# Lab Assignment 2

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**You should complete given exercises and submit them in separate files to LMS before the deadline.**

Your completed assignments will not be graded, but will be marked for completion. The maximum mark for completing all assignments in this semester is 10 points. Although it is an individual assignment and you cannot use other student's work in this assignment, you can still use publicly available online resources in this assignment. You must properly reference all resources. Otherwise, it will be considered as plagiarism.

## 1 Experiments on Perception

In this section, you should conduct experiments with fellow students in testing perception of various sensory stimuli.

### 1.1 Visual Search Test

Searching is a fundamental human activity. In visual search tasks, people are asked to find a visual stimulus amongst other visual stimuli (distracters). The more stimuli there are, the more time it takes to find a target stimulus.

In a visual search experiment, a target is the item that you need to find. A distracter or distractor is an item that you are not looking for, and which distracts you from finding the target.

Examples of visual search in real life

1. Searching for keys on a messy table
2. Searching for your wallet
3. Searching for teabags in the supermarket
4. Searching for your name on a list of names

Try this experiment on this website.

#### 1.1.1 Modelling the time necessary for search

You can model how much time a user spends while searching depending on the number of items on the screen.It can be modelled as a logarithmic function $T = b * \log_2(n + 1)$. You can approximate the coefficient $b$ for your case by trying this experiment:

1. Open the tool by navigating to the following URL in your web browser: `https://s-abdullaev.github.io/hick/index.html`
2. You will see a button labeled "Start". Click on this button to begin the experiment.
3. The tool will randomly generate a number of buttons, each labeled with a unique number. The number of buttons will be between 2 and 100.

4. A question will appear at the top of the screen, asking you to click on a specific button. The button you need to click on will be identified by its number.
5. Click on the button that matches the number in the question.
6. The tool will record the time it takes for you to click on the correct button.
7. This time will be stored in an array, along with the number of buttons that were displayed.
8. Steps 3-6 will be repeated 15 times, with a different number of buttons being generated each time.
9. After you have completed the experiment, you can download a CSV file that contains your results. The CSV file will include the number of buttons that were displayed and the time it took for you to click on the correct button for each round of the experiment.
10. You can use this CSV file to analyze your results and draw conclusions about the relationship between the number of choices and visual search.

Plot your results into a scatter plot and model it according to the formula provided above. Find $b$ =?. Use this Google Colab notebook.

## 1.2 Two-Point Threshold Test

The two-point threshold test is a valuable assessment of tactile perception. It helps determine how finely innervated an area of skin is. Here are the steps to conduct this test in a classroom setting:

1. Preparation
   (a) Materials Needs: You'll require a paper clip, a ruler, and a hard surface.
   (b) Patient Position: The patient should sit comfortably with their eyes closed to prevent visual interference.
2. Experimental Procedure
   (a) Select the Area: Choose the area of skin to be tested (e.g., fingertip, fist, wrist, palm, forearm).
   (b) Apply Pressure: Use the paper clip to apply pressure on two adjacent points in.
   (c) Find the Threshold: Find the minimal distance at which the patient can distinguish between the two stimuli. This distance is called the threshold.

You should record your measurements in this table in FigJam.

| # | Fingertip | Palm | Wrist | Forearm | Shoulder |
|---|---|---|---|---|---|
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |
| **Avg** | | | | | |

Table 1: Minimum thresholds for 2-point tests

## 1.3 Steven's Power Law

Steven's Power Law is a fundamental concept in psychophysics that relates sensation magnitude to stimulus intensity. Let's explore how to conduct an experiment related to this law specifically focusing on audio volume. We want to investigate the relationship between perceived loudness (sensation) and the actual intensity (stimulus) of sound.

1. Materials Needed:

   (a) Sound Source: A device capable of producing varying sound intensities (e.g., a speaker, earphones). You can use this online tool.

2. Experimental Procedure:

   (a) Preparation:

      i. Set up the sound source at a fixed distance from the participant.

3. Stimulus Presentation:

   (a) Present a series of sound stimuli with varying intensities (e.g., different volume levels).

   (b) Randomize the order of presentation to avoid order effects.

4. Data Collection:

   (a) Ask participants to rate the perceived loudness of each sound stimulus.

   (b) Use a numerical scale (e.g., 1 to 10) for perceived loudness.

   (c) Record participant's perceived loudness along with actual intensity.

5. Analysis:

   (a) Plot the participants' loudness ratings against the actual intensity

   (b) Fit your data into following function:

$$y = kx^{\alpha}$$

   where: $y$ is perceived loudness, $x$ is actual intensity, $k$ is a constant, $\alpha$ is the exponent specific to the type of stimulation (e.g. hearing).

6. Find $\alpha$ using following Python script given in this Google Colab notebook

# 2 Experiments on Working Memory

The aim of this exercise is to get the student to think about experimental design on human memory. The experiments devised can effectively be repeats of the originals.

## 2.1 Digit Memory Test

Play with this interactive test. It demonstrates that there is tough limit in our Working Memory. It does following:

1. Shows a sequence of digits briefly
2. User must recall and input the sequence
3. Adapts difficulty based on performance
4. Demonstrates the working memory limit of 3-4 items discussed in the textbook

## 2.2 Picture Memory Test

Open this tool to test your short-term memory. What items can you remember in 30 seconds? Don't write anything down! You can find more information about human short-term memory in this Jacob Nilsen's article.

## 2.3 Text Memory Decay Analysis

1. Create this table in FigJam:

| Students | 0 seconds | 5 seconds | 20 seconds | 1 minute | 5 minutes |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |

Table 2: WM Decay

2. Write your name in Students column. Ask your other team members to do the same. Each team member should follow these instructions:
   (a) Open `https://randomwordgenerator.com` and generate 20 nouns.
   (b) Look at these words for 20 seconds, and then switch back to FigJam
   (c) Set the timer to 0, 5, 20, 60 or 300 seconds
   (d) Work on something else. For example, start doing tasks given in Section 4.
   (e) After time elapses, write all words that you can remember on a piece of paper in the same order as you have seen them.
   (f) Switch back to `https://randomwordgenerator.com` and check which words you missed. Write their position.
   (g) In Table 2, write the percentage of words you missed.
   (h) Repeat these steps with new list of words for other time periods.
3. Plot your WM decay as a Serial Position Curve shown in the lecture slide per position of the word similar to the plot shown below:

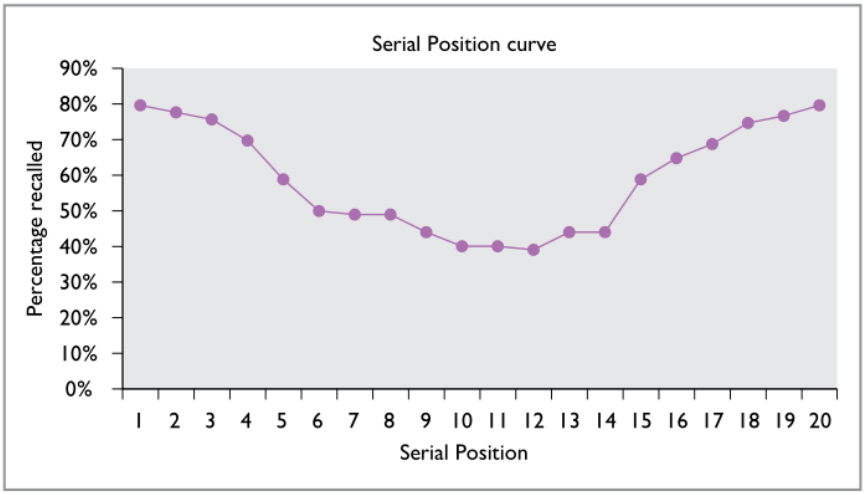


Figure 1: Serial Position Curve

4. Plot your overall WM decay as a function and compare it with your friends' function.

You can modify the number of generated words, type of words (e.g. not nouns, but verbs, or adjectives), add distractions and repeat the experiment. You will observe how your WM decay changes based on these factors.

# 3 Experiments on Attention

## 3.1 Stroop Effect

The Stroop effect is one of the best known phenomena in cognitive psychology. The Stroop effect occurs when people do the *Stroop task*, which is explained and demonstrated in detail in this lesson. The Stroop effect is related to selective attention, which is the ability to respond to certain environmental stimuli while ignoring others.

In the Stroop task, people simply look at color words, such as the words "blue", "red", or "green". The interesting thing is that the task is to name the color of the ink the words are printed in, while fully ignoring the actual word meaning. It turns out that this is quite difficult, and you can find out exactly how difficult this is below.

Try this experiment on this website

## 3.2 Hick's Law

People (and animals) can respond a lot faster when there is just one stimulus and one response type (Simple Response Time task). Also, the more stimuli and responses there are, the slower you get (this is known as Hick's law). Here we use the Deary-Liewald experiment which uses both a simple and a 4-choice response time task.

Try this experiment on this website

# 4 Logical Puzzles

Solve these exercises on FigJam together.

## 4.1 Numbers Graph

Insert the numbers listed into the circles so that – for any particular circle – the sum of the numbers in the circles connected to it equals the value corresponding to that circled number in the list. For example:

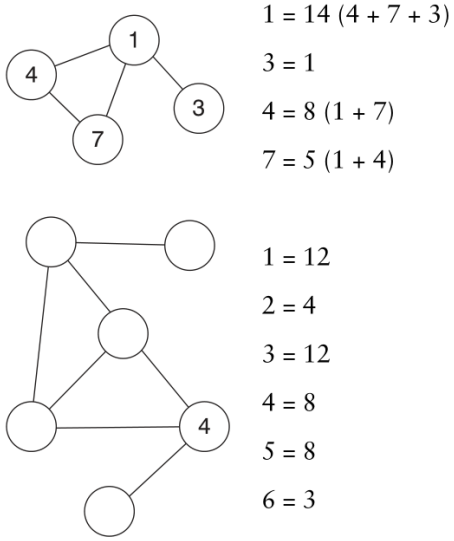


Figure 2: Graph

### 4.2 White Circles

Place four white circles correctly in the grid in accordance with the rules of logic already established.

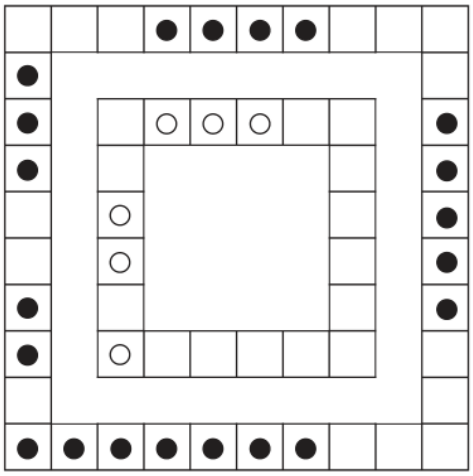

Figure 3: White Circles

### 4.3 Five Squares

Here are three squares made from twelve matches. How can you move just three matches to create five squares?

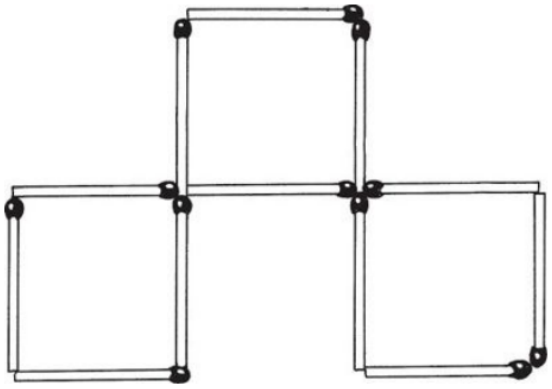

Figure 4: Squares