Kiel University
Christian-Albrechts-Universität zu Kiel
Faculty of Engineering

Intelligent Systems

Exercise 10 - Classification and Anomalies

Simon Reichhuber

January 20, 2020

University of Kiel, Winter Term 2019

Table of Content

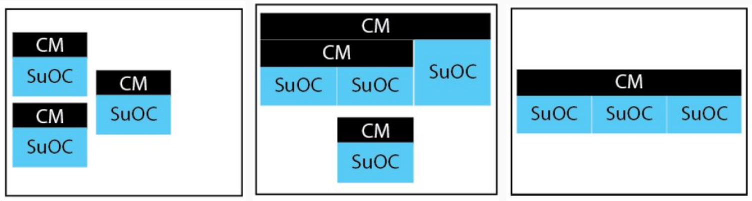
Quantifying self-organised systems

1. A

A. **compute the static degree of self-organisation**
B. categorise the static degree of self-organisation

Kiel University
Christian-Albrechts-Universität zu Kiel
Faculty of Engineering

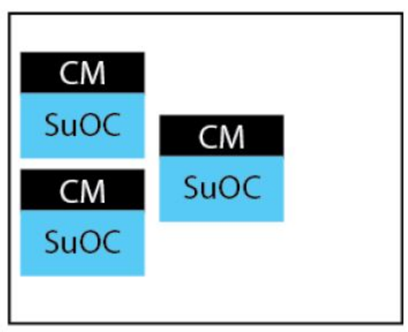
Compute the static degree of self-organisation



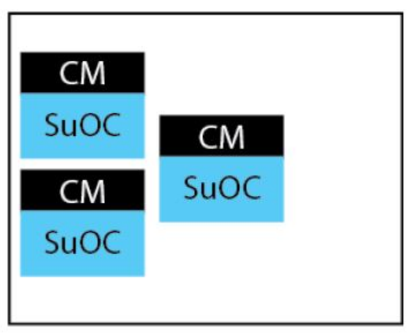
System 1 System 2 System 3

Three different self-organised systems.

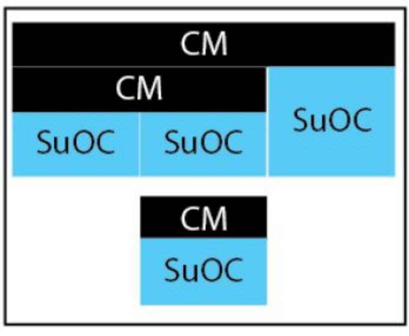
1. A System 1



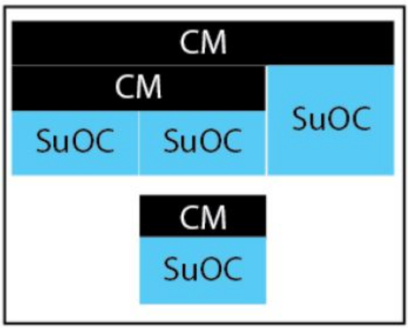
Strongly self-organised
$k = 3$
$m = 3$
$(3 : 3)$



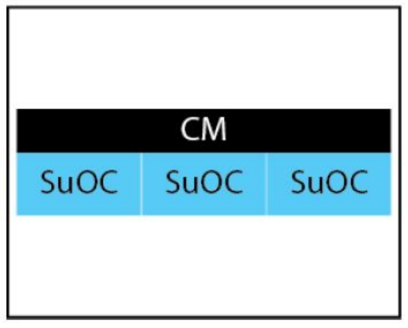
1. A System 2



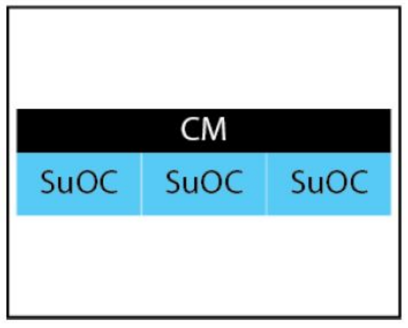
Self-organised
$k = 2$
$m = 4$
$(2 : 4)$



1. A System 3



Weakly self-organised
$k = 1$
$m = 3$
$(1 : 3)$



1. B

A. compute the static degree of self-organisation

B. categorise the static degree of self-organisation

Let S be an adaptive system consisting of m elements ($m > 1$) und and k fully or partially distributed control mechanisms CM ($k \geq 1$). Then, the static degree of self-organisation is given as ($k : m$), which is categorised under one of the following categories:

Kiel University
Christian-Albrechts-Universität zu Kiel
Faculty of Engineering

Strongly self-organised system

A system with $k = m$ and a static degree of self-organisation $(m : m)$ is named **strongly self-organised**

Self-organised

A system with $m > k > 1$ and a static degree of self-organisation $(k : m)$ is named **self-organised**.

Weakly self-organised

A system with $k = 1$ and a static degree of self-organisation $(1 : m)$ is named **weakly self-organised**.

categorise the static degree of self-organisation

System 1	System 2	System 3
$k = 3$	$k = 2$	$k = 1$
$m = 3$	$m = 4$	$m = 3$
$(3 : 3)$	$(2 : 4)$	$(1 : 3)$
$\Rightarrow$ **strongly s.-o.**	$\Rightarrow$ **s.-o.**	$\Rightarrow$ **weakly s.-o.**

Remark:

s.-o. $=$ self-organised

Dynamic degree of self-organisation

A. Build two graphs of the system for each observation

B. Quantify the self-organization of the process between the two observations

Build two graphs of the system for each observation

Observation$_1$

- Request message of size 10-packets using TCP protocol from router ID-102 to router ID-101
- Request message of size 12-packets using UDP protocol from router ID-101 to router ID-203
- Request message of size 03-packets using UDP protocol from router ID-203 to router ID-100
- Request message of size 06-packets using TCP protocol from router ID-100 to router ID-203
- Request message of size 01-packets using TCP protocol from router ID-007 to router ID-101
- Request message of size 05-packets using TCP protocol from router ID-101 to router ID-102

Kiel University
Christian-Albrechts-Universität zu Kiel
Faculty of Engineering

Two new routers of ID-301 and ID-311 added.

Observation$_2$

- Request message of size 05-packets using TCP protocol from router ID-102 to router ID-101
- Request message of size 03-packets (each) using UDP protocol from router ID-101 to routers ID-100 and ID-007
- Request message of size 12-packets (each) using UDP protocol from router ID-100 to routers ID-301 and ID-311
- Request message of size 01-packets using TCP protocol from router ID-301 to router ID-203
- Request message of size 10-packets using TCP protocol from router ID-100 to router ID-203

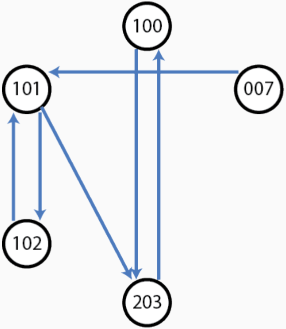
...

Observation$_2$

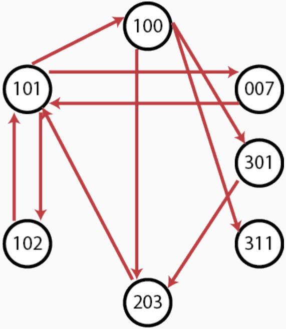
. . .

- Request message of size 06-packets using UDP protocol from router ID-203 to router ID-101
- Request message of size 02-packets using TCP protocol from router ID-007 to router ID-101
- Request message of size 05-packets using TCP protocol from router ID-101 to router ID-102

Kiel University
Christian-Albrechts-Universität zu Kiel
Faculty of Engineering



Observation 0



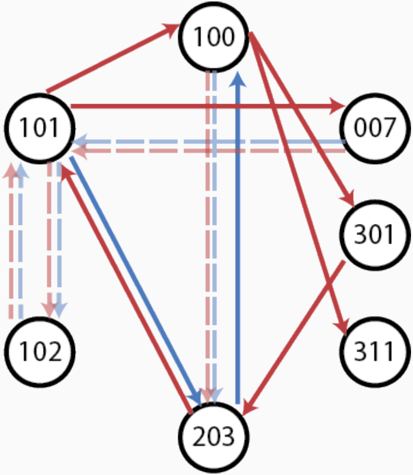
Observation 1

A. Build two graphs of the system for each observation

B. Quantify the self-organization of the process between the two observations

Quantify the self-organization of the process between the two observations

Formula given from the lecture:



$$\Delta(G_1, G_2) = \frac{|\{e_{ij} : e_{if} \in E_1 \oplus e_{ij} \in E_2\}|}{0.5 * (|V_1| + |V_2|)}$$

$$\Delta(G_1,\ G_2) =$$

$$\frac{8}{0.5\ *\ (5\ +\ 7)} \approx 1.33$$