

CS118 HW1 Solution

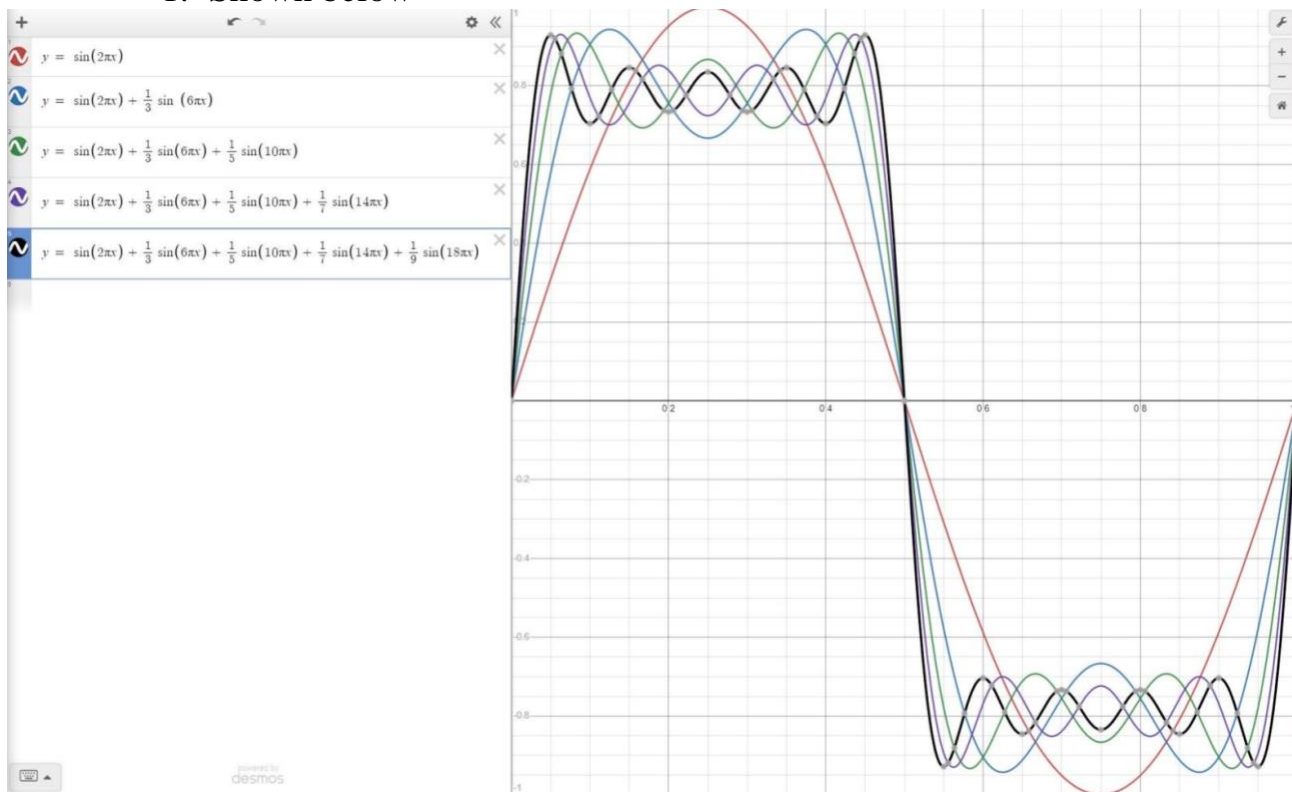
Fall 22

Q1:

A. Recall that $\int \sin(nx) dx = -\frac{\cos(nx)}{n}$, So, the nth coefficient b_n with period of T is $b_n = \int_0^T f(t) \sin(2\pi n t) dt = \frac{1}{2n} - \frac{\cos(n\pi)}{2n}$. The integral result in the scaling factor being inversely proportional to n is due to the n is in the divider resulting from integration $\sin(nx)$.

B.

1. Shown below



2. The bandwidth should be 1, 3, 5, 7, 9hz respectively.

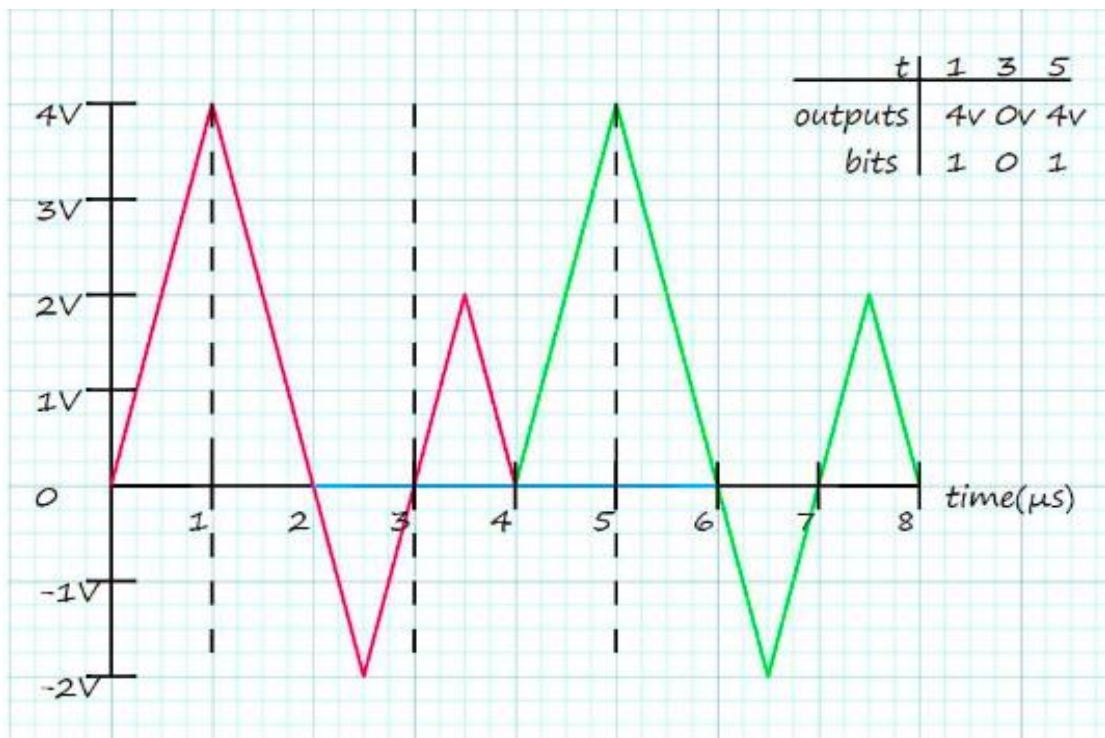
3. The formula of percent error is $\text{Math.abs}(\frac{\text{Actual}-\text{Exp}}{\text{Exp}})$, So there are 2 set of solution,

Assume 1 as amplitude: 41.22%, 33.33%, 30.72%, 29.96%, 29.64%

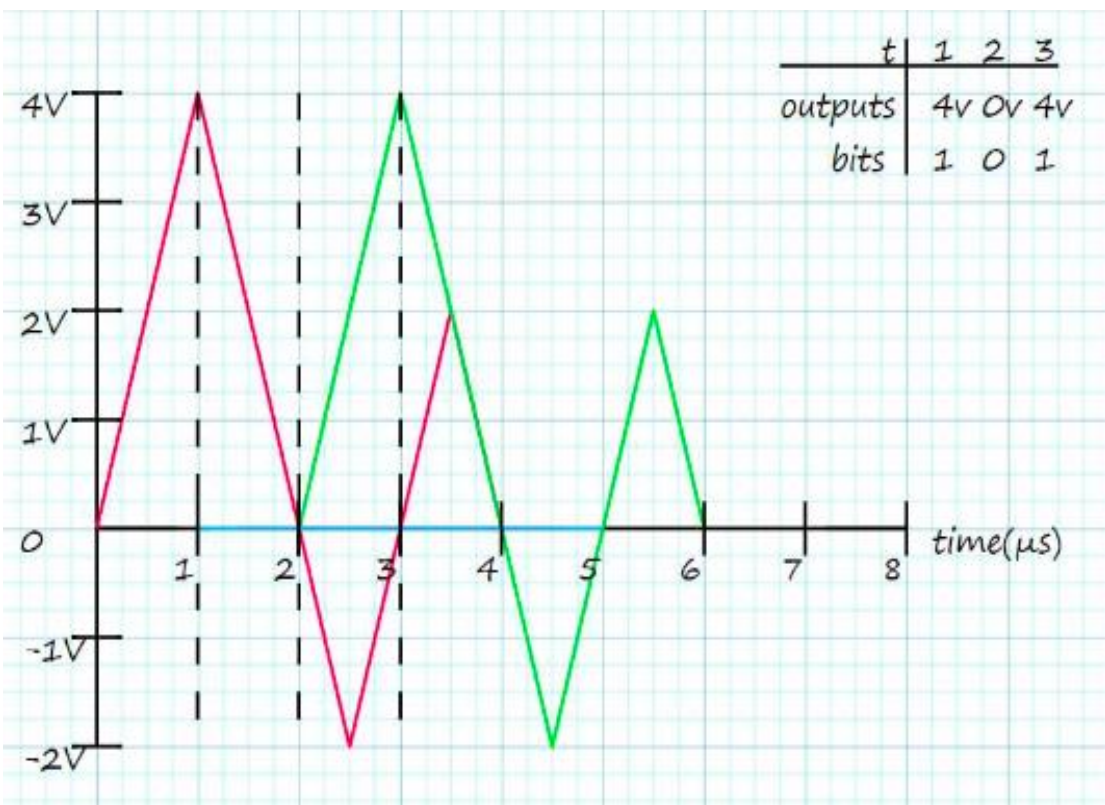
Assume $\frac{\pi}{4}$ as amplitude: 27.31%, 20.04%, 15.20%, 10.83%, 10.41%

4. 0.178, 0.087, 0.0674, 0.0051, 0.041

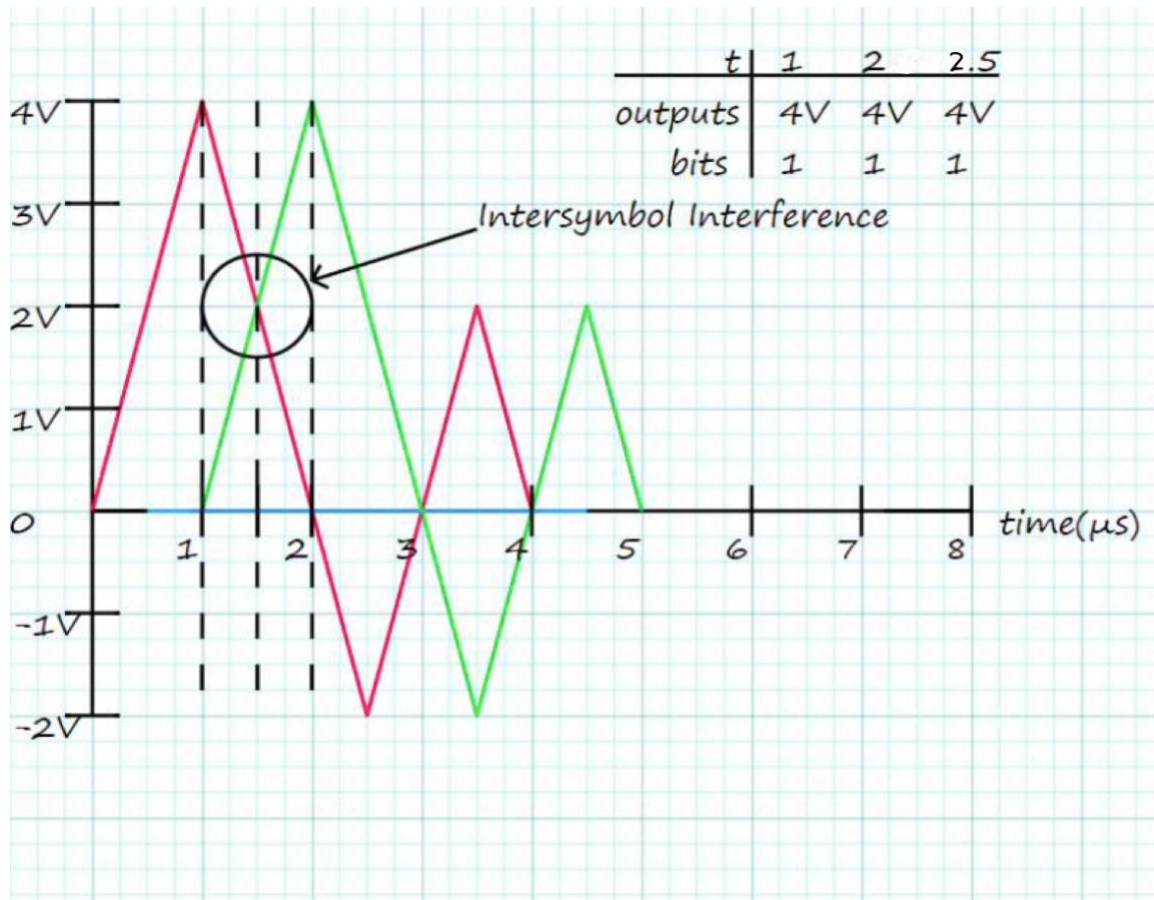
Q2:
1)



2)

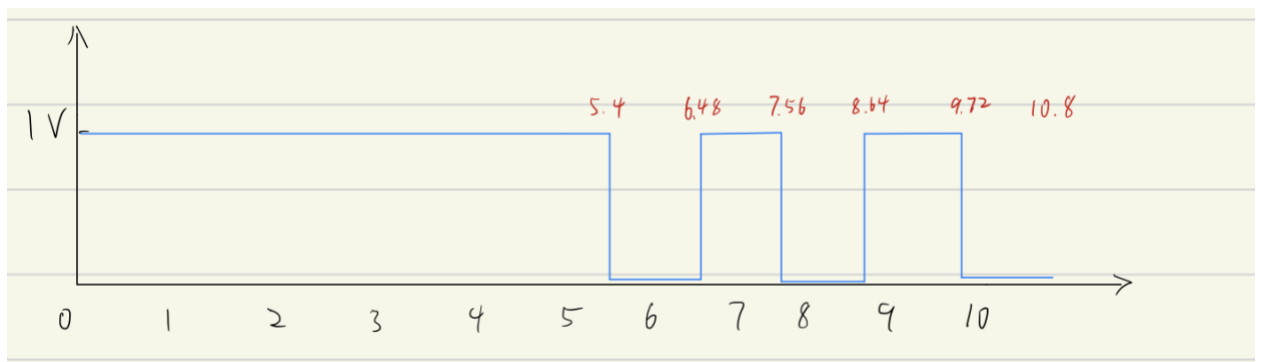


3)

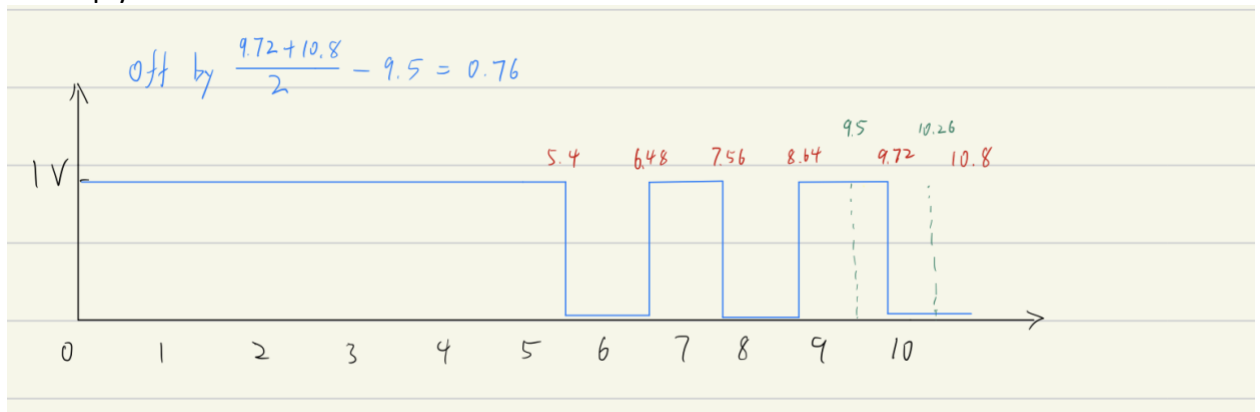


Q3:

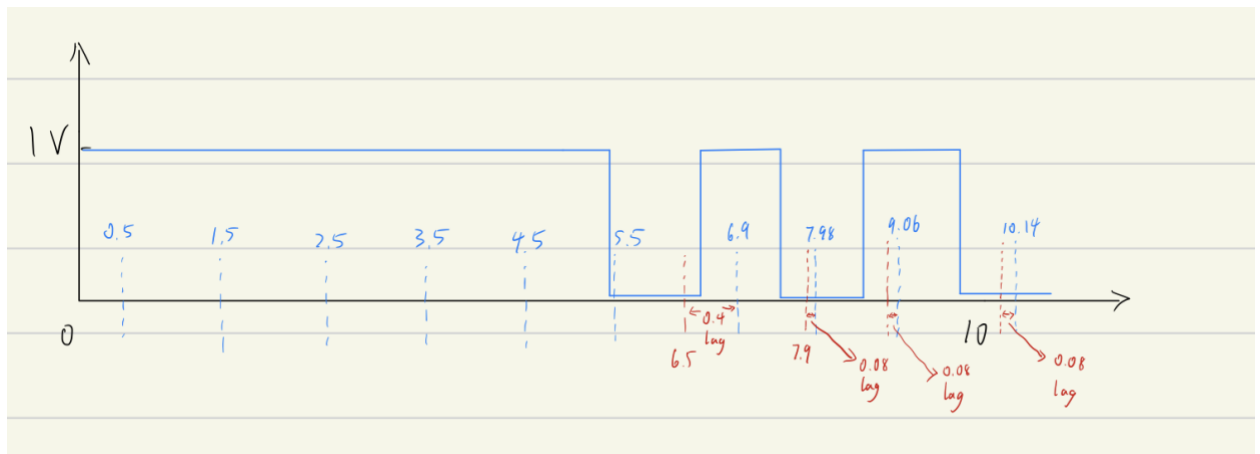
1.



2. Or simply $0.08 * 10 = 0.8$

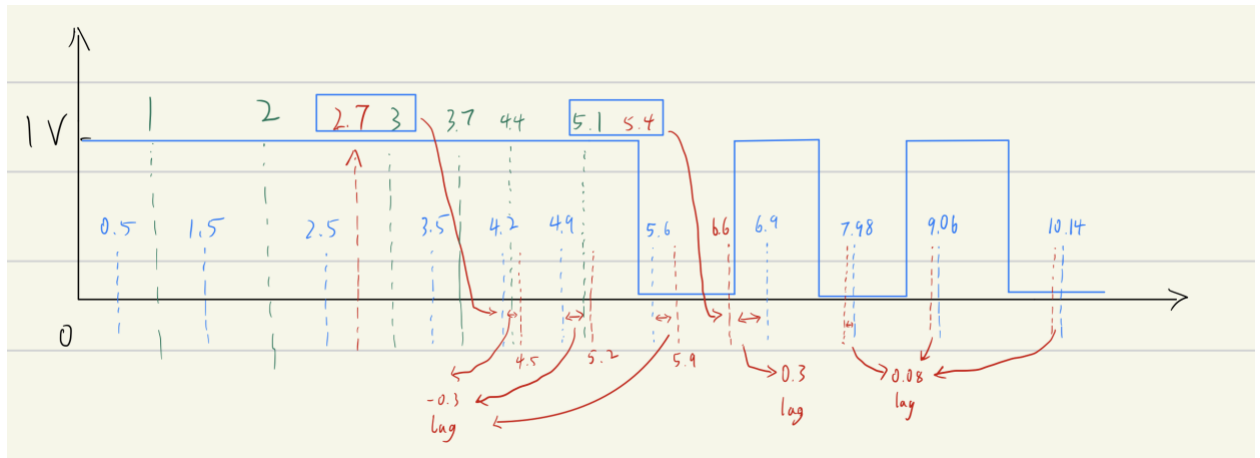


3.



t	lag	P	P = P + T + lag	T+lag	A	A-P
0.5	0	0	1	1	X	X
1.5	0	1	2	1	X	X
2.5	0	2	3	1	X	X
3.5	0	3	4	1	X	X
4.5	0.4	4	5	1	5.4	0.4
5.5	0.08	5	6.4	1.4	6.48	0.08
6.9	0.08	6.4	7.48	1.08	7.56	0.08
7.98	0.08	7.48	8.56	1.08	8.64	0.08
9.06	0.08	8.56	9.64	1.08	9.72	0.08
10.14	0.08	9.64	10.72	1.08	X	X

4. No effect, since it occurs before sync code begins(0.5).
- 5.



It sampled one extra bit, which lead to 1 1 1 1 1 1 0 1 0 1 0

t	lag	P	$P = P + T + \text{lag}$	T+lag	A	A-P
0.5	0	0	1	1	X	X
1.5	0	1	2	1	X	X
2.5	0	2	3	1	2.7	-0.3
3.5	-0.3	3	3.7	0.7	X	X
4.2	-0.3	3.7	4.4	0.7	X	X
4.9	-0.3	4.4	5.1	0.7	5.4	0.3
5.6	0.3	5.1	6.4	1.3	6.48	0.08
6.9	0.08	6.4	7.48	1.08	7.56	0.08
7.98	0.08	7.48	8.56	1.08	8.64	0.08
9.06	0.08	8.56	9.64	1.08	9.72	0.08
10.14	0.08	9.64	10.72	1.08	X	X