Concordia University
Department of Computer Science and Software Engineering

SOEN 331 - S and U
Introduction to Formal Methods
for Software Engineering

Assignment 4 - Solutions

Temporal Logic
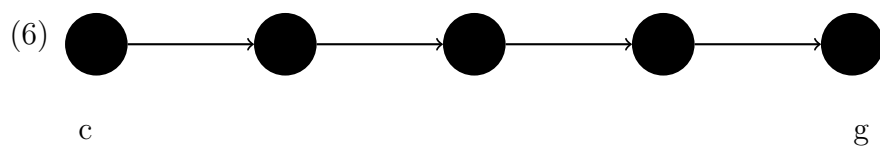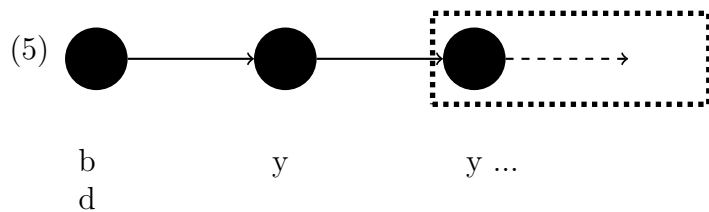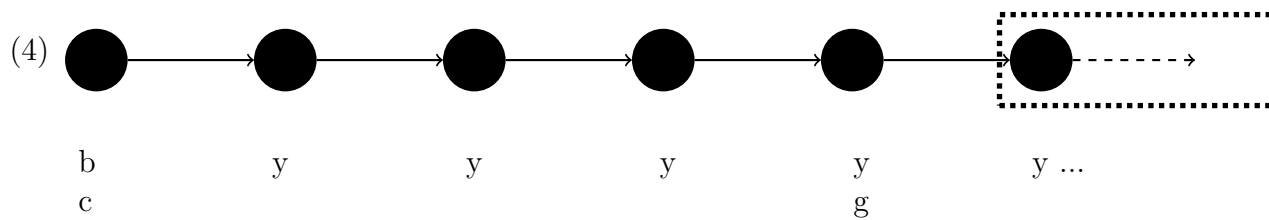
Team 19 - Section U

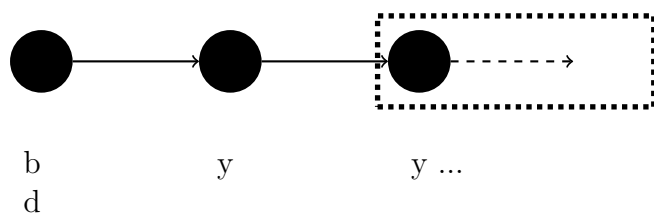**Samuel Boaknin**   **Ryan Leyland**   **Saleha Tariq**

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Date: April 19, 2021

1 Question 1

(1)

a e e e g
c
e

(2)

a y y y x w
d y

(3)

a y y y x z
d y n

b y y ...
d

(4)

b y y y y y ...
c g

(5)

b y y ...
d

(6)

c g

(7)

d   y   y ...
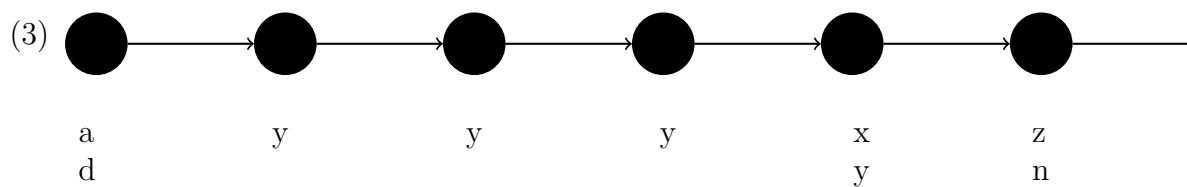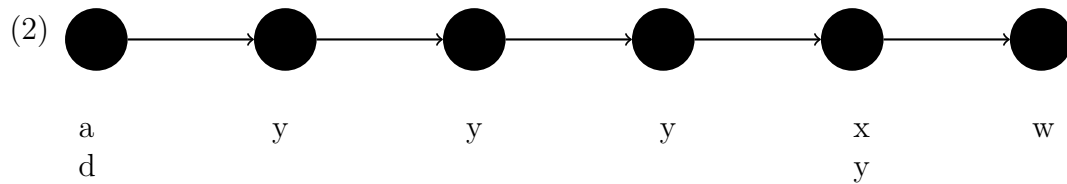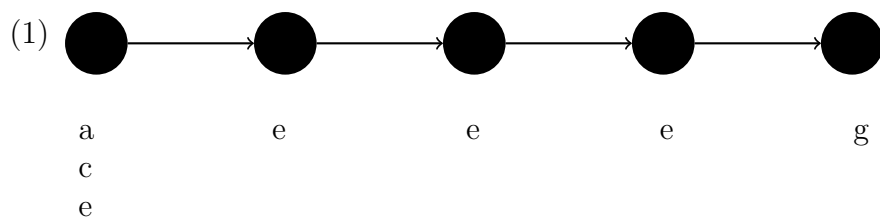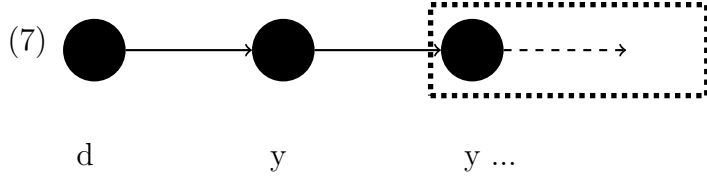
There exists three model's whereby the program terminates, given by the following expressions:

$< (a \wedge c \wedge e), \ e, \ e, \ e, \ g >$

$< (a \wedge d), \ y, \ y, \ y, \ (x \wedge y), \ w >$

$< c, \ \varnothing, \ \varnothing, \ \varnothing, \ g >$

2 Question 2

(1)

ϕ ϕ ...
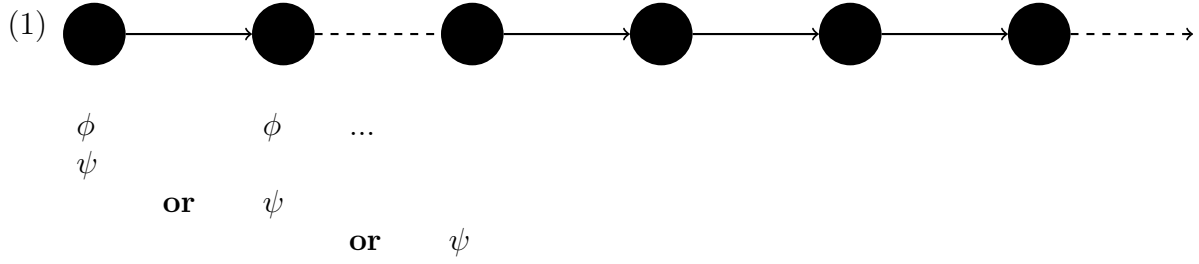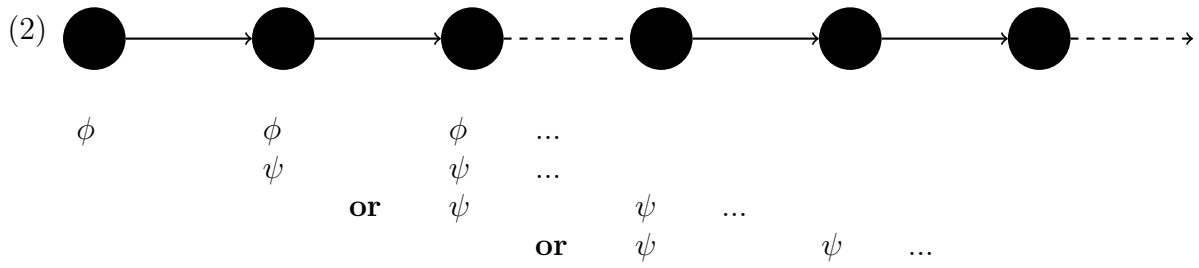ψ

or ψ

          or ψ

If ϕ is an invariant, then ψ is true in some moment in time.

(2)

ϕ ϕ ϕ ...
                ψ ψ ...

          or ψ ψ ...

                or ψ ψ ...

If ϕ is an invariant, then from $i + 1$ onwards, ψ will always eventually become true.

(3)

ϕ ψ
τ τ ...

          or τ τ ...

                or τ τ ...
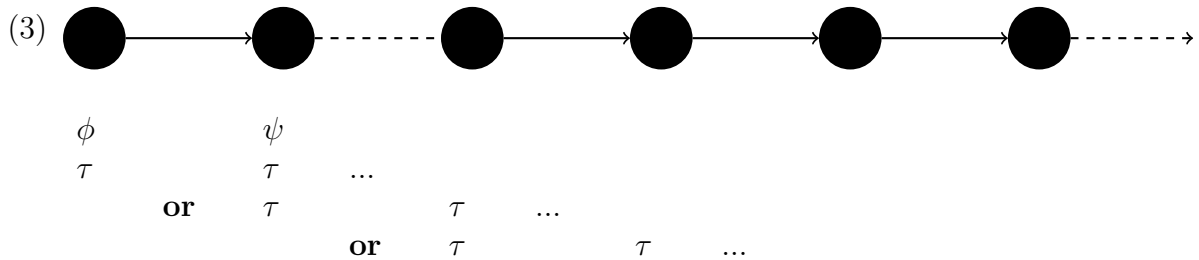
If ϕ is true at i and ψ is true at $i + 1$, then τ can become an invariant anywhere on the path.

(4)

ψ χ
                τ

If ψ is true at i and χ is true at $i + 1$, then τ is also true at $i + 1$.

(5)

$$\chi \qquad \omega \qquad \phi \qquad \phi \qquad \begin{matrix}\psi \\ \sim\phi\end{matrix}$$
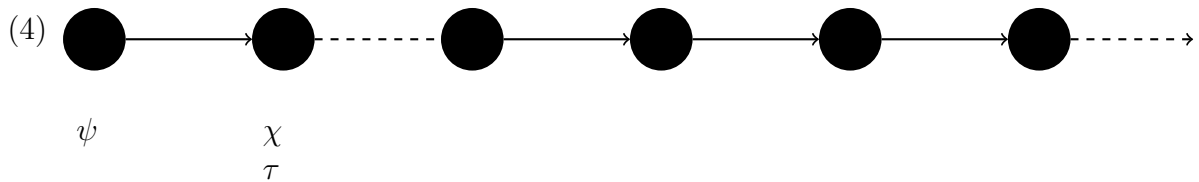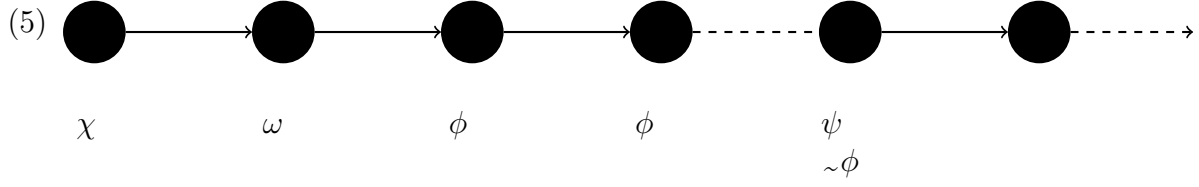
If χ is true at i and ω is true at $i+1$, then from $i+2$ onwards, ϕ is true until ψ becomes true.

(6)

$$\begin{matrix}\phi \\ \omega\end{matrix} \qquad \omega \qquad \begin{matrix}\dots \\ \omega\end{matrix} \qquad \omega \qquad \omega \qquad \omega$$

$$\begin{matrix}\psi \\ \omega\end{matrix} \qquad \omega \qquad \begin{matrix}\dots \\ \omega\end{matrix} \qquad \omega \qquad \omega \qquad \omega$$
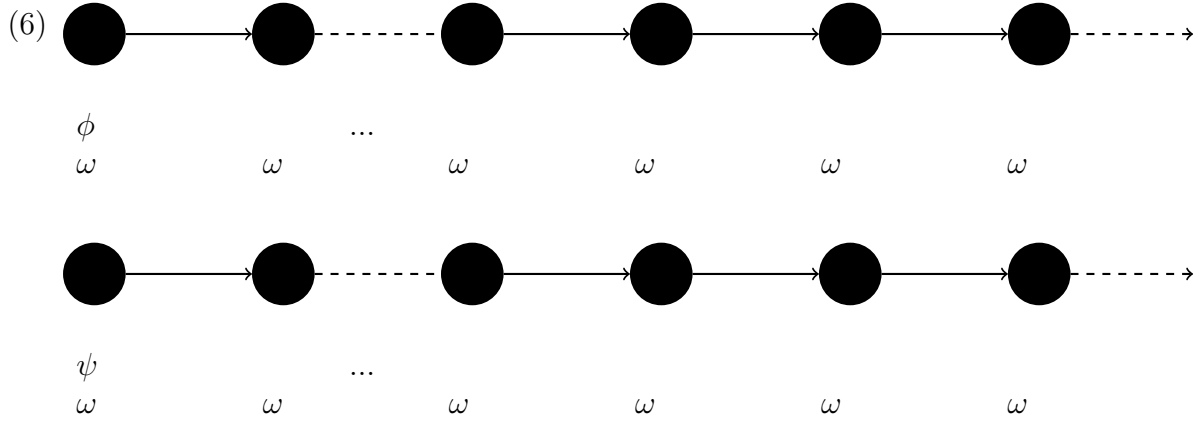
If only one of the mutually exclusive events ϕ or ψ is true, then ω will always be true.

(7)

$$\begin{matrix}\chi \\ \\ \omega\end{matrix} \qquad \begin{matrix}\chi \\ \psi \\ \end{matrix}$$

$$\text{or} \qquad \omega$$

$$\text{or} \qquad \omega \qquad \dots$$
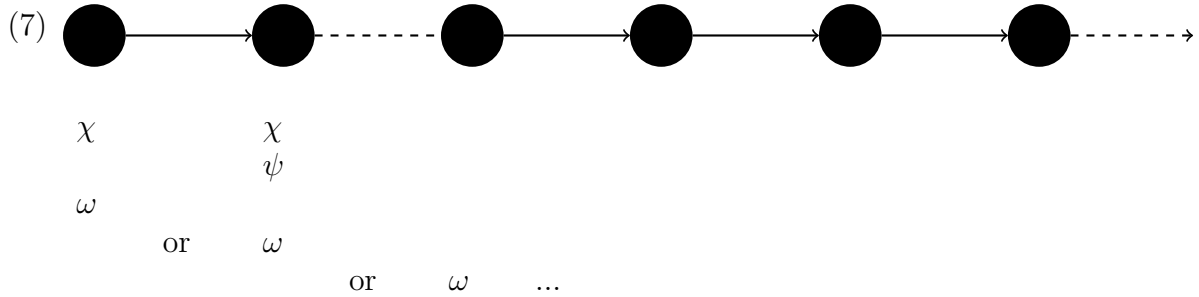
If χ is true at i and χ & ψ is true at $i+1$, then ω can emerge anywhere on the path.

(8)

$$\chi$$
$$\mu$$ $$\psi$$
       $$\tau$$ $$\tau$$ $$\tau$$ $$\omega$$
       $${\sim}\tau$$
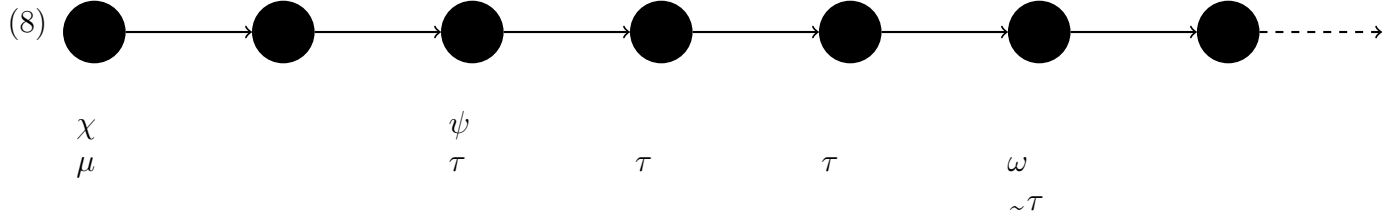
If χ is true at i and ψ is true at $i + 2$, then from $i + 2$ onwards, τ is true unless ω becomes true. If μ is true at i, then ω will be true at $i + 5$.