

Fundamentals of Health Workflow Process Analysis and Redesign

Unit 10.3c Process Mapping Yourdon Notation for Data Flow Diagrams

Component 10/Unit 3c

Health IT Workforce Curriculum
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Slide 1

Welcome to the Yourdon Notation for Data Flow Diagrams Subunit. This is the second Subunit of the Process Mapping Unit.

Upon successful completion of this sub-unit the student is able to:

- Describe Yourdon data flow diagram symbols and conventions
- Describe the entities, processes, data stores, and data path from a data flow diagram in Yourdon notation
- Given a healthcare scenario, create a corresponding Yourdon data flow diagram (DFD) using correct symbols and conventions

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Describe Yourdon data flow diagram symbols and conventions

Describe the entities, processes, data stores, and data path from a data flow diagram in Yourdon notation

Given a healthcare scenario, create a corresponding Yourdon data flow diagram (DFD) using correct symbols and conventions

Background

- Data flow diagrams (DFDs) provide a way to document and visualize the movement of data through a process.
- Yourdon notation was introduced in Edward Yourdon's 1989 book Modern Structured Analysis
- Yourdon notation exists for three types of diagrams 1) data flow diagrams, 2) state transition diagrams, and 3) entity-relationship diagrams.
- The most commonly used in healthcare is the data flow diagram.
- We will only cover data flow diagram notation here

<http://yourdon.com/strucanalysis/wiki/>

Data flow diagrams provide a way to document and visualize the movement of data through a process. As such, they document several aspects of process that analysts and process designers are interested in. There are multiple notations for data flow diagrams, including flowcharts, Yourdon notation and Gane-Sarson notation. We will only cover Yourdon notation for data flow diagrams here.

Yourdon notation was introduced in Edward Yourdon's 1989 book Modern Structured Analysis

Yourdon notation exists for three types of diagrams 1) data flow diagrams, 2) state transition diagrams, and 3) entity-relationship diagrams. (these are different from the entity-relationship diagrams that are data models)

The most commonly used in healthcare to date has been overwhelmingly the data flow diagram.

Methods for Diagramming Processes

Process Aspects	ISO 5807	Yourdon	Gane-Sarson	UML	E-R diagram
Context		X	X		
Process steps	X	X	X	X	
Information content				X	X
Information transformation	X	X	X	X	
Sequencing / control / state	X			X	
Roles involved	X			X	

Each of the methods for diagramming a process covers certain aspects of processes.

Data flow diagrams can represent the context in which a process operates, process steps, and information transformations that occur or should occur. Importantly, data flow diagrams do not represent information content, roles, or flow control (sequence of processes/flow can be indicated as we will see).

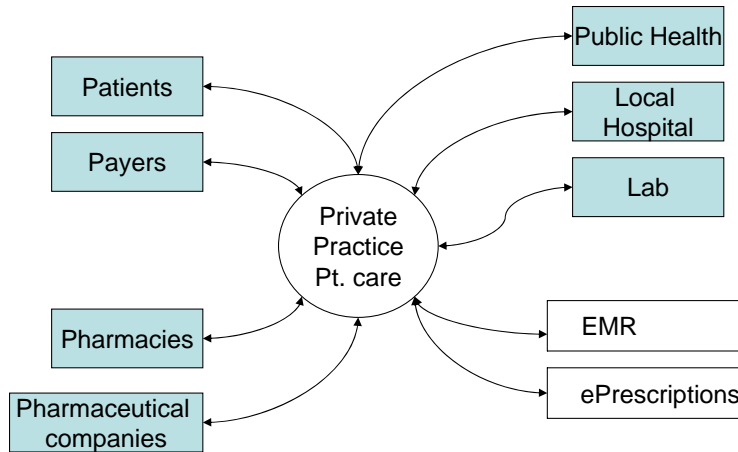
Use

1. The most popular use of Yourdon notation is to depict the context in which a process operates, i.e., high level interactions among
 1. major process entities, and
 2. interactions between the process and outside entities.
2. Context and more detailed DFDs, show entities, processes (data transformations), and data stores rather than procedural details; **DFDs show the what but not the how.**

We will cover two uses of data flow diagrams in this presentation: a high-level version that is called a context diagram, and the collection of more detailed versions called data flow diagrams. Both use the same notation, the only difference is that the context diagram is the 50,000 foot bird's eye view rather than the details. At the highest detail level, the context diagram represents an entire system as a single process and highlights the interfaces between the system and the outside world. Thus, context diagrams are helpful to document and share knowledge about what is included in a process (the scope).

Context and more detailed DFDs, show entities, processes (data transformations), and data stores rather than procedural details as a flow chart would; **DFDs show the what but not the how.**

Context Diagram Example



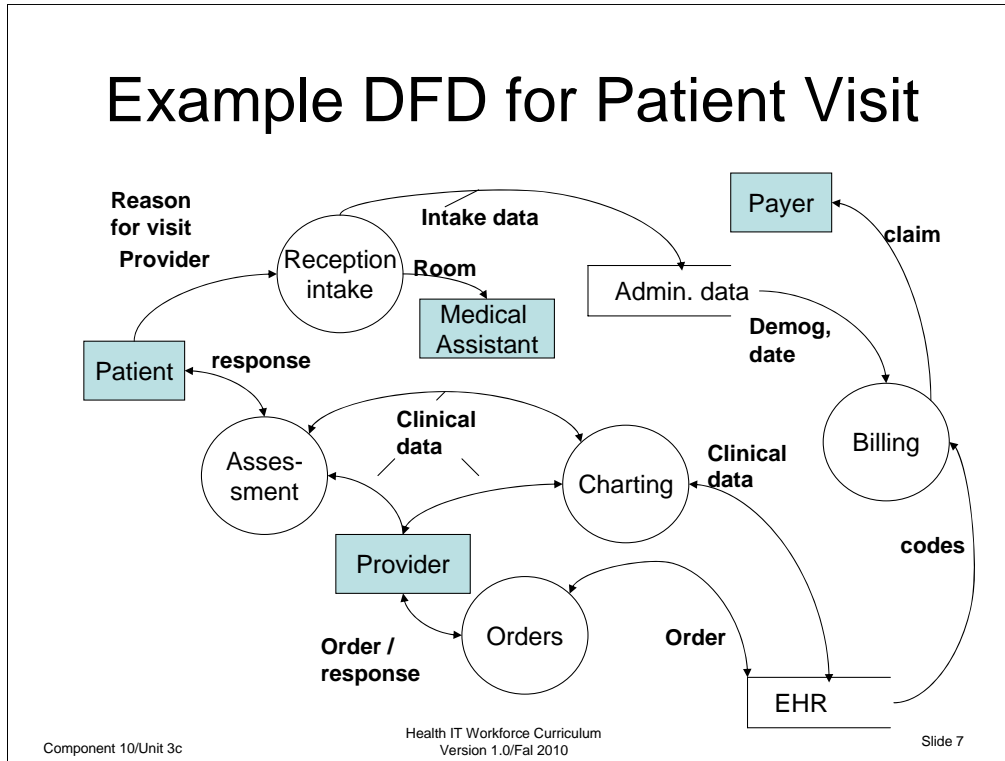
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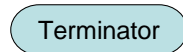
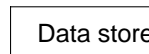
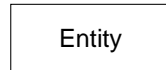
A context diagram (shown on the slide) is the highest level (i.e., least detail) DFD. The context diagram depicts the system or process you are modeling as ONE process, here private practice patient care. Entities that interact with that process are shown, here patients, payers, pharmacies, etc., as are the data stores (the EMR and an ePrescription data store), and the data flow between the entities, processes and data stores. Context diagrams are VERY HELPFUL in making sure that our analysis is complete, and that interactions with external entities are not forgotten.

Example DFD for Patient Visit



In this example data flow diagram, a patient goes through reception/intake process and intake data written to the administrative database that is used for billing. After intake, the medical office assistant is given the room assignment. The provider assesses the patient, charts clinical data and generates orders. The orders and clinical data are stored in the EHR. The HER data is used in the billing process that generates the claim for reimbursement (from the payer).

Yourdon Symbols



Dataflow diagrams consist of processes, data stores, and flows

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Entities are origins or consumers of data, they are sometimes referred to as external entities because they are “outside” the process represented by the circles. For example in the previous diagram, the patient is not part of the receptionists intake process, but the patient’s information is an input to the process.

Processes are shown by the circles, or “bubbles,” in the diagram. They represent the various individual functions that the system carries out, i.e., actions or work performed on data that transform them in some way, i.e., take inputs and create different outputs (input allergies and drug order and output an allergic alert or drug-drug interaction alert).

Flows are shown by curved, directed arrows. They are the connections between the processes (system functions), and they represent the information that the processes require as input and/or the information they generate as output.

Data stores represent data at rest. They are shown by two parallel lines with a “closed end”. They show collections (aggregates) of data that the system must remember for a period of time. When the systems designers and programmers finish building the system, the stores will typically exist as files or databases.

Terminators are used by some people and not by others. We list them here but do not include them in diagrams for this course. They show the external entities with which the system communicates. Terminators are typically individuals, groups of people (e.g., another department or division within the organization), external computer systems, and external organizations.

Yourdon published several books and papers with different people. Variations of this notation exist. We chose one here and use it consistently.

Entity

Entities

- Represent people, organizations, or other things that interact with an information processing system
 - A computerized or manual one
- Named with a noun or noun phrase
- Send or consume information
- Data flows can come to and from entities **ONLY** from processes

Entities represent people, organizations, or other things that interact with the system, i.e. entities are “outside of the system”, they may of course be part of a larger workflow process, but they are **EXTERNAL** to the information system processing the data.

Entities send or consume information, and are also called sources or sinks of information. Data flows can come to and from entities **ONLY** from processes

Process

Process

- Named with a single word, phrase, or simple sentence that describes *what* the process does.
 - a good name consist of a verb-object phrase such as assessment or assess patient
- Alternatively, name may be a: person, group of people, computer or mechanical device.
- Must have BOTH inputs and outputs

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Named or described with a single word, phrase, or simple sentence that describes *what* the process does.

a good name consist of a verb-object phrase such as assessment or assess patient

In some cases, the process will contain the name of a:

Person

group of people

computer or mechanical device.

That is, the process sometimes describes who or what is carrying out the process, rather than describing what the process is.



Flow

- Represented by curved arrows
- Arrow heads on the flow indicate direction
- Name represents the meaning of the data that moves along the flow
- The same content may have a different meaning in different parts of the system

Represented by curved arrows

Arrow heads on the flow indicate direction, i.e., whether data are moving into or out of a process or both.

name represents the meaning of the data that moves along the flow.

Importantly, the same content may have a different meaning in different parts of the system, e.g., address as given by a patient versus address that has been matched and validated.

Data store

Data Store

- Represents a collection of data at rest
- Named with noun or noun phrase
- Can be computerized or non-computerized, such as paper charts
- Data stores are passive
 - Arrows to data stores mean write, update, delete
 - Arrows from data stores mean read, retrieve, use
- Data flows to data stores can NOT come from other data stores or from entities

Represents a collection of data at rest

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Can be computerized or non-computerized, such as paper charts

Data stores are passive, i.e., processes put data in or read data out

Arrows to data stores mean write, update, delete

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Data flows to data stores can NOT come from other data stores or from entities

Event List

- In Yourdon notation, an event list accompanies a data flow diagram.
- An event list contains things that stimulate action from the system.
- For example, for prescribing:
 - a patient calls for a re-fill,
 - a pharmacy calls for a re-fill, or
 - a patient presents with a problem requiring medication.

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Conventions

- Choose meaningful names for processes, flows, stores, and terminators.
- Number the processes by placing a unique number in the circle at the top
- Redraw the DFD as many times as necessary until it is clear and complete
- Simplify DFDs.
 - A good DFD fits on 1 page and is not too crowded. If additional details are needed, processes can be “exploded” on a new page
 - Everything on 1 page should be at the same detail level

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Matters of Style

- Size and shape of bubbles are up to the diagram creator and their client
- Curved or straight arrows can be used. Looks neater with one or the other but not both
- There is no excuse for hand-drawn diagrams today except during a white-boarding stage
- Some name the processes for the role that performs them
- Some use color to differentiate types of entities or flows

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Beware of

Black holes: processes that have inputs but no outputs

Miracles: processes that have outputs but no inputs

Mysteries: unlabeled flows and unlabeled processes

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Leveled Diagrams

- Are encouraged
- Start with higher level (context) diagrams to understand the scope and boundaries
- Decompose processes to lower levels of detail when needed
- Remember the ultimate goal is an optimized clinic process **NOT** a large detailed set of diagrams

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Guidance from Yourdon

“...even if our job were to “design the world,” we would have to recognize that the world is only a part of the solar system, which is part of a small, obscure galaxy, which is (ultimately) part of the universe.”

“...the first major model that you must develop as a systems analyst is one that does nothing more than define the interfaces between the system and the rest of the universe, that is, the environment.”

-Yourdon, Just Enough Structured Analysis

There have been variations on Yourdon notation

- Yourdon-Code
- Yourdon-DeMarco
- Yourdon concepts and notation have been adapted to suit needs of individual projects
 - Yourdon notation for data flow diagrams has been adapted for healthcare process analysis and redesign by the Public Health Informatics Institute (PHII) in their recent Common Ground Initiative,
 - and by AHRQ funded initiatives.
- Yourdon himself makes the point that the actual shape chosen is not important as long as the analyst uses the shape to consistently represent the same meaning.

Yourdon-Code

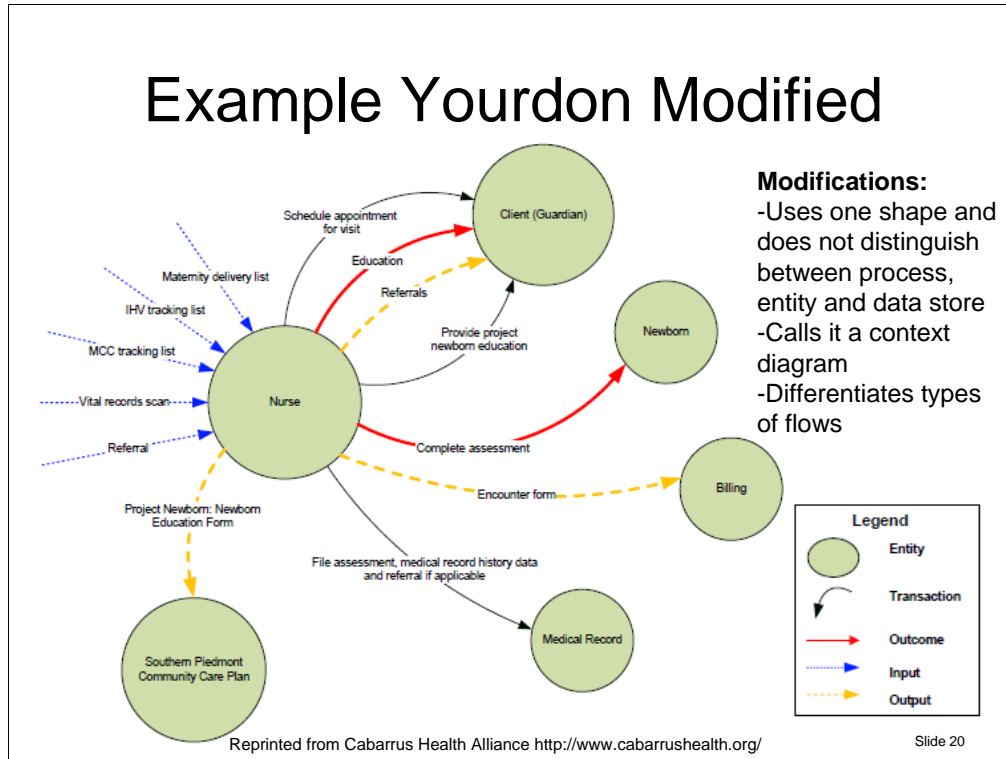
Yourdon-DeMarco

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Example Yourdon Modified



This DFD Uses one shape and does not distinguish between process, entity and data store

Calls it a context diagram – even though it is technically at a more detailed level, Differentiates types of flows

IMPORTANTLY – the diagram met the need for software selection and process re-design in many public health departments. The moral is, take what is useful and do not carry extra baggage.

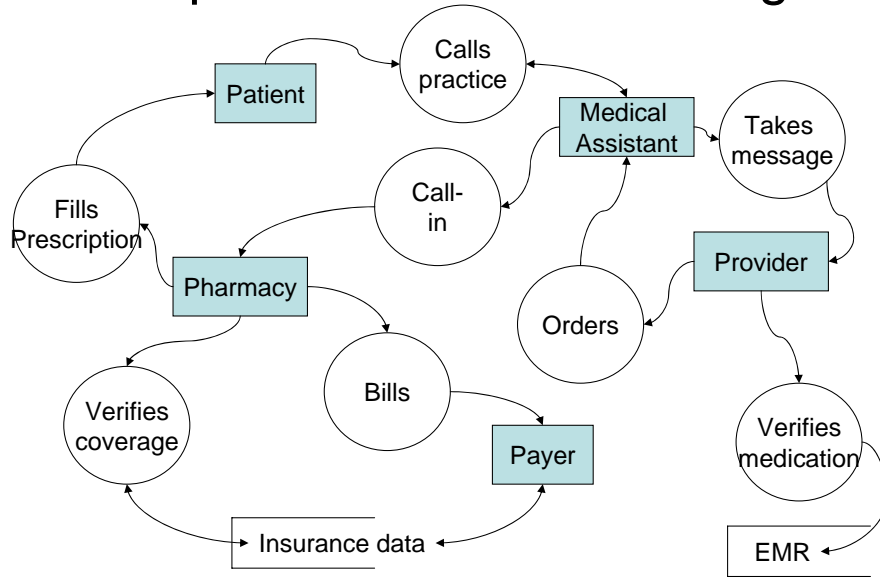
Context Diagram Example

- Without looking at the next slide, draw a 1 page DFD for a prescription refill process at a primary care provider based on the following scenario:
- Mrs. Jones takes Benecar 20mg QD for blood pressure control. She has taken this medicine for two years with good results. She does not use the “auto refill” program at her local pharmacy. Today, she called her provider, who does not use e-prescribing, and asked if the prescription could be called in to her pharmacy.

Without looking at the next slide, draw a 1 page DFD for a prescription refill process at a primary care provider based on the following scenario:

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Prescription Refill Context Diagram



Maintenance

- Yourdon notation is a set of symbols and conventions named for the person who developed it, Edward Yourdon.
- Yourdon notation has not been adopted as a standard. As such, there is no formal maintenance organization.
- Individuals use and adapt it to suit their needs.
- For an adaptation to “still be” a context diagram, it must show entities, processes and interactions

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References

1. Edward Yourdon, Just Enough Structured Analysis Chapter 9, available free at <http://yourdon.com/strucanalysis/wiki/>
2. Valacich JS, George JF, Hoffer JA, Essentials of Systems Analysis and Design. 2001 Prentice-Hall.

These references are provided for your use.