Assessed Coursework: Systems Verification

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Question 1

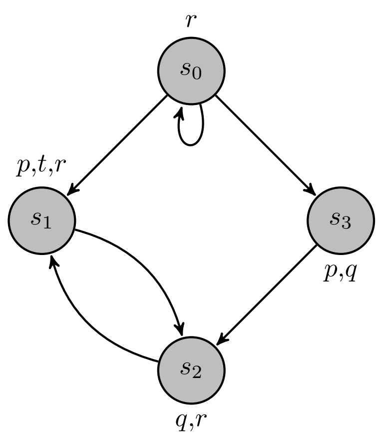

Figure 1: The transition system $\mathcal{M}_1$.

Algebraic Form

A transition system $\mathcal{M} = (S, \to, \pi)$ is a set of states S endowed with a transition relation $\to$ (a binary relation on S), such that every $s \in S$ has some $s' \in S$ with $s \to s'$, and an inverse labeling function $\pi : \mathcal{P} \to S$.

Our system $\mathcal{M}_1$ (figure: 1) can be described as following:
$\mathcal{P} = \{p, q, r, t\}$
$\mathcal{M}_1 = \{\{s_0, s_1, s_2, s_3\}, \{(s_0, s_0), (s_0, s_1), (s_0, s_3), (s_1, s_2), (s_2, s_1), (s_3, s_1)\}, \pi\}$
$\pi(p) = \{s_1, s_3\}$
$\pi(q) = \{s_2, s_3\}$
$\pi(r) = \{s_0, s_1, s_2\}$
$\pi(t) = \{s_1\}$

Infinite Tree

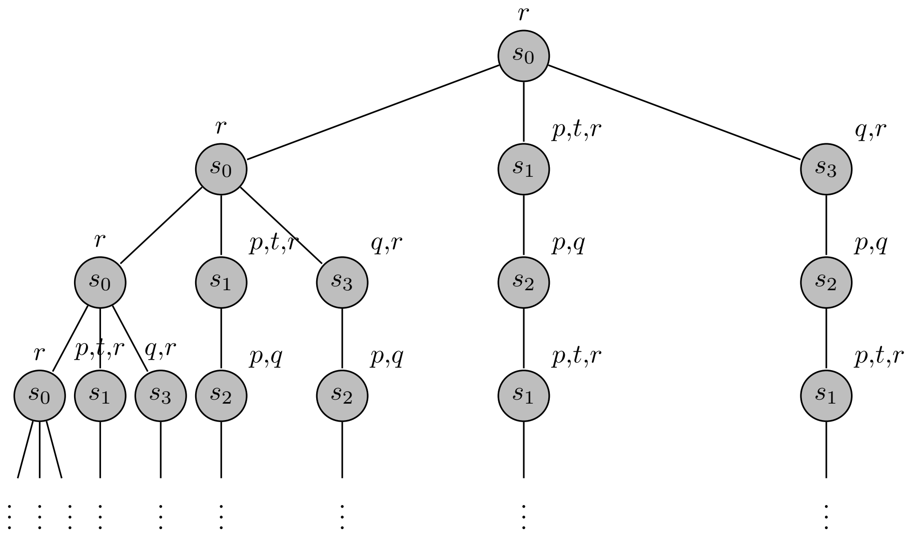

Figure 2: Unwinding the system described by $\mathcal{M}_1$ as an infinite tree of all computation paths beginning in s_0 (first layer).

Satisfiability

Question 2

Question 3

Question 4

Let $\phi = (x_1 \wedge x_2) \vee (y_1 \wedge y_2)$, the following truth table is derived to help us with our calculations

x_1	x_2	y_1	y_2	$x_1 \wedge x_2$	$y_1 \wedge y_2$	$(x_1 \wedge x_2) \vee (y_1 \wedge y_2)$
0	0	0	0	0	0	0
0	0	0	1	0	0	0
0	0	1	0	0	0	0
0	0	1	1	0	1	1
0	1	0	0	0	0	0
0	1	0	1	0	0	0
0	1	1	0	0	0	0
0	1	1	1	0	1	1
1	0	0	0	0	0	0
1	0	0	1	0	0	0
1	0	1	0	0	0	0
1	0	1	1	0	1	1
1	1	0	0	1	0	1
1	1	0	1	1	0	1
1	1	1	0	1	0	1
1	1	1	1	1	1	1

Binary Decision Tree

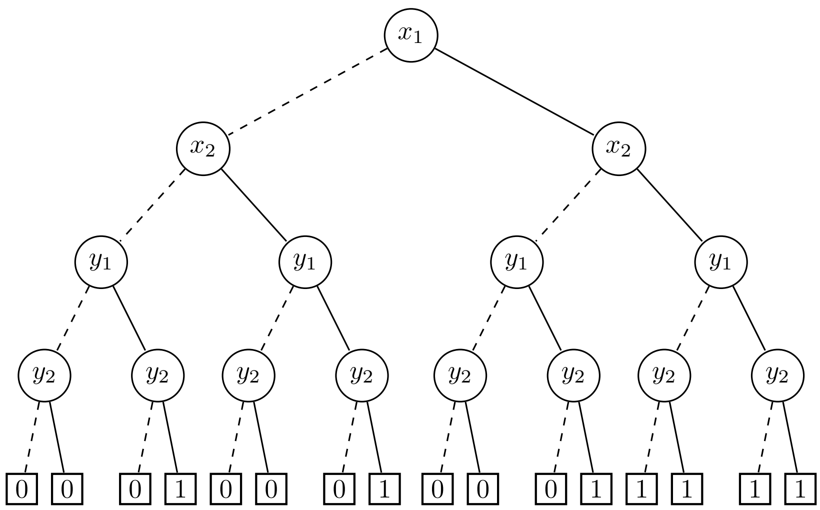

Figure 3: A BDT is easily derrived from the truth table. Every non-terminal node is labelled with a variable and every terminal node is labelled with either 0 or 1.

ROBDD for x1 x2 y1 y2

ROBDD for x1 y1 y2 x2

Discuss how ordering impacts ROBDD

Suggest an algorithm for choosing ordering