Introduction to Software Changes

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Based on Rajlich's slides

Introduction to software changes

- Software change (SC) is the process of adding new functionality to existing code
- Foundation of software servicing, evolution, and agile processes

Characteristics of SC

- Lientz and Swanson
  - perfective ~66%
  - adaptive
  - corrective
  - preventive

Functionality

- Incremental
  - adding new functionality
- Contraction
  - removing obsolete functionality
- Replacement
  - replacing existing functionality
- Refactoring
  - changing software structure without changing behavior

Impact

- Local impact
- Significant impact
- Massive impact

- Change strategy
  - improves structure
  - quick fix

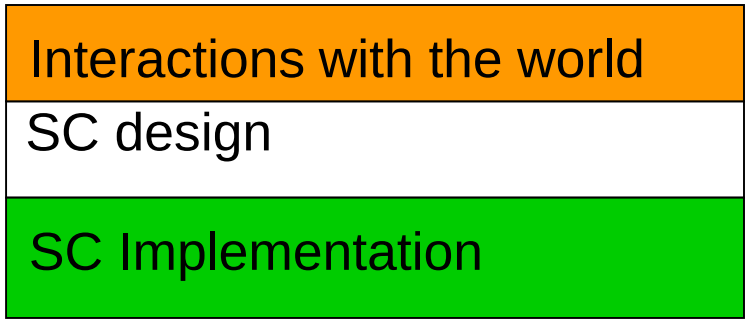
Form of changing code

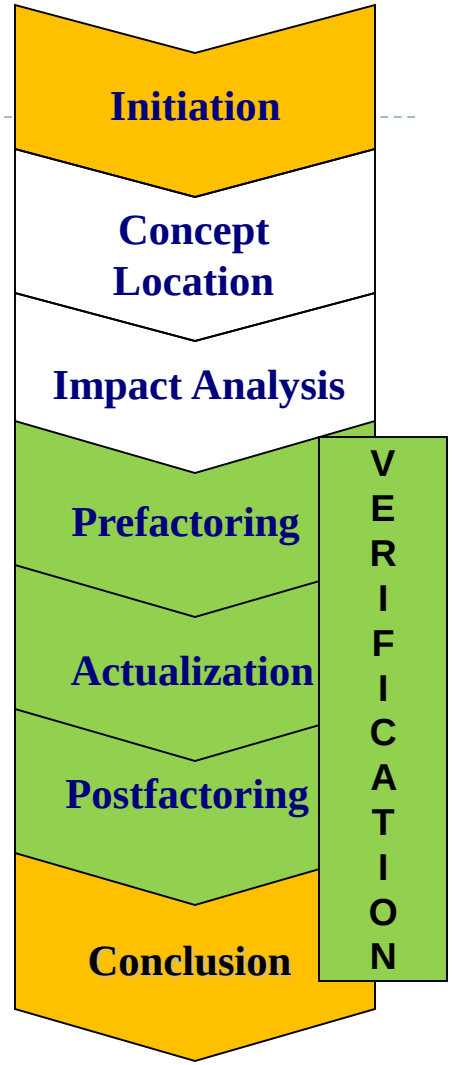
- Source code
  - most common
- Code after compilation
  - object form
  - executable form

A Software Change (SC) Process Model

SC process model

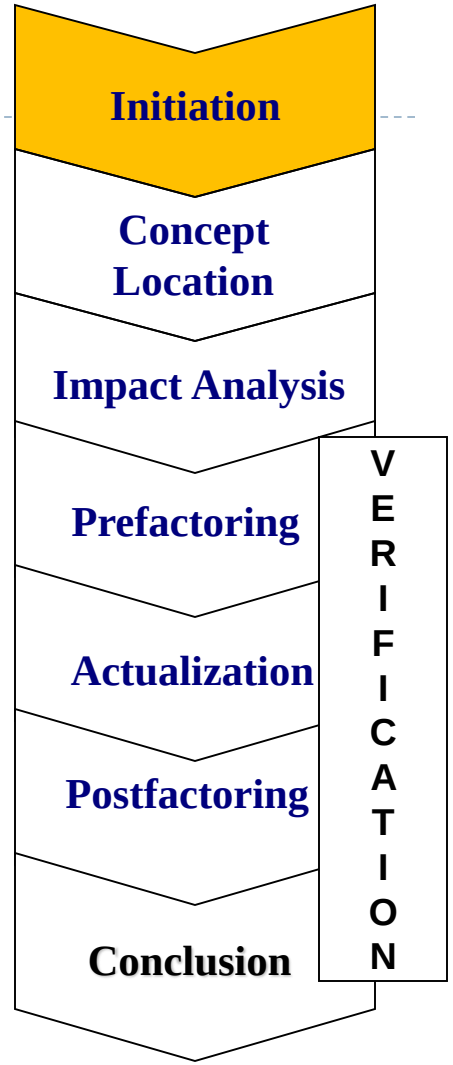
- **Phases** of SC



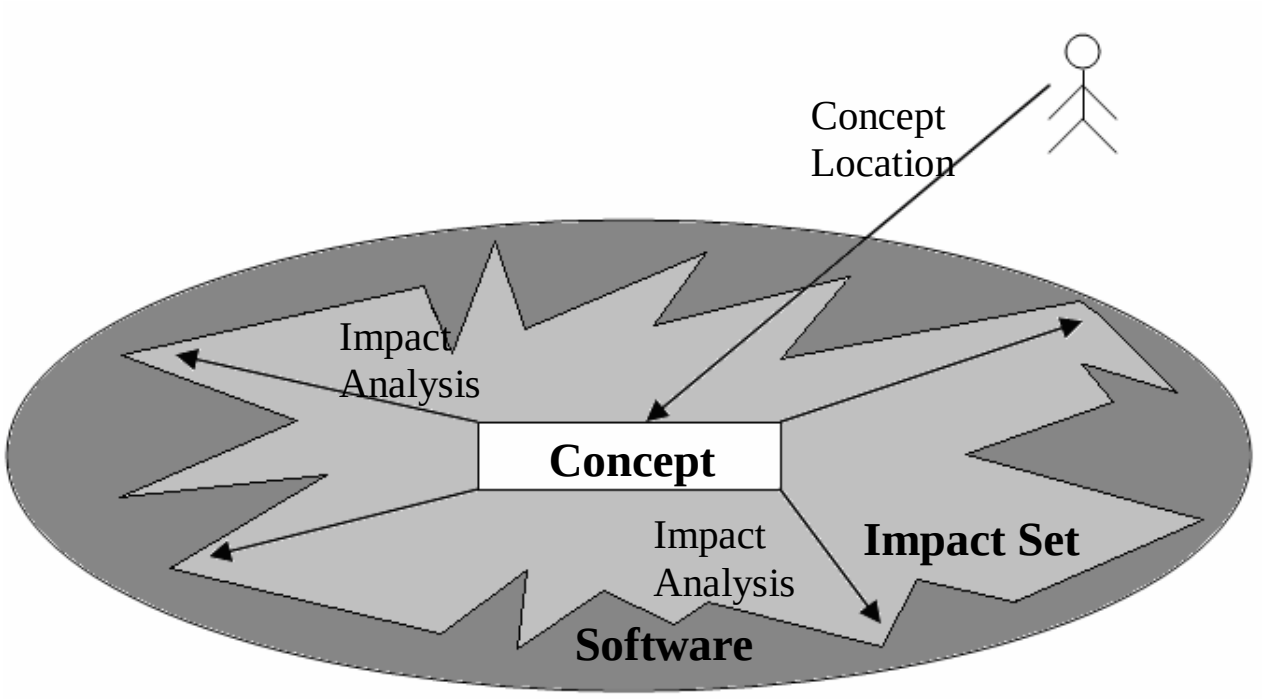


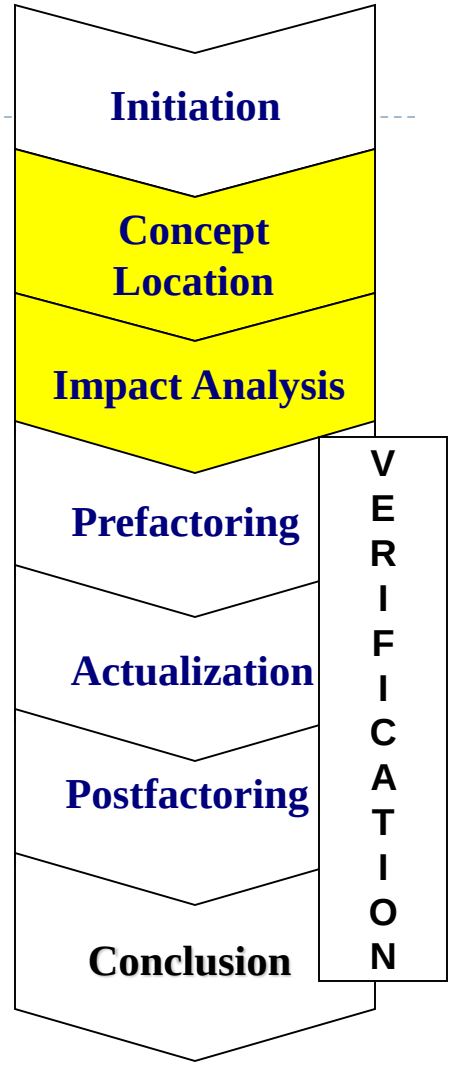
Initiation

- SC starts by a change request
- Prioritization of change requests, etc.



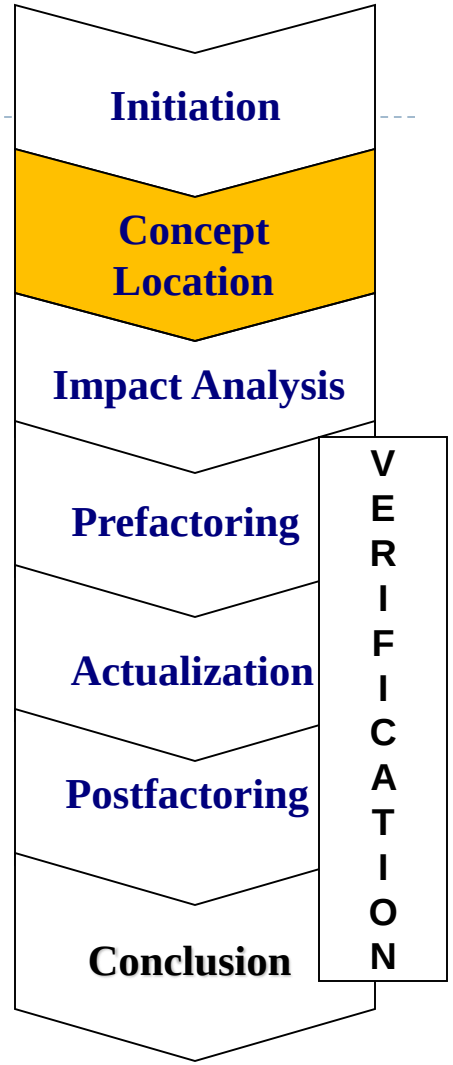
SC Design


Concept
Location
Impact
Analysis
Concept
Impact
Analysis
Impact Set
Software


Initiation
Concept
Location
Impact Analysis
Prefactoring
Actualization
Postfactoring
Conclusion
VERIFICATION

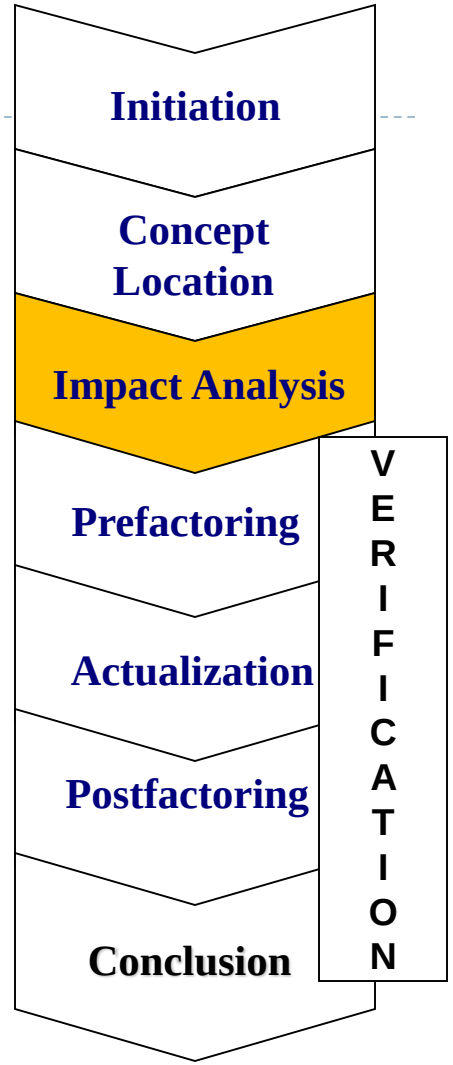
Concept Location

- Concepts are extracted from change request
- Extracted concepts are located in the code and used as a starting point of SC



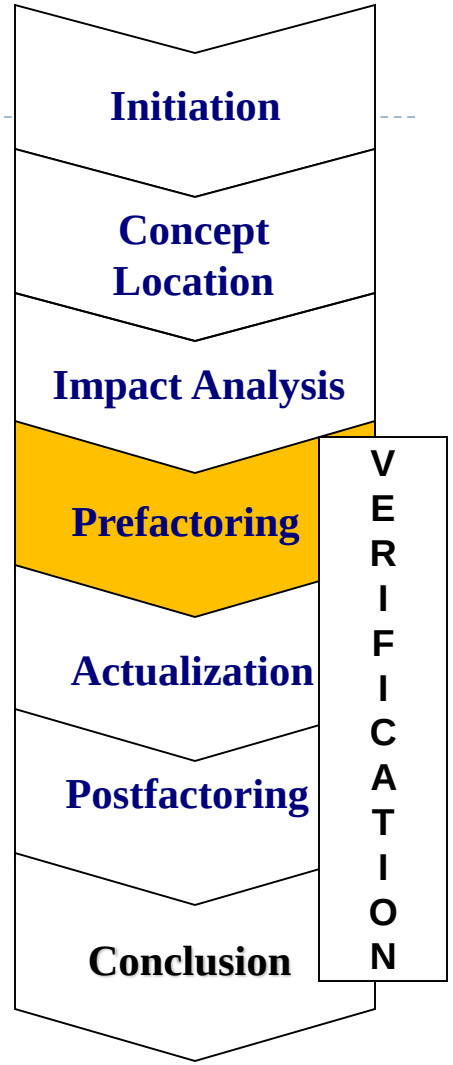
Impact Analysis

- Determine strategy and impact of change
- Classes identified in concept location make up the initial *impact set*
- Class dependencies are analyzed, and impacted classes are added to the impact set



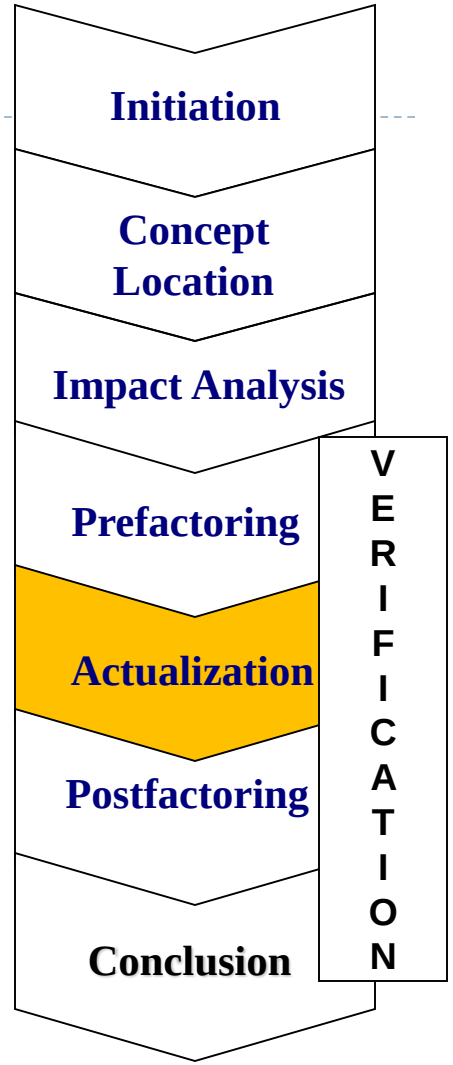
Prefactoring

- Opportunistic refactoring that localizes (minimizes) impact of SC on software
- *Extract Class* (Fowler)
  - gather fields, methods, and code snippets into a new component class
- *Extract Superclass*
  - create new abstract class



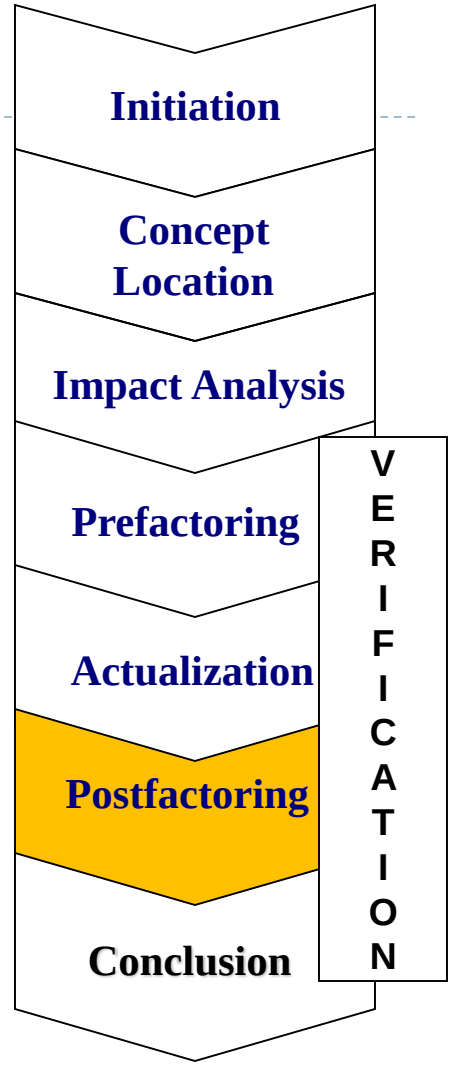
Actualization

- Creates new code
- Plugs it into the old code
- Visit neighboring classes and update them
  - change propagation
  - ripple effect



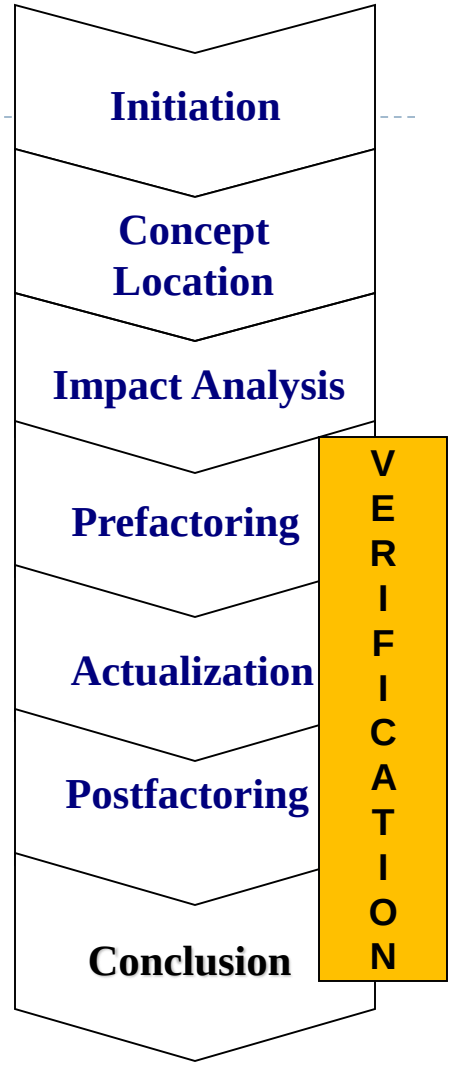
Postfactoring

- Eliminate any anti-patterns that may have been introduced
  - long method
    - after added functionality, some methods may be doing too much
  - bloated class
    - after added functionality, a class may be too large



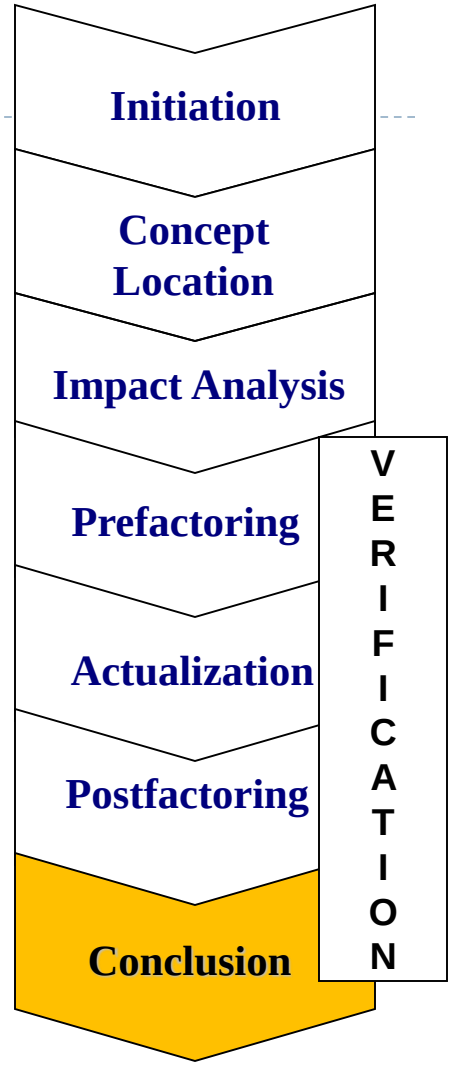
Verification

- Guarantees correctness of the change
- Testing
  - functional
  - unit
  - structural
- Code reviews



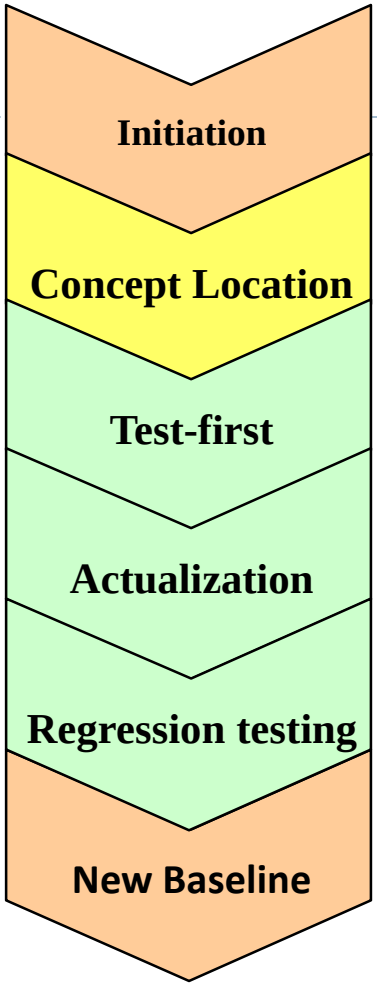
Conclusion

- Commit finished code into version control
- Build the new baseline
- Release?
- Prepare for the next change



Test-Driven Development

- Write test first
- Write code to pass the test



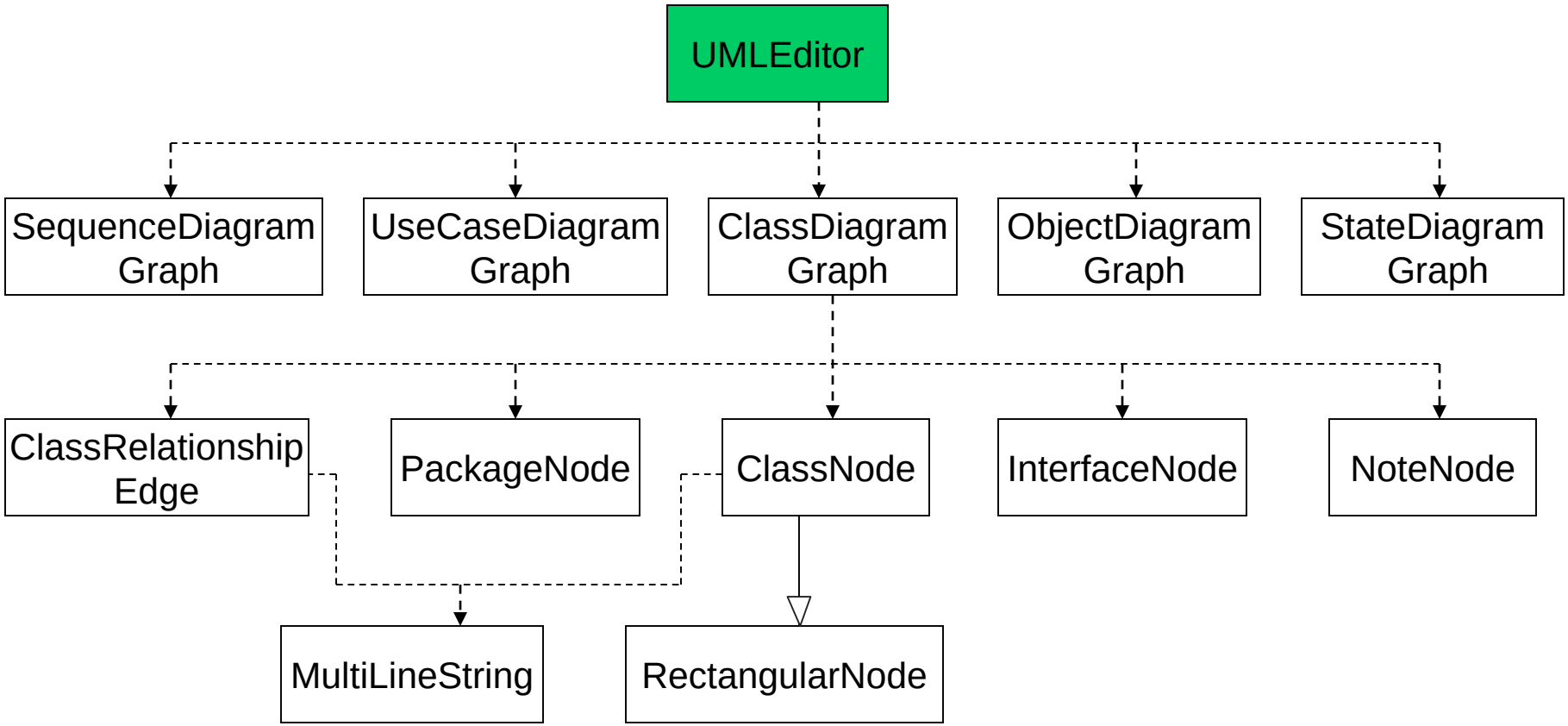
What would be a software change like?

Let us take a look at an example of software change...

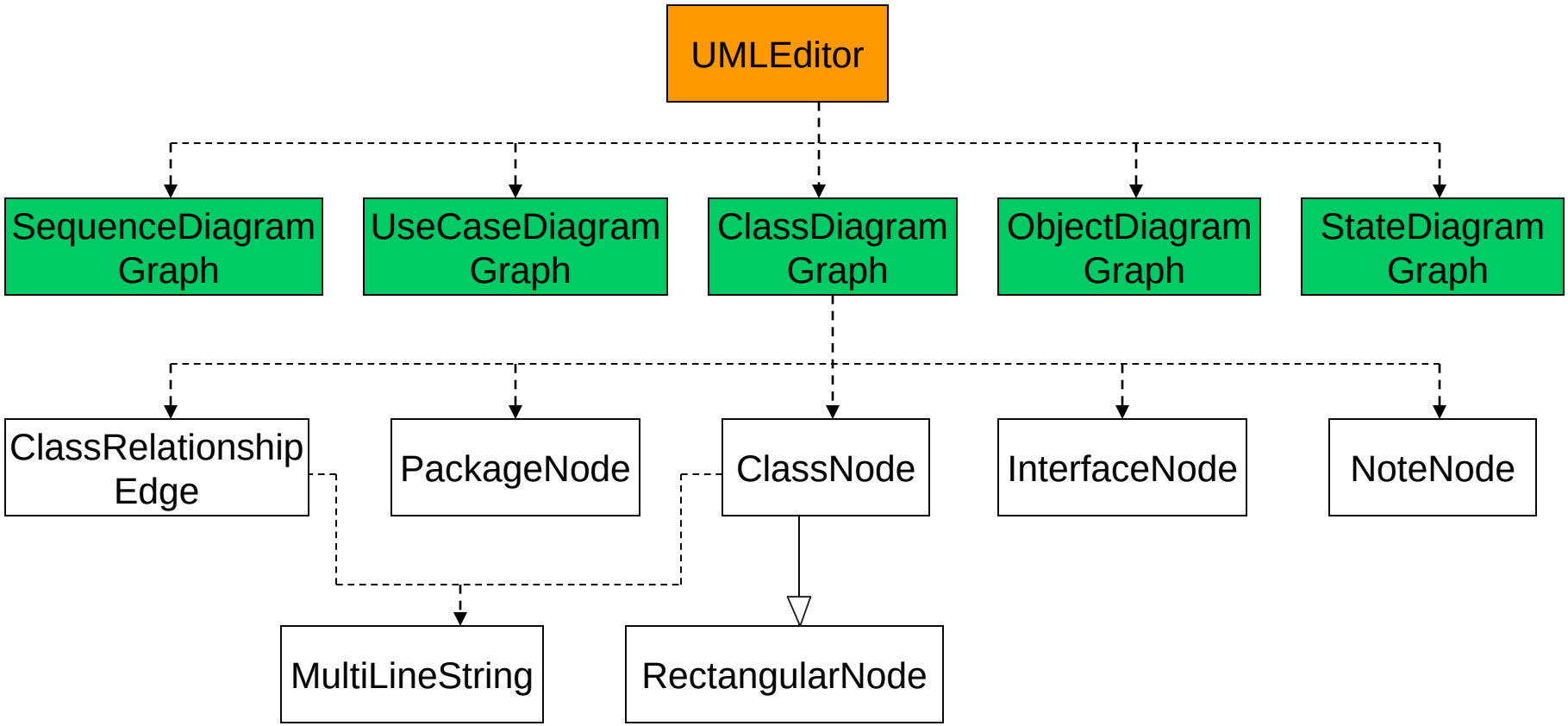
Suppose you need to make a change in an UML editor software…

- Issue / Change Request
  - Record the author for each figure
  - This change will make the editor more versatile
    - Support for cooperative work
    - Author creates a figure
      - Author knows the semantics of the figure

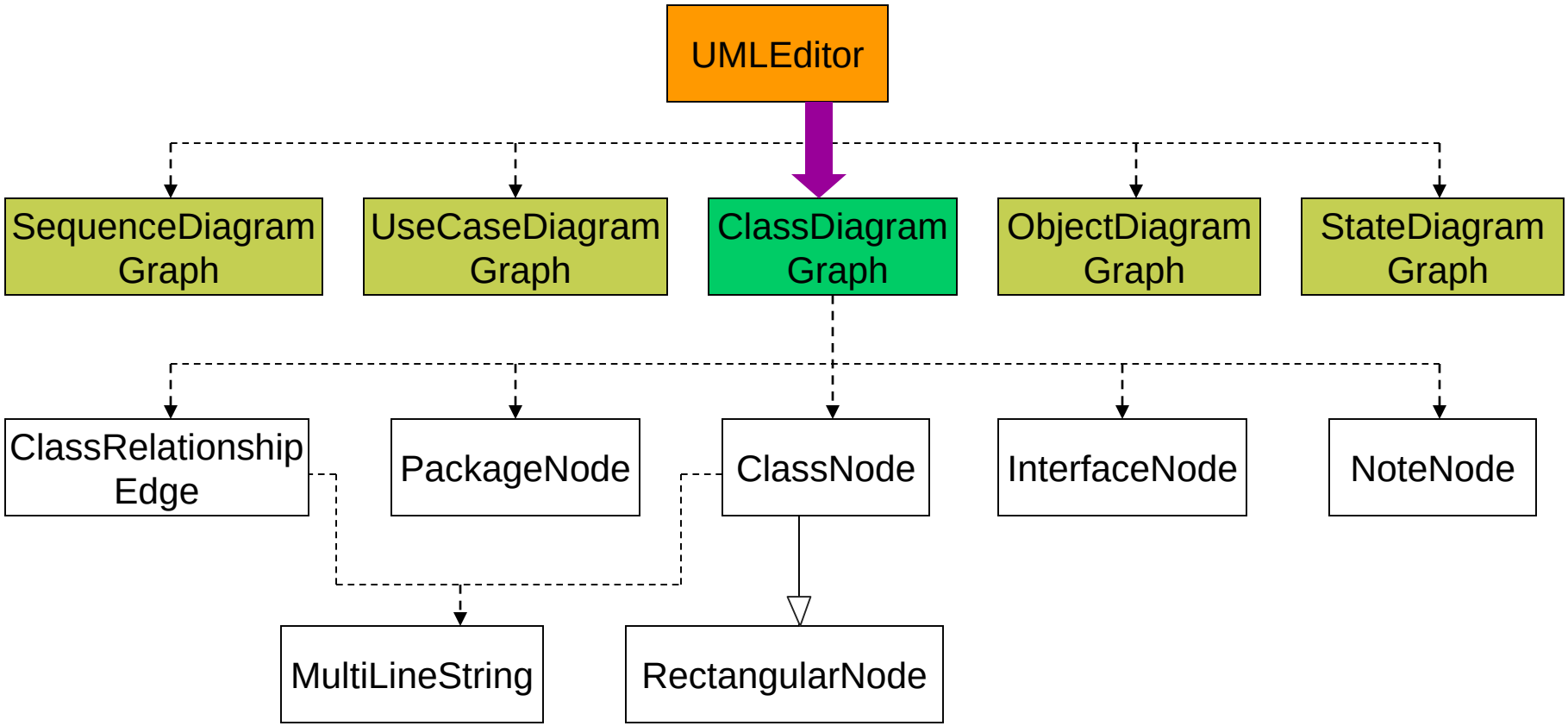
Locating figure properties: Start



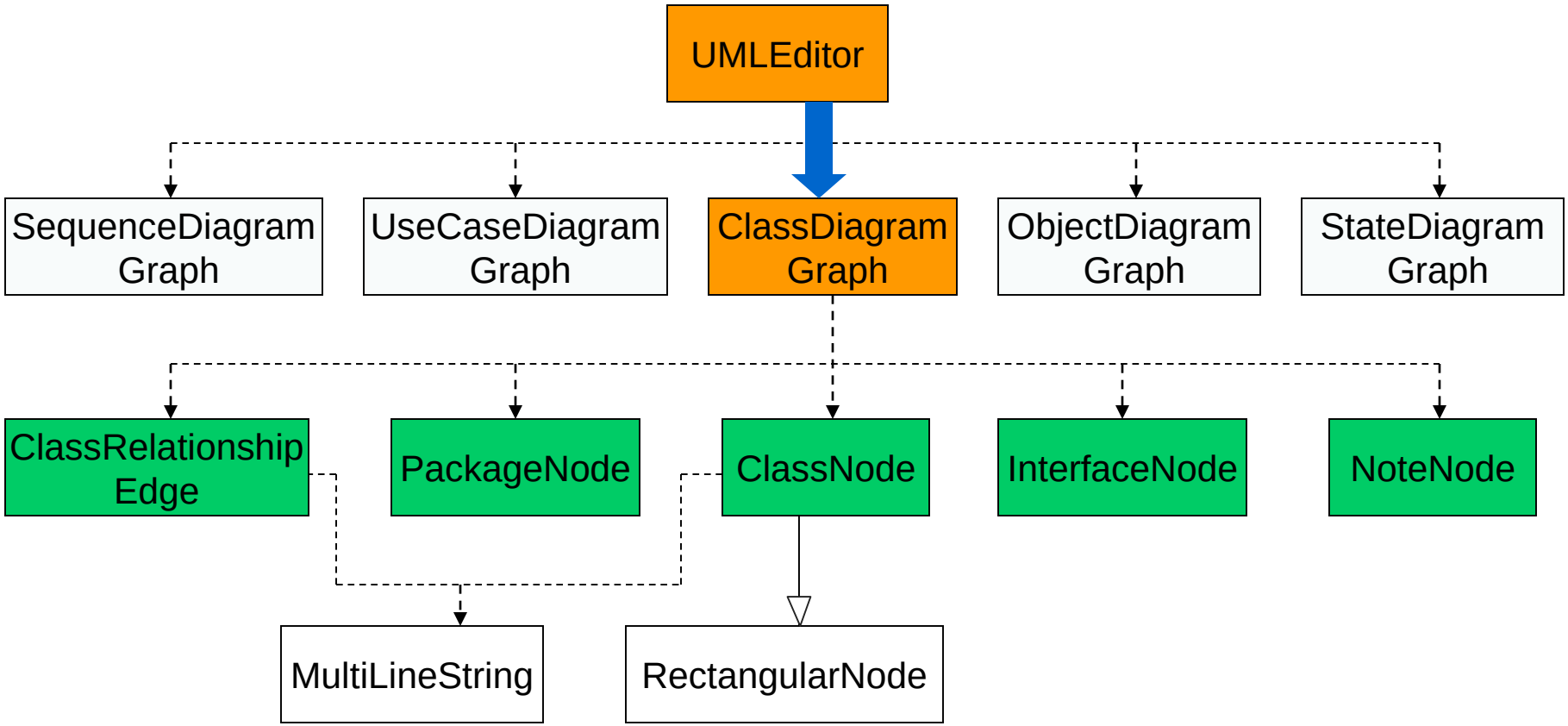
Classes to inspect



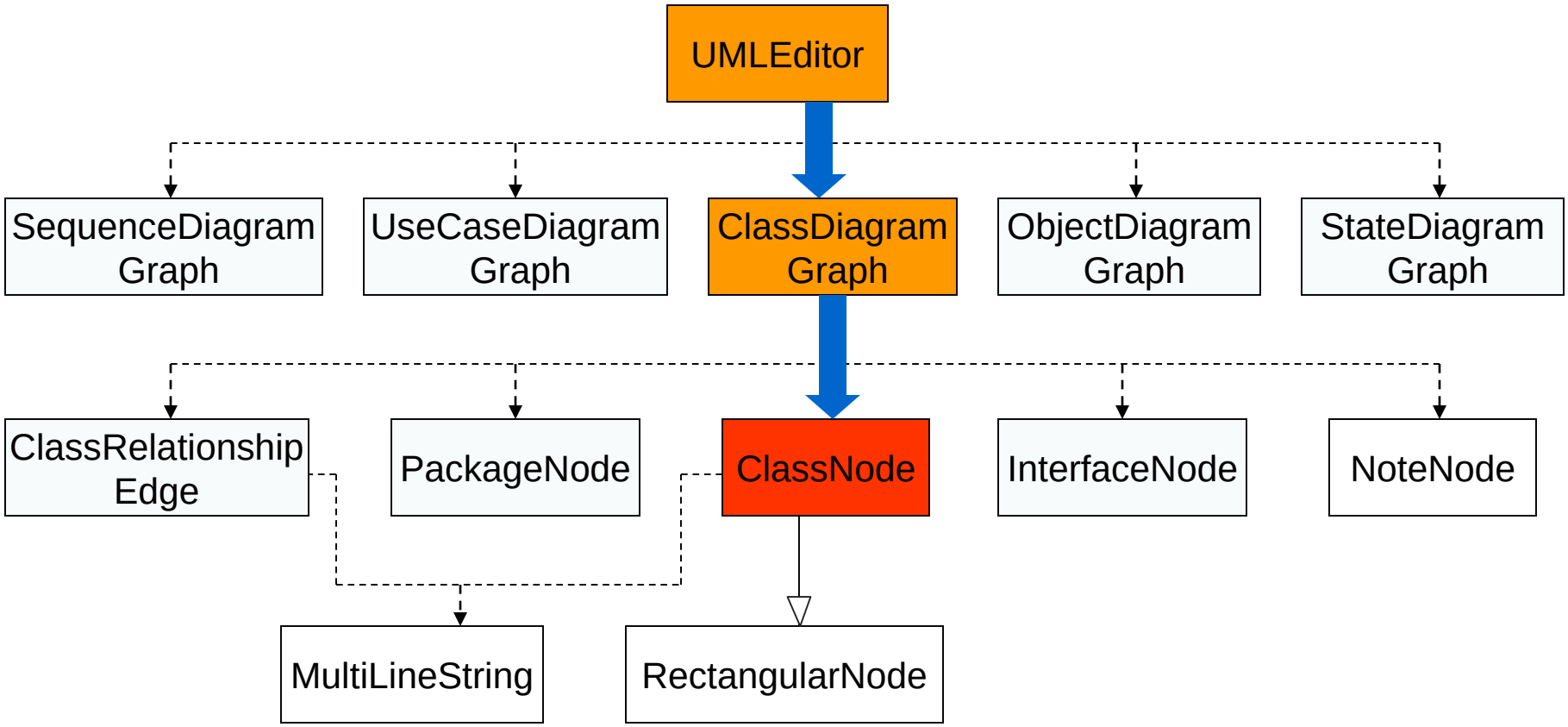
Most likely supplier



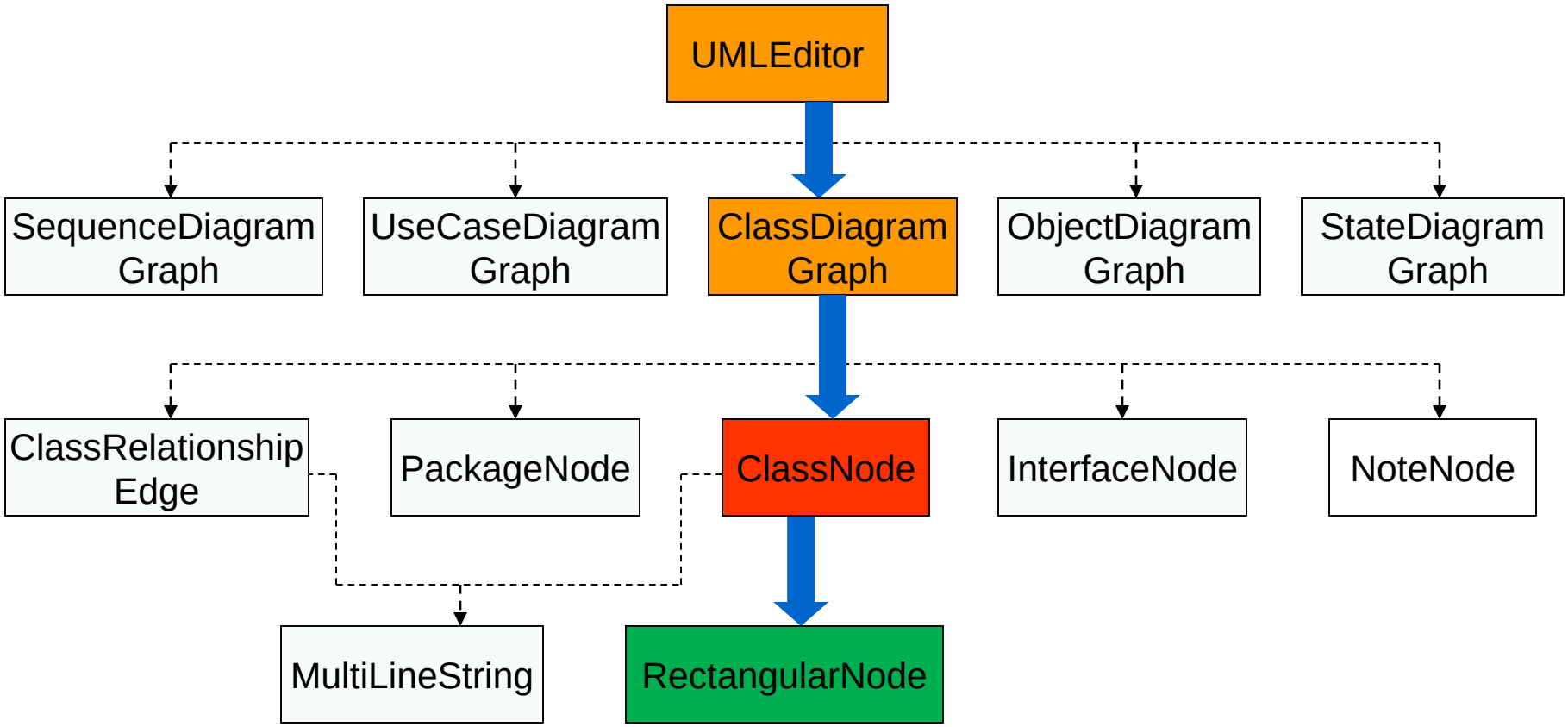
Next classes to inspect



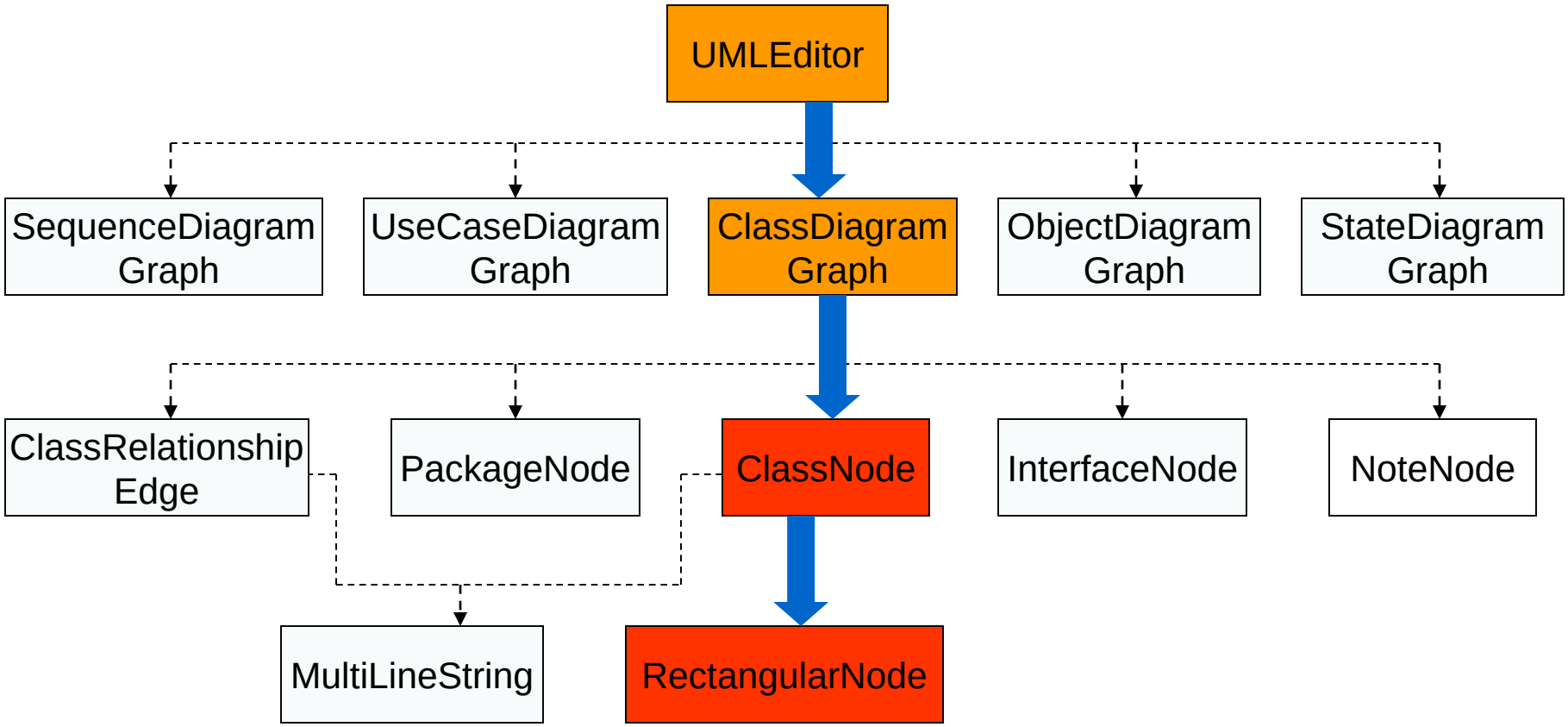
Concept location found



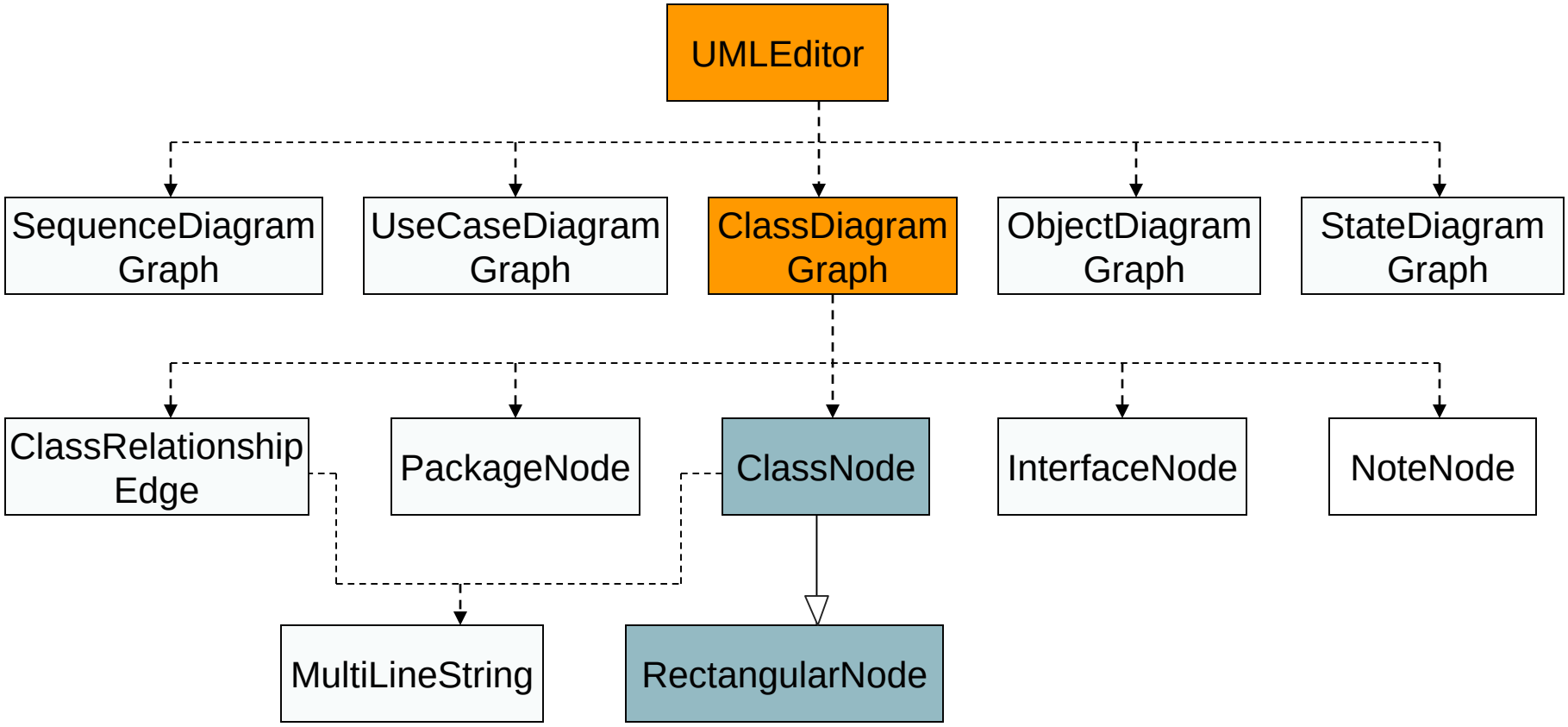
Possible extension of the search



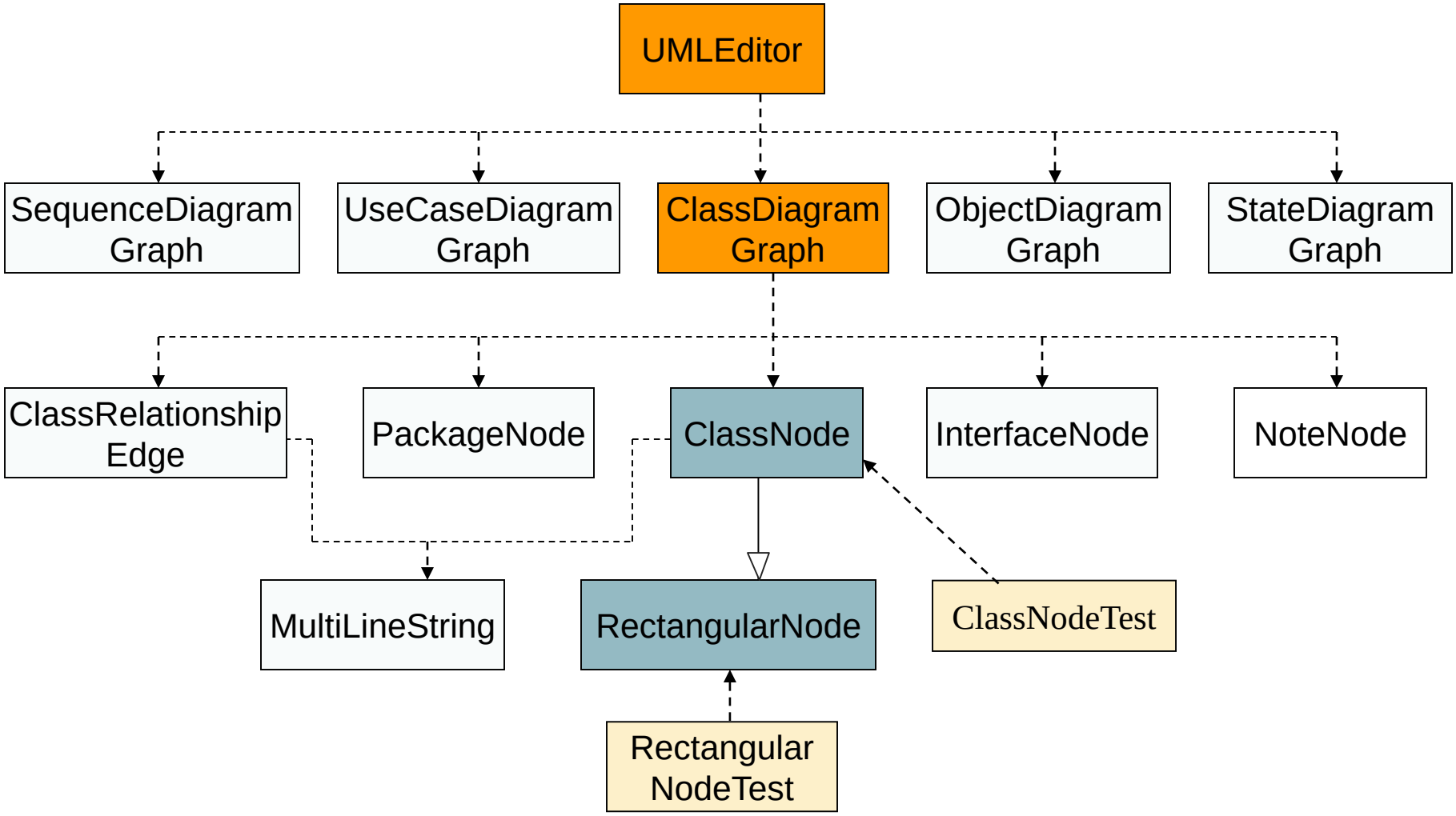
Another location found



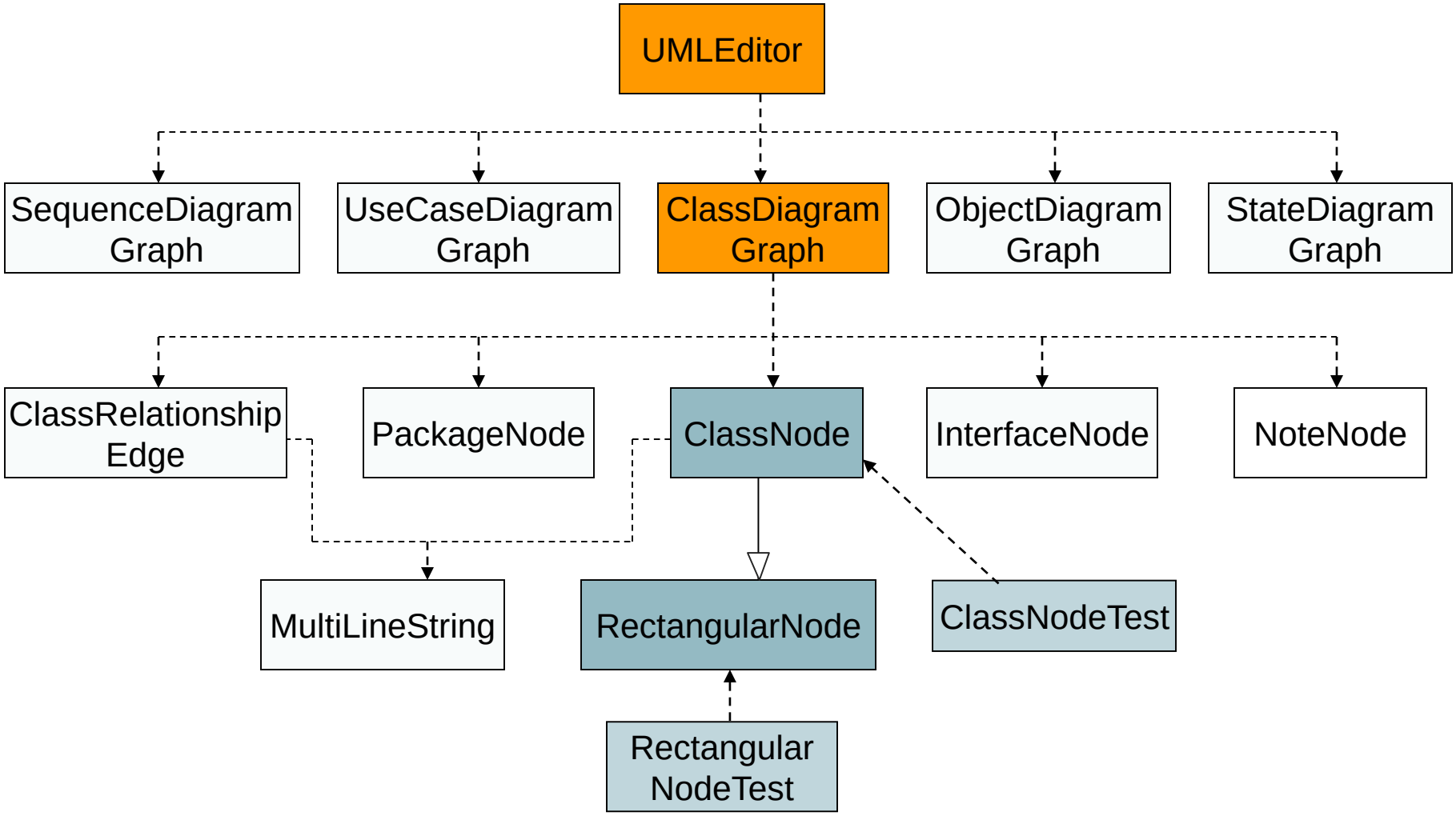
Then we perform the change in the code…



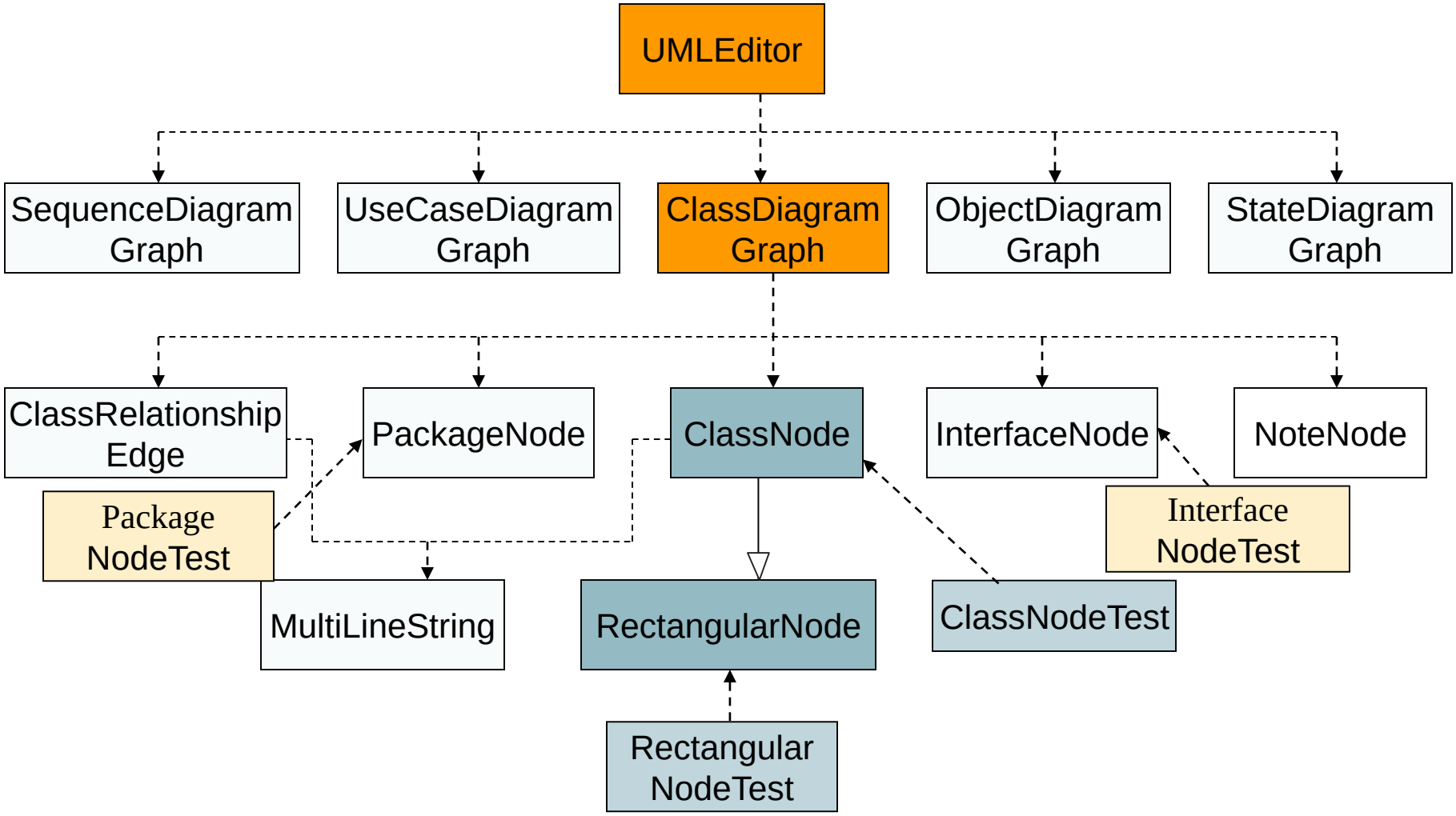
But previous tests need to be improved...



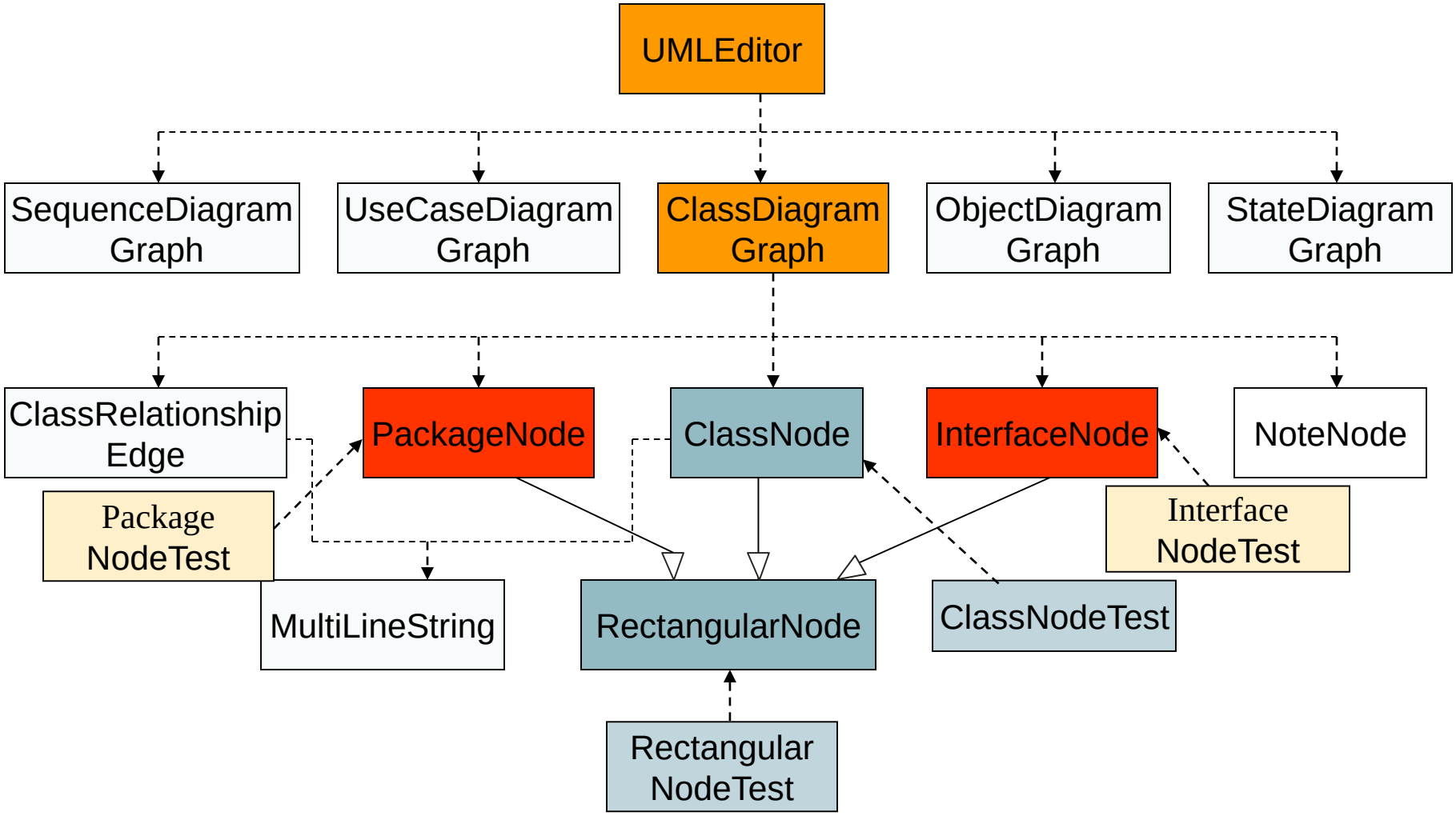
We fix those tests...



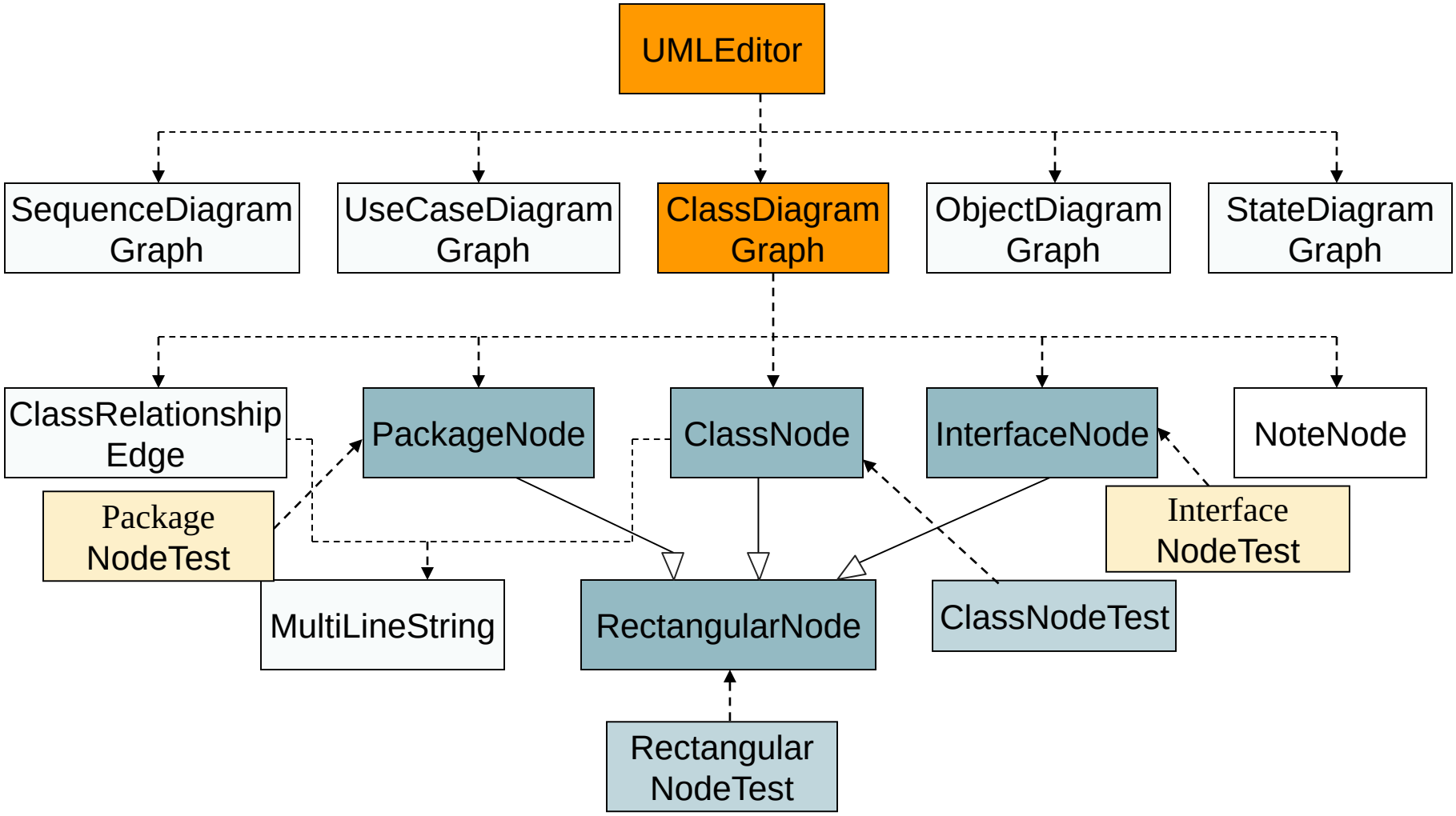
Then we run the regression tests, and some other tests have broken...



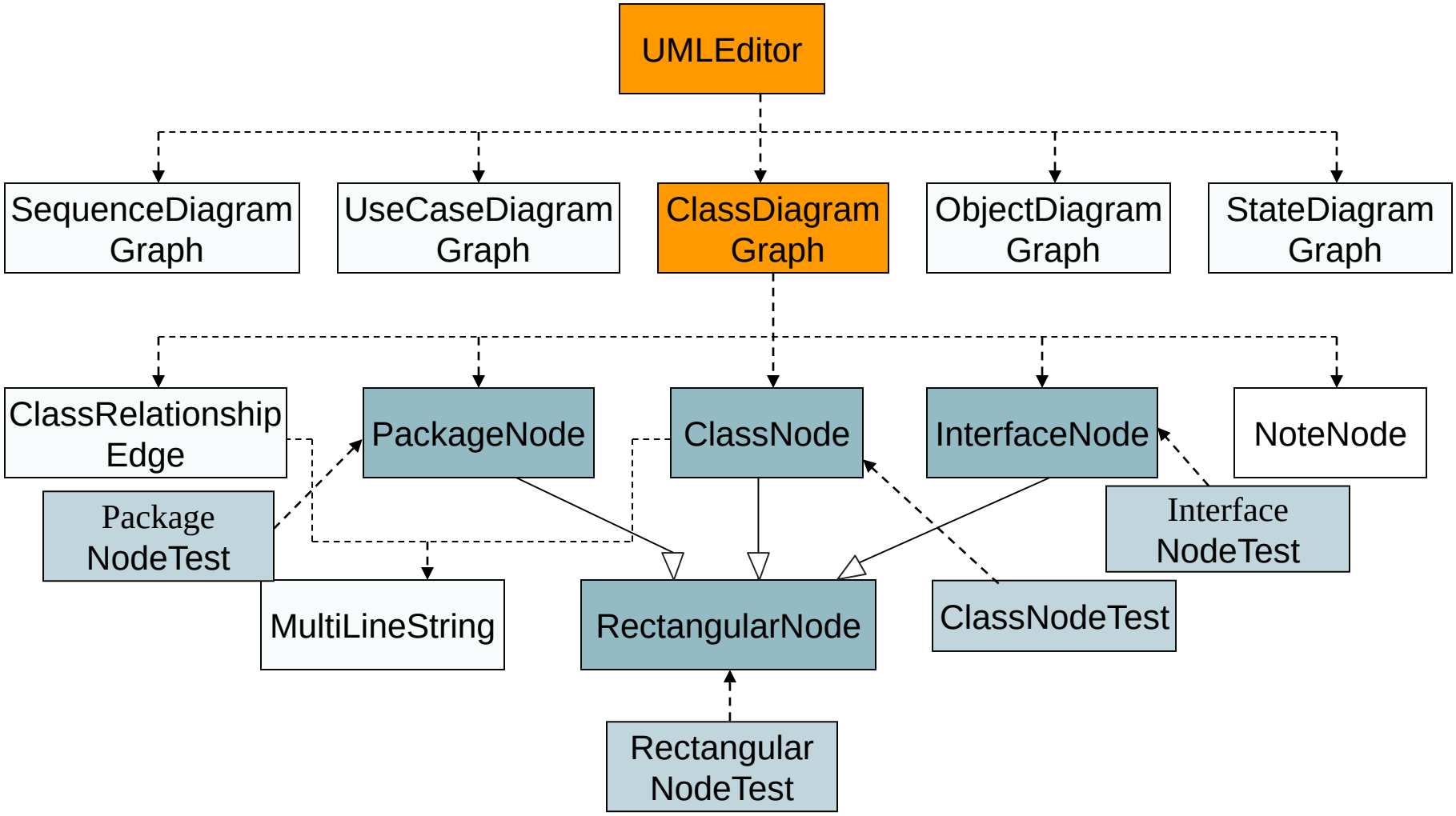
Which shows some other classes have been affected by the change…



We fix those impacted classes...



We also fix those tests that failed… We run the regression tests again, and they pass.



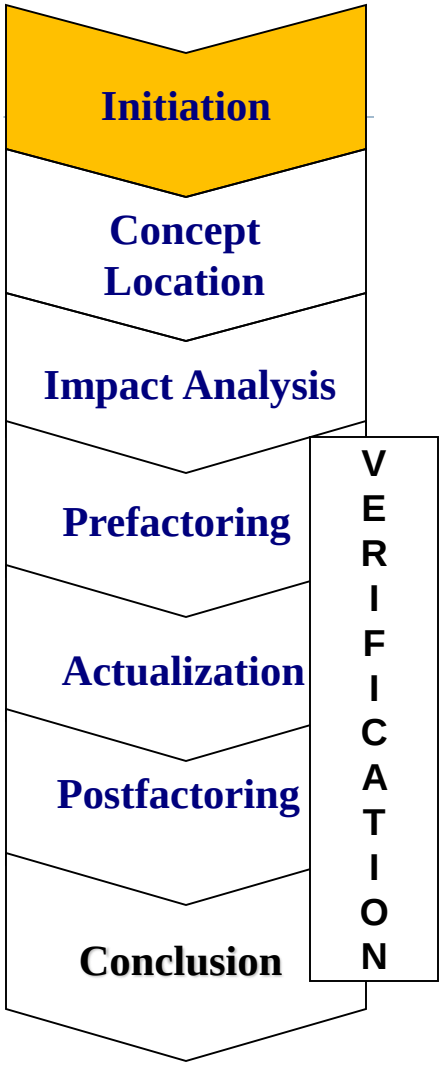
Then we make the change permanent…

- Commit and push the change
  - Commit the code with a good commit message
  - In case other developers need to be aware, make a pull request so they can review the new code
    - All things working, change is pushed to the repository
- Close issue
  - Describe the change performed in the issue tracking system

Change Initiation

Change initiation

- Requirements
  - user reports a software bug
  - user asks for an enhancement
  - programmer proposes improvement
  - manager wants to meet competitor's functionality



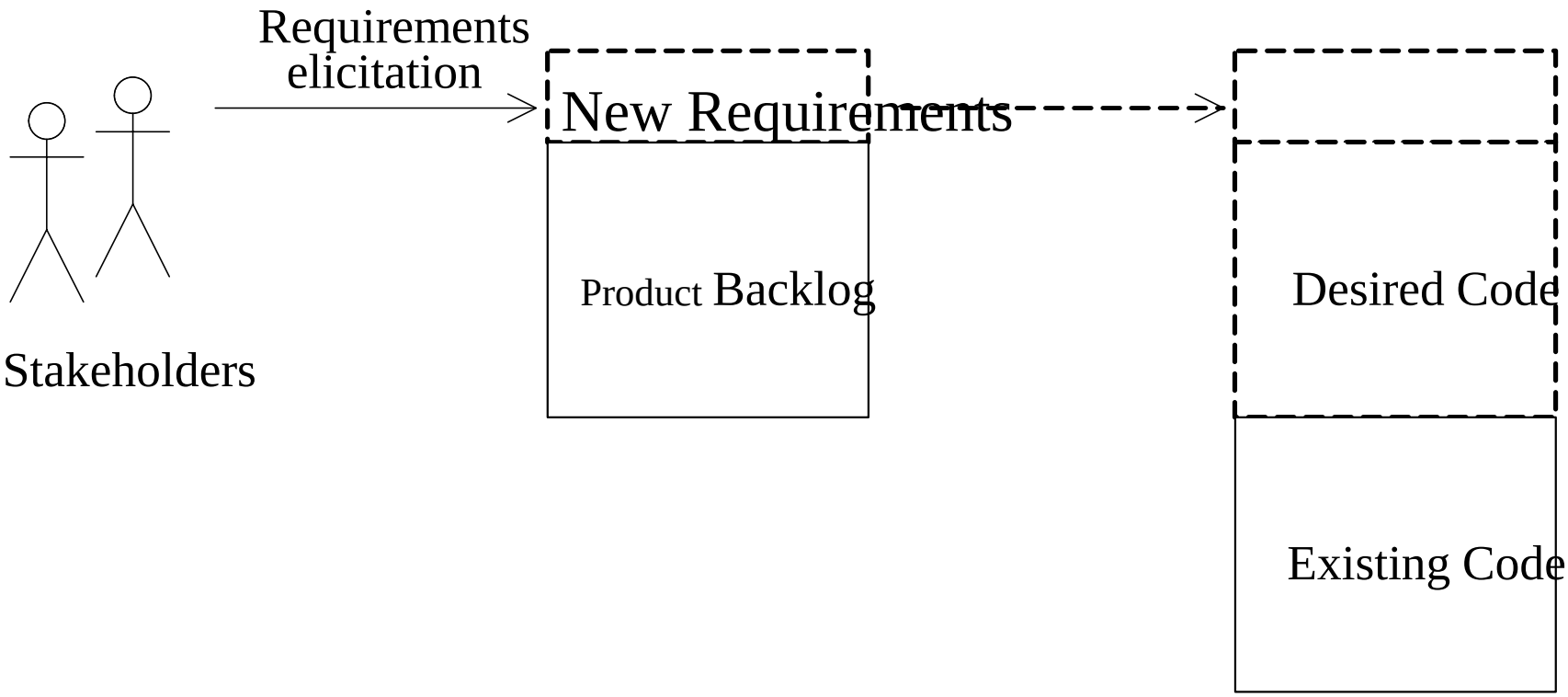
Requirements form

- Sentence or paragraph
- Bug report
- User story
  - limit the complexity of the story and potential for misunderstanding
  - user story fits on a 3” x 5” card
  - if a new functionality cannot fit, it has to be divided into several user stories

Product backlog

- Database of requirements
  - “wish list”
  - add/delete/modify requirements
  - additional knowledge is acquired by the users
  - additional clarification is needed by the programmers

Requirements Elicitation



Resolving inconsistencies

- Contradictions
  - ex. different formula for the same thing
- Inadequacy
  - ex. requirements are too terse -> programmers have to guess
- Noise
    - ex. irrelevant requirements (delete them)
- Unfeasibility
    - ex. project team or technology barriers
- Ambiguity or unintelligibility
    - ex. interpreting a requirement in more than one way

Prioritization - bugs

- 1. Fatal application error
- 2. Application is severely impaired
  - no workaround can be found
- 3. Some functionality is impaired
  - workaround can be found
- 4. Minor problem
  - not involving primary functionality

Business value

- 1. An essential functionality without which the application is useless
- 2. An important functionality that users rely on
- 3. A functionality that users need but can be without
- 4. A minor enhancement

Risk

- 1. A serious threat, the so-called "showstopper"
  - if unresolved, the project is in serious trouble
- 2. An important threat that cannot be ignored
- 3. A distant threat that still merits attention
- 4. A minor inconvenience

Process needs

- 1. Key requirement
  - if not implemented in advance, practically all code will have to be redone
- 2. An important requirement
  - if postponed, will lead to large rework
- 3. A nontrivial rework will be required if this requirement is postponed
- 4. A minor rework will be triggered

Change Initiation process

- Select a set of the highest priority requirements
- Analyze these requirements
- After this analysis, select the highest priority requirement as the next change request

Change Initiation