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MONASH University

Semester Two 2018
Examination Period

Faculty of Information Technology

EXAM CODES: **FIT3179**

TITLE OF PAPER: Data Visualisation - PAPER 1

EXAM DURATION: 2 hours writing time

READING TIME: 10 minutes

THIS PAPER IS FOR STUDENTS STUDYING AT: (tick where applicable)

☐ Caulfield ☒ Clayton ☐ Parkville ☐ Peninsula
☐ Monash Extension ☐ Off Campus Learning ☒ Malaysia ☐ Sth Africa
☐ Other (specify)

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AUTHORISED MATERIALS

OPEN BOOK	☐ **YES**	☒ **NO**
CALCULATORS	☐ **YES**	☒ **NO**
SPECIFICALLY PERMITTED ITEMS	☒ **YES**	☐ **NO**

if yes, items permitted are: coloured pencils, erasers, coloured pens and markers

Candidates must complete this section if required to write answers within this paper

STUDENT ID: __ __ __ __ __ __ __ __ DESK NUMBER: __ __ __ __ __

INSTRUCTIONS TO CANDIDATES:

- This exam consists of four sections. Section A contains five multiple choice questions, section B seven knowledge questions, section C six analysis questions and section D three visualisation questions, all of which should be attempted.

- This examination contains 100 marks, which contribute 40% towards your final assessment.

- The examination end is marked with "END OF EXAMINATION"

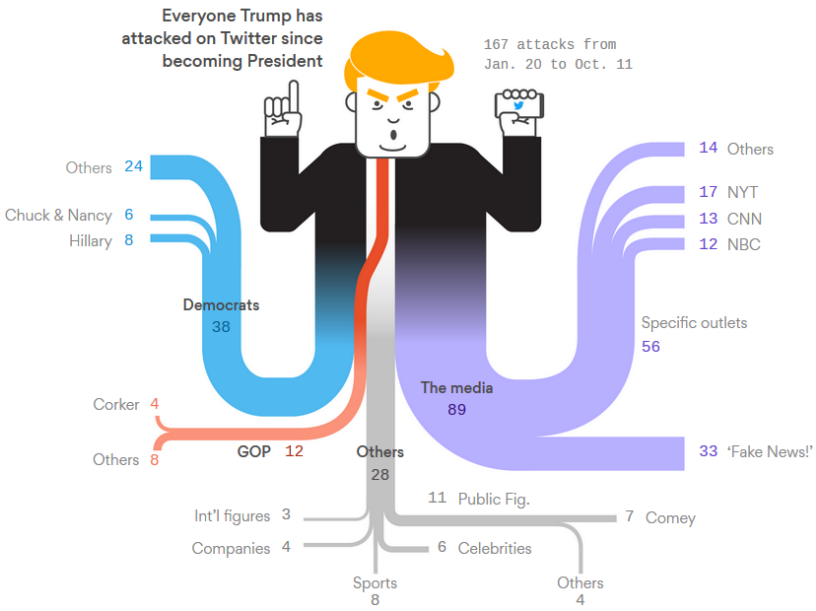
Section A: Multiple Choice (5 × 2 marks = 10 marks total)

Circle the most correct answer to each question in this exam booklet. Clearly circle only one answer for each question. If you make a mistake, cross it out and circle the correct answer.

1. Which of the following accurately lists channels from most effective to least effective at encoding quantitative data attributes?
   A. Length, Area, Volume, Luminance
   B. Tilt/angle, Area, Curvature, Volume
   C. Bar chart, Line chart, Node-link diagram, Isotype
   D. Volume, Area, Tilt/Angle, Position on common scale

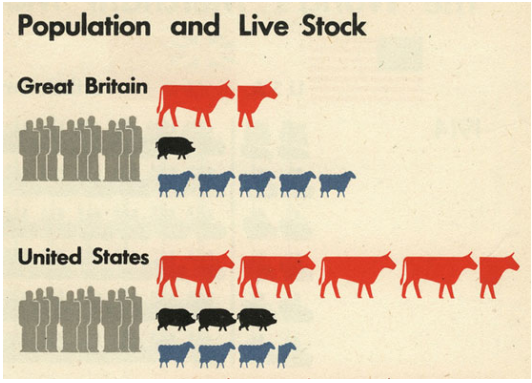
2. Which of the following is a true statement about colour in visualisation?
   A. Categorical attributes are best encoded with luminance, while hue can optionally vary between two values.
   B. The HSV colour space is used for colour pickers, because it is visually equidistant.
   C. The colour at the origin of the RGB colour cube is black.
   D. Rainbow colours are acceptable for visualising scalar fields if luminance does not vary substantially.

3. What is the best description of the following visualisation idiom:
   A. Sankey diagram
   B. Node-link diagram
   C. Alluvial diagram
   D. Stream graph



4. What is the best description of the following visualisation idiom:

   A. Small multiples
   B. Chart junk
   C. Iconographic bar chart
   D. Isotype



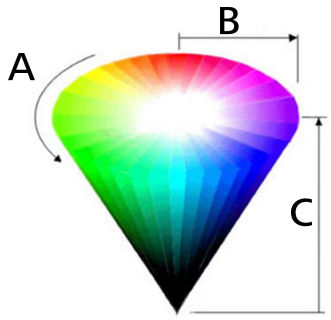
5. Which of the following statement about visualisation tools is **false**?

   A. D3.js is a JavaScript library for creating interactive visualisations for the web.
   B. SVG stands for Scalable Vector Graphs and is a web library for creating node-link diagrams.
   C. Leaflet is a JavaScript library for creating interactive web maps
   D. QGIS is a geographical information system for creating maps and conducting geospatial analysis.

Section B: Knowledge Questions (12 questions, 29 marks total)

For questions on this page, please write your answer directly in this exam booklet. If you make a mistake, clearly cross your answer out and write it again.

1. The figure below shows a colour space that is commonly used for colour picker in a graphics software application. What colour-related channels vary along the three axes? (A is a radial angle, B is a horizontal distance relative to the axis of the cone, and C is the dimension along the vertical axis of the cone.)
   (3 marks total: 1 mark per correct axes)



2. What **single** colour-related channel varies in this colour gradient?
   (1 mark)

3. Which **two** colour-related channels vary in this colour gradient?
   (1 mark)

4. Which **two** colour-related channel vary in this colour gradient?
   (1 mark)

5. Which of these two text labels is set with a serif typeface? Answer with "first" or "second".
   (*1 mark*)

Melbourne Melbourne

Please answer the questions on this and the following pages in the Exam Script Booklet provided unless indicated differently. Commence the answers to each question on a new page in the booklet; write on one side of the paper only.

6. Fonts
    a. What are the components of a font? (*1 mark*)
    b. What is the relation between a typeface, a font family and a font? (*2 marks*)

7. List three visual channels that can be used to visualise categorical data.
   (3 marks total: 1 mark per correct visual channel)

8. Explain when and why a line chart should be preferred to a bar chart.
   (2 marks)

9. Since August 2018, the maps in the online version of Google Maps transition to a globe when the user zooms out.
    a. What projection did Google use before August 2018 at all map scales? *(1 mark)*
    b. What was the problem with this previous projection for world maps showing the entire world? *(1 mark)*
    c. What is the advantage of using a globe when zooming out? *(1 mark)*

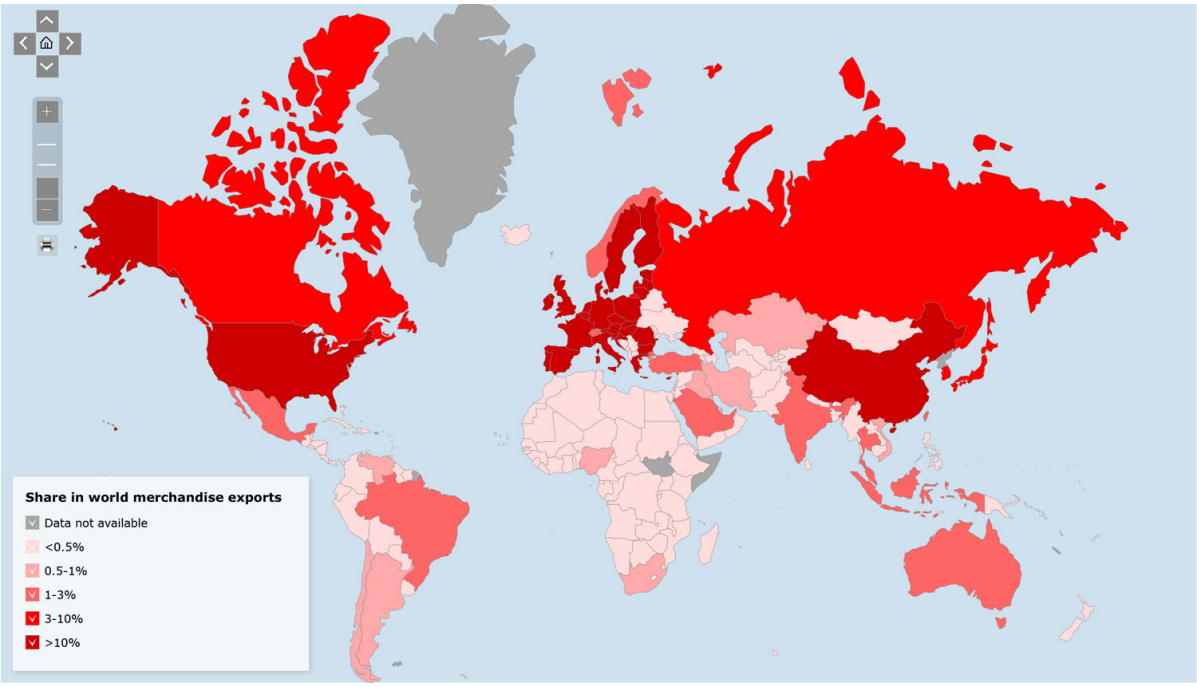
10. Dot maps
    a. Explain in what situation dot maps are difficult to read *(2 marks)*.
    b. Suggest an alternative geographic visualisation idiom that can be used instead of dot maps that are difficult to read. The alternative idiom needs to be able to show absolute quantitative values. *(1 mark)*
    c. How can you construct the suggested alternative idiom from a dot map? *(1 mark)*

11. Steve Haroz, Robert Kosara and Steven Franceroni conducted a user study to evaluate the effect of Isotype visualisations and pictographs for data visualisation. Describe their findings regarding:
    a. The use of a background image in a visualisation *(1 mark)*.
    b. The use of pictographs for the Isotype idiom *(1 mark)*.
    c. The two benefits of using the Isotype idiom *(2 marks)*.

12. Sketch three two-dimensional scatter plots, each showing two arbitrary attributes.
    a. One scatter plot with strong linear negative correlation (*1 mark*).
    b. One scatter plot with weak positive correlation (*1 mark*).
    c. One scatter plot without any correlation (*1 mark*).

Section C: Critical Analysis and Discussion (36 marks total)

1. What is the name of the visualisation idiom used in this map showing world merchandise export shares? *(1 mark)*
   Is this map showing quantitative or qualitative data? *(1 mark)*
   Identify and explain the single most serious problem of this map. *(Note: Only the first identified problem will be considered.) (2marks)*



2. Analyse the following aspects of the Madagascar map on the next page:
   a. What technique for terrain representation is used? (*1 mark*)
   b. What type of narrative genre is being used? (*1 mark*)
   c. Figure-ground: Where and how is a visual hierarchy created with figure-ground on and around the map? What are the figure elements and what are the ground elements? (*3 marks*)
   d. Sight lines: Mark the sight lines directly on the figure in this exam booklet. (1 mark)
   e. Layout: Besides the use of sight lines, what are the general design criteria for layout, and how are they applied here? (*4 marks*)
   f. Typography: What kinds of typefaces are used on and around the map? Explain which type characteristics are changed to visualise varying information. (*2 marks*)

RARE MADAGASCAR

Remnants of the island's original vegetation serve as critical biodiversity hot spots, crammed with hundreds of vulnerable endemic plant and animal species. Yet today only half of the high-priority sites lie within the country's network of protected areas. With the overthrow of the government, ambitious conservation plans are on hold, and illegal logging and poaching run rampant in parks.

DWINDLING WONDERS

Some 90 percent of Madagascar's plant and animal species are found nowhere else, having evolved in isolation for millions of years after the island broke from Africa and India. Many are restricted to small, unprotected biodiversity areas.

Plants

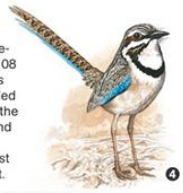
Most of Madagascar's estimated 13,000 plant species are endemic, like the threatened Grandidier's baobab, one of six baobab species unique to the island. ❶

Mammals

Lemurs live only on Madagascar and the nearby Comoros islands. Fifty species make up nearly half of Madagascar's mammals. More than 20, including the silky sifaka, are endangered. ❷

Reptiles

Chameleons, such as the colorful lesser chameleon, likely originated on Madagascar; two-thirds of the species are found here. Reptiles are under pressure from the pet trade. ❸



Birds

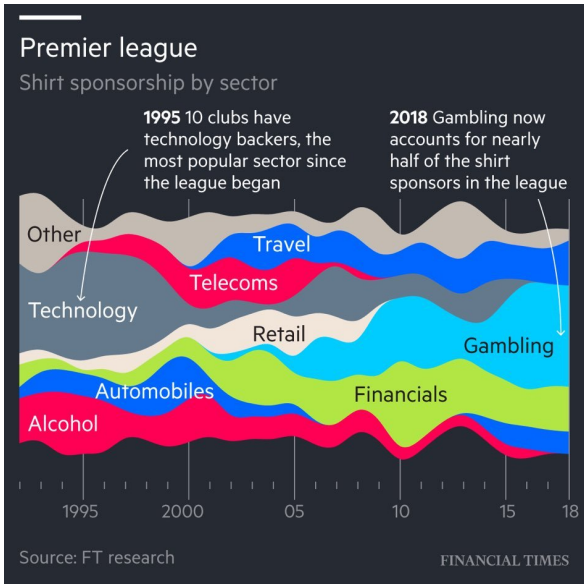
As many as three-quarters of the 108 endemic species live only in wooded areas, including the long-tailed ground roller, restricted to the spiny forest of the southwest. ❹

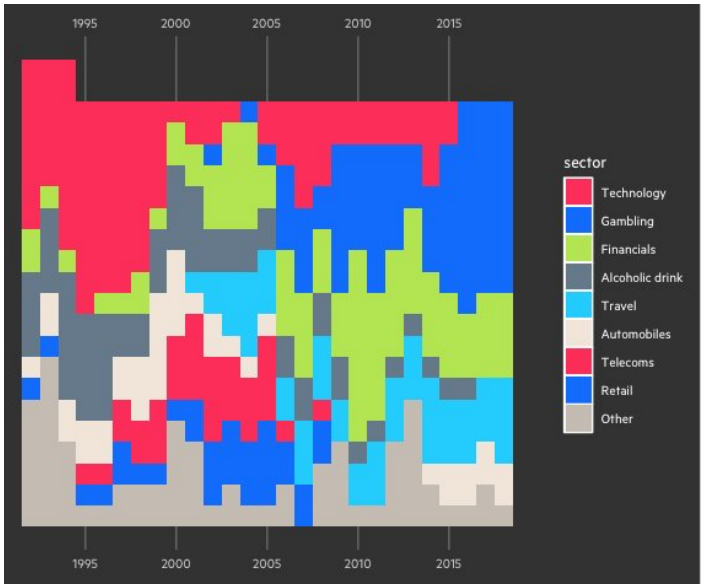
Amphibians

This population is all frogs, with 99 percent of the 373 species endemic, including the critically endangered harlequin mantella, found only on the central high plateau. ❺

WILLIAM E. McNULTY, SAM PEPPLE, AND LISA R. RITTER, NGM STAFF; INTERNATIONAL MAPPING
ART: ALDO CHIAPPE
SOURCES: REBIOMA; MADAGASCAR PROTECTED AREAS SYSTEM; WILDLIFE CONSERVATION SOCIETY; ROYAL BOTANIC GARDENS, KEW; MISSOURI BOTANICAL GARDEN

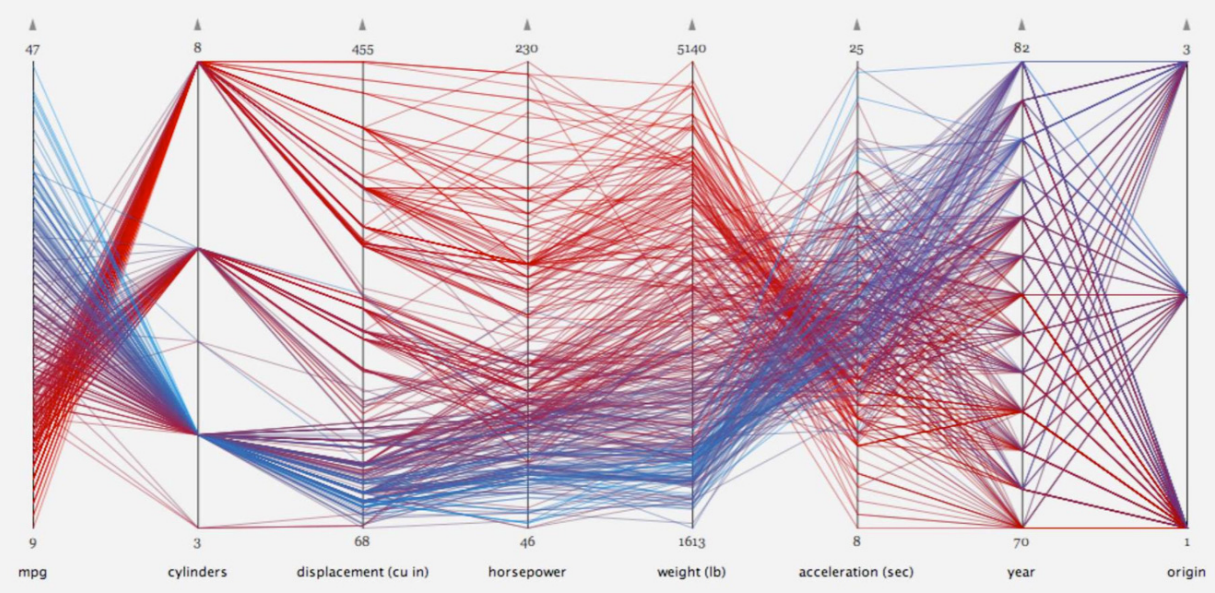
3. The two charts below were constructed from the same data but use two different idioms. They show the relative distribution of different industry sectors sponsoring British major league soccer clubs over time. (Note: The number of major league clubs was reduced from 22 to 20 clubs in 1994.)
    a. What are the names of the two idioms used? (*2 marks*)
    b. Discuss the advantage and disadvantage of the two idioms for this dataset. (*2 marks*)
    c. How can the visualisation on the right be improved (without changing the visualisaiton idiom)? (*2 marks*)





4. Data has not been classified for the map below. Describe how classifying the data would improve this map. *(1 mark)*
   List four methods for classifying data. *(2 marks)*
   Describe which classification method is likely to work well with this data. *(1 mark)*

5. The axes on the next visualisation show attributes for a set of cars (Note: *mpg* stands for miles per gallon and represents fuel efficiency; *cylinders* is the number of cylinders of an engine, *displacement* is the volume of the cylinders of an engine).
    a. What is the name of this visualisation idiom? (*1 mark*).
    b. Use Munzner's What/Why/How framework to analyse this visualisation. *(What? – 2 marks, Why? – 2 marks, How? – 2 marks*
    c. Interpret the lines connecting the "mpg" axis with the "cylinders" axis. Explain how you arrive at your interpretation. (*1 mark*)
    d. Interpret the lines connecting the "cylinders" axis with the "displacement (cu in)" axis. Explain how you arrive at your interpretation. (*1 mark*)



6. Why is the colour choice in the bar chart below problematic and what colours should be used instead? *(1 mark)*

Section D: Visualisation of Data (25 marks total)

1. Draft two radar charts (also called web chart, spider chart, star plot, cobweb, etc.) with 6 axes. The first radar chart has the following values for the 6 axes:

Axis	Value
A	9
B	1
C	9
D	1
E	9
F	1

The second radar chart uses the same values for each axis but reorders the axes:

Axis	Value
A	9
C	9
E	9
B	1
D	1
F	1

   a. What can the two different orders of axes imply? (*2 marks*)
   b. What potential issues can be identify when comparing the two radar charts? (*2 marks*)
   c. How can radar charts be used to "lie" when communicating data? (*2 marks*)

2. Create a table with four records of two varying quantitative attributes ordered by year. (The first column should contain the year, the second column contains attribute 1, the third column contains attribute 2). Create a series of "lying" line charts with two axes. Arrange the axes origins and scales such that very diverse "lying" stories can be told. For each chart
   a. explain how the axes' origins and scales are tweaked and
   b. what message the chart communicates.

   (*10 marks*)

3. Multivariate scatter plot
   a. Make up a table with data of the domain of your choice with four quantitative attribute columns and two qualitative attribute column. Indicate which four columns contain quantitative data, and which single column contains qualitative data. *(1 marks)*
   b. Sketch a single two-dimensional scatter plot that visualises all data in your table. *(5 marks)*
   c. For your scatter plot, explain what visual channels you use for each of the four quantitative attributes, and explain what visual channel you use for the two qualitative attributes *(4 marks)*.

Note: If you want to use colour and you don't have coloured pens or pencils, you can label the elements with their colour.

- END OF EXAMINATION -