TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI
VICTORIA
UNIVERSITY OF WELLINGTON

EXAMINATIONS — 2008
MID-YEAR

ENGR101/120

MODEL ANSWERS

ENGINEERING

TECHNOLOGY

Time allowed: TWO HOURS

Instructions: You must answer **ALL** questions

Marks for each question are shown.

The exam consists of 150 marks in total.

Paper foreign to English language dictionaries are allowed.

Calculators are permitted.

Electronic dictionaries are not allowed.

1. Hardware (25 marks)

(a)

Motherboard: Connects all the main components of the computer together [1 mark] such as CPU, memory, disk drives etc. [1 mark]

CPU socket: allows CPUs to be plugged in and plugged out of the motherboard [1 mark].

Heat sink: carries heat away from the CPU [1 mark], if the CPU gets too hot it will start working or may even be damaged [1 mark].

(b)

Arm moves read/write head to the right track. [1 mark]
Waits for the disk to rotate so that the head is above the sector. [1 mark]
Head reads the data [1 mark]
Data that is encoded as magnetic regions on the platter [1 mark].
Electronics convert this into signals representing the data that is fed to CPU [1 mark].

An answer that looks at the logical level can get a maximum of two marks.

(c)

Where a program requires frequent access to same data [1 mark].
Data too big to fit in small L2 cache [1 mark].
Fetches data from L2 cache rather than RAM [1 mark].
L2 cache access is faster than RAM [1 mark]
Difference in speed is at least one order slower [1 mark]

(d)

His programs occupy more space than he has RAM so they are being loaded into virtual memory [1 mark].
When swap between programs, space has to be made in RAM [1 mark]
Results in data being swapped between RAM and disk [1 mark].
Makes the hard drive light wink [1 mark].
Accessing hard drive is slower than RAM, hence the pause [1 mark].

(e)

Cannot say for certain without more information [1 mark].
Were the benchmark programs gaming related?[1 mark]
Otherwise not a fair comparison [1 mark].

Because gaming may rely on more than fast CPU [1 mark]
So will perform better than should for her purposes [1 mark].

2. Software (25 marks)

(a)
Registers store the most frequently used instructions and data [1 mark].
Arithmetic-logic unit performs arithmetic or logical operations [1 mark].
Control unit coordinates and controls all parts of the computer system such as moving data between registers and ALU etc. [1 mark]
It also decodes machine code instructions into microcode [1 mark].

(b)
You can have more assembly language statements than machine code [2 mark].
For example, you may not have a machine code instruction for branch if equal but you can have an assembly instruction. [1 mark]
The assembler will map the assembly instruction into as many machine code instructions as it required. [2 mark]

(c)
We don't know ahead of time how big the program is going to be [1 mark].
If we had separate memory we would either:
- waste memory that could be used for data [1 mark] because we have a program that is small but lots of data like a movie [1 mark]
- or be in a situation where we do not have enough [1 mark] where we have a big program that uses little data [1 mark].
A problem is that data can be treat as programs creating as security issue! [1 mark]

(c) A program that multiplies by a fixed amount [4 marks].
A program that attempts to solve it but has minor errors [6 marks] .
A correct program.

```
0: LOAD R0 20      # a = m[20]
1: LOAD R1 21      # b = m[21]
2: LOAD R2 22      # c = m[22]
3: LOAD R3 23      # d = m[23] our decrement value
4: SUB R2 R2 R2    # set c to zero (c = c - c)
5: ADD R2 R0 R2    # c = c + a
6: SUB R1 R1 R3    # b = b - d (d = 1)
7: BZERO 9         # b reached zero so exit
8: BRANCH 5        # repeat the addition
9: STORE 22 R2     # store c
10: HALT           # end of calculation
```

3. Operating Systems (25 marks)

(a) *BIOS is loaded, power-on-self test, OS loads from boot device, system is configured, system utilities load, user is authenticated.*

(b) *Interrupts would be better because changes would be infrequent [1 mark]*
Polling will waste time unlike interrupts [1 mark]
Polling has lots of wasted time of checking that the temperature has changed only to find that it is constant. [1 mark]
On the other hand interrupts means that the operating system is alerted only when a change takes place [1 mark].
This has overheads but they are less than polling [1 mark].

(c) *Limited screen real-estate on a mobile phone screen making it difficult to use long menus [1 mark]*
User wants quick access to phone functions and navigating menus may be too slow [1 mark]
Same argument for using lots of icons. [1 mark]
Post-GUI interface can take advantage of new ways to interact beyond a simple pointer such as using multi touch [1 mark] or gestures as input [1 mark].
This could also lead to faster interaction [1 mark].

(d) *Not much memory so may want to be able to customise the operating system for the phone to make it squeeze into the space [1 mark].*
This decision is also supported by the need to support quite different features [1 mark]
This means that not all of the operating system code is required all the time. [1 mark]
Downside is the overhead of making sure all the modules can be used together and testing each new module combination [2 marks].

(e) *Computers were expensive devices [1 mark].*
Idea was to share amongst multiple users [1 mark].
Amortise the cost across the users [1 mark].
Get better utilisation because computers actually idle when waiting for user input [1 mark].
When you have multiple users the chance that they are idle reduces [1 mark].

4. Internet (25 marks)

(a) *LAN is a local area network [1 mark].*
Set of computers networked over a small geographic area [1 mark].
Daisy chain means that every computer is connected to a single cable [1 mark].
Cutting his bit of the cable will disconnect his neighbour from the network [1 mark]
Can be hard to locate breaks (but not in this case) [1 mark]

(b) *Could share applications, hardware with multiple users [1 mark].*
Patients could easily visit other practices and have their data available [1 mark].
Downside is loss of autonomy/control over records, potential lack of privacy when data is transferred over the network and security threats because remote access is now possible [3 marks].

(c) *Packets would allow interleaving of the video and audio data. [1 mark]*
Streams would mean waiting for either the video first or the audio second. [1 mark]
Could wait for two related packets and play together while receiving the next two. [1 mark]
This is fairer and allows them to be played at the earlier opportunity. [1 mark]
To play both at the same time would require buffering them until both arrived and playing them [1 mark].
This results in a delay to playback [1 mark].

(d) *Data link defines how to represent data on the "wire" [1 mark] and how data is sent between computers on the same network [1 mark].*
Network layer defines how data is sent between networks [1 mark].
Transport layer defines different standards of reliability [1 mark]
Such as TCP (reliable) or UDP (unreliable) [1 mark].

(e)
It would block access from the Internet but allow access from her internal network.[1 mark]
This is done by specifying that packets with port 80 [1 mark] as a destination that come from the Internet are blocked by not those from her internal network. [1 mark]
The address of the packet or the network interface that it comes via would be used to determine where the packet came from [1 mark, 2 marks for both].

APPENDIX: ASSEMBLY LANGUAGE INSTRUCTIONS

Data Movement Instructions:	**Example:**	**Meaning:**
LOAD [REG] [MEM]	LOAD R2 13	R2 = M[13]
STORE [MEM] [REG]	STORE 8 R3	M[8] = R3
MOVE [REG1] [REG2]	MOVE R2 R0	R2 = R0
Arithmetic and Logic Instructions:	**Example:**	**Meaning:**
ADD [REG1] [REG2] [REG3]	ADD R3 R2 R1	R3 = R2 + R1
SUB [REG1] [REG2] [REG3]	SUB R3 R1 R0	R3 = R1 - R0
AND [REG1] [REG2] [REG3]	AND R0 R3 R1	R0 = R3 & R1
OR [REG1] [REG2] [REG3]	OR R2 R2 R3	R2 = R2 | R3
Branching Instructions:	**Example:**	**Meaning:**
BRANCH [MEM]	BRANCH 10	PC = 10
BZERO [MEM]	BZERO 2	PC = 2 IF ALU RESULT IS ZERO
BNEG [MEM]	BNEG 7	PC = 7 IF ALU RESULT IS NEGATIVE
Other Instructions:	**Example:**	**Meaning:**
NOP	NOP	Do nothing.
HALT	HALT	Halt the machine.