COMP5048
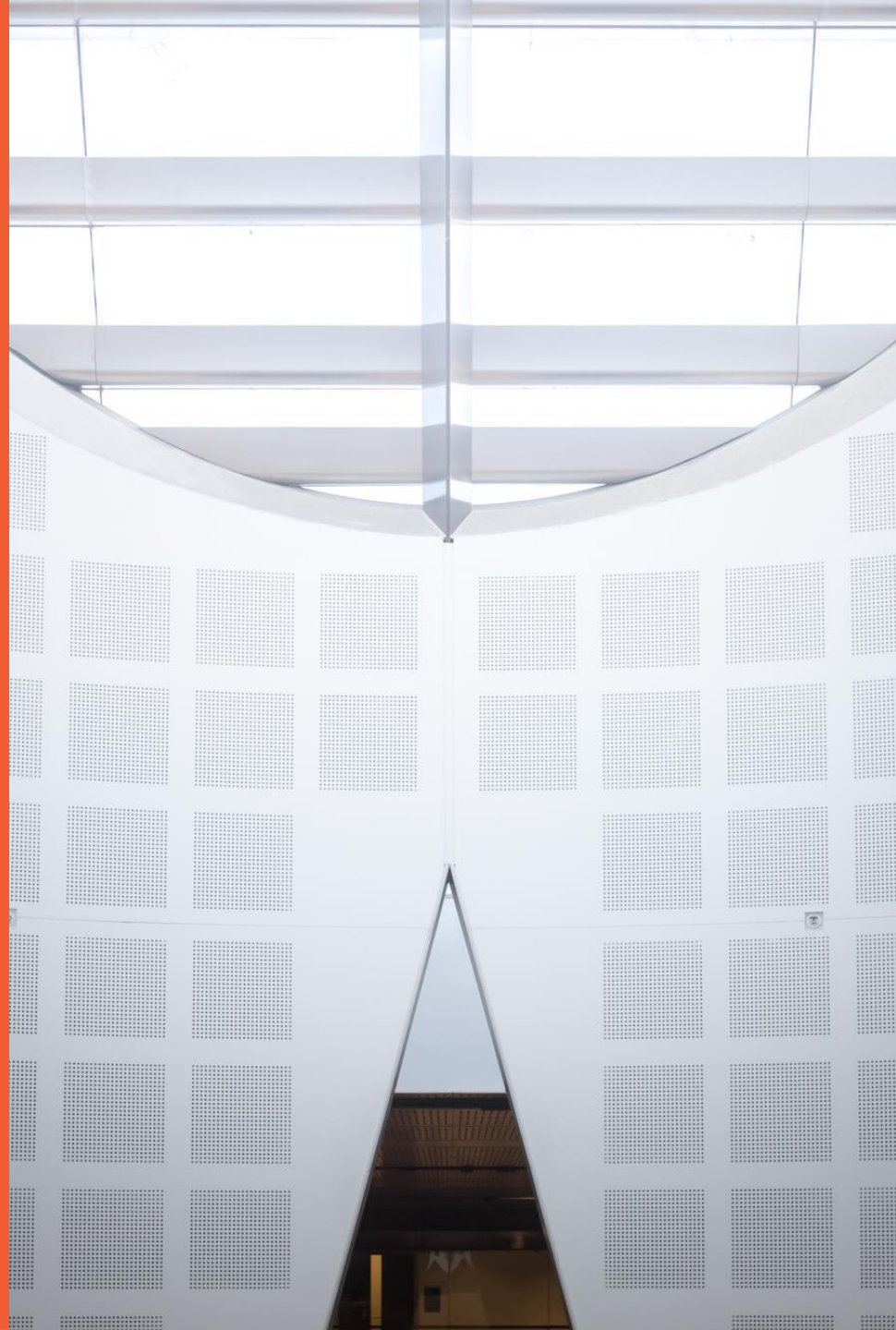# Visual Analytics

Week 13: Review

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Content:

1. Review

2. Exam

3. Reminder

1. Review

COMP5048 Visual Analytics (CUSP)

- *Visual Analytics aims to facilitate the data analytics process using Information Visualisation.*

- Information Visualisation aims to make good pictures of <u>abstract information</u>, such as stock prices, health data, social networks, and software diagrams.

- The challenge for Visual Analytics is to design and implement effective Visualisation methods that produce geometric representation of complex data so that data analysts can carry out critical decision making.

- ***This unit will provide <u>Visualisation techniques and fundamental algorithms</u> to achieve good visualisation of abstract information.***

- It will also provide opportunities for academic research and developing new methods for Visual Analytic methods.

Learning Outcomes (CUSP)

- ***knowledge of basic concepts, techniques and algorithms to produce good visualization of abstract data*** effectively and efficiently

- *understanding* of geometric algorithms and visualization methods

- *use* of geometric algorithms and visualisation methods to solve new problems

- be able to *apply and modify* visualisation methods for application area such as social networks and biological networks

- experience *academic research* in Visual Analytics and Information Visualisation

Assumed Knowledge (CUSP)

- Basic Knowledge in Data Structures and Algorithms

- Programming skills

Week 2: Complex Data Visualisation

1. **Multi-dimensional/Multi-variate Data**
    - Multiple attributes: ordinal, nominal, categorical, image

2. **Spatial Data**
    - Data with geometry (map, longitude/latitude)

3. **Temporal/Dynamic Data**
    - Data with time stamps: changing over time

4. **Relational Data with Constraints** (Week 2-4)
    - *Tree (Hierarchical Relational Data*): Week 2
        - ✓ Tidier Tree Drawing
        - ✓ Radial Tree Drawing
        - ✓ HV Tree Drawing
        - ✓ Other tree visualization examples

Week 3: Visualisation of Network Data

Force directed methods (spring algorithm):

1. Barycenter method

2. Spring & electrical force

3. FADE algorithm

4. Spectral methods

5. Example: Metromap layout

Week 4: Visualisation of Directed Graphs

Sugiyama Method:

▪step1. *Cycle removal*: make acyclic digraph

▪step2. *Layer assignment*: assign y-coordinates

▪step3. *Crossing reduction*: determine the order of vertices in each layer

▪step4. *Horizontal coordinate assignment*: assign x-coordinates (Straighten the long edges)

Week 5: Visualisation of Big Data

1. Cluster the data

2. Multi-level approach

3. Use 3 dimensions

4. Reduce Visual Complexity

5. Integration with Analysis

6. Integration with Interaction

Week 6: Visualisation of Complex Data

1. Multi-dimensional/Multi-variate Data (Table data)
   - Multiple attributes: ordinal, nominal, categorical, image etc

2. Spatial Data
   - Data with geometry (map, longitude/latitude)

3. Temporal/Dynamic Data
   - Data with time stamps: changing over time

4. **Data with Constraints** (Week 2-4)
   - Relations, Hierarchy, Clusters, Directions

5. **Multi-relational Data**
   - *Multiple clusters, multiple relationships etc*

Week 7: Design VA system

1. Overview first, then Details on demand

2. If the data is big/complex, reduce the data set

3. Integrate a number of analysis and visualisation methods

4. Overlay analysis using visual variables (data-ink ratio)

5. Storytelling with the data: narrative visualisation

Week 8: Perception/Color

1. **Human Perception System**

2. **Gestalt principles**

   - Figure/ground relationships
   - Grouping: Proximity, Similarity, Continuity, Closure
   - Goodness of figures

3. **Color**

   - Categorical vs Ordered color
   - Luminance, saturation, hue
   - Color deficiency
   - Colormaps

4. **Rules of Thumb**

Week 9: Evaluation Methods

1. **Quantitative Evaluation (Quality Metrics)**

2. **Qualitative Evaluation (HCI Evaluation methods)**
   - Survey:
     – Interview
     – Questionnaire
     – Focused group
   - Analytic inspection:
     – Heuristic Evaluation
     – Cognitive walkthroughs
   - Empirical evaluation:
     – Observational experiment
     – Controlled Experiment

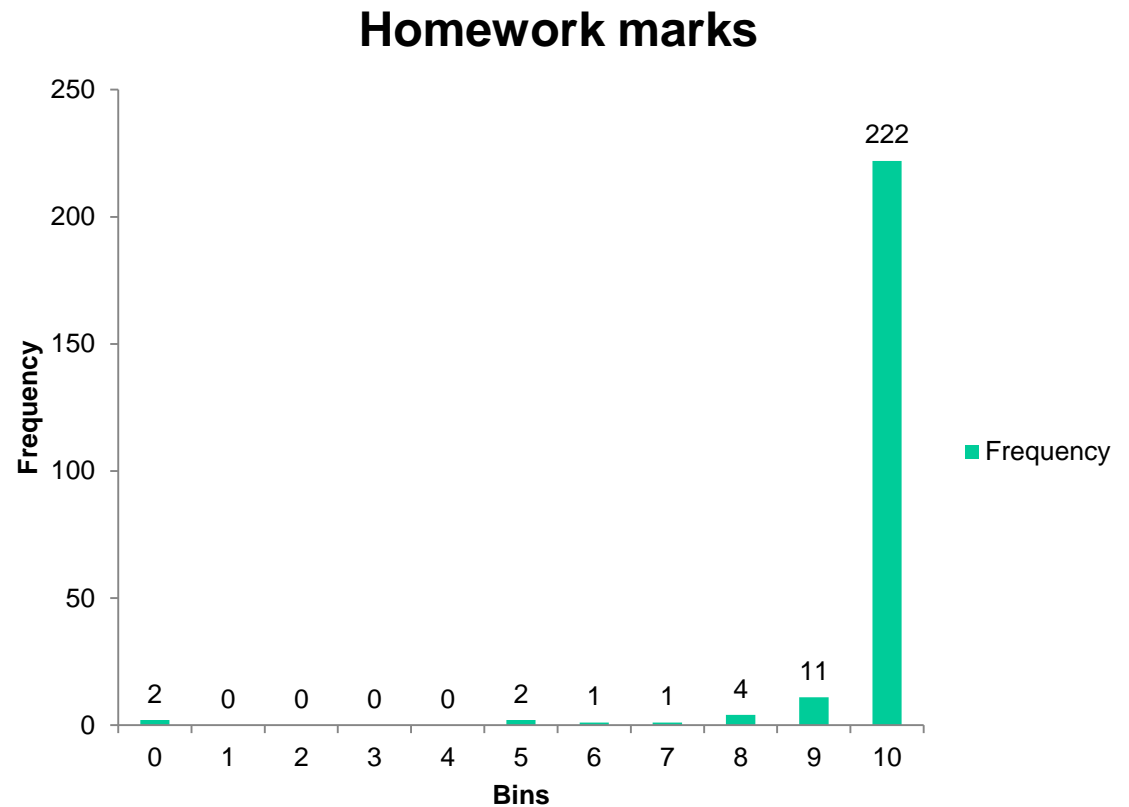**3. Examples: Graph Visualization Evaluation**

Assessment

- Homework (10 marks) : individual work

- Assignment 1 (10 marks) : individual work

- Assignment 2 (30 marks): Group work
  - Initial Report (5)
  - Presentation (10)
  - Final report (15): Week 13

- **Exam (50 marks)**
  - Nov 19 Monday
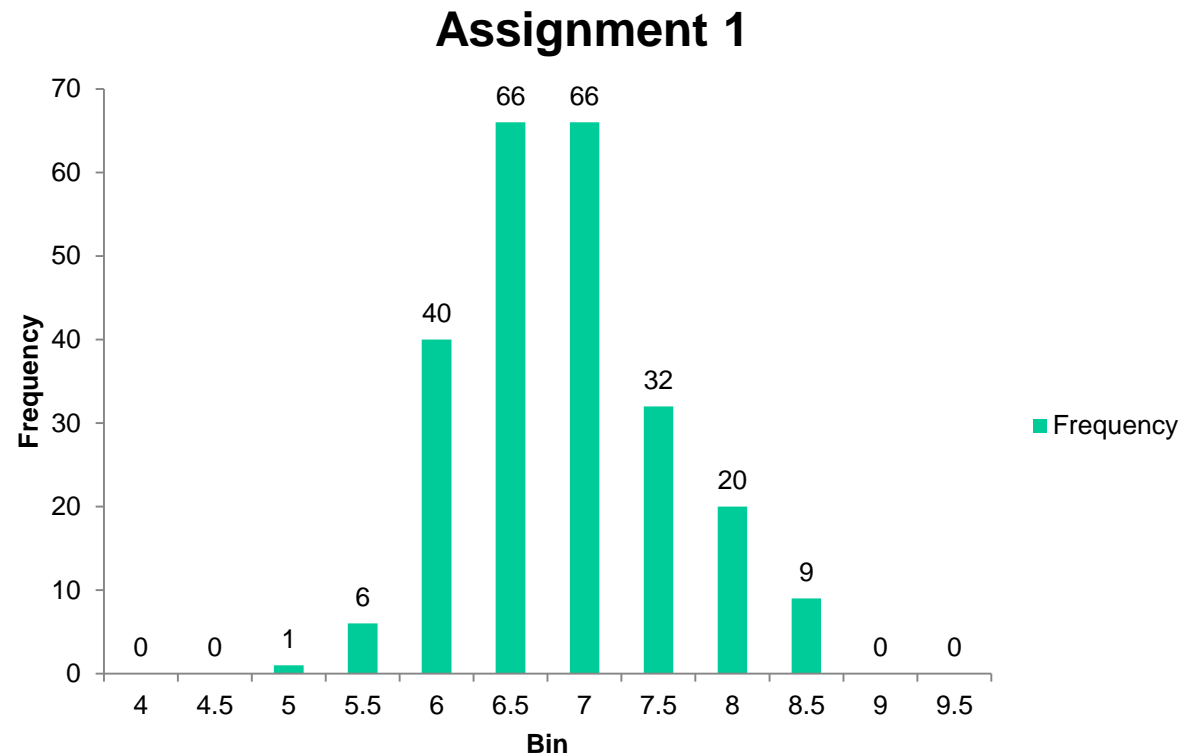 - student must achieve **at least 40%** in the written examination
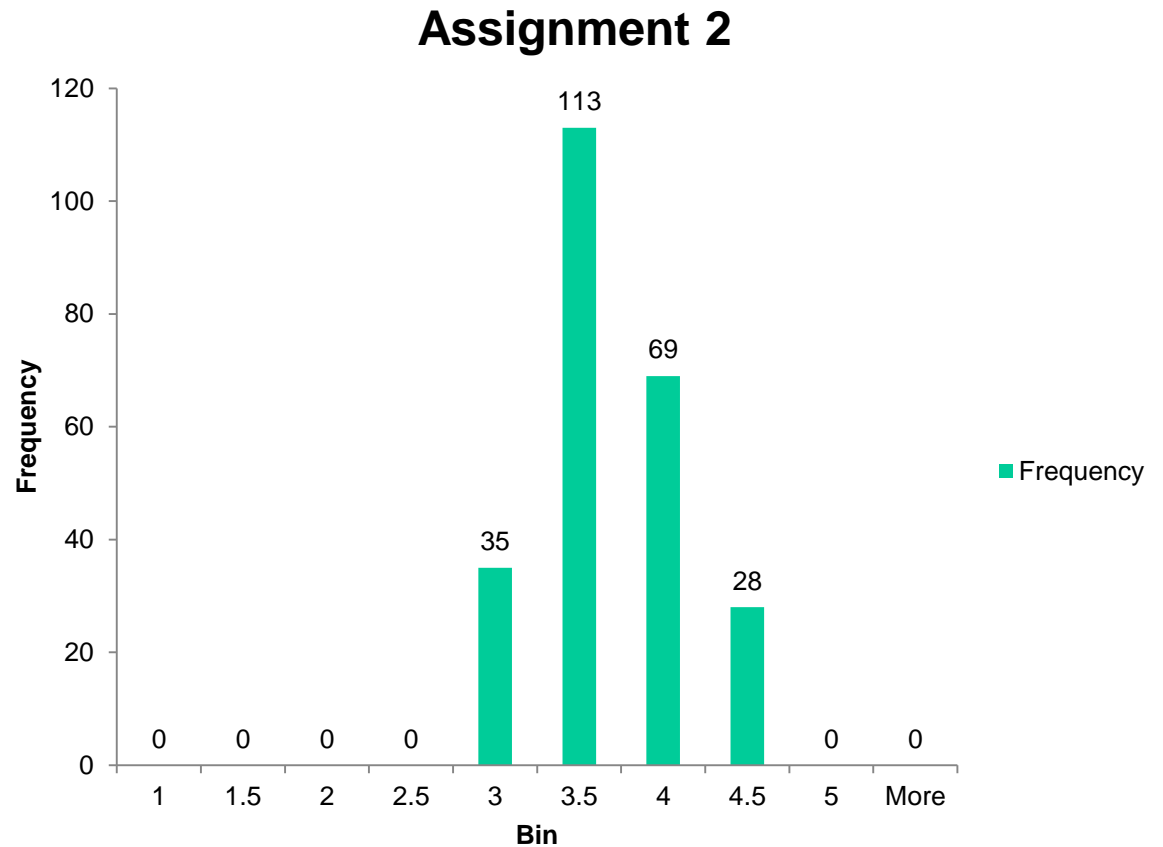
Homework

- **Average 9.77**

Homework marks

Assignment 1

- **Average   6.85**

Assignment 1

Assignment 2 – Initial Report

- **Average   3.67**

Assignment 2

Histogram showing Frequency vs Bin. Values: Bin 1: 0, 1.5: 0, 2: 0, 2.5: 0, 3: 35, 3.5: 113, 4: 69, 4.5: 28, 5: 0, More: 0. Legend: Frequency.
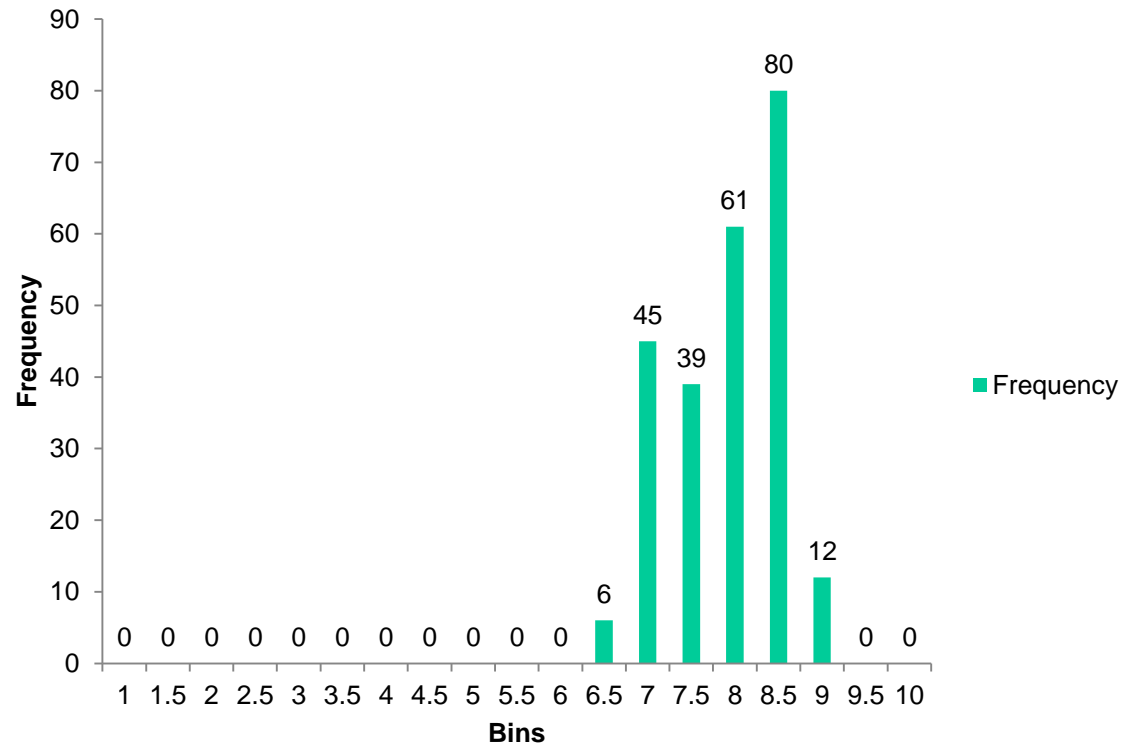
Assignment 2 – Presentation

- **Average   7.87**

Assignment 2 Presentations

2. Exam

Exam

- **<u>Closed book, written exam</u>**
- **<u>Scope: lectures notes (week 2-9: excluding week 8)</u>**

- Two hours writing plus 10 minutes reading at the start
- Write answers on the question booklet in spaces
- No calculators, No handout/memo

- ***<u>Answer 5 questions</u>*** worth in total 80 marks
  - Each question contains a set of ***subquestions***

Exam Questions: Scope

- (10 marks) Week 2: Visualisation of Complex Data I
- (15 marks) Week 3: Visualisation of Network Data
- (15 marks) Week 4: Visualisation of Directed Graphs

- (10 marks) Week 5: Visualisation of Big Data
- (10 marks) Week 6: Visualisation of Complex Data II
- (10 marks) Week 8: Perception/Color
- (10 marks) Week 9: Evaluation Methods

Sample Exam Question

Describe/Explain Concepts/Algorithms/Methods

1. Describe methods to visualize XXXX data.

2. Explain Algorithm/methods YYYY.

3. Explain ZZZZ in detail.

Exam technique

- **<u>Plan how you will allocate time (wisely)</u>**
  - Use "reading time" to check your understanding

- **<u>Answer everything (get the "easy marks")</u>**
  - show that you have some relevant knowledge

- **<u>Write clearly and efficiently</u>**
  - Start with outline/bullet points, then expand
  - Handwriting needs to be easy to read!

- If you need more space, use blank pages but leave a forwarding pointer in the provided space

Pragmatic Advice

- Find the room location before the exam day itself!
- Come in plenty of time

- Have your student id and put it on the desk
- Bring spare pens
- Switch off mobile phone and put it under the desk
- Illness and misadventure: Special consideration

Good Luck

Questions?

Reminder

- Fill out online Unit of Study Survey
  - Answer a few questions online at
    https://student-surveys.sydney.edu.au/students/

  - *Constructive* feedback: how to improve this unit

Visualisation Challenge

1. Scalability *(Computational complexity)*

    Efficiency

    Runtime

2. Visual complexity

    Effectiveness

    Readability

Scientific Challenges in IT