Bayan Hendawi

1 I Rename attributes and objects for short as follows:

	a	b	c	d	e	f	g	h	i
1	X	X	X	X	X		X	X	X
2		X		X					X
3		X		X					X
4				X					
5		X	X	X	X	X			X
6		X							
7	X	X	X	X	X	X	X		X
8	X		X				X	X	X
9	X	X		X		X			X
10		X	X	X	X	X			X
11	X	X		X				X	X
12	X	X	X	X			X	X	X
13	X	X		X		X	X		X

$a'' = (1\ 7\ 8\ 9\ 11\ 12\ 13)'. ai$

$(ab)'' = (1\ 7\ 9\ 11\ 12\ 13)'. (aibd)$

$(abc)'' = (1\ 7\ 12)'. aibdcg$

$(abce)'' = (1\ 7)'. aibdcge$

$(abcef)'' = (7)'. aibdcgef$

$(abceh)''. (\emptyset)'. aibdcgefh$

$(abceh)'' = (1)'. aibdcgeh$

$(abfg)'' = (7\ 13)'. aibdg$

$(abg)'' = (1\ 7\ 12\ 13)'. aibdg$

$(abh)'' = (1\ 11\ 12)'. aibdh$

$(ac)'' = (1\ 7\ 8\ 12)'. aicg$

$(ach)' = (1\ 8\ 12)'. aicgh$

$(ag)'' = (1\ 7\ 8\ 12\ 13)'. aig$

$(ah)'' = (1\ 8\ 11\ 12)'. aih$

$(b)'' = (1\ 2\ 3\ 5\ 6\ 7\ 9\ 10\ 11\ 12\ 13)' = b$

$(bc)'' = (1\ 5\ 7\ 10\ 12)'. (bcdi)$

$(bce)'' = (1\ 5\ 7\ 10)'. (bcdie)$

$(bcef)''. (5\ 7\ 10)'. bcdief$

$(bd)''. (1\ 2\ 3\ 5\ 7\ 9\ 10\ 11\ 12\ 13)'. bdi$

$(bdf)'' = (5\ 7\ 9\ 10\ 13)'. \{bdif\}$

$(c)'' = (1\ 5\ 7\ 8\ 10\ 12)'. ci$

$(d)'' = (1\ 2\ 3\ 4\ 5\ 7\ 9\ 10\ 11\ 12\ 13)'. d$

$(i)'' = (1\ 2\ 3\ 5\ 7\ 8\ 9\ 10\ 11\ 12\ 13)'. i$

(G, ∅)

$\frac{11}{13}$ $\frac{11}{13}$

$\frac{11}{13}$ $^{11}/13$ $\frac{11}{13}$ $\frac{11}{13}$

1 2 3 5 6 7 9 10 11 12 13 , b

1 2 3 4 5 7 9 10 11 12 13 , d

1 2 3 5 7 8 9 10 11 12 13, i

$\frac{10}{13}$ $\frac{10}{11}$ $\frac{10}{13}$ $\frac{10}{11}$ $\frac{10}{13}$ $\frac{10}{11}$ $\frac{6}{13}$ $6/11$ $7/11$ $7/13$

1 2 3 5 7 9 10 11 12 13,
bdi

1 5 7 8 10 12 ,
ci

1 7 8 9 11 12 13,
ai

$\frac{5}{13}$ $\frac{5}{10}$ $\frac{5}{13}$ $\frac{5}{10}$ $\frac{5}{6}$ $\frac{5}{13}$ $\frac{6}{10}$ $\frac{6}{13}$ $\frac{6}{7}$ $\frac{7}{13}$ $\frac{5}{13}$ $\frac{5}{7}$ $\frac{4}{7}$ $\frac{4}{13}$

5 7 9 10 13 ,
bdif

1 5 7 10 12 ,
bcdi

1 7 9 11 12 13
aibd

1 7 8 12 13,
aig

1 8 11 12,
aih

$\frac{3}{13}$ $\frac{3}{5}$ $\frac{3}{6}$ $\frac{3}{13}$ $\frac{4}{13}$ $\frac{4}{5}$ $\frac{4}{5}$ $\frac{4}{13}$ $\frac{4}{13}$ $\frac{4}{6}$ $\frac{4}{5}$ $\frac{4}{13}$ $\frac{4}{13}$ $\frac{4}{6}$ $\frac{4}{5}$ $\frac{4}{13}$

7 9 13,
aibdf

1 5 7 10 ,
bcdie

1 7 12 13,
aibdg

1 7 8 12,
aicg

$\frac{3}{13}$ $\frac{3}{4}$ $\frac{3}{13}$ $\frac{3}{5}$ $\frac{3}{4}$ $3/13$ $\frac{3}{4}$ $\frac{3}{13}$ $3/13$ $\frac{3}{4}$ $3/13$ $\frac{3}{6}$ $3/13$ $\frac{3}{4}$ $\frac{3}{13}$

5 7 10 ,
bcdief

1 7 12,
aibdcg

1 8 12,
aicgh

1 11 12,
aibdh

$\frac{2}{13}$ $\frac{2}{3}$ $\frac{2}{13}$ $\frac{2}{3}$ $\frac{2}{3}$ $\frac{2}{13}$ $\frac{2}{4}$ $\frac{2}{3}$ $\frac{2}{13}$

7 13,
aibdfg

$\frac{2}{4}$ $\frac{2}{13}$

1 12,
aibdcgh

$\frac{2}{3}$ $\frac{2}{13}$ $\frac{2}{4}$

1 7,
aibdcge

$\frac{1}{13}$ $\frac{1}{2}$

$\frac{1}{2}$ $\frac{1}{13}$

1,
aibdcgeh

$\frac{1}{13}$ $\frac{1}{3}$ $1/2$ V_{13} $\frac{1}{2}$ $\frac{1}{13}$

7,
aibdcgef

∅.m

Bas

a →

c →

e →

f →

g →

h →

ab —

ac —

ad —

ae

cb

gb

hb

ib

c

c

c

Base of implications:

a → ai

c → ic

e → ibced

f → ifbd

g → gai

h → iha

ab → iabd

ac → gaci

ad → iabd

ae → gibcaed

cb → ibd

gb → gibad

hb → ibahd

ib → ibd

cd → ibcd

cf → ibcfed

ch → gicah

gd → gicah

hd → ibahd

id → ibd

he → gibcaehd

fh → gibcfaehd

gh → gicah

[3] I calculated support and confidence as you taught us in lecture, and I put it on lattice ~~giag~~ diagram.

- I wrote confidence in black.

support > $\frac{3}{13}$, confidence > $\frac{4}{10}$

- I wrote support in green.

(I marked the edges on diagram with pink color)

[4] I suppose $G^+ = \{G_1, G_2, G_3, G_4\}$

$G^- = \{G_5, G_6, G_7\}$

now let us take a look at closures of all possible combinations of objects • Class +

- $\emptyset'' = \emptyset$

- $G_1'' = G_1$ • $G_3'' = G_3$
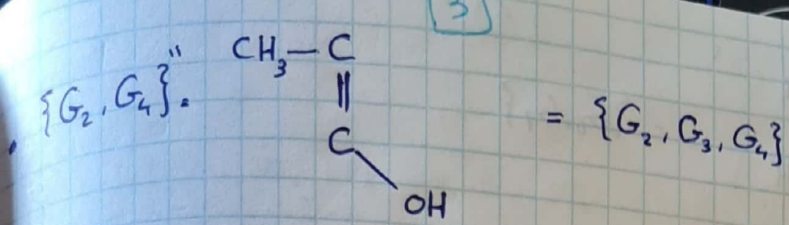
- $G_2'' = G_2$ • $G_4'' = G_4$

- $\{G_1, G_2\}'' = \left\{ \begin{array}{c} CH_3 - C - OH \\ \parallel \\ C \\ | \\ NH_2 \end{array} \right\} = \{G_1, G_2\}$

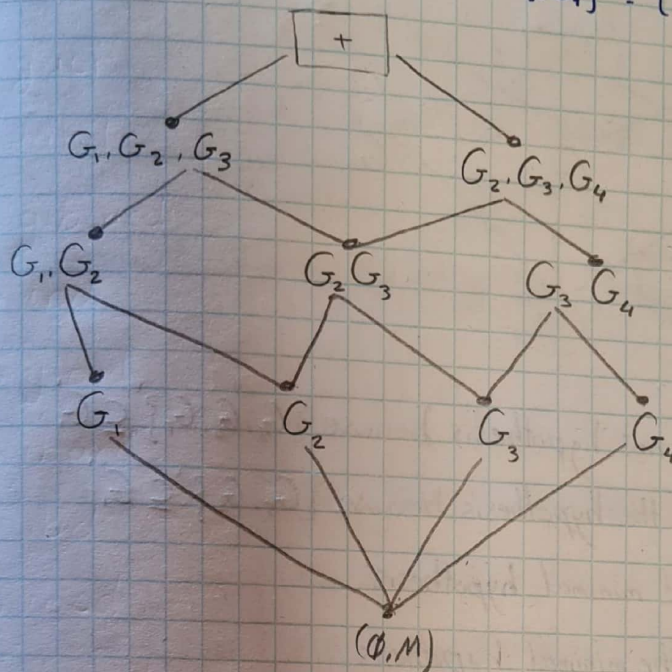- $\{G_1, G_3\}'' = \left\{ \begin{array}{c} CH_3 - C - OH \\ \parallel \\ C \end{array} \right\} = \{G_1, G_2, G_3\}$

- $\{G_1, G_4\}'' = \left\{ \begin{array}{cc} CH_3 - C & C - OH \\ \parallel & \parallel \\ C & , & C \end{array} \right\} = \{G_1, G_2, G_3, G_4\}$

- $\{G_2, G_3\}'' = \left\{ \begin{array}{cc} CH_3 - C - OH & CH_3 - C \\ \parallel & \parallel \\ C & , & C \\ & OH \end{array} \right\} = \{G_2, G_3\}$

$\{G_2, G_4\}''$:

$$CH_3-C \overset{\parallel}{\underset{C}{}} \diagdown OH$$

$= \{G_2, G_3, G_4\}$

$\{G_3, G_4\}''$:

$$\left\{ CH_3-C-Cl \overset{\parallel}{\underset{C}{}} \diagdown OH \quad , \quad CH_3-C \overset{\parallel}{\underset{C}{}} \diagdown Cl \right\} = \{G_3, G_4\}$$
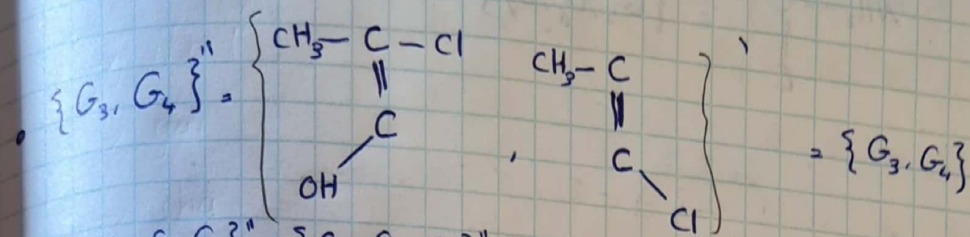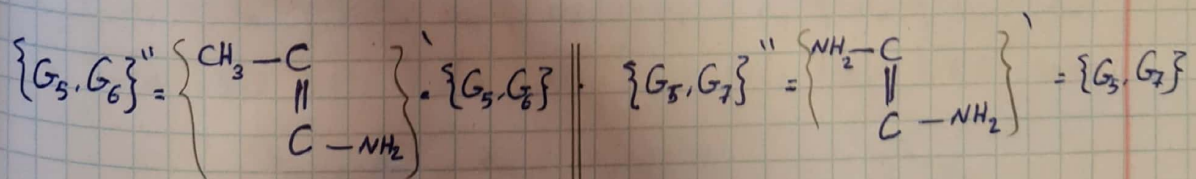
$\{G_1, G_2, G_3, G_4\}'' = \{G_1, G_3, G_4\}'' = \{G_1, G_2, G_3, G_4\}'' = \{G_1, G_4\}'' = \{G_1, G_2, G_3, G_4\}$

$$(\emptyset, M)$$

- $\{G_1, G_2, G_3\}$ is the minimal hypothesis.
- $\{G_3, G_4\}$ is the minimal hypothesis too.
- $\{G_1, G_2, G_3, G_4\}$ is not the hypothesis because $\{G_1, G_2, G_3, G_4\}$
  $\subseteq G_6$

- now let us
- Class -

$\emptyset'' = \emptyset$.

$G_5'' = G_5$, $G_6'' = G_6$, $G_7'' = G_7$

$\{G_5, G_6\}''$:

$$\left\{ CH_3-C \overset{\parallel}{\underset{C}{}} -NH_2 \right\} \cdot \{G_5, G_6\} \neq \{G_5, G_7\}'' = \left\{ NH_2-C \overset{\parallel}{\underset{C}{}} -NH_2 \right\} = \{G_5, G_7\}$$

$$\{G_6, G_7\}^{''} = \left\{ \begin{array}{c} NH_2 - C - Cl \\ \parallel \\ C - OH \end{array} \right\}^{'} = \{G_6, G_7\}$$

$$\{G_5, G_6, G_7\}^{''} \left\{ \begin{array}{c} NH_2 - C \\ \parallel \\ C \end{array} \right\}^{'} = \{G_5, G_6, G_7\}$$
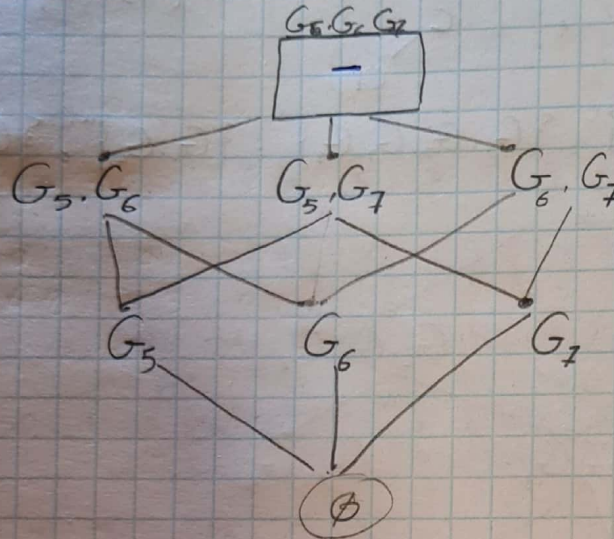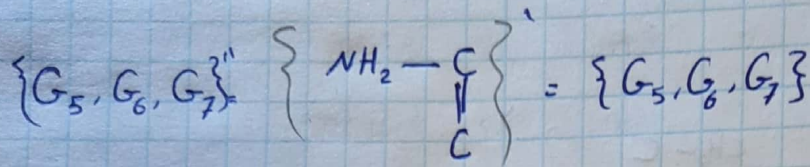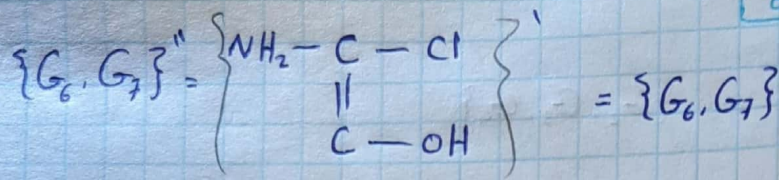
G_5, G_6, G_7

- $\{G_5, G_6, G_7\}$ is not hypothesis because $\{G_5, G_6, G_7\}^{'} \subseteq G_1^{'}$
- $\{G_5, G_6\}$ is not the hypothesis because $\{G_5, G_6\}^{'} \subseteq G_1^{'}$
- $\{G_5, G_7\}$ is the minimal hypothesis.
- $\{G_6, G_7\}$ is the minimal hypothesis.

G	a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	a_9	a_{10}	a_{11}	a_{12}	a_{13}	a_{14}	a_{15}	a_{16}
1	2	8	3	5	1	8	13	0	6	6	10	8	0	8	0	8
2	6	11	6	8	5	6	11	5	6	11	9	4	3	12	2	4
3	7	0	2	1	0	7	14	1	4	7	10	8	0	8	0	8
4	2	7	4	4	1	8	15	1	5	6	11	8	0	8	0	8
5	6	9	8	8	8	8	7	3	5	7	8	8	6	8	4	5
6	5	10	7	8	5	8	3	3	1	7	1	8	5	9	5	8
7	3	7	5	5	3	11	3	2	2	8	2	9	3	4	2	8

we will represent $G_1 \to G_7$ by rang So! for class $+$ $\emptyset'' = \emptyset$

G_1'

a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	a_9	a_{10}	a_{11}
2 2	8 8	3 3	5 5	1 1	8 8	13 13	0 0	6 6	6 6	10 10

a_{12}	a_{13}	a_{14}	a_{15}	a_{16}
8 8	0 0	8 8	0 0	8 8

, $G_1'' = G_1$

G_2'

a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	a_9	a_{10}	a_{11}
6 6	11 11	6 6	8 8	5 5	6 6	11 11	5 5	6 6	11 11	9 9

a_{12}	a_{13}	a_{14}	a_{15}	a_{16}
4 4	3 3	12 12	2 2	4 4

, $G_2'' = G_2$

G_3'

a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	a_9	a_{10}	a_{11}
1 1	0 0	2 2	1 1	0 0	7 7	14 14	1 1	4 4	7 7	10 10

a_{12}	a_{13}	a_{14}	a_{15}	a_{16}
8 8	0 0	8 8	0 0	8 8

, $G_3'' = G_4$

Scanned with CamScanner

G_4'

	a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	a_9	a_{10}
	2|2	7|7	4|4	4|4	1|1	8|8	15|15	1|1	5|5	6|6

	a_{11}	a_{12}	a_{13}	a_{14}	a_{15}	a_{16}
	11|11	8|8	0|0	8|8	0|0	8|8

$, \{G_4\}'' = G_4$

$\{G_1, G_2\}'$

	a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	a_9	a_{10}	a_{11}
	2|6	8|11	3|6	5|8	1|5	6|8	11|13	0|5	6|6	6|11	9|10

	a_{12}	a_{13}	a_{14}	a_{15}	a_{16}
	4|8	0|3	8|12	0|2	4|8

$, \{G_1, G_2\}'' = \{G_1, G_2\}$

$\{G_1, G_3\}'$

	a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	a_9	a_{10}	a_{11}
	1|2	0|8	2|3	1|5	0|1	7|8	13|14	0|1	4|6	6|7	10|10

	a_{12}	a_{13}	a_{14}	a_{15}	a_{16}
	8|8	0|0	8|8	0|0	8|8

$, \{G_1, G_3\}'' = \{G_1, G_3\}$

$\{G_1, G_4\}'$

	a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	a_9	a_{10}	a_{11}
	2|2	7|8	3|4	4|5	1|1	8|8	13|15	0|1	5|6	6|6	10|11

	a_{12}	a_{13}	a_{14}	a_{15}	a_{16}
	8|8	0|0	8|8	0|0	8|8

$, \{G_1, G_4\}'' = \{G_1, G_4\}$

$\{G_2, G_3\}'$

	a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	a_9	a_{10}	a_{11}
	1|6	0|11	2|6	1|8	0|5	6|7	11|14	1|5	4|6	7|11	9|10

	a_{12}	a_{13}	a_{14}	a_{15}	a_{16}
	4|8	0|3	8|12	0|2	4|8

$, \{G_2, G_3\}'' = \{G_2, G_3\}$

$\{G_2, G_4\}$

	a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	a_9	a_{10}
	2|6	7|11	4|6	4|8	1|5	5|8	11|15	1|5	5|6	10|11

	a_{11}	a_{12}	a_{13}	a_{14}	a_{15}	a_{16}
	9|11	4|8	0|3	8|12	0|2	4|8

$, \{G_2, G_3\}'' = \{G_2, G_3\}$

(partial, right page)

$\{G_3, G_4\}'$

	a_1	a_2
	1|2	0|7

$\{G_1, G_2, G_3 \ldots\}$

	a_1	$a_\ldots$
	1|6	0|1
		4|

$\{G_1, G_2 \ldots\}$

	a_{11}
	2|6	7

$\{G_1, G \ldots\}$

	a_1
	1|2

$\{G_2, \ldots\}$

	a_1
	1|6

$\{G_1 \ldots\}$

	a_1
	1|6

$\{G_3, G_4\}'$

a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	a_9	a_{10}	a_{11}
1|2	0|7	2|4	1|4	0|1	7|8	14|15	1|1	4|5	6|7	10|11

a_{12}	a_{13}	a_{14}	a_{15}	a_{16}
8|8	0|0	8|8	0|0	8|8

$$\{G_3, G_4\}'' = \{G_3, G_4\}$$

$\{G_1, G_2, G_3\}'$

a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	a_9	a_{10}	a_{11}
1|6	0|11	2|6	1|8	0|5	6|8	11|14	0|5	4|6	6|11	9|10

a_{12}	a_{13}	a_{14}	a_{15}	a_{16}
4|8	0|3	8|12	0|2	4|8

$$\{G_1, G_2, G_3\}'' = \{G_1, G_2, G_3\}$$

$\{G_1, G_2, G_4\}'$

a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	a_9	a_{10}	a_{11}
2|6	7|11	3|6	4|8	1|5	5|8	11|15	0|5	5|6	6|11	9|11

a_{12}	a_{13}	a_{14}	a_{15}	a_{16}
4|8	0|3	8|12	0|2	4|8

$$\{G_1, G_2, G_4\}'' = \{G_1, G_2, G_4\}$$

$\{G_1, G_3, G_4\}'$

a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	a_9	a_{10}	a_{11}
1|2	0|8	2|4	1|5	0|1	7|8	13|15	0|1	4|6	6|7	10|11

a_{12}	a_{13}	a_{14}	a_{15}	a_{16}
8|8	0|0	8|8	0|0	8|8

$$\{G_1, G_3, G_4\}'' = \{G_1, G_3, G_4\}$$

$\{G_2, G_3, G_4\}'$

a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	a_9	a_{10}	a_{11}
1|6	0|11	2|6	1|8	0|5	6|8	11|15	1|5	4|6	6|11	9|11

a_{12}	a_{13}	a_{14}	a_{15}	a_{16}
4|8	0|3	8|12	0|2	4|8

$$\{G_2, G_3, G_4\}'' = \{G_2, G_3, G_4\}$$

$\{G_1, G_2, G_3, G_4\}'$

a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	a_9	a_{10}	a_{11}
1|6	0|11	2|6	1|8	0|5	5|8	11|15	0|5	4|6	6|11	9|11

a_{12}	a_{13}	a_{14}	a_{15}	a_{16}
4|8	0|3	8|12	0|2	4|8

$$\{G_1, G_2, G_3, G_4\}' = \{G_1, G_2, G_3, G_4\}''$$

and now for (Class —)

(G₅')

~~6 6 / 1 1 / 6 6 / 8 8 / 5 5~~

a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	a_9	a_{10}	a_{11}
6|6	9|9	8|8	8|8	8|8	8|8	7|7	3|3	5|5	7|7	8|8

a_{12}	a_{13}	a_{14}	a_{15}	a_{16}
8|8	6|6	8|8	4|4	5|5

, $\{G_5\}'' = \{G_5\}$

(G₆')

a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	a_9	a_{10}	a_{11}
5|5	10|10	7|7	8|8	5|5	8|8	3|3	3|3	1|1	7|7	1|1

a_{12}	a_{13}	a_{14}	a_{15}	a_{16}
8|8	5|5	9|9	5|5	8|8

; $\{G_6\}'' = \{G_6\}$

(G₇')

a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	a_9	a_{10}
3|3	7|7	5|5	5|5	3|3	11|11	3|3	2|2	2|2	8|8

a_{11}	a_{12}	a_{13}	a_{14}	a_{15}	a_{16}
2|2	9|9	3|3	4|4	2|2	8|8

, $\{G_7\}'' = \{G_7\}$

$\{G_5, G_6\}'$

a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	a_9	a_{10}	a_{11}
5|6	9|10	7|8	8|8	5|8	8|8	3|7	3|3	1|5	7|7	1|8

a_{12}	a_{13}	a_{14}	a_{15}	a_{16}
8|8	5|6	8|9	4|5	5|8

, $\{G_5, G_6\}'' = \{G_5, G_6\}$

$\{G_5, G_7\}'$

a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	a_9	a_{10}	a_{11}
3|6	7|9	5|8	5|8	3|8	8|11	3|7	2|3	2|5	7|8	2|8

a_{12}	a_{13}	a_{14}	a_{15}	a_{16}
8|9	3|6	4|8	2|4	5|8

, $\{G_5, G_7\}'' = \{G_5, G_7\}$

$\{G_6, G_7\}'$

a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	a_9	a_{10}
3|5	7|10	5|7	5|8	3|5	8|11	3|3	2|3	1|2	7|8

a_{11}	a_{12}	a_{13}	a_{14}	a_{15}	a_{16}
1|2	8|9	3|5	4|9	2|5	8|8

, $\{G_6, G_7\}'' = \{G_6, G_7\}$

$\{G_5, G_6, G_7\}$

a_1: $3\ |\ 6$ a_2: $7\ |\ 10$ a_3: $5\ |\ 8$ a_4: $5\ |\ 8$ a_5: $3\ |\ 8$ a_6: $8\ |\ 11$ a_7: $3\ |\ 7$ a_8: $2\ |\ 3$ a_9: $1\ |\ 5$ a_{10}: $7\ |\ 8$ a_{11}: $1\ |\ 8$

a_{12}: $8\ |\ 9$ a_{13}: $3\ |\ 6$ a_{14}: $4\ |\ 9$ a_{15}: $2\ |\ 5$ a_{16}: $5\ |\ 8$

$\{G_5, G_6, G_7\}'' = \{G_5, G_6, G_7\}$

Classification:

G_8 unclear

G_9 unclear

G_{10} unclear

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22-12-2020