Custom Computing: Assessed Coursework

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February 28, 2013

Question 1

Recurring engin eering costs are the costs that will occur in a repeating fashion during the production, usually involving fabriction. These costs are usually descriped in a per unit form.

Non-recurring engineering cost is the one-time up-front cost for research, design, testing and development of a new product.

As we can see below, the minimum number of units that need to be sold for the ASIC implementation to be cost-effective is 1 million units.

$C_{FPGA} > C_{ASIC} \Rightarrow £2 \times N_{units} > £10^6 + £1 \times N_{units} \Rightarrow N_{units} > 10^6$

Question 2

(a) Diagramatic and symbolic Simulation

Diagram of circuit Q1

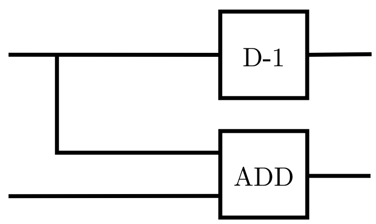

Figure 1: the circuit as derrived from Q1

Diagram of circuit P1

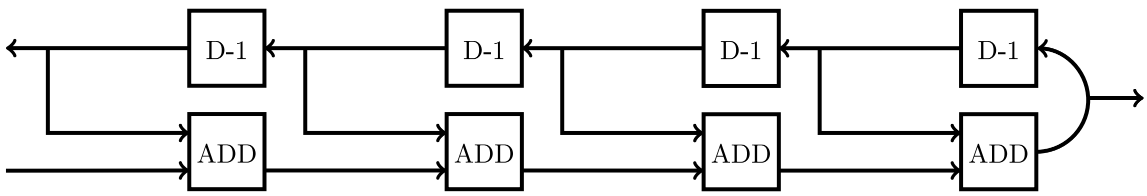

Figure 2: the circuit as derrived from P1

Simulation

The source code of the simulation (uninitialized delay) is the following:

```
INCLUDE "prelude.rby".
P1 n = Q1^n; fork^~1 .
Q1 = snd fork; rsh; [add,D^~1].
current = P1 4.
```

The circuit representation:

```
Name            Domain              Range
---------------------------------------
D ?             .1                  .2
D ?             .3                  .1
D ?             .4                  .3
D ?             .5                  .4
---------------------------------------
add             <.6,.2>             .7
---------------------------------------
add             <.7,.1>             .8
---------------------------------------
add             <.8,.3>             .9
---------------------------------------
add             <.9,.4>             .5
---------------------------------------

Directions -  <in,out> ~ out

Wiring -  <.6,.2> ~ .5

Inputs -  .6
```

The source code of the simulation (initialized delay with 0) is the following:

```
INCLUDE "prelude.rby".
P1 n = Q1^n; fork^~1 .
Q1 = snd fork; rsh; [add,DI 0^~1].
current = P1 4.
```

The circuit representation:

```
 Name            Domain              Range
---------------------------------------
D 0             .1                  .2
D 0             .3                  .1
D 0             .4                  .3
D 0             .5                  .4
---------------------------------------
add             <.6,.2>             .7
---------------------------------------
add             <.7,.1>             .8
---------------------------------------
add             <.8,.3>             .9
---------------------------------------
add             <.9,.4>             .5
---------------------------------------

Directions -  <in,out> ~ out

Wiring -  <.6,.2> ~ .5

Inputs -  .6
```

The simulation output (for 4 cycles) can be found in the included zip file.

Question 3

(a) Proof by induction

In order to show that $[P,Q]^n; R = R; Q^n$ for $n > 0$, we first have to show that it is $True$ for n = 1.

Base case: $[P,Q]^1; R = R; Q^1$

This is intuitively shown to be true by the given assumption $[P,Q]^n; R$ which is equivalent.

Assuming that it is also true for $n = k > 0$

$[P,Q]^k; R = R; Q^k$

We need to show that the same is true for $n = k + 1$

$[P,Q]^{k+1}; R$

$= [P,Q]^k; [P,Q]; R$

$= [P,Q]^k; R; Q$

$= R; Q^k; Q$

$= R; Q^{k+1}$

So by induction we have proved that if we know $[P,Q]; R = R; Q$ to be $True$, for $n > 0$:

$[P,Q]^n; R = R; Q^n$ is also $True$

Question 4