Take-Home Exam 2

Prob 1) $n=16$ $m=12$ TC

$$\left(-x_{15}2^{15}+\sum_{i=0}^{14}x_i 2^i\right)\left(-y_{11}2^{11}+\sum_{j=0}^{10}y_j 2^j\right)$$

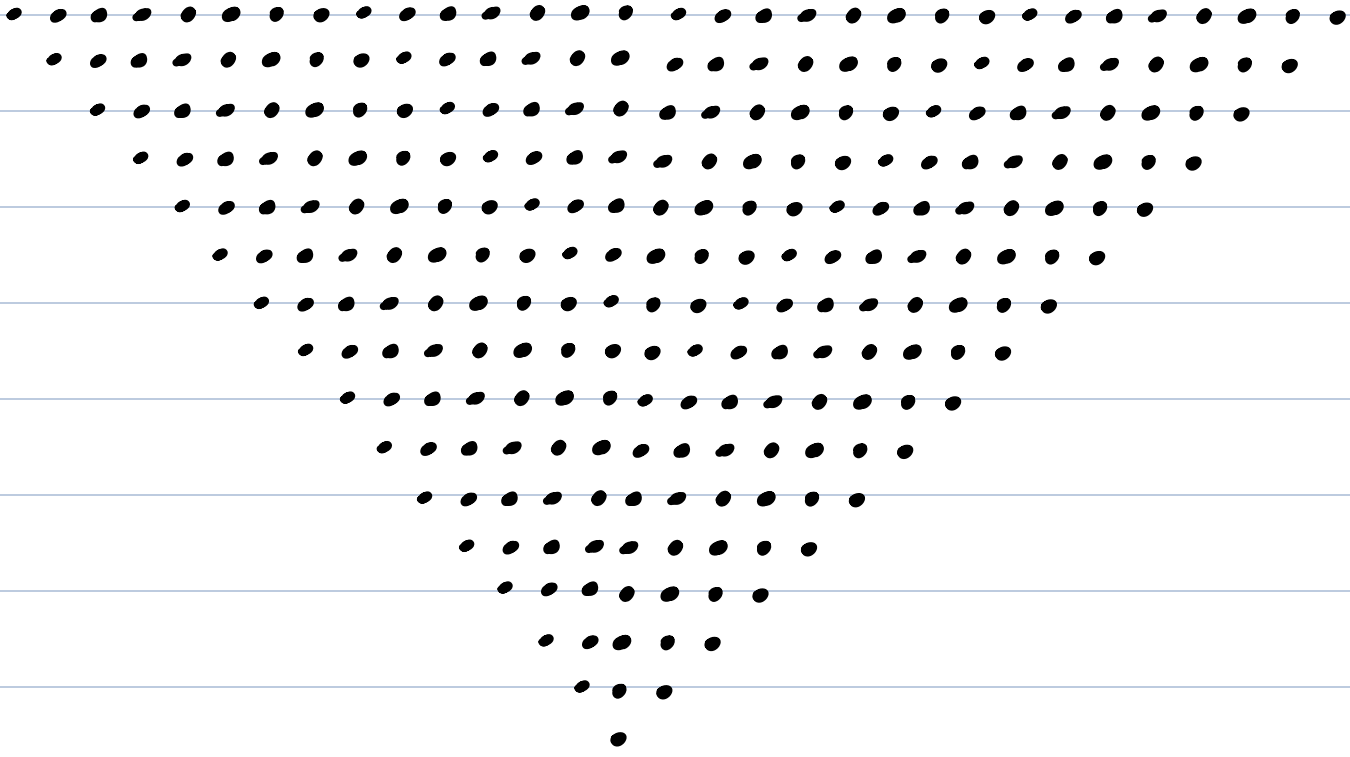
$$= x_{15}y_{11}2^{26}+\sum_{i=0}^{14}\sum_{j=0}^{10}x_i y_j 2^{i+j}+\sum_{i=0}^{14}\overline{x_i y_{11}}\,2^{i+11}+\sum_{j=0}^{10}\overline{x_{15}y_j}\,2^{j+15}+\underbrace{\left(2^{15}+2^{11}\right)}+\left(2^{15+11}+2^{15+11}\right)$$

$$+2^{15}+2^{11}$$

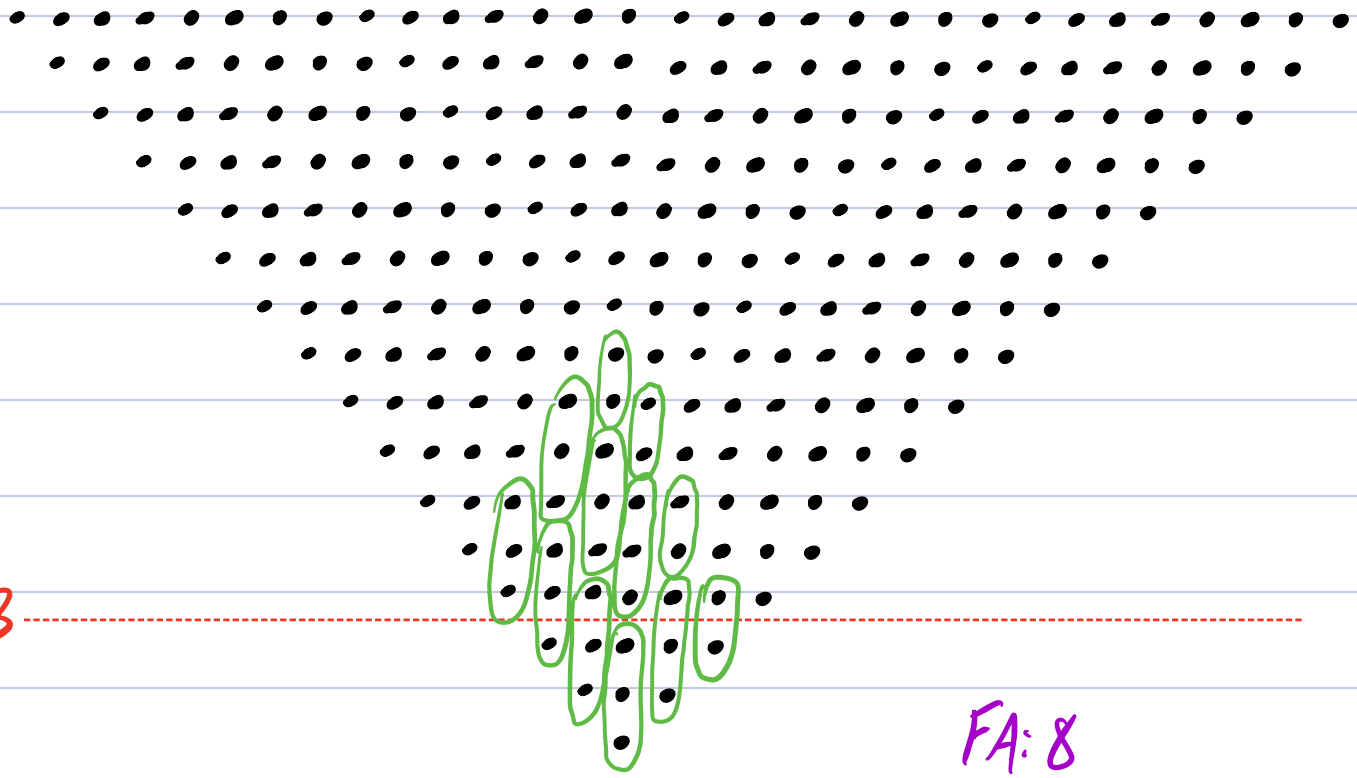
↓ ↓

Convert HAs to FA with $c_{in}=1$

Prob 2)



$d_6 = 13$

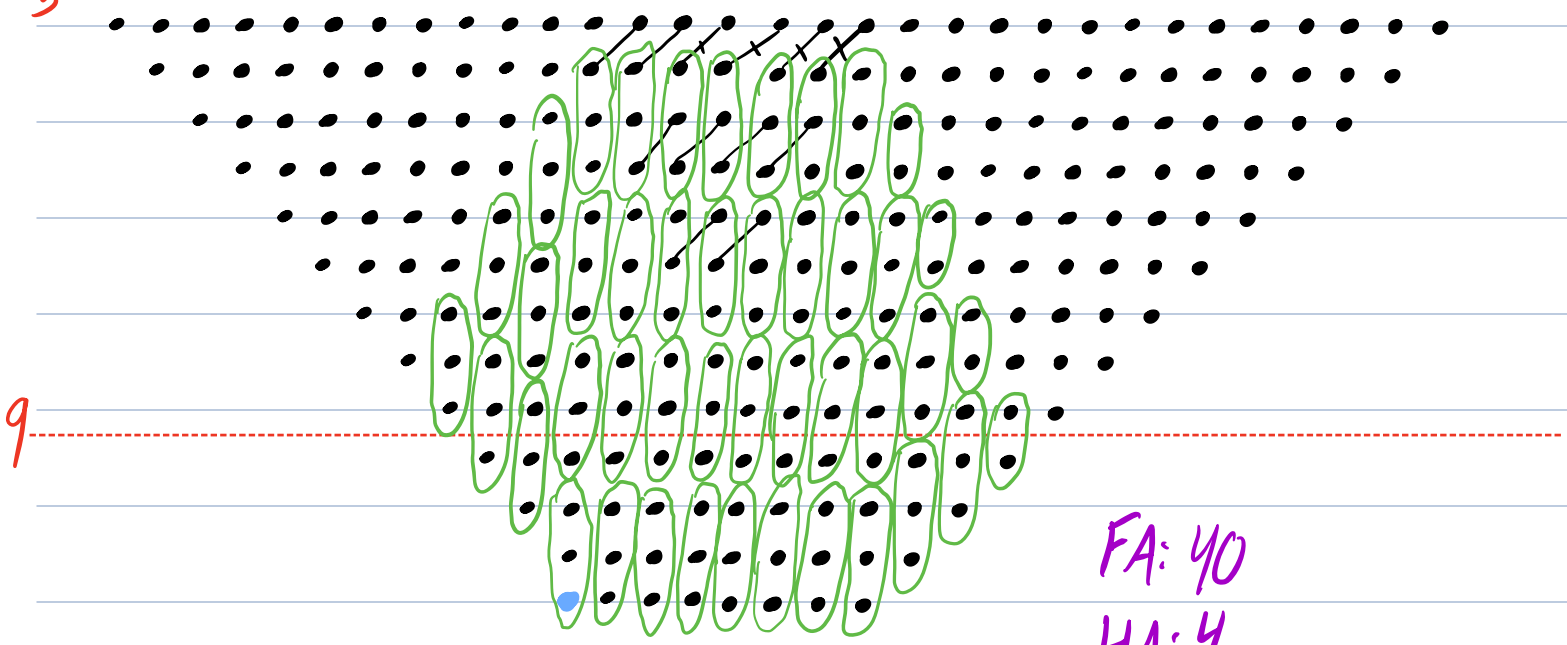


13

FA: 8

HA: 4

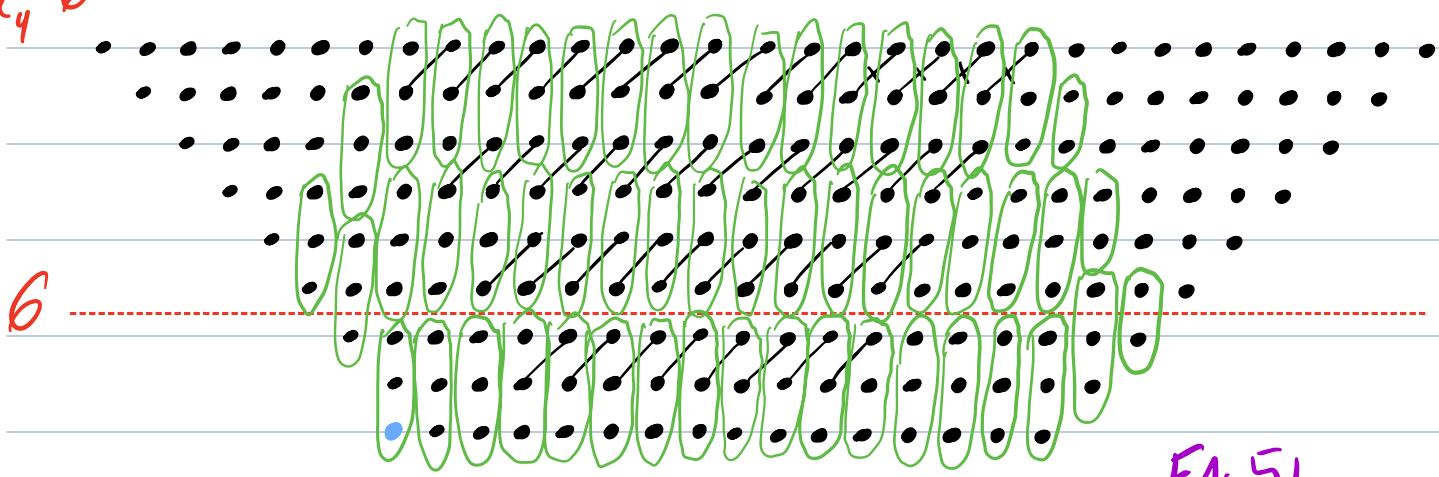
$d_5 = 9$



FA: 40

HA: 4

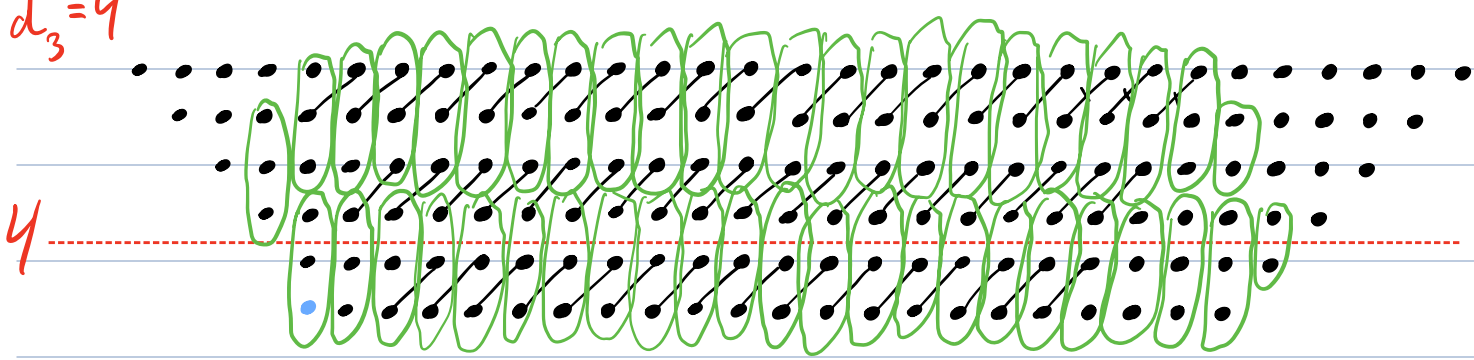
$d_4 = 6$



FA: 51

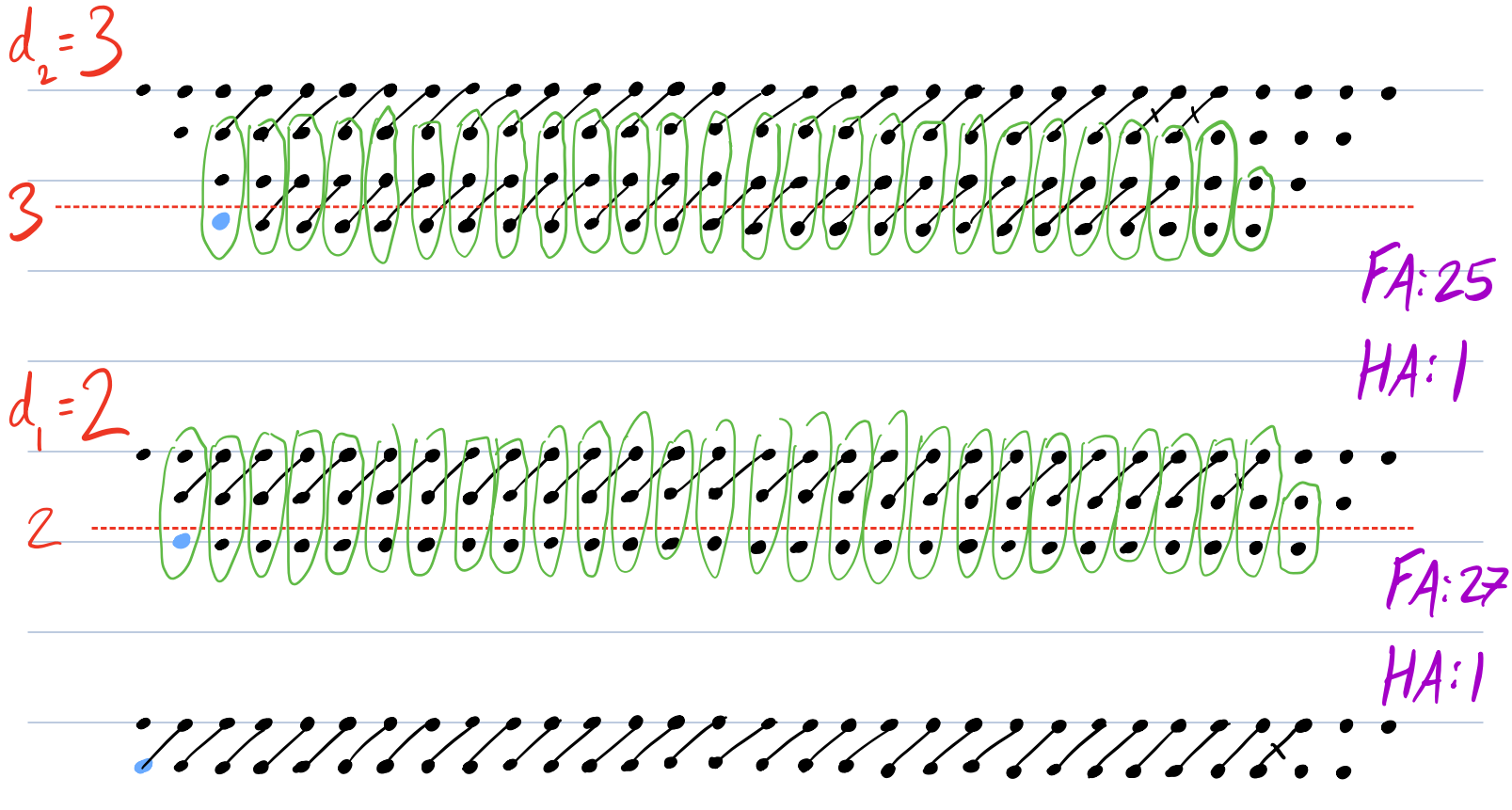
HA: 3

$d_3 = 4$



FA: 44

HA: 2



30-bit RCA

	Area	Delay
HA	4	3
FA	9	6
RCA	$9n$	$2n+4$

$\Sigma(FA) = 8+40+51+44+25+27 = 195$

$\Sigma(HA) = 4+4+3+2+1+1 = 15$

$n_{RCA} = 30$

Reorganization: 1 gate, 1Δ

$$Area = 15(4)+195(9)+9(30)+1 \rightarrow \boxed{Area = 2086 \text{ gates}}$$

$$Delay: Reorg + (6 \text{ layers}) \cdot (FA) + RCA$$
$$= 1 + 6(6) + 2(30) + 4 \rightarrow \boxed{Delay = 101\,\Delta}$$

Prob 4)

- For 4-bit input $n = 0, 1, \ldots, 14, 15$ representing $1.03125 + \frac{n}{16}$

$$\text{output} = \frac{1}{1.0325 + \frac{n}{16}} \cdot \underbrace{2^{15}}_{\text{fixed-point conversion}}$$

- ERROR - largest error is when halfway between partitions

- e.g., $\frac{1}{a} = .9408825057 \rightarrow \frac{.968523002421 - .9408825057777}{.9408825057777}$

$$= \boxed{2.94\% \text{ max error}}$$