

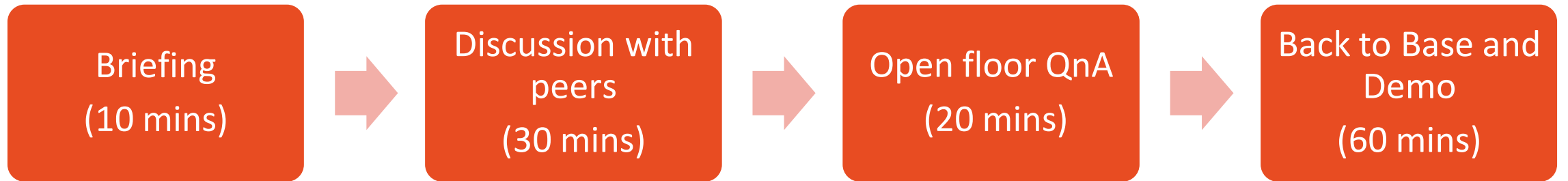
ECE3141 Lab Briefing

S1 2021

LAB 1 Quantisation

Online students, Please rename yourself as Group **10 Full Name**

ECE3141 Lab Organisation



Laboratory – How its done

10 mins – Briefing

- You will be briefed on the key objectives, challenges and muddy points of the lab
- For online students, Rename yourself using the Format Group 12 Lee Wei Kiat while we brief you.

30 mins – Discussion with peers

- Lab Group of 4 students per group plus any online zoom
- Work with your peers exchanging ideas on what you could or couldn't figure out prior to the session
- Try to solve some issues you have been facing.
- Attempt to write parts of the code that you were unable to do.
- Fill out pending answers.
- Tutors will move between groups

20 mins – Open floor QnA

- Any student or group can ask anything, just put up your hands
- This could give you an insight into common issues faced by peers and hints on how to solve them.

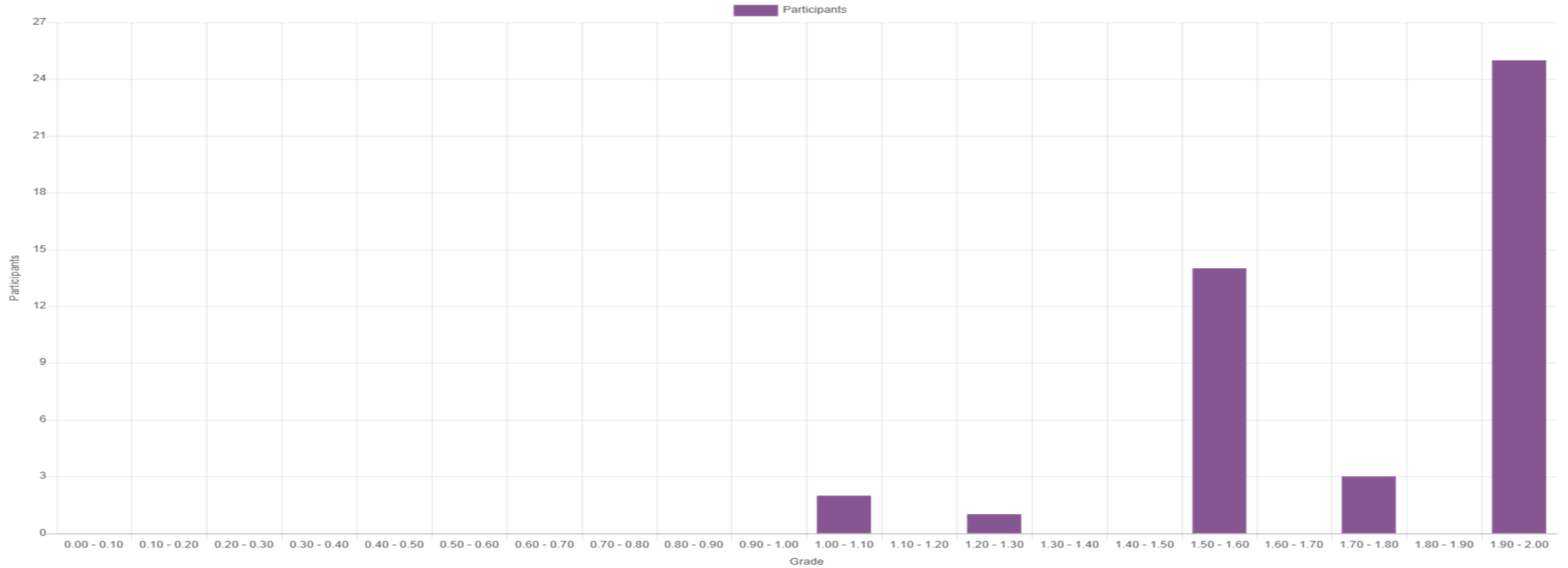
60 mins – Back to base

- Questions randomized so that each group answers unique questions for demo.
- You can indicate you are ready (by calling for help) so that we can prioritise the order.
- Tutor can choose to ask for a demo from each student on a certain part of the lab. You will be asked a couple of questions to test your understanding.
- Each student will be marked on 10 in this session with a starting mark of 10 and deductions based on how the QnA progresses.
- You should submit your report at the end of the lab. But you will have additional time until Sunday (of the week you do the lab) night 8.55 pm to submit your updated lab report. Both being present in the lab session and submission of lab report are hurdles to get your lab mark. FAILURE RESULTS IN THE NEXT SLIDE !

Lab Marking Rubrics

	1 Beginning or incomplete	2 Developing	3 Accomplished	4 Exemplary	Score Max: 10
Preliminary Quiz	MCQ via Moodle Quiz				Max: 2
Lab Engagement and Demo	Several tasks were not comprehended and requested demos could not be shown.	Some tasks were not comprehended and some of the requested demos could not be shown.	Most tasks were comprehended and requested demos could be shown.	All tasks were well comprehended and all requested demos could be shown.	Max:6
Lab Report	Very incomplete or incorrect interpretation of questions asked indicating a lack of understanding of results.	Some of the questions have been interpreted, discussed and answered correctly; partial but incomplete understanding of the issues being asked.	Almost all of the questions have been interpreted, discussed and answered correctly and discussed, only minor improvements are needed.	All questions have been interpreted, discussed and answered correctly, a good understanding of results is conveyed.	Max:2

Lab 1 Prelim Quiz



Topics: Digital and Analogue Signals, Sampled Signals, Sampling rates, SNR

The muddiest point..

A sampled signal (y_s in the discussion in the Introduction of the laboratory class) can take on the following values:

Select one:

- ☐ a. It is quantised to a limited number of possible values, defined by the parameter "m"
- ☐ b. It can take on any real number value between limits $-V$ and $+V$
- ☐ c. It can take only one of the two possible values $-V, +V$
- ☐ d. It can take on any integer value

Lab Objectives

- Understand some of the decisions involved in designing a quantiser.
- Listen to the effect as you vary the number of quantisation steps used to represent a sinusoidal signal, as well as segments of recorded sound (speech and music).
- Measure the SNR resulting from quantisation of audio signals as you increase the accuracy of the representation, and compare the result with theory
- Develop your skills in Matlab and audio processing

* $\text{SNR(dB)} = (6m - 7.2) \text{ dB}$ when $V/\sigma = 4$ – linear relationship with a slope of 6dB per bit/sample.

*Nyquist criteria for sampling frequency, $f_s > 2B$, where B is the signal bandwidth

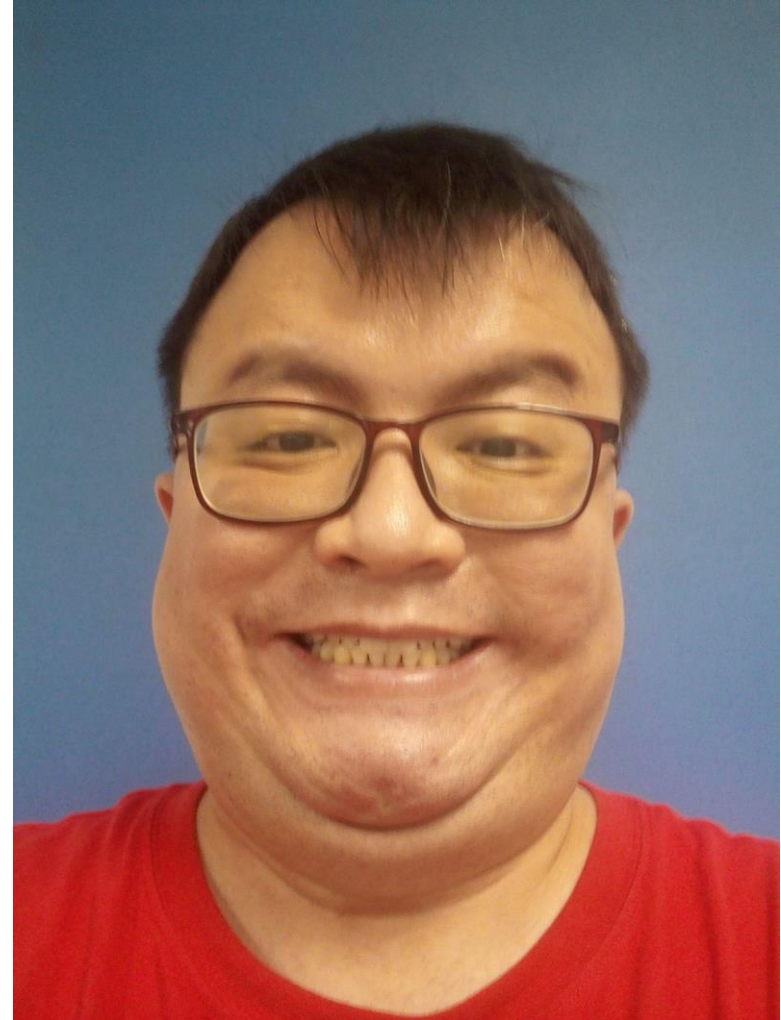
Today

- Section 1 – 4 – Mostly theoretical considerations expanded from lectures and short answers.
- Section 5 – Quantise a sine wave, plot SNR vs m for different sampling frequency, compare with theoretical estimates. Explain differences based on pdf of noise.
- Section 6 – Quantise a music audio signal and repeat the analysis in 5.
- Section 7 (optional) – Non-uniform quantisation of an music audio signal.

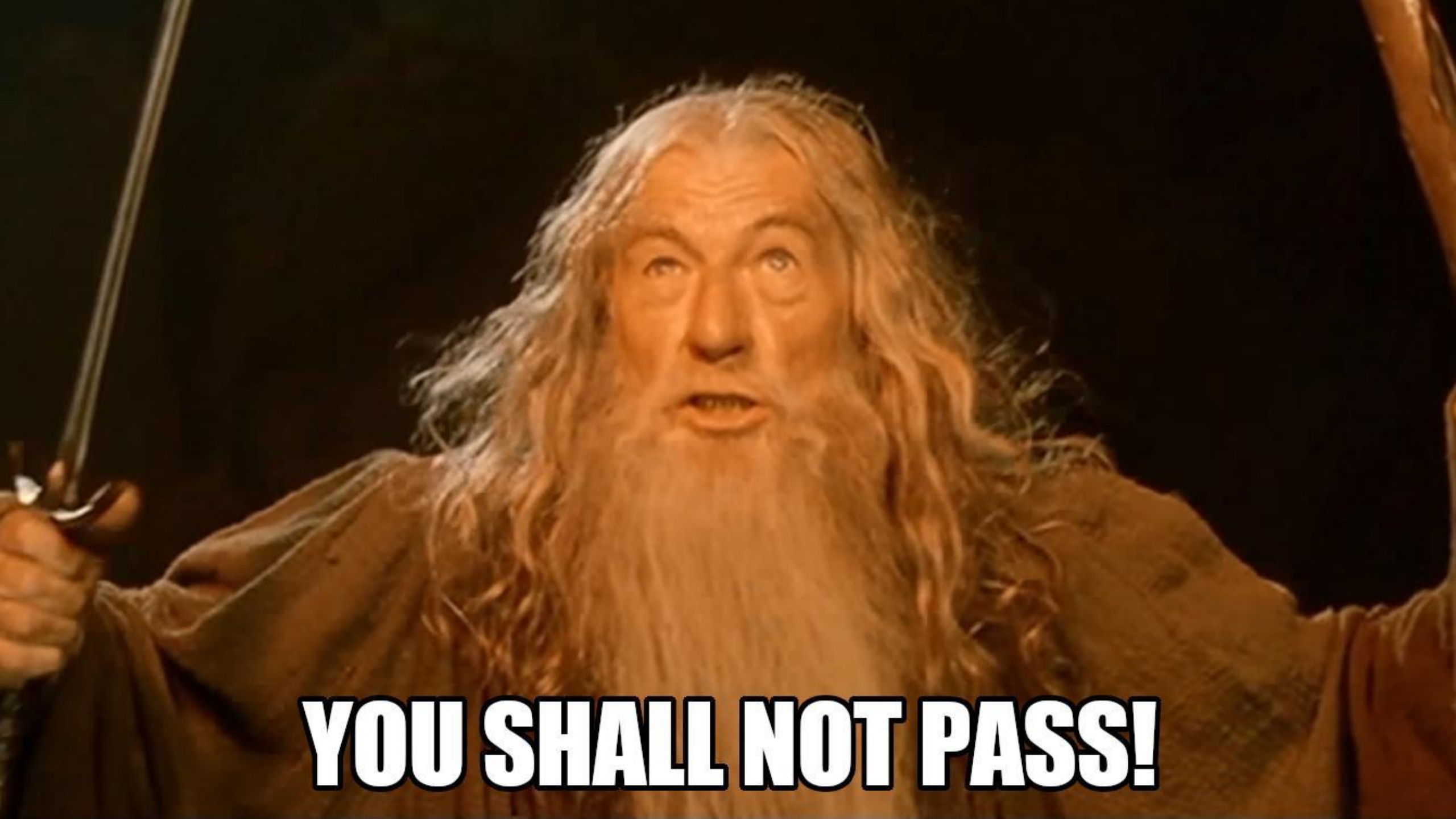
Who's who...



Associate Professor Vineetha Kalavally



Dr. Joshua Nah (Lab Tutor)



YOU SHALL NOT PASS!

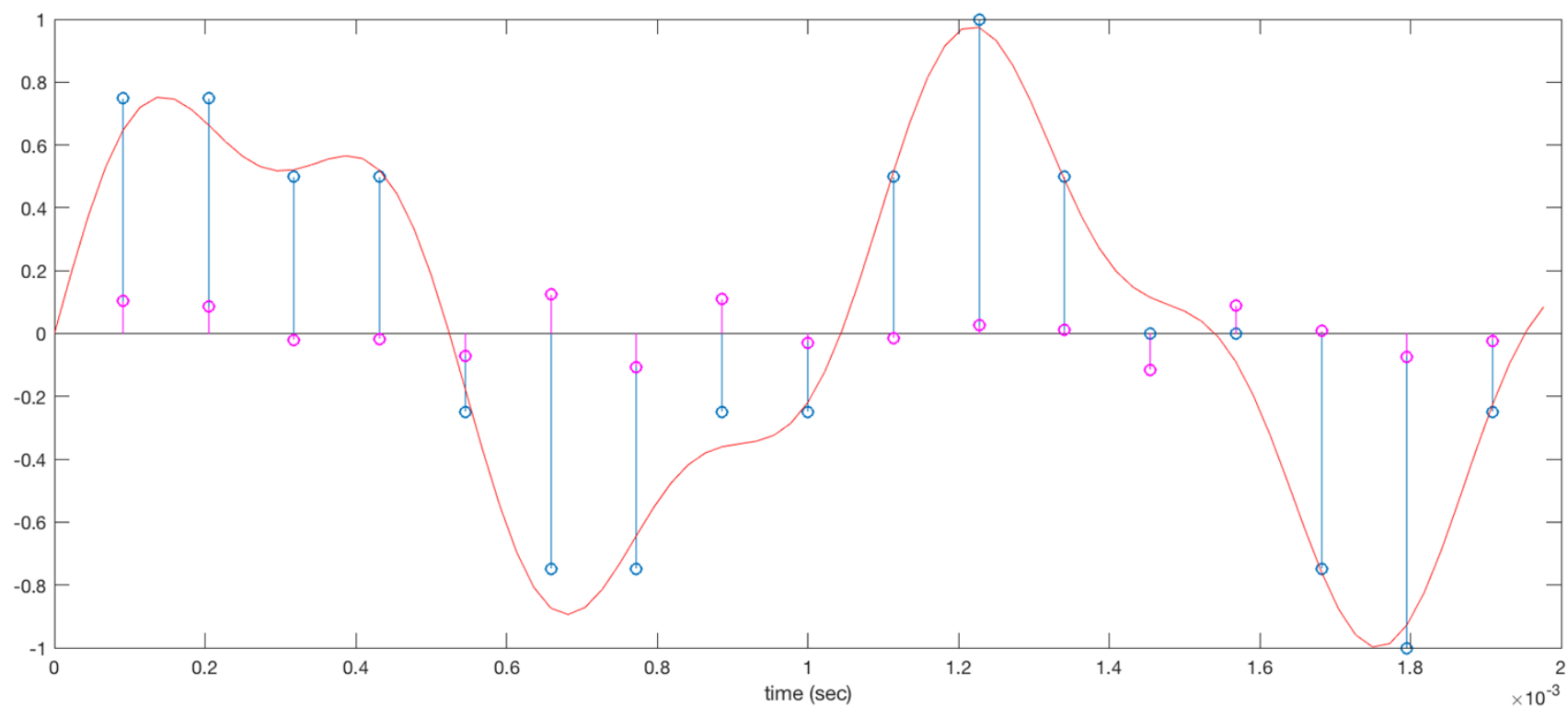


Figure: . *Sampling and quantisation of a one-dimensional analogue signal.*

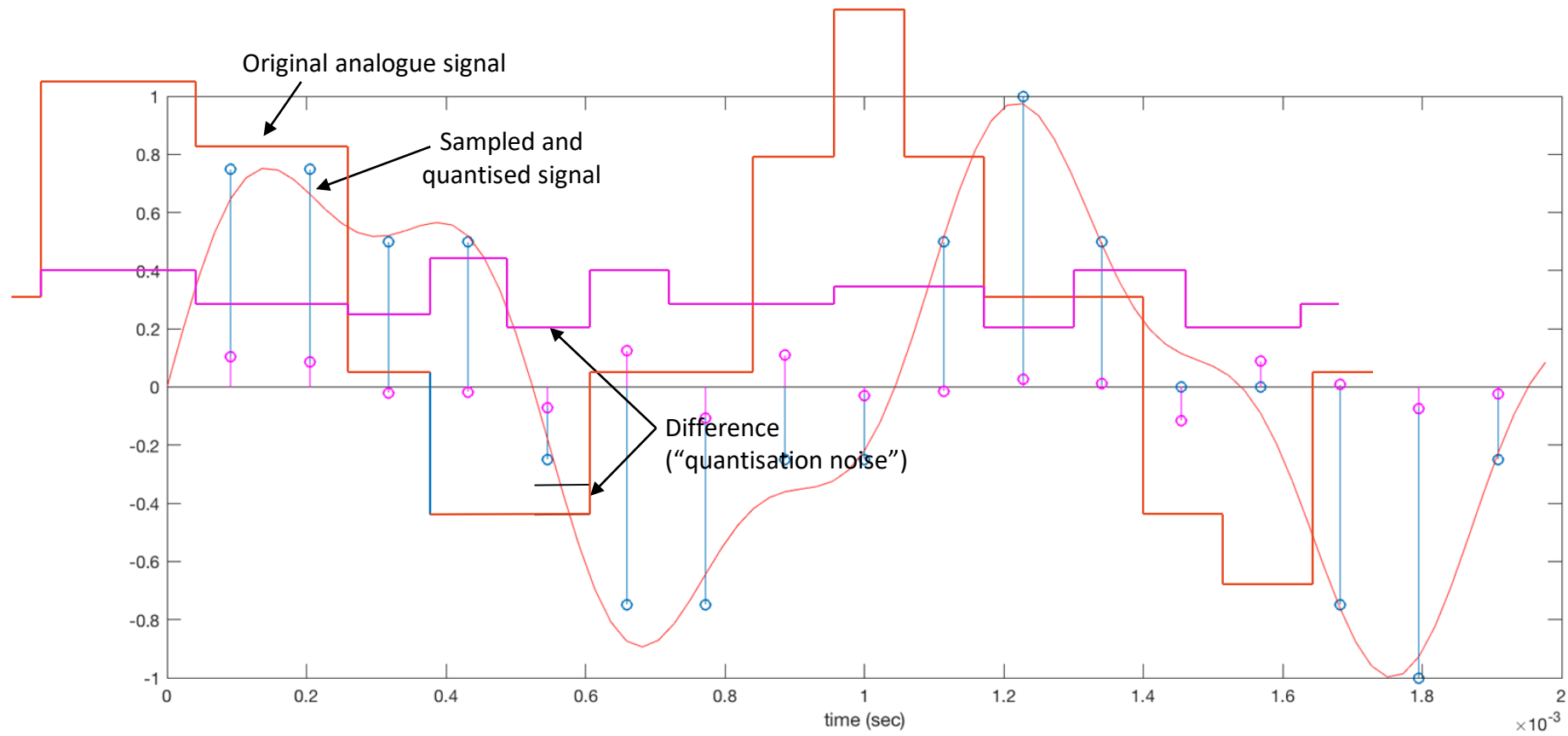
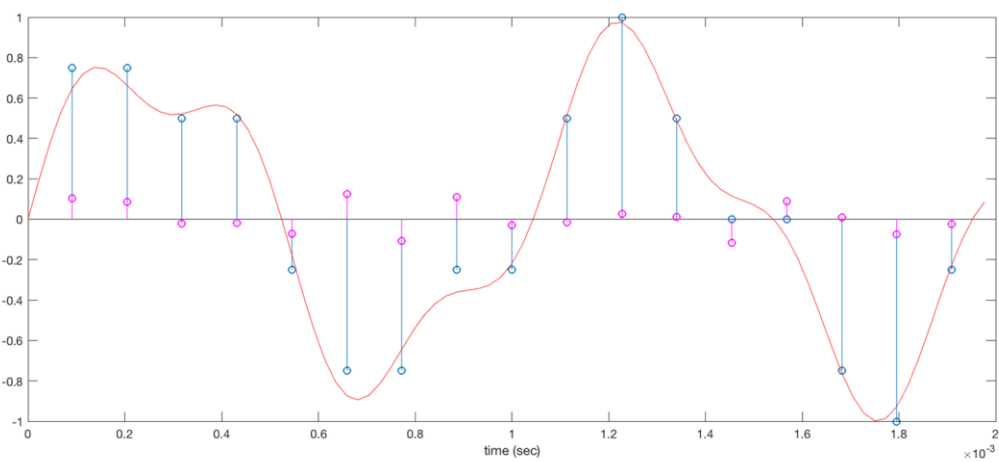
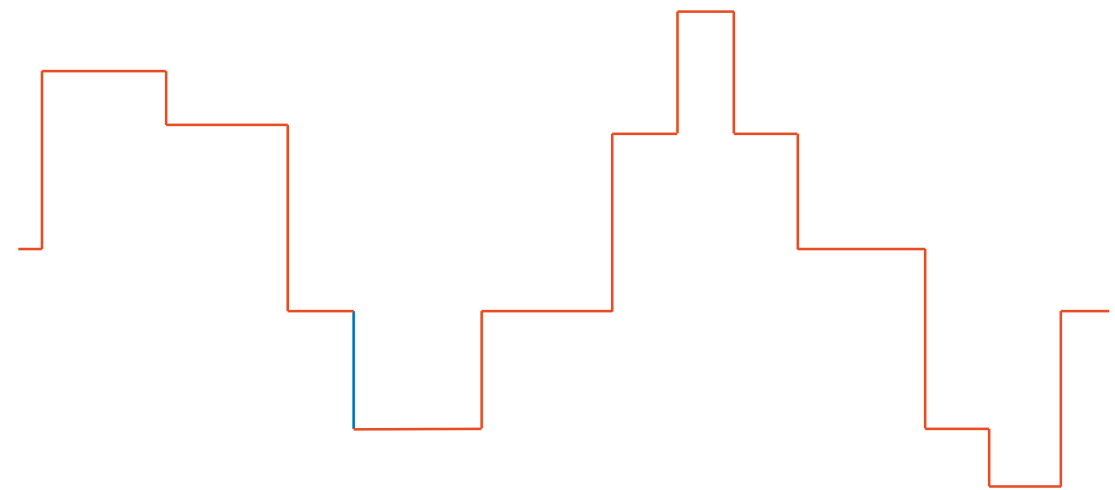


Figure : What the Quantised Signal Looks Like



MINUS



=

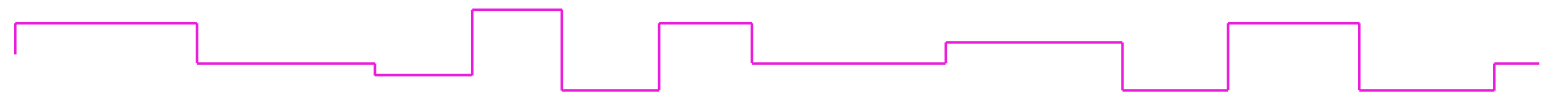
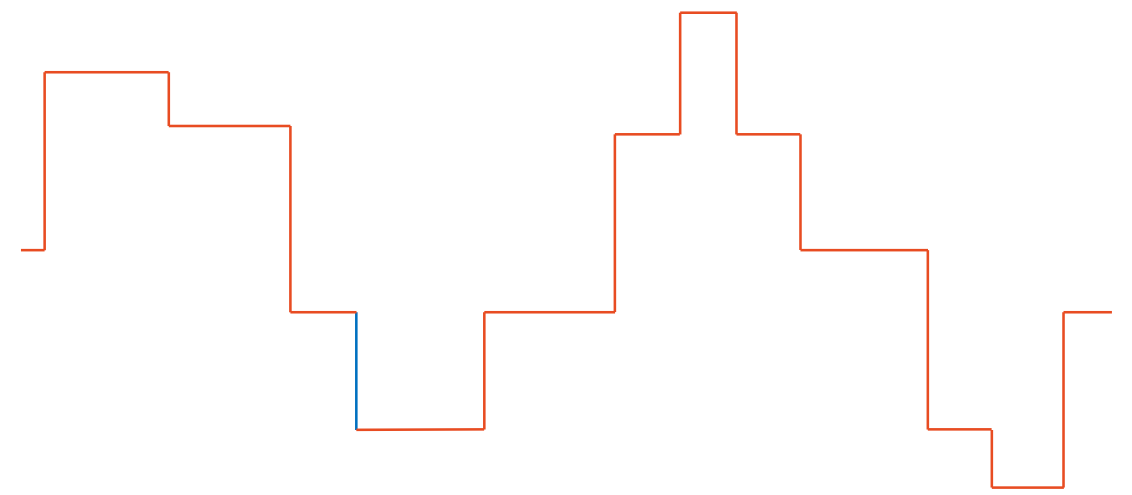
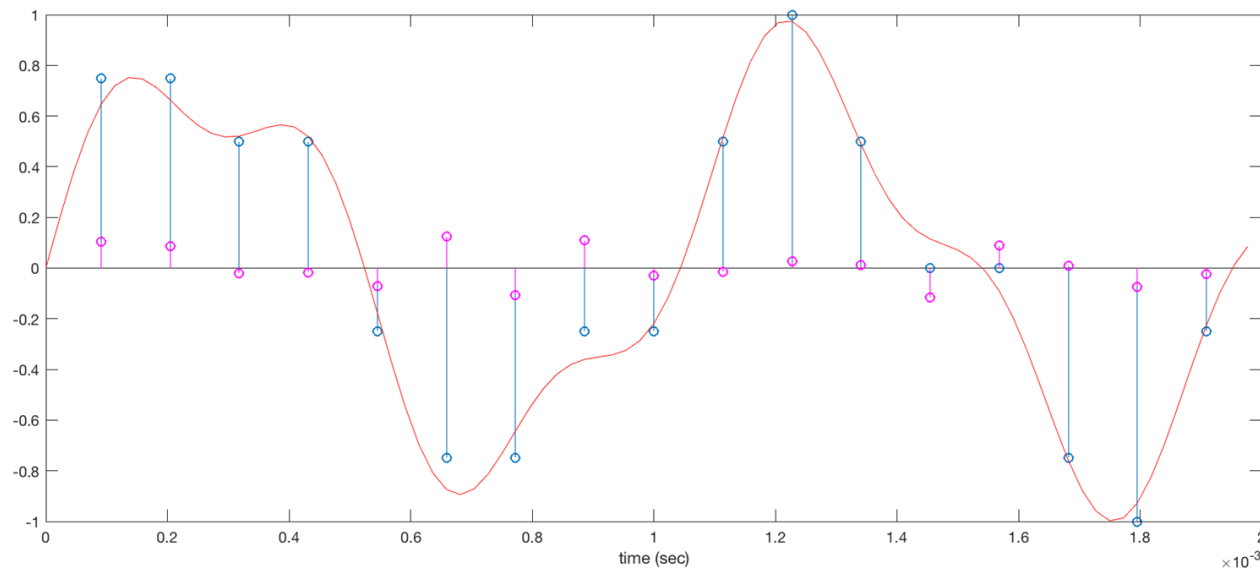


Figure: How Quantized Noise is generated



```
% midtread quantiser
>> Num_levels=2^m-1; % Note: odd number of levels
>> Quant_vec = 2*round(signal_vec*(Num_levels-1)/2) / (Num_levels-1);
```

Figure: How MATLAB quantizes the signal

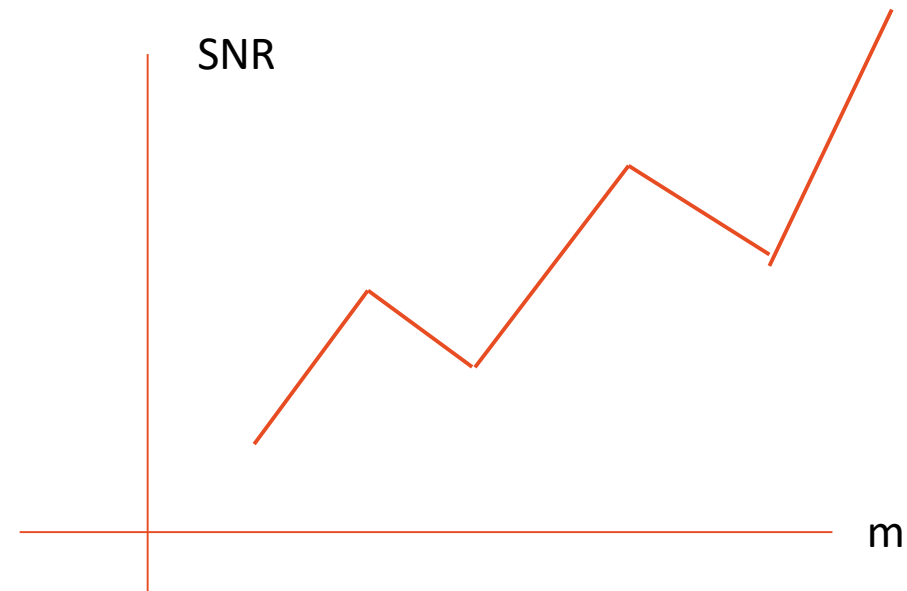
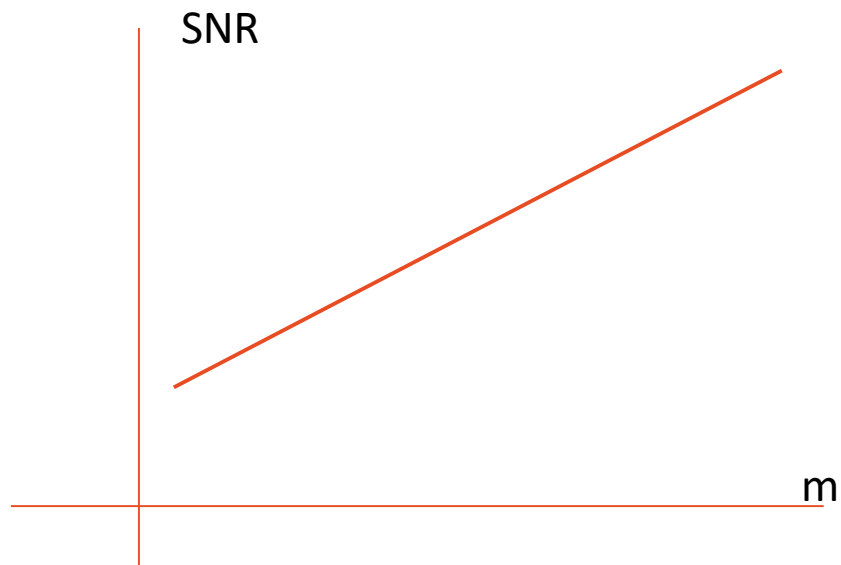
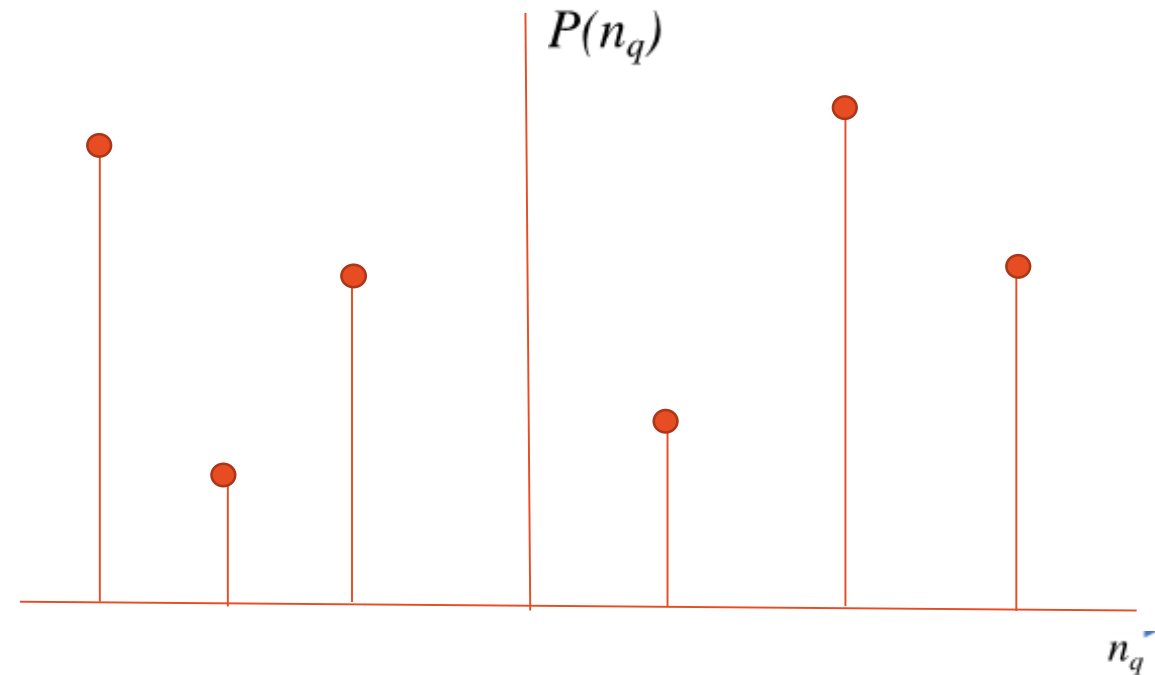
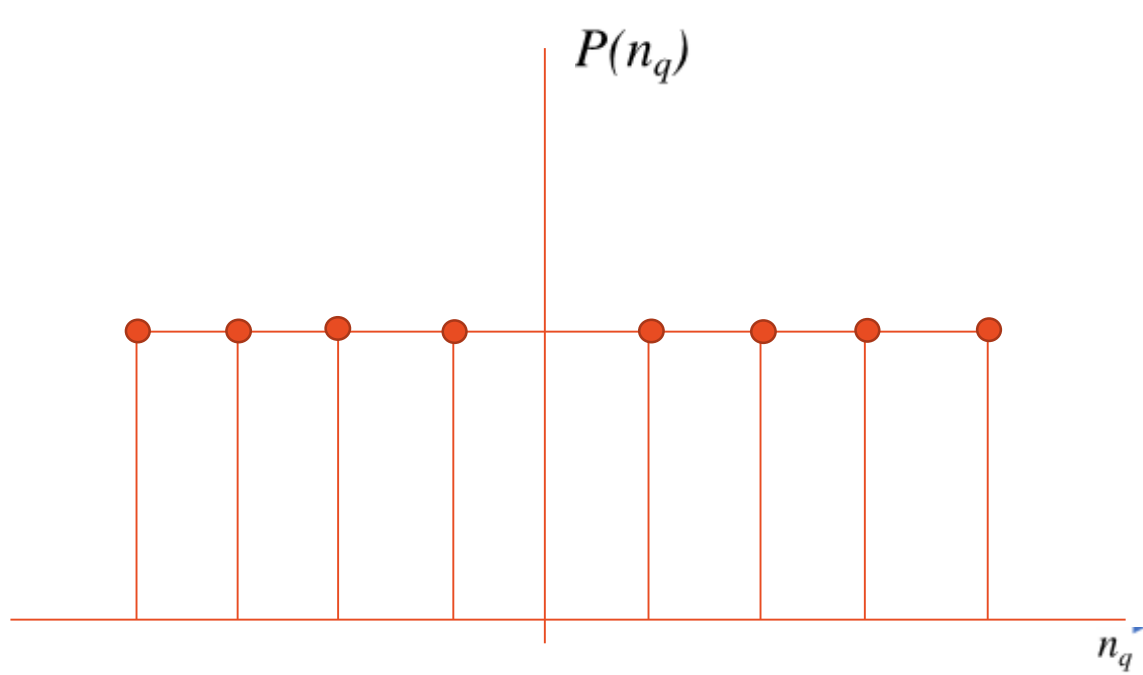


Figure: Why Noise Randomness affects SNR vs m graph

Output

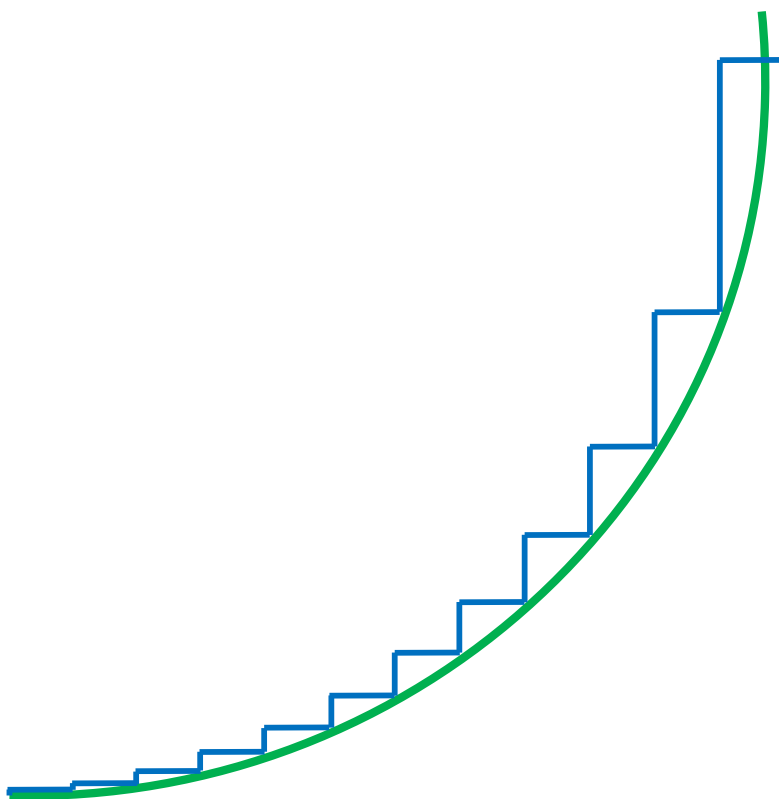
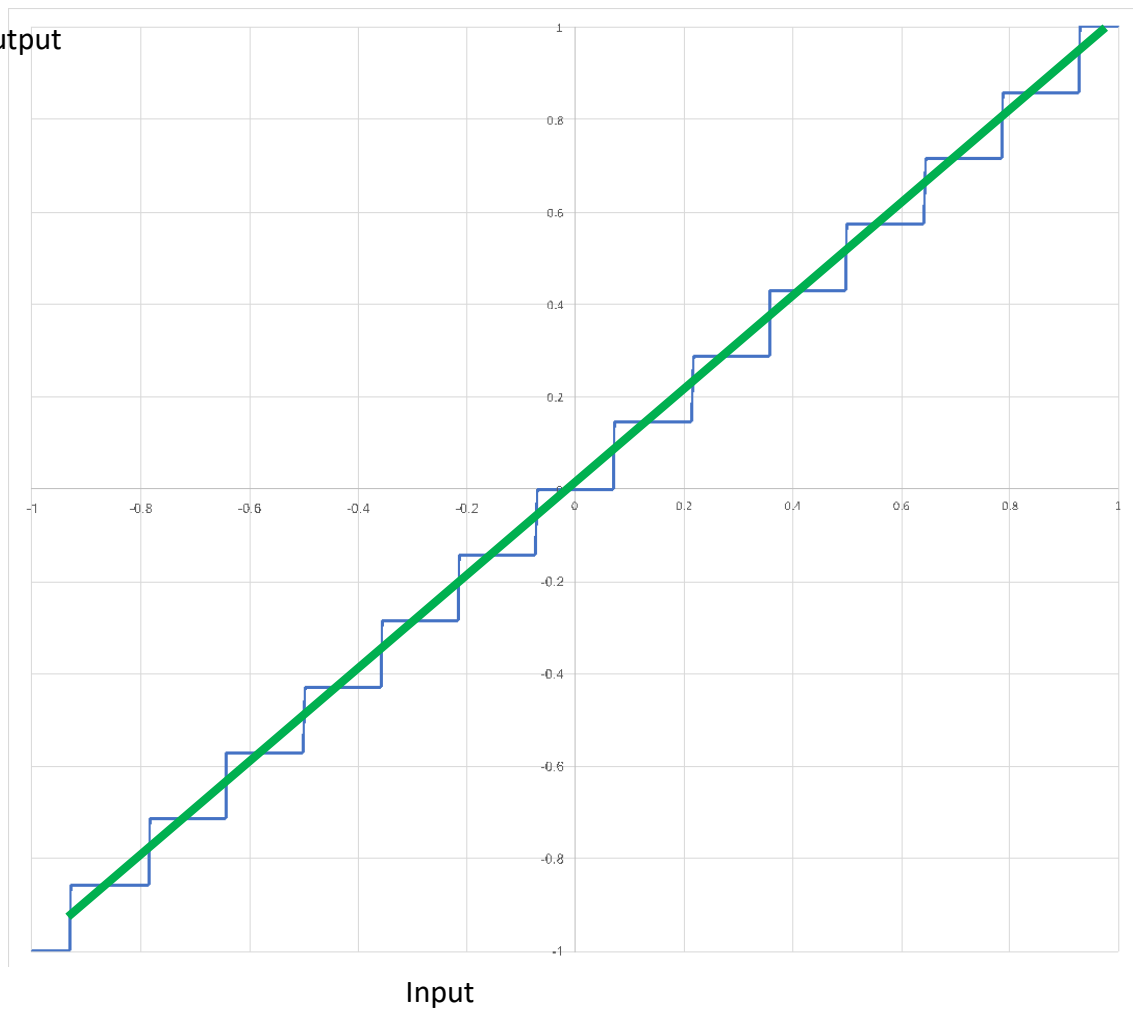


Figure: Linear Quantization vs Non-Linear Quantization