ECSE-4670: CCN
Quiz 1: Solutions

Time: **45 min (strictly enforced)**

Points: **50**

YOUR NAME:

Be brief, but DO NOT omit necessary detail

True or False? [2.5*10 = 25]

T or F **[0.5 points]**. Either way, state the correct explanation/reason. **[2 pts]**. Right ideas earn partial credit.

❑ √ Statistical multiplexing is especially useful when the peak rate equals the average rate.

Useful when peak rate is different from average rate

❑ √ With 8-level signaling (each level = 3 bits), the baud rate =1/4 *bit rate, and the minimum bandwidth required as per Nyquist theorem = 1/6 *bit rate.

Baud rate = 1/3*bit rate

√ ❑ From Amdahl's law, we learn that the part(s) of the system that is (are) the best candidate for speedup is that which is responsible for a larger fraction of the system's performance.

Same as: speed up the common case. The unaffected part will otherwise drag down system performance

- ❑ √ Techniques like ASK, PSK, FSK are better than baseband transmission because they use a wider frequency spectrum.

They use a narrower frequency spectrum

- ❑ √ Dispersion's primary effect is to dampen signal amplitudes

Dispersion widens signals - causes inter-symbol interference. Attenuation dampens signals

- √ ❑ All-zeros is a valid set of CRC-bits (i.e the bits which are finally added to form T(x)), but 0 is not a valid check-digit in the check-digit method.

You have a "subtract" step in decimal check-digit. The only way to get 0 = 9-9, but 9 can never be the remainder !

- ❑ √ On a channel having bandwidth 10 MHz and S/N of 30dB, we can achieve a gigabit (10^9 bits/s) rate.

No. From Shannon's theorem max = 10 MHz * 10 = 100 Mbps

- ❑ √ The reason light does not escape from the sides of a fiber optic cable is because the cable lies underground.

Due to total internal reflection.

- √ ❑ The Hamming distance between any two valid codewords in the 1-bit odd parity scheme is 2.

You need to change at least two bits to maintain parity and get a new codeword.

- ❑ √ Selective-Reject ARQ makes more efficient use of the sequence number space compared to Go-back-N ARQ

Uses only half the sequence number space due to the ambiguity problem.

- 1. [10 pts] Derive the Stop-and-wait ARQ utilization formula:
  U = (1-P)/(1+2a). Show your work used to get key intermediate results.

W/o ARQ: the only useful part is the transmission time

$U=T_f/[(T_f+2T_p)] = 1/(1+2\alpha)$

W/ ARQ, **U = 1/[N_r(1+2α)], …. Eqn (1)**

Nr = expected number of cycles to complete transmission

$N_r=\Sigma\, i\, P^{i-1}(1-P)$.

Now $\Sigma\, P^i = 1/(1-P)$, and $\Sigma\, i\, P^{i-1} = d/dp\, (\Sigma\, P^i) = 1/(1-P)^2$

So, **Nr** = $(1-P)/(1-P)^2$ = **1/(1-P)**

Substituting in Eqn (1), we get:

U=(1-P)/(1+2α)

- 2. [7 pts] Explain why packet-switching is able to exploit temporal multiplexing gains whereas circuit-switching is not. What is the tradeoff packet-switching makes to achieve this benefit ?

- In temporal multiplexing, many users may be active at once, but the average over time will be lesser.
- In such a case, users may need to wait for service.
- Circuit switching cannot provide this because all meta-data is associated with timing and will be lost in such a case.
- Packets have explicit meta-data in the form of headers and can hence be “stored” and “forwarded”.

- 3) (8 pts) Use the (decimal) check digit method to calculate the check-digit for 636. If the number received at destination is 6361, explain why it will be detected as being in error.
- M = 636. Multiply by 10 => 6360
- Divide by 9, remainder = 0.
- Subtract from 9 => **check digit = 9**
- Number transmitted = T = 6369
- When 6361 is received, the receiver divides it by 9 and finds the remainder as 1. But 9 - 1 = 8 which should have been the check digit, whereas it finds that 1 is the check digit. Therefore it flags an error.