Optimisation Outreach Activity 1: Travelling Strings Problem

Thank you to OPTIMA Associate Investigator Dr Matthew Tam for this activity idea. This resource is intended as a quick-start guide for OPTIMA members doing outreach to schools, or engaging and educating young people in other settings. You are invited to make your own adjustments, changes and additions to the activity to engage your specific audience.

Supplies checklist

- ☐ WWCC card – always be ready to show your Working With Children Check.
- ☐ 5 x cork boards and pins. Alternatively, you could create your own boards with craft supplies such as wooden blocks and nails, or ask the school if they have pegboards or corkboards that are available.
- ☐ 5 x A3 printed problem maps. Use the maps at the end of this document or create your own with Google My Maps or other software.
- ☐ String and scissors.
- ☐ OPTIMA lanyard and name tag.
- ☐ (optional) USB with PowerPoint presentation. However, always be prepared to run the class without any technology if required. Take printed copies of key slides.
- ☐ (optional) OPTIMA merch prizes.

Please contact OPTIMA ARC Centre Manager if you would like to request any supplies: optima-arc@unimelb.edu.au

Activity summary

Students collaborate in small groups to find the shortest path for a given network of cities, using pins to mark cities/stops and string to show the length of their path. This can be run as a competition where groups compare their solution at the end with the shortest string winning.

Following this demonstration of the Travelling Salesperson Problem, discuss the difficulty of finding optimal solutions for some problems, despite advancements in technology, to explain why researchers are working on optimisation today.

OPTiMA ARC TRAINING CENTRE IN OPTIMISATION TECHNOLOGIES INTEGRATED METHODOLOGIES AND APPLICATIONS

Lesson Plan

1. Introduce yourself briefly, you can come back to this at the end. Write your name on a whiteboard if possible.
2. Introduce OPTIMA briefly, as a research centre that focusses on optimisation. Define optimisation in simple terms. Write the word "optimisation" on a whiteboard if possible and encourage students to try to use the word.
3. As an example of an optimisation problem, introduce the Travelling Salesperson Problem (TSP) and why it is difficult, even for computers. You may want to mention AI here. Pause to ask students if they have any questions, and check their understanding of optimisation and the TSP.
4. Explain the activity that you are about to begin. Students will work together (in pairs or groups) for 10 minutes and then stop to compare strings and figure out whose path was shortest. Demonstrate with Map A as an example, showing how to set up the board and how to use the string to find a path, by tying it around the starting pin and then wrapping it around each stop. Emphasise that to qualify as a solution, the string must (a) start and stop at the same peg and (b) wrap around every pin/peg.
5. Ask the teacher to help you divide the class into 4 or 5 groups, with each group having a board, a copy of Map B, a set of pins, and a length of string.
6. Set a timer for 10 minutes. Walk around the room as students are working on their solution and see if any groups need help setting up the board or string or a reminder about the goal.
7. When the time is up, ask students to put down the boards. Hold up some of the different solutions for the rest of the class to see. Check that each solution passes through every town (i.e. their string should wrap around every peg). Then find out who had the shortest path in the class, either by
    - comparing the string left at the end of their path, or
    - if they have scissors, they can cut the strings to size and then unwind them to show the length of their solution.

    Congratulate the winning group with prizes or a round of applause.
8. Briefly share some real-world applications of the TSP and how solutions could help people. Highlight some key takeaway points, for example:
    - In school maths you learn about problems that have a known solution, but if you work in mathematics research after school then you get to focus on problems that no-one has solved yet.
    - Many optimisation problems are still not fully solved and it's a challenge even with computers and AI to find solutions.
    - To solve challenging problems we need creativity and collaboration. OPTIMA brings together different researchers to collaborate and try to figure out new solutions together.
9. Come back to your career story, and share an example of the kind of problems you tackle in your research.
10. Allow time for any questions from students about the TSP, about your work or about maths careers in general. You may be able to offer a chance for students to stay behind and speak to you after the class, if the teacher is happy to wait in the room with you.

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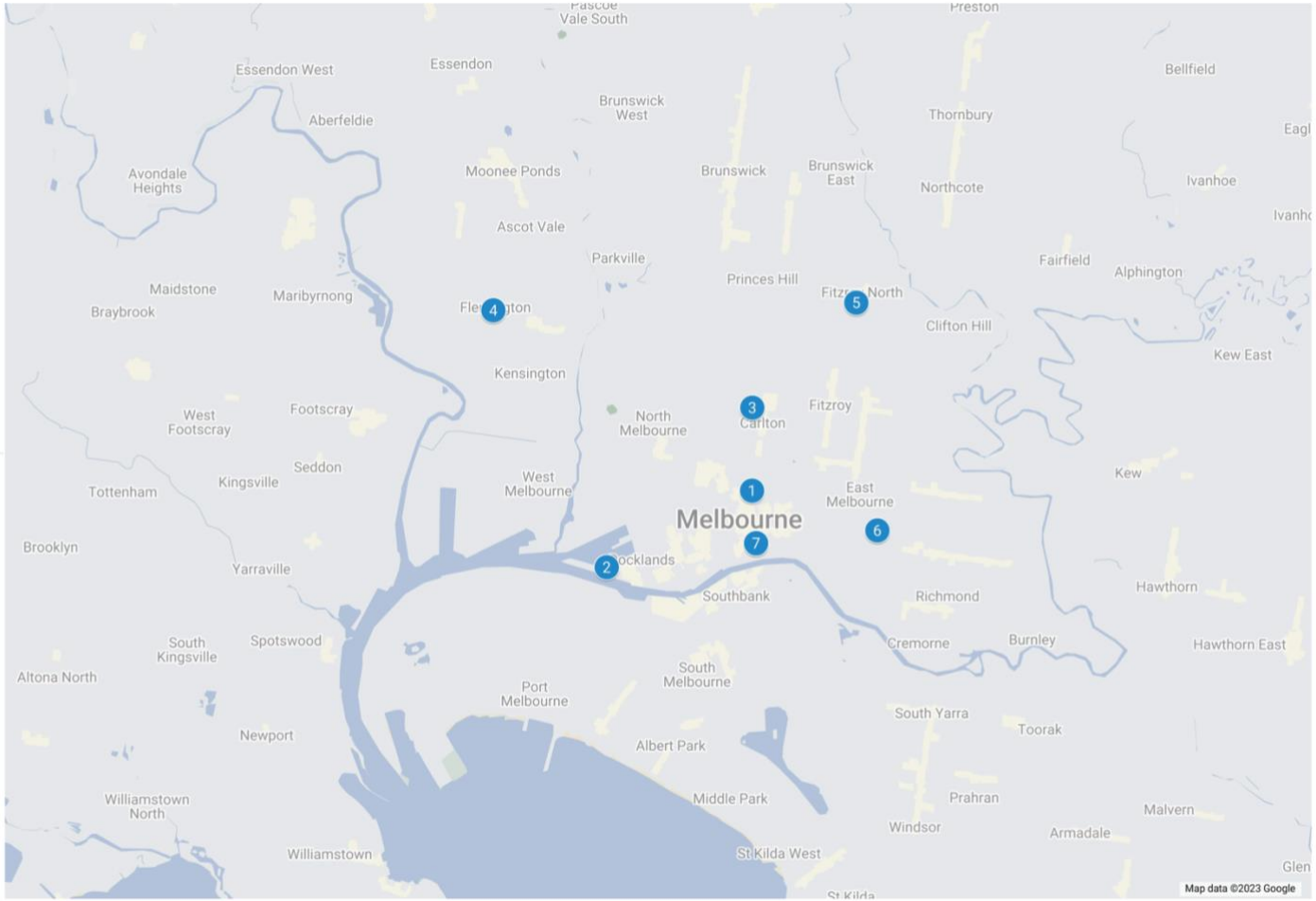
Map A: Melbourne libraries

Libraries

1. State Library Victoria
2. Library at The Dock
3. Kathleen Syme Library and Community Centre
4. Flemington Library
5. Bargoonga Nganjin, North Fitzroy Library
6. East Melbourne Library
7. City Library

Victorian towns, Melbourne libraries



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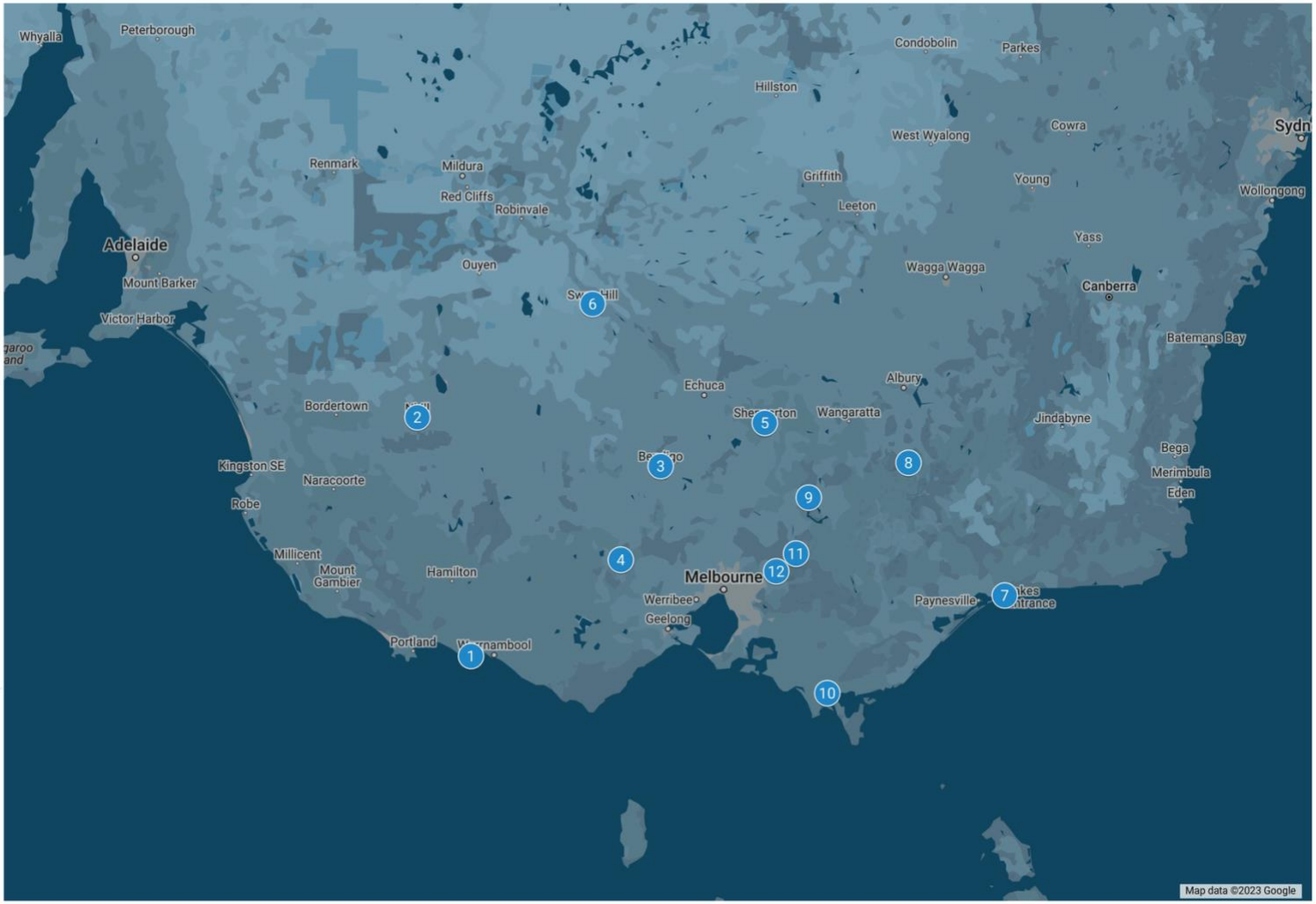
Map B: Victorian towns

Towns

1. Port Fairy
2. Nhill
3. Bendigo
4. Ballarat
5. Shepparton
6. Swan Hill
7. Lakes Entrance
8. Bright
9. Bonnie Doon
10. Fish Creek
11. Marysville
12. Healesville

Victorian towns, Melbourne libraries



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Campus maps for Open Days

Monash University maps: https://www.monash.edu/about/our-locations/transport-parking/rhs-navigation/campus-maps

University of Melbourne maps: https://maps.unimelb.edu.au/download-maps