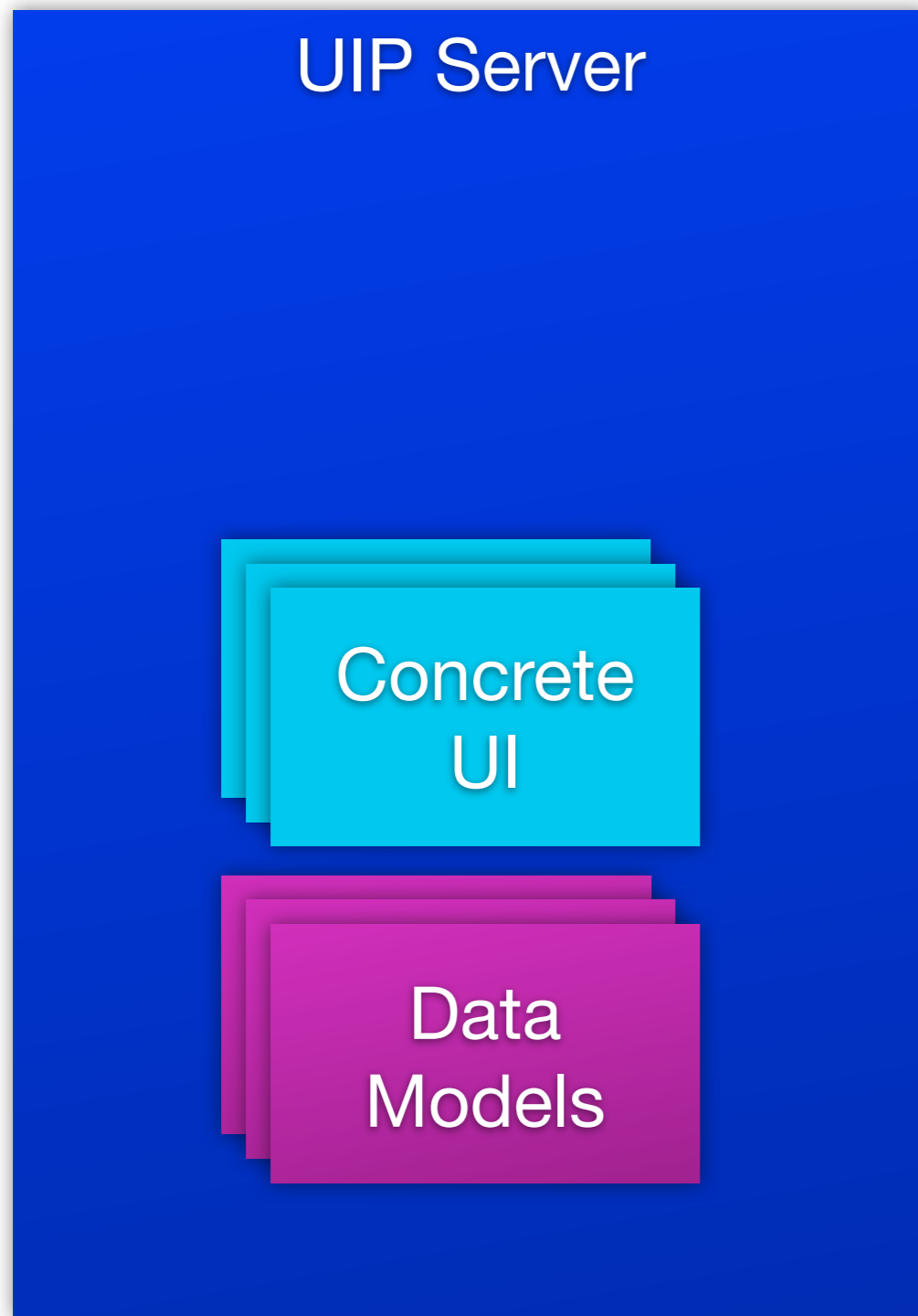


# UIP | USER INTERFACE DELIVERY

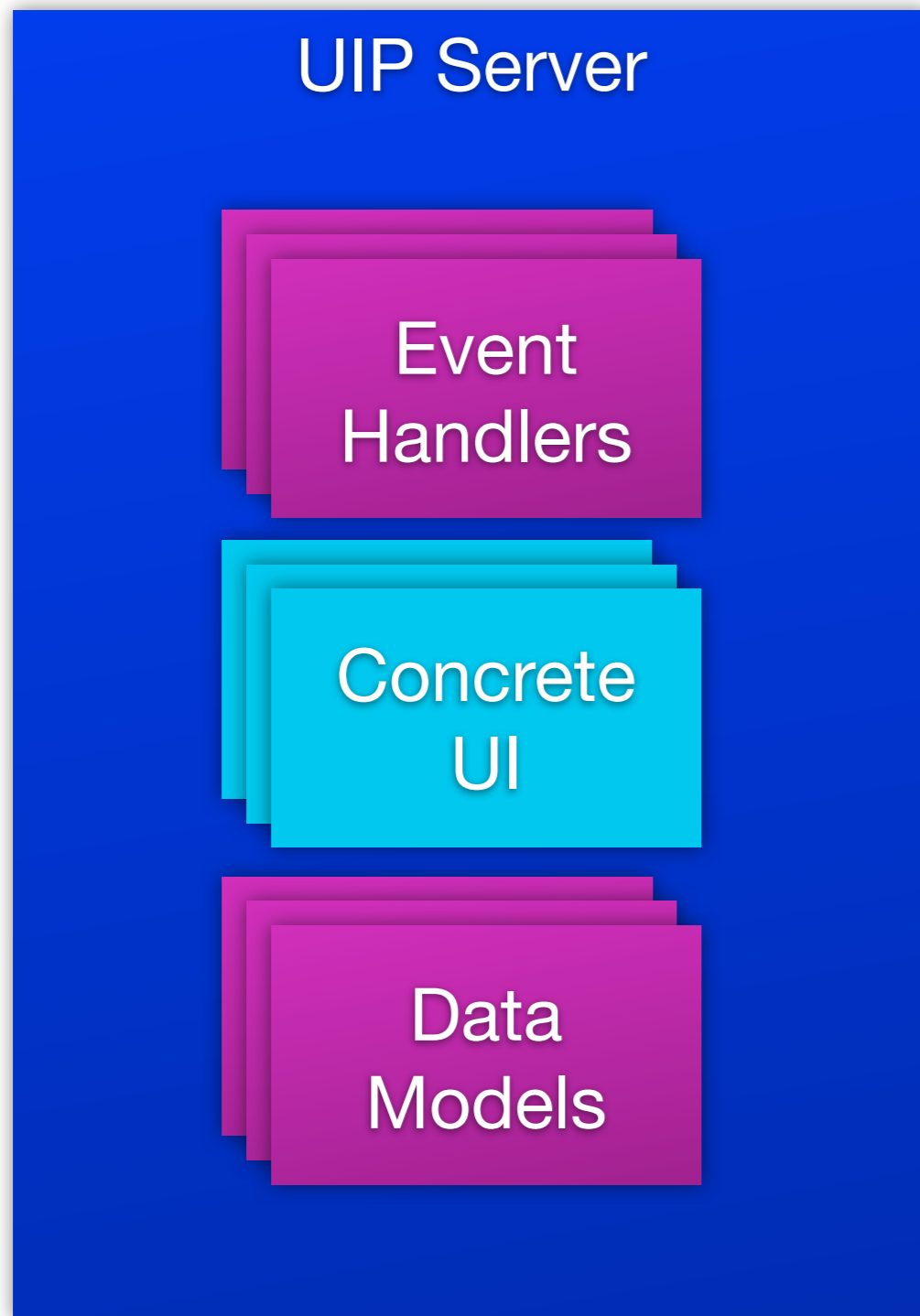




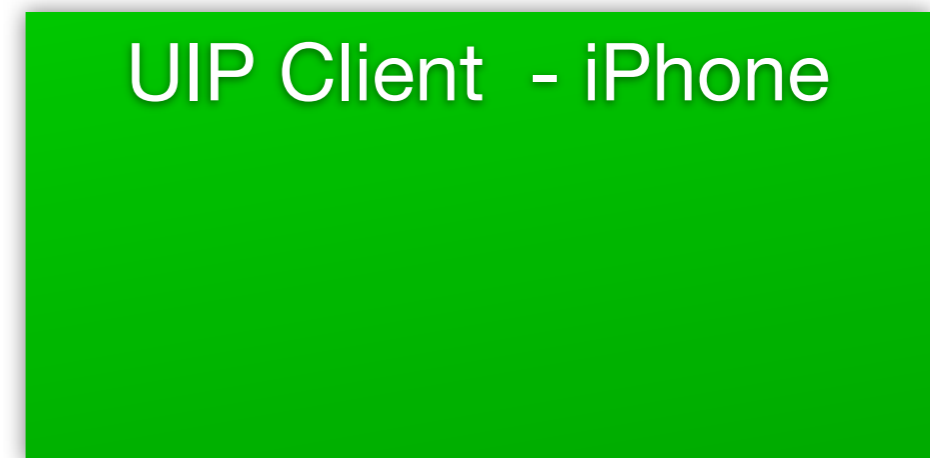
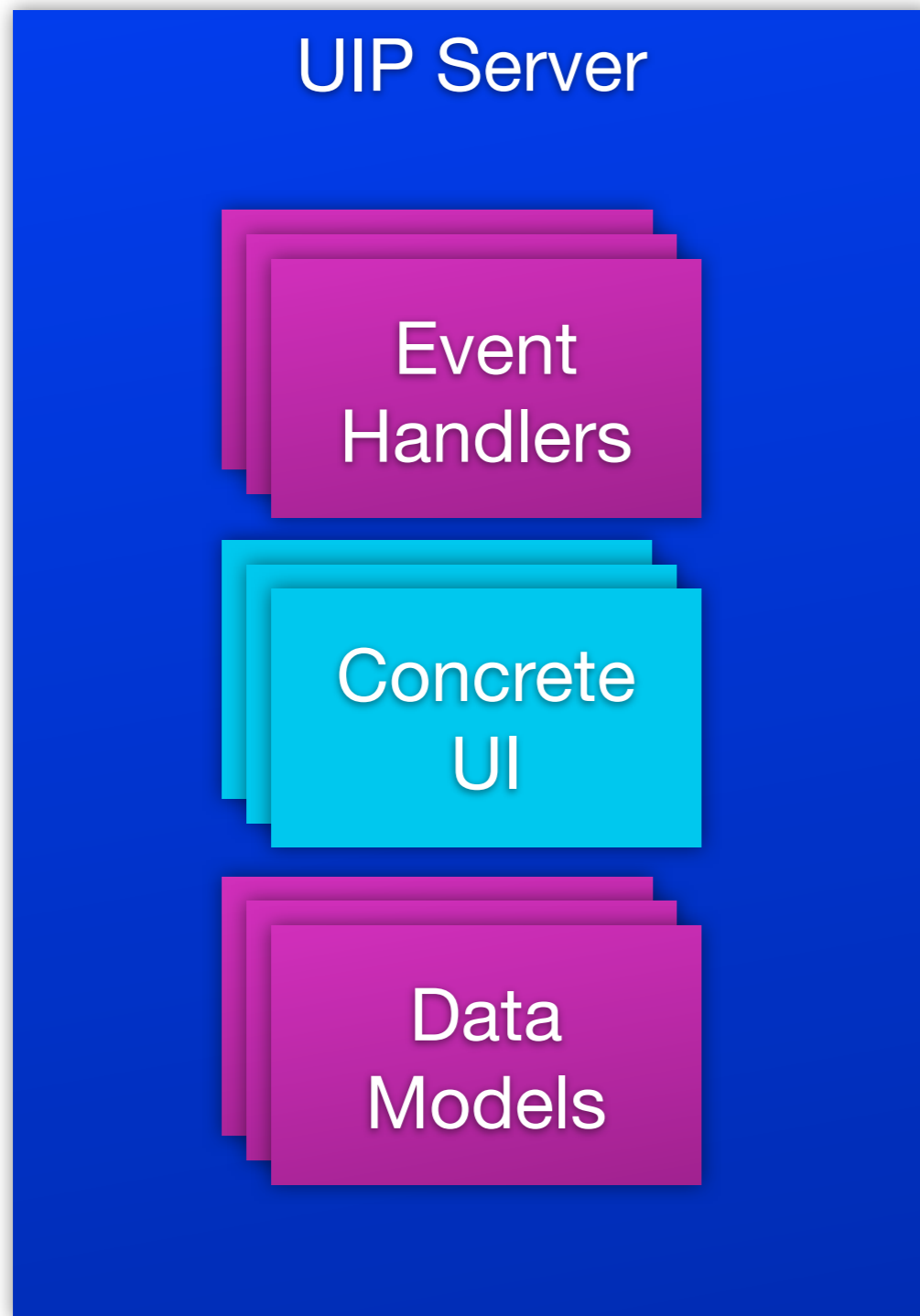
# UIP | USER INTERFACE DELIVERY



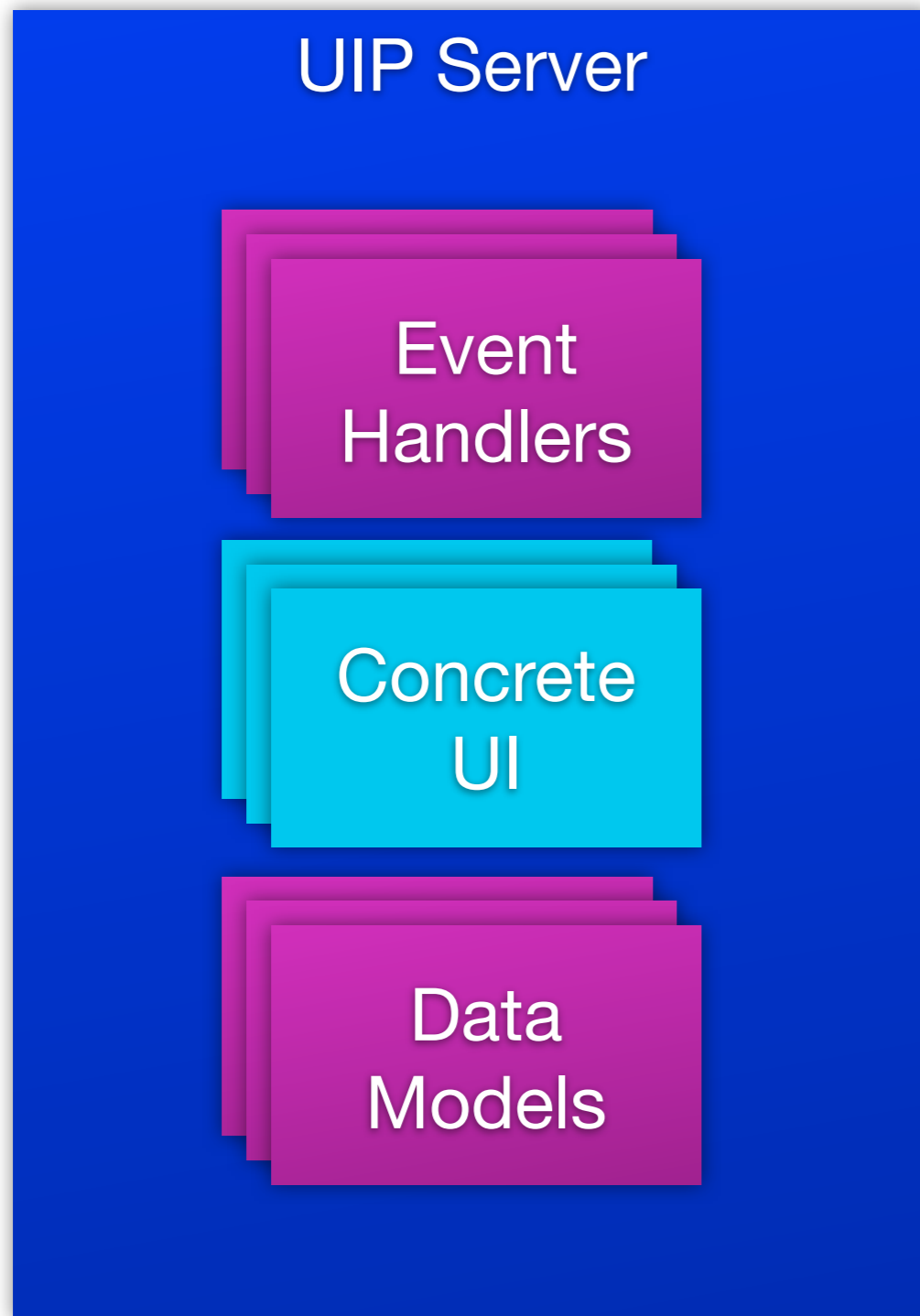
# UIP | USER INTERFACE DELIVERY



# UIP | USER INTERFACE DELIVERY



# UIP | USER INTERFACE DELIVERY

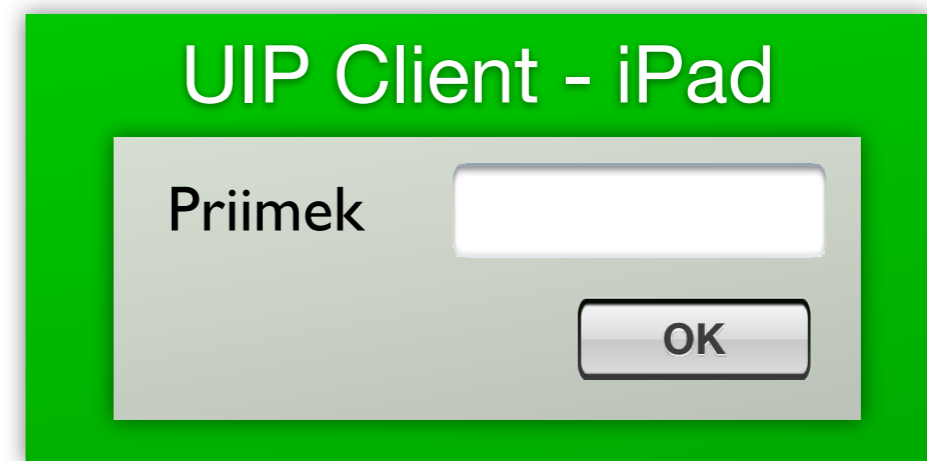
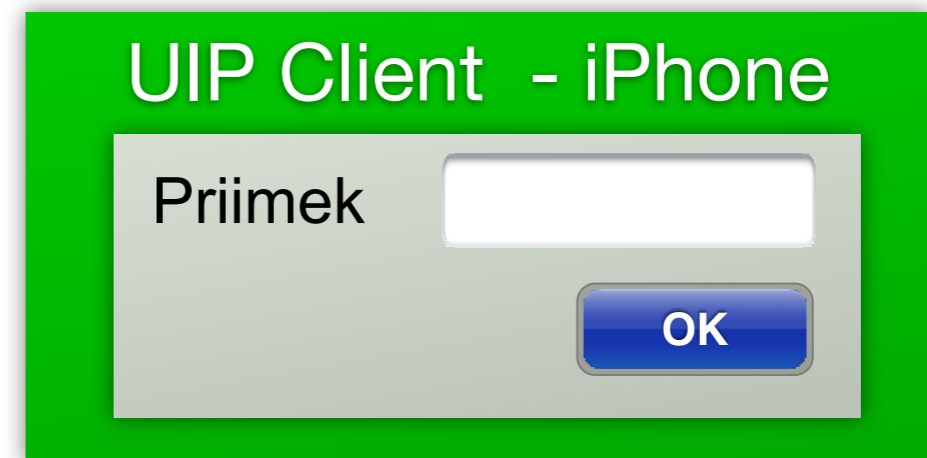
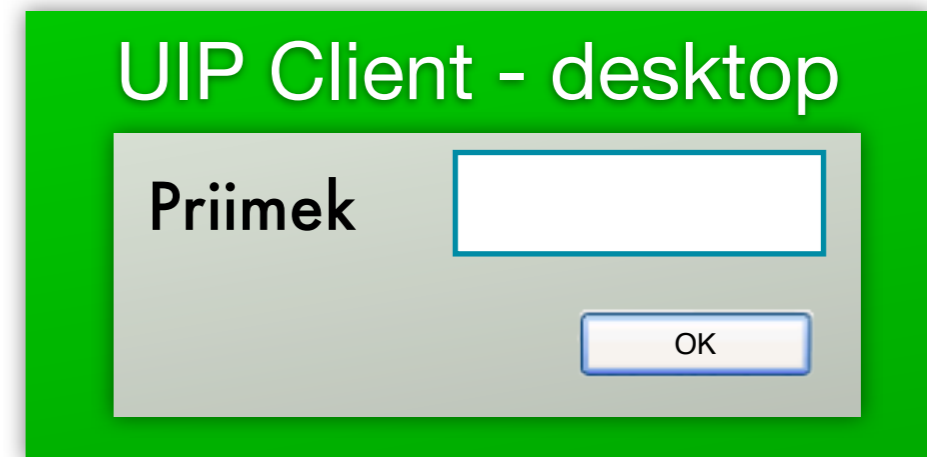
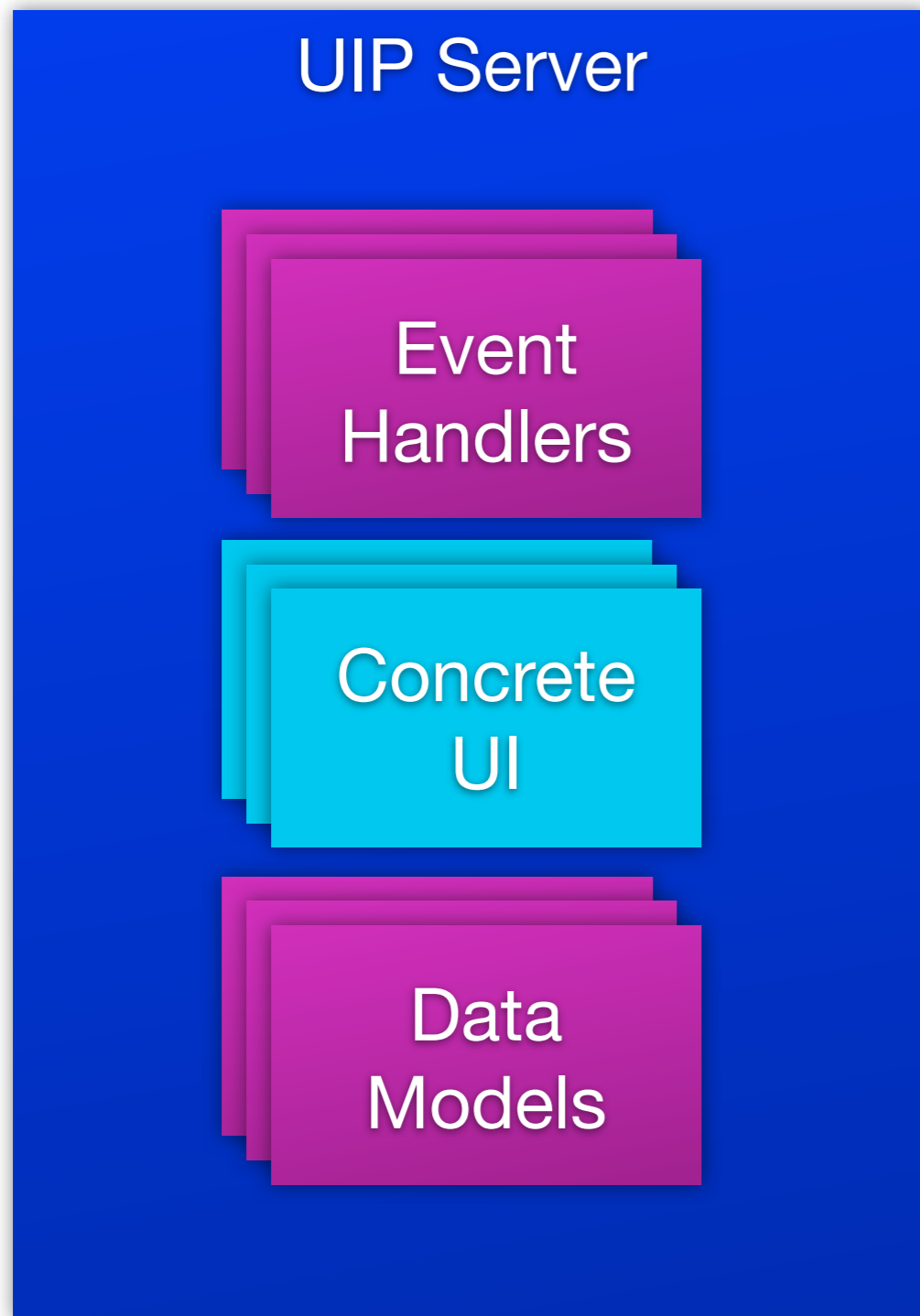


This form is titled "UIP Client - desktop" and is displayed within a green border. It features a light gray background with a "Surname" label on the left and a white text input field on the right. Below the input field is a small, rectangular "OK" button.

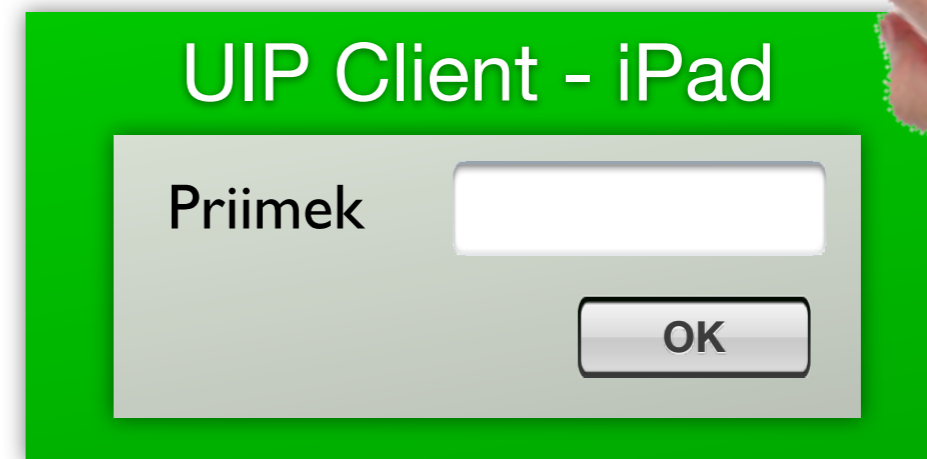
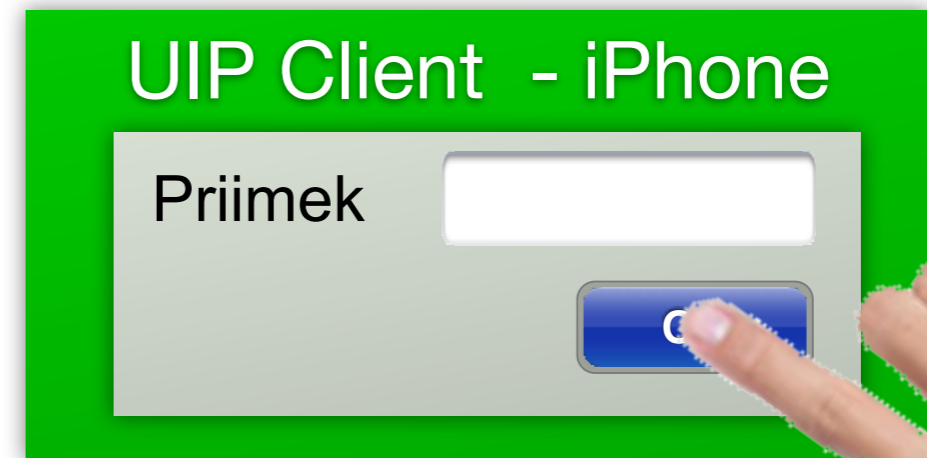
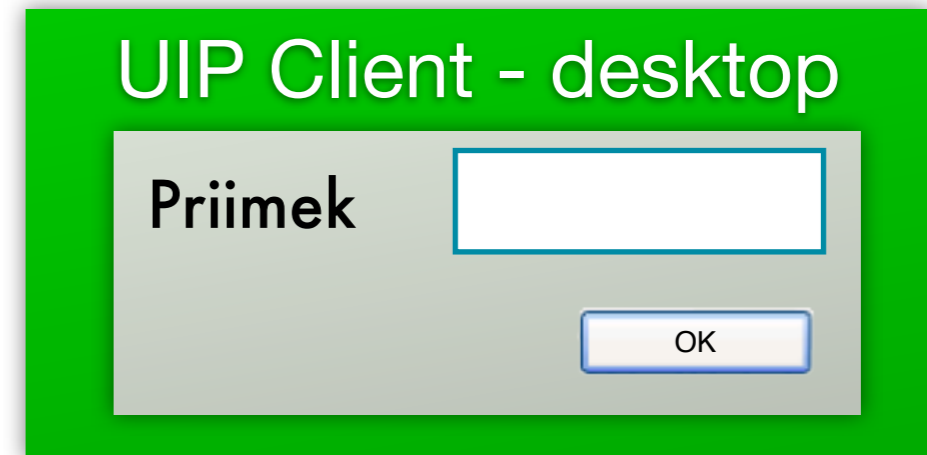
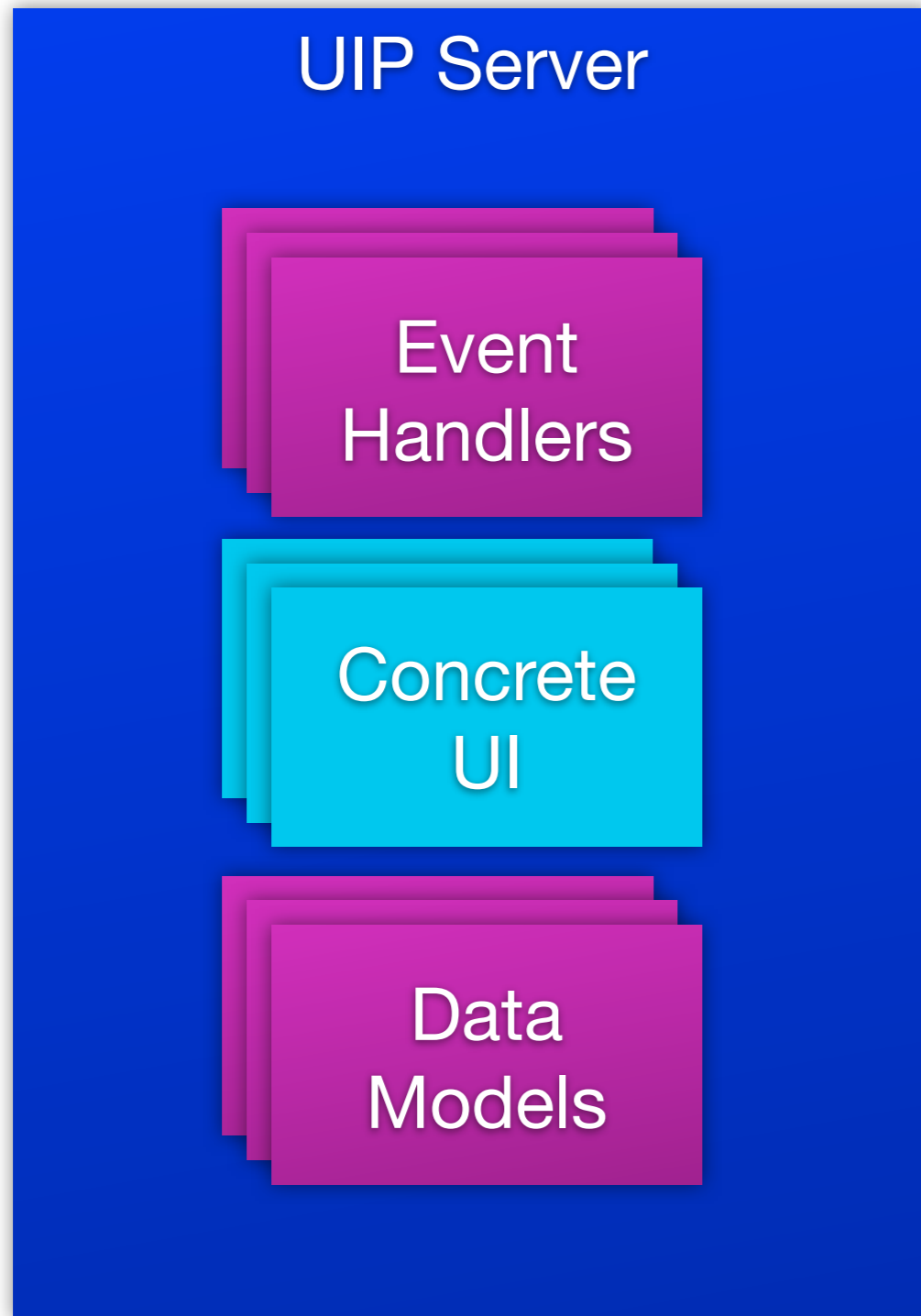
This form is titled "UIP Client - iPhone" and is displayed within a green border. It features a light gray background with a "Surname" label on the left and a white text input field on the right. Below the input field is a blue "OK" button with rounded corners.

This form is titled "UIP Client - iPad" and is displayed within a green border. It features a light gray background with a "Surname" label on the left and a white text input field on the right. Below the input field is a gray "OK" button with rounded corners.

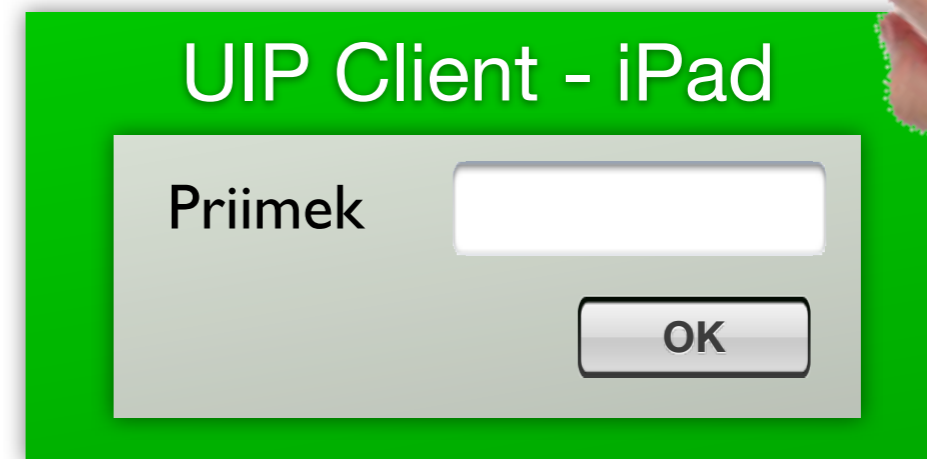
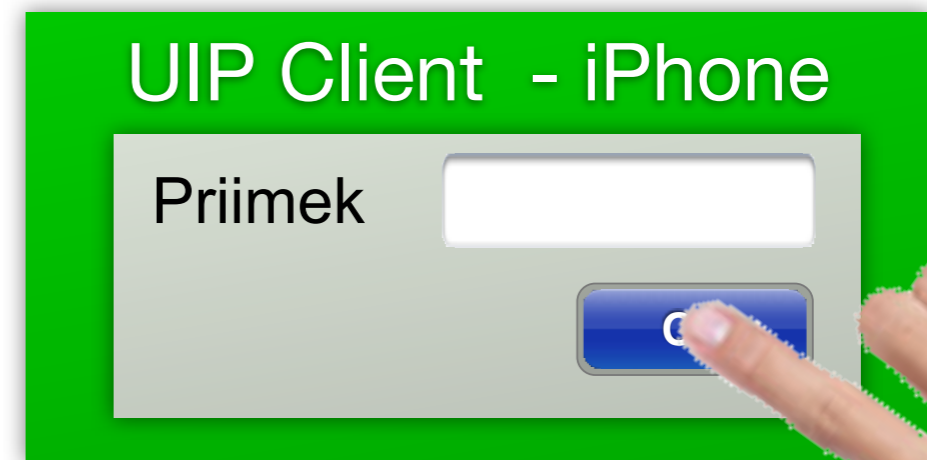
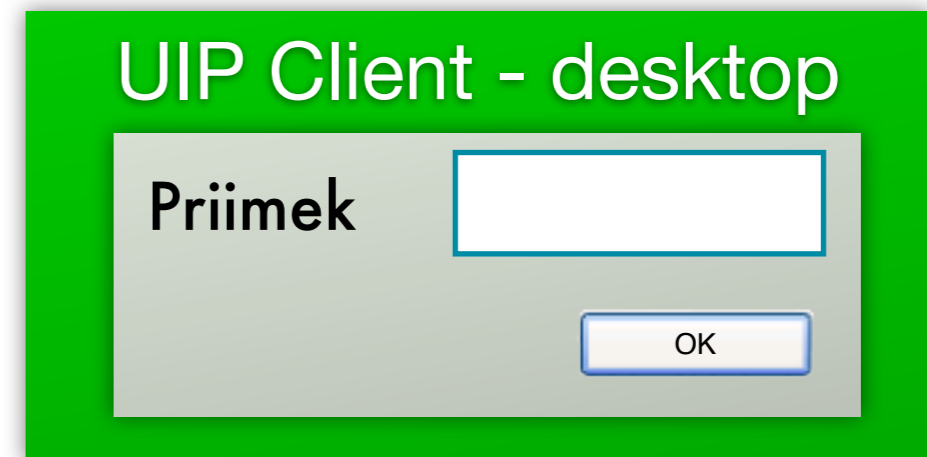
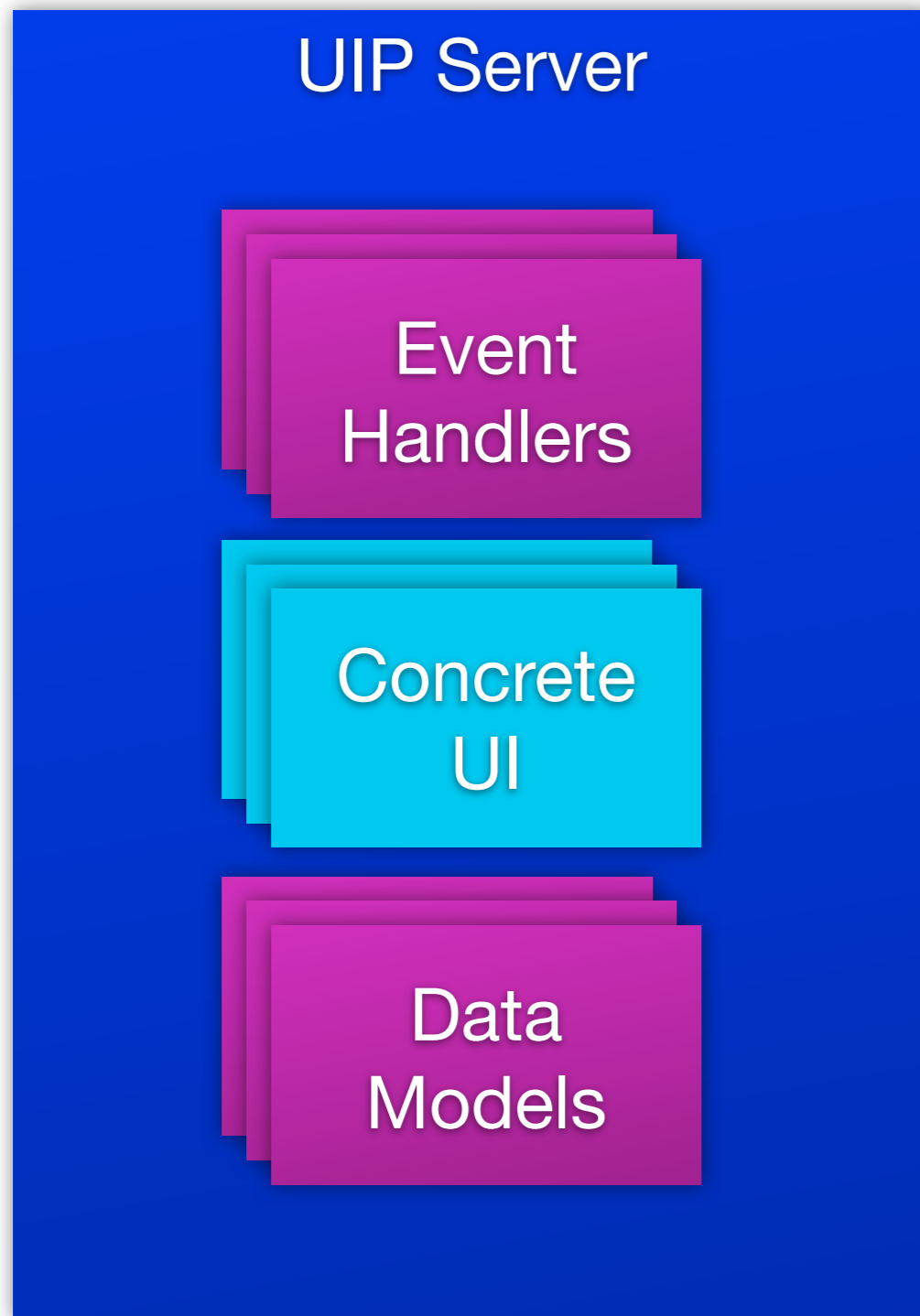
# UIP | USER INTERFACE DELIVERY



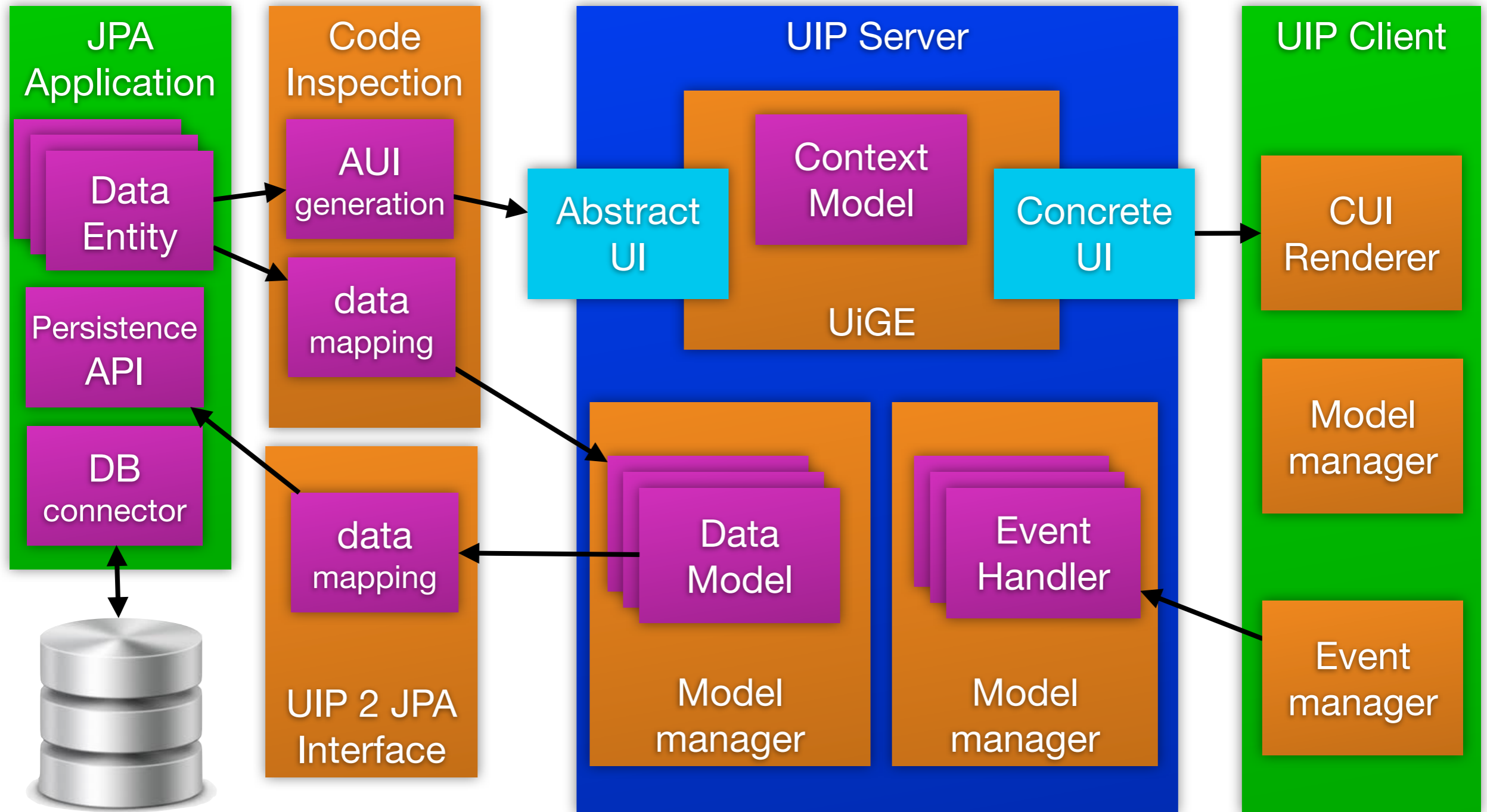
# UIP | USER INTERFACE DELIVERY



# UIP | USER INTERFACE DELIVERY



# INTEGRATION





# RESULTS

without templates

Login information

Username

Password

Password confirmation

User information

Degree

First name

Last name  Last name is mandatory. Max length of the last name is 100 characters and must not start with space.

Email

Age

Organization

Organization name

Carrier 3:54 PM

Doctor

Engineer

First name

First name is mandatory. Max length of the first name is 100 characters and must not start with space.

Last name

Last name is mandatory. Max length of the last name is 100 characters and must not start with space.

with templates

Carrier 3:51 PM

Password confirmation

User information

Degree

First name

First name is mandatory. Max length of the first name is 100 characters and must not start with space.

Last name

Your last name

Email

Carrier 5:09 PM 100%

Login information

Username

Password

Password confirmation

User information

Degree

First name

First name is mandatory. Max length of the first name is 100 characters and must not start with space.

Last name

Email

Age

Organization

Organization name

Address line 1

Address line 2

City

Country

State

# RESULTS

without templates

with templates

Login information

Username

Password

Password confirmation

User information

Degree

First name

Last name  Last name is man start with space.

Email

Age

Organization

Organization name

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without templates

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Carrier 5:09 PM 100%

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Address line 1

Address line 2

City

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State

Carrier 3:51 PM

Password confirmation

User information

Degree

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Last name

Your last name

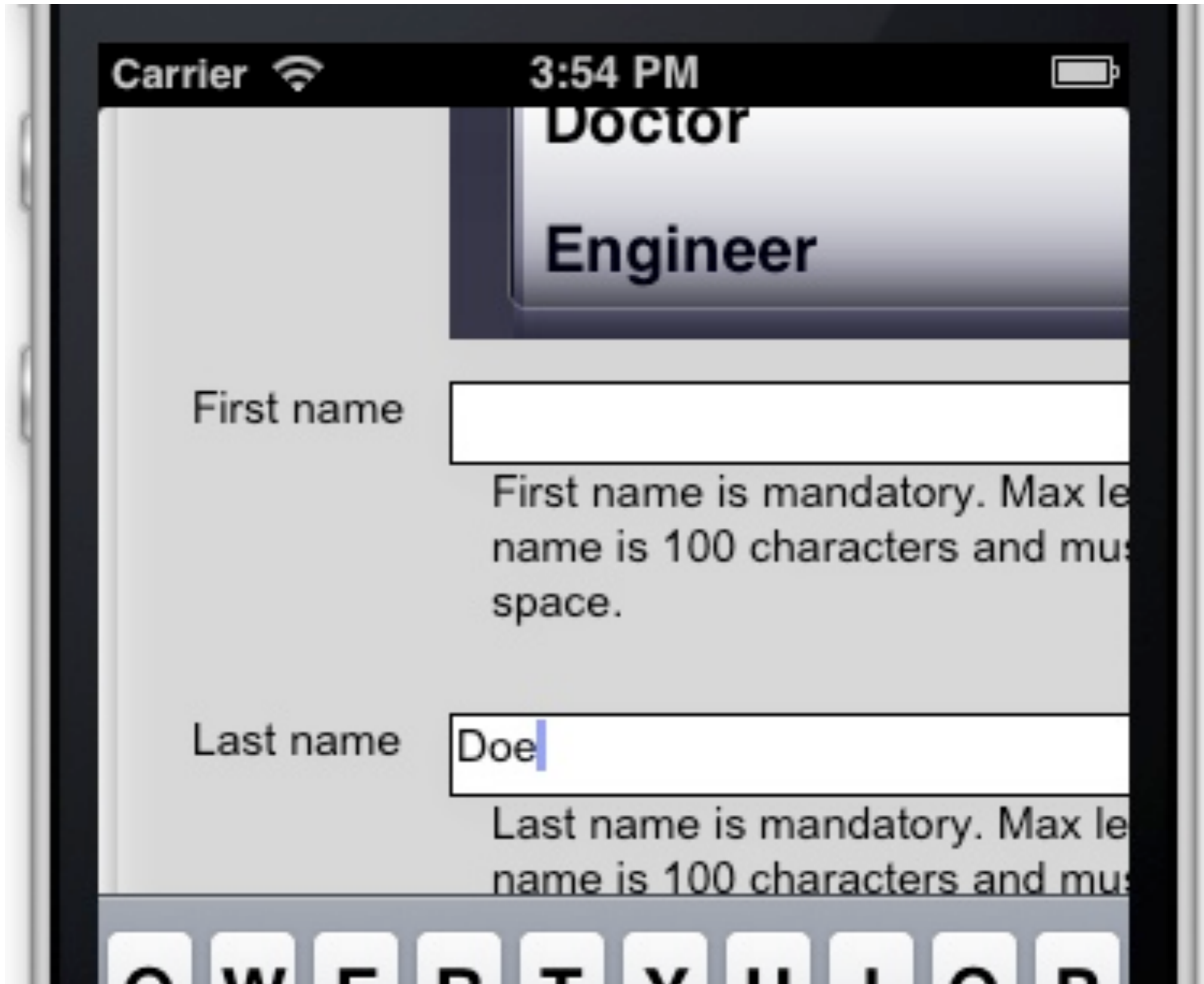
Email

with templates

# RESULTS

without templates

with templates



# RESULTS

without templates

Login information

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Password

Password confirmation

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Organization name

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Carrier 5:09 PM 100%

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Age

Organization

Organization name

Address line 1

Address line 2

City

Country

State

Carrier 3:51 PM

Password confirmation

User information

Degree

First name

First name is mandatory. Max length of the first name is 100 characters and must not start with space.

Last name

Your last name

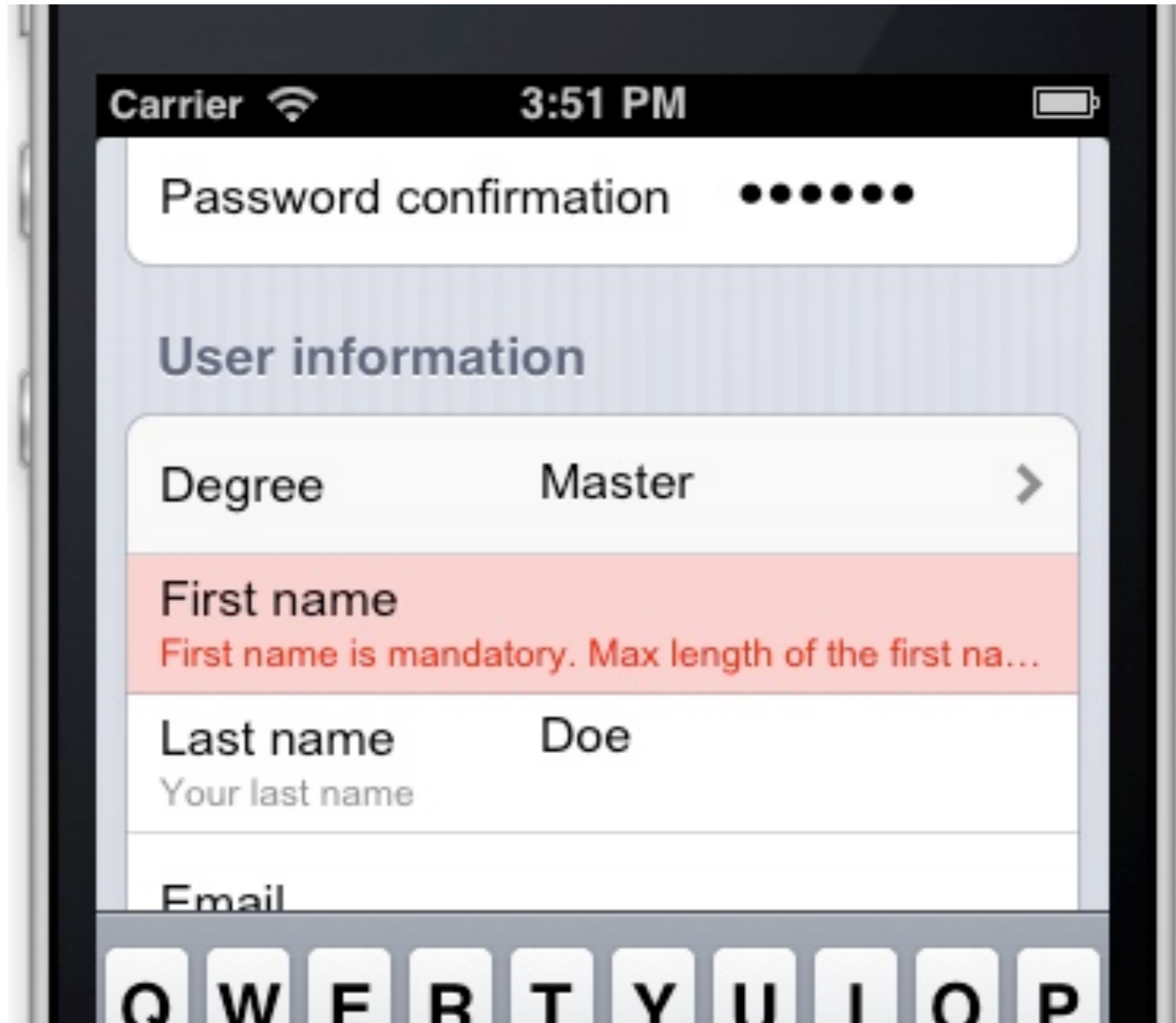
Email

with templates

# RESULTS

without templates

with templates



# RESULTS

without templates

Login information

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Password

Password confirmation

User information

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Email

Age

Organization

Organization name

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Carrier 5:09 PM 100%

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Organization

Organization name

Address line 1

Address line 2

City

Country

State

Carrier 3:51 PM

Password confirmation

User information

Degree

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First name is mandatory. Max length of the first name is 100 characters and must not start with space.

Last name

Your last name

Email

with templates

# RESULTS

without templates

with templates

The screenshot shows a mobile application interface with a form divided into three sections: Login information, User information, and Organization. The 'First name' field in the 'User information' section is highlighted in red, indicating a validation error. The error message reads: 'First name is mandatory. Max length of the first name is 100 characters and must not start with space.' The form fields are as follows:

Login information	
Username	Johndoe
Password	.....
Password confirmation	.....

User information	
Degree	None
First name	<span style="color: red;">First name is mandatory. Max length of the first name is 100 characters and must not start with space.</span>
Last name	Doe
Email	johndoe@site.org
Age	25

Organization	
Organization name	Harvard Uniersity
Address line 1	1350 Massachusetts Avenue
Address line 2	
City	Cambridge
Country	USA
State	Massachusetts



# RESULTS

without templates

Login information

Username

Password

Password confirmation

User information

Degree

First name

Last name  Last name is mandatory. Max length of the last name is 100 characters and must start with space.

Email

Age

Organization

Organization name

Carrier 3:54 PM

Doctor

Engineer

First name

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Last name

Last name is mandatory. Max length of the last name is 100 characters and must start with space.

Carrier 5:09 PM 100%

Login information

Username

Password

Password confirmation

User information

Degree

First name

First name is mandatory. Max length of the first name is 100 characters and must not start with space.

Last name

Email

Age

Organization

Organization name

Address line 1

Address line 2

City

Country

State

Carrier 3:51 PM

Password confirmation

User information

Degree

First name

First name is mandatory. Max length of the first name is 100 characters and must not start with space.

Last name

Your last name

Email

with templates

# PROOF OF CONCEPT | USER STUDY

- ▶ 12 participants, compared against web application

Device	UI aspect	M(web)	M(UIP)	Statistics
Desktop	comfort	2	1	$p < 0.05$
	efficiency	2	1	$p > 0.05$
	aesthetic quality	4	2	$p < 0.05$
iPhone	comfort	4	2	$p < 0.005$
	efficiency	4	2	$p < 0.05$
	aesthetic quality	4	2	$p < 0.005$
iPad	comfort	3	2	$p < 0.05$
	efficiency	3	2	$p < 0.05$
	aesthetic quality	4	2	$p < 0.005$

# PROOF OF CONCEPT | DEVELOPMENT AND MAINTENANCE EFFORT

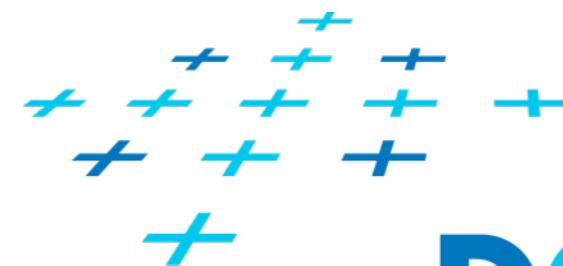
Component	Manual (LOC)	Our approach (LOC)
Persistence model	370	370
Extension to persistence model	-	96
Text Label Properties	-	108
UIP XML Forms	703	-
Java Script Library	300	300
Java Script in View	446	-
Total	1819	874

# CONCLUSION

- ▶ code inspection significantly reduces development and maintenance effort
- ▶ various heterogeneous target UI platforms supported
- ▶ context-sensitive UIs generated at runtime
- ▶ simple but scalable context model

# FUTURE WORK

- ▶ focus on non data-oriented applications
  - e.g. workflow based
- ▶ more challenging target user audience
  - blind users
- ▶ support for more modalities
- ▶ market dissemination



**DCGI**

**Q & A**

UIPROTOCOL.EU

ASPECTFACES.COM

Thank you for your attention.

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[cernyto3@fel.cvut.cz](mailto:cernyto3@fel.cvut.cz)



Technologická agentura  
České republiky

