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COIS 4310H Computer Networks | Assignment 1

1. **Compute the Fourier Coefficients for the function $f(t)=t(0\le t\le 1)$. (Note: This question appears to be missing quite a lot of relevant information – I've deliberately left it as is, because well – this is the standard book on Computer Networks after all).**

$$a_n = \frac{2}{T}\int_0^T g(t)\sin\left(\frac{2\Pi n t}{T}\right)dt$$
$$= \frac{2}{1}\int_0^1 g(t)\sin\left(\frac{2\Pi n t}{1}\right)dt$$
$$= 2 * \left[\frac{\sin(2\Pi n) - 2\Pi n\cos(2\Pi n)}{4\Pi^2 n^2}\right]$$
$$= 2 * \left[\frac{0 - 2\Pi n}{4\Pi^2 n^2}\right]$$
$$= 2 * \left[\frac{-1}{2\Pi n}\right]$$
$$= \frac{-1}{\Pi n}$$

$$b_n = \frac{2}{T}\int_0^T g(t)\cos\left(\frac{2\Pi n t}{T}\right)dt$$
$$= 2\int_0^1 t\cos(2\Pi n t)dt$$
$$= 2(\sin(2\Pi n t)(2\Pi n t) + \cos(2\Pi n t)(4\Pi^2 n^2))$$
$$= 2(\sin(2\Pi n)(2\Pi n) + \cos(2\Pi n)(4\Pi^2 n^2))$$
$$= 0 + 4\Pi^2 n^2 - 0 - 4\Pi^2 n^2$$
$$= 0$$

$$c = \frac{2}{1}\int_0^1 f(t)\,dt$$
$$= 2\int_0^1 t\,dt$$
$$= 2\left[\frac{t^2}{2}\right]_0^1$$
$$= 2 * \frac{1}{2}$$
$$C = 1$$

2. **TV channels are 6MHz wide. How many bits/sec can be sent if we use 4 level digital signals? (Assume a noiseless channel)**

   Max data rate = 2 * B * lg(V) bits per second
   Where B is the bandwidth, and V is number of discrete levels.

   Max data rate = 2 * 6MHz * lg(4)
   = 12MHz * 2 bits/sample
   = 24Mb per second.

3. **If a binary signal is sent over a 3kHz channel whose signal to noise ratio is 20dB (a factor of 100) what is the maximum achievable data rate?**
   $10 * \log_{10} S/N = 20$
   $10 * log_{10}(\frac{S}{N}) = 20$
   $log_{10}(\frac{S}{N}) = 2$
   $(\frac{S}{N}) = 100$
   $maximum\ number\ of\ bits/sec = B\ log_2(1 + S/N)$
   = 3kHz * $\log_2(101)$ = 3 * 6.66
   = 19.98, The Shannon Limit is 19.98 Kbps

Nyquist Limit

Binary signal = 2 levels

Max data rate = 2*3kHz*lg(2)

= 6kbps

The Nyquist limit throttles the maximum data rate to 6kbps

4. **An upper-layer packet is split into 10 frames each of which has an 80% change of arriving undamaged. If no error control is done by the data link protocol how many times must the message be sent on average to get the entire thing through?**

   Frames have a 80% chance to make it undamaged.

   The chance for the entire message to make it through unharmed is $0.8^{10} = 0.107\backslash$

   Number of transmissions for an entire message is

   $p \sum_{i=1}^{\infty} i(1-p)^{i-1}$

   $\sum_{i=1}^{\infty} \alpha^i = \frac{1}{1-\alpha}$, $\alpha = 1-p$

   $\sum_{i=1}^{\infty} i\alpha^{i-1} = \frac{1}{(1-\alpha)^2} = 1/p$ Therefore, it takes an avg of 1/0.107 transmissions 9.3

5. **What is the maximum overhead in a byte stuffing algorithm?**

   If every byte in the payload consists of escape and FLAG bytes, then they must all be escaped. The maximum overhead is therefore 100%

6. **Imagine you are working on an online interactive product. Assuming you do not want any frame delay due to network latency, and that it takes 10 millisecond to process any input received. Also assume also that any signal sent will travel at $2x10^8$ m/s. How close must your data centre be for this to be achievable at 30frames per second? How about 60? Consider only the time it takes for the signal to bounce back and forth, we aren't worried about controller input lag or screen display lag. What big city is farthest from Peterborough that could host this data centres in either case?**

   10ms required to process input. Therefore we only have 90ms left to send signals. 30 Frames per second, means that you have 90ms / 30 so 3ms per frame. Therefore the max distance can be $2*10^8$ m/s * .03s = 6000 kilometers. 60 Frames per second, means that you have 90ms/ 60 so 1.5ms per frame. Therefore the max distance can be $2*10^8$ m/s * .015s = 3000 Kilometers. There are a large number of cities available that could be used to host these data centers.

7. **Suppose you are trying to optimize a massive video streaming service (youtube, Netflix, that sort of thing), with 1 billion users (exactly 1 billion). Assume that your average customer has 78 ms of latency (that's a real number I calculated using some Verizon data). Using https://support.google.com/youtube/answer/1722171?hl=en calculate how much data is stuck in transit for 1080p and 2160p video with 5.1 Audio (use 35 Mb/s for 2160p video). If you wanted to buffer enough to cover a very poor case – like north America to India (266ms) how much data do you need? Estimate bandwidth costs per user in both cases (companies like rackspace offer bandwidth pricing data, but it's up to you to research and source the data). Assume that you get the best rate available for data.**

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8. **Write a program in python that calculates hamming codes for a 16 bit number and show how you tested this program to verify correctness.**

---------- Attached in directory ----------

9. **The Edward Snowden leaks gave us a list of 4 products the NSA was unable to crack. One of those (trucrypt) we are going to ignore, as it's a dead project. The other 3 are OTR, TOR, and Zoho email. Each assignment will have you install and try out one of these products and see how well it works. For this assignment you should create a free Zoho account, and experiment with sending/receiving emails, files etc. Try and access the account on different devices (mobile phone, web browser, email program like thunderbird), and tell me about what works or what doesn't. Fair warning – last year when we tried this many emails simply didn't send or didn't receive, but that might be fixed. Write approximately 500 words on the process of setting up and using this service, problems you encountered and generally whether or not you think this is something the public could use.**

Surprisingly, I've never used, or even heard of, Zoho before. When I first searched for it, I wasn't sure if it was the correct mail client, perhaps I had found a similarly named competitor or something of the sort. But no, the brightly coloured logo signified that this was the mail client I was looking for.

Following a link to zoho.com/mail, I was surprised by how clean and modern the landing page looked. Usually, when groups or companies set goals of functionality and security, design and form are not priorities. But, with just a couple of clicks and a filled out form, I had created my zoho email account, verified it with my phone, and logged in.

It looks very simplistic. Drafting an email was very slick and fluid. I was surprised to see that Zoho did much more than just mail, with an entire content resource management system for businesses as well.

After sending an email to my personal email, I checked the level of encryption and saw that it uses standard TLS, which is good. Emails shouldn't be able to be read or changed.

Whilst downloading the Zoho Mail application on my Oneplus 3, I browsed the comments, and saw that a lot of users were having issues with push notifications working on their systems. Other users complained about issues with trying to attach files over specific sizes, and still more complained about the user experience of the application. All of these reviews had received quick responses from a representative of zoho, requesting that they email support so that a case may be created to address whatever issues the users were experiencing. The representative made the company seem as though they really want to improve their application and are wide open to suggestions from their users.

My own experience of the application is very pleasant actually. The application was quick to load and looks very crisp. It seems to use the design patterns that many applications on android do; Material Design. The application is very reminiscent of the Gmail application, with extra icon shortcuts to different services that the application offers. This includes a file manager, managing contacts, along with a calendar as well. Despite some users remarking that the application doesn't sync well between devices, it sure did.

Overall, it's a pretty solid application, and as for the general public's use, it seems to be ready, if the company continues to accept feedback from their community, and stay up to date with their competitors, with more marketing and advertisements, I'm positive that the application will do well.