Lecture Note 11

2024年4月7日 13:53

Ch.11 Requirements Modeling: Behavior, Patterns, and Web/Mobile Apps

Behavioral Modeling

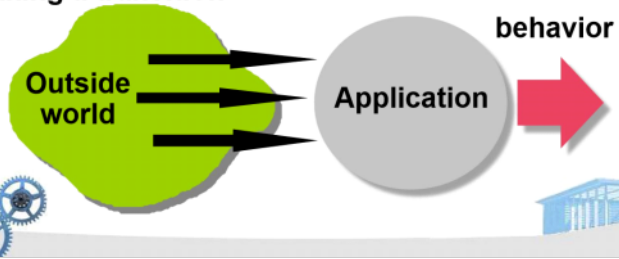
- The behavioral model indicates how software will respond to external events or stimuli. To create the model, the analyst must perform the following steps:
  - Evaluate all use-cases to fully understand the sequence of interaction within the system.
  - Identify events that drive the interaction sequence and understand how these events relate to specific objects.
  - Create a sequence for each use-case.
  - Build a state diagram for the system.
  - Review the behavioral model to verify accuracy and consistency.

行为模型展示了软件如何对外界的事件做出反应、反馈

需要对use-case进行分析。需要找到各种外部事件。外部事件发生后系统会有哪些状态。

The States of a System

- state—a set of observable circumstances that characterizes the behavior of a system at a given time
- state transition — the movement from one state to another
- event—an occurrence that causes the system to exhibit some predictable form of behavior
- action—process that occurs as a consequence of making a transition



状态图：

1、状态：某个系统在特定时间内处于的某个态势

2、状态迁移

3、事件：状态迁移的诱导因素

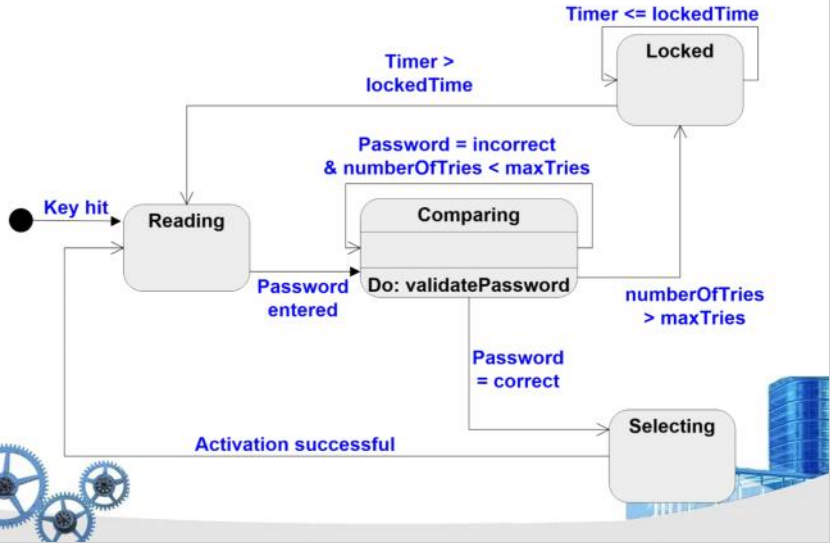
4、action：状态迁移发生过程中系统会做的各种动作

State Representations

- In the context of behavioral modeling, two different characterizations of states must be considered:
  - the state of each class as the system performs its function
  - the state of the system as observed from the outside as the system performs its function

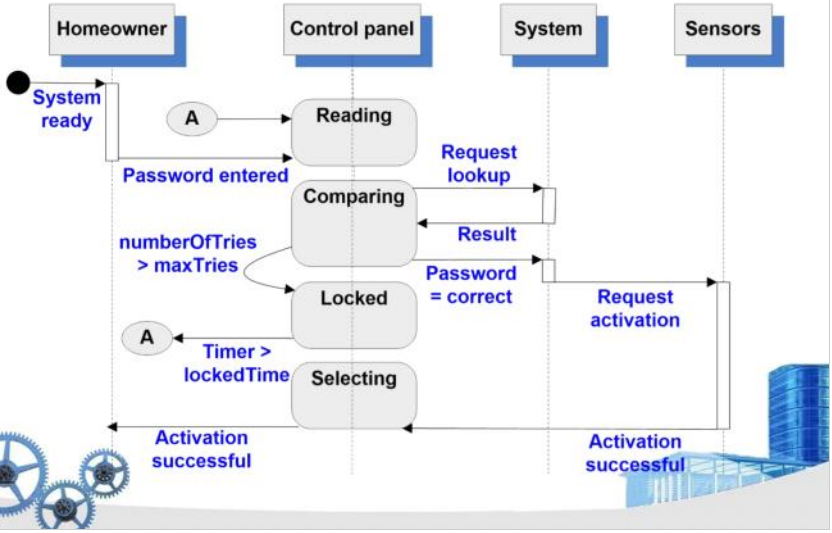
状态分为两类
1、类的状态（eg. 打印机的状态）
2、系统的状态（eg. 打印系统的状态）

State Diagram for the ControlPanel Class



每个类之间迁移都要有一个输入参数

Sequence Diagram



序列图来表示状态的迁移
从角色的角度进行描述

Data Modeling

- examines data objects independently of processing
- focuses attention on the data domain
- creates a model at the customer's level of abstraction
- indicates how data objects relate to one another

基于流（flow-based）的model
结构化的需求建模方式
没有类的概念
只有数据对象、过程
它的任务是将所有的数据对象找出来，同时将相关数据流程、过程找到

What is a Data Object?

Object — something that is described by a set of attributes (data items) and that will be manipulated within the software system

- Each instance of an object (e.g., a book) can be identified uniquely (e.g., ISBN#)
- Each plays a necessary role in the system i.e., the system could not function without access to instance of the object
- Each is described by attributes that are themselves data items

首先要找到所有数据对象
之后要找到所有处理这些数据对象的过程
数据对象和类不一样。
类包含成员变量、成员函数，有静态数据结构和动态行为
数据对象只是个结构化的数据结构，有各种属性，但没有动态行为。动态行为都在数据流图里。

Typical Objects

- external entities (printer, user, sensor)
- things (e.g, reports, displays, signals)
- occurrences or events (e.g., interrupt, alarm)
- roles (e.g., manager, engineer, salesperson)
- organizational units (e.g., division, team)
- places (e.g., manufacturing floor)
- structures (e.g., employee record)

找数据对象的方法也是做语法分析
1、外部实体
2、事物
3、事件
4、角色
5、组成单元
6、地点
7、数据结构

Data Objects and Attributes

A data object contains a set of attributes that act as an aspect, quality, characteristic, or descriptor of the object

object: automobile

attributes:
- make
- model
- body type
- price
- options code

What is a Relationship?

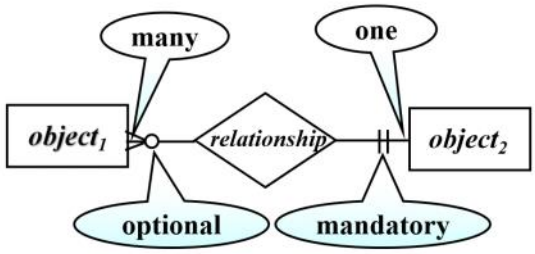
Relationship — indicates “connectedness”; a "fact" that must be "remembered" by the system and cannot or is not computed or derived mechanically

- several instances of a relationship can exist
- objects can be related in many different ways

还要分析数据对象之间的关联关系。关系必须要告诉系统，否则系统就不知道。

ERD Notation

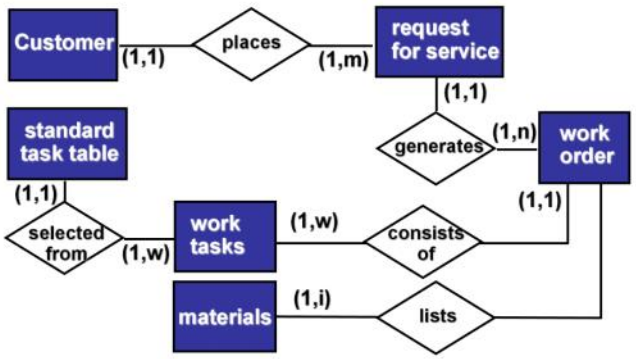
- **Cardinality**: One-to-one, One-to-many, Many-to-many
- **Modality**: Mandatory, optional



or

使用实体关系图表示
是表示类之间关系比较好的手段

The ERD: An Example



Flow-Oriented Modeling

- Represents how data objects are transformed at they move through the system
- A data flow diagram (DFD) is the diagrammatic form that is used
- Considered by many to be an 'old school' approach, flow-oriented modeling continues to provide a view of the system that is unique — it should be used to supplement other analysis model elements

对于行为的建模，使用DFD图，也就是数据流图。表示数据处理过程。

Data Flow Diagram (DFD)

- Every computer-based system is an information transform system
- Is a graphical representation that depicts information flow and the transforms that are applied as data move from input to output
- Be used to represent a system or software at any level of abstraction

Notation of DFD

External entity

Data flow

process

Data storage

External Entity

A producer or consumer of data

Examples: a person, a device, a sensor

Another example: computer-based system

Data must always originate somewhere and must always be sent to something

表示外部实体，可能是个数据的产生者或消费者

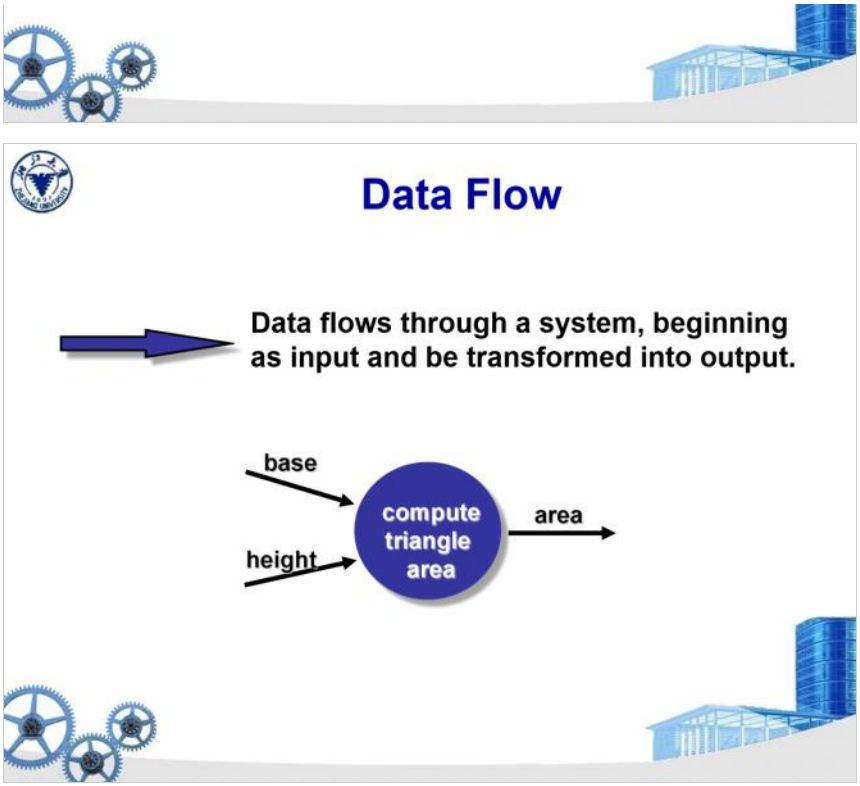
Process

A data transformer (changes input to output)

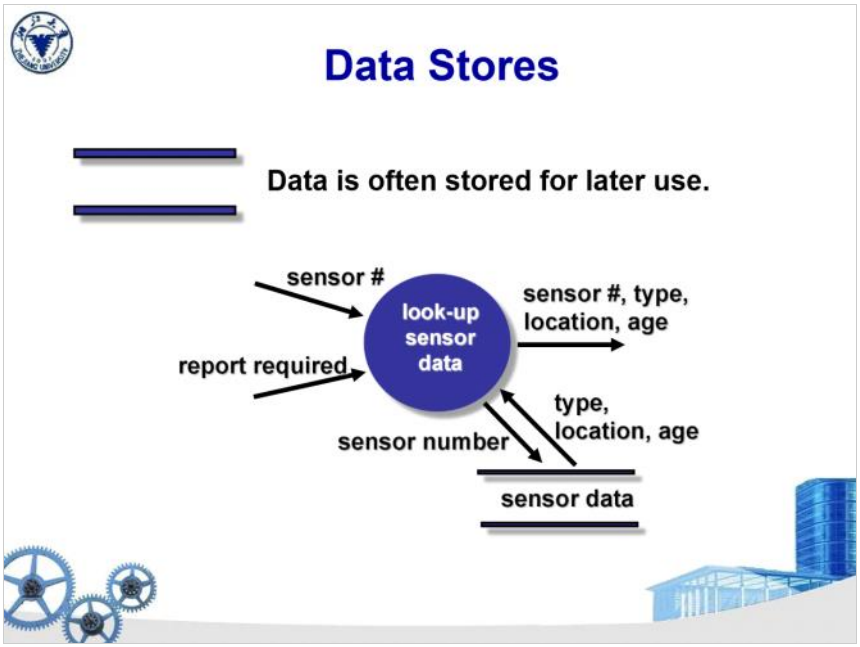
Examples: compute taxes, determine area, format report, display graph

Data must always be processed in some way to achieve system function

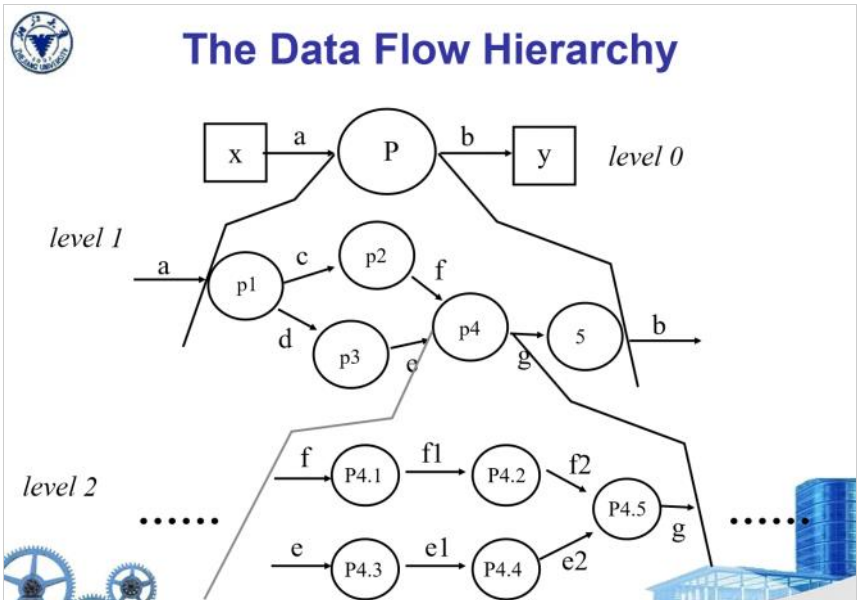
处理：接收一定的输入，之后进行一定的计算，output进行输出。是数据的变迁过程



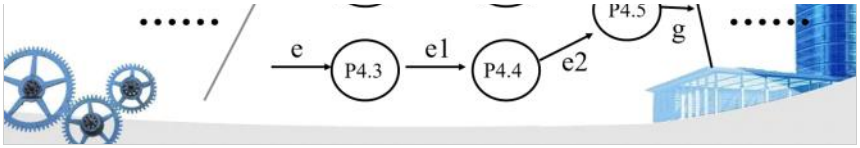
数据流，用箭头表示。起点表示数据从哪里来，终点表示到哪里去



数据存储，数据要进行持久化，需要书名库/出版社库。用来表示系统外部第三方的数据源



层次化结构，例如level1就是对P的细化

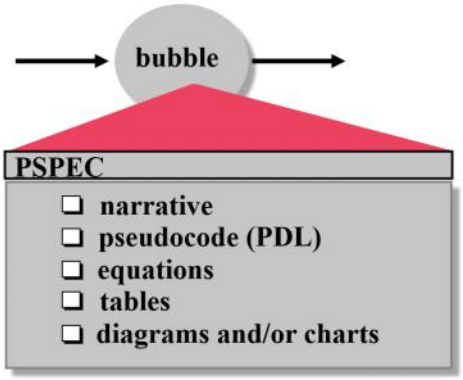


DFD Guidelines

- always label data flow arrows, and all icons must be labeled with meaningful names
- always begin with a context level diagram (also called level 0),and show external entities at level 0
- do not represent procedural logic
- the DFD evolves through a number of levels of detail, and the information flow continuity must be maintained

在细化过程中一定要注意逻辑的约束关系，各个层的输入输出不能相互矛盾

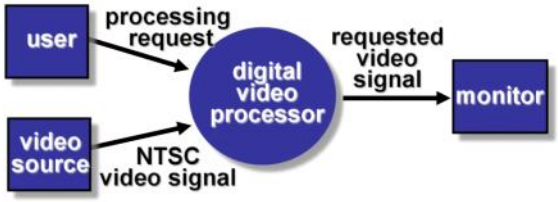
Process Specification (PSPEC)



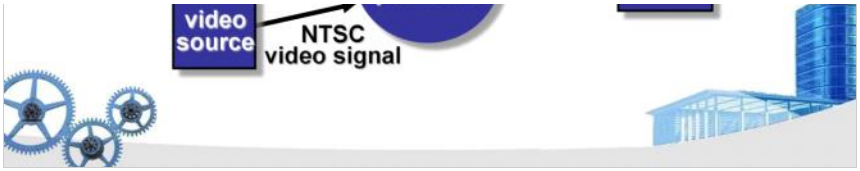
到底怎么进行处理没有在图上进行表示
对每个process定义处理的SPEC，可以是伪代码、自然语言描述、方程式、图形

Constructing a DFD — I

- review the data model to isolate data objects and use a grammatical parse to determine "operations"
- determine external entities (producers and consumers of data)
- create a level 0 DFD



确定第一级DFD图，主要识别外部实体



Constructing a DFD — II

- write a narrative describing the transform
- parse to determine next level transforms
- "balance" the flow to maintain data flow continuity
- develop a level 1 DFD
- use a 1:5 (approx.) expansion ratio

进行细化，首先要保证一致性。每次细化的层次、比例一般是1：5。之后再进行细化。随着深入比例越来越下降

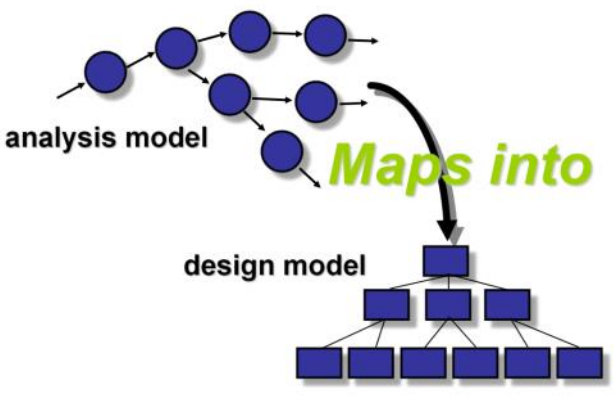
对一般的系统，3~7层就足够了

Flow Modeling Notes

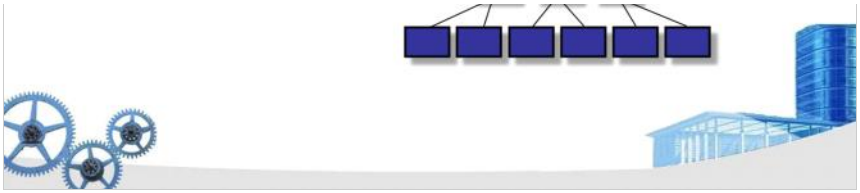
- each bubble is refined until it does just one thing
- the expansion ratio decreases as the number of levels increase
- most systems require between 3 and 7 levels for an adequate flow model
- a single data flow item (arrow) may be expanded as levels increase (data dictionary provides information)

什么时候截止？当一个事情可以比较清晰的表达

DFDs: A Look Ahead



可以直接将分析模型转换为设计模型



Writing the Software Specification

最终要写一个软件的规格说明书

Patterns for Requirements Modeling

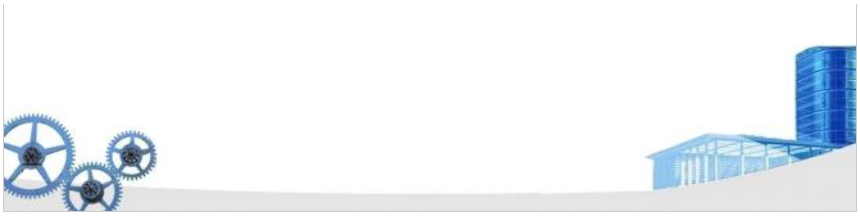
- Software patterns are a mechanism for capturing domain knowledge in a way that allows it to be reapplied when a new problem is encountered
  - domain knowledge can be applied to a new problem within the same application domain
  - the domain knowledge captured by a pattern can be applied by analogy to a completely different application domain.
- The original author of an analysis pattern does not "create" the pattern, but rather, discovers it as requirements engineering work is being conducted.
- Once the pattern has been discovered, it is documented

需求模型的pattern。
pattern是对经验的总结

Discovering Analysis Patterns

- The most basic element in the description of a requirements model is the use case.
- A coherent set of use cases may serve as the basis for discovering one or more analysis patterns.
- A semantic analysis pattern (SAP) "is a pattern that describes a small set of coherent use cases that together describe a basic generic application." [Fer00]

依托于领域专家。
也可以依赖一些工具。可以用一些算法发现不同模型的共性，用图挖掘的方法找到公共的流程。公共的子图就是一些pattern



Requirements Modeling for WebApps

- **Content Analysis.** The full spectrum of content to be provided by the WebApp is identified, including text, graphics and images, video, and audio data. Data modeling can be used to identify and describe each of the data objects.
- **Interaction Analysis.** The manner in which the user interacts with the WebApp is described in detail. Use-cases can be developed to provide detailed descriptions of this interaction.
- **Functional Analysis.** The usage scenarios (use-cases) created as part of interaction analysis define the operations that will be applied to WebApp content and imply other processing functions. All operations and functions are described in detail.
- **Configuration Analysis.** The environment and infrastructure in which the WebApp resides are described in detail.
- **Navigation Analysis.** The organization of web page link.

面向webapp也有相关需求建模的方法
1、内容分析：静态数据的分析，包括class、数据对象
2、交互分析，就是webapp如何进行交互
3、功能分析
4、配置分析，性能收到配置的影响，webapp的运行环境是开放环境，用户使用环境多
5、导航分析，超链接如何串在一起

When Do We Perform Analysis?

- **In some Web/Mobile App situations, analysis and design emrge. However, an explicit analysis activity occurs when …**
  - the Web or Mobile App to be built is large and/or complex
  - the number of stakeholders is large
  - the number of developers is large
  - the development team members have not worked together before
  - the success of the app will have a strong bearing on the success of the business

当应用比较复杂，开发者比较多，用户比较多的时候

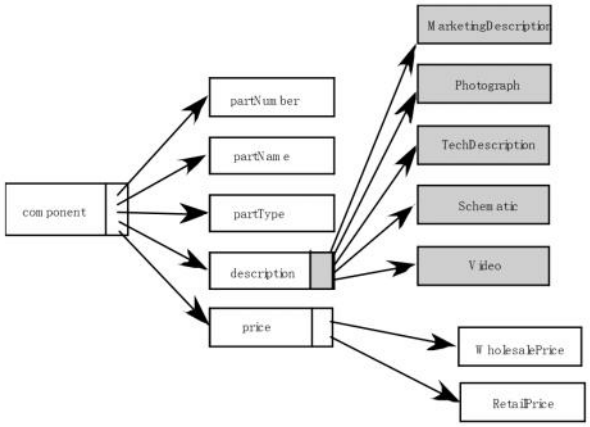
The Content Model

- **Content objects are extracted from use-cases**
  - **examine the scenario description for direct and indirect references to content**
- **Attributes of each content object are identified**
- **The relationships among content objects and/or the hierarchy of content maintained by a WebApp**
  - **Relationships—entity-relationship diagram or UML**
  - **Hierarchy—data tree or UML**

内容模型是对静态结构的分析
信息和内容的建模方式可以使用UML，也可以用ER图、数据树

– Hierarchy—data tree or UML

Data Tree



可以把所有数据组成一棵树。例如要做零件的电商系统

The Interaction Model

- **Composed of four elements:**
  - use-cases
  - sequence diagrams
  - state diagrams
  - a user interface prototype
- **Each of these is an important UML notation and is described in Appendix I**

交互模型

很多表达方式

The Functional Model

- **The functional model addresses two processing elements of the WebApp**
  - user observable functionality that is delivered by the WebApp to end-users
  - the operations contained within analysis classes that implement behaviors associated with the class.
- **An activity diagram can be used to represent processing flow**

用活动图、泳道图

processing flow

The Configuration Model

- **Server-side**
  - Server hardware and operating system environment must be specified
  - Interoperability considerations on the server-side must be considered
  - Appropriate interfaces, communication protocols and related collaborative information must be specified
- **Client-side**
  - Browser configuration issues must be identified
  - Testing requirements should be defined

对配置模型进行建模
服务端：硬件、操作系统
重要的系统一般选择至少两个云

Navigation Modeling-I

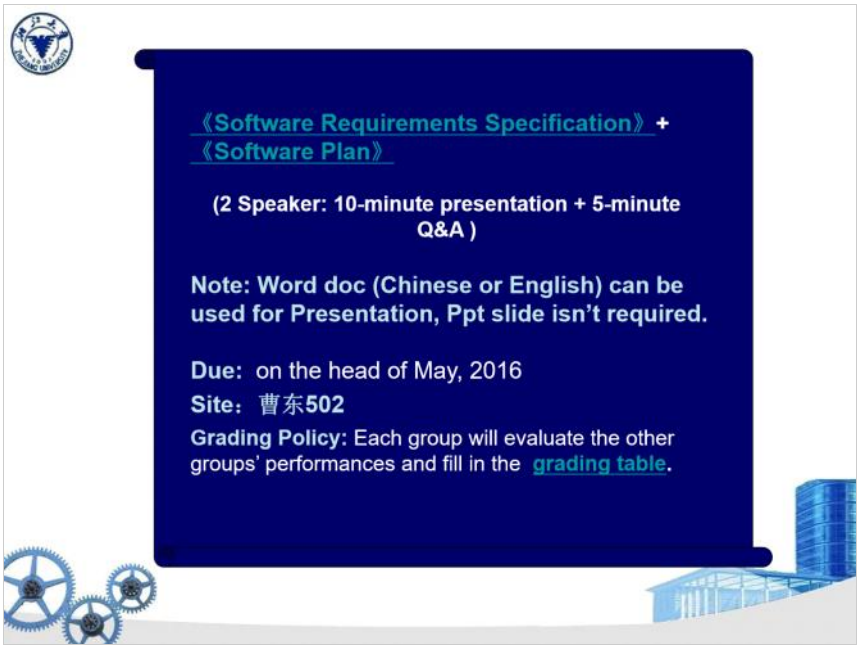
- Should certain elements be easier to reach (require fewer navigation steps) than others? What is the priority for presentation?
- Should certain elements be emphasized to force users to navigate in their direction?
- How should navigation errors be handled?
- Should navigation to related groups of elements be given priority over navigation to a specific element.
- Should navigation be accomplished via links, via search-based access, or by some other means?
- Should certain elements be presented to users based on the context of previous navigation actions?
- Should a navigation log be maintained for users?

在设计超链接有什么要求
比如说一定要有搜索框、主菜单等特殊需求
导航链接出错之后怎么处理

Navigation Modeling-II

- Should a full navigation map or menu (as opposed to a single “back” link or directed pointer) be available at every point in a user’s interaction?
- Should navigation design be driven by the most commonly expected user behaviors or by the perceived importance of the defined WebApp elements?
- Can a user “store” his previous navigation through the WebApp to expedite future usage?
- For which user category should optimal navigation be designed?

- For which user category should optimal navigation be designed?
- How should links external to the WebApp be handled? overlaying the existing browser window? as a new browser window? as a separate frame?



《Software Requirements Specification》 + 《Software Plan》

(2 Speaker: 10-minute presentation + 5-minute Q&A)

Note: Word doc (Chinese or English) can be used for Presentation, Ppt slide isn't required.

Due: on the head of May, 2016

Site：曹东502

Grading Policy: Each group will evaluate the other groups' performances and fill in the grading table.