# Systems Approach we talk about today

- **Value Graph (upper half)**
  - purpose and alternative viewpoint
  - higher purposes and alternative ideas
- **Causal Loop Diagram**
  - cause-and-effect viewpoint
  - causes and effects
- **Customer Value Chain Analysis (CVCA)**
  - value chain viewpoint
  - stakeholders and their values
- **Function and Physical Architecture**
  - function and physical viewpoints
  - functions and physical structures
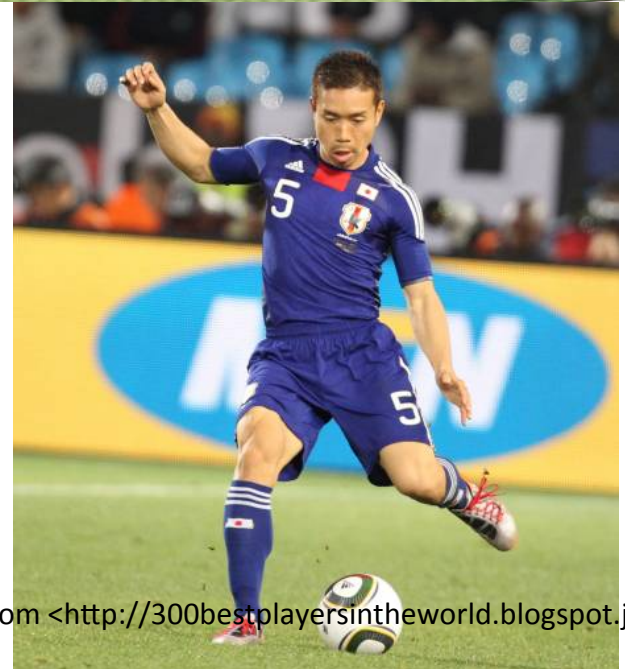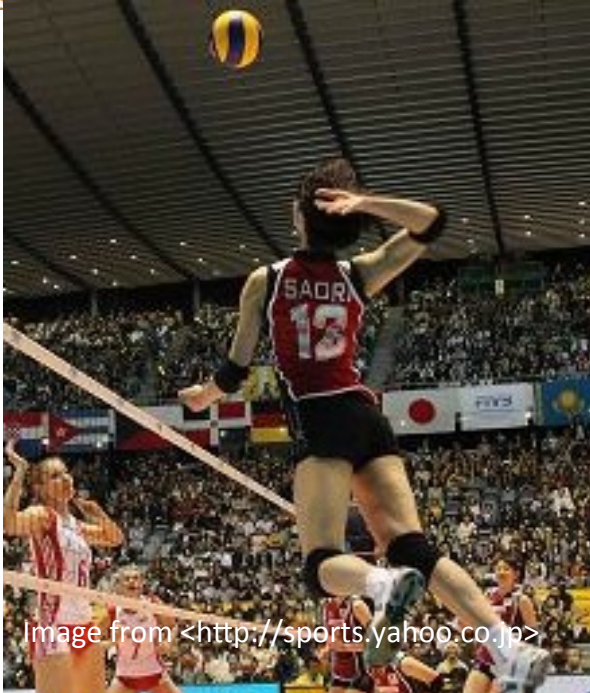
# Architecture？



www.intel.com

http://slowbuddy.com/design/modern-architecture/

http://www.amd.com/
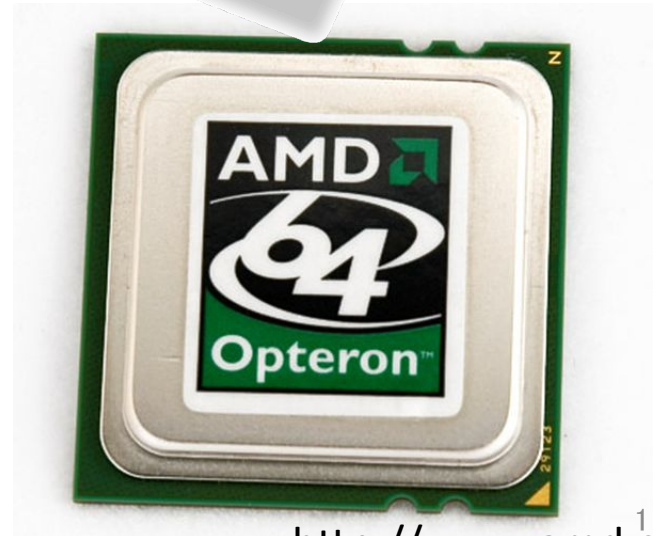
# Which of following have the same architecture?



Image from <http://sports.yahoo.co.jp>

Image from <http://www.takaphoto.com/>

Image from <http://sports.yahoo.co.jp>

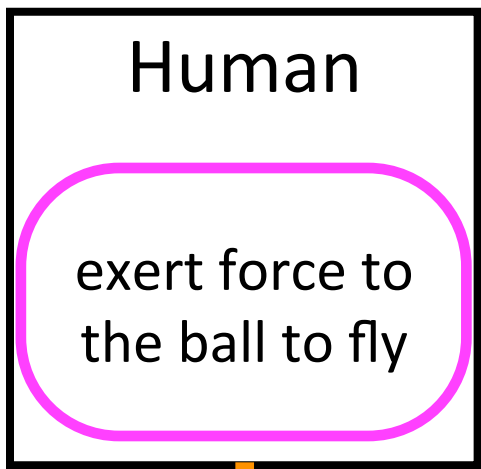Keio EDGE  Image from <http://300bestplayersintheworld.blogspot.jp/>
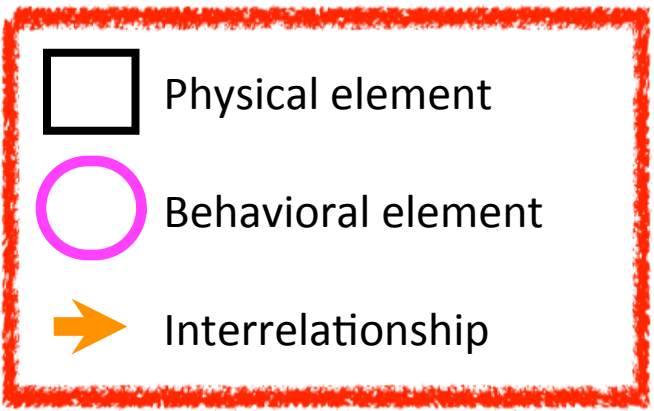
# Example of an architectural description
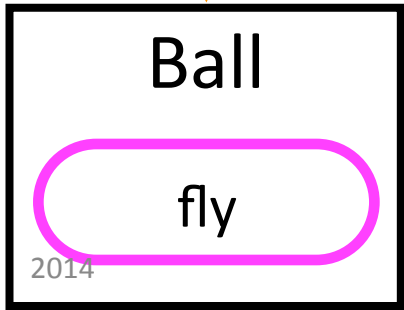


Architecture that human and a ball interact directly.

Architecture that human and a ball interact with a tool in between.

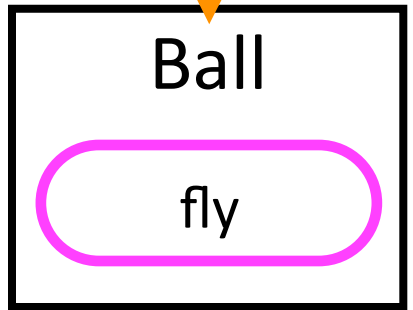# An example of architecture

**Human**

exert force to the ball to fly

**Force**

**Ball**

fly

Human exerts force to the ball.
Ball flies.
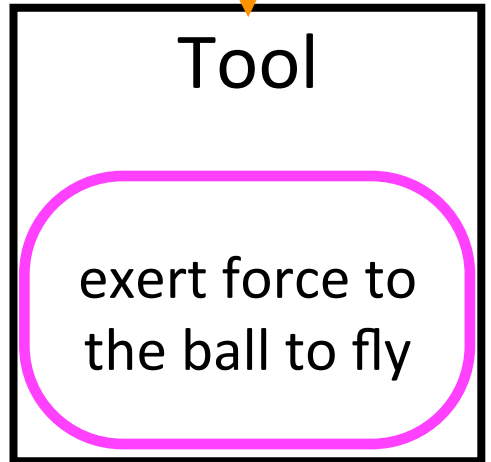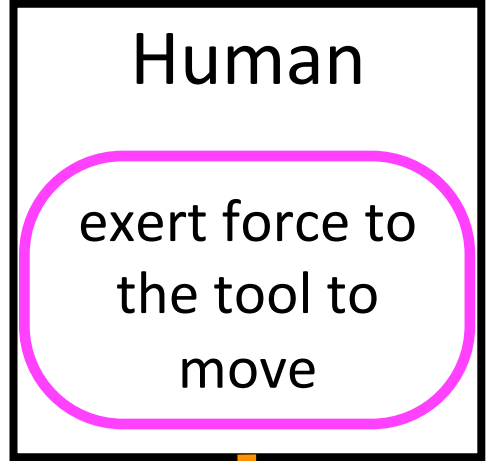
Human exerts force to the tool.
Tool exerts force to the ball.
Ball flies.

**Human**

exert force to the tool to move

**Force**

**Tool**

exert force to the ball to fly

**Force**

**Ball**

fly

# An example of architecture-2

Physical element

Behavioral element

**Human**

exert force to the tool to move

**Force**

**Tool**

exert force to the shuttle to fly

exert force to the ball to fly

**Force**

**Human**

exert force to the ball to

**Force**

**Ball**

fly

run

**shuttle**

**ball**

fly

Image from <http://pt.
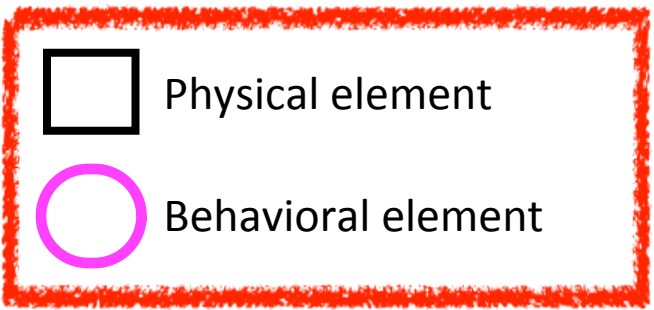
Image from <http://www.sports-online.biz/>

2014/10/09

5

5
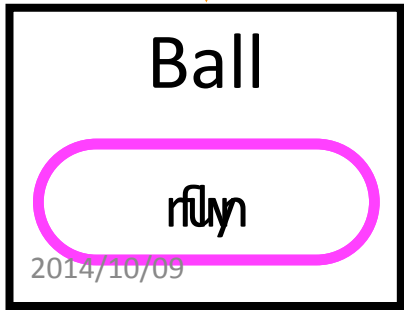
# Definition of Architecture

- The **arrangement** of **function** and **feature** that maximizes some **objective**. (Ring, "*Discovering the Architecture of Product X*", 2001)

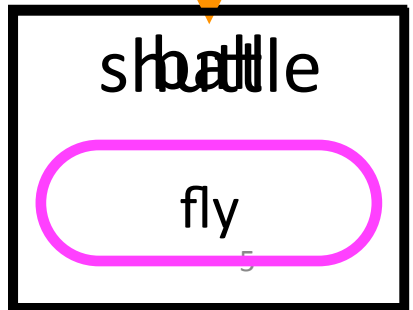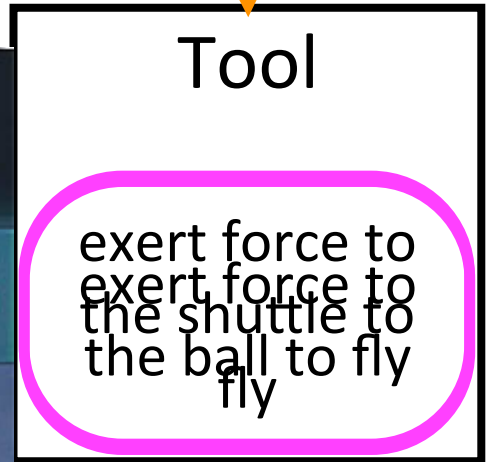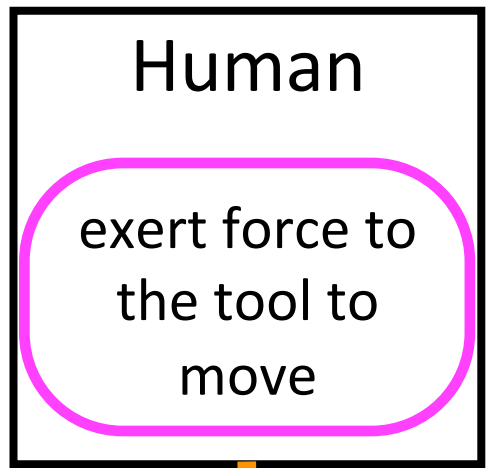- Fundamental organization of a system embodied in its **components**, their **relationships** to each other, and to the environment, and the **principles** guiding its design and evolution. (*ISO/IEC/IEEE 24765*, 2010)

# Definition of Architecture
# MIT Engineering Systems Division

System architecture is an abstract description of the **entities** of a system and the **relationships** between those entities. (de Nufville, R. 2004)
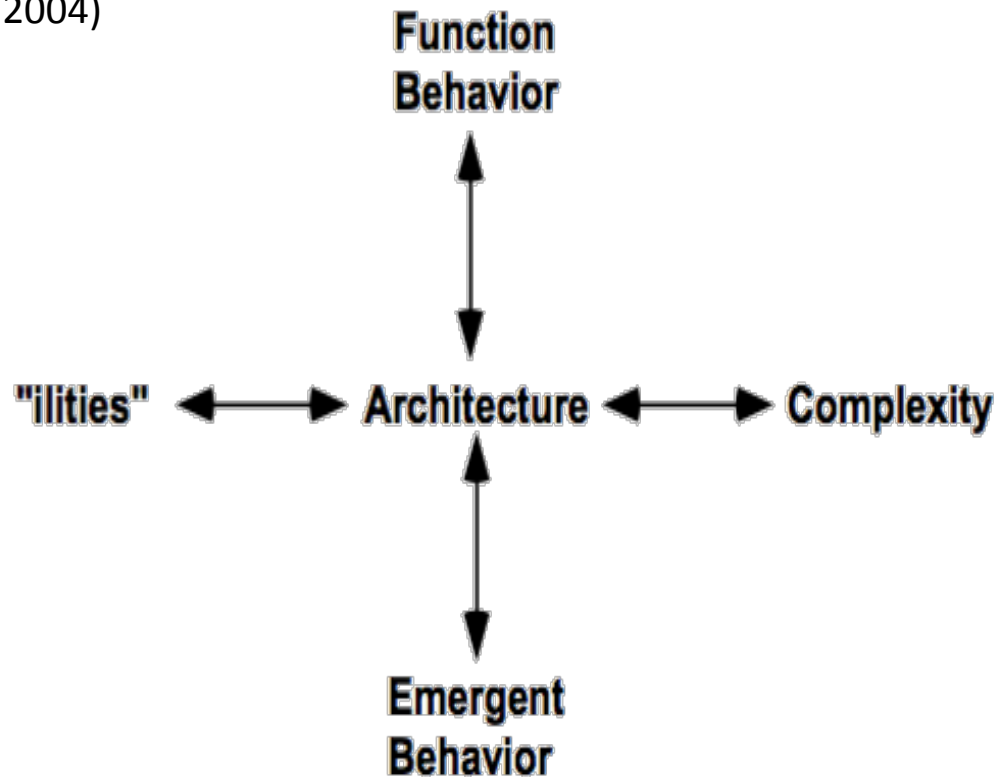


Figure 1: Architecture Plays a Central Role in Giving a System Its Behavior and "ilities," as Well as Generating Emergent Behavior and Complexity

de Neufville, R., et al. "*THE INFLUENCE OF ARCHITECTURE IN ENGINEERING SYSTEMS.*" (2004)

# Definition of Architecting

# Building Architecture

# Definition of Architecting

- Allocate functions to elements and clarify the relation (interface) between elements（Maeno 2010）

**Physical Element "Bamboo"**

Function to be held

Function to sting

# Definition of Architecting

- Allocate functions to elements and clarify the relation (interface) between elements（Maeno 2010）

**Physical Element "Bamboo"**

**Function to be held**

**Function to sting**

# Definition of Architecting

- Allocate functions to elements and clarify the relation (interface) between elements （Maeno 2010）

**Physical Element "Bamboo"**

Function to be held

Function to sting

Bamboo

Function to be held
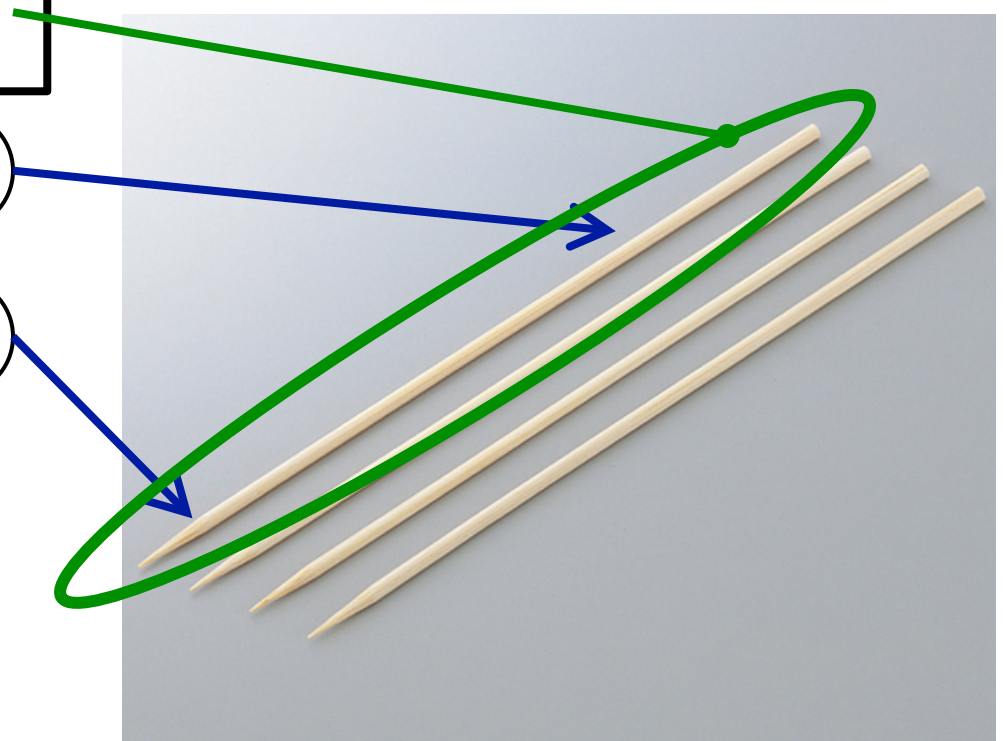
Function to sting

Kane Ishibashi
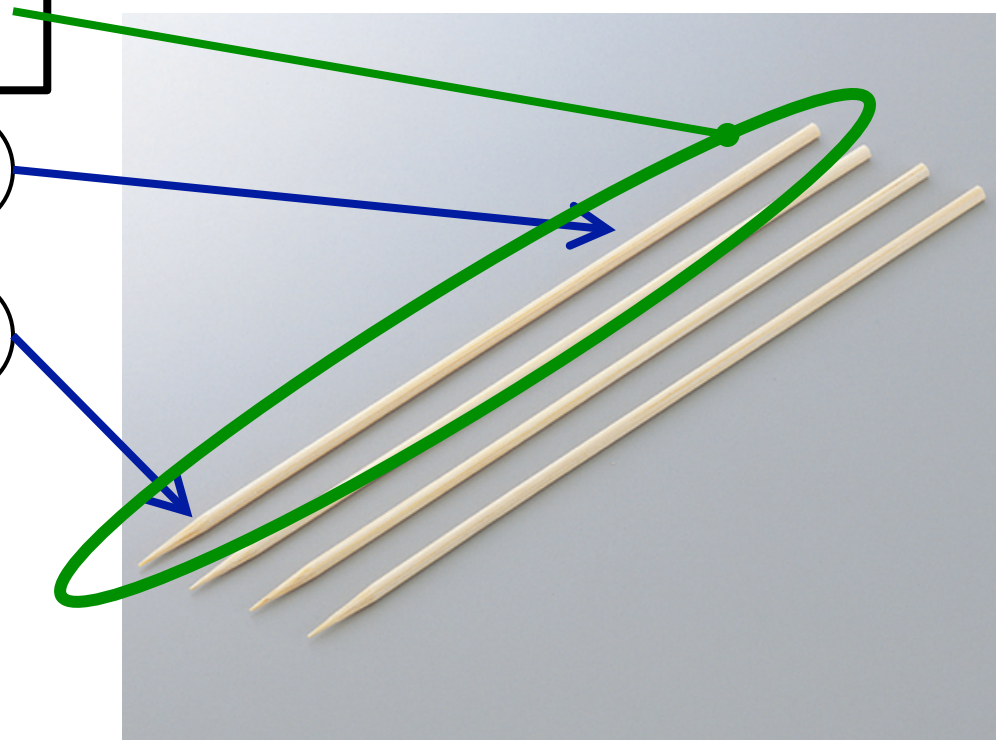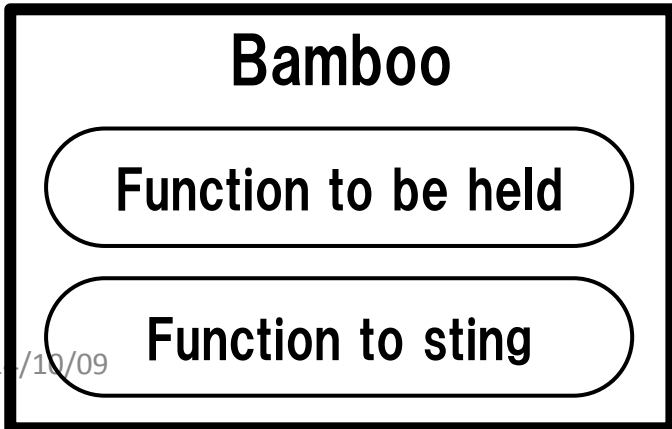
# Architecture

- Relation between <u>system and context</u> and <u>elements</u> which constitute a system and <u>the relation between elements</u>（Shirasaka）
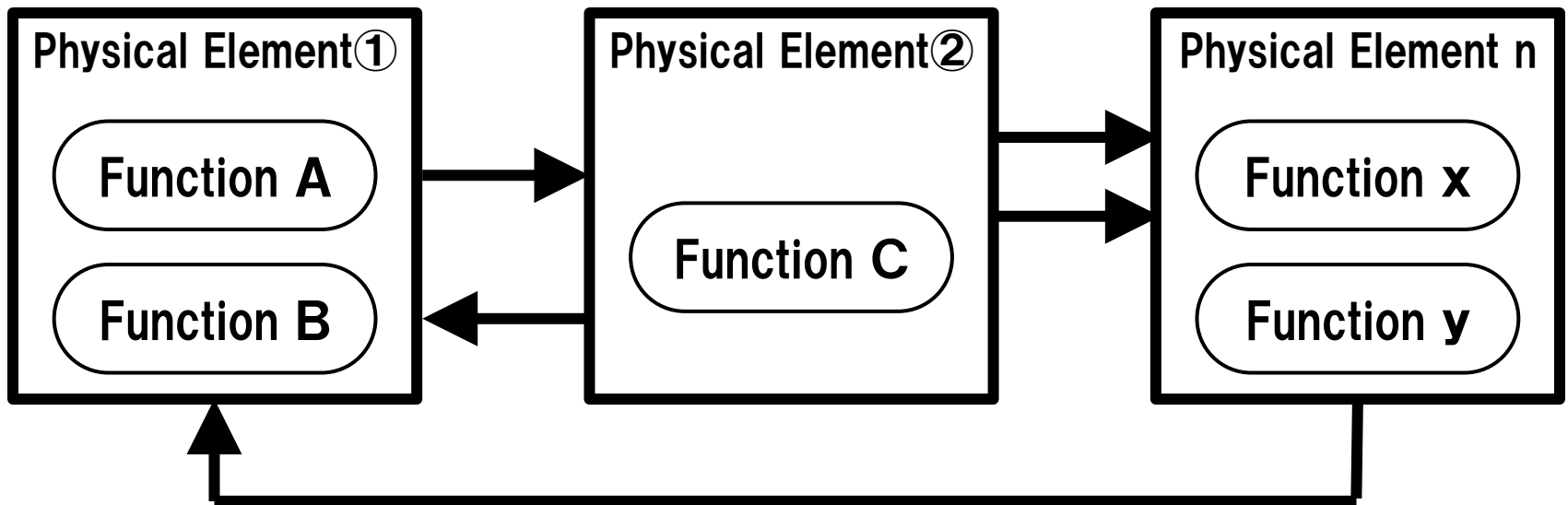


【example of Functional and Physical Architecture】

# アーキテクティング

- Allocate functions to elements and clarify the relation (interface) between elements（Maeno 2010）

<div style="background-color:#c0504d; color:white; padding:20px;">

System Design

＝Architecting

</div>

# Let's try!

# Basic steps of Architecting

Think what kinds of functions are required

↓ Think the logical order of functions

Think physical elements which realize the functions

Think hierarchy of physical elements
Allocate functions to physical elements

(IEEE 1220-2005)

# Example of Architecting①

## Architecture to share housekeeping

## Functions

## Physical Elements

Function to work in the kitchen

Function to do washing

Function to clean up rooms

Function to bring out garbage

husband

wife

# Example of Architecting①

## **Architecture to share housekeeping**

| husband | | wife |
|---|---|---|
| Function to do washing | ← Communication | Function to work in the kitchen |
| Function to bring out garbage | Communication → | Function to clean up rooms |
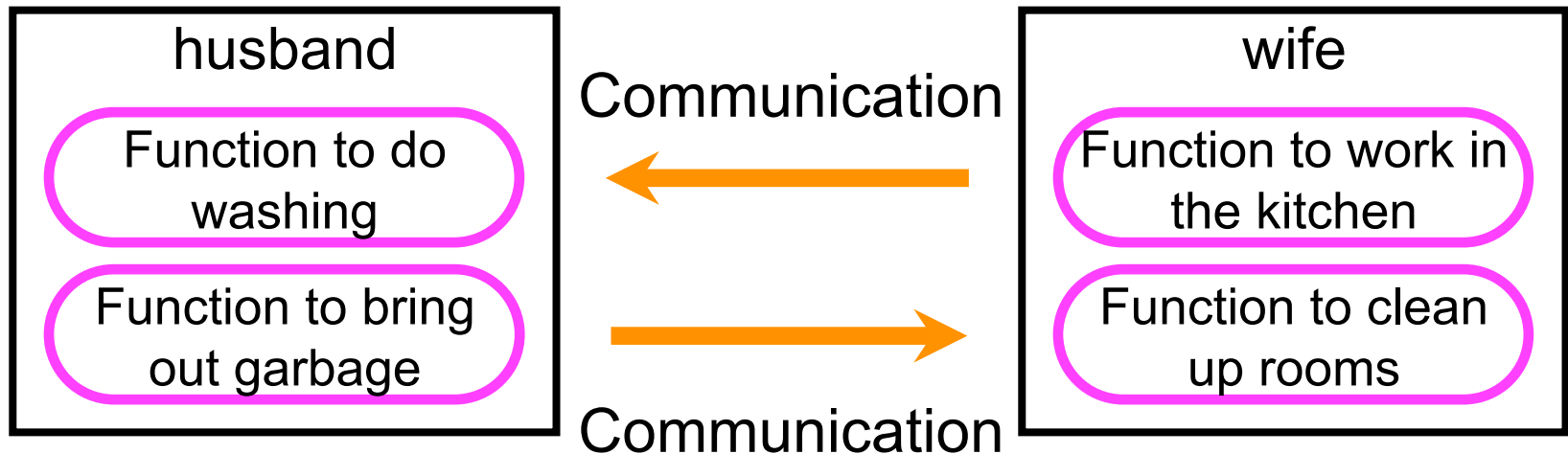
# Example of Architecting②

## Architecture to cook simmered dish at well-established restaurant

**Functions**

Function to peel ⇢ Function to cut ⇢ Function to simmer

Function to flavor ⇢ Function to arrange ⇢ Function to set a table
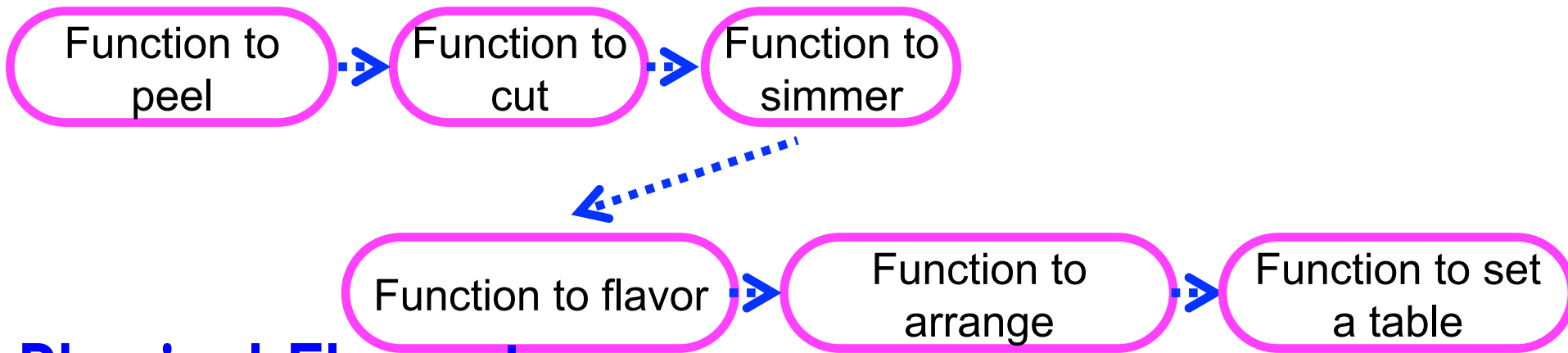
**Physical Elements**

| Junior Apprentice | Senior Apprentice | Master |
|---|---|---|
| | | |

# Architecture to cook simmered dish at well-established restaurant

**Junior Apprentice**

- Function to peel
- Function to cut
- Function to set a table

precooked vegetable →

← arranged cooked vegetable

**Senior Apprentice**

- Function to simmer
- Function to arrange

simmered vegetable →

← cooked vegetable

**Master**

- Function to flavor

# Architecting① : Think functions

☐ <span style="color:red">Think functions</span> which you need for your solution based on theme and insights.

☐ Write in the format of "<span style="color:red">Function to do something</span>"

➢ **Focus on the most important functions**

➢ **Be careful not to much detail**

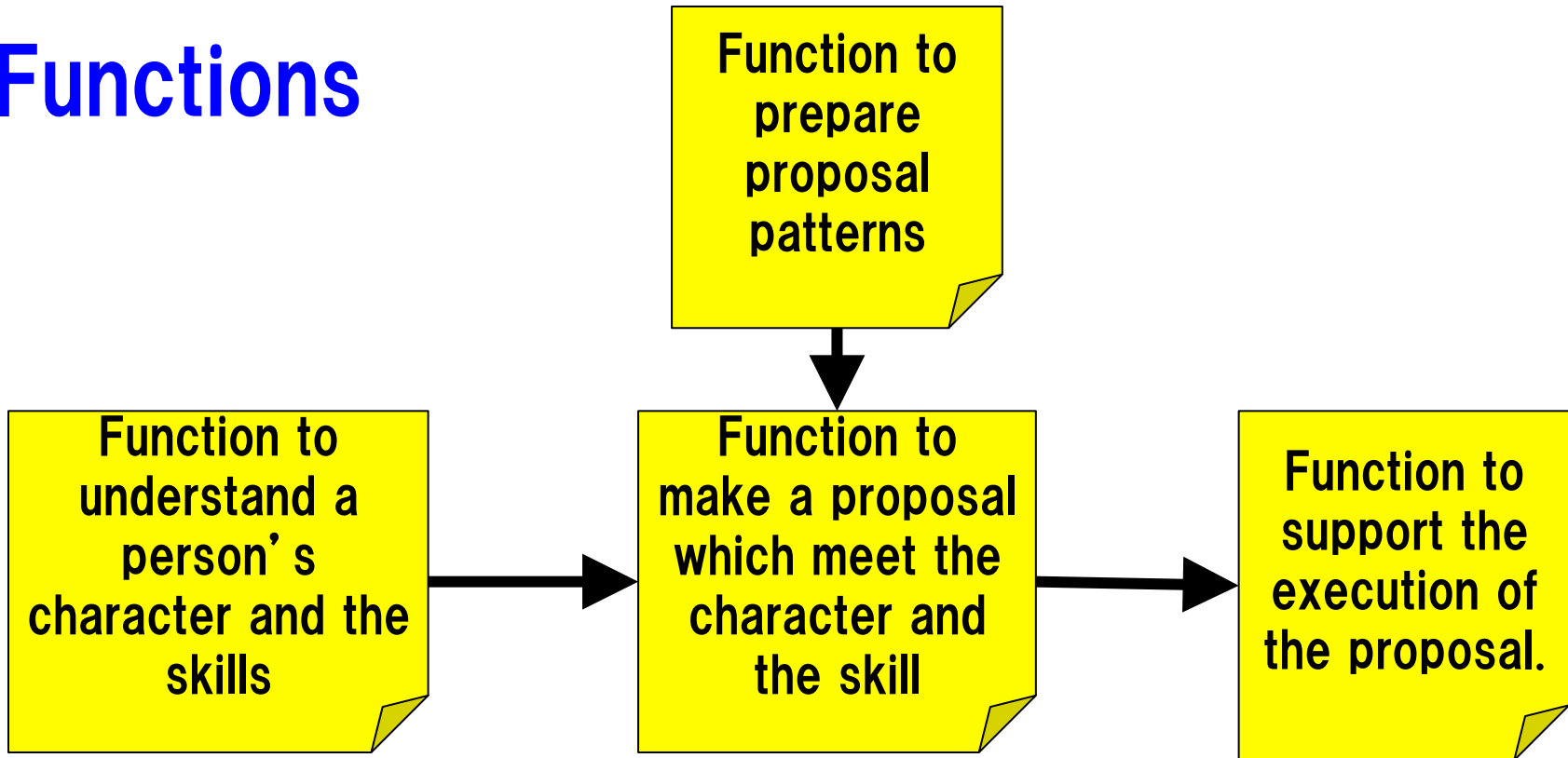**Think what kind of functions you need to realize your idea.**

# Example of architecting① : Think functions

To support a person, who is more than 60 years old, to have motivation in life

## Functions

Function to prepare proposal patterns

Function to understand a person's character and the skills

Function to make a proposal which meet the character and the skill

Function to support the execution of the proposal.

**Think what kind of functions you need to realize your idea**
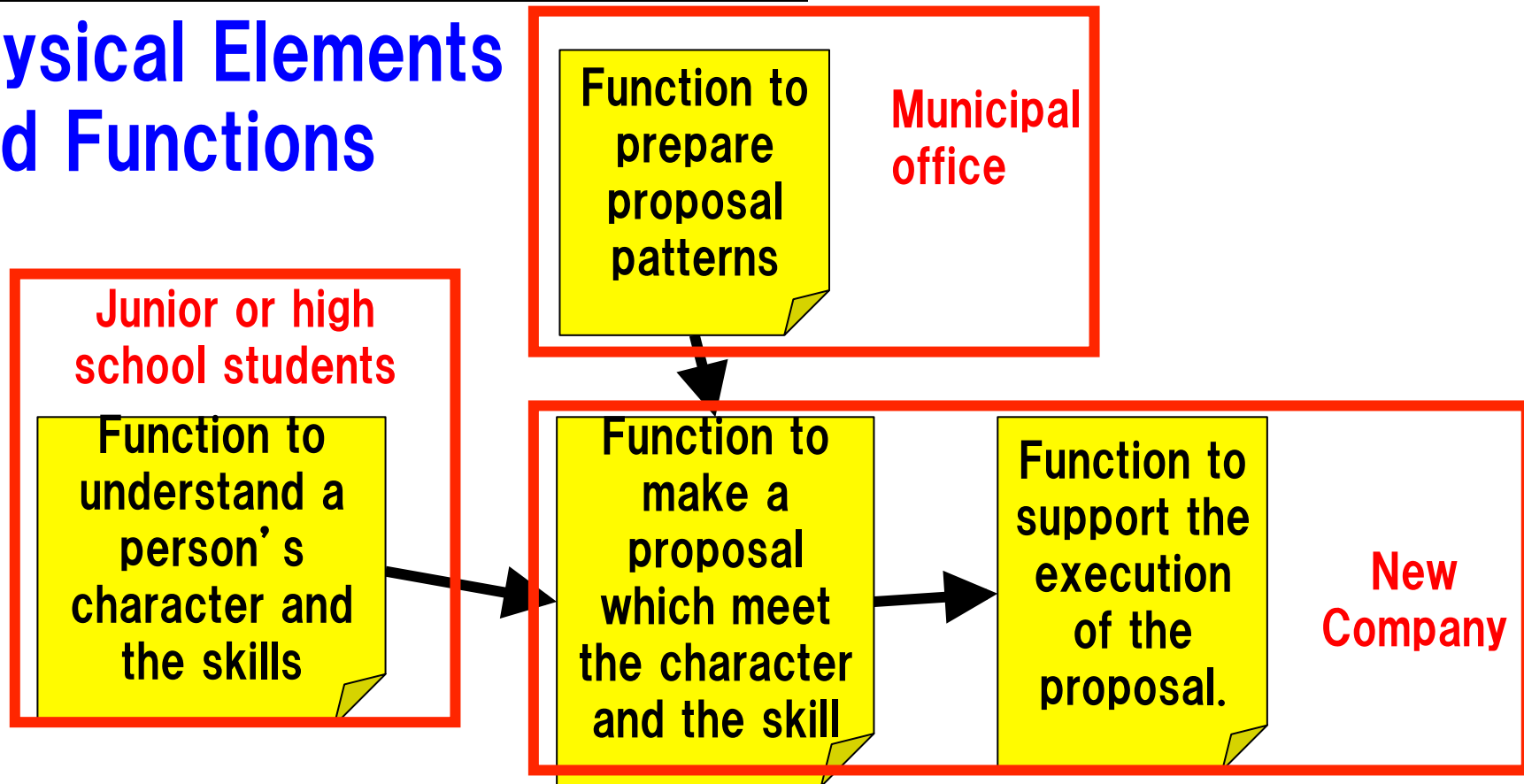
# Architecting② : Think Physical Elements

☐ <u>Think physical elements</u> which you need for your solution based on theme and insights.

☐ Physical elements can be human, organization, product, system service and other means.

➢ **Think means with picked up functions.**

➢ **One physical element can have more than one functions.**

**Think what kind of physical elements can realize the functions.**

# Example of Architecting② : Think Physical Elements

To support a person, who is more than 60 years old, to have motivation in life

**Physical Elements and Functions**

Municipal office

Function to prepare proposal patterns

Junior or high school students

Function to understand a person's character and the skills

Function to make a proposal which meet the character and the skill

Function to support the execution of the proposal.

New Company

**Think what kind of physical elements can realize the functions**

# EOF

Keio EDGE