Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

November 2017

Computer science

Higher level

Paper 3

6 pages

1. (a) Bioinformatics is the analysis of biological data by computers;
For example: DNA / patient statistics / results from blood samples *etc*. **[2]**

Note: *Accept any example related to medical research.*

(b) *Award **[1]** for a feature of fuzzy logic and **[1]** for outlining its relevance to medical diagnosis, up to **[2 max]**.*
Fuzzy logic can put a measure on uncertainty (give an approximate/probabilistic value);
Can express relationships in a probabilistic manner;
Patterns can be found which are not easy to classify with traditional logic;
Work with multi-variable connections;
Can help to give probability of certain diagnoses; **[2]**

Note: *One symptom may be important only if there are some related ones; vagueness and uncertainty of measurements eg borderline blood results etc;*

2. (a) *Award **[1]** for each comparison up to **[4 max]**. Note that the italicised descriptions below are from then case study and will not gain credit unless they are expanded on.*

Characteristic	Ultrasound	CT Scan
Waves	Sound	X-ray
Scope	Nearest organs	Whole body
D?	Normally 2-D	3-D
Mode of operation	Unidirectional	Taken from all angles (360 degrees)
Hardware	Mobile scanner	Large static machines
Safety	Safe *non-invasive*	X-rays can be dangerous (pregnancies)
Processing	More simpler processing / transducer produces a single image	Complex processing to make 3-D / several images combined into 3-D image *Computationally expensive*
Cost / availability	*Relatively cheap therefore readily available*	*Relatively expensive so not readily available*
Detail	Less detail than a CT scan	Can spot fine differences
Operation	Easy to use / portable	Needs more training than for ultrasound / static
Speed	Real-time results	Needs time to construct images

[4]

(b) *Award **[1]** for each issue and **[1]** for each associated outline, for two issues up to **[4 max]**.*

Hardware incompatibility;
Different machines making measurements with dedicated processors;

Software incompatibility;
eg different OS where not all function with the electronic records software;

Different format of records;
Not all centres taking the same measurements;

Different format of results;
For example temperature "> 40" or temperature "= 40.5";
Analogue values may be rounded differently;

***Note:** Accept other reasonable issues which could occur.* **[4]**

3. *Award **[2]** for a clear description of augmented reality, **[2]** for a clear explanation of how an image could be sent to the expert surgeon, and **[2]** for the role in the operation **(up to [6 max])**.*

AR:
Augmented reality projects digital/additional information;
onto a real-time situation/onto the real world;

Augmented reality allows an actual situation to be complemented in such a way;
that essential information is added to a video image;

An expert surgeon in another place sees the operation as if they were there/as a video being filmed;

Tags attached to the affected area to be operated can be overlaid on the image;
Can overlay information on the view they have;

Transmission;
Annotated video data is continually streamed between the two;
Using a camera at the operation end;
In real-time over a (very) secure and fast network;
Viewed by expert surgeon on a screen;

Example of use;
The expert can show on the image what actions should be made (and where);
Allow example;
Using the information being sent back on a headset tablet/smart phone/transparent screen; **[6]**

4. Discussion should focus on:

"health carers at the health centre for visits made by appointment"
People will need a physical presence at the centre for reassurance which means carers need to be employed and in place – enough to cope with the estimated need especially as visits to the hospital are difficult.

"expert doctors from other locations, who are available 24 hours a day via a VPN connection"
Essential for crises which occur outside of the hours the centre is open.
Will need a secure and reliable connection with access from mobile device, and access to any data and phone calls coming into the centre.

"a comprehensive care system for chronically sick patients at home"
Continual measurements can be sent to the health centre; this could be done with wearables. Someone with a heart problem could have the heart rate continually measured on a bracelet with an imbedded RFID to communicate wirelessly via NFC to a receiving device which sends the data automatically to the health centre.
The centre would need to have software to interpret the data (or this could be done at the patient side – therefore less to send) and any fluctuations identified.
Danger signals would mean the doctor needs to know. Health carer would check on minor changes as well as regular check-ups – need for health carers depends on proportion of chronically sick and elderly.
Effect on population – good system to stay at home may be met with some aversion to remote monitoring.

"some provision for emergency operations in the health centre"
Could be dealt with by telesurgery when essential but will need appropriate cameras/connections and software, as well as a doctor who is confident to be involved.

"diagnostic equipment to identify cases where a person needs to be treated at the large hospital"
An ultrasound scanner should probably be purchased. For example, regular scans are needed for pregnant women. However, these need expert technical operators and interpreters. One suggestion would be for the scans to take place via telemedicine and the results sent electronically to be analysed at the hospital.

An internet site for communication and advice would have the advantages of knowledge so that a decision whether or not to make an appointment can be made. Accounts would need to be set up and security ensured via firewalls, encryption *etc* as personal medical information is sensitive. It would be helpful to give information as to when an appointment should be made and simple remedies for simple problems. Some people may be suspicious of using this medium for medical uses and be concerned about privacy.

Marks	Level descriptor
No marks	• No knowledge or understanding of the relevant issues. • No use of appropriate terminology.
Basic 1–3 marks	• Minimal knowledge and understanding of the relevant issues. • Minimal use of appropriate terminology. • No reference is made to the information in the case study or independent research. • The answer may be little more than a list.
Adequate 4–6 marks	• A descriptive response with limited knowledge and/or understanding of the relevant issues. • A limited use of appropriate terminology. • There is limited evidence of analysis. • There is evidence that limited research has been undertaken. • The answer shows some understanding but is lacking in one or more of the issues.
Competent 7–9 marks	• A response with knowledge and understanding of the related issues. • A response that uses terminology appropriately in places. • There is some evidence of analysis. • There is evidence that research has been undertaken. • The answer shows a reasonable level of understanding of all related issues.

Proficient
10–12 marks
	• A response with a detailed knowledge and clear understanding of the relevant issues and/or concepts, including:
	  • *the issues and technology involved*
	  • *the consequences in planning for the clinic*
	  • *the effect and reaction of the community.*
	• A response that uses terminology appropriately throughout.
	• There is competent and balanced analysis.
	• There is clear evidence that extensive research has been undertaken.

[12]

Total: [30]