Homework 3 assignment for ECE597/697SI
Posted: 10/29/2013
Due: 11/05/2013

Note: In all written assignments, please show as much of your work as you can. Even if you get a wrong answer, you can get partial credit if you show your work. If you make a mistake, it will also help the grader show you where you made a mistake. For this specific homework it is important that you clearly identify the sources you obtained the information for your answers from (using appropriate sources on the web is okay!)

In this homework we focus on Kansas City, Missouri and NOT Kansas City, KC!

Problem 1 (25 Points): Kansas City - Weather

In this problem, we will start focusing on the city that your final projects will be concerned about. In your final project, the goal is to define the requirements for a CASA-type network in Kansas City. To prepare for this task we have to gather some background information. Answering the following question will help you gather that information.

Note: Use this link as a starting point http://www.ncdc.noaa.gov/stormevents/

a. How many severe thunderstorms occurred in Kansas City in the past 10 years?
b. How many hail storms occurred in Kansas City in the past 10 years?
c. How many tornadoes occurred in Kansas City in the past 10 years? How many people were injured by these tornados? How many were killed?
d. How many flash flood events occurred in Kansas City in the past 10 years?
e. Have there been any reports on severe winter weather in Kansas City in the past 10 years?

Solution:
The city of Kansas City, MO is located in four counties, Cass, Clay, Jackson, and Platte.

a. Cass: 31 days with t-storms
Clay: 36 days with t-storms
Jackson: 53 days with t-storms
Platte: 30 days with t-storms

Alternative:
Cass: 54 events
Clay: 91 events
Jackson: 124 events
Platte: 62 events
b. Cass: 53 days
    Clay: 56 days
    Jackson: 85 days
    Platte: 48 days

Alternative:
    Cass: 133 events
    Clay: 161 events
    Jackson: 236 events
    Platte: 117 events

c. Cass: 9 days
    Clay: 6 days
    Jackson: 3 days
    Platte: 3 days

Alternative:
    Cass: 12 events
    Clay: 10 events
    Jackson: 3 events
    Platte: 4 events

d. Cass: 20 days
    Clay: 16 days
    Jackson: 32 days
    Platte: 12 days

Alternative:
    Cass: 25 events
    Clay: 23 events
    Jackson: 53 events
    Platte: 23 events

e. Cass: 8 days
    Clay: 3 days
    Jackson: 8 days
    Platte: 3 days

Alternative:
    Cass: 8 events
    Clay: 11 events
    Jackson: 16 events
    Platte: 11 events
Problem 2 (25 Points): Data Flow Diagram

In this problem, we focus on Data Flow Diagrams (DFD). Your task in this assignment is to create a DFD for an online bookstore. As a starting point for this assignment the context diagram for this DFD is given below. Similar to the examples given in the lecture slides (slides 12 and 13 in the “System Modeling for Requirements Engineering” lecture) you should:

a. Create a level 1 DFD that shows internal system functionality and
b. Create a level 2 DFD that represents a detailed model of the online bookstore.

Solution:

- a.
Problem 3 (25 Points): Model
Modeling is one of the major components in the requirements engineering process in systems engineering.

a. Explain how modeling can be used to derive lower level from higher level requirements in the requirements engineering process.
b. Name three representation methods for Requirements Engineering and briefly explain their characteristics.
c. Name three different Viewpoint Methods and explain their major characteristics.
d. Create a customer viewpoint VORD for the online bookstore you specified in problem 2. To create this VORD diagram use the example shown on slide 37 of the “System Modeling for Requirements Engineering” lecture.

Solution:

a. Models aid the Systems Engineer in deriving lower level requirements from higher level requirements. One example for this approach is the solution of problem 2 of this HW. The highest level DFD starts on the basis of a set of very high-level requirements. Starting from this high level diagram and developing the internal system functionality and detailed model diagrams aids the System Engineer in deriving lower level requirements. E.g., the detailed model for the solution in problem 2 shows that for the warehouse the following
Functionalities are required:
- allocate book, reorder from publisher, monitor inventory

b. Data Flow Diagram:
- Basis of most traditional modeling methods
- Minimalist graphical representation of system structure and interfaces
- Can be used to show any type of flow
- DFD do NOT show control flow
- Elements in DFD are: Data flows (labeled arrows), Data transformations (circles or “bubbles”), Data stores (horizontal parallel lines), External entities (rectangles)

Entity-Relationship Diagram:
- Provide a means of modeling the entities of interest and the relationships that exist between them
- Entity: Object that can be distinctly identified customer, supplier, part, product
- Property: Information that describes entity
- Relationship: Expresses nature of association one-to-one, one-to-many, many-to-many
- Subtype: Subset of another entity
- Model is independent of processing which is required to generate or use information

State-Chart
- All states of system and actions/functions that cause state changes.

c. **CORE, SADT, VORD**

Controlled Requirements Expression (CORE)
- Developed following on requirements analysis for UK Ministry of Defense
- Finding: Methods often started by defining context of a solution to a problem before assessing possible solutions
- Central concept: Viewpoint and associated representation known as viewpoint hierarchy
- Person, role, or organization can be a viewpoint
- Viewpoint can also represent intended system and its subsystems

Structured Analysis Design Technique (SADT)
- Purely hierarchical approach to the problem with succession of blueprints
- Modularizing and Refining it until solution is achieved

Elements:
- Box, represents activity (in activity diagram) or data (in data diagram)
- Arrows, that join boxes and represent data needed or provided by activities
- Input arrows enter box from left side, and represent data that is available to activity
- Output arrows exit box from right side, and represent data that is produced by
activity
Control arrows enter box from top, and govern way in which transformation is taking place
Mechanism arrows enter box from bottom, and control way in which activity may use outside mechanisms

Viewpoint-oriented Requirements Definition (VORD)
Method based on viewpoints
Service-oriented model where viewpoints are to be considered clients (almost like client-server system)
Viewpoint:
Receives services from system
Passes control information to the system
Well-suited for specifying interactive systems
Two types of viewpoints:
**Direct viewpoints** receive services from system and send control information and data to system
**Indirect viewpoints** do not interact directly with system but rather have an “interest” in some or all services delivered

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**Problem 4 (25 Points): Simulations**

a. Name 4 different subsystems of the CASA system that could be analyzed through simulations.

b. Explain how you would carry out a simulation for 2 of these subsystems. Explain, in detail, how the outcome of such a simulation would support the requirements engineering process for the system.

c. Give two other examples of simulations and how they can be used in the requirements engineering process. These examples should be from systems different than the CASA system.
d. Explain the meaning of trace-based simulations by giving an example for such a simulation.

e. Explain the difference between simulation and emulation by using an example that involves studying the behavior of a computer network protocol based on the latency of a link.

Solution:

a. Examples: Radar placement, MC&C, Phased-array antenna, communication
b. N/A
c. N/A
d. YouTube trace-based simulation as presented in lecture.
e. Emulation uses actual hardware that mimics certain real-world scenarios while simulation is usually completely in software. To study the impact of latency on a link on a computer network protocol through simulation, that could be simply done in a simulation program like ns-2 or ns-3. To do this in emulation, at least 3 real computers would be required. 2 end nodes that have the new communication protocol implemented and a middle node that emulates the network delay. This node would basically capture a packet transmitted by one of the end node and not forward it until after a certain amount of time has passed.