

Module_3

Map ER to Schema, Normalization

CS 3410 Database

Topic Map ER to Schema, Normalization

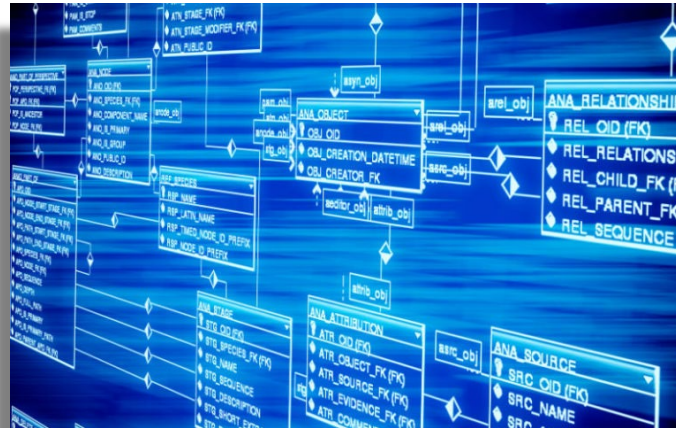
Cameron Cherry, David Ceballos, and Ben Costea



3.1 Introduction

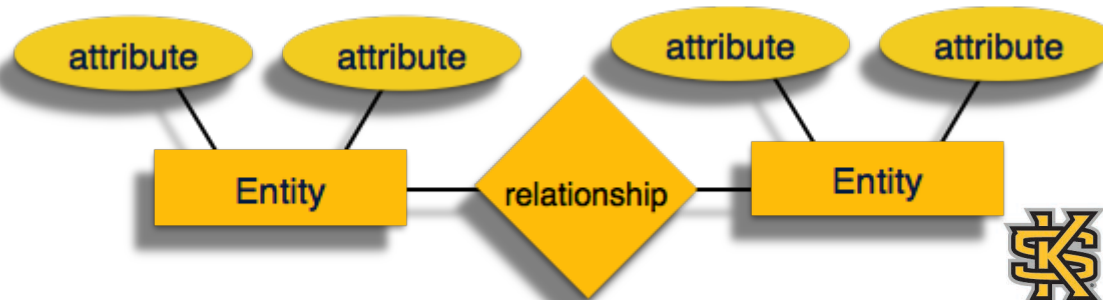
Mapping an ER model gives a good overview of the design of a system with the target to make it easier to be understood at a technical level, whilst normalization is used to organize tables in a manner that reduces redundancy and dependency of data.

These two techniques are essential to database design , database management systems (DBMS) and a key to understanding the organization and visual representation of a database.



3.1 Mapping ER to Schema

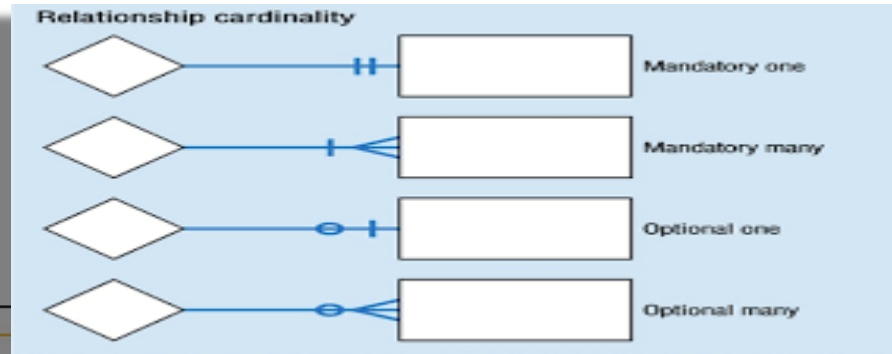
1. Create table for a relationship.
2. Add the primary keys of all participating Entities as field of table with their respective data.
3. If relationship has any attributes, add each attribute as a field of the table.
4. Declare a primary key composing all the primary keys of participating entities.
5. Declare all foreign key constraints.



3.1 ER models, diagrams and relation schema

The ER diagrams can be mapped to a relation schema which means, we create relational schema to show the relationship between its members.

ER model is used to model the logical view of the system that contains these components: Entity, Entity Type and Entity Set and relationship between them.

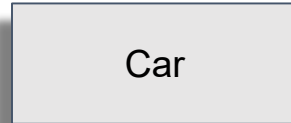


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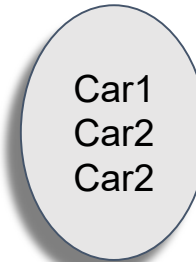
3.1 Entity Type

Entity can be a person, an object, a concept, a virtual file or it can represent an idea that can be quantified: a company, a job, a document. As a general idea an Entity is an object consisting of an Entity Type and everything that consists of Entity Type is called an Entity Set.

Entity Type

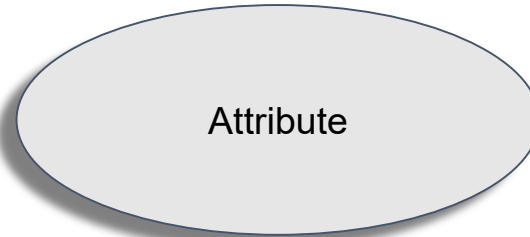


Entity Set



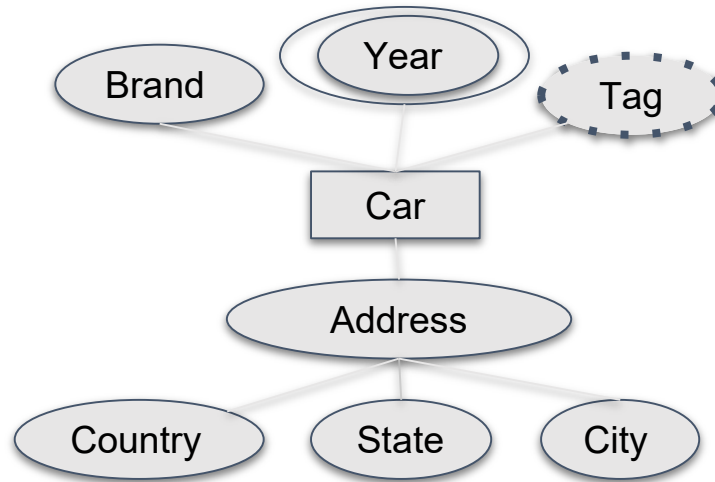
3.1 Attributes

The next important step in understanding the mapping is the Attributes. They are properties which define the entity type. There are many examples to describe this including: Name, DOB, Address. The attribute in an ER diagram is represented by an oval.



3.1 Multiple type of attributes

To complete the attribute section for complex designing there are multiple type of attributes:
Composite Attribute – composing many attributes, Multivalued Attribute-consisting more than one value, and Derived Attribute-derived from other attributes.

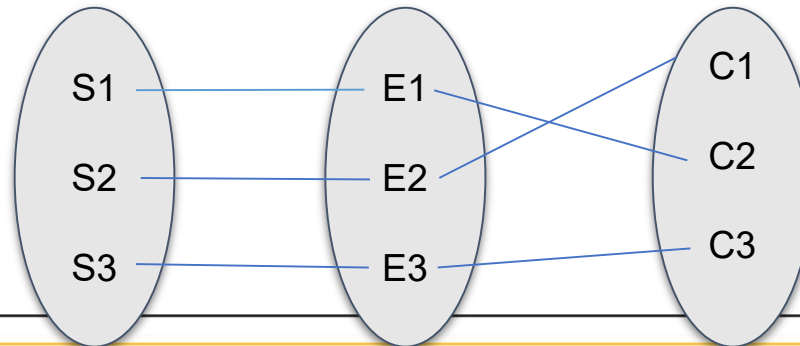


3.1 Relationship Type and Set

- Relationship type



- Relationship Set



3.2 Relations

- Relations exist as a two-dimensional table of data. This typically has multiple named columns and an unknown quantity of rows for data to be entered. Specific data, such as JSON data that easily identified by a user.
- These properties separate themselves distinctly non-relational tables.

Name	Dry/Wet Food	Good Boy (Y/N)
Fido	Dry	Y
Rex	Wet	N
Bubbles	Dry	Y
Cujo	Wet	N

Tag #	Height (in)	Weight (lbs)
1573	15	21
2684	9	7
3795	27	130
4806	6	5

Tag #	Name	Breed	Color	Age
1573	Fido	Beagle	Brown/White	1.5
2684	Rex	Pekingese	White	9
3795	Bubbles	Rottweiler	Black	5
4806	Cujo	Chihuahua	Gold	4

Non-relational vs relational databases

3.2 Relational Properties

The different properties of these relations are as listed:

- Each relation (or table) in a database has a unique name.
- An entry at the intersection of each row and column is atomic (or single valued).
 - There can be only one value associated with each attribute on a specific row of a table; no multivalued attributes are allowed in a relation.
- Each row is unique; no two rows in a relation can be identical.
- Each attribute (or column) within a table has a unique name.
- The sequence of columns (left to right) is insignificant. The order of the columns in a relation can be changed without changing the meaning or use of the relation.
- The sequence of rows (top to bottom) is insignificant. As with columns, the order of the rows of a relation may be changed or stored in any sequence.



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3.2 Explanations of Properties

Some of the properties relate to one another while others seem to stand alone a bit more.

- 1, 4, and 6 - These are the first, fourth, and sixth. The columns having unique attributes and the individual rows being arbitrarily organized very simply explains the core properties of relations. These compounded with the following will contain the overall encompassing explanation.

<u>EmpID</u>	Name	DeptName	Salary	CourseTitle	DateCompleted
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Figure 1 Example of property one. Referenced material from Fig 4-2 in book.

3.2 Relational Properties Ctd.

- 2 - that each and every single attribute in individual tuples inside of a relation will only consist of a single value and not allow any different multivalued values of the kind supported in databases

EMPLOYEE1			
<u>EmpID</u>	Name	DeptName	Salary
100	Margaret Simpson	Marketing	48,000
140	Allen Beeton	Accounting	52,000
110	Chris Lucero	Info Systems	43,000
190	Lorenzo Davis	Finance	55,000
150	Susan Martin	Marketing	42,000

Figure 2 Example of property two. Referenced material from Fig 4
1 in book.



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3.2 Relational Properties Ctd.

- 3 - the uniqueness within the table itself and how each individual row can only have values of data that are individual to the row itself. This ensures that no two rows will be identical and the value of the data within will have

<u>EmpID</u>	Name	DeptName	Salary	CourseTitle	DateCompleted
100	Margaret Simpson	Marketing	48,000	SPSS	6/19/2015
				Surveys	10/7/2015
140	Alan Beeton	Accounting	52,000	Tax Acc	12/8/2015
110	Chris Lucero	Info Systems	43,000	Visual Basic	1/12/2015
				C++	4/22/2015
190	Lorenzo Davis	Finance	55,000		
150	Susan Martin	Marketing	42,000	SPSS	6/16/2015
				Java	8/12/2015

Figure 3 Example of property three. Referenced material from Fig 4-2 in book.

- 5 - the order does not matter in regards to the columns themselves.

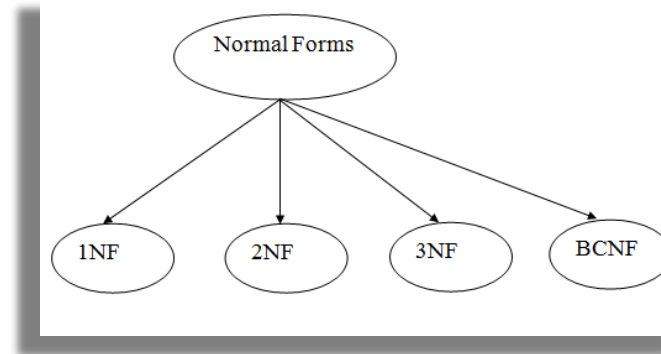


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3.3 First, Second, and Third Normal Forms

Normalization is a database design technique that is used to organize tables in a manner that reduces redundancy and dependency of data. The use of this technique divides larger tables into smaller tables and links them using relationships.

- The main idea with this theory is that a table should be about a specific topic and only supporting topics included which minimizes duplicate data, minimizes or avoids data modification issues, and simplifies queries.



3.3 First, Second, and Third Normal Forms (cont.)

The first normal form like all normal forms have specific requirements to be validated as first normal form.

First normal form rules:

1. Must have have two dimensions with rows and columns.
2. Each row must contain data that pertains to something (cannot be null).
3. Each column must contain data for a single attribute of the thing it's describing.
4. Each cell of the table must have only a single value (cannot be multivalued).
5. Entries in any column has to have the same type of data.
6. Each column must have a unique name.
7. All rows should be uniquely identified.
8. The order of the columns and rows have no significance.

3.3 First Normal Form Example

Customer_ID	Customer Name	Item	Price	Supplier	Supplier Phone
allen_d	Allen Davidson	Xbox One	250	Microsoft	1-800-BUY-XBOX
cameron123	Cameron Cherry	PlayStation 4	300	Sony	1-800-BUY-SONY
trinity9	Trinity Wilson	PS Vita	200	Sony	1-800-BUY-SONY

Table in first normal form.

3.3 First, Second, and Third Normal Forms (cont.)

Second normal form requires all attributes or non-key columns to be dependent on the key.

For example, the price of the item in the table isn't determined by the primary key or unique identifier of the customer so this would break second normal form.

Customer_ID	Customer Name	Item	Price	Supplier	Supplier Phone
allen_d	Allen Davidson	Xbox One	250	Microsoft	1-800-BUY-XBOX
cameron123	Cameron Cherry	PlayStation 4	300	Sony	1-800-BUY-SONY
trinity9	Trinity Wilson	PS Vita	200	Sony	1-800-BUY-SONY

In this case, the table can be split into two, with one table having the primary key as Customer_ID and all of their personal information and the second being a table with the primary key as the item name and the supplier information and prices.

Tip: All other normal forms go by the rules of first normal form along with their own specific rules.

3.3 Second Normal Form Example

Customer_ID	Customer Name
allen_d	Allen Davidson
cameron123	Cameron Cherry
trinity9	Trinity Wilson

Item	Supplier	Supplier Phone	Price
Xbox One	Microsoft	1-800-BUY-XBOX	250
PlayStation 4	Sony	1-800-BUY-SONY	300
PS Vita	Sony	1-800-BUY-SONY	200

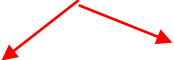
Now this data is accurately represented in second normal form.

3.3 First, Second, and Third Normal Forms (cont.)

In third normal form, all columns can be determined only by the key in the table and no other column.

- Having this type of normalization gets rid of redundancy and is especially vulnerable to some types of modification anomalies.

Take a look at second normal form where the items table has duplicate supplier phone numbers and supplier names.



Item	Supplier	Supplier Phone	Price
Xbox One	Microsoft	1-800-BUY-XBOX	250
PlayStation 4	Sony	1-800-BUY-SONY	300
PS Vita	Sony	1-800-BUY-SONY	200

If Sony were to have more products under their item key, the supplier phone number would keep repeating because it's directly related to the supplier name and will always be that same phone number.

3.3 Third Normal Form Example

Customer_ID	Customer Name
allen_d	Allen Davidson
cameron123	Cameron Cherry
trinity9	Trinity Wilson

Supplier	Supplier Phone
Microsoft	1-800-BUY-XBOX
Sony	1-800-BUY-SONY

Item	Supplier	Price
Xbox One	Microsoft	250
PlayStation 4	Sony	300
PS Vita	Sony	200

Separating these two tables into individual representations makes all of the columns dependent on only the key in the table and no other column, making the third normal form valid.



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3.3 Normalization (1NF, 2NF, 3NF)

2nd Normal Form - All attributes (Non-Key Columns) dependent on the key

Primary Key

Cust ID	Cust Name	Shipping Address	Newsletter
al_smith	Alan Smith	35 Palm St, Miami	Xbox News
roger25	Roger Banks	87 Campus Rd, Boston	PlayStation News
wilson44	Evon Wilson	28 Rock Av, Denver	Xbox News
wilson44	Evon Wilson	28 Rock Av, Denver	PlayStation News
am_smith	Alan Smith	47 Campus Rd, Boston	PlayStation News

Primary Key

Item	Supplier	Supplier Phone	Price
Xbox One	Microsoft	(800) BUY-XBOX	250
PlayStation 4	Sony	(800) BUY-SONY	300
PS Vita	Sony	(800) BUY-SONY	200

Primary Key Primary Key

Cust ID	Item
al_smith	Xbox One
roger25	PlayStation 4
wilson44	Xbox One
wilson44	PS Vita
am_smith	PlayStation 4

3rd Normal Form - All Fields (columns) can be determined Only by the Key in the table and and no other column



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3.4 Properties of Candidate Keys

A candidate key is a conglomerate of attributes that identify a database record in a unique way without referencing any other key data from the database.

A table may contain one or more candidates and one of those candidate keys has to be referred to as the primary key.

The absolute requirement for a table to have is the primary key, but the maximum number of candidate keys is unlimited by any constraints.

3.4 Candidate Keys

1. The value of Candidate Key is unique and non-null for every tuple
2. There can be more than one candidate key in a relation
3. The candidate key can be simple or composite as well.

For example {STUD_NO,COURSE_NO} is a composite candidate key for relation STUDENT_COURSE.

3.4 Example of Candidate Key

The highlight are unique attributes therefore all of them are **Candidate Keys**.

Stud ID	Roll NO	FirstName	LastName	Email
1	11	Ben	RandomA	abc@gmail.com
2	12	David	RandomB	xyz@gmail.com
3	13	Cameron	RandomC	mnp@gmail.com

Introduction & Background

Our Interaction Changes as technologies advances

This part of the course is set in two different topics:

- **Conceptualization** - is the process of clarifying and developing of terms at arriving at precise definitions (“Conceptualization excerpt”, 2012). While most people have a different idea/confuse when a *concept is presented the conceptualization process should have ideological differences cleared up.*
- **User Interface (UI) Design** - should take into account how certain frameworks work within and how certain designs should be noted. This section will name out certain UI designs that are notable and how individuals use them on a day to day basis.

Conceptualization

- Conceptualization is the process of clarifying and developing of terms at arriving at precise definitions.
- When using concepts, conceptualization is the clear and concise way of writing definitions to the various concepts so that nothing becomes confused when carrying out said concepts.
- Conceptualization can be viewed as the stage where interface designs are prototyped.

User Interface Design

- User Interface Design is the process of making interfaces in software or computerized devices with a focus on looks and styles.
- User Interfaces generally refer to graphical interfaces, but voice-control interfaces are also included.
- Every website on the internet has a User Interface Design.

Conceptualization

- In order for a service to be popular, it is necessary that **user clearly recognize** the value of the service in order to engage to take action, this is the Key to achieving the goal of UI (User Interface).
- **UI is the bridge between User and tool/technologies with well-designed UI.**
- One of the methods of Conceptualization is to **apply a development methodology known as User-Centered Design (UCD).**

Conceptualization Cont...

- Since User is the Final viewer of product, **UI goal is to keep the User in mind.**
- UCD-based development is one way to **minimizing the common pitfalls** of product/service that providers, developers /designers produce.

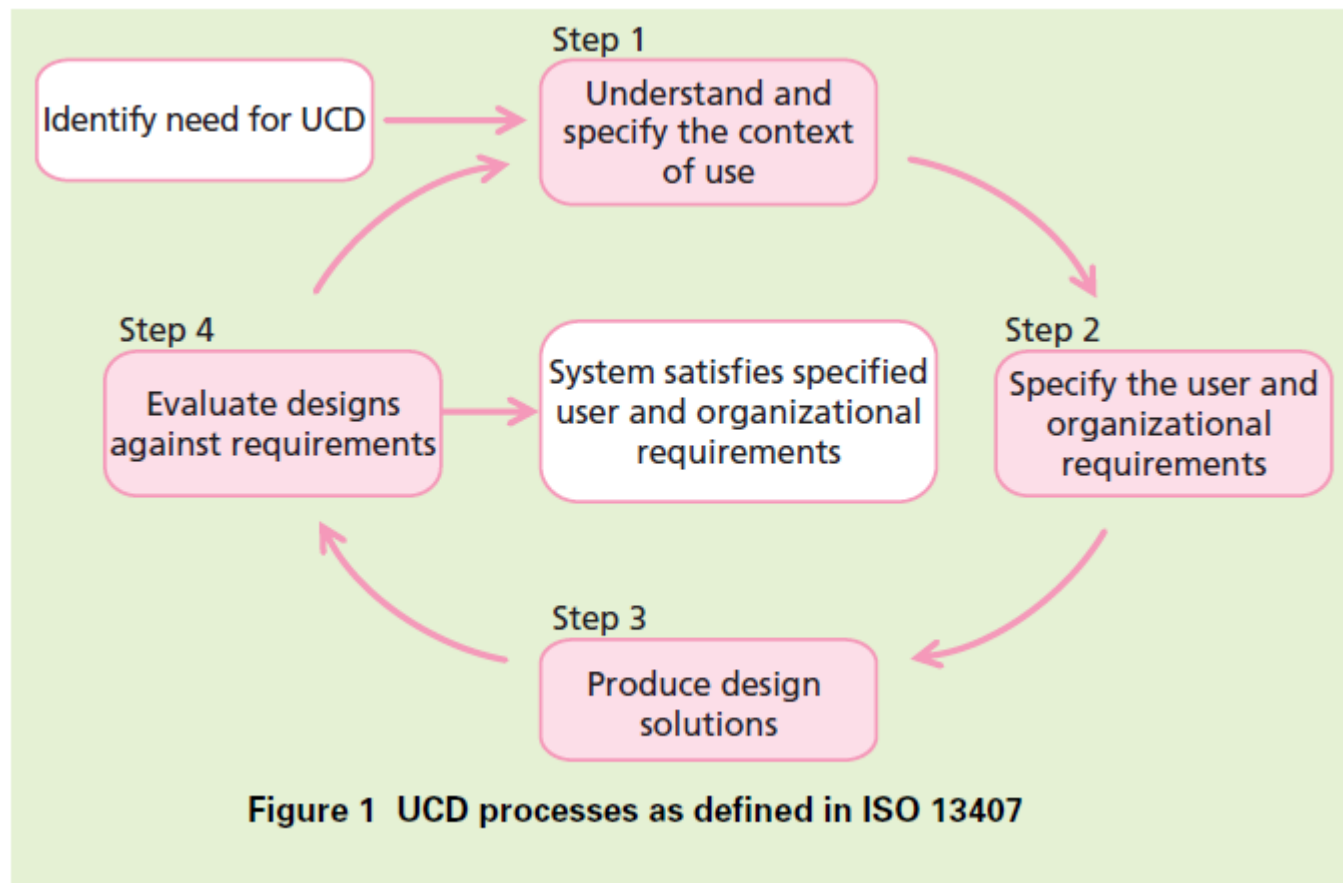


Figure 1: The UCD processes consist of the four steps

Conceptualization Phase

- The goal is to visualize several UI concepts and design appeal to User and advanced the design.
- Four Steps correspond with UCD processes in Figure 1
 1. Gather information
 2. Synthesize and determine focus areas
 3. Visualize several UI Concepts
 4. Screen the visualized UI to prototyping phase.



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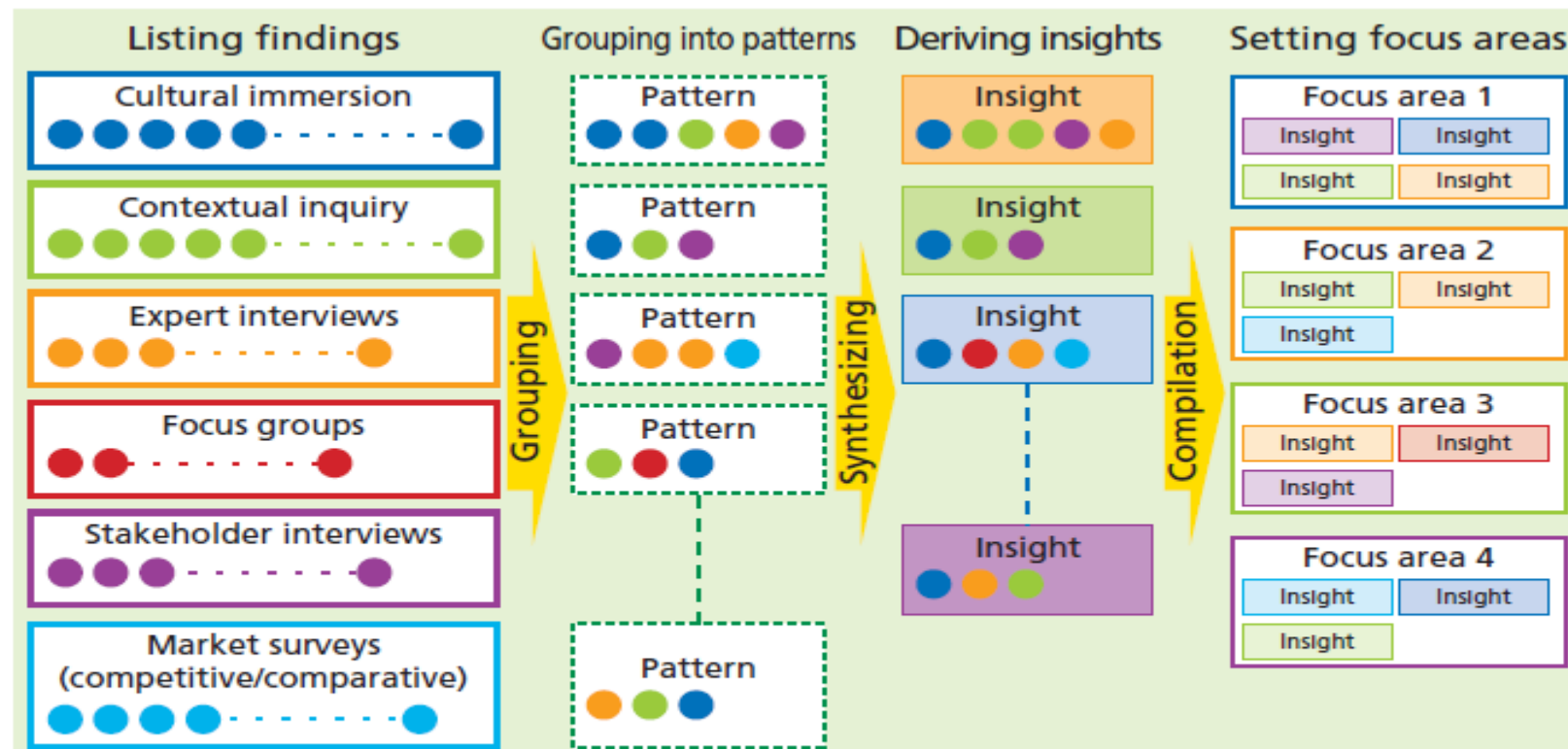


Figure 2 General flow of procedures used to define focus areas

1. **Extract Findings**
2. **Define Users**
3. **Create** a UI prototype that present a solution
4. **Evaluate** the UI prototype





Focus areas	Corresponding insights	
Streams What does it mean to activate mobile phones with a constant stream of people, rich-media, and information?		
	Streams of information	Streams of people
Specialization How can we enable multi-tasking through multi-devices in the mobile ecosystem?		
	Specialty stores	Many specialized devices

Figure 3 Example focus areas and corresponding insights

Introduction to the Prominence of UI Design

- Today we live in an age in which people can effectively use some of the most advanced pieces of technology without a complete because of the many developments of User Interface Design.
- **UI Design:**
 - is a sub-set of interaction design primarily dealing with the **interactions involving people and machinery.**
 - “Designing interactive **products to support the way people communicate and interact in their everyday and working lives**” (Sharp, Rogers, Preece, 2015).
 - became a prominent design focus because it allowed these advance machineries to become *wanted* instead of solely being *needed*.



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Table 2 Check items used in heuristic evaluation

1	Is the system always keeping users informed about what is going on, through appropriate feedback within reasonable time?
2	Is the system speaking the users' language, with words, phrases and concepts familiar to the user?
3	Is there a clearly marked "emergency exit" to easily return the user to the previous state in case he/she makes a mistake?
4	Is there a consistent set of rules (in operative structure and interface) from beginning to end in the system?
5	Is there a careful design which prevents a user error from occurring in the first place?
6	Are there designs in place so that the user doesn't have to remember information while using the system?
7	Are there shortcuts or can users tailor frequent actions so that expert users can use the system efficiently?
8	Are unneeded dialogues eliminated, and is the design minimalist and aesthetic?

Problem and Design Environments and Models

The Main Problems Plaguing Graphical User Interfaces (GUI)

- **Appear elements are not appealing**
 - A byproduct of bad user interface is having unappealing elements
- **Elements' on GUI is not functions obvious**
 - One should try and make the element obvious for the user so the user can properly navigate the user interface
- **Architecture is not well planned**
 - A poor architecture can be heavily detrimental to user engagibility
- **Incorrect requirement assumptions**
 - User Interfaces that does not properly meet the client's requirements will lead to poor business relationships.

User Experience (UX) is a *person's emotions and attitudes about using a particular product, system or service*. It includes the practical, experiential, affective, meaningful and valuable aspects of human–computer interaction and product ownership.

User interface (UI) design is the process of making interfaces in software or computerized devices with a focus on looks or style. Designers aim to create **designs** users will find easy to use and pleasurable.

UI design typically refers to graphical user interfaces but also includes others, such as voice-controlled ones.

What makes up a good UI?



Common Characteristics of GUI

- Simplistic
- Concise
- Responsive
- Intuitive
- Efficient

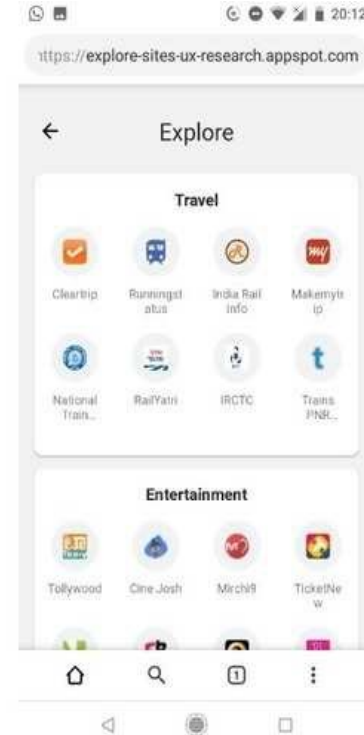


Image courtesy: Android Police

Principles of User Interface Design

- **A good UI should be able to**
 - properly capture and hold the user's attention and guide them to their desired goal.
 - hand off control to the user.
 - The feedback principle (an equal amount of output feedback for input) should be properly followed.
 - located on one screen when possible.
 - then the information should be located on as few screens as possible.

Principles of User Interface Design (cont.)

- The appearance of the interface should be consistent with its behavior.
- One should keep in mind critical incident technique, a method of gathering facts from domain experts and lesser experienced users to identify difficulties with the system, in order to create the best possible user interface interaction.
- Lastly, an emphasis should be placed on pleasing the largest possible amount of users, rather than focusing on the specific needs of each user.

Characteristics of User Interface Design (cont.)

- Visualization is a major aspect that can make or break a program in both the eyes of the consumer and the eyes of a customer.
- Poor visualization can lead to an overcrowded user interface or even an interface that visually is unappealing.
- Poor visualization also leads to poor user retention.
- An unresponsive design can lead a consumer to think the website/device is not functioning properly.



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Guidelines, Theories, Principles, Models, and Frameworks



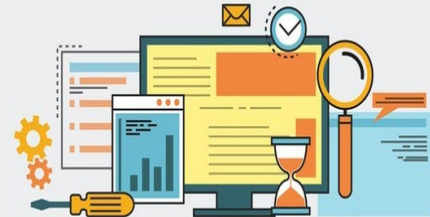
Ruby on Rails or Rails, is a server-side web application framework written in Ruby under the MIT License. Rails is a model-view-controller framework, providing default structures for a database, a web service, and web pages.



JavaScript (JS) is a lightweight, interpreted, or just-in-time compiled programming language with first-class functions.

Django is a Python-based free and open-source web framework, which follows the model-template-view architectural pattern. It is maintained by the Django Software Foundation, an independent organization established as a 501 nonprofit.

Django's primary goal is to ease the creation of complex, database-driven websites.



django

Proper Guidelines for User Interface

- The user interface should **properly scale** with the computer competency of the average user.
 - *A computer literate user will not need as many buttons and bars compared to a computer illiterate user.*
- Any corporation should make sure they're appropriately meeting their established style guidelines.
 - *Every major corporation shall have a style guideline so that all corporate products have a similar look and design*
- There should be a clear and concise outline for the flow of the user interface.
 - *This will help reduce the number of lost consumers when navigating the website.*



GUI Frameworks

- A framework
 - refers to the the software tools used to build software programs that run on the web.
 - used by both front-end and back-end developers.
 - provide longevity and enforce good coding practices.
 - have great community support which can heavily reduce the amount of debugging needed.
- Most common languages that use frameworks are:
 - Javascript and Ruby.

Conclusion

- Create prototypes before implementing
- Appeal to a wide variety of users
- Make a user interface that directs the user to their intended goal
- Correctly follow all style guidelines established
- Create a simplistic, yet elegant user interface



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