UNIVERSITY OF CAMBRIDGE

Computer Laboratory

Research Skills – Test – Example 2013–14

MPhil in Advanced Computer Science
Part III of the Computer Science Tripos
Certificate in Postgraduate Studies

Name:	
CRSID:	

Mark:

You have 10 minutes reading time. Do not open this booklet until told to do so.

You have 90 minutes writing time. Do not start writing until told to do so.

Write your name and CRSID clearly in the spaces above.

Write all of your answers in this booklet.

Extra paper is available if space in the booklet is insufficient. Please ensure that any extra sheets of paper are firmly attached in this booklet. Please write your name and CRSID on any extra sheets that you use.

Write legibly. Handwriting that the assessor is unable to read will receive no credit.

This booklet is marked out of 60 marks.

THIS TEST IS AN EXAMPLE ONLY.

1. Writing style

The following is a ten-sentence summary of an academic paper by authors Galek and Nelson. For each sentence, explain one thing that is wrong with the sentence in terms of grammar or writing style. Some sentences have more than one error but only one error need be explained here. [1 mark each]

(a) Galek and Nelson perform experiments on three sets of individuals to assess whether their theories about fluency are correct.

(b) Three experiments will be performed.

(c) The first experiment measures lay beliefs, number two considers reading goals and font readability, and the final experiment is concerned with facial feedback.

(d) Graphical representations of aggregated data are presented to facilitate reader assimilation.

(e) The results of the first experimental indicate that lay beliefs do affect how people perceive the text in that they will prefer a simpler ideal vocabulary and an easier read if they believe that they are reading for pleasure while they will expect a more complex ideal vocabulary and, possibly consequentially, a more difficult read if they believe that they are reading for information gathering purposes.

(f) Second and third experiment demonstrate that manipulating secondary characteristic effects reader perception of fluency.

(g) The conclusions are very clear.

(h) Although the experiments did not have all the bells and whistles of some larger studies, they did produce significant results at the 95% confidence level.

(i) Of course, it might possibly have helped if they had performed further comparison against Oppenheimer's (2006) work, but it is probably unnecessary for them to reinvent the wheel in this case.

(j) I, myself, speaking personally, believe this paper is sufficiently good that a future researcher could base his work on its results.

2. Editing

Edit the following passage to improve it. You may do the initial edits on the text on this page. You must write your final edited version on the following page.

University of Cambridge Computer Laboratory is top computer science department in the whole of the United Kingdom of Great Britain and Northern Ireland. It comprises some 40 full-time, tenured, academic staff members along with a further forty research fellows and post-doctoral researchers on short-term contract. The Laboratory currently has over one hundred students studying towards the PhD degree. It has eight research groups that cover topics as diverse as, i.e., artificial intelligence and wireless communications, etc. It runs a masters degree in advanced computer science which attracts applications from brilliant students around the world, from many countries and backgrounds. In 2012, 280 applications were made, from which fifty students came. The masters degree has two distinctive flavours: Option A and B. In the first, student take nine taught modules and write an extended research essay; in option B, students take six taught modules and undertake a signifyicant research project, culminating in the production of a dissertation. The masters decree is intended to lead students on to research as a PhD student. Many students do go on to further study, but several instead continue into industry.

[10 marks]

3. Summarisation

Summarise the following text, from a 1997 extended abstract. Summarise it in your own words using five or fewer sentences.

A camera system has been developed at the University of Cambridge to provide live 3D video input to our time-multiplexed autostereoscopic 3D display. The system is capable of taking video input from up to sixteen sources and multiplexing these into a single video output stream with a pixel rate an order of magnitude faster than the individual input streams. Testing of the system with eight cameras and a Cambridge autostereoscopic 3D display has produced excellent live autostereoscopic 3D video. This paper describes the camera system and the challenges involved in electronically aligning and synchronising the multiple inputs.

The time-multiplexed autostereoscopic 3D display developed at the University of Cambridge is based on a fast CRT with an additional active optical element to direct each image on the CRT to one of several abutting zones in front of the display. Originally demonstrated in 1991, the display has undergone considerable development over the past five years.

The input to the display is a simple extension to conventional video. Standard video, horizontal sync and vertical synchronisation signals are provided at high speed. Adjacent views are placed in sequential fields. An additional azimuth synchroniscation (Z-sync) signal is required to indicate to the display which fields contain images for the left-most view.

The main image source for the display has been an off-the-shelf graphics card installed in an IBM PC clone. This has produced monochrome 3D video with eight views at VGA resolution (640×480) or sixteen views at half-VGA resolution (320×480). A colour version of the display, developed in 1994, can be driven with six views at half-VGA resolution. Colour is obtaining using a colour-sequential method, and provides 24-bit colour rendition.

The display is in the process of being commercialised. Potential uses include visualisation, entertainment and remote manipulation. For the latter, live 3D video input is required. This requirement led to the development of the prototype autostereoscopic 3D camera system described in this paper.

The basic operation of the camera system is to digitise multiple input video streams, one for each view direction, and to multiplex these into a single autostereoscopic 3D video stream. A simple circuit board (the camera board) can digitise, process and buffer the video input from a single video source. Several of these are connected together via a backplane to another circuit board (the multiplexer board) which contains all the circuitry necessary for generating the output video signal and the synchronisation signals and for controlling the rest of the system. The backplane distributes data, control signals and power between the boards.

An image processing chip on the camera board allows arbitrary down-sizing and windowing of the video input. This provides pixel-level control of the alignment of each input. Inputs must be aligned precisely with one another to prevent eye strain. In practice a combination of coarse physical alignment and fine electronic alignment proved very effective.

The other major challenge that needed to be met in the design of the system was ensuring that all components were correctly synchronised. The time taken to read in a frame from one video source must be equal to the time taken to output one frame for every view on the autostereo display.

For monochromatic operation, all video data is held on the individual camera boards. The multiplexer board pulls the appropriate fields off each camera board in turn and runs than across the backplane into a D/A converter. Running at 144 MHz pixel rate, this system is capable of eight views at a resolution of 648×576.

The same camera boards are used for colour operation in conjunction with a modified multiplexer board. Significant buffering is required on the colour multiplexer board to allow operation with parallel colour input from the camera boards and sequential colour output to the autostereoscopic display. The colour system runs at 110 MHz pixel rate, providing six view output at 384×288 resolution (quarter PAL).

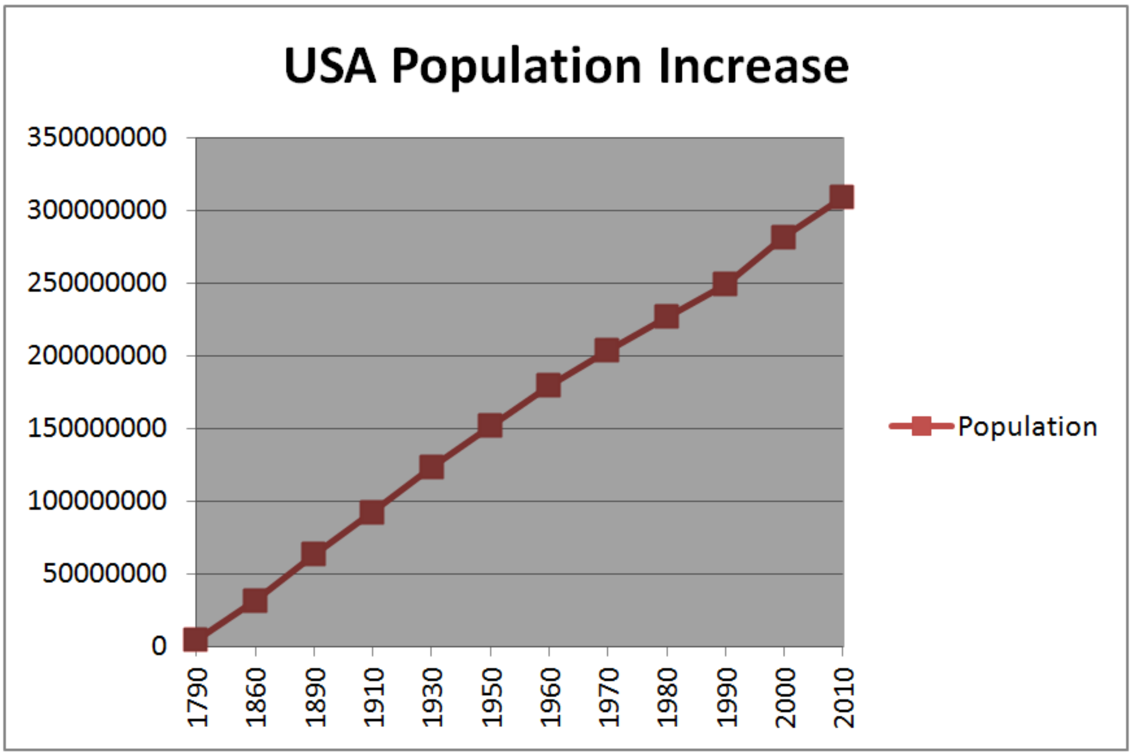
Subjectively, the camera system and display give a good 3D effect. This prototype is quite expensive and, to be commercially viable, several cost-reducing measures would need to be implemented. Nevertheless the system has proved the feasibility of time-multiplexed live autostereoscopic 3D video.

[5 marks]

4. Graphing

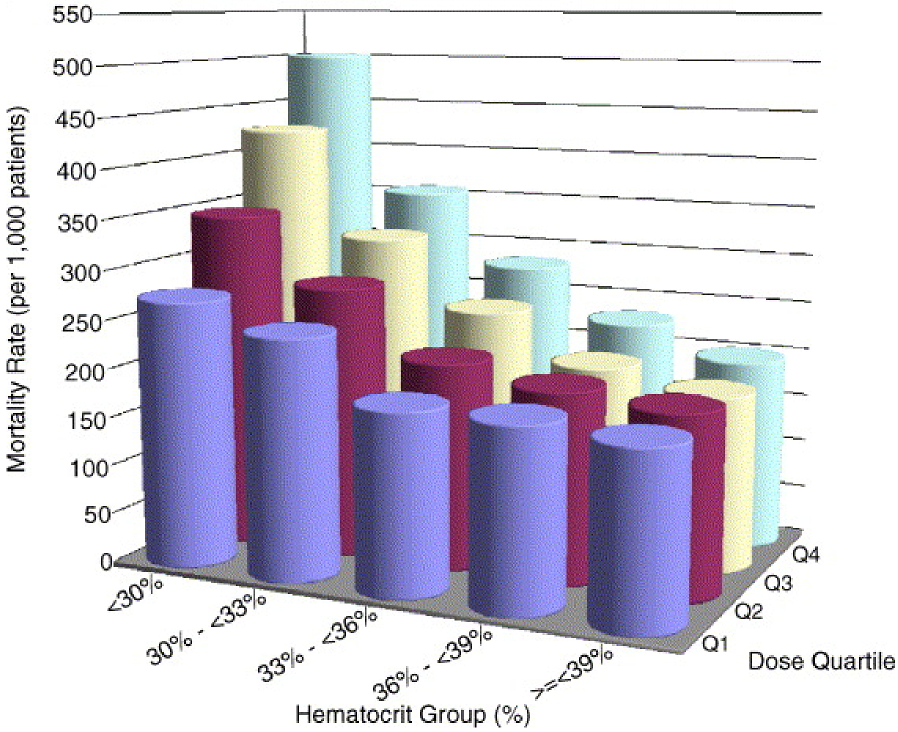
Explain all of the problems of each of the following graphs including an explanation of why each is a problem.

(a)



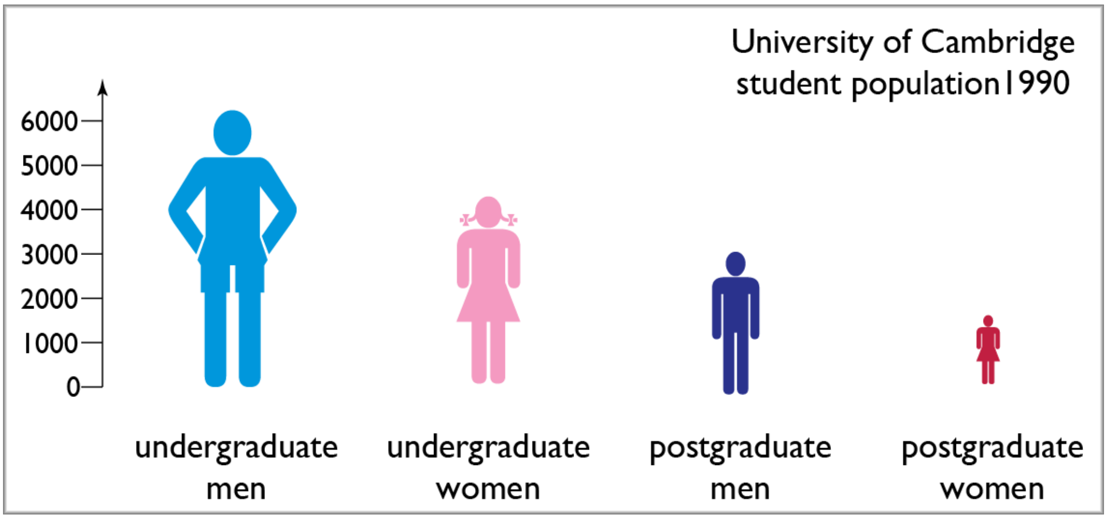
[5 marks]

(b)


Mortality Rate (per 1,000 patients)
550
500
450
400
350
300
250
200
150
100
50
0
<30%
30% - <33%
33% - <36%
36% - <39%
>=<39%
Hematocrit Group (%)
Q1
Q2
Q3
Q4
Dose Quartile

[5 marks]

(c)


University of Cambridge
student population 1990
6000
5000
4000
3000
2000
1000
0
undergraduate men
undergraduate women
postgraduate men
postgraduate women

[5 marks]

(d) Sketch a better version of the graph in (c)

[5 marks]

5. Experimental Analysis

(a) Explain the error that is illustrated by the following cartoon.

[5 marks]

(b) Jane has conducted an experiment on the time that it takes a participant (`times`) to enter data into a piece of software using three methods of data input (`method`=A, B, C) with five different tasks (`task`=i,ii,iii,iv,v). She has collected data from seven participants (`participant`=1,2,3,4,5,6,7).

She runs the following ANOVA test on her results, in R.

```
> summary( aov( times~method*task
                       + Error(participant/(method*task) ) ) )

Error: participant
          Df Sum Sq Mean Sq F value Pr(>F)
Residuals  6 156540   26090

Error: participant:method
          Df Sum Sq Mean Sq F value   Pr(>F)
method     2 348518  174259   16.78 0.000334 ***
Residuals 12 124608   10384
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Error: participant:task
          Df Sum Sq Mean Sq F value Pr(>F)
task       4  23301    5825   0.396  0.809
Residuals 24 353002   14708

Error: participant:method:task
            Df Sum Sq Mean Sq F value Pr(>F)
method:task  8 119510   14939   1.564  0.161
Residuals   48 458503    9552
```

(a) Explain what this ANOVA test is testing for.

(b) Explain what the output table tells us.

(c) Explain what tests Jane should run next.

[10 marks]

END OF PAPER