CAS CS 350 HW3

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TOTAL POINTS

97 / 100

QUESTION 1

1 Q1 40 / 40

✓ **- 0 pts** **Correct**

a)

- **- 2 pts** Minor error in calculation
- **- 5 pts** Incorrect answer but some work shown
- **- 8 pts** Missing answer/ No attempt to calculate Ts

b)

- **- 1 pts** Minor error in calculation
- **- 2 pts** Incorrect answer but some work shown
- **- 2 pts** No attempt to calculate Tq
- **- 3 pts** No work shown

c)

- **- 1 pts** Minor error in calculation
- **- 2 pts** Incorrect answer but some work shown
- **- 3 pts** No work shown

d)

- **- 0 pts** Incorrect answer due to previous mistakes
- **- 1 pts** Minor error in calculation
- **- 2 pts** Incorrect answer but some work shown
- **- 3 pts** No work shown

e)

- **- 0 pts** Incorrect answer due to previous mistakes
- **- 1 pts** Minor error in calculation
- **- 2 pts** Incorrect answer but some work shown
- **- 3 pts** No work shown

f)

- **- 1 pts** Minor error in calculation
- **- 2 pts** Incorrect answer but some work shown
- **- 3 pts** No work shown

g)

- **- 2 pts** Minor error in calculation
- **- 4 pts** Incorrect answer but some work shown
- **- 6 pts** No work shown

h)

- **- 2 pts** Minor error in calculation
- **- 4 pts** Incorrect answer but some work shown
- **- 6 pts** Incorrect answer with wrong logic
- **- 8 pts** No work shown

i)

- **- 1 pts** Minor error in calculation
- **- 2 pts** Error in the comparison/No comparison
- **- 3 pts** No work shown

QUESTION 2

2 Q2 30 / 30

✓ **- 0 pts** **Correct**

a)

- **- 0 pts** Correct
- **- 2 pts** minor error in calculation
- **- 5 pts** major error in calculation
- **- 4 pts** correct answer without steps
- **- 8 pts** incorrect answer/missing answer

b)

- **- 0 pts** Correct
- **- 1 pts** minor error in calculation
- **- 4 pts** major error in calculation
- **- 3 pts** correct answer but missing steps
- **- 6 pts** incorrect answer/answer not provided

c)

- **- 0 pts** Correct
- **- 1 pts** calculation error
- **- 2 pts** missing/incorrect reasoning
- **- 3 pts** answer not provided

d)

- **0 pts** Correct
- **2 pts** Minor calculation error
- **6 pts** Major calculation error
- **5 pts** correct answer but missing steps
- **10 pts** incorrect/missing answer

e)

- **0 pts** Correct
- **1 pts** Calculation error/missing answer for "by how much?"
- **2 pts** missing/incorrect reasoning
- **3 pts** no answer provided

QUESTION 3

3 Q3 27 / 30

- **0 pts** Correct

a)

✓ - **0 pts** **Correct**
- **1 pts** calculation error/missing steps
- **3 pts** incorrect/missing answer

b)

- **0 pts** Correct

✓ - **3 pts** **Minor calculation error**
- **6 pts** Major calculation error
- **8 pts** Incorrect reasoning
- **12 pts** missing/incorrect answer

c)

✓ - **0 pts** **Correct**
- **1 pts** Calculation error
- **3 pts** Missing/incorrect answer

d)

✓ - **0 pts** **Correct**
- **2 pts** Minor calculation error/missing answer for "by how much"
- **6 pts** Major calculation error/missing steps
- **5 pts** Correct answer with no steps shown
- **10 pts** missing/incorrect answer

e)

✓ - **0 pts** **Correct**
- **1 pts** Calculation error
- **2 pts** Missing/incorrect answer

1 this is the right lambda to use!

Problem 1

a) $q \leq 15$

① solve for T_S by using this: $\frac{T_S}{1-P}$ → solve for P!

* $q = \frac{P}{1-P}$ → plug in vals & solve for P

$1-P\left(15 = \frac{P}{1-P}\right)+P$

$15 - 15P = P$

$+15P \quad +15P$

$\frac{15}{16} = \frac{16P}{16} \rightarrow P = \frac{15}{16}$

solve for T_q

↳ $T_q = T_w + T_s$

we can use $q = \lambda \cdot T_q$ to find T_q

① solve for λ

- 86400 sec/day

$\frac{21,000}{86,400} = \frac{\lambda \cdot 86,400}{86,400}$

$\lambda = 0.25$

② plug in to formula: $q = \lambda \cdot T_q$

$q = 15$

$\lambda = 0.25$

$T_q = q/\lambda$

$= 15/0.25$

$T_q = 60$ sec

② plug in values to equation: $\frac{T_S}{1-P} = T_q$

$\frac{T_S}{1-\left(\frac{15}{16}\right)} = 60$

$0.0625\left(\frac{T_S}{0.0625} = 60\right)0.0625$

$\boxed{T_S = 3.75 \text{ sec}}$

Problem 1 continued...

b) Find T_W.

↳ $T_W = T_q - T_s$

60 (for T_q), 3.75 (for T_s)

$T_W = 60 - 3.75$

$\boxed{T_W = 56.25}$

c) compare utilizations:

previous = 0.9375 ← bigger

new = $48/60 = 0.8$

- Yes, we the investors should budget for water cooling.

d) slowdown = $\frac{T_q}{T_s} = \frac{60}{3.75} = \boxed{16}$

e) $\rho = \lambda \cdot T_s$

$\frac{1}{3.75} = \frac{\lambda \cdot 3.75}{3.75}$

$\lambda = 1/3.75$

$q = \lambda \cdot T_q$

$q = \frac{1}{3.75} \cdot 86{,}400$

$\boxed{q = 23{,}040 \text{ requests}}$

← max # of requests per day system can sustain

f) since there are never more than 15 requests in the system, and the pictures each have an avg size of 3MB, then

$15 \times 3 = \boxed{45 \text{ MB of memory}}$

g) $\lambda = \frac{1}{T_s} = \frac{36000}{86400} = 0.417 \text{ sec}$

$T_s(0.417 = \frac{1}{T_s})T_s$

$\frac{T_s(0.417)}{0.417} = \frac{1}{0.417}$

$\boxed{T_s = 2.398}$

Problem 1 continued...

h) ① calculate q of compression

$$q = \frac{P}{1-P} = \frac{\lambda \cdot T_s}{1-(\lambda \cdot T_s)}$$ → plug in values!

$$\frac{(0.413)(2)}{1-(0.413 \cdot 2)} = \frac{0.826}{0.174} = 4.74$$

② Calculate q processing

$$q = \frac{P}{1-P} = \frac{\lambda \cdot T_s}{1-(\lambda \cdot T_s)}$$ → plug in values

$$\frac{(0.413)(1)}{1-(0.413 \cdot 1)} = \frac{0.413}{0.587} = 0.703$$

③ add the 2 q's

$0.703 + 4.74 = 5.443$ → q

④ solve for T_q

$q = \lambda \cdot T_q$ → plug in values!

$$\frac{5.443}{0.413} = \frac{0.413\,(T_q)}{0.413}$$

$$\boxed{T_q = 13.05}$$

i) $q = \frac{P}{1-P}$ → solve for P

$1-P\left(q = \frac{P}{1-P}\right)1-P$

$q - Pq = P$

$+Pq \quad +Pq$

$q = P + Pq$

$\frac{q}{(1+q)} = \frac{P(1+q)}{(1+q)}$

$P = \frac{q}{1+q} = \frac{5.443}{1+5.443} = 0.845$ so you do NOT need cooling at the main processing server.

1 Q1 **40 / 40**

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Problem 2

a) $\lambda = 8000$ packets/sec

$\mu = (100{,}000{,}000 / 8) / 1024$

$\mu = 12{,}207.031$

$T_S = 1/\mu = 1/12{,}207.03 = 0.00008192$

$\rho = \lambda \cdot T_S = 0.655$

$q = \rho / 1-\rho = 0.655 / (1-0.655) = \frac{0.655}{0.345} = 1.8986$

To find the packets that are needed, you multiply

$1.8986 \times 1024 =$ **1,944.12 bytes**

b) $T_W = T_q - T_S$

↳ $T_S = 0.00008192$

↳ $T_q = q/\lambda = 1.8986 / 8000 = 0.000237$

$T_W = 0.000237 - 0.00008192$

$T_W = 0.0001554$

The diff btwn the 2 time stamps will be (on avg)

0.0001554 seconds.

c) NO, I don't need to add a fan in my design because I would only have to if the utilization is 0.7 or greater, but it is 0.655.

d) From Little's Law =

$T_q' = \frac{T_S'}{1-\rho} = \frac{0.00000819}{(1-0.0655)} = \frac{0.00000819}{0.9345} = 0.00000876$

$T_S' = 1/\mu = 1/122{,}070.313 = 0.00000819$

$\mu = (1{,}000{,}000{,}000 / 8) / 1024$

$\mu = 122{,}070.313$

$\rho = \lambda \cdot T_S = 8000 \cdot 0.00000819 = 0.0655$

The get the speed up, you put $\frac{T_q}{T_q'} = \frac{0.000237}{0.00000876} =$ **27.055 s**

Problem 2 continued...

e) $q = p/1-p = 0.0655 / (1-0.0655) = 0.0655/0.9345 = 0.0701$

↳ multiply by 1024!

$-0.0701 \times 1024 = 71.77$

↳ subtract from answer in A!

$-1944.12 - 71.77 =$ **1,872.35 bytes**

2 Q2 30 / 30

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Problem 3

a) add all the times given & divide by the total number of samples (10)

$$\frac{30+27+26+31+25+28+30+29+32+26}{10} = 28.4 \text{ ms}$$

The avg amount of time it takes to process a single frame is 28.4!

b) $\lambda = 30$ frames/sec $\quad T_W = \frac{p \cdot T_s}{1-p} \rightarrow T_s = \frac{\lambda}{p}$

$q = 10$ frames

we know the equation to use is $W = \lambda \cdot T_W$ → $\frac{p \cdot T_s}{1-p}$

so we need to solve for p using equation for q ($q = \frac{p}{1-p}$).

- find p!

$p = \lambda \cdot T_s$

$\frac{1}{30}$ ↙ ↘ 28.4 ms → .0284 s

$p = 0.0009467$

- find T_W!

$T_W = \frac{p \cdot T_s}{1-p}$ plug in

$T_W = \frac{0.0009467 \cdot 0.0284}{1 - 0.0009467} = \frac{0.0000269}{0.9991} = \boxed{T_W = 0.0000269}$

c) we need to find q!

↳ $q = \lambda \cdot T_q$

↳ $\frac{T_s}{1-p} = \frac{0.0284}{1-0.000946} = \frac{0.0281}{0.9991} = 0.0284$

$q = \frac{1}{30} \times 0.0284$

$q = 0.033 \times 0.0284 = 0.00095$

$q = 0.000946$

- multiply by 2 to get total memory = $\boxed{0.00189 \text{ memory}}$

Problem 3 continued...

a) get standard deviation of chart!

- get mean

↳ 28.4 ms

- $\sum(\#-\text{mean})^2$

$(30-28.4)^2 + (27-28.4)^2 + (26-28.4)^2 + (31-28.4)^2 + (25-28.4)^2 +$

$(28-28.4)^2 + (30-28.4)^2 + (29-28.4)^2 + (32-28.4)^2 + (26-28.4)^2 =$

$2.56 + 1.96 + 5.76 + 6.76 + 11.56 + 0.16 + 2.56 + 0.36 +$

$12.96 + 5.76 = 50.4$

- get avg of those ↑

$\frac{50.4}{10} = 5.04$

- get square root!

$\sqrt{5.04} = 2.245$

$\sigma = 2.245$ (in terms of ms)

↳ $\sigma = 0.002245$ (in terms of secs)

plug in to formula & solve

$$A\left|\frac{1}{2}\left[1+\left(\frac{(\sigma T_s)}{T_s}\right)^2\right]\right.$$

$$A\left|\frac{1}{2}\left[1+\left(\frac{0.00225 \cdot 0.0284}{0.0284}\right)^2\right]\right. = 0.500$$

plug in to formula!

$$q = \frac{p^2 A}{1-p} + p$$

$$= \frac{.0009467^2(0.5)}{1-.0009467} + .0009467$$

$$= 0.000946$$

- to get memory occupied, multiply by 2

$0.000946 \times 2 = 0.00189$ memory used

- You don't need more or less memory, because you use the same amount!

Problem 3 continued--

e) $p = \lambda \cdot T_s$ ↘ find λ when $p = 1$

$$\frac{1}{0.0284} = \frac{\lambda \cdot 0.0284}{0.0284}$$

$$\boxed{\lambda = 35.211}$$

↖ max frame-rate

3 Q3 27 / 30

- **0 pts** Correct

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✓ - **3 pts** **Minor calculation error**

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d)

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e)

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1 this is the right lambda to use!