DSP Homework 03

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Contents

Abstract

Through this week039;s study and homework, I learned about the animal world through a few videos, Bluetooth headset work principle process and the importance of sports. Secondly, through the research on the happiest and unhappiest time of the week of college students, I know the time and reason of high and low mood, and I also know the direction I need to go. Then I learned more about the properties of Fourier transform Fourier transform through an eight-way proof.

1 Problem 1

1.1 Problem description

Write a summary of this week's videos and your further thoughts on the content.

1.2 Animals and our world

This week, we watched three videos, the most impressive of which is the animal world. In this video, we see animals living freely where they live. Of course, they also face difficulties and dangers. They move with the seasons, year after year, looking for a more suitable place to live. Animals also encounter predators, fight to the death, run away, and need to ascend to find food. Then there are the catastrophes of environmental change. There are also cute polar bears, but the melting glaciers are making their lives more difficult.

After watching this video, I have roughly three feelings. When I first saw them, I thought, these animals are so happy and free, they can run and forage in their own territory every day, unrestrained. And we are, from small to large, according to the steps of growth, primary school, junior high school, High School, university, graduate school .... work, work overtime, retire...... this certainty of life really bores me. At the same time, our life is full of pressure everywhere, since childhood we are faced with countless examinations and all kinds of pressure from the family and society. So just see these animals when very envious . But they also live in a competitive environment, and if they don't work hard to improve, there are predators hunting and foraging. Both the animal world and human society are natural selection laws. We don't want to be eliminated. We have to improve ourselves.

The second is that I'm seeing the polar bear habitat, where the icebergs are melting and there are fewer places for them to live. Over the years, due to the various effects of our human life, the Earth's environment is now changing more and more bad, but also hurt a lot of other animals and plants living space. The Earth is our common home, we should protect the environment, protect the place where we live. We should do our best to protect our common home, not for our own development, regardless of everything else. We live on the Earth with other creatures. We are friends and family. We human beings are relatively advanced, so we have the responsibility to protect other animals and plants. We only have one Earth, once destroyed, there is no more. So, protect the environment, protect our common home, protect our families on the earth!

1.3 Bluetooth headset

Through this video, we basically understand how Bluetooth headsets work. It includes the process of Bluetooth headset reception, which converts the received signal into sound signal.

Bluetooth headsets work, roughly, first of all, the phone's decoder chip to decode music files, and then generate a digital signal sent to the Bluetooth headset via Bluetooth. Then, after the Bluetooth headset receives the digital signal, it converts the digital signal into an analog signal through the digital-to-analog conversion chip of the Bluetooth headset, and then the analog signal is amplified through the signal amplifier chip to produce sound, we can hear the sound from the Bluetooth headset.

Many people now say that Bluetooth headsets have poor sound quality, and that once the transmission distance exceeds 10 meters, the signal will be lost. First of all, Bluetooth transmission of audio, a certain compression, loss of sound quality, moreover, the headphone head contained a series of components such as a battery, a Bluetooth module, a digital-to-analog converter circuit, an amplifier circuit, a headphone unit, and so on. Such a small volume required portability at the same time, so you have to sacrifice sound quality. At present in the digital-analog conversion, amplification, Bluetooth headsets or a lot of room for improvement. This requires the improvement of science and technology and the development of chips.

1.4 Exercise is the best way for us to improve our brain

Everyone wants to improve their brain, want to become smarter, more flexible. Through this video, we learned about the importance of exercise and its benefits to our brain. Take Me, for example, my high school principal, when we were in high school, every morning at six o'clock we had to go for a run, for about ten minutes, and then go back to the classroom to recite. At first I didn't understand why I was running. Later, slowly, after running and then back to the classroom endorsement, my efficiency has improved a lot, and not so sleepy. At the same time, there are small half a year's time, I every night under the night self-study, and friends will go to run a few laps. I have to say, running really brings me a lot. Running can improve our brain, it can help us improve our memory, improve our mental agility. Running can be very helpful if you really want to be smart... In addition, running can help strengthen our immunity, help to grow taller, adjust our mood, relieve stress... ... When I got to college, I hardly ever ran, except for the running required by my freshman year. This has led to a lot of reduced immunity, but also put on a lot of weight, and the efficiency of a lot of low endorsement! . I really should start running from this semester, exercise, improve the brain!

2 Problem 2

2.1 Problem description

Do a campus survey to meaningfully answer the following questions:

When is an average undergraduate student most or least happy during a day.

When is an average undergraduate student most or least happy in a particular day of the week?

Then, based on your survey,

(a) Write an article on what the school can do to make the students' campus life more suitable for them?

(b) Explore other meaningful results from your data.

(c) Propose ways to teach computers to get similar results automatically.

2.2 The solution to (a)

I surveyed a total of 33 college students in the questionnaire. The main questions were: the happiest and unhappiest times of the day, the reasons for being happy and unhappy during the day, and which day of the week was the happiest and unhappiest, the reasons for this, the biggest emotional impact on their own causes of stress.The results of the survey are presented at the end.From the questionnaire, we can see the following results:%

51.52% of college students think that evening (approximately 18:00 -23:00) is the happiest, and 21.21% of college students think that morning (approximately 6:00 -8:30) is the happiest. 45.45% thought that the morning is the most unhappy, and 21.21% thought that the midnight is the most unhappy. Most of the reasons that affect the happiness of the day are getting up, morning and evening, not sleeping enough, staying up late.

48.48% of college students thought Saturday was the happiest, followed by Friday, accounting for 30.3% . 36.36% of the students thought that Monday was the most unhappy, while 21.21% of the students thought that Tuesday and Friday were the most unhappy. Through the students' answers, we can know that most of them are because of the reasons for class, class, homework, pressure.

First of all, most students are unhappy during the day, is generally late at night, not up in the morning, and then eat breakfast will also have problems. Our school class time is very reasonable, can completely meet our work and rest requirements. I think this can be organized by the department or Class students run morning exercises, the physical quality of the students go up, get up early naturally will be much easier, and at night sleep will be more sweet. As for staying up late, it required the students' self-awareness as well as external supervision. The school could change the lights-out time, but some students would not sleep even if they switched off the lights. In the weekly mood survey, college students were happiest on Friday and Saturday, and most unhappy on Monday and Tuesday. This is mainly an academic problem for college students. For this, I think the school needs

to improve the enthusiasm of students to learn. For example, our class has classes every day of the week. Although there are not many classes, they are too scattered. I think we can make use of Mondays to Fridays and try to arrange classes for these few days, but for example, if the experimental classes are scheduled on weekdays, then it is estimated that some classes will be scheduled into the evening, but also need to consider the safety of teachers. The school can hold more activities on Sunday, can be academic, can also be entertainment, also can find some professors and teachers to give lectures. Let students choose what they are interested in (it can be held twice a week or once a week) . In this way, most students have been in school will not feel bored, and activities of the urge, we will try to complete the study before the activities. This will not only enhance the enthusiasm of students to learn, initiative, but also help students to increase knowledge literacy, as well as exercise. College students spend the most time in school, can not give them too much pressure, but also can not be too indulgent. The university period, is a university student three views, the study habit, the exercise habit formation important time.

2.3   The solution to (b)

From this survey, one of the biggest factors affecting their mood, most college students are filled in the academic pressure, future worries, internal friction. Now there is a very popular word "juan", this phenomenon is seen everywhere in life. In the school, we strive for ranking, scholarships, research places, postgraduate entrance examination. In society, we are also working harder and harder to promote, raise wages, promotion. Now the social pressure is very big, even not yet fully into the community of students, in school every day began to worry about the future, worry about work. I can understand that every college student is with their own expectations to come to the university, certainly hope that they have the ability. But I still feel that the university is where we learn and grow knowledge. Just for the sake of competition, and forget to come to the University of the heart but not worth it. What we should be concerned about at this stage is to work hard to improve ourselves, study hard and work hard to improve our own advantages. Instead of worrying about things that haven't come yet. Work hard to be yourself, study hard, and prepare for the future.

Another interesting thing is that disciplined people are happier. In the course of my research, I found that many people who stay up late can not get up the next morning, so it is easy to be unhappy in the morning, and thus affect their mood for the day. And self-disciplined people, often able to complete their tasks in time, to the evening more free, and have time to relax, and not stay up late. So they get up very easily the next morning, sleep habits are very good, get up in the morning spirit is very good, so the day down to work efficiency is also very high. I still suggest that college students, should take this opportunity to make a good change, the formation of good habits. Stay up late, can't get up in the morning, a long time, the harm to the body is also great, and will greatly reduce the next day's learning efficiency. There are many students feel that the class, homework, there is no class is not happy, no class, no homework is happy. Students should not have too much pressure, but we come to school, in order to learn, improve their own, rather than let us fall, wasted life. We should at least finish what we should finish. Self-discipline can make us happier and healthier. If you have the opportunity, you can also run every day, exercise, improve your concentration.

2.4   The solution to (c)

Python pymysql module to connect to the database to read the latest data, using xlsxwriter module to make Excel, with timing module, can do from extract data, processing data to send data automation.

We can also use machine learning method of artificial intelligence to set up quantitative analysis model in Python. After a lot of training sets of computer, we can analyze the characteristics and relevance of data.

3   Problem 3

3.1   Problem description

The Fourier transform pair can be defined as:

$$\tilde{x}(f) = \int_{-\infty}^{\infty} x(t)e^{-j2\pi ft}dt$$

$$x(t) = \int_{-\infty}^{\infty} \tilde{x}(f)e^{j2\pi ft}df$$

Prove the following:

$$ax(t) + by(t) \leftrightarrow a\tilde{x}(f) + b\tilde{y}(f) \tag{1}$$

$$x(st) \leftrightarrow \frac{1}{|s|}\tilde{x}(\frac{f}{s}) \tag{2}$$

$$x^*(t) \leftrightarrow \tilde{x}^*(-f) \tag{3}$$

$$\tilde{x}(t) \leftrightarrow x(-f) \tag{4}$$

$$x(t - t_0) \leftrightarrow e^{-j2t_0 f}\tilde{x}(f) \tag{5}$$

$$e^{j2f_0 t}x(t) \leftrightarrow \tilde{x}(f - f_0) \tag{6}$$

$$x^{'}(t) \leftrightarrow j2\pi f\tilde{x}(f) \tag{7}$$

$$\int x(u)y(t - u)du \leftrightarrow \tilde{x}(f)\tilde{y}(f) \tag{8}$$

3.2 The solution

1. The solution to (1).

   prove:

   let F(t)=ax(t)+by(t)

   due to

   $$\tilde{x}(f) = \int_{-\infty}^{\infty} x(t)e^{-j2\pi ft}dt$$

   we can know

   $$\begin{aligned}
   \tilde{F}(f) &= \int_{-\infty}^{\infty} [ax(t) + by(t)]\, e^{-j2\pi ft}dt \\
   &= \int_{-\infty}^{\infty} ax(t)e^{-j2\pi ft}dt + \int_{-\infty}^{\infty} by(t)e^{-j2\pi ft}dt \\
   &= a\int_{-\infty}^{\infty} x(t)e^{-j2\pi ft}dt + b\int_{-\infty}^{\infty} y(t)e^{-j2\pi ft}dt \\
   &= a\tilde{x}(f) + b\tilde{y}(f)
   \end{aligned}$$

   so, ax(t) + by(t) $\leftrightarrow a\tilde{x}(f) + b\tilde{y}(f)$

2. The solution to (2).

   prove:

   from this question,we can know,

   It doesn't make sense when s equals 0, so s doesn't equal 0

   let F(t)=x(st)

   when s>0,

   $$\begin{aligned}
   \tilde{F}(f) &= \int_{-\infty}^{\infty} x(st)e^{-j2\pi ft}dt \\
   &= \frac{1}{s}\int_{-\infty}^{\infty} x(st)e^{-j2\pi \frac{f}{s} st}dst \\
   &= \frac{1}{s}\int_{-\infty}^{\infty} x(st)e^{-j2\pi \frac{f}{s} u}du \\
   &= \frac{1}{s}\tilde{x}(\frac{f}{s})
   \end{aligned}$$

   when s<0,

4

$$\tilde{F}(f) = \int_{\infty}^{-\infty} x(st)e^{-j2\pi ft}dt$$

$$= \frac{1}{s}\int_{\infty}^{-\infty} x(st)e^{-j2\pi\frac{f}{s}st}dst$$

$$= -\frac{1}{s}\int_{-\infty}^{\infty} x(st)e^{-j2\pi\frac{f}{s}u}du$$

$$= -\frac{1}{s}\tilde{x}(\frac{f}{s})$$

To sum up, x(st) $\leftrightarrow \frac{1}{|s|}\tilde{x}(\frac{f}{s})$

3. The solution to (3).

prove:

let F(t)=x*(t)

due to,

$$\tilde{x}(f) = \int_{-\infty}^{\infty} x(t)e^{-j2\pi ft}dt$$

$$\tilde{F}(f) = \int_{-\infty}^{\infty} x^*(t)e^{-j2\pi ft}dt$$

$$= \int_{-\infty}^{\infty} \left[x(t)e^{j2\pi ft}\right]^* dt$$

$$= \left[\int_{-\infty}^{\infty} x(t)e^{-j2\pi(-f)t}dt\right]^*$$

$$= [\tilde{x}(-f)]^*$$

$$= \tilde{x}^*(-f)$$

so, x*(t) $\leftrightarrow \tilde{x}^*(-f)$

4. The solution to (4).

prove:

let F(t)=(f),

we can know,

$$x(t) = \int_{-\infty}^{\infty} \tilde{x}(f)e^{j2\pi ft}df$$

so,

$$\tilde{F}(f) = \int_{-\infty}^{\infty} \tilde{x}(t)e^{-j2\pi ft}dt$$

$$= \int_{-\infty}^{\infty} \tilde{x}(t)e^{j2\pi(-f)t}dt$$

$$= x(-f)$$

so, (t) $\leftrightarrow x(-f)$

5. The solution to (5).

prove:

let F(t)=x(t-t$_0$),

$$\tilde{F}(f) = \int_{-\infty}^{\infty} x(t-t_0)e^{-j2\pi ft}dt$$

$$= e^{-j2\pi ft_0}\int_{-\infty}^{\infty} x(t-t_0)e^{-j2\pi f(t-t_0)}d(t-t_0)$$

$$= e^{-j2\pi ft_0}\int_{-\infty}^{\infty} x(u)e^{-j2\pi fu}du$$

$$= e^{-j2\pi ft_0}\tilde{x}(f)$$

so,x(t-t$_0$) $\leftrightarrow e^{-j2t_0f}\tilde{x}(f)$

6. The solution to (6).

   prove:

   let F(t)=$e^{j2f_0t}x(t)$,

   we can know,

$$\tilde{F}(f) = \int_{-\infty}^{\infty} e^{j2f_0t}x(t)e^{-j2\pi ft}dt$$
$$= \int_{-\infty}^{\infty} x(t)e^{-j2\pi(f-f_0)t}dt$$
$$= \tilde{x}(f - f_0)$$

   so, $e^{j2f_0t}x(t) \leftrightarrow \tilde{x}(f - f_0)$

7. The solution to (7).

   prove:

   let F(t)=$x^{'}(t)$,

   we can know,

$$\tilde{F}(f) = \int_{-\infty}^{\infty} x^{'}(t)e^{-j2\pi ft}dt$$
$$= \int_{-\infty}^{\infty} e^{-j2\pi ft}dx(t)$$
$$= lim_{t\to+\infty}x(t)e^{-j2\pi ft} - lim_{t\to-\infty}x(t)e^{-j2\pi ft} - \int_{-\infty}^{\infty} x(t)de^{-j2\pi ft}$$
$$= lim_{t\to+\infty}x(t)e^{-j2\pi ft} - lim_{t\to-\infty}x(t)e^{-j2\pi ft} + j2\pi f \int_{-\infty}^{\infty} x(t)e^{-j2\pi ft}dt$$

   we know,
$$lim_{t\to+\infty}x(t)e^{-j2\pi ft} = lim_{t\to+\infty}x(t)e^{-j2\pi ft} = lim_{t\to+\infty}x(t) * 0 = 0$$

   we also know,

   when t → -∞,

   $lim_{t\to-\infty}x(t) = 0$;

   so, $lim_{t\to-\infty}x(t)e^{-j2\pi ft} = 0$;

   therefore

$$\tilde{F}(f) = lim_{t\to+\infty}x(t)e^{-j2\pi ft} - lim_{t\to-\infty}x(t)e^{-j2\pi ft} + j2\pi f \int_{-\infty}^{\infty} x(t)e^{-j2\pi ft}dt$$
$$= 0 + j2\pi f \int_{-\infty}^{\infty} x(t)e^{-j2\pi ft}dt$$
$$= j2\pi f\tilde{x}(f)$$

   so,$x^{'}(t) \leftrightarrow j2\pi f\tilde{x}(f)$

8. The solution to (8).

   prove:

   let F(t)=$\int x(u)y(t - u)du$,

   so, we can get,

$$\tilde{F}(f) = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} x(u)y(t-u) du\, e^{-j2\pi ft} dt$$

$$= \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} x(u)y(t-u) e^{-j2\pi ft} dt\, du$$

$$= \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} y(t-u) e^{-j2\pi ft} dt\, x(u) du$$

$$= \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} y(t-u) e^{-j2\pi f(t-u)} d(t-u) x(u) e^{-j2\pi fu} du$$

$$= \int_{-\infty}^{\infty} \tilde{y}(f) x(u) e^{-j2\pi fu} du$$

$$= \tilde{y}(f) \int_{-\infty}^{\infty} x(u) e^{-j2\pi fu} du$$

$$= \tilde{y}(f)\tilde{x}(f)$$

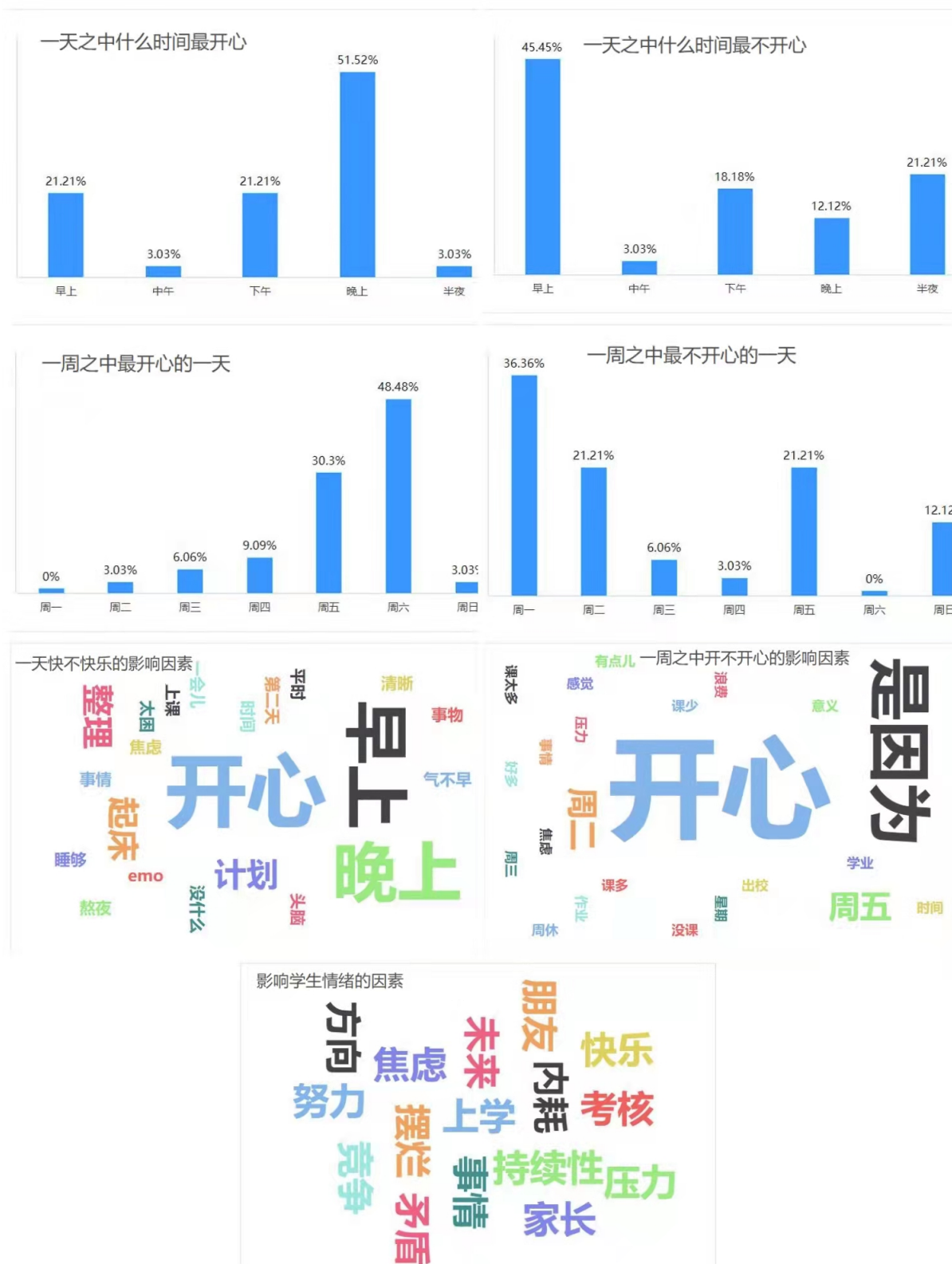$$= \tilde{x}(f)\tilde{y}(f)$$

so, $\int x(u)y(t-u) du \leftrightarrow \tilde{x}(f)\tilde{y}(f)$

Figure 1: Mood survey results