Milestone One Journal

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1 INTRODUCTION

This journal focuses on three areas: Raven's Test of Intelligence Examples, Potential Design of AI agent, and Potential Problems with AI Agent and Implementation.

2 RAVEN'S TEST OF INTELLIGENCE EXAMPLES

The Raven's Progressive Matrices (RPM) Test is a visual test of general intelligence. The test measures abstract reasoning through displaying a series of images or cells in a matrix. Within the matrix, the transition between cells or groups of cells communicates information to the test taker. To answer the question correctly, the test taker must infer what the omitted cell image should be given the information from the cell transitions and select the image from a solution set.

The test provides multiple layers of abstraction and complexity. RPM may be in the form of 2x2, 3x3, or larger in size and may have increasing levels of abstraction needed to solve the problem. The following sections discuss examples of the varying levels of size and abstraction needed.

2.1 Example One - 2x2

Figure 1 depicts the first example and problem set for a 2x2 Raven's matrix. All shapes in the problem set (A,B,C) are black squares. The only plausible relation between A to B and A to C is that there is no change. In relation to A, the square in B and C does not move, does not rotate, and does not increase in size. Therefore, the expectation to be found in the possible solution set shown in figure 2 is a black square. Luckily, there is a black square in the solution set image 2 and a re-evaluation of the heuristic is unnecessary.

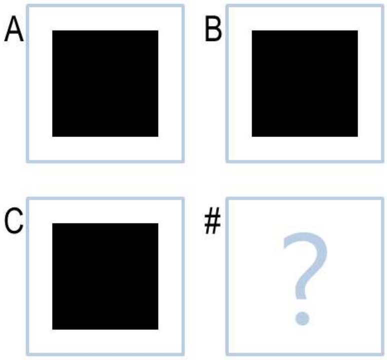

Figure 1— The problem set of shapes for example one.

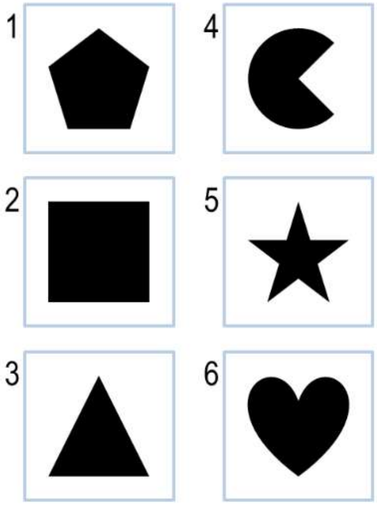

Figure 2— The solution set for example one.

2.2 Example Two - 2x2

The problem set for example two is shown in figure 3. The image shows rotation, reflection, and highlighting of a circle missing a quadrant (Pacman). B is a reflection of A across the vertical axis. C is a reflection of A on its horizontal axis but is missing the color fill or highlighting of A. The missing image must be a reflection of B on its horizontal access without highlighting. Image 3 in figure 4 is the solution.

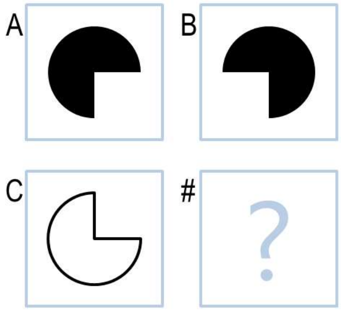

Figure 3— The problem set of shapes for example one.

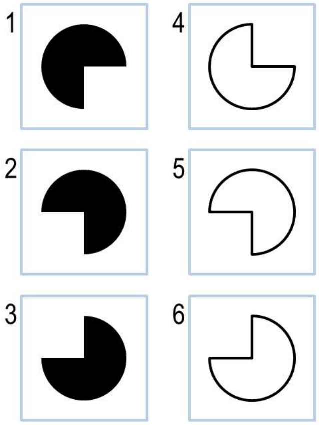

Figure 4— The solution set for example one.

2.3 Example Three - 3x3

This section evaluates the problem set shown in figure 5. Following the same logic in section 2.2, at a row level, each cell in the matrix contains the same shape. As the missing shape is in row three, the expectation for the missing image is the repeated shape in row three. This shape corresponds to image 3 in the solution set shown in figure 6.

Additionally, there is more justification that image 3 is the correct solution. Consider the transitions from A to D to G and C to E to G in figure 6. The transitions appear to add a larger square encompassing the image from one row to the next and from one diagonal cell to the next. Following this logic, the missing cell should have one more square than E and F which the image 3 in the solution set has.

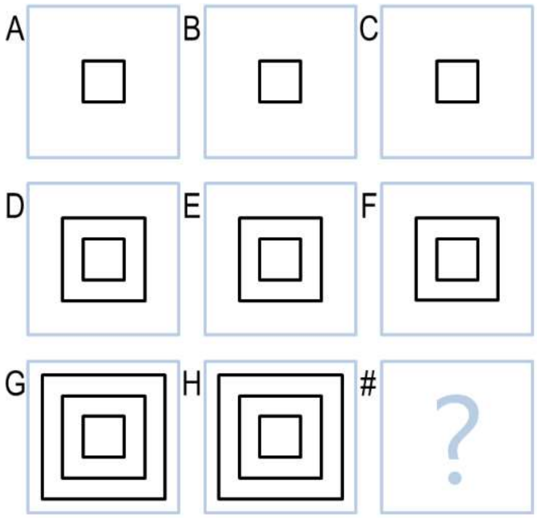

Figure 5— The problem set of shapes for example three.

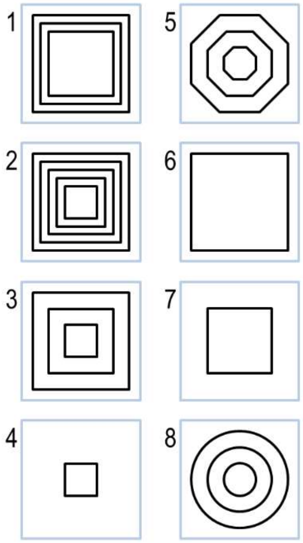

Figure 6— The solution set for example three.

3 Potential AI Agent Design

At this stage in the course, an AI agent that solves RPM problems is an algorithm that senses shapes and relationships between the shapes within a matrix. The algorithm should be able to infer based on the shapes, and known relationships, what the omitted image should be. Once an expectation is created, the algorithm should be able to compare the expectation to the list of possible solutions and return the ideal solution. Essentially, the algorithm will have four main functions: identify the shapes within each cell, create a transformation function between the cells in the rows and columns of the matrix, create an expectation of the missing image using the patterns learned in the transformation functions, and choose an image from the solution set that best matches the expectation.

3.1 Identify Shapes

To identify an image, the algorithm will need a sample set of images. For each cell, the program will loop through the pixels and identify all shapes in the image based on a sample set of images. Metadata will be created for each cell and unique shape position combination and contain information on orientation and highlighting of each shape.

3.2 Create Transition Functions

After identifying what shapes are present in the matrix, the algorithm will trace a shape position through each cell in a row, each cell in a column and each cell in a diagonal. While the program traces through the matrix, it will test against defined semantic transformations and take note of what occurred for each transition. Ultimately, after comparing all transition functions, it will choose the most likely candidate function.

3.3 Create an Expectation and Test

Using the transformation functions described in 3.2, the algorithm will apply the candidate transformation function to the adjacent cell next to the omitted cell creating an expectation shape. The expectation shape is then tested against the solution set of shapes. If there is a close match between the expectation shape and a solution shape, then that solution shape is returned.

4 Potential Problems with AI Agent and Implementation

Issues will arise when attempting to create the AI agent that solves the RPM problems. The first and foremost issue will be computational power and time. There are a large number of complex transformations that the algorithm will need to test and detect. The comparison between the estimated transformations for all the cell to cell changes will also be computationally expensive. Secondly, the developer will need to create a dynamic program to generate defined semantic transformations to infer all possible transitions between images. Some possible transformations may be unintentionally left out of development.