**Concordia University**

**SOEN 6611**

**SOFTWARE MEASUREMENT**

**Assignment 3**

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# Description of Understand API and Usage

"Understand" provides API access for 3 languages - Perl, Python and C. We have used Python module of "Understand" API which runs only for Python 3x versions. Python module for "Understand" API access is packaged with the "Understand" tool's installation and found in the directory *"SciTools/bin/pc-win64/python/"*. It is a DLL file (understand.pyd) whose path needs to added to the CLASSPATH variable of the system environment for any python modules to use it.

For using "Understand" API in Python scripts, we need to *import understand* module into the script. After importing, we need to open the "*.udb"* project file (in the script) created by "Understand" tool for the project source code. Now, the opened handle to the *".udb"* file can be used to invoke various methods (API's) for accessing information about the source code.

# Calculation of LCOM and CBO Measure

**CBO (Coupling between Objects)** is a measure of how many other classes, a class is coupled with. In other words, CBO of a single class measures the number of OTHER classes it USES + the number of OTHER classes USING it. Mathematically, it can be formulated as:



For calculating CBO, we performed the following steps:

1) Extract a Set of all the System Classes (.CPP files) (Excluding any classes which are part of Library). Global Classes and Classes defined in namespaces and nested namespaces were extracted (Recursion).

2) For each Class in the above Set, perform the following steps:

a) Find all other Classes which are using this Class (ent->dependsby() API)

b) Find all other Classes which are used by this Class (ent->depends() API)

c) Do a UNION of the Classes found in steps a) and b) to remove duplicates.

d) Do an INTERSECTION of the Set in step c) with the Set of all System Classes from step 1) to remove any non-system Classes (Classes in the library).

3) Count the number of items in the Set created in step 2-d). This is the CBO value of the Class.

4) Repeat steps 2) to 4) for all System Classes.

**LCOM (Lack of Cohesion)** is a measure of cohesiveness of a Class. LCOM (Hitz and Montazeri) is calculated by the number of disjoint components in a graph where each node represents a method. There is an edge between 2 nodes if they share a variable or 1 node calls the other. For calculating LCOM, we performed the following steps:

1) Extract a Set of all the System Classes (.CPP files) (Excluding any classes which are part of Library). Global Classes and Classes defined in namespaces and nested namespaces were extracted.

2) For each Class in the above Set, perform the following steps:

a) Extract the Set of Attributes defined in the Class.

b) Extract the Set of Methods defined in the Class.

c) Create an Array of Set of Methods if either of the following is TRUE:

i) Methods are sharing (accessing) a common attribute.

ii) One Method is calling other Method.

d) For the Array of Set created in step c) do the following until we have an Array of Set with no common element (i.e. the Intersection of all Sets must be null).

i) Find combination of Sets with common elements (i.e. their intersection must not be null) and merge them into one Set.

3) The Array of Set created in step 2-d) are all disjoint Sets. Count of this Array of Set is the LCOM value of the Class.

4) Repeat steps 2) to 4) for all System Classes.