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# Answer Sheet for Assessment 1

## L349 - Mobile Health

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239 words (excluding bibliography, headers, and captions)

### Part 1: Audio Processing Basics [25 marks]

#### Task 1.2

**Question 1: Discuss any differences between the two files in the time domain, giving possible reasons.**

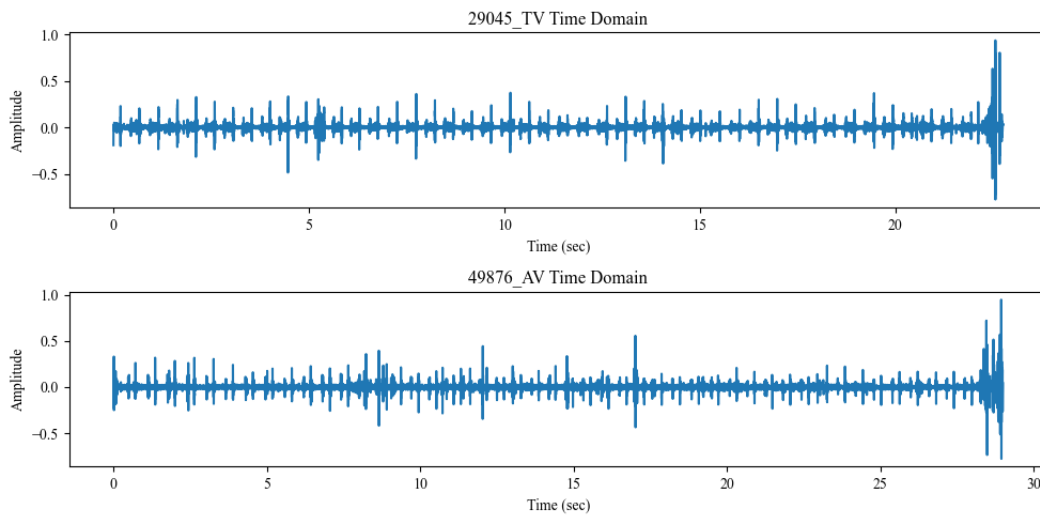


Figure 1: Enter Caption

- 29045\_TV:
  - relatively clearly recognizable heartbeats, especially when zoomed in -> reason: clear sound recording, little noise
  - constantly noticeable amplitude **between** S1 and S2, otherwise relatively small amplitude
- 49876\_AV
  - heartbeats (incl. S1 & S2) can also be identified, but with greater irregularity and variation in amplitude
  - stronger fluctuations throughout
  - reason: less accurate recording, more noise

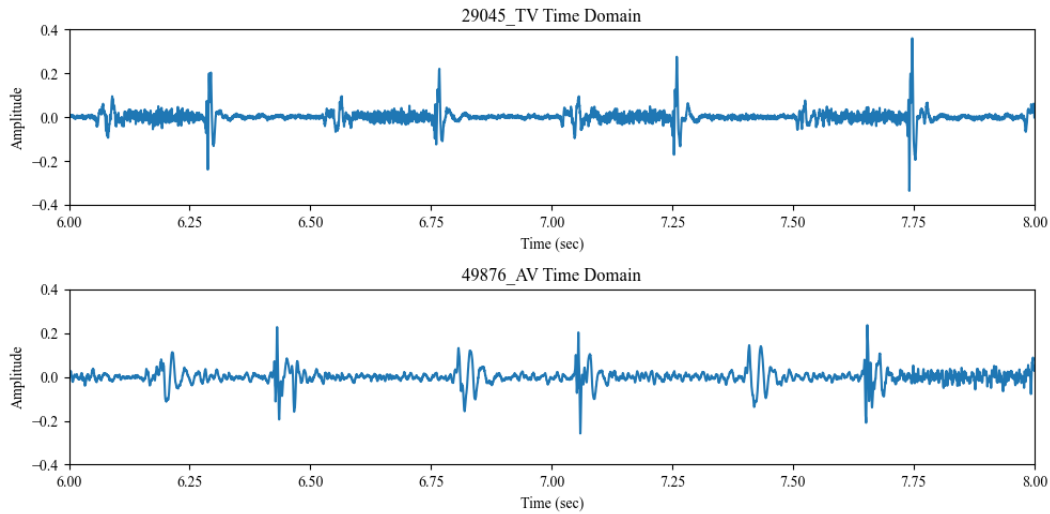


Figure 2: Enter Caption

**Question 2: Based on the above, can you visually differentiate between the murmur and non-murmur heart sounds? Predict which is the murmur and which is the non-murmur.**

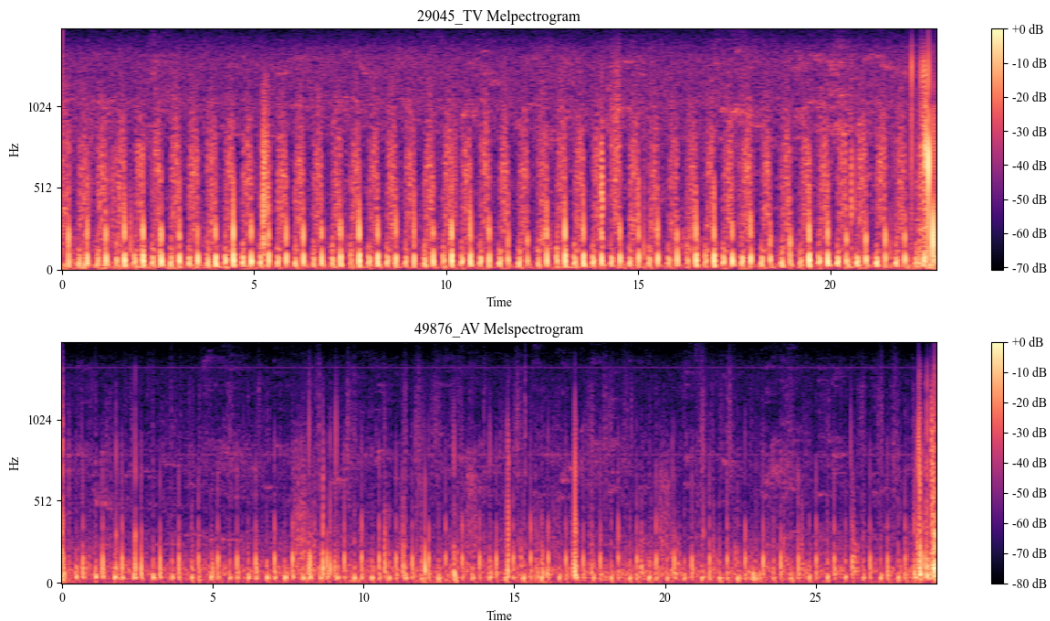


Figure 3: Enter Caption

- 29045\_TV looks more regular and less conspicuous at first glance
- nevertheless, possible limitations of the sound file quality (i.e. noise, recording accuracy etc.) must also be taken into account
- research shows: sound development between S1 ("lub") and S2 ("dub") is particularly relevant to identify murmur [6]
- Only **29045\_TV** shows noticeable sound here -> could represent "blowing, whooshing, or rasping sound heard during a heartbeat", indicating a murmur [8]
- -> 29045\_TV = murmur, 49876\_AV = non-murmur,

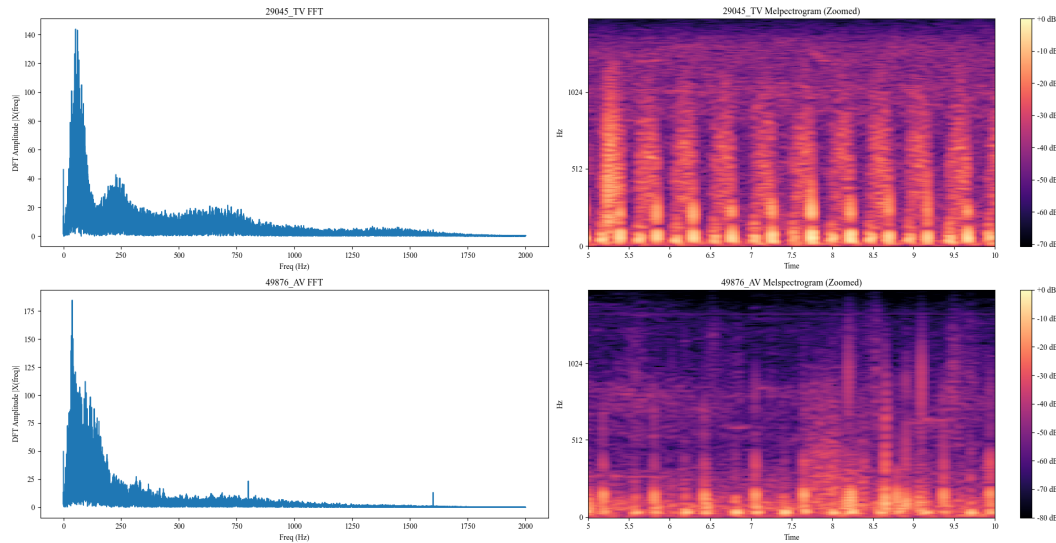


Figure 4: Enter Caption

### Task 1.3

**Question 1: Discuss any differences between the frequency domain representations of the murmur and non-murmur files.**

- 29045\_TV (Murmur):
  - concentration of peaks primarily in low-frequency range, up to  $\sim 150\text{Hz}$
  - exhibits two further peaks in the distribution of frequencies around  $\sim 250\text{Hz}$  and  $\sim 650\text{Hz}$
  - generally more spread-out
- 49876\_AV (Non-murmur):
  - almost exclusively concentration of peaks in low-frequency range, although slightly higher, up to  $\sim 200\text{Hz}$
  - exhibits some isolated peaks, likely noise

**Question 2: Are there any features that are evident in the frequency domain that you could not distinguish in the time domain?**

- time domain was not able to show which frequencies make up the signal  $\rightarrow$  frequency domain allows conclusions regarding involved frequencies and the extent of their involvement
- graphs reveal that the 29045\_TV signal is composed of much stronger higher frequency signals than the 49876\_AV signal, which, in line with scholarship [e.g. 1, 2, 7] confirms the classification of 29045\_TV as murmur

### Task 1.4

**Question 1: Discuss and provide reasons for your choice of filter type and cutoffs.**

[4]

[7]

[1]

**Question 2:** Provide a discussion of the differences between the raw and filtered data, and thus on the importance of filtering in signal processing. Are there any potential disadvantages or tradeoffs of applying signal processing?

**Task 1.5**

**Question 1:** Discuss whether you can differentiate between the signals or not and if not, why not.

**Part 2: Dataset processing [15 marks]**

**Task 2.2**

**Question 1:** What is the ratio of normal to murmur patients? And what is the ratio of normal to murmur samples? Can you think of any implications of this?

**Question 2:** Prepare some graphs representing basic demographic split across classes, such as sex, age, etc. Make sure you use the correct type of graph for your data to display the information intuitively.

**Question 3:** What significance does the demographic split carry in datasets used for ML?

**Task 2.4**

**Question 1:** What is the effect of tackling the imbalance on the resulting classification performance? Give results to compare different methods of tackling imbalance.

**Part 3: Feature extraction [30 marks]**

**Task 3.1**

[3]

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[5]

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- [6] Hassaan Malik, Umair Bashir, and Adnan Ahmad. “Multi-classification neural network model for detection of abnormal heartbeat audio signals”. In: *Biomedical Engineering Advances* 4 (Dec. 2022), p. 100048. ISSN: 2667-0992. DOI: 10.1016/j.bea.2022.100048. URL: <https://www.sciencedirect.com/science/article/pii/S266709922200024X> (visited on 02/15/2024).
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