Problem definition

The purpose of this exercise is to experiment with patterns in software engineering. (a) Use the IC cards to specify the activities involved in organizing a personal health care system such as processing sensor input from blood pressure meter, body temperature, heart rate and so on, scheduling routine and non-routine appointments with physician, obtaining and processing prescriptions, following up test results and so on. (b) Can you identify certain patterns from the above activities? Describe some of the patterns you have identified. (see the article by James Coplien.)

Scenario chosen

Management of cardinal health system specific to monitoring of patient’s pacemaker performance

Task specification

I am the manager of the cardinal health system specific to monitoring of patient’s pacemaker performance on a weekly basis. As a manager, I have the following tasks:

- **Notify the patient** to send the pacemaker sensor data via internet/phone
- **Gather pacemaker sensor data**
- **Make the doctor analyze** sensor data and generate report
  - If the report shows 2/more **untimely shocks**, then
    - **Schedule** appointment for formal device interrogation
    - **Make doctor diagnose patient**
    - **Give medicines** per prescription by doctor
    - **Billing** for diagnoses and analysis
  - If pacemaker sensor data has **no untimely shocks**
    - **Mail the report** to patient
    - **Billing** for analysis alone

I have mentioned the how the tasks are divided as a diagram in Figure 1 (Page 2). I have also specified the “IC Cards for each task in the end” (Page 4).

Patterns identified

1. Composite Pattern (Tree structure)

   **Problem**: Managing the performance of pacemaker
   **Context**: Planning how to manage the performance of pacemaker
   **Solution**: Composition: composes objects in term of a tree structure to represent part as well as whole hierarchy. Hence by dividing the tasks into subtasks in a tree structure simplifies management.
   **Consequences**: May make the system look to general when there are too many subtasks.
Example: The management of the performance of pacemaker *composes* of Notify patient, gather sensor data and make doctor analyze tasks and make doctor analyze *composes* of if report shows untimely shocks or report shows no untimely shocks.

![Diagram of managing pacemaker performance](image)

Figure 1: Task Specification

2. **Indirection Pattern (From GRASP Object Oriented Design)**

![Diagram of indirection](image)

Figure 2: Indirection

**Problem:** The doctor has to diagnose many patients and hence cannot be contacted by the patient directly for all management tasks.  
**Context:** When the patient needs to communicate to doctor apart from diagnoses.  
**Solution:** Indirection pattern/ Delegation pattern. A manager can act as a proxy, and the patient can use the manager to communicate with the doctor, hence reducing the load of the doctor.  
**Consequences:** If the manager has too many patients to handle, due to the one level of indirection, the patient may be delayed the service.
3. **Sequential pattern**

*Problem:* As a manager, I would like to arrange my tasks in a particular order.

*Context:* When one wishes to describe a process that follows a specific series of steps.

*Solution: Sequential Pattern:* allows one to arrange tasks according to the order in which they need to be performed.

*Consequences:* will not be applicable if a decision needs to be made what task needs to be done.

Example 1: Figure 3 and Example 2: Figure 4

![Figure 3: Example 1 Sequential pattern](image)

![Figure 4: Example 2 Sequential pattern](image)

4. **Iterative pattern**

*Problem:* As a manager, I am required to check the performance of sensor data regularly.

*Context:* To decide how often I need to check the performance.

*Solution:* Every week iterate over all the tasks mentioned in the task specification.

*Consequences:* works only when a set of tasks need to be repeated.

![Figure 5: Iterative Pattern](image)
IC cards

IC CARD 1

**IC Card**

**IC Name:** Manage Cardinal Health System

**Description:** Manage the organization responsible for monitoring cardinal health

**Interaction Pattern:**

- Mixed

**My Task:** Manage the health of the patient with pacemaker
**Time Critical Condition:** Weekly
**Name of Other IC:** Staff
**Message to Other IC:** Check performance of patient pacemaker
**Other IC's Task:** Monitor patients pacemaker performance
**Card 1 of 1 (If necessary please use several IC cards to describe an IC)**

IC CARD 2

**IC Card**

**IC Name:** Notify patient to send data

**Description:** Patient needs to send pacemaker sensor data

**Interaction Pattern:**

- By Others with Interaction

**Time Critical Condition:** First day of the week
**Name of Other IC:** Patient
**Message to Other IC:** Reminder to send sensor data
**Other IC's Task:** Patient sends pacemaker data via telephone/internet
**Card 2 of 2 (If necessary please use several IC cards to describe an IC)**
IC CARD 3

**IC Card**

IC Name: Gather pacemaker sensor data

Description: Gather patients pacemaker data to monitor performance of pacemaker

Interaction Pattern:

By Myself no Interaction

Time Critical Condition: After patient sends sensor data from home
Name of Other IC: None
Message to Other IC: None
Other IC's Task: None
Card 3 of 3 (If necessary please use several IC cards to describe an IC)

IC CARD 4

**IC Card**

IC Name: Analyze pacemaker sensor data

Description: Analyze the pacemaker sensor data to find if there are any untimely shocks

Interaction Pattern:

By Others with Interaction

Time Critical Condition: After I gather the data
Name of Other IC: Doctor
Message to Other IC: Please analyze the patients pacemaker data
Other IC's Task: Analyze the patients pacemaker data
Card 4 of 4 (If necessary please use several IC cards to describe an IC)
IC Card 5

<table>
<thead>
<tr>
<th>IC Card</th>
<th>IC Name: If two or more repetitive shocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description: If the patient faces untimely 2 or more repetitive shocks, he/she is in danger</td>
<td></td>
</tr>
<tr>
<td>Interaction Pattern:</td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Interaction Pattern" /></td>
<td></td>
</tr>
<tr>
<td>By Others with Interaction</td>
<td></td>
</tr>
<tr>
<td>Time Critical Condition: After the doctor analyses the data and finds repetitive shocks</td>
<td></td>
</tr>
<tr>
<td>Name of Other IC: Doctor</td>
<td></td>
</tr>
<tr>
<td>Message to Other IC: Check for time when doctor is free</td>
<td></td>
</tr>
<tr>
<td>Other IC's Task: Gives a convenient time</td>
<td></td>
</tr>
<tr>
<td>Card 5 of 5 (If necessary please use several IC cards to describe an IC)</td>
<td></td>
</tr>
</tbody>
</table>

IC Card 6

<table>
<thead>
<tr>
<th>IC Card</th>
<th>IC Name: Schedule appointment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description: to schedule an appointment with doctor and patient</td>
<td></td>
</tr>
<tr>
<td>Interaction Pattern:</td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Interaction Pattern" /></td>
<td></td>
</tr>
<tr>
<td>By Myself with Interaction</td>
<td></td>
</tr>
<tr>
<td>Time Critical Condition: after doctor mentions the convenient time</td>
<td></td>
</tr>
<tr>
<td>Name of Other IC: Patient</td>
<td></td>
</tr>
<tr>
<td>Message to Other IC: confirm time please</td>
<td></td>
</tr>
<tr>
<td>Other IC's Task: Confirms time</td>
<td></td>
</tr>
<tr>
<td>Card 6 of 6 (If necessary please use several IC cards to describe an IC)</td>
<td></td>
</tr>
</tbody>
</table>
IC Card 7

<table>
<thead>
<tr>
<th>IC Card</th>
<th>IC Name: diagnose the patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description: The doctor performs formal device interrogation</td>
<td></td>
</tr>
<tr>
<td>Interaction Pattern:</td>
<td></td>
</tr>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td></td>
</tr>
<tr>
<td>By Others with Interaction</td>
<td></td>
</tr>
<tr>
<td>Time Critical Condition: After patient comes at the specified time</td>
<td></td>
</tr>
<tr>
<td>Name of Other IC: Doctor</td>
<td></td>
</tr>
<tr>
<td>Message to Other IC: Here is the patient, please diagnose</td>
<td></td>
</tr>
<tr>
<td>Other IC’s Task: Diagnoses patient</td>
<td></td>
</tr>
<tr>
<td>Card 7 of 7 (If necessary please use several IC cards to describe an IC)</td>
<td></td>
</tr>
</tbody>
</table>

IC Card 8

<table>
<thead>
<tr>
<th>IC Card</th>
<th>IC Name: Give medicines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description: Give medicines according to prescription by doctor</td>
<td></td>
</tr>
<tr>
<td>Interaction Pattern:</td>
<td></td>
</tr>
<tr>
<td><img src="image2.png" alt="Image" /></td>
<td></td>
</tr>
<tr>
<td>By Myself with Interaction</td>
<td></td>
</tr>
<tr>
<td>Time Critical Condition: After the doctor prescribes medicines</td>
<td></td>
</tr>
<tr>
<td>Name of Other IC: patient</td>
<td></td>
</tr>
<tr>
<td>Message to Other IC: Have these medicines on time</td>
<td></td>
</tr>
<tr>
<td>Other IC’s Task: none</td>
<td></td>
</tr>
<tr>
<td>Card 8 of 8 (If necessary please use several IC cards to describe an IC)</td>
<td></td>
</tr>
</tbody>
</table>
IC Card 9

IC Card
IC Name: Billing for visit

Description: Mail the bill to the patient for diagnoses
Interaction Pattern:

By Myself no Interaction

Time Critical Condition: After the patients treatment
Name of Other IC: patient
Message to Other IC: Please pay bill
Other IC’s Task: pays bill
Card 9 of 9 (If necessary please use several IC cards to describe an IC)

IC Card 10

IC Card
IC Name: If there are no untimely shocks

Description: Mail the patient that everything fine and no need of visit
Interaction Pattern:

By Myself no Interaction

Time Critical Condition: after the doctor analyses the data
Name of Other IC: Patient
Message to Other IC: Everything is fine
Other IC’s Task: none
Card 10 of 10 (If necessary please use several IC cards to describe an IC)
Description: Mail the bill to the patient for sensor data analysis

Interaction Pattern:

By Myself no Interaction

Time Critical Condition: None
Name of Other IC: Patient
Message to Other IC: Please pay bill
Other IC’s Task: Pays bill when free
Card 11 of 11 (If necessary please use several IC cards to describe an IC)