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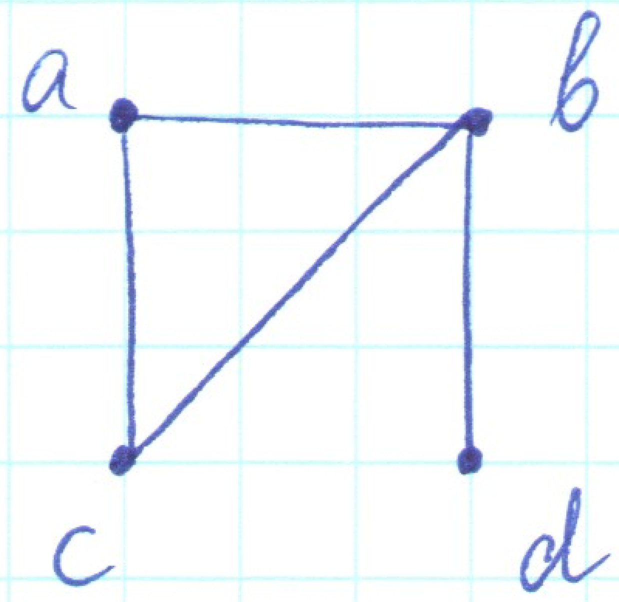

the graph has:

- undirected edges
- no loops
- no multiple edges

Therefore, it is a simple graph

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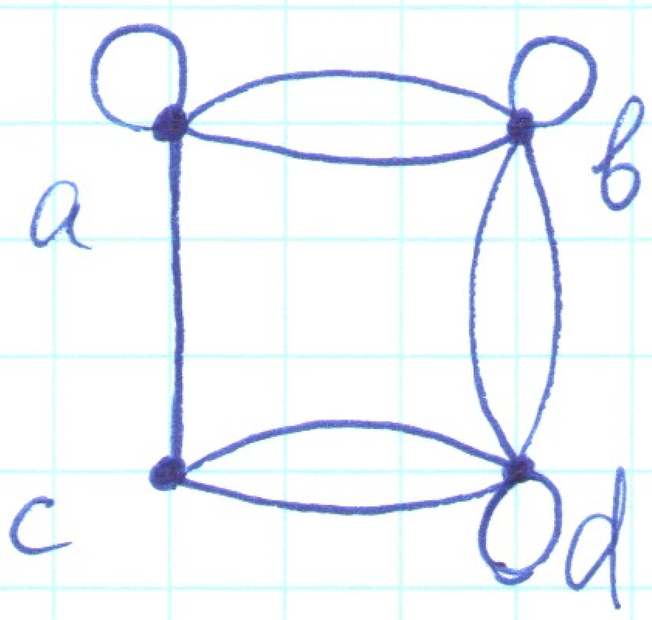

the graph has:

- undirected edges
- loops
- multiple edges

Therefore, it is a pseudograph.

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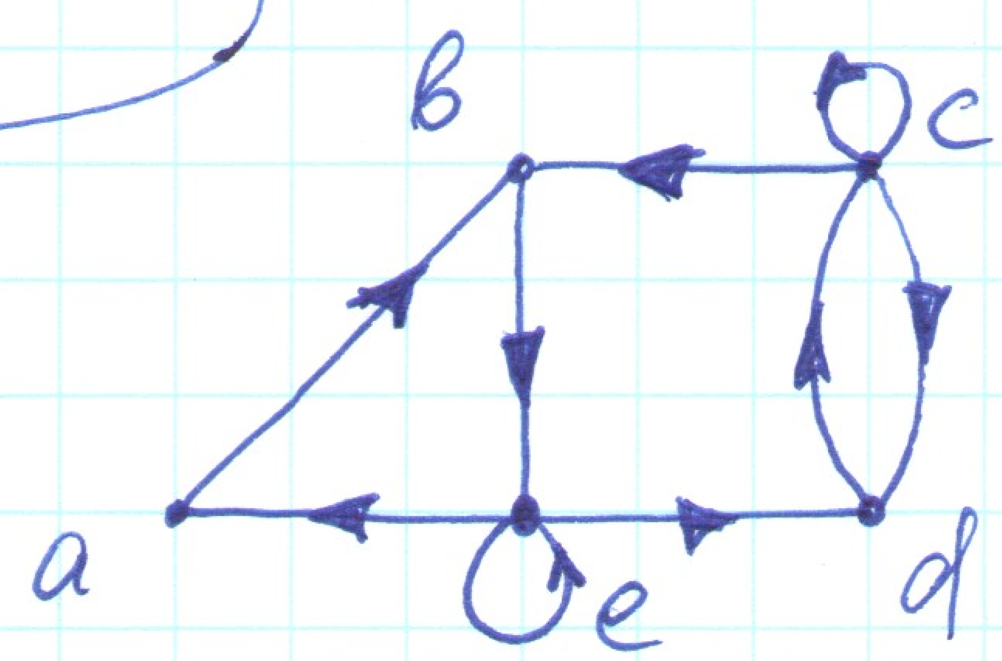

the graph has:

- directed edges
- loops
- no multiple edges

Therefore, it is a directed multigraph or directed graph

Note that the directed graph definition doesn't have any restrictions on loops/multiple edges, while multigraph (directed) allows both multiple edges and loops. Our graph has loops only, so to be formal, we should say that it is just a directed graph

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page 650/11 $G = (V, E)$ simple graph

relation R, uRv iff $\exists$ edge $\{u, v\}$

Show that R is symmetric and irreflexive on G.

Solution: simple graph has:

- undirected edges, hence if $\{u, v\} \in E$, then $\{v, u\} \in E$, therefore R is symmetric.
- no loops, therefore for any $v \in V$ $\{v, v\} \notin E$. Hence R is irreflexive.
- no multiple edges. (but we don't need to use it)

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p. 650/13 $A_1, A_2, \ldots, A_n$ - a collection of sets.

graph G: vertices: sets (A_i)

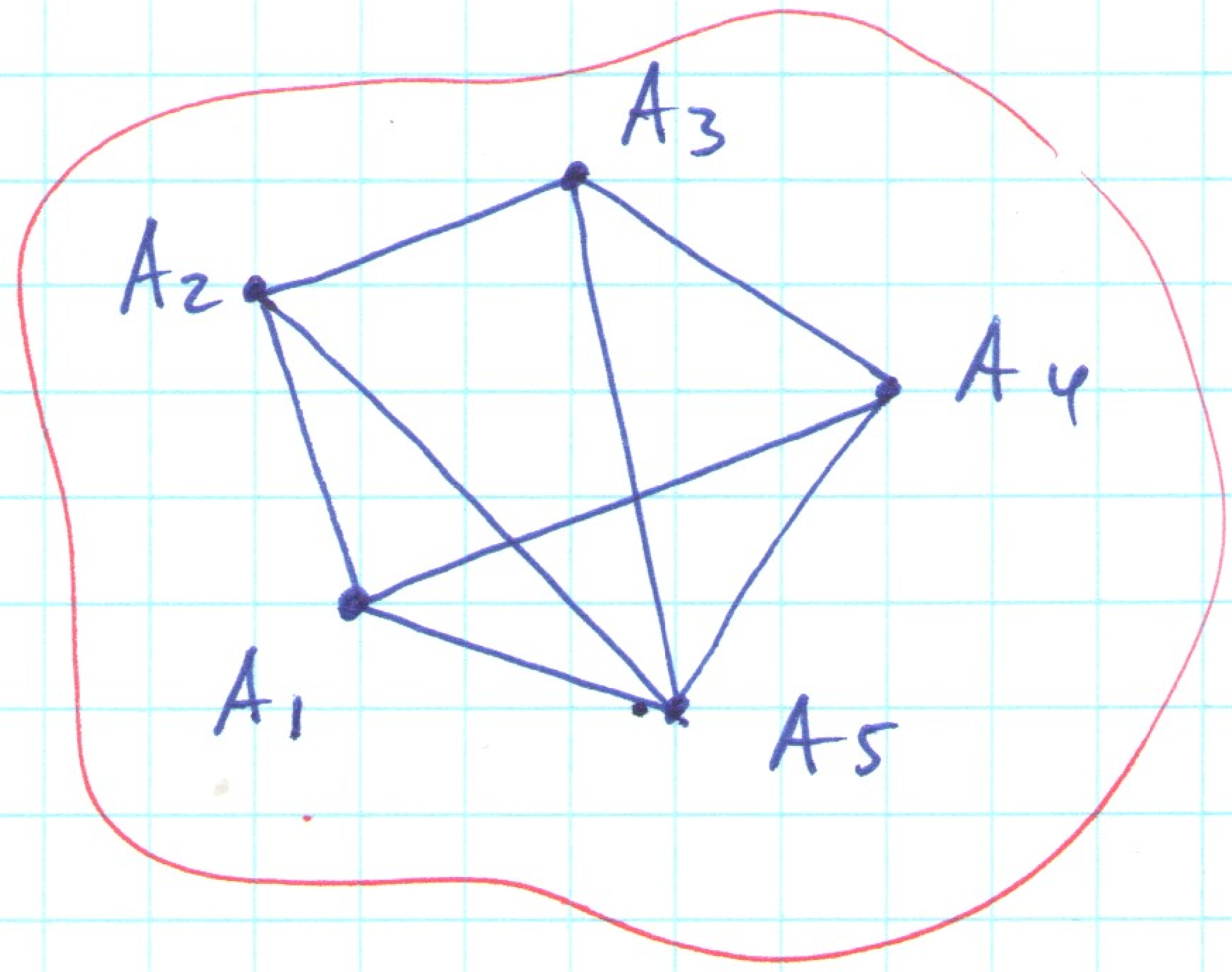
edges: if two sets have a non-empty intersection, then there is a edge between them.

a)

$A_1 \cap A_2 = \{0, 2, 4\} \neq \emptyset$
$A_1 \cap A_3 = \emptyset$
$A_1 \cap A_4 = \{6, 8\} \neq \emptyset$
$A_1 \cap A_5 = \{0, 8\} \neq \emptyset$

$A_2 \cap A_3 = \{1, 3\} \neq \emptyset$
$A_2 \cap A_4 = \emptyset$
$A_2 \cap A_5 = \{1\} \neq \emptyset$

$A_3 \cap A_4 = \{5, 7, 9\} \neq \emptyset$



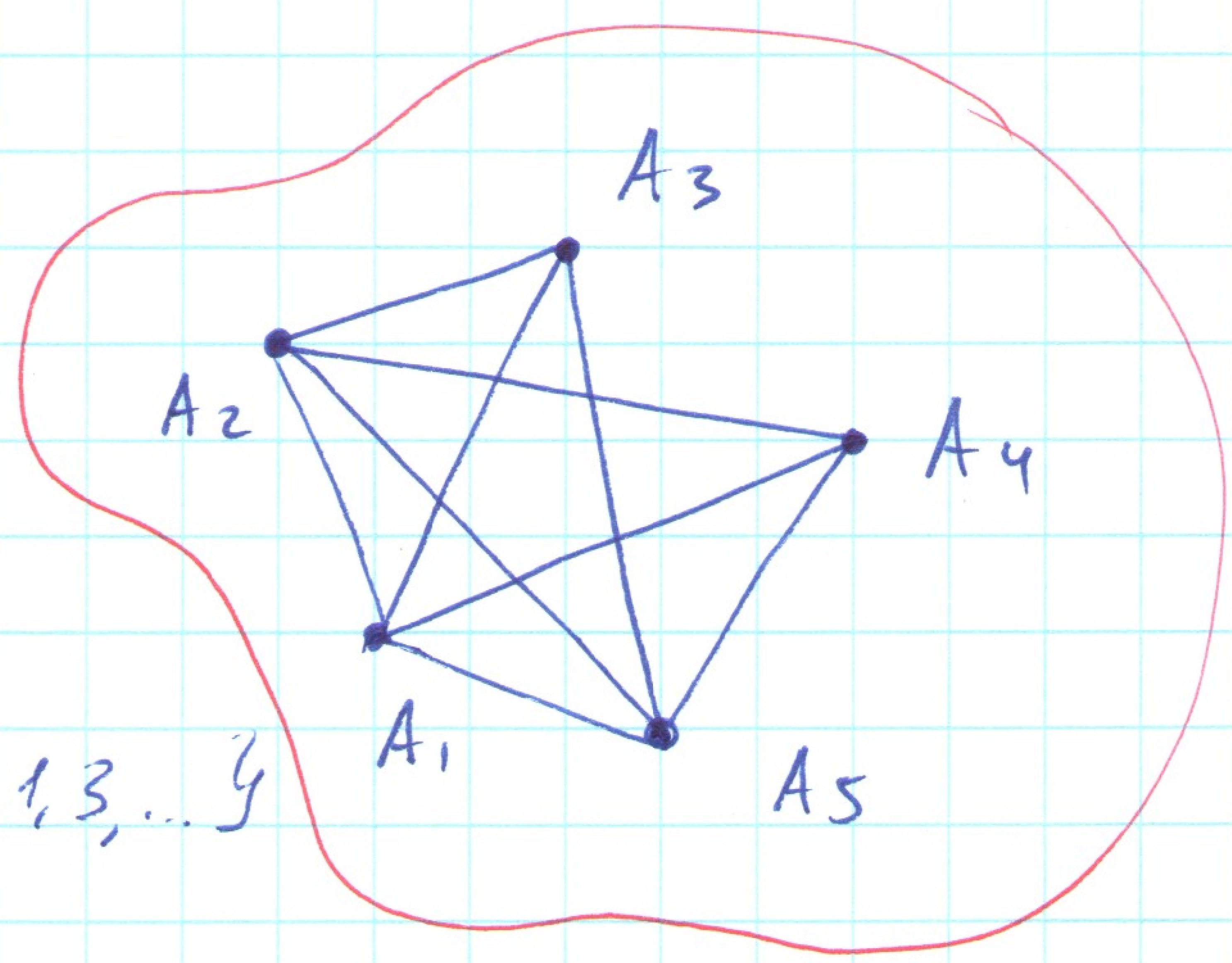
8 edges

$A_3 \cap A_5 = \{1, 9\} \neq \emptyset$ $A_4 \cap A_5 = \{8, 9\}$

b)

$A_1 \cap A_2 = \{-2, -1, 0\} \neq \emptyset$
$A_1 \cap A_3 = \{-2, 0\} \neq \emptyset$
$A_1 \cap A_4 = \{-3, -1\} \neq \emptyset$
$A_1 \cap A_5 = \{-3, 0\} \neq \emptyset$

$\{\ldots, -2, 0, 2, \ldots\}$
$A_2 \cap A_3 = \neq \emptyset$
$A_2 \cap A_4 \neq \emptyset = \{\ldots, -3, -1, 0, 1, 3, \ldots\}$
$A_2 \cap A_5 = \{0\} \neq \emptyset$



$A_3 \cap A_4 = \cancel{\{\ldots, -3, 0, 3, \ldots\}} \neq \emptyset$ $A_3 \cap A_5 = \{\ldots, -6, 0, 6, \ldots\} \neq \emptyset$

$A_4 \cap A_5 = \{\ldots, -3, 0, 3, \ldots\} \neq \emptyset$

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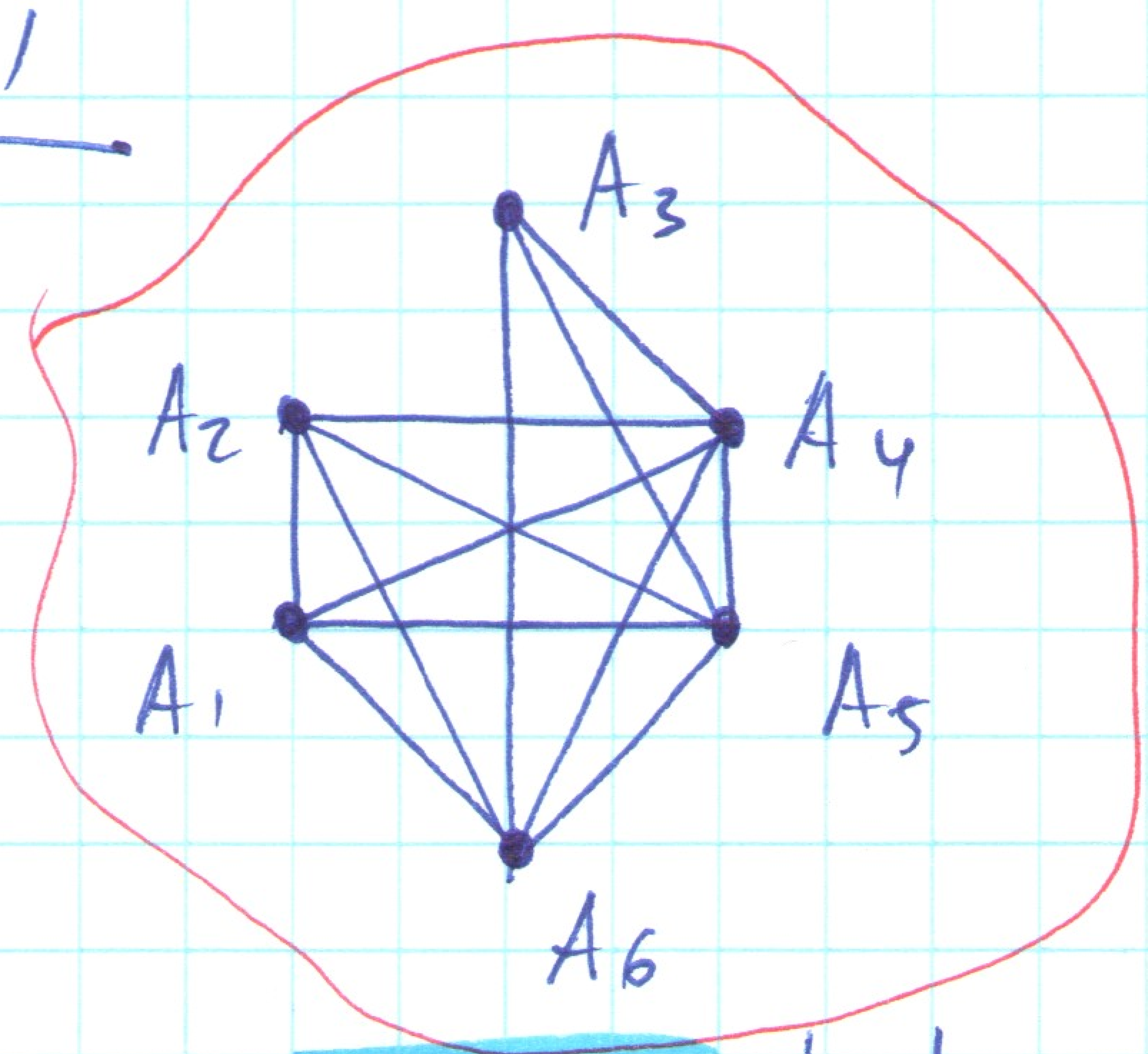
p. 650/13 c)



$A_1 \cap A_2 = \{x \mid -1 < x < 0\} = A_2$

$A_1 \cap A_3 = \emptyset$

$A_1 \cap A_4 = \{x \mid -1 < x < 0\}$ $\quad A_1 \cap A_5 = \{x \mid -1 < x < 0\}$

$A_1 \cap A_6 = \{x \mid x < 0\} = A_1$

$A_2 \cap A_3 = \emptyset$ $\quad A_2 \cap A_4 = \{x \mid -1 < x < 0\} = A_2$

$A_2 \cap A_5 = A_2$ $\quad A_2 \cap A_6 = A_2$

$A_3 \cap A_4 = \{x \mid 0 < x < 1\} = A_3$ $\quad A_3 \cap A_5 = A_3$ $\quad A_3 \cap A_6 = A_3$

$A_4 \cap A_5 = A_4$ $\quad A_4 \cap A_6 = A_4$ $\quad A_5 \cap A_6 = A_5.$

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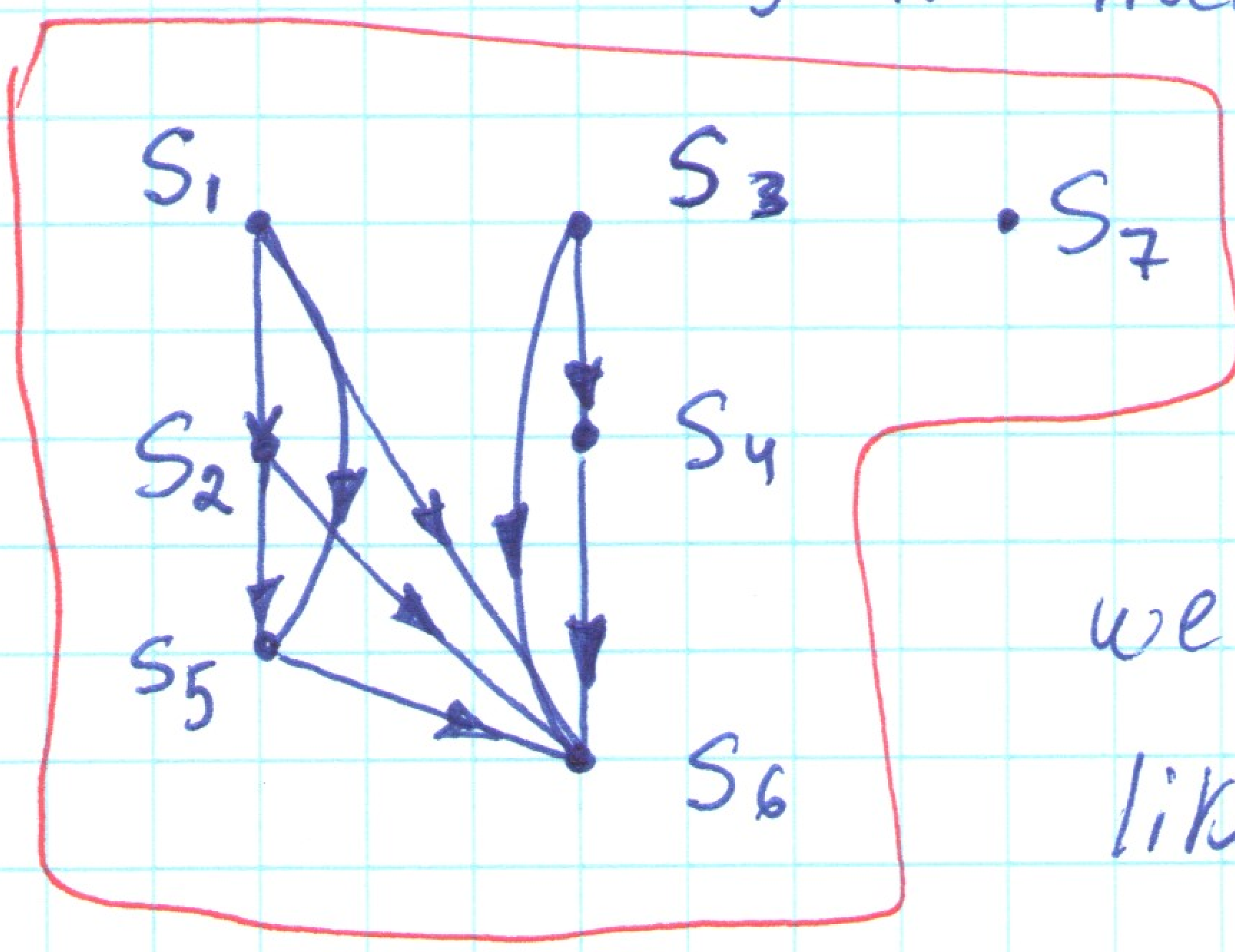
S_1 is needed in calculations ~~ad~~ in lines S_2, S_5, S_6
~~and in~~
S_3 is needed in calculations in lines S_4, S_6,



also S_1 and S_2 are needed for S_5, hence for S_6 as well.

we can flip it vertically to look like the answer in the book: