Chip Design
Summer Term 2016

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Exercise Set 10

Exercise 10.1:
Show that any instance of the *deadline* version of the DISCRETE TIME-COST TRADEOFF PROBLEM can be transformed into an equivalent instance in which all processing times are positive.

(5 points)

Exercise 10.2:
Consider a chain of $n \in \mathbb{N}$ continuously sizable inverters with sizes $x_i > 0$ ($1 \le i \le n$), as in Figure 1.
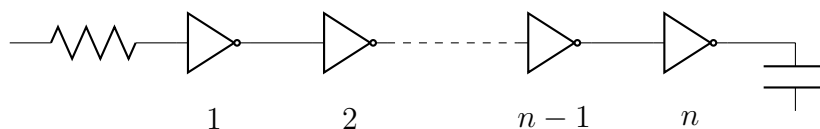
Figure 1

Assume that the delay θ_i through inverter i is given by

$$\theta_i(x) = \alpha + \frac{\beta \cdot x_{i+1} + \gamma}{x_i} \qquad \text{for } 1 \le i < n - 1$$

where $x = (x_1, \ldots, x_n)$, $\alpha, \gamma \ge 0$, $\beta > 0$. Wire delays, slews and transitions are ignored.

Derive a closed formula for the size x_i of the i-th inverter in a solution x of the total delay minimization problem, assuming x_1 and x_n are fixed:

$$\min \left\{ \sum_{i=1}^{n-1} \theta_i(x) \mid x_i > 0 \text{ for all } 2 \le i \le n - 1 \right\}.$$

(5 points)

Exercise 10.3:
Prove Proposition 4.17 from the lecture.

(5 points)

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Exercise 10.4:
Consider the netlist shown below in Figure 2. Assume that arrival times
at the primary inputs E_1 and E_2 and required arrival times at the primary
outputs A_1 and A_2 are all identical in each cycle. The latches Z_1 and Z_2
receive a clock signal once every cycle; this is the latest time when the signal
must be stable at the input and the earliest time that the signal at the output
can be used. Assume that for each net the delay from the source to any sink
is 10 ps, and the circuit delay is 20 ps for all circuits, except for the latches
which have no delay and circuit no. 8 whose delay is 40 ps. Determine the
maximum possible frequency (i.e. minimum possible cycle time), and the best
possible arrival times of the clock signals at the two latches (i.e. a solution
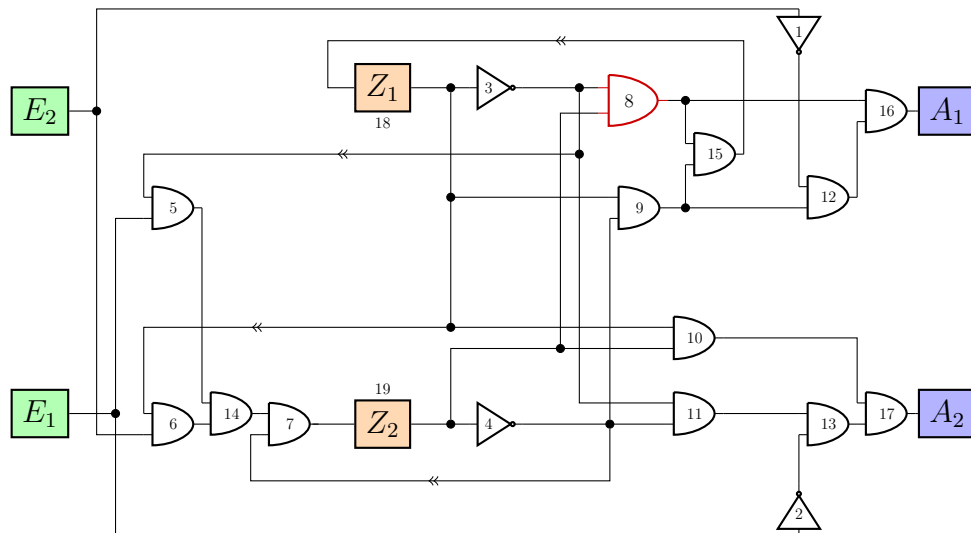of the corresponding instance of the SLACK BALANCING PROBLEM).

Figure 2

(5 points)

Deadline: July 7th, before the lecture. The websites for lecture and exer-
cises can be found at

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http://www.or.uni-bonn.de/lectures/ss16/ss16.html

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In case of any questions feel free to contact me at saccardi@or.uni-bonn.de.