For this exercise, I designed by first creating the root IC cards in the hierarchy, patient, doctor, and pharmacist. Next, for each individual I created the IC cards for software/mechanical functionalities that each individual would require. Finally, the lowest level of ICCs relates to the sensors that support the functions of the software/mechanical ICCs. Among each ICC there are many tasks, and therefore there are several cards for each to support all tasks. Additionally, for the doctor and patient they both require a calendar IC. To support this, I created only one ICC type of a calendar app, since both doctor and patient could have different instances of the same ICC type. This is similar to the concept of having multiple object instances of the same type supporting different programs.

This hierarchical structure for the patient is a pattern that solves the problem of informing individuals and healthcare professionals with health updates. The environment in this case includes the patient, but it also extends to their physician and emergency medical services, in the event of a critical need. To solve this problem, the patient and physician ICs interact with a healthcare app and healthcare database IC. The information is fed to the healthcare database through a series of requests to the healthcare app. Further extending this information, the healthcare app communicates with a set of lower level sensor IC cards that collect an assortment of health readings from the patient. This is similar to Coplien’s HOPP structure, which relied on local symmetry to provide coverage of tasks to upper levels. The sensors provide this symmetry to cover the tasks necessary to provide the health app with information.

The serialization of patient-doctor process is another pattern, which solves the lifecycle of medical treatment. As stated before through sensing and collection, the information is aggregated, compiled, and finally analyzed by the roots of the IC Card tree. This process is connected to bring the doctor, pharmacist, and patient, together to provide healthcare services to the patient. In order to address an individual’s health ailments, the doctor is informed through the interaction with the health database and examining the patient. Continuing through this process the doctor can choose to utilize other tools to test the patient. If necessary, the doctor transitions the medical care from his/her responsibility to the pharmacist, when the patient receives the prescription. Continuing through this process, the patient makes a context change to the pharmacy. At this point, the prescription is received through the pharmacist’s interaction with the patient and prescription database. When the prescription is filled, this closes the patient’s process to receive healthcare treatment.
<table>
<thead>
<tr>
<th>Patient</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IC Card</strong></td>
</tr>
<tr>
<td><strong>IC Name:</strong> Patient</td>
</tr>
<tr>
<td><strong>Description:</strong> Person who is utilizing the health software</td>
</tr>
<tr>
<td><strong>Interaction Pattern:</strong></td>
</tr>
<tr>
<td><strong>My Task:</strong> Walk</td>
</tr>
<tr>
<td>Time Critical Condition: Not Critical</td>
</tr>
<tr>
<td>Name of Other IC: Sensor - Accelerometer</td>
</tr>
<tr>
<td>Message to Other IC: None</td>
</tr>
<tr>
<td>Other IC’s Task: Measure the motion of the phone</td>
</tr>
<tr>
<td>Card 1of 11 (If necessary please use several IC cards to describe an IC)</td>
</tr>
</tbody>
</table>

| **IC Card** |
| **IC Name:** Patient |
| **Description:** Person who is utilizing the health software |
| **Interaction Pattern:** |
| **My Task:** Enter appointment information |
| Time Critical Condition: Not Critical |
| Name of Other IC: Calendar |
| Message to Other IC: This is my appointment time and date |
| Other IC’s Task: Store appointment time |
| Card 3of 11 (If necessary please use several IC cards to describe an IC) |

| **IC Card** |
| **IC Name:** Patient |
| **Description:** Person who is utilizing the health software |
| **Interaction Pattern:** |
| **My Task:** Open and look at Health App |
| Time Critical Condition: Not Critical |
| Name of Other IC: Health App |
| Message to Other IC: Open health app |
| Other IC’s Task: Display health information |
| Card 5of 11 (If necessary please use several IC cards to describe an IC) |

| **IC Card** |
| **IC Name:** Patient |
| **Description:** Person who is utilizing the health software |
| **Interaction Pattern:** |
| **My Task:** Decide on the next appointment |
| Time Critical Condition: upon need |
| Name of Other IC: Doctor |
| Message to Other IC: Does this date work |
| Other IC’s Task: This date works |
| Card 6of 11 (If necessary please use several IC cards to describe an IC) |
**Health App**

**IC Card**

**IC Name:** Health App  
**Description:** Collect and analyze health information from sensors  
**Interaction Pattern:**

My Task: Collect health information from sensors  
**Time Critical Condition:** Intermediate sampling from sensors  
**Name of Other IC:** Sensor ICs  
**Message to Other IC:** Display sensor values  
**Other IC’s Task:** Send sampled sensor values  
**Card 1 of 8 (If necessary please use several IC cards to describe an IC)**

**IC Card**

**IC Name:** Health App  
**Description:** Collect and analyze health information from sensors, send information to doctors, and notify EMS in an emergency  
**Interaction Pattern:**

By Myself with Interaction  

My Task: Display health stats to patient when requested  
**Time Critical Condition:** At patients request  
**Name of Other IC:** Patient  
**Message to Other IC:** Display of the patients vitals  
**Other IC’s Task:** Phone needs to display health information  
**Card 3 of 8 (If necessary please use several IC cards to describe an IC)**

**IC Card**

**IC Name:** Health App  
**Description:** Collect and analyze health information from sensors, send information to doctors, and notify EMS in an emergency  
**Interaction Pattern:**

My Task: Notify EMS because of emergency vital signs  
**Time Critical Condition:** Immediate  
**Name of Other IC:** EMS  
**Message to Other IC:** Send an ambulance  
**Other IC’s Task:** EMS will send an ambulance to get the individual  
**Card 2 of 8 (If necessary please use several IC cards to describe an IC)**

**IC Card**

**IC Name:** Health App  
**Description:** Collect and analyze health information from sensors, send information to doctors, and notify EMS in an emergency  
**Interaction Pattern:**

By Myself no Interaction  

My Task: Analyze health information calculating average and standard deviation  
**Time Critical Condition:** Intermediate sampling from sensors then analyze  
**Name of Other IC:** None  
**Message to Other IC:** None  
**Other IC’s Task:** None  
**Card 4 of 8 (If necessary please use several IC cards to describe an IC)**
IC Card
IC Name: Health App
Description: Collect and analyze health information from sensors, send information to doctors, and notify EMS in an emergency.
Interaction Pattern:

By Myself with Interaction
My Task: Send collected health information to physician
Time Critical Condition: Send sensor information periodically (as specified)
Name of Other IC: Doctor Patient Database
Message to Other IC: Send average values and standard deviations of vital signs

Other IC's Task: Receive the information
Card 5 of 8 (If necessary please use several IC cards to describe an IC)

IC Card
IC Name: Health App
Description: Collect and analyze health information from sensors, send information to doctors, and notify EMS in an emergency.
Interaction Pattern:

Mixed
My Task: Collect accelerometer info
Time Critical Condition: Peridically
Name of Other IC: Sensor - Accelerometer
Message to Other IC: Send motion information
Other IC's Task: Submit motion information
Card 7 of 8 (If necessary please use several IC cards to describe an IC)

IC Card
IC Name: Health App
Description: Collect and analyze health information from sensors, send information to doctors, and notify EMS in an emergency.
Interaction Pattern:

Mixed
My Task: Collect and store weight information
Time Critical Condition: Upon entry by patient
Name of Other IC: Patient
Message to Other IC: None
Other IC's Task: Enter weight information
Card 6 of 8 (If necessary please use several IC cards to describe an IC)

IC Card
IC Name: Health App
Description: Collect and analyze health information from sensors, send information to doctors, and notify EMS in an emergency.
Interaction Pattern:

By Myself no Interaction
My Task: Computer Steps
Time Critical Condition: When no accelerometer data is received
Name of Other IC: None
Message to Other IC: None
Other IC's Task: None
Card 8 of 8 (If necessary please use several IC cards to describe an IC)
**Calendar App**

**IC Name:** Calendar App  
**Description:** Store and notify patient of upcoming appointments  
**Interaction Pattern:**

<table>
<thead>
<tr>
<th>My Task</th>
<th>Notify patient of appointment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of Other IC</td>
<td>Patient</td>
</tr>
<tr>
<td>Message to Other IC</td>
<td>Display notification</td>
</tr>
<tr>
<td>Other IC's Task</td>
<td>None</td>
</tr>
<tr>
<td>Card 1 of 2</td>
<td>(If necessary please use several IC cards to describe an IC)</td>
</tr>
</tbody>
</table>

**Blood Pressure**

**IC Card**

**IC Name:** Sensor - Blood Pressure  
**Description:** Sample the patients blood pressure and send it to the health app when requested  
**Interaction Pattern:**

<table>
<thead>
<tr>
<th>My Task</th>
<th>Sample the patients blood pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time Critical Condition</td>
<td>Periodically</td>
</tr>
<tr>
<td>Name of Other IC</td>
<td>Patient</td>
</tr>
<tr>
<td>Message to Other IC</td>
<td>No message</td>
</tr>
<tr>
<td>Other IC's Task</td>
<td>No task</td>
</tr>
<tr>
<td>Card 1 of 3</td>
<td>(If necessary please use several IC cards to describe an IC)</td>
</tr>
</tbody>
</table>

**IC Card**

**IC Name:** Calendar App  
**Description:** Store and notify patient of upcoming appointments  
**Interaction Pattern:**

<table>
<thead>
<tr>
<th>My Task</th>
<th>Store calendar information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time Critical Condition</td>
<td>Upon entry</td>
</tr>
<tr>
<td>Name of Other IC</td>
<td>Patient</td>
</tr>
<tr>
<td>Message to Other IC</td>
<td>None</td>
</tr>
<tr>
<td>Other IC's Task</td>
<td>Sends appointment information to app</td>
</tr>
<tr>
<td>Card 2 of 2</td>
<td>(If necessary please use several IC cards to describe an IC)</td>
</tr>
</tbody>
</table>
IC Card
IC Name: Sensor - Blood Pressure
Description: Sample the patients blood pressure and send it to the health app when requested
Interaction Pattern: 

- By Myself no Interaction
My Task: Delete previously collected sensor information to free space
Time Critical Condition: After health app collects health information or sensor memory space reaches capacity
Name of Other IC: None
Message to Other IC: None
Other IC's Task: None
Card 3of 3 (If necessary please use several IC cards to describe an IC)

---

**Body Temperature Sensor**

IC Card
IC Name: Sensor - Body Temperature
Description: Sample the patients body temperature and send it to the health app when requested
Interaction Pattern: 

- By Myself no Interaction
My Task: Sample the patients body temperature
Time Critical Condition: Periodically
Name of Other IC: Patient
Message to Other IC: None
Other IC's Task: None
Card 1of 3 (If necessary please use several IC cards to describe an IC)

---

IC Card
IC Name: Sensor - Body Temperature
Description: Sample the patients body temperature and send it to the health app when requested
Interaction Pattern: 

- Mixed
My Task: Send body temperature to health app at request
Time Critical Condition: Upon request
Name of Other IC: Health App
Message to Other IC: Send patients body temperature
Other IC's Task: Collect body temperature values
Card 2of 3 (If necessary please use several IC cards to describe an IC)

---

IC Card
IC Name: Sensor - Body Temperature
Description: Sample the patients body temperature and send it to the health app when requested
Interaction Pattern: 

- By Myself no Interaction
My Task: Delete previously collected sensor information to free space
Time Critical Condition: After health app collects health information or sensor memory space reaches capacity
Name of Other IC: None
Message to Other IC: None
Other IC's Task: None
Card 3of 3 (If necessary please use several IC cards to describe an IC)
**Heart Rate Sensor**

<table>
<thead>
<tr>
<th>IC Card</th>
</tr>
</thead>
</table>
| **IC Name:** Sensor - Heart Rate  
**Description:** Sample the heart rate and send it to the health app when requested  
**Interaction Pattern:** |
| **By Myself with Interaction**  
**My Task:** Sample the patients heart rate  
**Time Critical Condition:** Periodically  
**Name of Other IC:** Patient  
**Message to Other IC:** None  
**Other IC's Task:** None  
**Card 1 of 3 (If necessary please use several IC cards to describe an IC)** |
| **IC Card** |
| **IC Name:** Sensor - Heart Rate  
**Description:** Sample the heart rate and send it to the health app when requested  
**Interaction Pattern:** |
| **By Myself no Interaction**  
**My Task:** Delete previously collected sensor information to free space  
**Time Critical Condition:** After health app collects health information or sensor memory space reaches capacity  
**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)** |

<table>
<thead>
<tr>
<th>IC Card</th>
</tr>
</thead>
</table>
| **IC Name:** Sensor - Heart Rate  
**Description:** Sample the heart rate and send it to the health app when requested  
**Interaction Pattern:** |
| **Mixed**  
**My Task:** Send heart rate to health app at request  
**Time Critical Condition:** Upon request  
**Name of Other IC:** Health App  
**Message to Other IC:** Send patients heart rate values  
**Other IC's Task:** Collect heart rate values  
**Card 2 of 3 (If necessary please use several IC cards to describe an IC)** |
**Accelerometer Sensor**

<table>
<thead>
<tr>
<th>IC Card</th>
</tr>
</thead>
</table>
| IC Name: Sensor - Accelerometer  
Description: Sensor that checks phone motion  
Interaction Pattern: |

By Myself no Interaction  
My Task: Collect the motion as the phone moves  
Time Critical Condition: Sample as motion changes  
Name of Other IC: None  
Message to Other IC: None  
Other IC's Task: None  
Card 1of 3 (If necessary please use several IC cards to describe an IC)  

<table>
<thead>
<tr>
<th>IC Card</th>
</tr>
</thead>
</table>
| IC Name: Sensor - Accelerometer  
Description: Sensor that checks phone motion  
Interaction Pattern: |

By Myself no Interaction  
My Task: Delete previously collected sensor information to free space  
Time Critical Condition: After health app collects health information or sensor memory space reaches capacity  
Name of Other IC: None  
Message to Other IC: None  
Other IC's Task: None  
Card 3of 3 (If necessary please use several IC cards to describe an IC)  

<table>
<thead>
<tr>
<th>IC Card</th>
</tr>
</thead>
</table>
| IC Name: Sensor - Accelerometer  
Description: Sensor that checks phone motion  
Interaction Pattern: |

My Task: Send collected motion information to health app  
Time Critical Condition: Upon request  
Name of Other IC: Health App  
Message to Other IC: Sending motion information  
Other IC's Task: Request motion information  
Card 2of 3 (If necessary please use several IC cards to describe an IC)  

Mixed
### Pharmacist

**IC Name:** Pharmacist  
**Description:** Examines patients, schedules appointments, and implements actions based on patient health  
**Interaction Pattern:**

- **My Task:** Check prescription database for availability and if so debit quantity  
- **Time Critical Condition:** upon need  
- **Name of Other IC:** Prescription database  
- **Message to Other IC:** Is this drug available and if so remove needed quantity  
- **Other IC's Task:** Debit quantities stored  
- **Card 1of 4 (If necessary please use several IC cards to describe an IC)**

---

### IC Card

**IC Name:** Pharmacist  
**Description:** Authenticate and administer prescription dosage  
**Interaction Pattern:**

- **By Myself no Interaction**  
- **My Task:** Collect pharmaceutical drugs and place into appropriate container  
- **Time Critical Condition:** Upon request  
- **Name of Other IC:** none  
- **Message to Other IC:** none  
- **Other IC's Task:** none  
- **Card 3of 4 (If necessary please use several IC cards to describe an IC)**

---

### IC Card

**IC Name:** Pharmacist  
**Description:** Authenticate and administer prescription dosage  
**Interaction Pattern:**

- **By Myself with Interaction**  
- **My Task:** Charge patient and give prescription  
- **Time Critical Condition:** After filling prescription  
- **Name of Other IC:** Patient  
- **Message to Other IC:** Prescription information  
- **Other IC's Task:** none  
- **Card 4of 4 (If necessary please use several IC cards to describe an IC)**
**Health Database**

**IC Card**

**IC Name:** Health Database  
**Description:** Stores health information received from patients  
**Interaction Pattern:**

- Mixed

- **My Task:** Request and store health information  
- **Time Critical Condition:** Periodically  
- **Name of Other IC:** Health App  
- **Message to Other IC:** Request to send health information  
- **Other IC's Task:** Send health information  
- **Card 1 of 2 (If necessary please use several IC cards to describe an IC)**

**Prescription Database**

**IC Card**

**IC Name:** Prescription Database  
**Description:** Stores the quantity of prescription drugs available in the pharmacy  
**Interaction Pattern:**

- **Quiet State**

- **My Task:** Store entered quantities of drugs  
- **Time Critical Condition:** none  
- **Name of Other IC:** none  
- **Message to Other IC:** none  
- **Other IC's Task:** none  
- **Card 1 of 2 (If necessary please use several IC cards to describe an IC)**
Doctor

IC Card
IC Name: Doctor
Description: Examines patients, schedules appointments, and implements actions based on patient health
Interaction Pattern:

My Task: Examine patient based on data and health status
Time Critical Condition: Based on appointment
Name of Other IC: Patient
Message to Other IC: Tells results of examination
Other IC's Task: Perform doctors actions when requested
Card 1of 8 (If necessary please use several IC cards to describe an IC)

IC Card
IC Name: Doctor
Description: Examines patients, schedules appointments, and implements actions based on patient health
Interaction Pattern:

My Task: Enter a new appointment in the calendar
Time Critical Condition: No
Name of Other IC: Calendar App (Doctor)
Message to Other IC: This is the appointment date
Other IC's Task: Store appointment date and time
Card 3of 8 (If necessary please use several IC cards to describe an IC)

IC Card
IC Name: Doctor
Description: Examines patients, schedules appointments, and implements actions based on patient health
Interaction Pattern:

My Task: Consult/analyze patient status with health database
Time Critical Condition: Periodically
Name of Other IC: Health Database
Message to Other IC: Request display health information
Other IC's Task: Display health information
Card 5of 8 (If necessary please use several IC cards to describe an IC)
IC Card
IC Name: Doctor
Description: Examines patients, schedules appointments, and implements actions based on patient health
Interaction Pattern:

My Task: Operate scan machine for patient test
Time Critical Condition: upon need
Name of Other IC: Patient and Scan Machine
Message to Other IC: Operate buttons on scan machine
Other IC's Task: Perform scan
Card 7of 8 (If necessary please use several IC cards to describe an IC)

Scan Machine
IC Name: Scan Machine
Description: Performs scan on patient and prints results
Interaction Pattern:

My Task: Perform scan on patient
Time Critical Condition: Upon request
Name of Other IC: Doctor, Patient
Message to Other IC: None
Other IC's Task: Operate scan machine
Card 1of 2 (If necessary please use several IC cards to describe an IC)

IC Card
IC Name: Doctor
Description: Examines patients, schedules appointments, and implements actions based on patient health
Interaction Pattern:

By Myself with Interaction
My Task: Determine if follow up appointment is necessary
Time Critical Condition: Upon need
Name of Other IC: Test results
Message to Other IC: Print results
Other IC's Task: Produce results
Card 8of 8 (If necessary please use several IC cards to describe an IC)

IC Card
IC Name: Scan Machine
Description: Performs scan on patient and prints results
Interaction Pattern:

My Task: Prints scanned results
Time Critical Condition: Upon request
Name of Other IC: Doctor
Message to Other IC: Printed results
Other IC's Task: Take results and analyze them
Card 2of 2 (If necessary please use several IC cards to describe an IC)
**Prescription Pad**

IC Card

IC Name: Prescription Pad
Description: Display an authenticated patient prescription
Interaction Pattern:

My Task: Display prescription
Time Critical Condition: upon need
Name of Other IC: Doctor
Message to Other IC: None
Other IC's Task: Write the prescription
Card 1of 1 (If necessary please use several IC cards to describe an IC)