What is a software metric, and why

A software metric is a measure of some property of a piece of software or its specifications.

- quality must be clearly defined
- quantitative methods have proved powerful in other sciences

“You can’t control what you can’t measure”

-- Tom DeMarco

What to measure

Product properties
- Lines of Code
- Number of classes
- Cohesion & Coupling
- Conformance of code to OO principles

Process properties
- Man-month spent on software
- Number of bugs introduced per hour
- Ratio of debugging/developing time
- CMM, PSP

McCabe Cyclomatic Complexity

A measure based on a connected graph of the module (shows the topology of control flow within the program)

Definition

\[ M = E - N + P \]

- \( M \) = cyclomatic complexity
- \( E \) = the number of edges of the graph
- \( N \) = the number of nodes of the graph
- \( P \) = the number of connected components.

Example of Cyclomatic Complexity

\[
\text{if condition then}
\text{code 1}
\text{else}
\text{code 2}
\text{end}
\]

\( E = 4, N = 4, P = 2 \)
\( M = 4 - 4 + 2 = 2 \)
Source Lines of Code

A measure of the number of physical lines of code.

Different counting strategies:
- Blank lines
- Comment lines
- Automatically generated lines

EiffelBase has 63,474 lines, Vision2 has 153,933 lines, EiffelStudio (Windows GUI) has 1,881,480 lines in all compiled classes.

Comment Percentage

Ratio of the number of commented lines of code divided by the number of non-blank lines of code.

Critique:
If you need to comment your code, you better refactor it.

OO metrics

- Weighted Methods Per Class (WMC)
- Depth of Inheritance Tree of a Class (DIT)
- Number of Children (NOC)
- Coupling Between Objects (CBO)
- Response for a Class (RFC)

Weighted Methods Per Class

Sum of the complexity of each feature contained in the class.
Feature complexity: (e.g. cyclomatic complexity)
When feature complexity assumed to be 1, WMC = number of features in class

In Eiffel base, there are 5,341 features,
In Vision2 (Windows), there are 10,315 features,
In EiffelStudio (Windows GUI), there are 89,630 features.

Depth of Inheritance Tree of a Class

Length of the longest path of inheritance ending at the current module

for CHAIN, DIT=7

Number of Children

Number of immediate subclasses of a class.

In Eiffel base, there are 3 classes which have more than 10 immediate subclasses:
- ANY
- COMPARABLE
- HASHABLE

And of course, ANY has most children.
Coupling Between Objects

Number of other classes to which a class is coupled, i.e., suppliers of a class.

In Eiffel base, there are 3 classes which directly depend on more than 20 other classes, they are:

- STRING_8
- STRING_32
- TUPLE

Class SED_STORABLE_FACILITIES indirectly depends on 91 other classes.

Response for a Class

Number of features that can potentially be executed in a feature, i.e., transitive closure of feature calls.

foo is do
  bar
end

bar is
  f1
  f2
end

Metrics tool in EiffelStudio

A code quality checking tool with seamlessly working style:
- Coding
- Metricing
- Problem solving
- Coding

Highly customizable:
- Define your own metrics to match particular requires

Metric archive comparison:
- Compare measurement of your software to others

Automatic metric quality checking:
- Get warned when some quality criterion are not met

Metrics tool – Evaluate metric

Metrics tool – Investigate result

Metrics tool – Define new metric