Software Engineering

Problem Frames II:
Decomposition, Modeling & Recombination

何明昕 HE Mingxin, Max

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Topics

- Problem Domain Modeling
- Recombining Problem Frames

Typical System Requirements

- **REQ-1**: Map input data to output data as said by given rules

  Transformation

- **REQ-2**: Allow repository (or *document*) editing, where "repository" is a collection of data

  Simple Workpieces

- **REQ-3**: Automatically control a physical object/device

  Required Behavior

- **REQ-4**: Interactively control a physical object/device

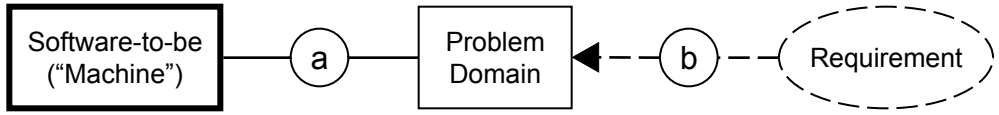
  Commanded Behavior

- **REQ-5**: Monitor and display information about an object

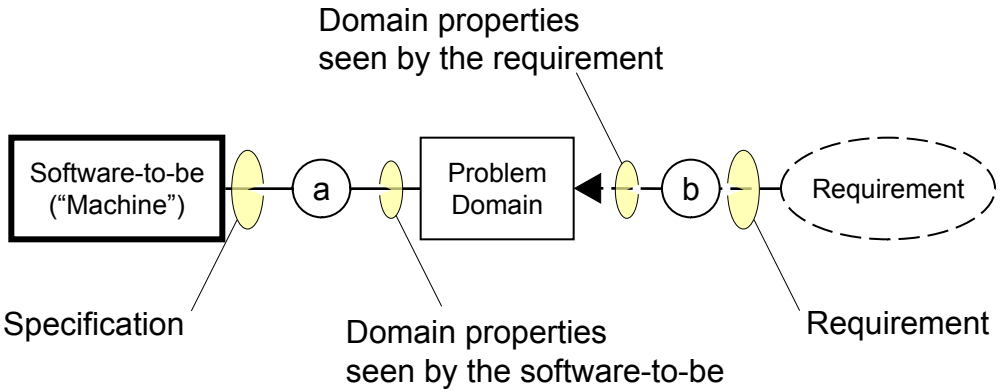
  Information Display

Machine and Problem Domain

(a)

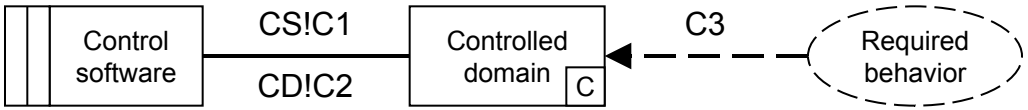


(b)



a: specification interface phenomena
b: requirement interface phenomena

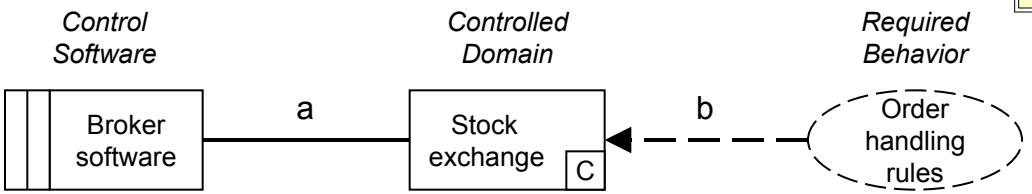
Basic Frame 1: Required Behavior



Key:

- C Causal domain
- B Biddable domain
- X Lexical domain
- [C·] Causal phenomena
- [E·] Events
- [Y·] Symbolic requirement phenomena

Example: Execute a Trading order

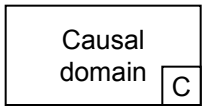


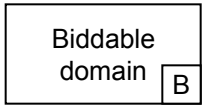
a: BS! {Execute[i]} [C1]
SE! {PriceQuotes, Ack[i], Failed[i]} [C2]

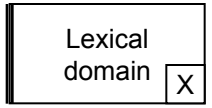
b: SE! {Place[i], Cancel[i], Executed[i], Expired[i]} [C3]

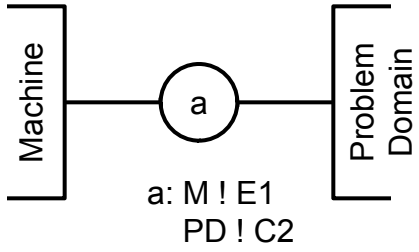
Notation Syntax for Shared Phenomena

- C – causal domain
  - predictable causal relationships among its causal phenomena such as physical laws or business contracts or social norms
- B – biddable domain
  - usually people: unpredictable, incoercible
- X – lexical domain
  - a physical representation of data (i.e., symbolic phenomena)
- [C·] - causal phenomena
  - events, states; directly produced or controlled by an entity; can give rise to other phenomena in turn
- [E·] - events
- [Y·] – symbolic requirement phenomena
  - values, and truths and states relating only values; symbolize other phenomena and relationships among them

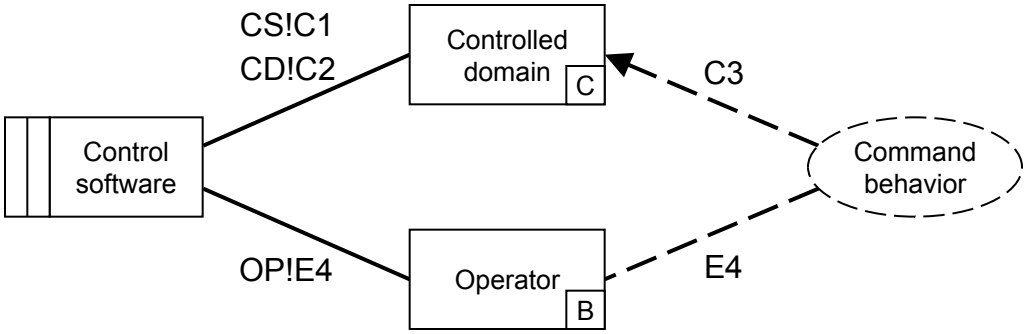




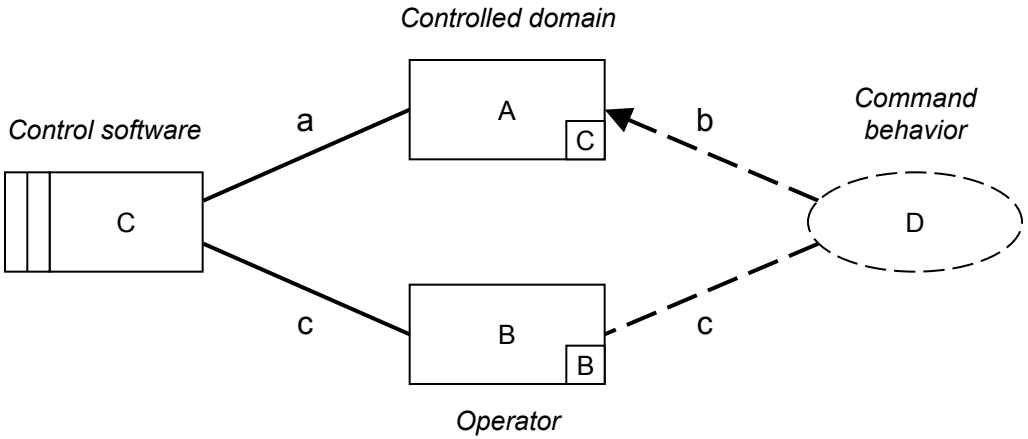




Basic Frame 2: Commanded Behavior



Example: Place a Trading order

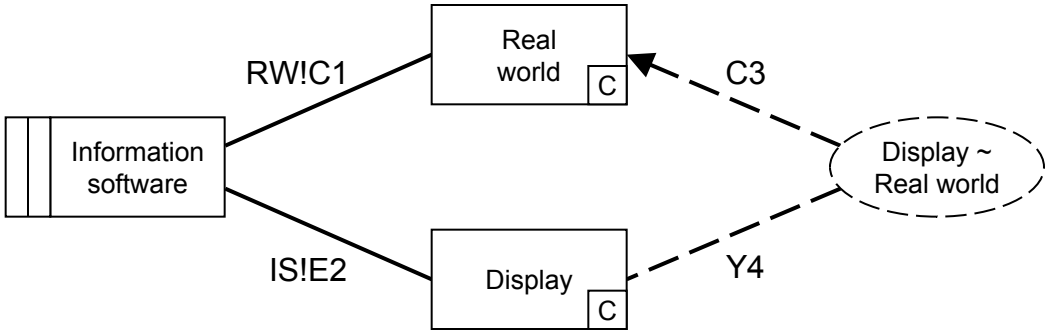


a: TS! {Create[i]} [E1]

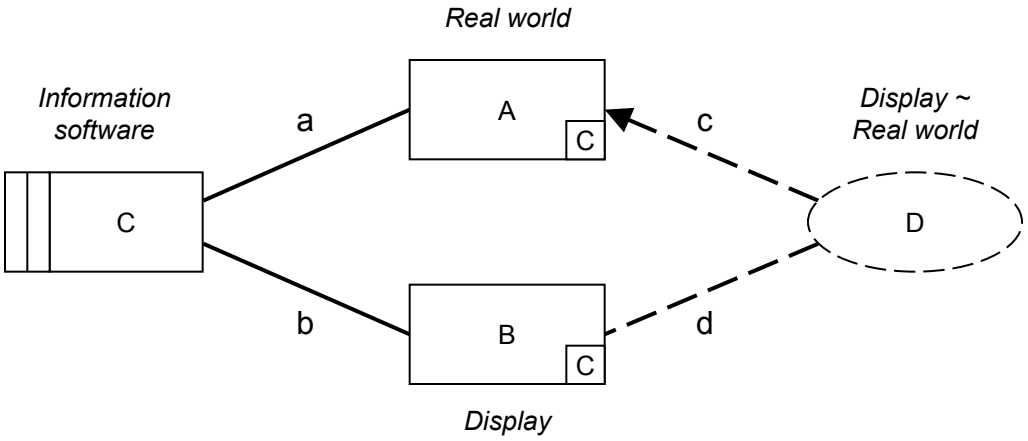
b: TR! {PriceQuotes, Place[i]} [Y2]

c: TR! {Place[i], Cancel[i], Executed[i], Expired[i]} [Y3]

Basic Frame 3: Information Display



Example: Place a Trading order

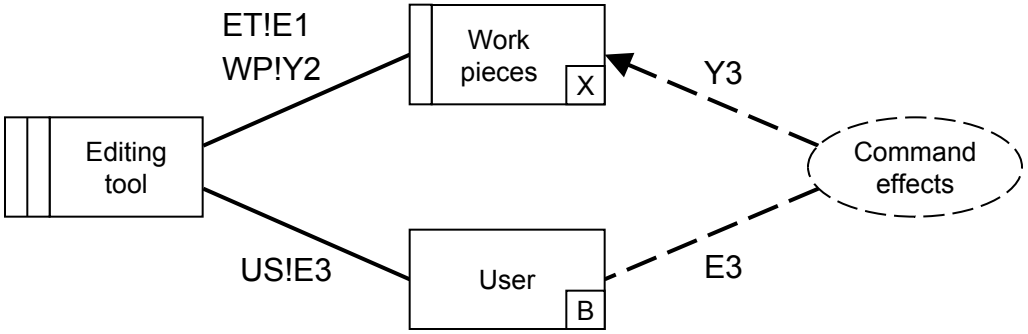


a: TS! {Create[i]} [E1]

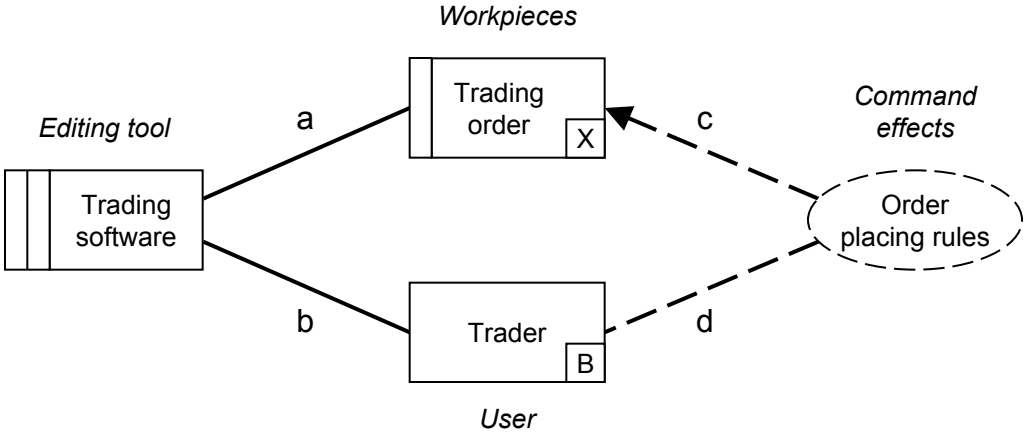
b: TR! {PriceQuotes, Place[i]} [Y2]

c: TR! {Place[i], Cancel[i], Executed[i], Expired[i]} [Y3]

Basic Frame 4: Simple Workpieces



Example: Place a Trading order

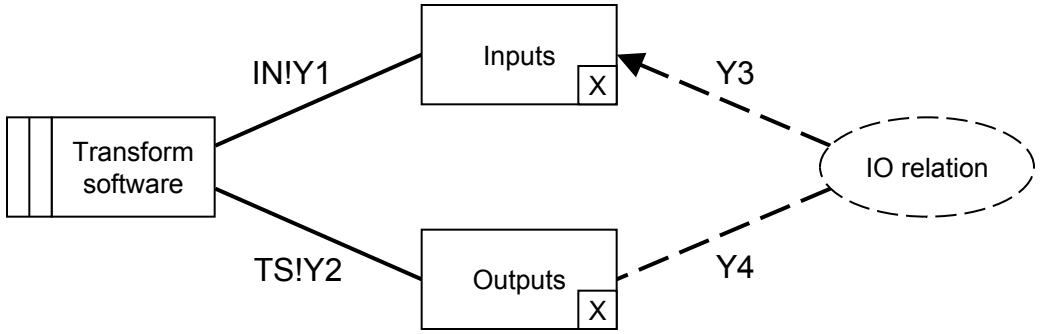


a: TS! {Create[i]} [E1]

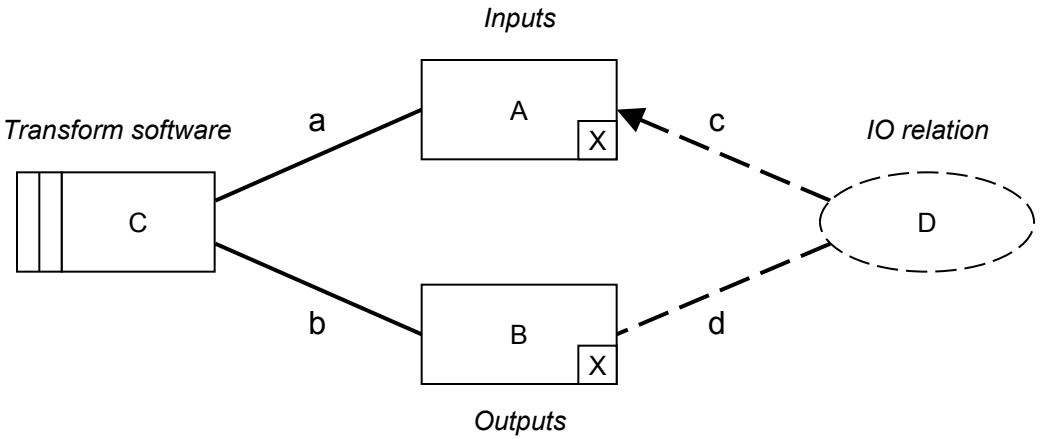
b: TR! {PriceQuotes, Place[i]} [Y2]

c: TR! {Place[i], Cancel[i], Executed[i], Expired[i]} [Y3]

Basic Frame 5: Transformation



Example: Place a Trading order



a: TS! {Create[i]} [E1]

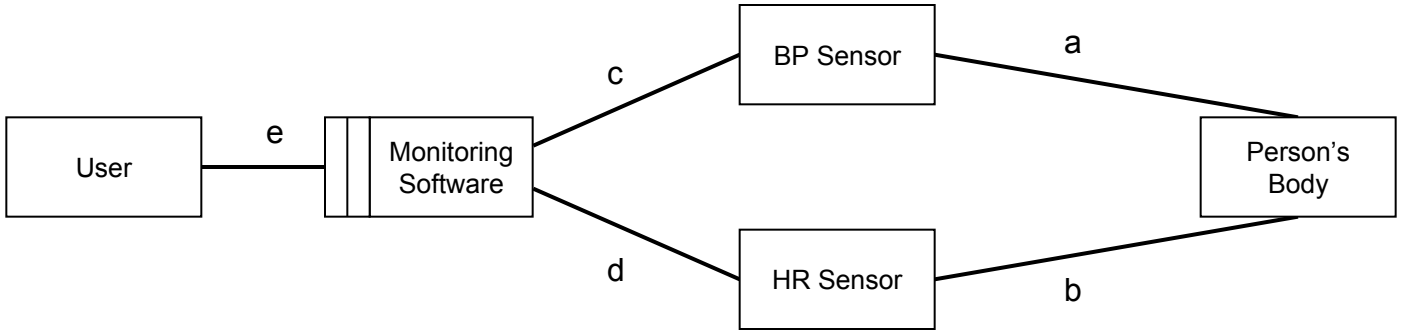
b: TR! {PriceQuotes, Place[i]} [Y2]

c: TR! {Place[i], Cancel[i], Executed[i], Expired[i]} [Y3]

Example: Personal Health Monitoring

- REQ1: keep track of person's data (vital signs, activities, food, etc.)[Information Display] or [Simple Workpieces] when user enters food data
- REQ2: Calculate statistics of the data [Transformation?] but also [Model Building] in real time
- REQ3: Allow the user to query for trends and issues [Model Operating]
- REQ4: Propose a fitness regime suitable for this user [Information Display] or [Model Operating]?

Personal Health Monitoring



a = blood vessel pressure (upper right arm)
b = pulse (upper right arm)
c = blood pressure values (systolic/diastolic) measured every *x* minutes
d = heart rate values, measure every *y* minutes
e = querying commands