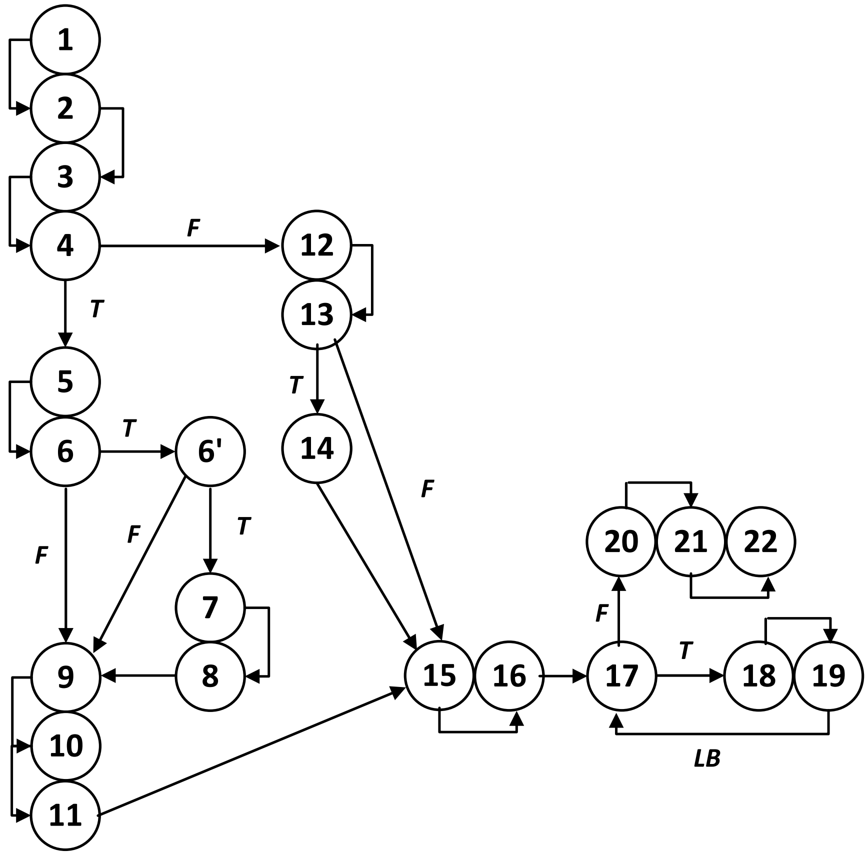
Concordia University
SOEN 6611 – Winter 2013
Software Measurement: Theory & Practice
Midterm Test Solutions

Exercise 1



Number of nodes: N = **23**
Number of edges: E = **27**
CC = E – N + 2 = 27 – 23 + 2 = **6**
Paths:
P1 <1, 2, 3, 4, 5, 6, 6’, 7, 8, 9, 10, 11, 15, 16,…>
P2 <1, 2, 3, 4, 5, 6, 6’, 9, 10, 11, 15, 16,…>
P3 <1, 2, 3, 4, 5, 6, 9, 10, 11, 15, 16,…>
P4 <1, 2, 3, 4, 12, 13, 14, 15, 16,…>
P5 <1, 2, 3, 4, 12, 13, 15, 16,…>
… is P6 <17, 20, 21, 22>
or P6’ <17, 18, 19, 17, 20, 21, 22>

Exercise 2

The correct slice profile is **B**

a) V_O = {`author`, `title`, `path`} Overlap = 0, Tightness = 0, Coverage = 1/3*(10/22 + 8/22 + 6/22) = 24/66 = 0.364

b) V_O = {`author`, `title`} Overlap = 1/2*(2/10 + 2/8) = 0.225, Tightness = 2/22 = 0.091, Coverage = 1/2*(10/22 + 8/22) = 18/44 = 0.409

The computation of variable `path` (statements 15-19) can be extracted in a separate method without causing any code duplication.

The computations of variables `author` (statements 1, 3-8, and 13-14) and `title` (statements 2-4, 9-12) share two common statements (3 and 4) that will have to be duplicated after extracting the computation of one of the two variables. However, the number of duplicated statements (2) is significantly smaller compared to the size of the variable slices (9 statements for `author`, and 7 for `title`) and thus further decomposition would have a positive impact.

Exercise 3

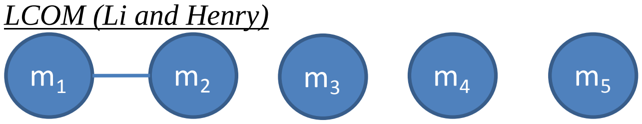
LCOM (Chidamber & Kemerer)

P = {(m_1, m_3), (m_1, m_4), (m_1, m_5), (m_2, m_3), (m_2, m_4), (m_2, m_5), (m_3, m_4), (m_3, m_5), (m_4, m_5)}

Q = {(m_1, m_2)}

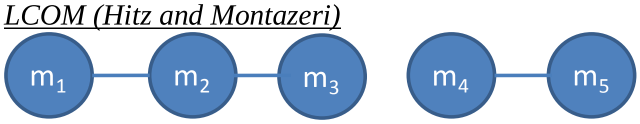
LCOM = |P| – |Q| = 9 – 1 = 8

LCOM (Li and Henry)



LCOM = number of unconnected components = 4

LCOM (Hitz and Montazeri)



LCOM = number of unconnected components = 2

LCOM (Henderson-Sellers)

$p(a_1) = 2$

$p(a_2) = 1$

$p(a_3) = 1$

$p(a_4) = 1$

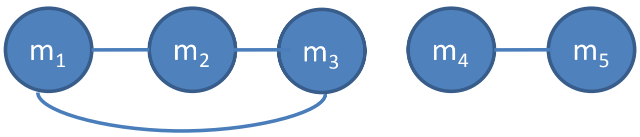
$p(a_5) = 1$

$$LCOM = \frac{5 - 6/5}{4} = \frac{19}{20}$$

Cohesion (Briand et al.)

$$Coh = \frac{6}{5 \times 5} = \frac{6}{25}$$

Tight Class Cohesion (Bieman and Kang)
(m_1, m_2) are connected because they access directly attribute a_1.
(m_2, m_3) are connected because m_2 accesses directly attribute a_1 and m_3 accesses a_1 through m_2.
(m_1, m_3) are connected because m_1 accesses directly attribute a_1 and m_3 accesses a_1 through m_2.
(m_4, m_5) are connected because m_4 accesses directly attributes a_4, a_5 and m_5 accesses a_4, a_5 through m_4.



$$TCC = \frac{4}{10}$$

Class Cohesion (Bonja & Kidanmariam)
sim(m_1, m_2) = 1/2
sim(m_1, m_3) = 0/3
sim(m_1, m_4) = 0/4
sim(m_1, m_5) = 0/2
sim(m_2, m_3) = 0/2
sim(m_2, m_4) = 0/3
sim(m_2, m_5) = 0/1
sim(m_3, m_4) = 0/3
sim(m_3, m_5) = 0/1
sim(m_4, m_5) = 0/2

$$CCoh = \frac{1/2}{10} = \frac{1}{20}$$

The most appropriate decomposition is $comp_1$ = {m_1, m_2, m_3, a_1, a_2, a_3} and $comp_2$ = {m_4, m_5, a_4, a_5}. The metrics that represent better this decision is LCOM by Hitz and Montazeri and Tight Class Cohesion by Bieman and Kang.

After the decomposition, both $comp_1$ and $comp_2$ will have LCOM and TCC values equal to 1.

Exercise 4

Coupling Between Objects (Chidamber and Kemerer)
CBO(*C*) = 4

Response For Class (Chidamber and Kemerer)
|M| = 2
|R| = 4
RFC(*C*) = 6

Message Passing Coupling (Li and Henry)
MPC(*C*) = 6
MPC'(*C*) = 7 (including invocations of inherited methods)

Coupling Factor (F. Brito e Abreu)

client(*A*, *C*) = 1
client(*C*, *superC*) = 1
client(*C*, *B*) = 1
client(*C*, *D*) = 1
client(*D*, *B*) = 0

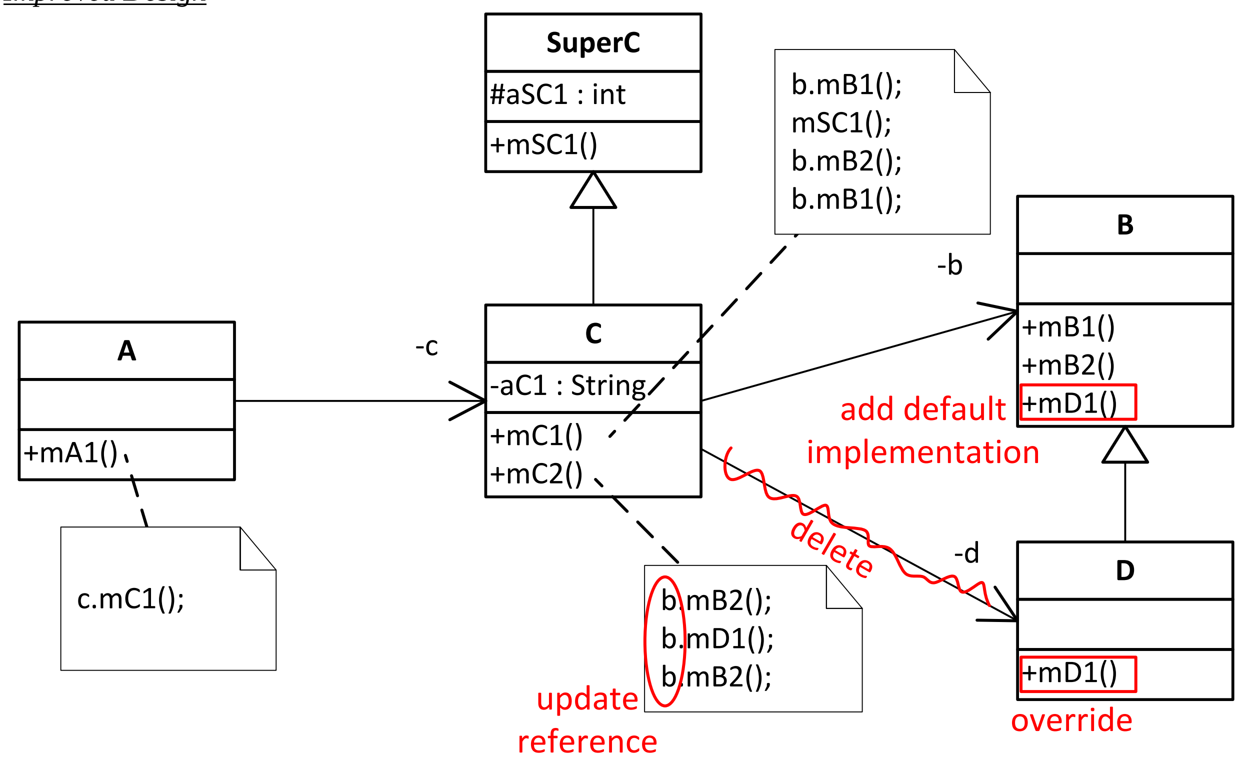
CF = 4/(25-5) = 4/20 = 1/5

Coupling Factor (Briand et al.)

client(*A*, *C*) = 1
client(*C*, *superC*) = 0
client(*C*, *B*) = 1
client(*C*, *D*) = 1
client(*D*, *B*) = 0

CF' = 3/(25-5-4) = 3/16

Improved Design



Affected metrics

CBO(*C*) = 3

client(*C*, *D*) = 0
CF = 3/20
CF' = 2/16

RFC and MPC are unaffected.