北京航空航天大學
BEIHANG UNIVERSITY

信息系统分析与设计

数据流程图 Data Flow Diagram

信息系统系　刘冠男

数据流程图 DFD

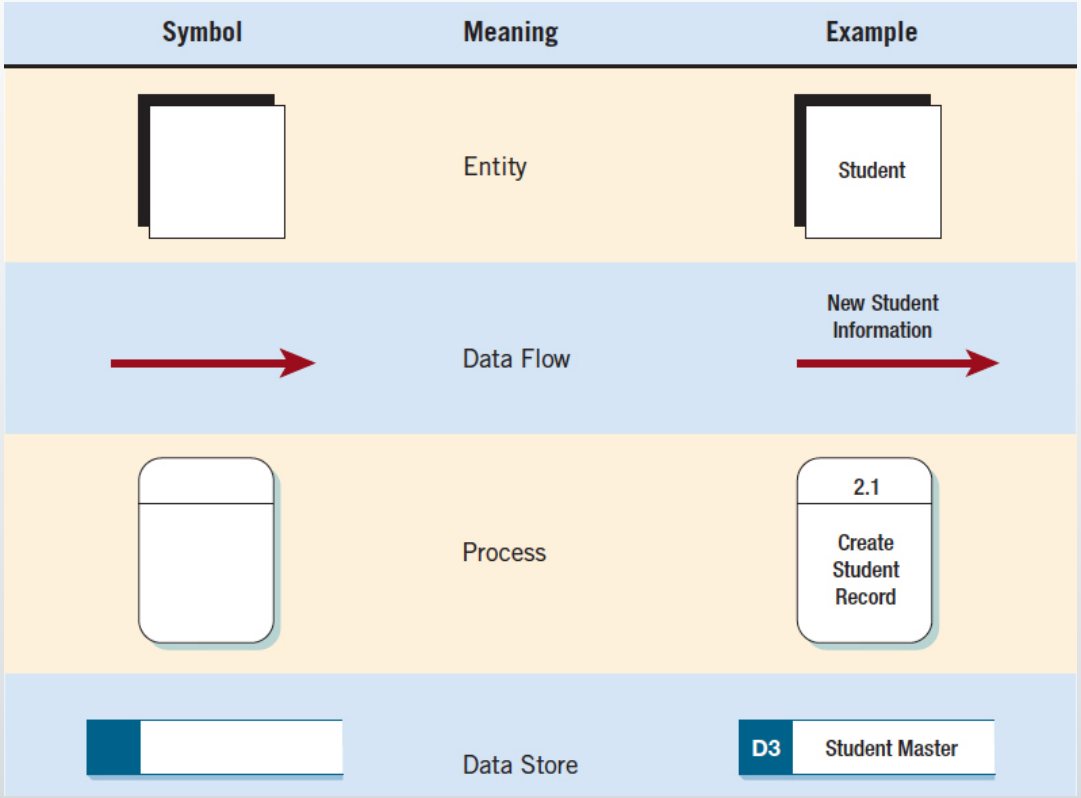
- 以图形方式刻画业务系统中的数据处理过程和数据流
- 展示
  - Inputs
  - Processes
  - Outputs

使用数据流图的优势

- 不需要太早讨论系统的技术实现问题
- 可以深入理解系统与子系统的相互关系
- 可以通过DFD将当前系统知识传达给用户
- 通过分析所提出的系统，可以判断是否已经定义好必要的数据和过程。

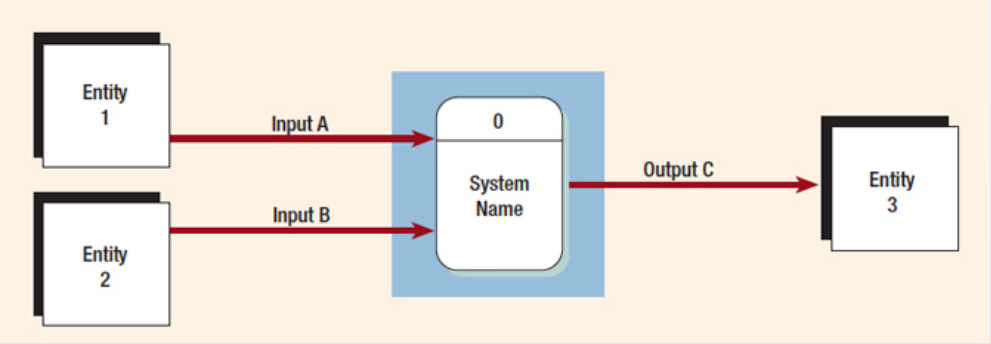
数据流程图的基本符号表示

- 实体 Entity
  - 外部实体：位于系统之外
  - 一个部门、一个人、一台机器...
- 数据流 Data Flow
  - 数据的移动方向
  - 可表示有关人、事的数据
- 过程 Process
  - 意味着数据的改变或变换
  - 唯一编号
  - 高级过程：库存控制系统
  - 子系统：库存管理子系统
  - 具体过程：动词-形容词-名词
- 数据存储 Data Store
  - 手工文档
  - 计算机文件/数据库
  - 需要有一个反映层级的编号



开发数据流图 – 绘制上下文图

- 自顶向下的方法
  - 总-分结构
- **Make a list of business activities and use it to determine various**
  - External entities
  - Data flows
  - Processes
  - Data stores
- **Create a context diagram** 创建上下文图
  - Show external entities and data flows **to** and **from** the system
    - All external entities, as well as major data flows are shown
  - Do not show any detailed processes or data stores
  - Contains only one process, representing the entire system

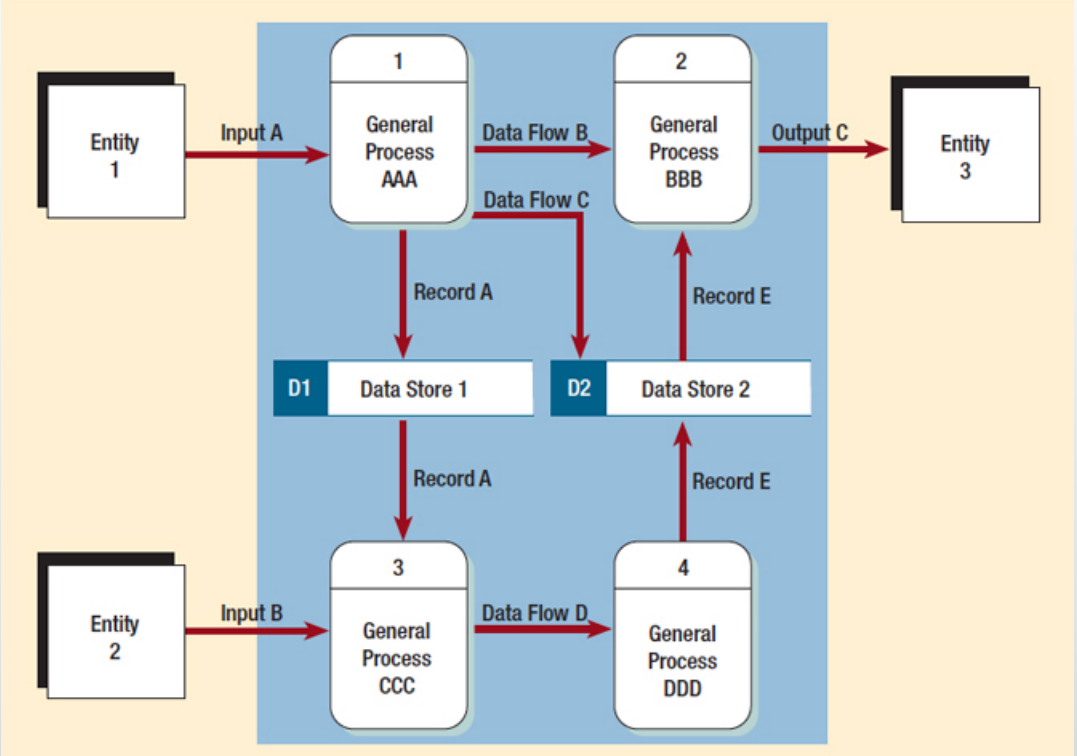


开发数据流图 – 绘制0层图

- Draw Diagram 0, the next level of Context Diagram
  - Show processes, but keep them general.
  - Show data stores at this level.
  - Each process is numbered
  - Major data stores and all external entities are included
- 从输入端的一个实体开始
  - 进入系统的数据会发生什么变化？
  - 是否存储？是否可以启动多个过程？
- 从输出数据流向后处理
  - 从哪儿来？
  - 用于计算还是存储？
  - 工资单？

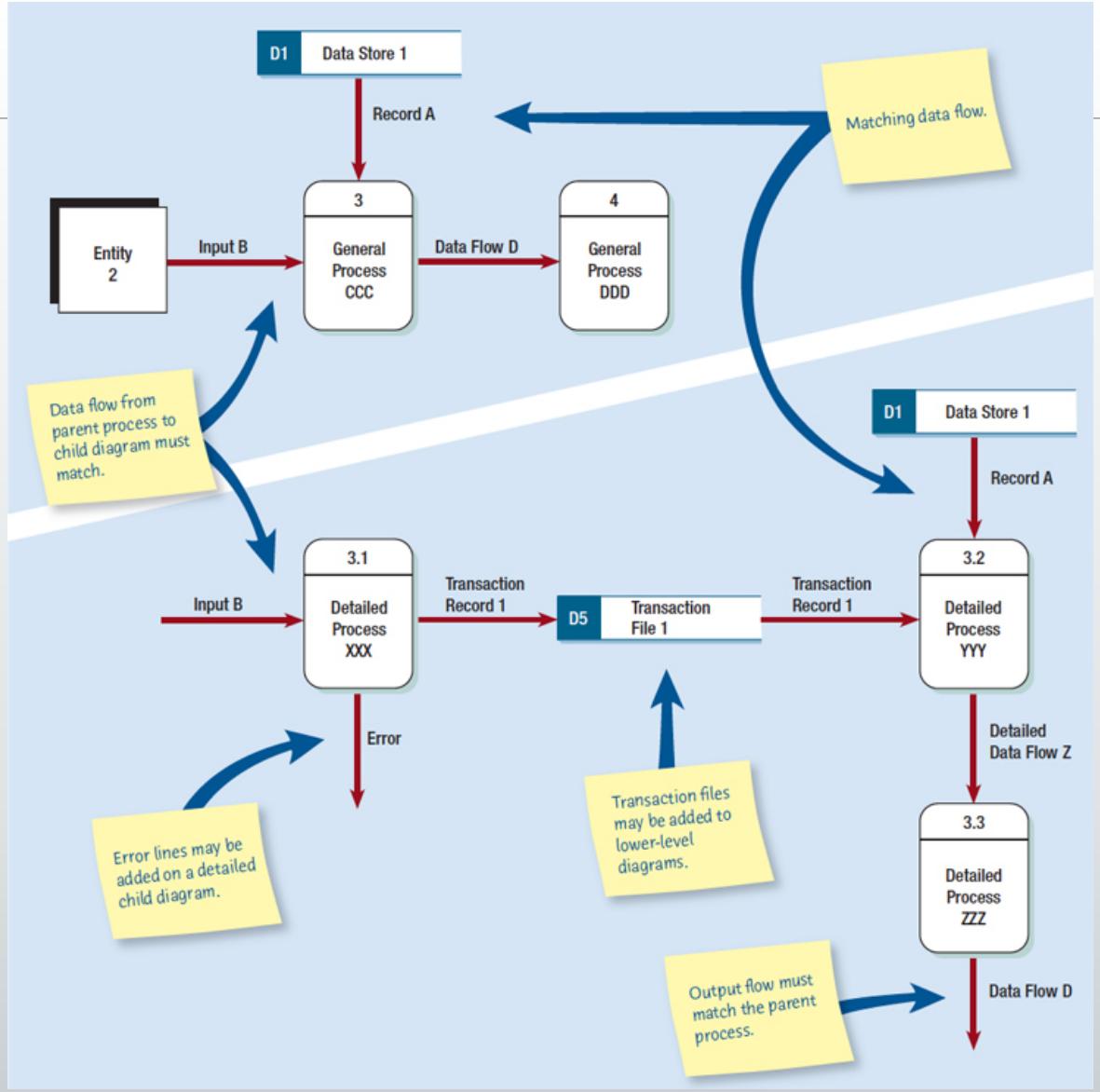
开发数据流图 – 绘制0层图（续）

- 检查输入或输出数据存储的数据流
  - 哪些过程需要存储？
  - 哪些过程要使用该数据？
- 分析一个明确定义的过程
- 注意模糊领域
  - 不确定的，不清楚的整体问题列表



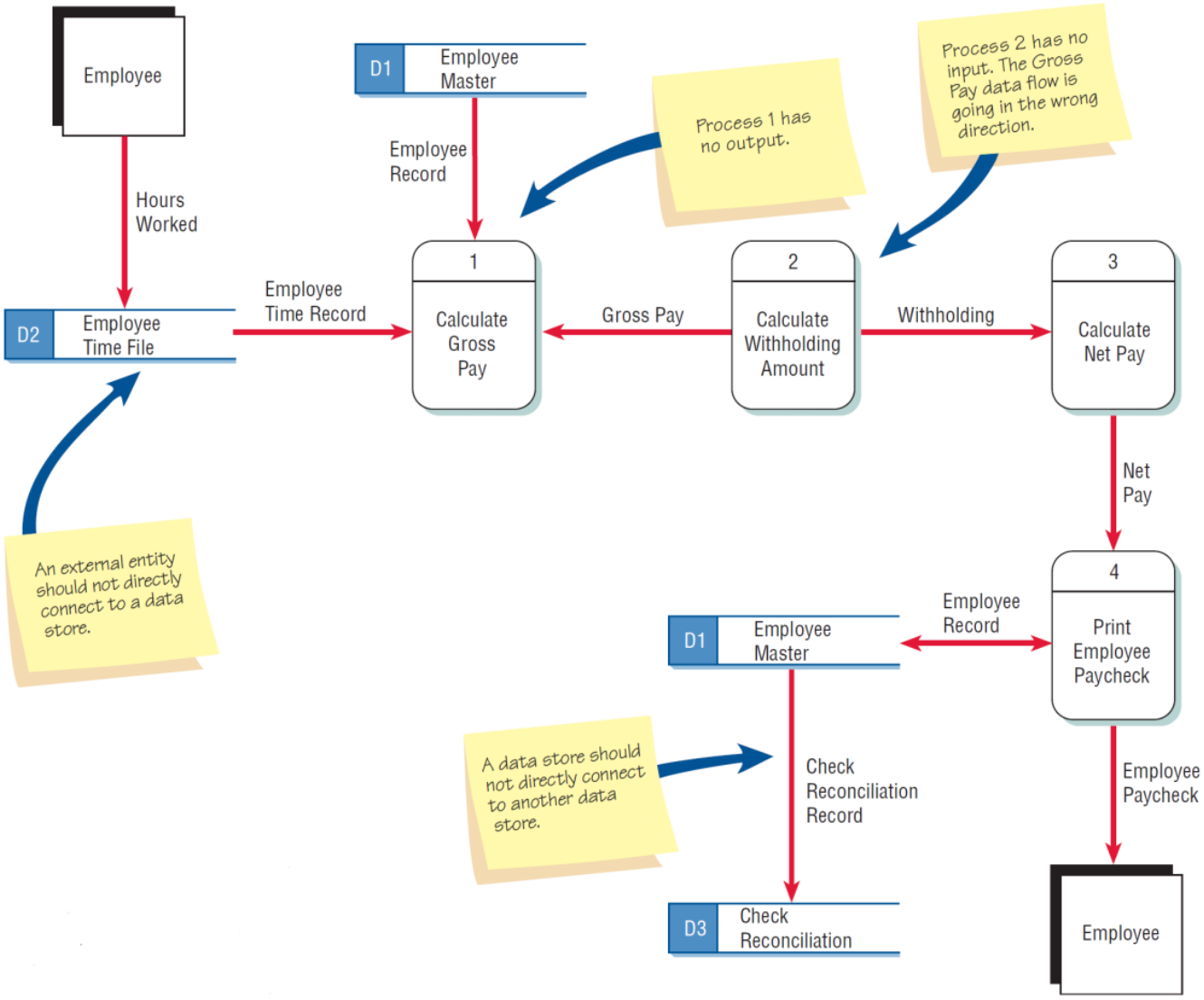
开发数据流图 – 创建子图 Child Diagrams

- Each process on diagram 0 may be exploded to create a child diagram
- A child diagram cannot produce output or receive input that the parent process does not also produce or receive
- The child process is given the same number as the parent process
  - Process 3 would explode to Diagram 3
- Entities are usually not shown on the child diagrams below Diagram 0
- If the parent process has data flow connecting to a data store, the child diagram may include the data store as well
- When a process is not exploded, it is called a primitive process


D1
Data Store 1
Record A
Matching data flow.
3
General Process CCC
4
General Process DDD
Entity 2
Input B
Data Flow D
Data flow from parent process to child diagram must match.
D1
Data Store 1
Record A
3.1
Detailed Process XXX
Input B
Transaction Record 1
D5
Transaction File 1
Transaction Record 1
3.2
Detailed Process YYY
Error
Detailed Data Flow Z
Error lines may be added on a detailed child diagram.
Transaction files may be added to lower-level diagrams.
3.3
Detailed Process ZZZ
Output flow must match the parent process.
Data Flow D

DFD中的常见错误

- 忘记包含一个数据流，箭头指向错误
- 数据存储和外部实体直接互相连接
  - 数据存储和外部实体只能与过程连接
- 不正确地标记过程或数据流
- 一个数据流图中包含过多的过程
- 漏掉数据流
  - 输入输出
- 不平衡的子图分解
  - 子图应与父过程具有相同的输入和输出数据流


Employee
Hours Worked
D1 Employee Master
Employee Record
Process 1 has no output.
Process 2 has no input. The Gross Pay data flow is going in the wrong direction.
D2 Employee Time File
Employee Time Record
1 Calculate Gross Pay
Gross Pay
2 Calculate Withholding Amount
Withholding
3 Calculate Net Pay
Net Pay
An external entity should not directly connect to a data store.
4 Print Employee Paycheck
Employee Record
D1 Employee Master
A data store should not directly connect to another data store.
Check Reconciliation Record
Employee Paycheck
D3 Check Reconciliation
Employee

DFD实例

- 订单处理系统
- 客户订单进来，同时更新商品主文件和客户主文件。如果某个商品无现货，通知库存控制部门
- 如果订单来自新客户，在客户主文件中创建一条新记录
- 为该客户订单生成产品列表，发送给仓库
- 准备发货通知单
- 发送客户订单的过程涉及从仓库取到货物和匹配客户发货单，获得正确的客户地址，并把货全部发送给客户
- 产生客户结算单，每月一次把账单寄给客户
- 给会计部门发送“应收账款”报表

逻辑数据流图与物理数据流图

逻辑DFD与物理DFD

- Logical DFD
  - Focuses on the business and how the business operates
  - Not concerned with how the system will be constructed
  - Describes the business events that take place and the data required and produced by each event
- Physical DFD
  - Shows how the system will be implemented
  - Depicts the system

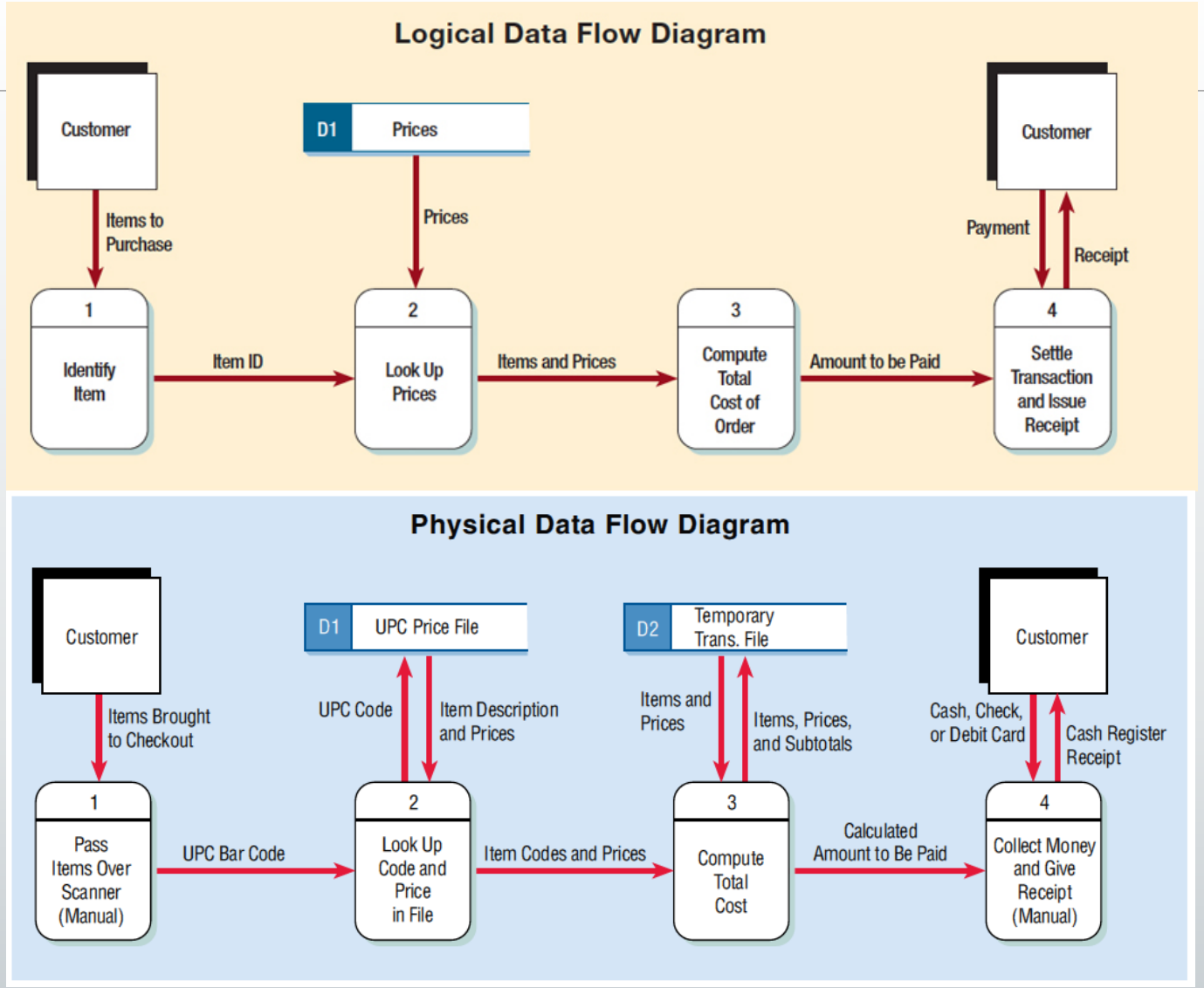
逻辑DFD与物理DFD的关系的区别

Design Feature	Logical	Physical
What the model depicts.	How the business operates.	How the system will be implemented (or how the current system operates).
What the processes represent.	Business activities.	Programs, program modules, and manual procedures.
What the data stores represent.	Collections of data regardless of how the data are stored.	Physical files and databases, manual files.
Type of data stores.	Show data stores representing permanent data collections.	Master files, transition files. Any processes that operate at two different times must be connected by a data store.
System controls.	Show business controls.	Show controls for validating input data, for obtaining a record (record found status), for ensuring successful completion of a process, and for system security (example: journal records).

检查现行物理DFD，分离出业务活动，获取当前逻辑DFD

在当前系统逻辑中增加新系统需要的输入、输出和过程；取消不必要的过程

在当前系统逻辑中增加新系统需要的输入、输出和过程；取消不必要的过程


Logical Data Flow Diagram
Customer
Items to Purchase
D1
Prices
Prices
Customer
Payment
Receipt
1
Identify Item
Item ID
2
Look Up Prices
Items and Prices
3
Compute Total Cost of Order
Amount to be Paid
4
Settle Transaction and Issue Receipt
Physical Data Flow Diagram
Customer
Items Brought to Checkout
D1
UPC Price File
UPC Code
Item Description and Prices
D2
Temporary Trans. File
Items and Prices
Items, Prices, and Subtotals
Customer
Cash, Check, or Debit Card
Cash Register Receipt
1
Pass Items Over Scanner (Manual)
UPC Bar Code
2
Look Up Code and Price in File
Item Codes and Prices
3
Compute Total Cost
Calculated Amount to Be Paid
4
Collect Money and Give Receipt (Manual)

开发物理DFD

- Clarifying which processes are performed by **humans** and which are **automated**
- Describing processes in more detail
- Sequencing processes that have to be done in a particular order
- Identifying **temporary** data stores
- Specifying actual names of files and printouts
- Adding controls to ensure the processes are done properly

CRUD矩阵

- The acronym CRUD is often used for
  - Create
  - Read
  - Update
  - Delete
- These are the activities that must be present in a system for each master file
- A CRUD matrix is a tool to represent where each of these processes occurs in a system

CRUD矩阵示例

Activity	Customer	Item	Order	Order Detail
Customer Logon	R			
Item Inquiry		R		
Item Selection		R	C	C
Order Checkout	U	U	U	R
Add Account	C			
Add Item		C		
Close Customer Account	D			
Remove Obsolete Item		D		
Change Customer Demographics	RU			
Change Customer Order	RU	RU	RU	CRUD
Order Inquiry	R	R	R	R

基于事件建模的物理DFD

- An input flow from an external entity is sometimes called a **trigger** because it starts the activities of a process
- **Events** cause the system to do something and act as a trigger to the system
- An approach to creating physical data flow diagrams is to create a data flow diagram fragment for each unique system event
- 事件响应表
  - An event table is used to create a data flow diagram by analyzing each event and the data used and produced by the event
  - Every row in an event table represents a data flow diagram fragment and is used to create a single process on a data flow diagram

事件响应表示例

Event	Source	Trigger	Activity	Response	Destination
Customer logs on	Customer	Customer number and password	Find customer record and verify password. Send Welcome web page	Welcome web page	Customer
Customer browses items at Web storefront	Customer	Item information	Find item price and quantity available. Send Item Response web page.	Item Response web page	Customer
Customer places item into shopping basket at Web storefront	Customer	Item purchase (item number and quantity)	Store data on Order Detail Record. Calculate shipping cost using shipping tables. Update customer total. Update item quantity on hand.	Items Purchased web page	Customer
Customer checks out	Customer	Clicks "Check Out" button on web page	Display Customer Order web page.	Verification web page	
Obtain customer Payment	Customer	Credit card information	Verify credit card amount with credit card company. Send.	Credit card data Customer feedback	Credit card company Customer
Send customer email		Temporal, hourly	Send customer an email confirming shipment.		Customer

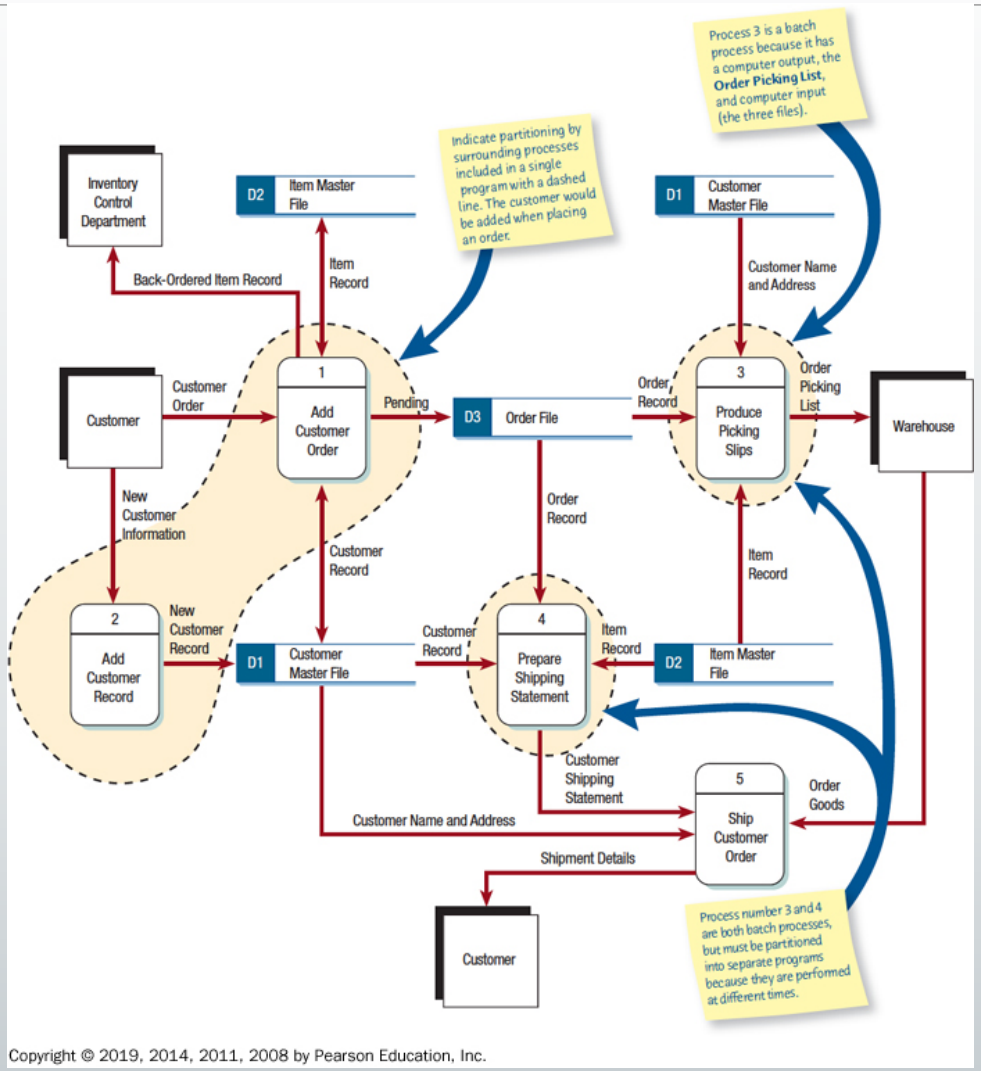
划分DFD

- Partitioning is the process of examining a data flow diagram and determining how it should be divided into collections of manual procedures and computer programs
- A dashed line is drawn around a process or group of processes that should be placed in a single computer program

分割原因

- Different user groups
- Timing
- Similar tasks
- Efficiency
- Consistency of data
- Security

分割示例



分割Web站点

- Improves the way humans use the site
- Improves speed of processing
- Ease of maintaining the site
- Keep the transaction secure

刘冠男
liugn@buaa.edu.cn

数据智能研究中心
RESEARCH CENTER FOR DATA INTELLIGENCE