# Dr. UML

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Homework #6

# 1 Change History

## 1.1 HW1

- Add section Problem statement.
- Add section Development Language.

## 1.2 HW2

- Add section 3-8.
- Change section ”Development Language” to ”Software Environments” as demanded.
- Change the project name to ”Dr. UML”.

## 1.3 HW3

- Add section 9(Domain Model).
- Merge UC7(Host Session) and UC8(Join Session).
- Change Acronyms for System Features into FEA.

## 1.4 HW4

- Extract UC01-extension *b to UC09.
- Refine pre-condition of UC01.
- Use case
  - Remove extension ”3.a If User connects Gadget to nothing, a default Gadget will be generated automatically.” in UC01.
- Domain Model
  - Add Timer and Verifier and their associates.
  - Add zIndex attribute to Components.
- Add Logical architecture
- Add System Sequence Diagrams with GRASP Patterns
- Add Design Class Model

### 1.5 hw6

- Update Figure
  - Domain model with associations
  - Domain model with associations and attributes
- Use case
  - UC01
    - In Main Success Scenario step 1, Change the wording from "drag" to "select".
    - Replace "1-4 steps can be repeated" in the Main Success Scenario with "User can skip any step from 1 to 4" in the Extension.
    - Remove extension 4.d.

## 2 Problem statement

There are several tools available for creating UML diagrams on the internet but many of them come with paid subscriptions or limitations that make them less accessible. Moreover, they often resort to creating poorly formatted documents due to the lack of affordable, high-quality options. As the result, we propose Dr. UML.

Dr. UML is an innovative collaborative platform designed for software developers, system architects, and students who need to efficiently create and manage Unified Modeling Language (UML) diagrams.

The tool meets the pressing need for collaborative designing by allowing teams to work together simultaneously, regardless of their physical location. In addition, it offers real-time updates and integrated communication features. Dr. UML will be used primarily in design meetings, brainstorming sessions, and technical workshops where immediate visual feedback is essential. It is needed when precise and dynamic visual representation of complex systems is required to align team understanding and streamline development processes.

Dr. UML integrates a robust set of customizable UML elements with drag-and-drop functionality and real-time collaboration. This not only enhances the creative aspects of system design but also ensures that technical requirements are met with precision and clarity. The platform's intuitive design and collaborative capabilities make it an essential tool for modern software development teams, system architects, and students aiming to create high-quality UML diagrams efficiently.

## 3 Summary of System Features

- FEA01: Create a UML diagram file.

- FEA02: Edit a UML diagram(draw, edit Component properties, copy and paste Components)
- FEA03: Save and load progress.
- FEA04: Export UML diagram into image formats.
- FEA05: Start a online Session, allowing other Users to join.
- FEA06: Connect to online Sessions, edit UML with other users simultaneously.
- FEA07: Real-time chatroom in a online Session.

## 4 Use Case Diagram

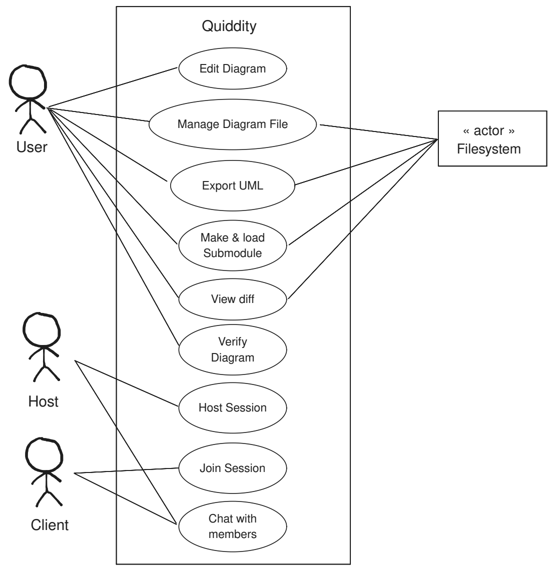


Figure 1: Use case diagram

## 5 Use Cases

### 5.1 UC01: Edit UML

- **Scope**: Dr. UML
- **Level**: User goal
- **Primary Actor**: User
- **Stakeholders and Interests**:
  - **User**: Wants to create and connect Components.

- **Preconditions**:
  - User has opened a UML Project.
  - At least one UML Diagram is opened.
  - UML Editing Canvas and Toolbox are loaded.
- **Success Guarantee**: UML is edited according to the User's specifications.
- **Main Success Scenario**:
  1. User selects Gadgets from Toolbox.
  2. User edits the Gadgets.
  3. User establishes connections between Gadgets via Associations.
  4. User modifies the Associations as needed.
- **Extensions**:
  - *a In the event of System failure, User restarts System. UML will revert to the last successfully saved state.
  - *b When editing text, User may design their text as desired(See UC09)
  - *c User may select Gadgets within the canvas.
  - *d When User drags Gadget with multiple Associations, System will automatically update them.
  - *e User can determine the layering order when Gadgets overlap.
  - *f User may copy and paste Components.
    1. Copying or pasting Associations will also include connected Gadgets.
  - *g User may undo or redo actions.
  - *h User can skip any step from 1 to 4
  - 1.a Edit fails if Gadget is dragged to an invalid location.
  - 1.b User can also import an available Submodule in the current Project.
  - 2.a Different types of Gadgets will have distinct Fields available for editing.
  - 2.b Edited Gadgets will automatically scale to fit the changes.
  - 2.c User can modify the color of a Gadget. The color will apply to Gadget's background.
  - 2.d User can move the Gadget as long as the destination is valid. The associations will be updated automatically.
  - 3.a Deleting a Gadget will also remove the associated connections.
  - 3.b Self-Associations are allowed.
  - 4.a User may change the type of Association.
  - 4.b User may add, remove, and move text Fields in Association.

  - 4.d When multiple Associations are created between two Gadgets, System will automatically distinguish the different paths to prevent overlap.
  - 4.d User can modify the path of an Association.
- **Special Requirements**:
  - When multiple users are editing, no unintended behavior should occur.
- **Frequency of Occurrence**: Often
- **Open Issues**: None specified

## 5.2 UC02: Manage UML

- **Scope**: Dr. UML
- **Level**: User goal
- **Primary Actor**: User
- **Stakeholders and Interests**:
  - **User**: Wants to create, save, export, delete a Diagram.
  - **Filesystem**: Requires the file to be read/saved properly.
- **Preconditions**:
  - System is up.
- **Success Guarantee**:
  - User manage Project and Diagram.
- **Main Success Scenario**:
  1. User selects existing Project.
  2. User selects Diagram in the Project.
  3. User edit Diagram as described in UC1.
  4. User exports Diagram to Filesystem.
  5. User deletes the Diagram.
- **Extensions**:
  - *a In both Project and Diagram, the time of last edit is recorded and can be viewed by User.
  - *b If System fails manage (load, save, and export) Project or Diagram, User will be prompted to either retry the operation or abort.
  - 1.a User may choose to create a new Project.
  - 1.b User can modify the name of the Project.

  - 2.a User may choose to create a new Diagram.
  - 3.a User can modify the type, background color, filename of the Diagram.
  - 4.b When exporting Diagram, User may select one of the supported UML formats (for future verification purposes).

- **Frequency of Occurrence**: Occasionally

- **Open Issues**: None specified

## 5.3 UC03: Export UML

- **Scope**: Dr. UML

- **Level**: User goal

- **Primary Actor**: User

- **Stakeholders and Interests**:
  - **User**: Wants to export UML-Project to image formats with desired name and extension.
  - **Filesystem**: Requires the exported image to be saved properly.

- **Preconditions**:
  - System is up.
  - User has opened a UML project.

- **Success Guarantee**: Exported image is saved to Filesystem.

- **Main Success Scenario**:
  1. User starts the exporting current UML.
  2. User selects a supported image format and specifies a filename.
  3. System saves the exported image to Filesystem.

- **Extensions**:
  - 2.a Supported formats:
    * JPEG
    * PNG
    * SVG
    * WebP
  - 3.a If Filesystem fails to save the exported image, User will be prompted to either retry the operation or abort.

- **Frequency of Occurrence**: Occasionally

- **Open Issues**: None specified

## 5.4 UC04: Manage Submodule

- **Scope**: Dr. UML
- **Level**: User goal
- **Primary Actor**: User
- **Stakeholders and Interests**:
  - **User**
    - Imports Submodule to UML Project, which can be included it to any UML Diagram in the Project.
    - Removes any imported Submodule(s) from UML Project
    - Exports a part of components to a Submodule and save it to Filesystem.
  - **Filesystem**: Wants to save and load a Submodule file.
- **Preconditions**:
  - System is up.
  - User has opened a UML-Project.
  - For exporting Submodule, User is also required to open a UML Diagram and have a number of Component drawn.
- **Success Guarantee**:
  - Submodule is exported on Filesystem.
  - Submodule is imported to UML-Project.
- **Main Success Scenario**:
  1. User imports a Submodule file from Filesystem.
  2. From the Project menu, User select a outdated Submodule and remove it.
  3. After drawing a number of Component, User selects and export them as a Submodule.
  4. The Submodule file is saved to Filesystem.
- **Extensions**:
  - 1.a If Filesystem fails to import Submodule, User will be prompted to either retry the operation or abort.
  - 3.a If nothing is selected, User cannot export it as Submodule.
  - 3.b Optionally, the saved Submodule may have empty Fields.
  - 4.a If Filesystem fails to save Submodule file, User will be prompted to either retry the operation or abort.
- **Frequency of Occurrence**: Sometimes
- **Open Issues**: None specified

## 5.5 UC05: Verify UML

- **Scope**: Dr. UML
- **Level**: User goal
- **Primary Actor**: User
- **Stakeholders and Interests**:
  - **User**: Wants to verify the correctness of UML.
- **Preconditions**:
  - System is up.
  - A UML is available.
- **Success Guarantee**: System verifies and displays the correctness of the UML diagram.
- **Main Success Scenario**:
  1. User opens a UML project.
  2. User instructs System to verify the UML.
  3. System checks the correctness of the UML.
  4. System displays the verification results.
- **Extensions**:
  - 1.a If System fails to open the UML file, User will be prompted to either retry the operation or abort.
  - 3.a If System fails to verify the UML, User will be prompted to either retry the operation or abort.
  - 3.b System verifies the UML by diagram type.
    1. If the UML type verification is unavailable, inform the User.
  - 4.a If System fails to display result, User will be prompted to either retry the operation or abort.
  - 4.b System informs User of verification results, which may include:
    1. All clear, UML is correct in terms of diagram type.
    2. Warnings, UML is mostly free of syntax errors, but contains some bad smells™.
    3. Invalid, UML contains critical errors.
- **Special Requirements**:
  - Error messages should be user-friendly and provide actionable insights.
- **Technology**:
- **Frequency of Occurrence**: Sometimes
- **Open Issues**: None specified

## 5.6 UC06: Join Session

- **Scope**: Dr. UML
- **Level**: User goal
- **Primary Actor**: Client
- **Stakeholders and Interests**:
  - **Host**: Wants Client to join current opened project.
  - **Client**: Wants to connect to an existing project.
- **Preconditions**:
  - System is up.
  - A stable connection exists between Host and Client.
  - Host opened a UML project.
- **Success Guarantee**: Connection is established and maintained, UML is synced, and no conflicts occur.
- **Main Success Scenario**:
  1. Host starts a Session.
  2. Client connects to the Session.
  3. Both Host and Client edit the UML as described in UC1.
  4. Step 3 is repeated until UML is complete.
  5. Host ends the Session.
- **Extensions**:
  - *a User may opens a session for a project. Assuming the role of Host.
  - *b At any time, a Component can only be edited by exactly one User.
  - 2.a If a connection error occurs, notify Client of the issue encountered.
  - 3-4.a Host can remove any Client from the Session.
  - 3-4.b If an action fails to send, the System retries the action.
    1. If retry limit is reached, System will remove that Client from current Session.
  - 3-4.c Clients may redo and undo their own edits.
  - 5.a Session ends if Host closes it, whether intentionally or unintentionally.
- **Frequency of Occurrence**: Sometimes
- **Open Issues**: Undo/redo conflicts

## 5.7 UC07: Chat with Members

- **Scope**: Dr. UML
- **Level**: User goal
- **Primary Actor**: User
- **Stakeholders and Interests**:
  - **User**: Wants to communicate with other users in Session via text messages.
- **Preconditions**:
  - System is up.
  - Users have joined a Session.
- **Success Guarantee**:
  - Users in Session can communicate with each other with text messages.
  - Users in Session can view chat history.
- **Main Success Scenario**:
  1. User opens the chatroom for current Session.
  2. User views chat history.
  3. User types and sends messages.
- **Extensions**:
  - *a The time of each sent message is recorded and can be viewed by User.
  - 1.a If a new Session is created, System creates a new chatroom with no messages.
  - 2.a If System fails to load the chatroom, it will attempt to retry.
    1. If retry limit is reached, notify User of the issue encountered. User will not be able to view the previous messages.
  - 3.a If System fails to send User's message, it prompts the User to either remove or resend the message.
- **Frequency of Occurrence**: Sometimes
- **Open Issues**: None specified

## 5.8 UC08: Edit Attribute of a Component

- **Scope**: Dr. UML
- **Level**: User goal
- **Primary Actor**: User
- **Stakeholders and Interests**:
  - **User**: Wants to edit Attributes of a existed Component.
- **Preconditions**:
  - A Component is created.
- **Success Guarantee**:
  - Attributes is edited according to the User's specifications.
- **Main Success Scenario**:
  1. User select a Component.
  2. User add a new Attribute into the Component.
  3. User select an Attribute.
  4. User change the size, font, type of the texts.
  5. Steps 1-3 are repeated in any order until the editing is complete.
- **Extensions**:
  - *a If a Component or Attribute is deselected during editing, System saves its current state.
  - 2.a User may select a exited Attribute instead of creating a new one.
  - 3.a After an Attribute is selected, User may also remove it from the Component.
  - 4.a Text type has these options:
    - Bold
    - Italic
    - Underline
- **Frequency of Occurrence**: Often
- **Open Issues**: None specified

# 6 Non-functional Requirements and Constraints

## 6.1 Performance Requirements

- **NFR1: Response Time**: Operations (e.g., dragging components, editing text, collaboration) should respond within **1s**.
- **NFR2: Concurrent Users**: The system should support at least **4 users** editing a UML diagram in real-time.
- **NFR3: File Handling**: Loading or saving UML files should take **less than 3 seconds** (for diagrams with 100+ elements).
- **NFR4: Export Speed**: UML diagrams should be converted to PNG, JPEG, SVG, or WebP formats within **5 seconds**.
- **NFR5: Network Efficiency**: Collaboration mode should minimize data traffic and prioritize critical updates to reduce bandwidth usage.

## 6.2 Usability Requirements

- **UR1: User-friendly Interface**: Users should be able to understand basic operations within **20 minutes**.
- **UR2: Undo/Redo**: The system should support **at least 50 levels** of undo and redo history.
- **UR3: Accessibility**: Keyboard shortcuts should be provided to enhance usability.
- **UR4: Collaboration Features**: Users should see real-time updates and be able to communicate via chat or annotations.

## 6.3 Reliability & Availability Requirements

- **RAR1: Uptime**: The system should maintain **99.9% availability**.
- **RAR2: Autosave**: Progress should be automatically saved every **30 seconds**.
- **RAR3: Error Handling**: The system should handle network failures gracefully, allowing users to reconnect without data loss.
- **RAR4: Data Consistency**: All users should see the same UML diagram state in collaborative mode.

# 7 Glossary

- Submodule: a part of UML diagram, it can be imported into other UML diagram
- Gadget: a block contains text Fields

- Toolbox: A bar containing Components, allowing Users to add them to the canvas.
- Association: connection between two Gadgets
- Field: the place where User can insert text
- Session: A shared project allowing other Users to collaborate.
- Component: Gadget or Association o the canvas.
- Host: A User who has started a Session.
- Client: A User who has joined a Session.
- User: A general term that refers to any participant, including both the Host and Client.
- Attribute: Property of a Components.
- Attribute Tree: A tree-like UI listing Attributes of a component.

## 8 Software Environments

Golang.

## 9 Domain model

### 9.1 Domain Class Diagram Showing Only Concepts

#### 9.1.1 Classes Identified

The nouns listed below are found in the use case.

Table 1: Classes Identified

| | | | | |
|---|---|---|---|---|
| *User | System | *UMLDiagram | Component | *Gadget |
| *Association | TextField | Path | UMLFile | Filesystem |
| *UMLProject | ImageFormat | Filename | *Submodule | Field |
| DiagramType | VerificationResult | Host | Client | *Session |
| Project | Connection | *Chatroom | *Message | ChatHistory |
| TextStyle | | | | |

Note: Classes marked with asterisk(*) are good classes.

### 9.1.2 Bad Classes

Table 2: Categorization of Terms

| Attributes | Super Class | Abstract Concepts | Implementation Construction | Too UI |
|---|---|---|---|---|
| TextField | Component | System | UMLFile | Toolbox |
| ImageFormat | | Host | Filesystem | Canvas |
| Filename | | Client | VerificationResult | |
| Field | | Project | ChatHistory | |
| DiagramType | | Connection | TextStyle | |
| position | | | | |
| fontSize | | | | |
| isBold | | | | |
| isItalic | | | | |
| isUnderline | | | | |

### 9.1.3 Good Classes

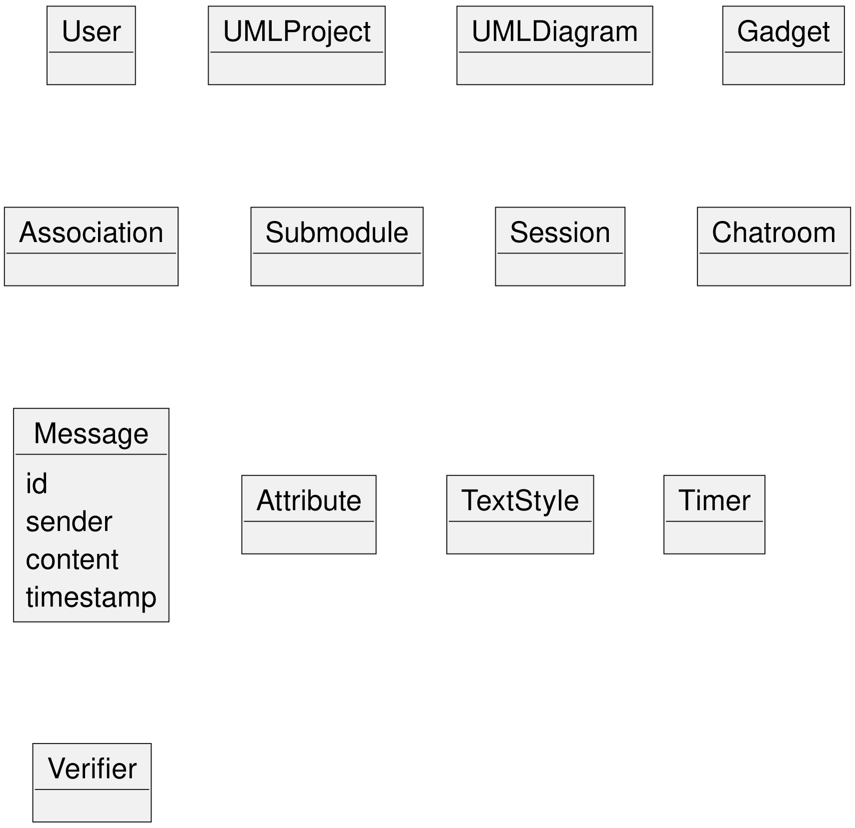


Figure 2: Domain class diagram showing only concepts

## 9.2 Add Associations

- One User hosts or joins several Sessions.

- One User manages one UMLProject.
- One UMLProject manages one UMLDiagram.
- One UMLDiagram consists of several Submodules.
- One Submodule consists of several Gadgets.
- One Gadget associates with one or two Associations.
- One Association contains several Attributes.
- One Attribute is described by one TextStyle.
- One Session connects to one Chatroom.
- One Chatroom contains several Messages.
- One User sends several Messages.

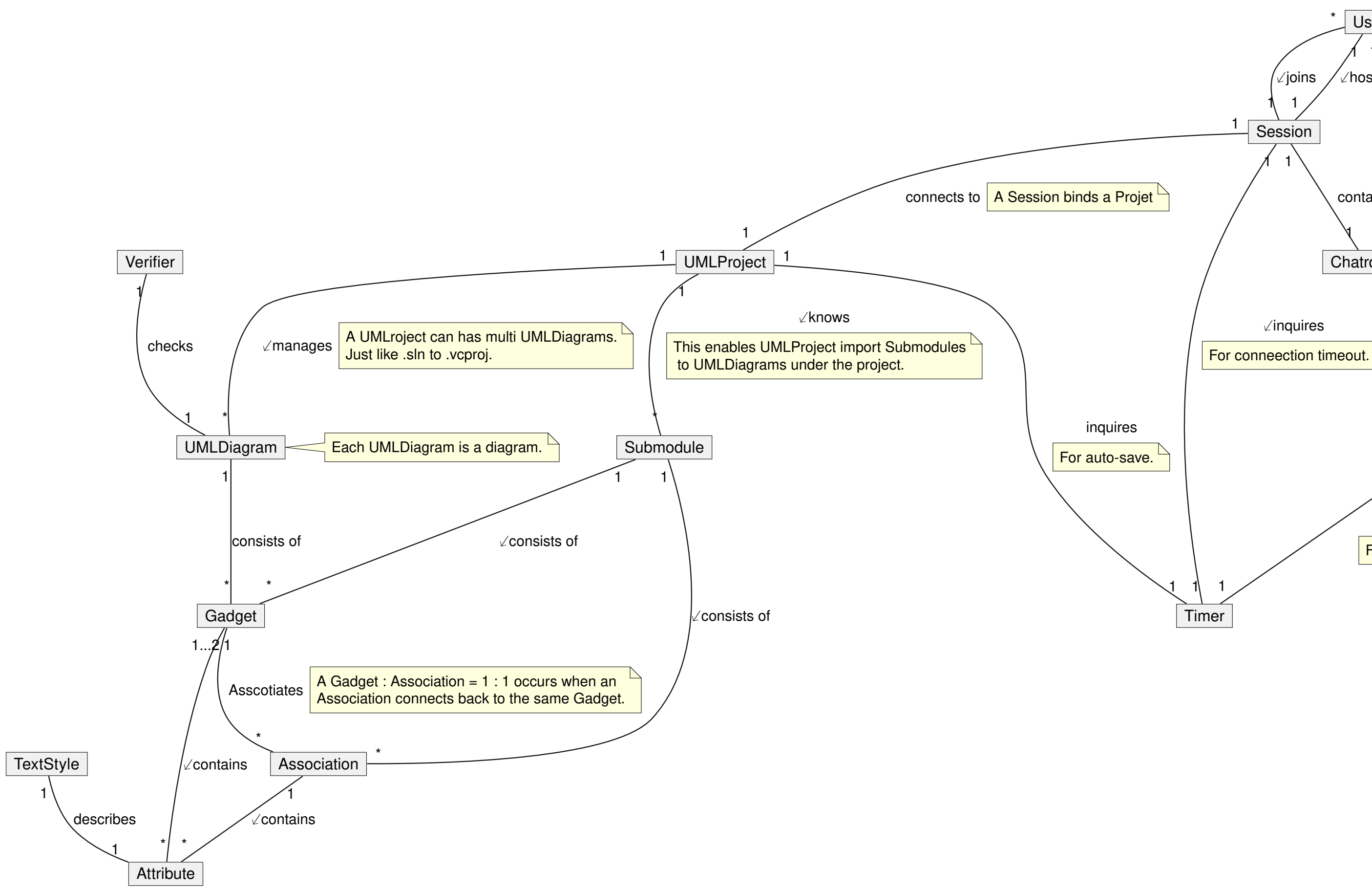


Figure 3: Domain class diagram with associations added

## 9.3 Add Attributes

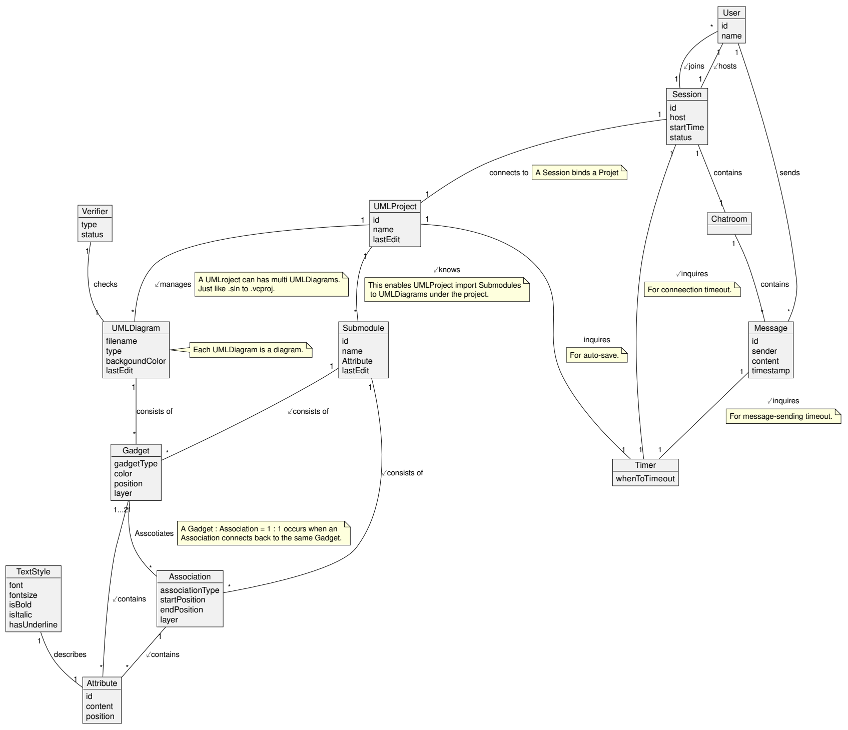


Figure 4: Domain class diagram with attributes added.

## 10 Logical Architecture

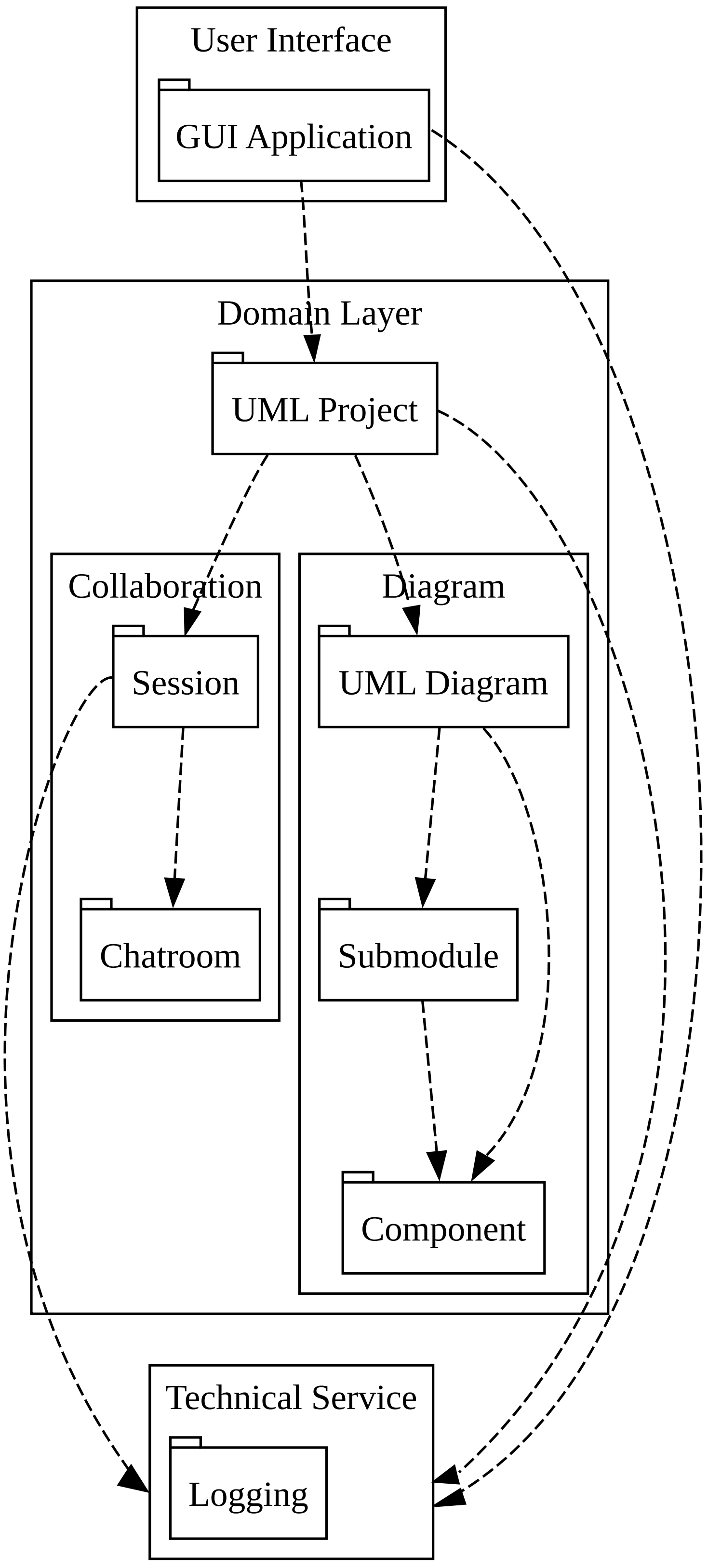


Figure 5: Logical architecture

## 11 System Sequence Diagrams with GRASP Patterns

We pick UC1 as our most significant use-case. Since UC1 is made of series of system events, we decide to provide SSDs for each one of them.

## 11.1 main SSD

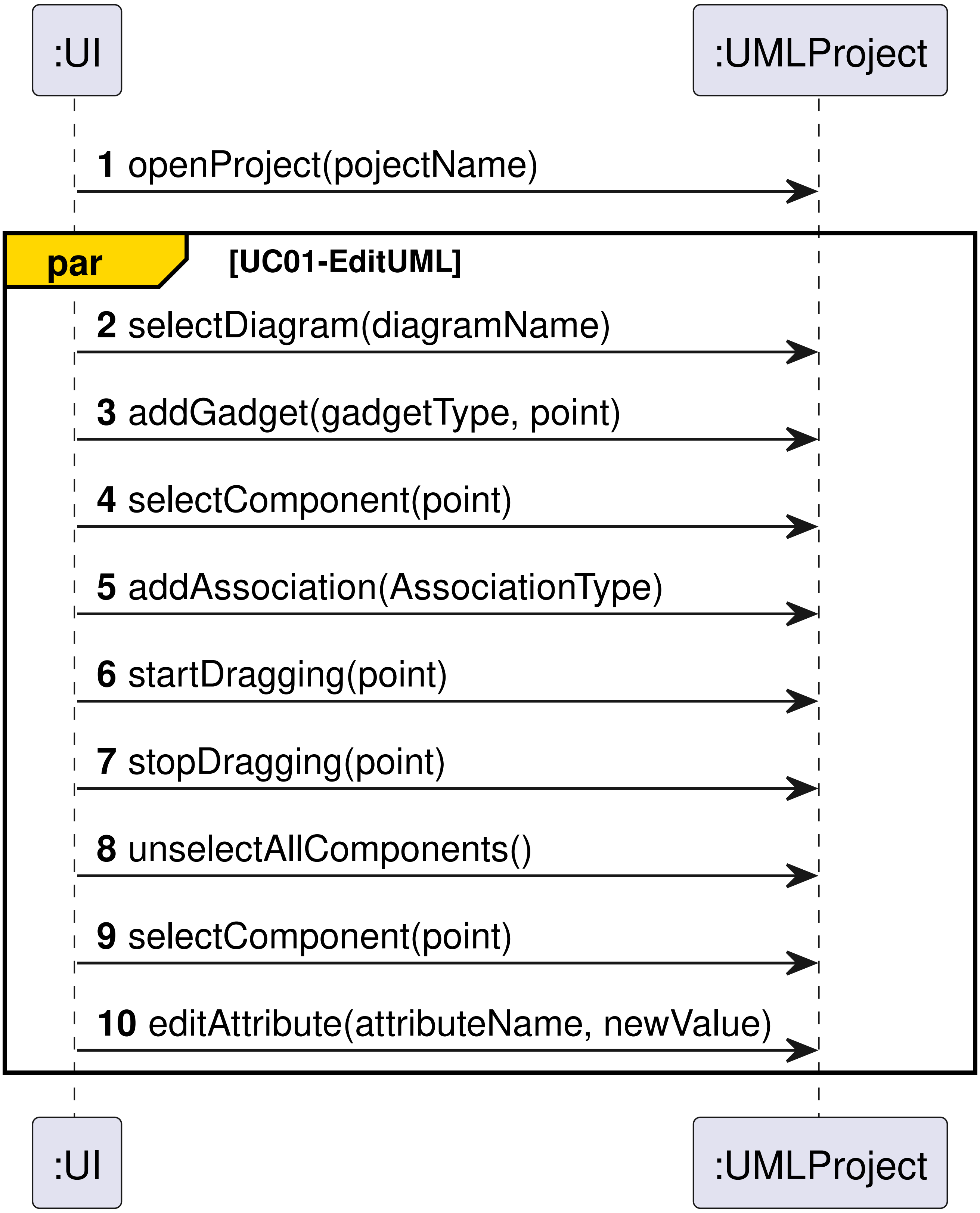

:UI
:UMLProject
1 openProject(pojectName)
par
[UC01-EditUML]
2 selectDiagram(diagramName)
3 addGadget(gadgetType, point)
4 selectComponent(point)
5 addAssociation(AssociationType)
6 startDragging(point)
7 stopDragging(point)
8 unselectAllComponents()
9 selectComponent(point)
10 editAttribute(attributeName, newValue)
:UI
:UMLProject

Figure 6: main SSD

## 11.2 addAssociationToDiagram

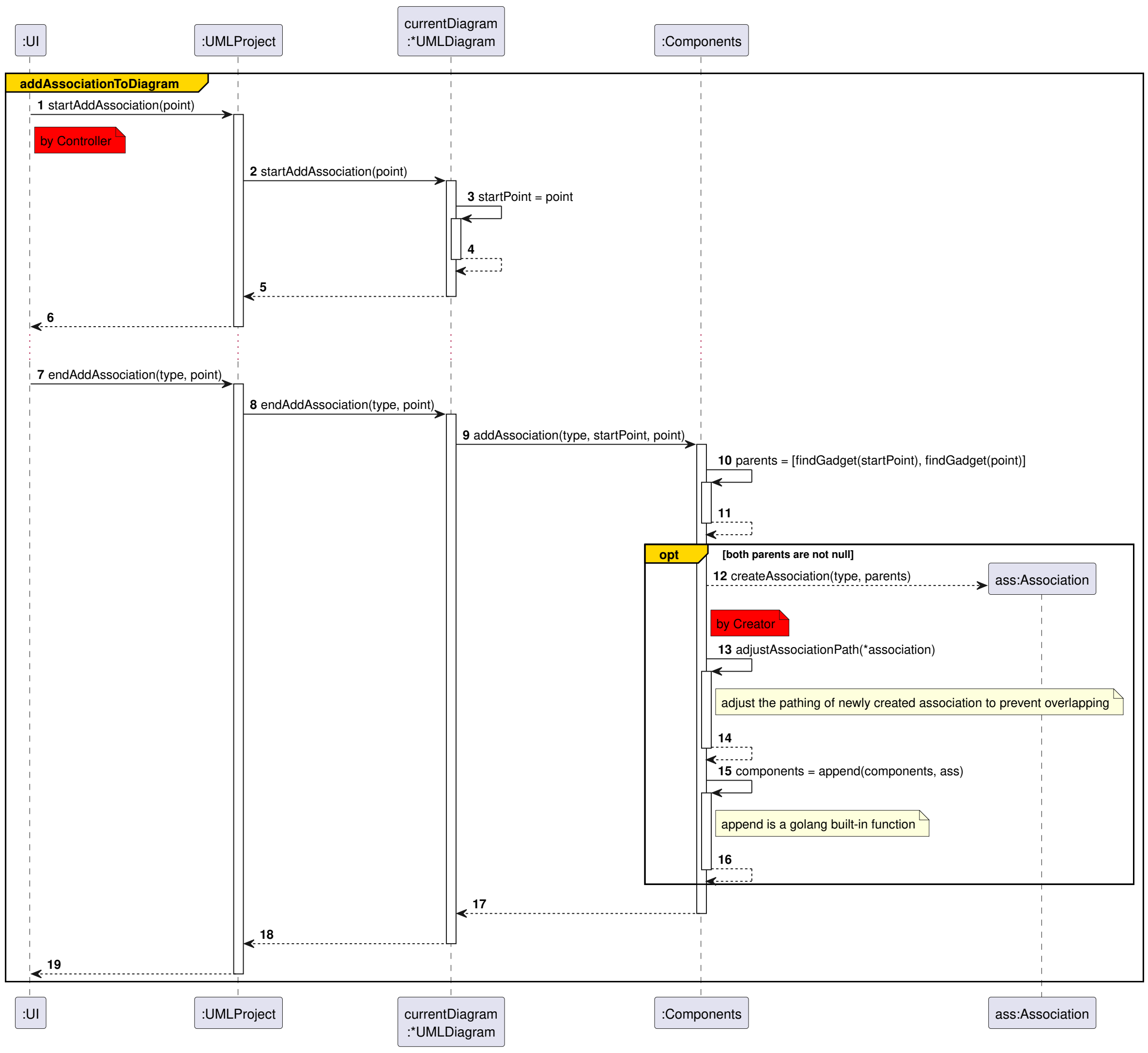

:UI
:UMLProject
currentDiagram :*UMLDiagram
:Components
ass:Association
addAssociationToDiagram
1 startAddAssociation(point)
by Controller
2 startAddAssociation(point)
3 startPoint = point
4
5
6
7 endAddAssociation(type, point)
8 endAddAssociation(type, point)
9 addAssociation(type, startPoint, point)
10 parents = [findGadget(startPoint), findGadget(point)]
11
opt
[both parents are not null]
12 createAssociation(type, parents)
by Creator
13 adjustAssociationPath(*association)
adjust the pathing of newly created association to prevent overlapping
14
15 components = append(components, ass)
append is a golang built-in function
16
17
18
19

Figure 7: addAssociationToDiagram

tt

## 11.3 addGadgetToDiagram

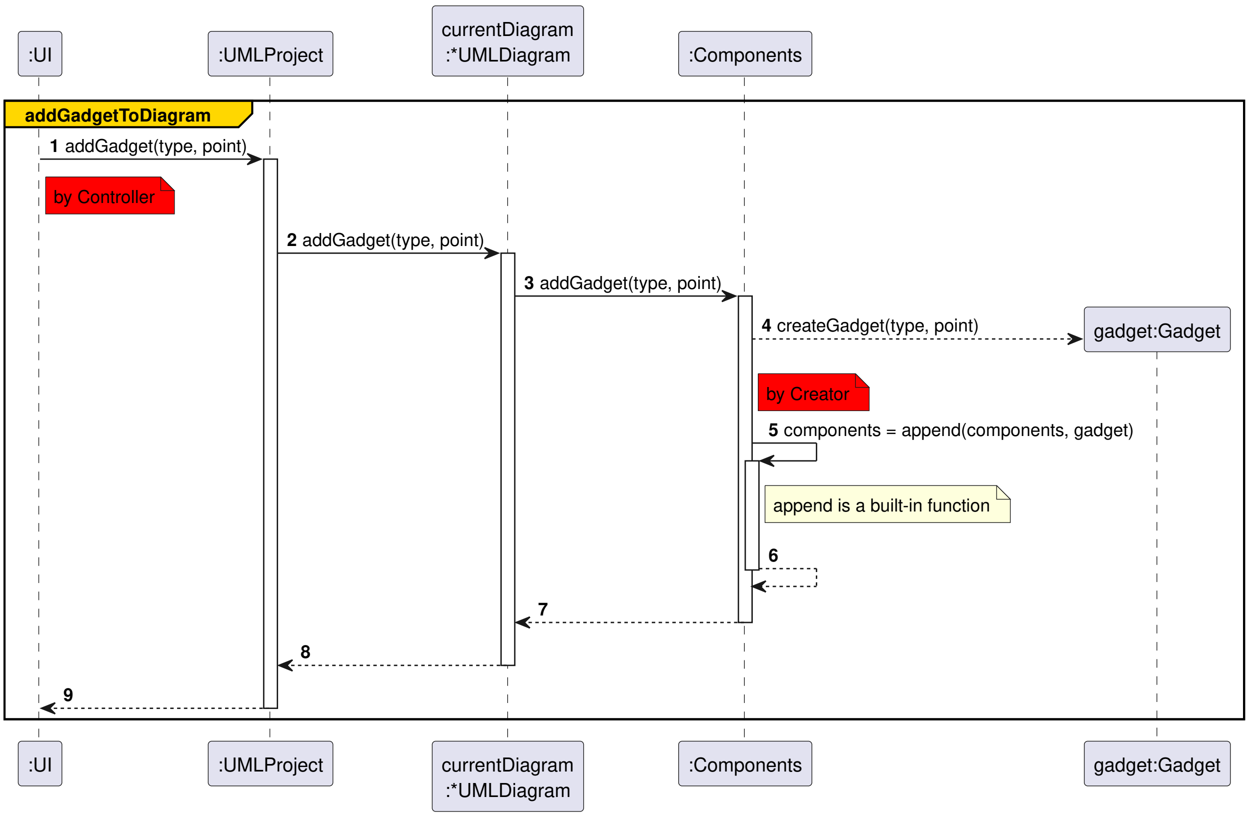


Figure 8: addGadgetToDiagram

## 11.4 copyComponents

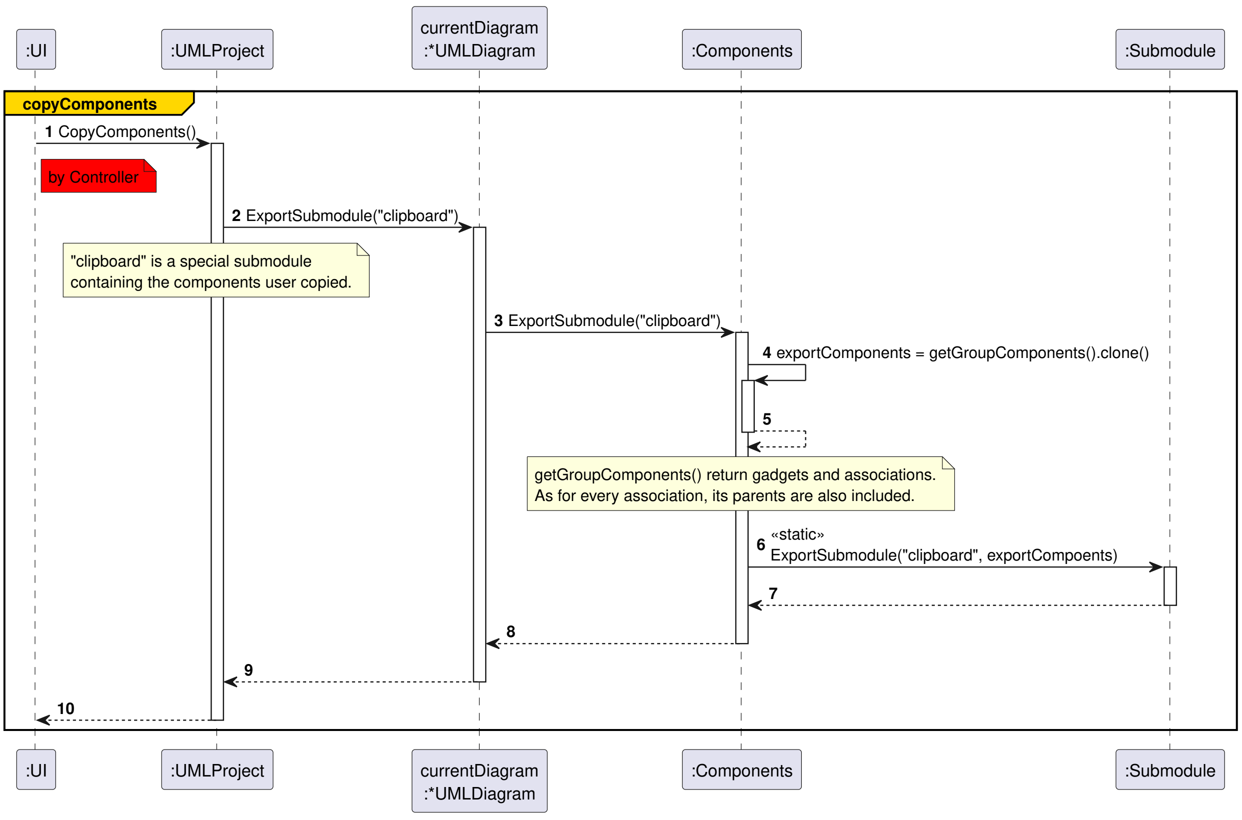

:UI
:UMLProject
currentDiagram :*UMLDiagram
:Components
:Submodule
copyComponents
1 CopyComponents()
by Controller
2 ExportSubmodule("clipboard")
"clipboard" is a special submodule containing the components user copied.
3 ExportSubmodule("clipboard")
4 exportComponents = getGroupComponents().clone()
5
getGroupComponents() return gadgets and associations. As for every association, its parents are also included.
6 «static» ExportSubmodule("clipboard", exportCompoents)
7
8
9
10

Figure 9: copyComponents

## 11.5 deleteComponent

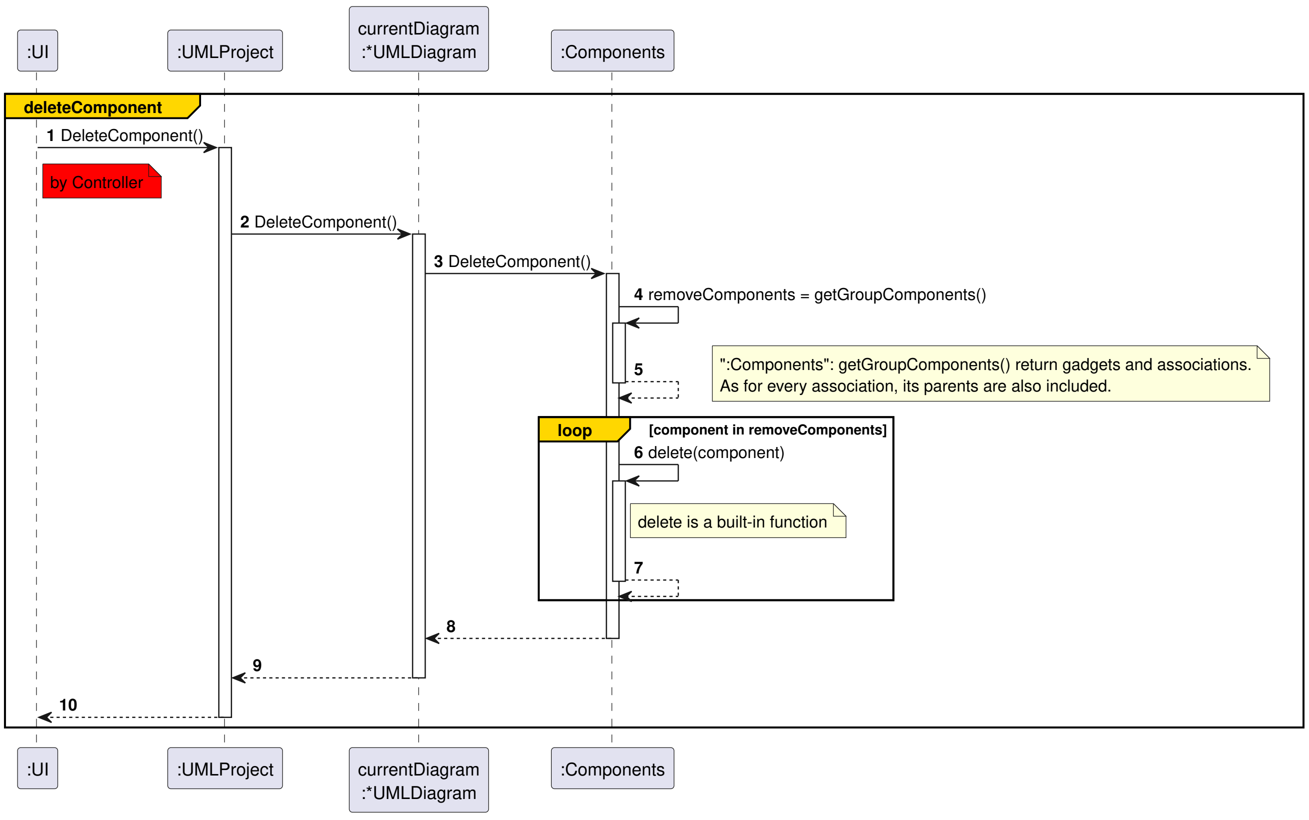

:UI
:UMLProject
currentDiagram :*UMLDiagram
:Components
deleteComponent
1 DeleteComponent()
by Controller
2 DeleteComponent()
3 DeleteComponent()
4 removeComponents = getGroupComponents()
5
":Components": getGroupComponents() return gadgets and associations. As for every association, its parents are also included.
loop
[component in removeComponents]
6 delete(component)
delete is a built-in function
7
8
9
10

Figure 10: deleteComponent

## 11.6 drawAll

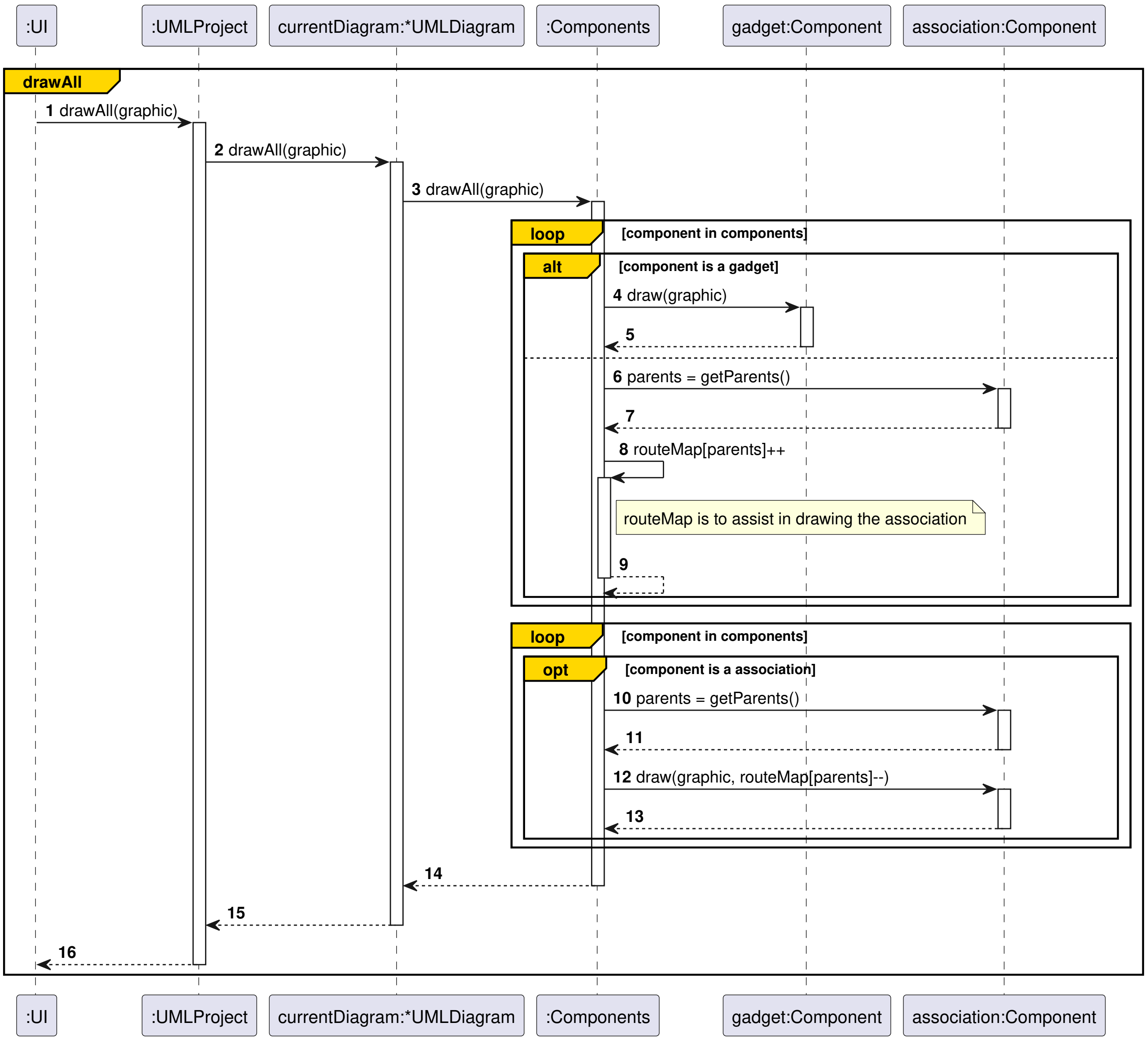


Figure 11: drawAll

## 11.7 importSubmodule

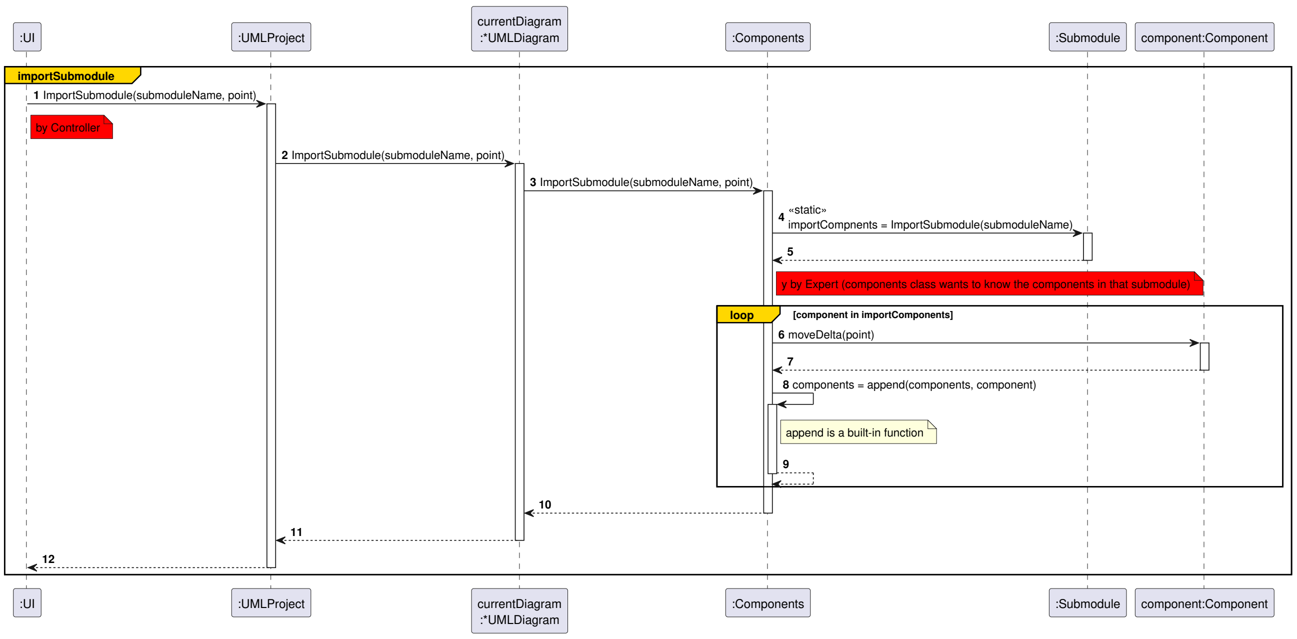

:UI
:UMLProject
currentDiagram :*UMLDiagram
:Components
:Submodule
component:Component
importSubmodule
1 ImportSubmodule(submoduleName, point)
by Controller
2 ImportSubmodule(submoduleName, point)
3 ImportSubmodule(submoduleName, point)
4 «static» importCompnents = ImportSubmodule(submoduleName)
5
y by Expert (components class wants to know the components in that submodule)
loop
[component in importComponents]
6 moveDelta(point)
7
8 components = append(components, component)
append is a built-in function
9
10
11
12

Figure 12: importSubmodule

## 11.8 moveComponent

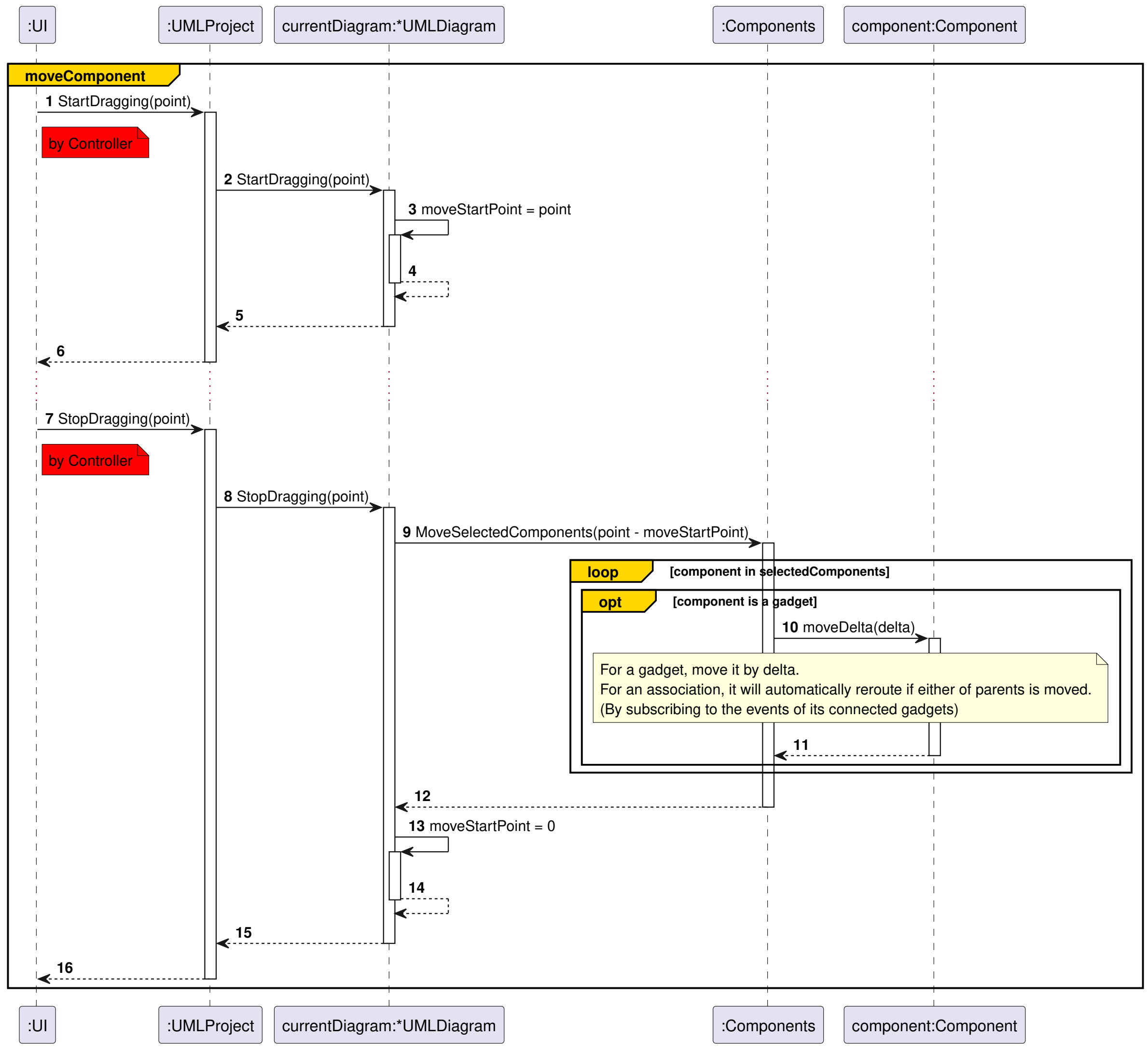

:UI
:UMLProject
currentDiagram:*UMLDiagram
:Components
component:Component
moveComponent
1 StartDragging(point)
by Controller
2 StartDragging(point)
3 moveStartPoint = point
4
5
6
7 StopDragging(point)
by Controller
8 StopDragging(point)
9 MoveSelectedComponents(point - moveStartPoint)
loop [component in selectedComponents]
opt [component is a gadget]
10 moveDelta(delta)
For a gadget, move it by delta.
For an association, it will automatically reroute if either of parents is moved.
(By subscribing to the events of its connected gadgets)
11
12
13 moveStartPoint = 0
14
15
16

Figure 13: moveComponent

## 11.9 openProject

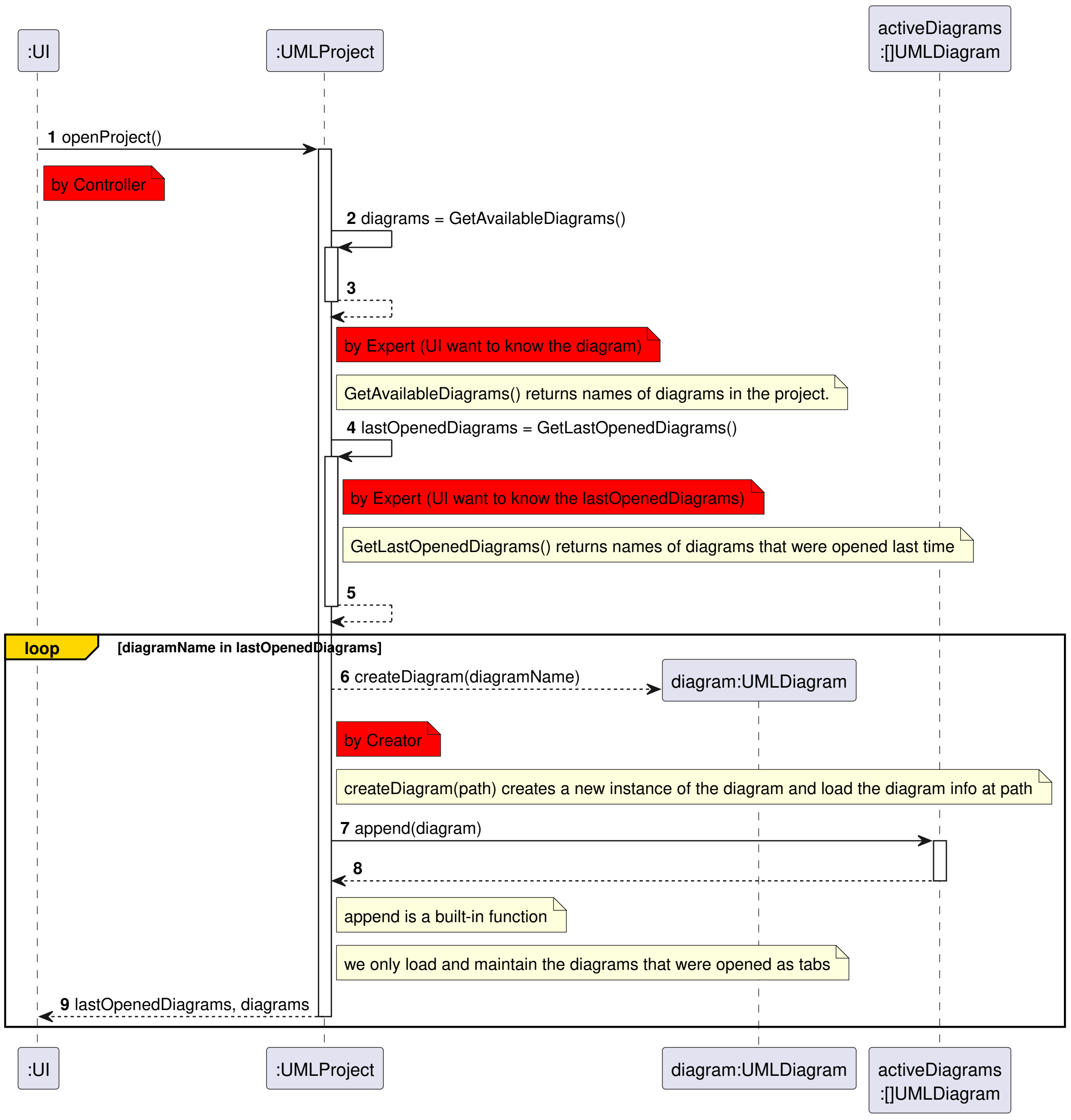

:UI
:UMLProject
activeDiagrams :[]UMLDiagram
1 openProject()
by Controller
2 diagrams = GetAvailableDiagrams()
3
by Expert (UI want to know the diagram)
GetAvailableDiagrams() returns names of diagrams in the project.
4 lastOpenedDiagrams = GetLastOpenedDiagrams()
by Expert (UI want to know the lastOpenedDiagrams)
GetLastOpenedDiagrams() returns names of diagrams that were opened last time
5
loop
[diagramName in lastOpenedDiagrams]
6 createDiagram(diagramName)
diagram:UMLDiagram
by Creator
createDiagram(path) creates a new instance of the diagram and load the diagram info at path
7 append(diagram)
8
append is a built-in function
we only load and maintain the diagrams that were opened as tabs
9 lastOpenedDiagrams, diagrams
:UI
:UMLProject
diagram:UMLDiagram
activeDiagrams :[]UMLDiagram

Figure 14: openProject

## 11.10 pasteComponents

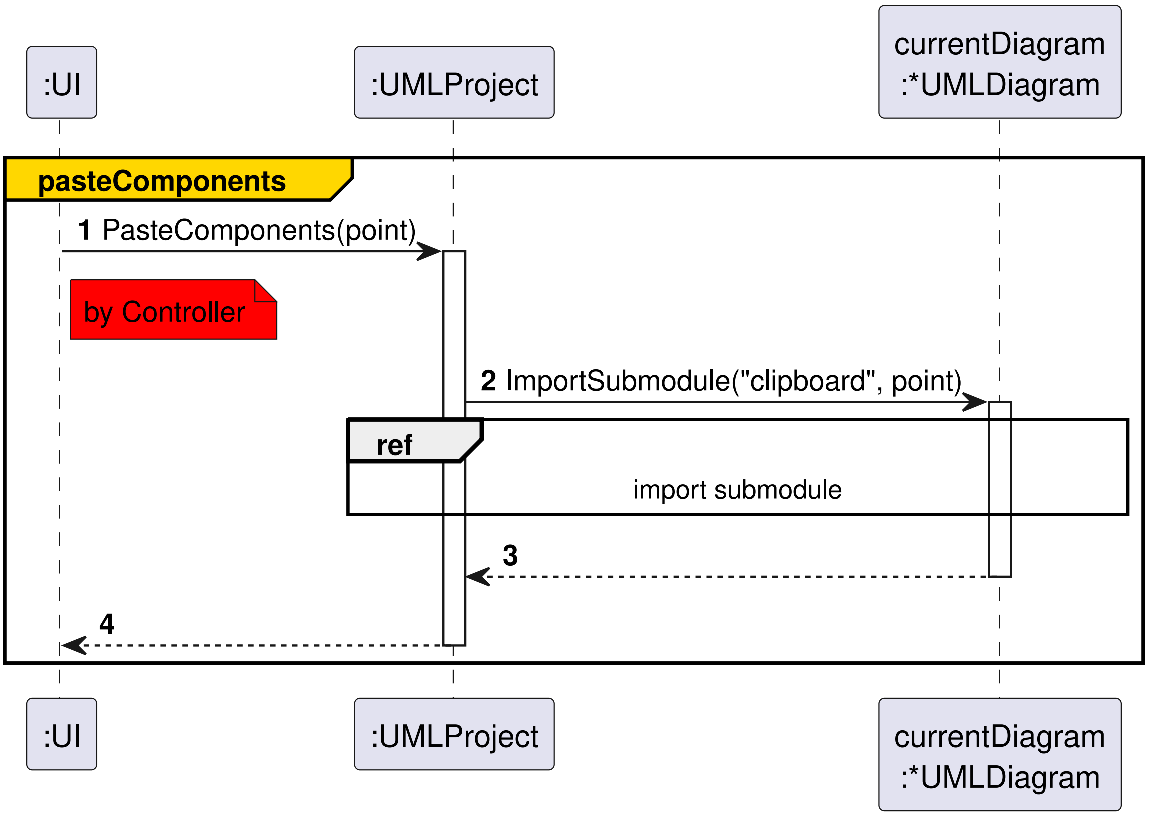
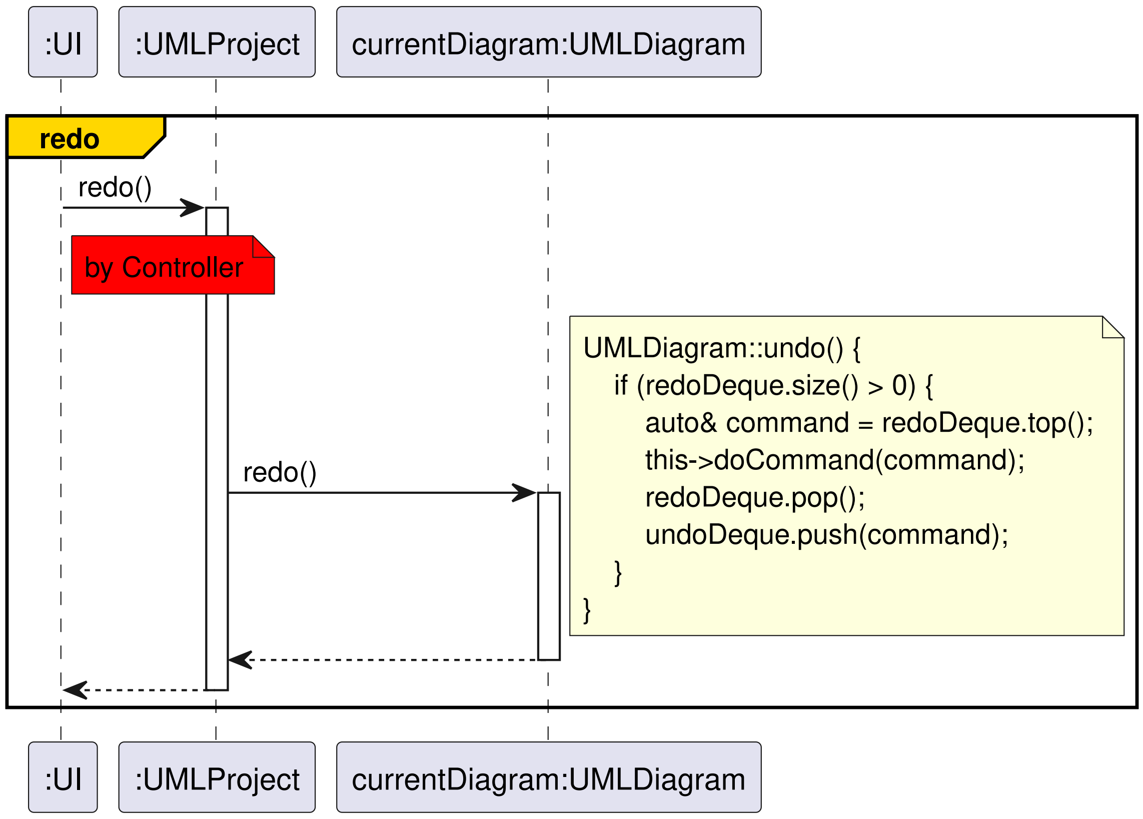


Figure 15: pasteComponents

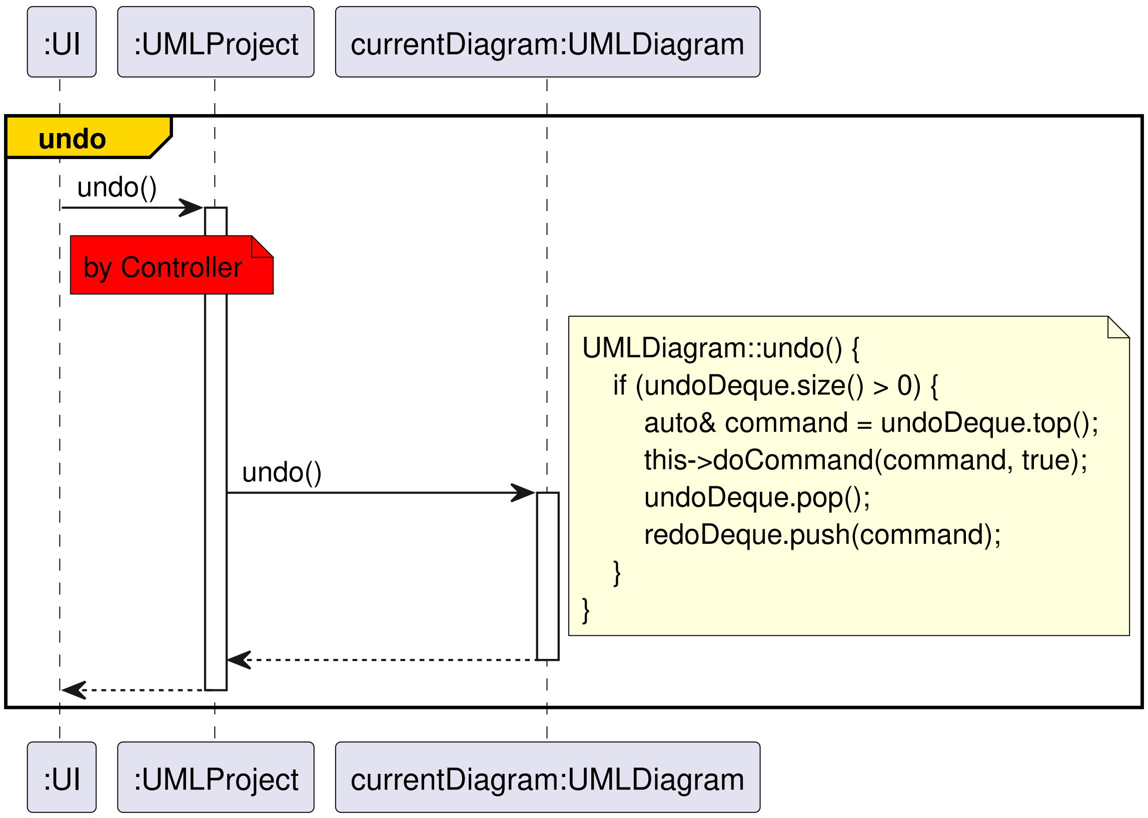
## 11.11 redo



```
UMLDiagram::undo() {
    if (redoDeque.size() > 0) {
        auto& command = redoDeque.top();
        this->doCommand(command);
        redoDeque.pop();
        undoDeque.push(command);
    }
}
```

Figure 16: redo

## 11.12 undo



```
UMLDiagram::undo() {
    if (undoDeque.size() > 0) {
        auto& command = undoDeque.top();
        this->doCommand(command, true);
        undoDeque.pop();
        redoDeque.push(command);
    }
}
```

Figure 17: undo

## 11.13 selectComponent

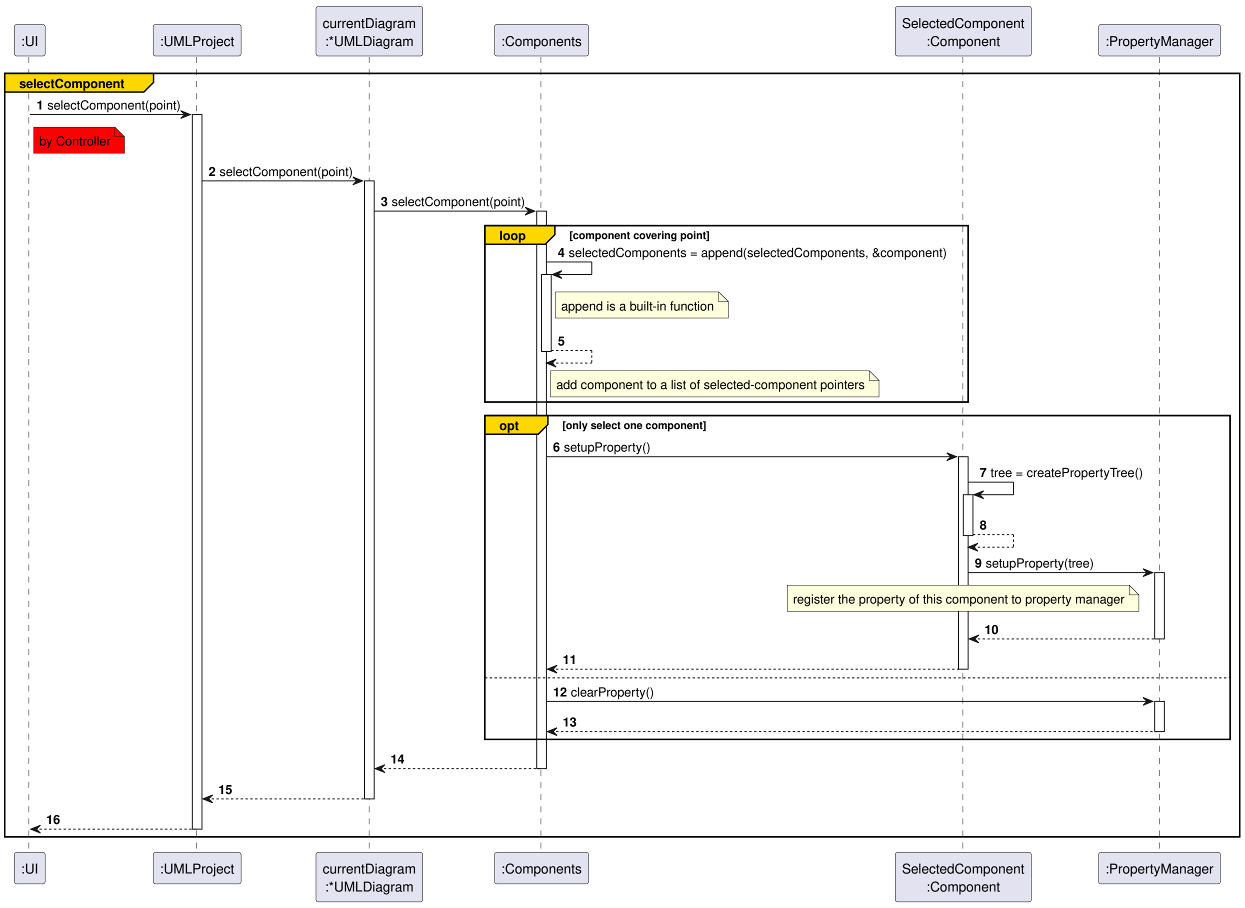

:UI
:UMLProject
currentDiagram :*UMLDiagram
:Components
SelectedComponent :Component
:PropertyManager
selectComponent
1 selectComponent(point)
by Controller
2 selectComponent(point)
3 selectComponent(point)
loop
[component covering point]
4 selectedComponents = append(selectedComponents, &component)
append is a built-in function
5
add component to a list of selected-component pointers
opt
[only select one component]
6 setupProperty()
7 tree = createPropertyTree()
8
9 setupProperty(tree)
register the property of this component to property manager
10
11
12 clearProperty()
13
14
15
16

Figure 18: selectComponent

## 11.14 selectDiagram

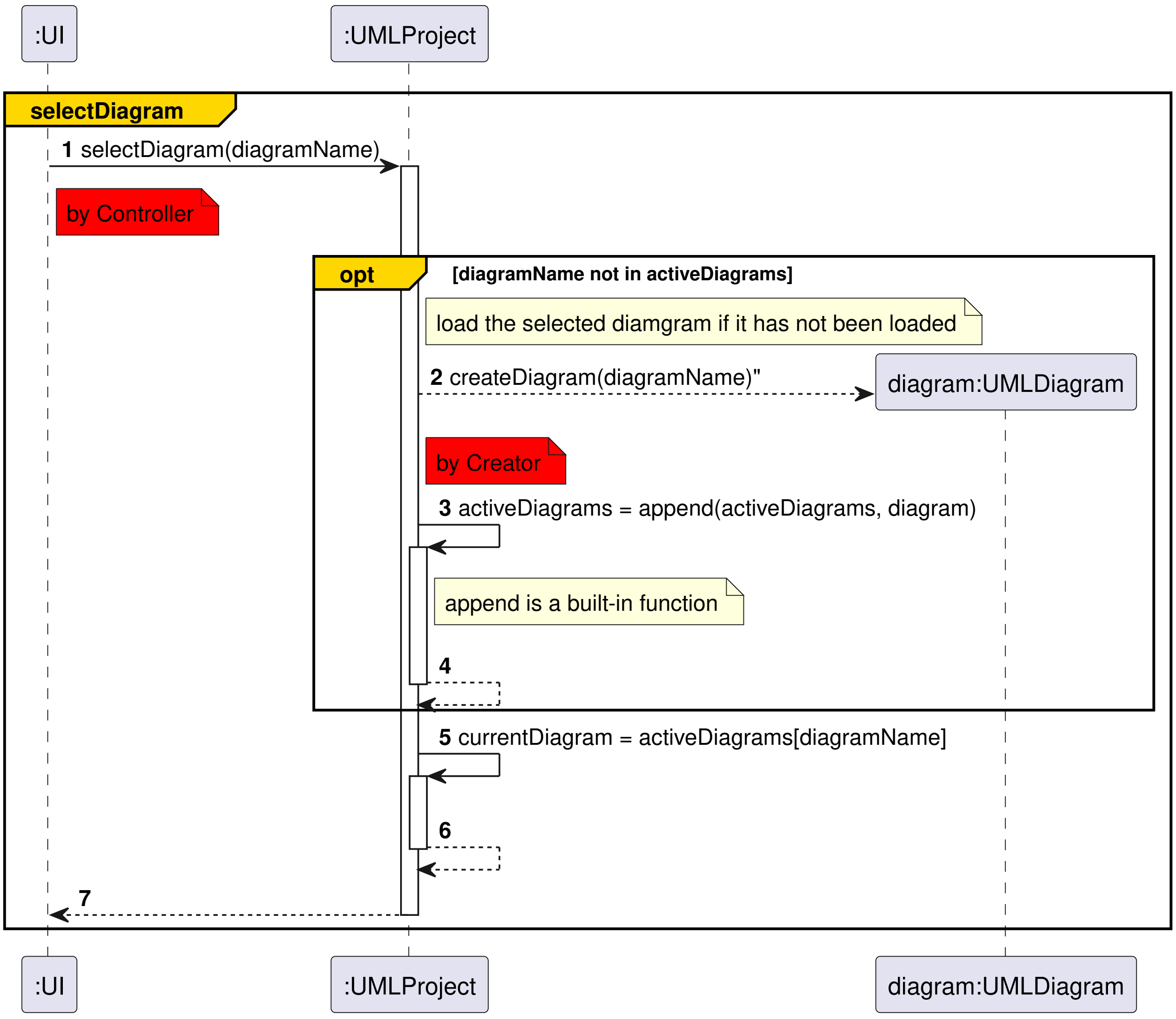

:UI
:UMLProject
selectDiagram
1 selectDiagram(diagramName)
by Controller
opt
[diagramName not in activeDiagrams]
load the selected diamgram if it has not been loaded
2 createDiagram(diagramName)"
diagram:UMLDiagram
by Creator
3 activeDiagrams = append(activeDiagrams, diagram)
append is a built-in function
4
5 currentDiagram = activeDiagrams[diagramName]
6
7
:UI
:UMLProject
diagram:UMLDiagram

Figure 19: selectDiagram

## 11.15 unselectAllComponents

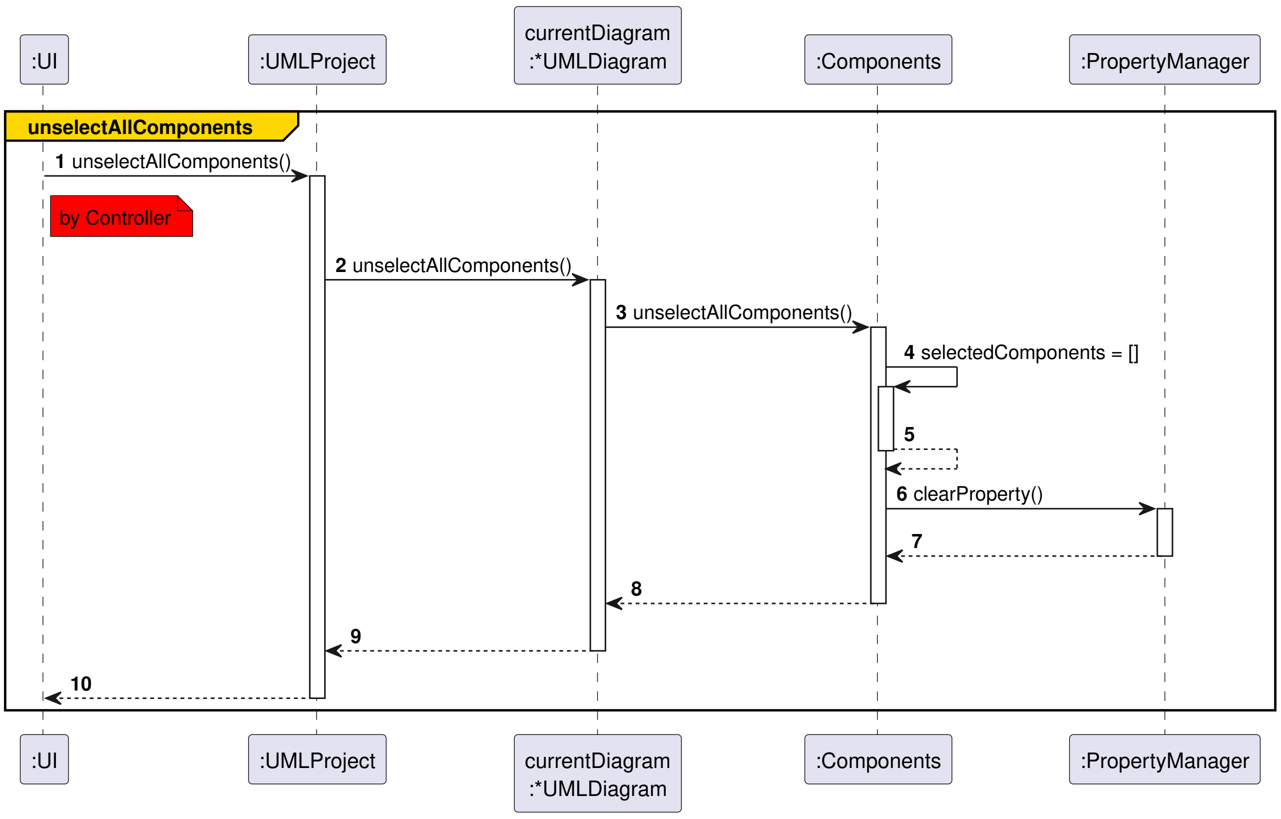

:UI
:UMLProject
currentDiagram :*UMLDiagram
:Components
:PropertyManager
unselectAllComponents
1 unselectAllComponents()
by Controller
2 unselectAllComponents()
3 unselectAllComponents()
4 selectedComponents = []
5
6 clearProperty()
7
8
9
10
:UI
:UMLProject
currentDiagram :*UMLDiagram
:Components
:PropertyManager

Figure 20: unselectAllComponents

## 11.16 unselectComponent

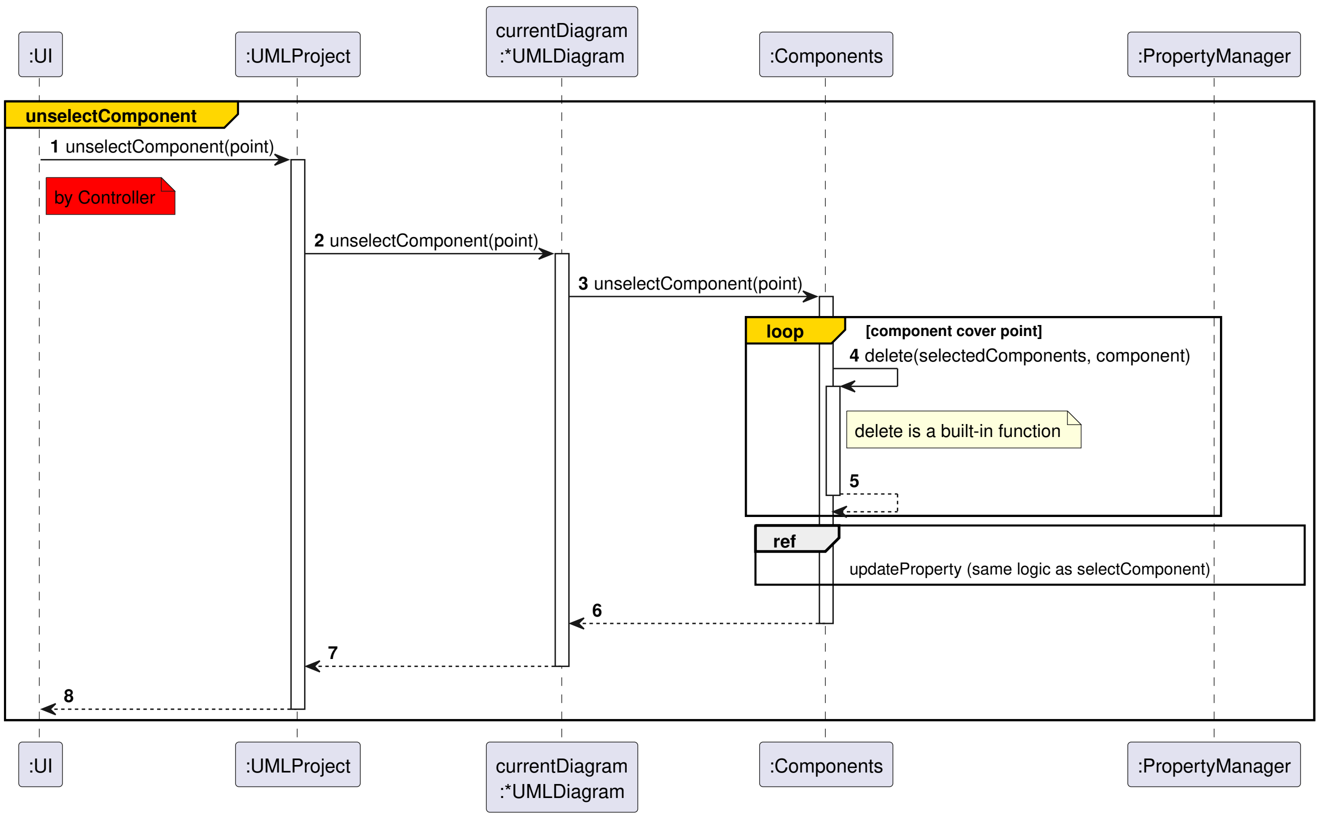

:UI
:UMLProject
currentDiagram :*UMLDiagram
:Components
:PropertyManager
unselectComponent
1 unselectComponent(point)
by Controller
2 unselectComponent(point)
3 unselectComponent(point)
loop
[component cover point]
4 delete(selectedComponents, component)
delete is a built-in function
5
ref
updateProperty (same logic as selectComponent)
6
7
8

Figure 21: unselectComponent

## 11.17 updateProperty

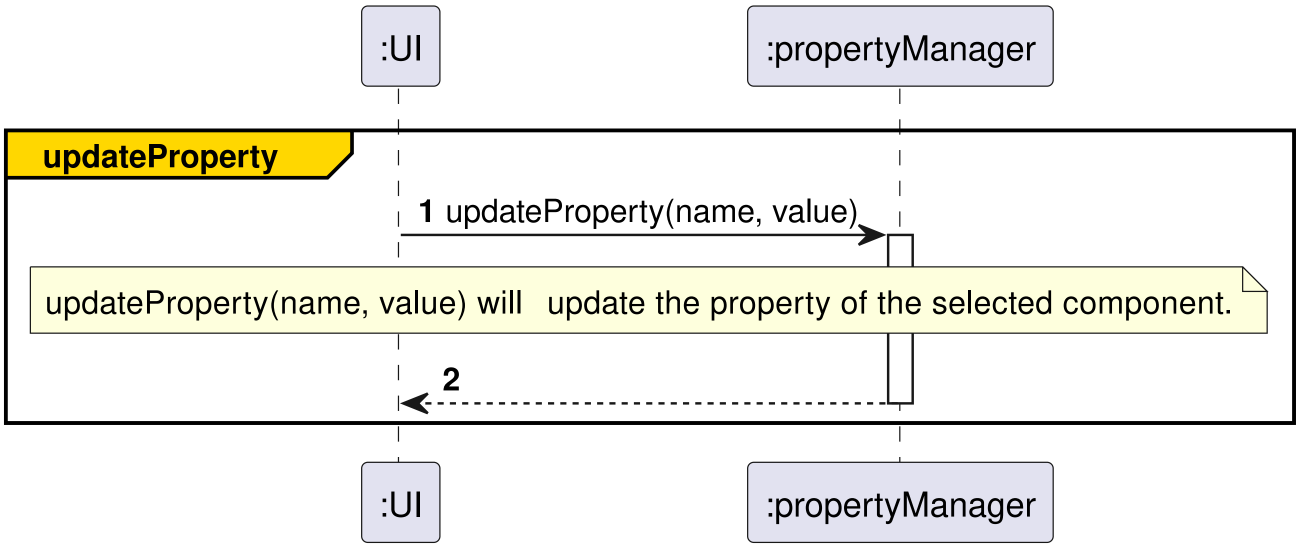

:UI
:propertyManager
updateProperty
1 updateProperty(name, value)
updateProperty(name, value) will update the property of the selected component.
2

Figure 22: updateProperty

# 12 Design Class Model

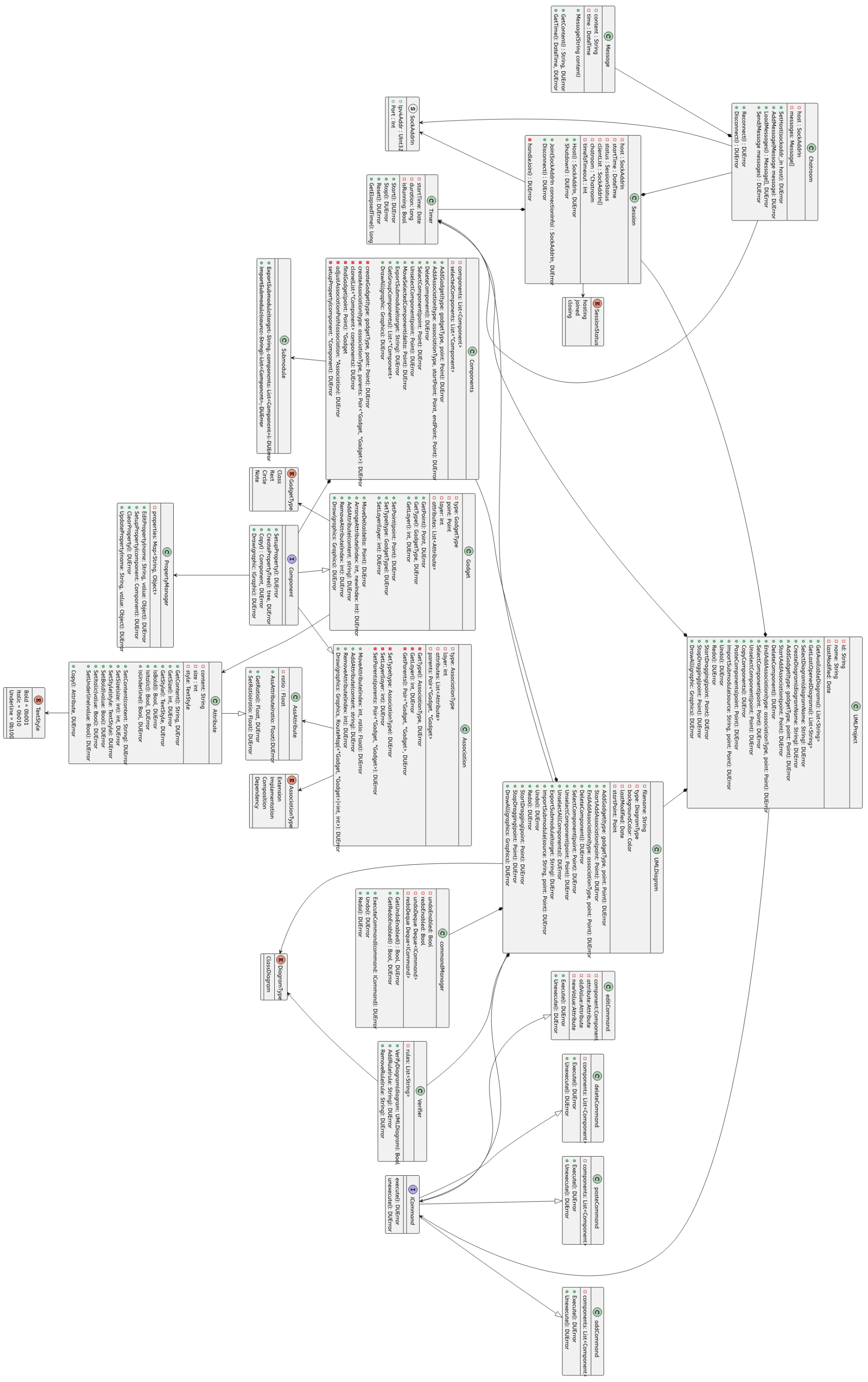


Figure 23: Design Class Diagram

# 13 Implementation Class Model

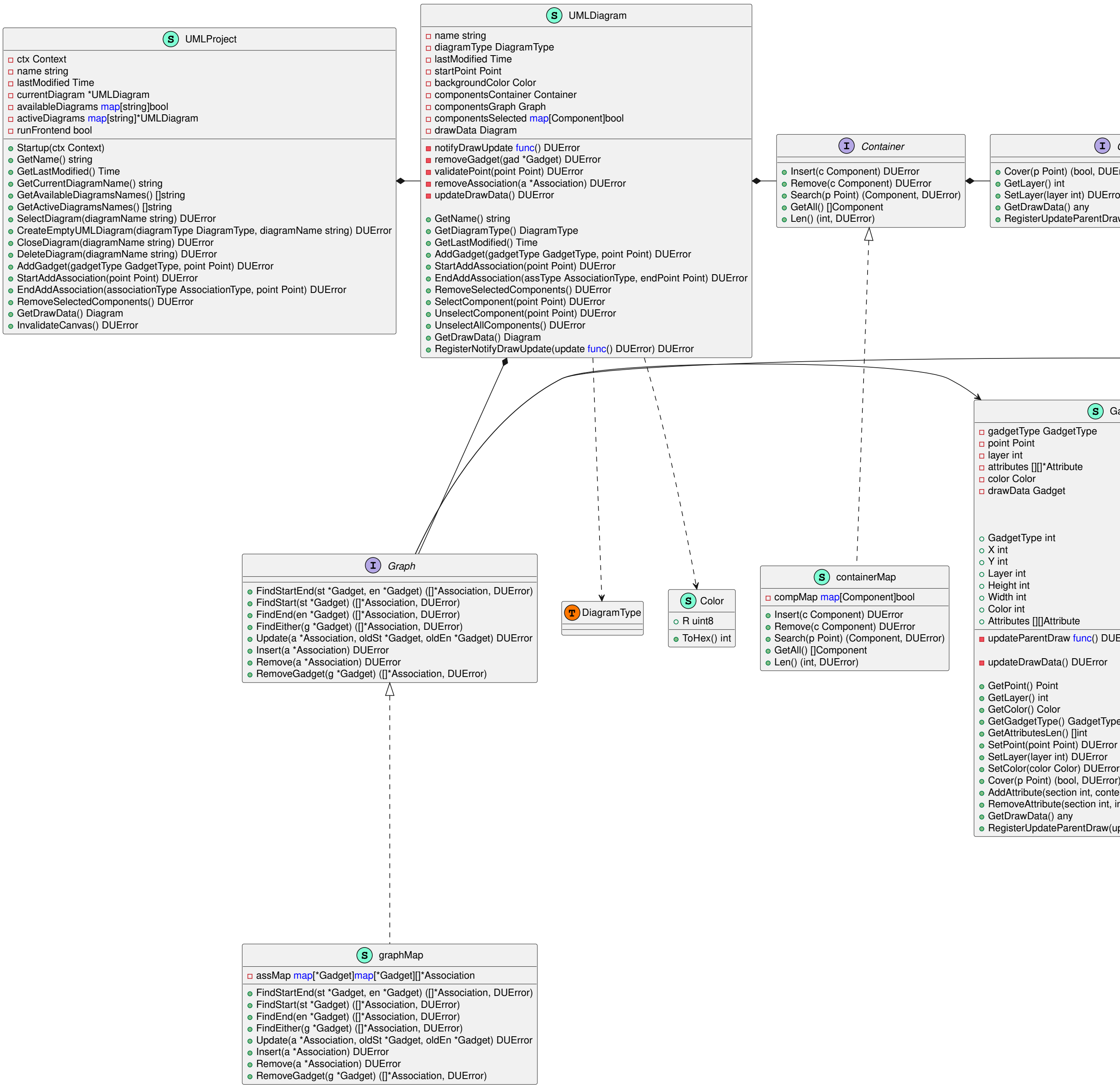

UMLProject
ctx Context
name string
lastModified Time
currentDiagram *UMLDiagram
availableDiagrams map[string]bool
activeDiagrams map[string]*UMLDiagram
runFrontend bool
Startup(ctx Context)
GetName() string
GetLastModified() Time
GetCurrentDiagramName() string
GetAvailableDiagramsNames() []string
GetActiveDiagramsNames() []string
SelectDiagram(diagramName string) DUError
CreateEmptyUMLDiagram(diagramType DiagramType, diagramName string) DUError
CloseDiagram(diagramName string) DUError
DeleteDiagram(diagramName string) DUError
AddGadget(gadgetType GadgetType, point Point) DUError
StartAddAssociation(point Point) DUError
EndAddAssociation(associationType AssociationType, point Point) DUError
RemoveSelectedComponents() DUError
GetDrawData() Diagram
InvalidateCanvas() DUError
UMLDiagram
name string
diagramType DiagramType
lastModified Time
startPoint Point
backgroundColor Color
componentsContainer Container
componentsGraph Graph
componentsSelected map[Component]bool
drawData Diagram
notifyDrawUpdate func() DUError
removeGadget(gad *Gadget) DUError
validatePoint(point Point) DUError
removeAssociation(a *Association) DUError
updateDrawData() DUError
GetName() string
GetDiagramType() DiagramType
GetLastModified() Time
AddGadget(gadgetType GadgetType, point Point) DUError
StartAddAssociation(point Point) DUError
EndAddAssociation(assType AssociationType, endPoint Point) DUError
RemoveSelectedComponents() DUError
SelectComponent(point Point) DUError
UnselectComponent(point Point) DUError
UnselectAllComponents() DUError
GetDrawData() Diagram
RegisterNotifyDrawUpdate(update func() DUError) DUError
Container
Insert(c Component) DUError
Remove(c Component) DUError
Search(p Point) (Component, DUError)
GetAll() []Component
Len() (int, DUError)
Cover(p Point) (bool, DUE
GetLayer() int
SetLayer(layer int) DUErro
GetDrawData() any
RegisterUpdateParentDra
Ga
gadgetType GadgetType
point Point
layer int
attributes [][]*Attribute
color Color
drawData Gadget
GadgetType int
X int
Y int
Layer int
Height int
Width int
Color int
Attributes [][]Attribute
updateParentDraw func() DUE
updateDrawData() DUError
GetPoint() Point
GetLayer() int
GetColor() Color
GetGadgetType() GadgetType
GetAttributesLen() []int
SetPoint(point Point) DUError
SetLayer(layer int) DUError
SetColor(color Color) DUError
Cover(p Point) (bool, DUError)
AddAttribute(section int, conte
RemoveAttribute(section int, i
GetDrawData() any
RegisterUpdateParentDraw(u
Graph
FindStartEnd(st *Gadget, en *Gadget) ([]*Association, DUError)
FindStart(st *Gadget) ([]*Association, DUError)
FindEnd(en *Gadget) ([]*Association, DUError)
FindEither(g *Gadget) ([]*Association, DUError)
Update(a *Association, oldSt *Gadget, oldEn *Gadget) DUError
Insert(a *Association) DUError
Remove(a *Association) DUError
RemoveGadget(g *Gadget) ([]*Association, DUError)
DiagramType
Color
R uint8
ToHex() int
containerMap
compMap map[Component]bool
Insert(c Component) DUError
Remove(c Component) DUError
Search(p Point) (Component, DUError)
GetAll() []Component
Len() (int, DUError)
graphMap
assMap map[*Gadget]map[*Gadget][]*Association
FindStartEnd(st *Gadget, en *Gadget) ([]*Association, DUError)
FindStart(st *Gadget) ([]*Association, DUError)
FindEnd(en *Gadget) ([]*Association, DUError)
FindEither(g *Gadget) ([]*Association, DUError)
Update(a *Association, oldSt *Gadget, oldEn *Gadget) DUError
Insert(a *Association) DUError
Remove(a *Association) DUError
RemoveGadget(g *Gadget) ([]*Association, DUError)

Figure 24: Design Class Diagram

HW5 TODO

## 14 Misc

### 14.1 View online

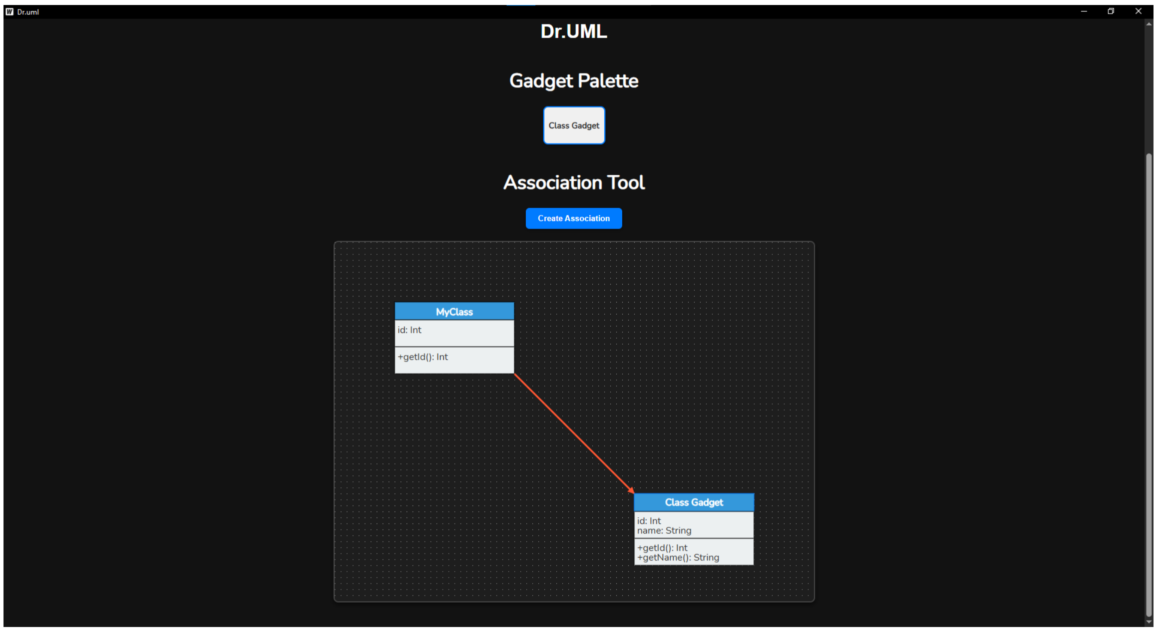
Since the report contains many images, we suggest visiting the GitHub repository to view higher-resolution versions.

## 15 Calculate Line of Code

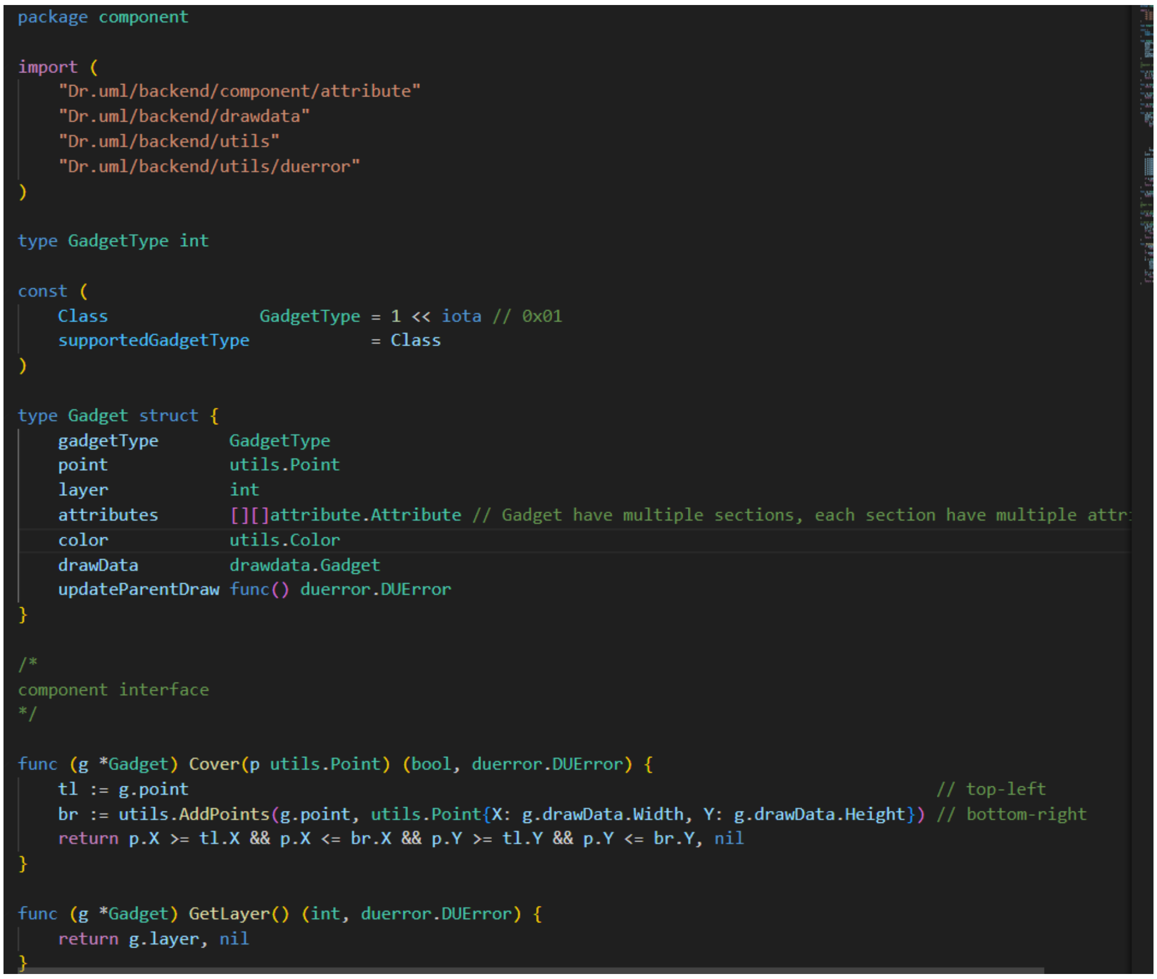
| No | Class Name | Number of methods | Line of Code in Class |
|---|---|---|---|
| 1 | AssAttribute | 10 | 98 |
| 2 | Attribute | 18 | 160 |
| 3 | Association | 17 | 185 |
| 4 | Component | 5 | 17 |
| 6 | Gadget | 9 | 133 |
| 7 | AssociationGraph | 8 | 18 |
| 8 | AssociationMap | 10 | 178 |
| 9 | Components | 10 | 154 |
| 10 | ComponentsContainer | 5 | 15 |
| 11 | ContainerMap | 6 | 70 |
| 12 | UMLDiagram | 10 | 123 |
| 13 | UMLProject | 12 | 140 |
| 14 | ConnectionError | 2 | 13 |
| 15 | DUError | 1 | 6 |
| 16 | FileIOError | 3 | 13 |
| 17 | InvalidArgumentError | 3 | 13 |
| 18 | MemoryFullError | 3 | 13 |
| 19 | FileIOError | 3 | 13 |
| 20 | SendError | 3 | 13 |
| 21 | Point | 5 | 33 |
| Total | - | 143 | 1408 |

# 16 Programming

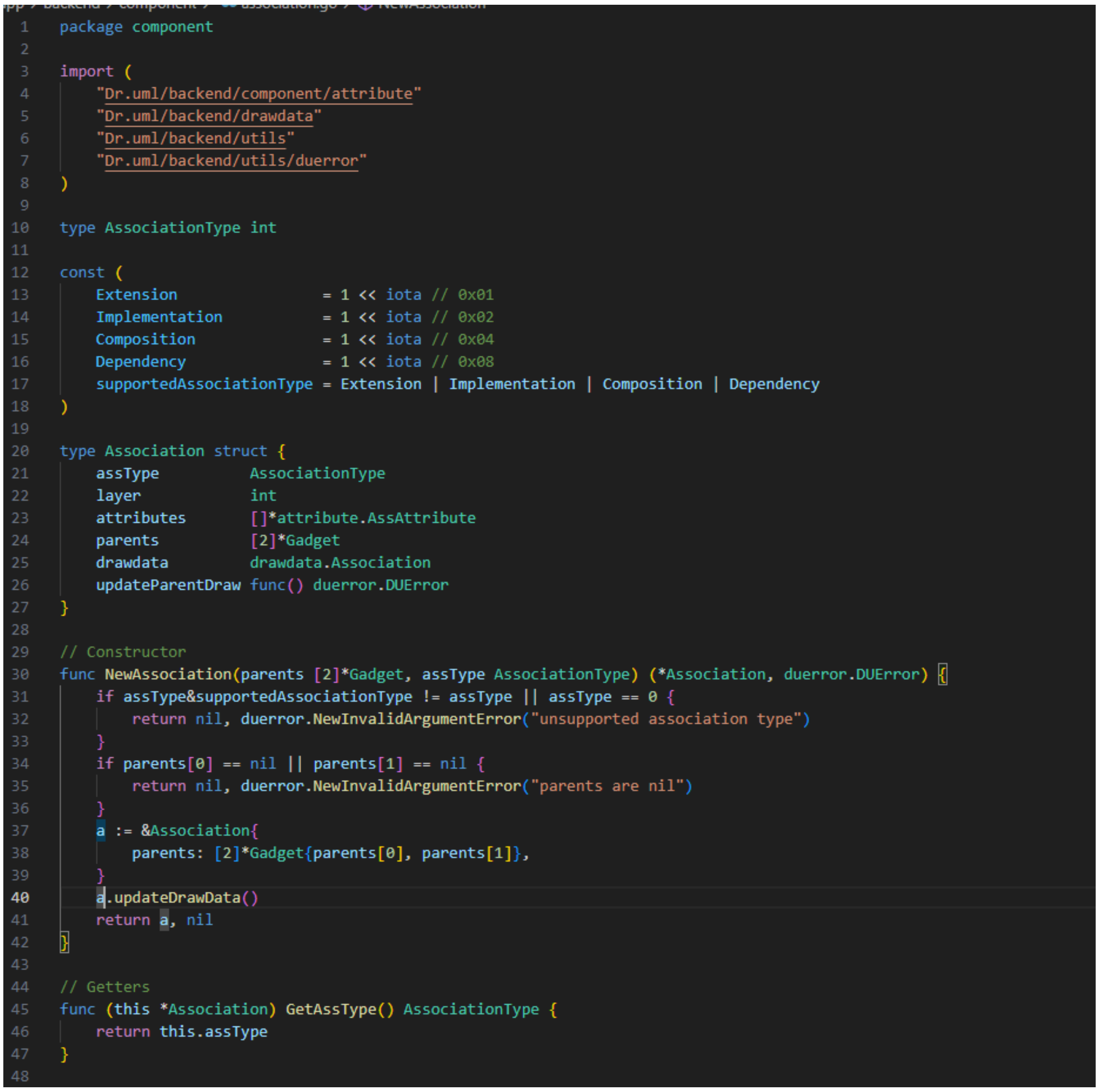
## 16.1 Snapshots of System Execution



## 16.2 Source Code Listing



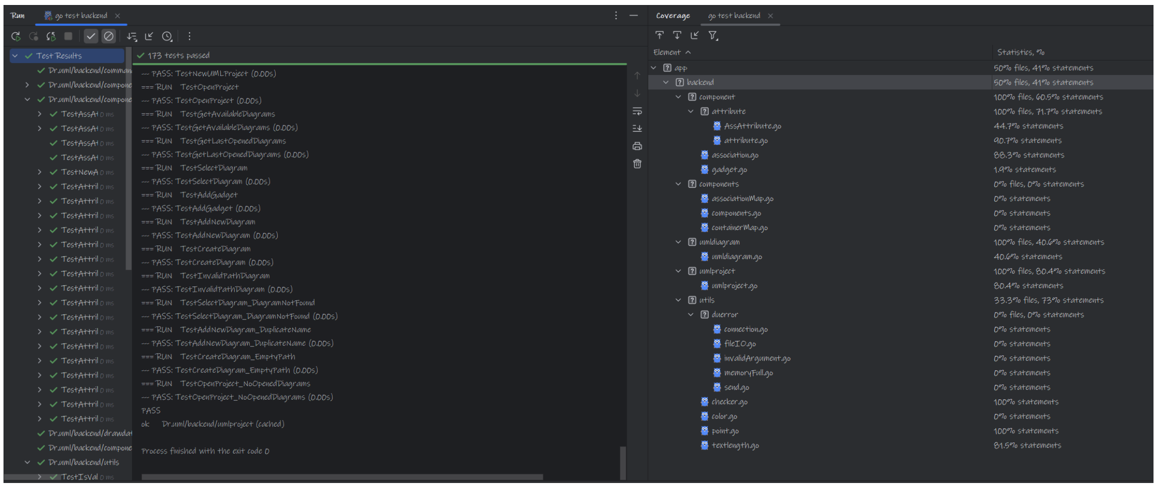
```go
package component

import (
	"Dr.uml/backend/component/attribute"
	"Dr.uml/backend/drawdata"
	"Dr.uml/backend/utils"
	"Dr.uml/backend/utils/duerror"
)

type GadgetType int

const (
	Class                 GadgetType = 1 << iota // 0x01
	supportedGadgetType              = Class
)

type Gadget struct {
	gadgetType       GadgetType
	point            utils.Point
	layer            int
	attributes       [][]attribute.Attribute // Gadget have multiple sections, each section have multiple attr
	color            utils.Color
	drawData         drawdata.Gadget
	updateParentDraw func() duerror.DUError
}

/*
component interface
*/

func (g *Gadget) Cover(p utils.Point) (bool, duerror.DUError) {
	tl := g.point                                                                    // top-left
	br := utils.AddPoints(g.point, utils.Point{X: g.drawData.Width, Y: g.drawData.Height}) // bottom-right
	return p.X >= tl.X && p.X <= br.X && p.Y >= tl.Y && p.Y <= br.Y, nil
}

func (g *Gadget) GetLayer() (int, duerror.DUError) {
	return g.layer, nil
}
```



```go
package component

import (
    "Dr.uml/backend/component/attribute"
    "Dr.uml/backend/drawdata"
    "Dr.uml/backend/utils"
    "Dr.uml/backend/utils/duerror"
)

type AssociationType int

const (
    Extension                = 1 << iota // 0x01
    Implementation           = 1 << iota // 0x02
    Composition              = 1 << iota // 0x04
    Dependency               = 1 << iota // 0x08
    supportedAssociationType = Extension | Implementation | Composition | Dependency
)

type Association struct {
    assType          AssociationType
    layer            int
    attributes       []*attribute.AssAttribute
    parents          [2]*Gadget
    drawdata         drawdata.Association
    updateParentDraw func() duerror.DUError
}

// Constructor
func NewAssociation(parents [2]*Gadget, assType AssociationType) (*Association, duerror.DUError) {
    if assType&supportedAssociationType != assType || assType == 0 {
        return nil, duerror.NewInvalidArgumentError("unsupported association type")
    }
    if parents[0] == nil || parents[1] == nil {
        return nil, duerror.NewInvalidArgumentError("parents are nil")
    }
    a := &Association{
        parents: [2]*Gadget{parents[0], parents[1]},
    }
    a.updateDrawData()
    return a, nil
}

// Getters
func (this *Association) GetAssType() AssociationType {
    return this.assType
}
```

# 17 Unit Testing

## 17.1 Snapshot



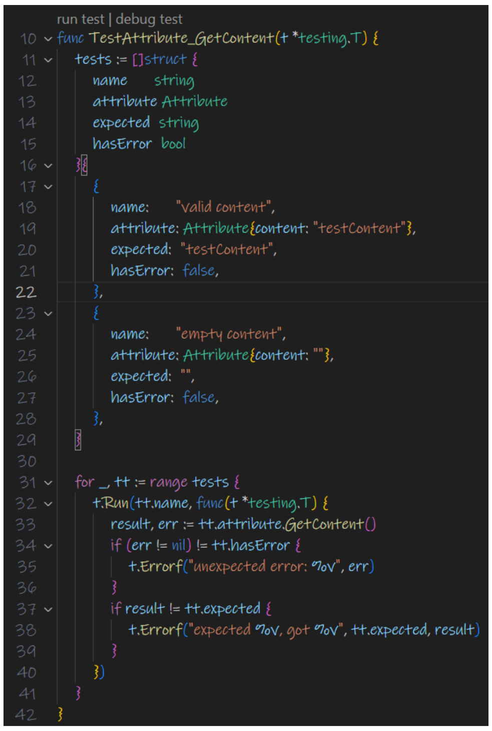
```
Test Results
  Dr.uml/backend/comman
  Dr.uml/backend/compone
  Dr.uml/backend/compone
    TestAssAt 0 ms
    TestAssAt 0 ms
    TestAssAt 0 ms
    TestAssAt 0 ms
    TestNewA 0 ms
    TestAttril 0 ms
    TestAttril 0 ms
    TestAttril 0 ms
    TestAttril 0 ms
    TestAttril 0 ms
    TestAttril 0 ms
    TestAttril 0 ms
    TestAttril 0 ms
    TestAttril 0 ms
    TestAttril 0 ms
    TestAttril 0 ms
    TestAttril 0 ms
    TestAttril 0 ms
    TestAttril 0 ms
    TestAttril 0 ms
    TestAttril 0 ms
  Dr.uml/backend/drawdat
  Dr.uml/backend/compone
  Dr.uml/backend/utils
    TestIsVal 0 ms
```

```
173 tests passed
--- PASS: TestNewUMLProject (0.00s)
=== RUN   TestOpenProject
--- PASS: TestOpenProject (0.00s)
=== RUN   TestGetAvailableDiagrams
--- PASS: TestGetAvailableDiagrams (0.00s)
=== RUN   TestGetLastOpenedDiagrams
--- PASS: TestGetLastOpenedDiagrams (0.00s)
=== RUN   TestSelectDiagram
--- PASS: TestSelectDiagram (0.00s)
=== RUN   TestAddGadget
--- PASS: TestAddGadget (0.00s)
=== RUN   TestAddNewDiagram
--- PASS: TestAddNewDiagram (0.00s)
=== RUN   TestCreateDiagram
--- PASS: TestCreateDiagram (0.00s)
=== RUN   TestInvalidPathDiagram
--- PASS: TestInvalidPathDiagram (0.00s)
=== RUN   TestSelectDiagram_DiagramNotFound
--- PASS: TestSelectDiagram_DiagramNotFound (0.00s)
=== RUN   TestAddNewDiagram_DuplicateName
--- PASS: TestAddNewDiagram_DuplicateName (0.00s)
=== RUN   TestCreateDiagram_EmptyPath
--- PASS: TestCreateDiagram_EmptyPath (0.00s)
=== RUN   TestOpenProject_NoOpenedDiagrams
--- PASS: TestOpenProject_NoOpenedDiagrams (0.00s)
PASS
ok    Dr.uml/backend/umlproject (cached)

Process finished with the exit code 0
```

```
Element                         Statistics, %
app                             50% files, 41% statements
  backend                       50% files, 41% statements
    component                   100% files, 60.5% statements
      attribute                 100% files, 71.7% statements
        AssAttribute.go         44.7% statements
        attribute.go            90.7% statements
      association.go            88.3% statements
      gadget.go                 1.9% statements
    components                  0% files, 0% statements
      associationMap.go         0% statements
      components.go             0% statements
      containerMap.go           0% statements
    umldiagram                  100% files, 40.6% statements
      umldiagram.go             40.6% statements
    umlproject                  100% files, 80.4% statements
      umlproject.go             80.4% statements
    utils                       33.3% files, 73% statements
      duerror                   0% files, 0% statements
        connection.go           0% statements
        fileIO.go               0% statements
        invalidArgument.go      0% statements
        memoryFull.go           0% statements
        send.go                 0% statements
      checker.go                100% statements
      color.go                  0% statements
      point.go                  100% statements
      textlength.go             81.5% statements
```

Figure 25: Unit test snapshot

## 17.2 Code listing



```go
func TestAttribute_GetContent(t *testing.T) {
	tests := []struct {
		name      string
		attribute Attribute
		expected  string
		hasError  bool
	}{
		{
			name:      "valid content",
			attribute: Attribute{content: "testContent"},
			expected:  "testContent",
			hasError:  false,
		},
		{
			name:      "empty content",
			attribute: Attribute{content: ""},
			expected:  "",
			hasError:  false,
		},
	}

	for _, tt := range tests {
		t.Run(tt.name, func(t *testing.T) {
			result, err := tt.attribute.GetContent()
			if (err != nil) != tt.hasError {
				t.Errorf("unexpected error: %v", err)
			}
			if result != tt.expected {
				t.Errorf("expected %v, got %v", tt.expected, result)
			}
		})
	}
}
```

Figure 26: Unit test code

for Chinese

| Info | Total |
|---|---|
| production code | 1648 |
| class in production code | 15 |
| methods in production code | 183 |
| number of unit tests | 173 |
| lines of unit tests | 2036 |
| 蕭耕宏's time effort | 48 |
| 張庭瑋's time effort | 48 |
| 黃冠鈞's time effort | 48 |
| 吳宥駒's time effort | 48 |
| total time effort | 192 |

## 18 Misc

### 18.1 View online

Since the report contains many images, we suggest visiting the GitHub repository to view higher-resolution versions.

Deadline-Driven Development

## References