Metrics for Reuse

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Size and Reuse

- Reuse is the extent to which the software is new
  - Size of the reused product

- Extent of Reuse
  - Reused Verbatim (reused as is)
  - Slightly modified (< 25% LOC)
  - Extensively Modified (> 25% LOC)
  - New (nothing comes from a previous code)

Measuring Size

- Size is the most obvious software attribute which can be measured statically

- Aspects of size
  - Length: physical size
  - Functionality: what users get
  - Complexity: problem solved

How hard is measuring size?

- Each software artifact is a physical entity
  - It can be described in terms of size

- Measuring size should be simple and straightforward
  - And consistent with measurement theory

- In practice, measuring size (software) presents great challenges

Example: LOC is not Simple

- Measuring Lines of Code (LOC) is not fully consistent
  - Some lines are more difficult to code than others
  - One solution could be give weight to lines that have more “stuff”

- This problem also occurs with most software metrics

Bibliography

  - Sections 7.1 to 7.3
Software Reuse: Metrics and Models


Software Reuse

- Software reuse is the use of existing software artifacts or knowledge to create new software
- Reusability is the degree to which a thing can be reused

Metric and Models

- Organizations implementing systematic reuse must be able to measure
  - Quantify their progress
  - Identify the most effective reuse strategies
- A metric is a quantitative indicator of an attribute of a thing (software, process, ...)
- A model specifies relationships among metrics (and external attributes)

Reuse Metrics and Models

1. Cost-benefit analysis
2. Maturity assessment
3. Amount of reuse
4. Failure analysis
5. Reusability
6. Reuse library metrics

Cost-benefit Analysis

- Organizations need to justify the costs and time involved in reuse
  - They should be able to estimate these costs and potential payoffs
- Models for cost-benefit analysis allow a user to simulate the tradeoffs between reuse benefits and economic parameters
  - They measure a project without reuse and simulate it with reuse
Maturity Assessment

- Reuse maturity models assess how advanced a reuse program is
  - They are inspired by CMM / CMMI
- They categorize the reuse process by maturity level
  - The organization use the model to guide activities to achieve higher levels of reuse

Example of Reuse Maturity Model

- Ingrained level of reuse incorporates
  - Fully automated support tools
  - Accurate reuse measurement to track progress

Amount of Reuse

- Amount of reuse metrics are used to
  - assess and monitor the reuse improvement
  - track percentages of reuse of objects over time
- In general, a metric could be:
  \[
  \text{amount of life cycle object reused} \over \text{total size of life cycle object}
  \]
- A common form of this metric is:
  \[
  \frac{\text{lines of reused code in a system or module}}{\text{total lines of code in a system or module}}
  \]

Reuse Level

- A system is composed of parts at different levels of abstraction
  - The metric level of abstraction must be defined to measure reuse
- Level of abstractions for a Java program
  - System, Package, Class, Method, Lines of Code, etc.

Reuse Level Definitions

- Given that a higher level item is composed of lower level items
  - \( L = \text{the total number of lower level items in the higher level item} \)
  - \( E = \text{the number of lower level items from an external repository in the higher level item} \)
  - \( M = \text{the number of items not from an external repository that are used more than once} \)

Reuse Level Metrics

- External Reuse Level (ERL)
  \[ ERL = \frac{E}{L} \]
- Internal Reuse Level (IRL)
  \[ IRL = \frac{M}{L} \]
- Total Reuse Level (TRL)
  \[ TRL = ERL + IRL \]
Failure Analysis

- A reuse failure analysis supports understanding why reuse is not taking place in the organization
- Failure analysis can be used to
  - Evaluate the quality of a reuse program
  - Determine reuse impediments in an organization
  - Define an improvement strategy for a reuse program

Failure Analysis

- Reusability metrics indicate the likelihood that an artifact is going to be reused
  - These metrics are potentially useful for reuse design and reengineering for reuse
- Some attributes of a module that favor reusability
  - Fewer module calls (fan-out)
  - Fewer lines of code
  - Higher comment to code ratio

Reusability

Reuse Library Metrics

- A reuse library is
  - A repository for storing reusable assets
  - A interface for searching the repository
- Reuse library metrics are used to manage and track usage of a repository
- Examples
  - Reuse statistic: successfully reused by others
  - Time in use: reused in long-lasting systems

Reuse Library Metrics

Bibliography