

## CEE 3804 Assignment 2 Solution

### Problem 1: (Total of 5 points)

a) Early microchips had a modest number of transistors. Name the number of transistors in the Intel 4004.

Solution/answer: The Intel 4004, which is often considered one of the first microprocessors, had a total of 2,250 transistors.

b) Considering the number of transistors in the Intel 4004 and the Apple M2 chip, explain if "Moore's Law" still applies.

Solution/answer: Intel 4004 was introduced in 1971 with 2,250 transistors. Apple M2 chip has 20 billion that was introduced in 2022. Moore's law says that the number of chip transistors doubles every 2 years. Therefore:

$$2022-1971 = 51 + 1(\text{consider the year 1971}) = 52 \\ 52/2 = 26$$

$2,250 * 2^{25} = 75,497,472,000 > 20,000,000,000$  (If we consider the year 2021 when M2 was introduced)

$2,250 * 2^{26} = 150,994,944,000 > 20,000,000,000$  (If we consider the year 2023 when M2 was introduced)

The growth rate is much more than what Moore's law used to predict.

c) DENDRAL was an early artificial intelligence program developed in 1965. Name two of the three developers of the software.

Solution/answer: Joshua Lederberg and Carl Djerassi.

d) The Atari 400 was an early game computer. Name the year of introduction of the Atari 400.

Solution/answer: 1979

e) Briefly explain the difference between a byte and a bit.

Solution/answer: Bit (Binary Digit): A bit is the smallest unit of digital data and represents a single binary value, which can be either 0 or 1. It's the basic building block of all digital communication and computing. Bits are used to represent the most basic form of data and are essential for encoding and transmitting information.

Byte: A byte is a group of 8 bits. It's a larger unit of data that is often used to represent a character, such as a letter, number, or symbol. Bytes are used to encode more complex data, such as text, images, and sound.

Note: Any reasonable and similar answer gets full credit.

f) In 1984, Apple introduced the Macintosh computer. Name the microprocessor used and two novel features of the computer.

Solution/answer: Microprocessor: Motorola 68000 microprocessor.

Features: first successful mouse-driven computer and equipped with a graphical user interface.

g) Name the fastest supercomputer today and the number of CPU cores.

Solution/answer: One of the fastest supercomputers is the Fugaku supercomputer, developed by RIKEN and Fujitsu in Japan. Fugaku is capable of performing over 442 petaflops (quadrillions of calculations per second).

Fugaku consists of a massive number of CPU cores. It is composed of various types of processors, including ARM-based A64FX CPUs. The total number of CPU cores in Fugaku is approximately 7.3 million cores (reference: Wikipedia).

h) Motorola introduced the 68000 microprocessor for graphic applications. State the year and the number of transistors of the Motorola 68000.

Solution/answer: Year: 1979

Number of transistors: approximately 68,000

i) In the year 1981, IBM introduced the IBM-PC (model 5150). Name the microprocessor used in the early IBM-PC computer and the operating system used by the IBM-PC.

Solution/answer: IBM 5150 was equipped with 4.77 MHz Intel 8088 microprocessor and used Microsoft's MS-DOS operating system.

j) Name the year when Microsoft introduces the Windows 3.0 operating system. Name one important feature of the OS.

Solution/answer: Year: 1990

Feature: capability to run multiple programs, simultaneously.

## **Problem 2: (total of 3 Points)**

a) Number and model of CPU processor used

Solution/answer: Quad-Core Intel Core i5

b) CPU clock speed

Solution/answer: 2 GHz

c) Computer Random Access Memory (RAM) size

Solution/answer: 16 GB 3733 MHz LPDDR4X

d) Graphics processing unit if any (GPU)

Solution/answer: None (it depends on your machine. For example, Apple M1 and M2 come with GPU).

e) How many bytes does your computer hard drive have to store information?

Solution/answer: First, get the capacity of your hard drive (H.D.D or S.S.D) in GB. Then use the below formula:

$$499.96 \text{ GB} * 1,073,741,824 \text{ bytes per GB} = 536,827,962,327$$

**Problem 3: (total of 6 Points)**

f) Concatenate the Name of the dam and the County where the dam is located. Create a new column with the concatenated text.

Solution/answer:

Concatenated Dam Name and County
PATILLAS PATILLAS
LOCO YAUCO
CARITE GUAYAMA
ANTONIO LUCCHETTI YAUCO
GUAYABAL JUANA DIAZ
TOA VACA DAM VILLALBA
GARZAS ADJUNTAS
GUINEO VILLALBA
PRIETO MARICAO
CIDRA CIDRA
ADIUNTAS ADJUNTAS
PELEJAS ADJUNTAS
MATRULLAS OROCOVIS
GUAYO ADJUNTAS
YAHUECAS ADJUNTAS
VIVI UTUADO
CAONILLAS UTUADO
STRUCTURE 3 AÑASCO
LOIZA SAN JUAN
DOS BOCAS ARECIBO
LA PLATA TOA ALTA
LAS CURIAS RIO PIEDRAS
GUAJATACA QUEBRADILLAS
KAHANA DAM MAUI
NUUANU DAM NO. 4 HONOLULU
KANEHOE DAM HONOLULU
RESERVOIR 510 HONOLULU
RESERVOIR 545A HONOLULU
WAHIAWA DAM HONOLULU
ALEXANDER KAUAI
ANZALDUAS DIVERSION HIDALGO
DELTA LAKE UNIT NO 2 LEVEE HIDALGO
FALCON STARR
STRUCTURE 79 LEE
G-90 HIGHLANDS
LAKE CASA BLANCA DAM WEBB

Note: A few dams do not have either a Name or a County.

g) Create a new column in the spreadsheet to assign a size attribute for each dam according to the parameters shown in the table below. Use Excel to classify the dam's normal storage according to the following table. In your answer, show me an example of the Excel formula(s).

Solution/answer:

Latitude	County	Height	Max Storage	Normal Storage	Surface Area	Drain Area	Hazard	Scale	Year	N	Concatenated Dam Name and County	New Size Category
18.021	PATILLAS	147	13797	11029	367	25	H	PR	1914	1914	PATILLAS PATILLAS	Large
18.046	YAUCO	74	2059	1039	69	8	H	PR	1951	1951	LOCO YAUCO	Small
18.072	GUAYAMA	104	14992	8953	333	8	H	PR	1913	1913	CARITE GUAYAMA	Large
18.081	YAUCO	175	17595	11575	266	17	H	PR	1952	1952	ANTONIO LUCCHETTI YAUCO	Large
18.088	JUANA DIAZ	130	5933	4798	373	21	H	PR	1913	1913	GUAYABAL JUANA DIAZ	Medium
18.103	VILLALBA	215	54875	50620	836	22	H	PR	1972	1972	TOA VACA DAM VILLALBA	Extra Large
18.133	ADIUNTAS	201	4873	4073	108	6	H	PR	1943	1943	GARZAS ADJUNTAS	Medium
18.1616	VILLALBA	125	1954	1635	77	2	H	PR	1931	1931	GUINEO VILLALBA	Small
18.1837	MARICAO	98	565	285	20	10	H	PR	1955	1955	PRIETO MARICAO	Small
18.198	CIDRA	115	10800	5300	268	8	H	PR	1946	1946	CIDRA CIDRA	Medium
18.2016	ADIUNTAS	80	760	465	15	15	H	PR	1950	1950	ADIUNTAS ADJUNTAS	Small
18.2116	ADIUNTAS	120	280	108	5	9	H	PR	1950	1950	PELEJAS ADJUNTAS	Small
18.2116	OROCOVIS	120	2879	2294	77	4	H	PR	1934	1934	MATRULLAS OROCOVIS	Small
18.2133	ADIUNTAS	190	14515	11527	285	10	H	PR	1956	1956	GUAYO ADJUNTAS	Large
18.239	ADIUNTAS	90	1300	470	55	17	H	PR	1956	1956	YAHUECAS ADJUNTAS	Small
18.233	UTUADO	85	174	71	8	7	H	PR	1950	1950	VIVI UTUADO	Small
18.2716	UTUADO	239	54970	35182	700	50	H	PR	1948	1948	CAONILLAS UTUADO	Extra Large
18.3011	ARECIBO	50	395	334	7	1	H	PR	1978	1978	STRUCTURE 3 AÑASCO	Small
18.329	SAN JUAN	95	16300	9800	175	208	H	PR	1954	1954	LOIZA SAN JUAN	Large
18.335	ARECIBO	188	39380	19800	634	170	H	PR	1942	1942	DOS BOCAS ARECIBO	Extra Large
18.3416	TOA ALTA	131	28000	13700	560	183	H	PR	1974	1974	LA PLATA TOA ALTA	Large
18.3446	RIO PIEDRAS	75	1425	1120	48	1	H	PR	1946	1946	LAS CURIAS RIO PIEDRAS	Small
18.4	QUEBRADILLAS	120	46655	30955	1000	31	H	PR	1928	1928	GUAJATACA QUEBRADILLAS	Extra Large
20.972	MAUI	58	225	59	6	4.53	H	HI	1984	1984	KAHANA DAM MAUI	Small
21.355	HONOLULU	73	3600	242	25	2	H	HI	1910	1910	NUUANU DAM NO. 4 HONOLULU	Small
21.395	HONOLULU	82	4500	260	26	3	H	HI	1980	1980	KANEHOE DAM HONOLULU	Small
21.427	HONOLULU	57	227	227	12	2.5	H	HI	1935	1935	RESERVOIR 510 HONOLULU	Small
21.44	HONOLULU	56	140	140	8	0.53	H	HI	1920	1920	RESERVOIR 545A HONOLULU	Small
21.5	HONOLULU	98	9200	7761	302	16.5	H	HI	1906	1906	WAHIAWA DAM HONOLULU	Large
21.96	KAUAI	119	2540	1070	31.5	2.86	H	HI	1911	1911	ALEXANDER KAUAI	Small
26.137	HIDALGO	23	16400	10340	1287	176112	H	TX	1960	1960	ANZALDUAS DIVERSION HIDALGO	Large
26.43	HIDALGO	16	22545	17788	1227	3.01	S	TX	1939	1939	DELTA LAKE UNIT NO 2 LEVEE HIDALGO	Extra Large
26.519	STARR	175	317700	266000	115400	159270	H	TX	1963	1963	FALCON STARR	Extra Large
26.755	LEE	31	32266	26404	800	839	H	FL	1965	1965	STRUCTURE 79 LEE	Extra Large
27.34	HIGHLANDS	29	44676	33324	3662	44	H	FL	1962	1962	G-90 HIGHLANDS	Extra Large
27.5333	WEBB	78	58600	20000	1596	117	H	TX	1946	1946	LAKE CASA BLANCA DAM WEBB	Extra Large

$$=IF(H2 < 3500, "Small", IF(AND(H2 >= 3501, H2 < 6000), "Medium", IF(AND(H2 >= 6001, H2 < 16000), "Large", "Extra Large"))))$$

h) Count how many dams belong to each of the new size classes using the Excel COUNT or COUNTA commands.

Solution/answer:

fx =COUNTIF(P2:P91659, "Small")						
N	O	P	Q	R	S	T
	<b>Concatenated Dam Name and County</b>	<b>New Size Category</b>	<b>Count "Small"</b>	<b>Count "Medium"</b>	<b>Count "Large"</b>	<b>Count "Extra Large"</b>
	PATILLAS PATILLAS	Large	88907	343	770	1638

i) Use Excel conditional formatting to color code the values based on the dam size category. Assign red to Extra Large, Blue to Large, Yellow to Medium, and Green to Small.

Solution/answer:

New Size Category C
Large
Small
Large
Large
Medium
Extra Large
Medium
Small
Small
Medium
Small
Small
Small
Large
Small
Small
Extra Large
Small
Large
Extra Large
Large
Small
Extra Large
Small
Small
Small
Small
Small
Large
Small
Large
Extra Large
Extra Large

**Problem 4: (total of 6 Points)**

a) The bank offers loans at 7.5% per year over 12 years. Find the monthly payments to pay back the loan for 40 vehicles.

Solution/answer:

	A	B	C	D	E	F	G	H	I
1	Loan Amount	Number of Years	Number of Months	Yearly Interest Rate	Monthly Interest Rate	Number of Vehicles	Total Loan	Monthly Payment for All Forty Vehicle	Total Payment for All Forty Vehicle in the End of Twelve Years
2	428000	12	144	7.50%	0.00625	40	17120000	(\$180,654.74)	(\$26,014,283.14)
3									
4									

$$E2 = D2/12$$

$$C2 = B2*12$$

$$G2 = A2*F2$$

b) Estimate the total amount to be paid to the bank including interest.

Solution/answer:

	A	B	C	D	E	F	G	H	I
2	Loan Amount	Number of Years	Number of Months	Yearly Interest Rate	Monthly Interest Rate	Number of Vehicles	Total Loan	Monthly Payment for All Forty Vehicle	Total Payment for All Forty Vehicle in the End of Twelve Years
	428000	12	144	7.50%	0.00625	40	17120000	(\$180,654.74)	(\$26,014,283.14)

Note: 144 = 12 years \* 12 months for each year

**The amount paid to the bank after 12 years is 52% (26.014 million) more than the original loan.**