Raven's Progressive Matrices Solver

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This is a brief overview of the project. Due to academic integrity policies, the full code and report cannot be shared publicly. Please feel free to contact me directly for access or additional details.

1 RAVEN'S PROGRESSIVE MATRICES AI AGENT

A knowledge-based AI agent was developed to pass the Raven's Progressive Matrices (RPM) human intelligence test. The agent is configured to solve 2x2 and 3x3 matrix problems. The agent solves the problems using nine main components: Preprocessing, Equality, Reflections, Rotations, Area Change, Shape Fill, Shape Quantity functions, Logic Operation functions, and Dark Pixel Pattern functions. The agent's solving process is illustrated in Figure 1. The agent processes the images before passing them through a list of 2x2 or 3x3 functions in the order they are listed till a suitable answer is returned. For example, if a 3x3 RPM problem has a transformation that involves the area of a shape changing, the agent would first pass the preprocessed input through Equality, then Reflections, before finding a suitable option through the Area Change function.

2 AGENT PERFORMANCE

The agent's performance is evaluated based on its ability to solve the Basic, Test, Challenge, and Raven's type problems. Since the objective of the project is for the agent to mimic human cognition and pass a human intelligence, it can further be assessed by converting its performance on the RPM test to a percentile and IQ in human terms. Table 1 summarizes the agent's performance across the four different sets and four types of problems. The agent performs satisfactorily on the Basic and Test problems. It can solve all 48 of the Basic problems and 36 out of 48 of the Test problems for a combined 84 out of 96 problems, giving it an 87.5% success rate on these sets. The agent's high performance on these sets can be attributed to the fact that Basic problems were solely used to develop the agent and the Test problems are directly analogous to the Basic problems. Though the performance is high, the agent might be vulnerable to overfit and could have a bias towards the transformations and trends found in these types of problems. This

is evident as the agent's performance drops significantly when facing problems from the Raven's and Challenge sets, solving 60.42% of the Raven's problems and only 35.42% of the Challenge problems.

The agent's performance can be further analyzed by converting its results to a percentile rank and IQ score in human terms. Since the raw scores used for the conversions are out of 60 and not 48, the success rate is applied to derive a raw score for conversion. The tables used for the conversion of raw scores into percentile ranks and IQ score were developed by Peck (1970). The agent can be compared to a 30-year-old human, the same age as me, its creator. The Basic and Test problems are inspired by the real RPM test, so we can use its results for an assessment of the agent. The agent's 87.50% success rate gives a raw score of 52/60, giving the agent an 85-percentile rank for a 30-year-old and an IQ of 115. Strictly for only the Raven's problems, the 60.42% success rate translates to a raw score of 36/60 giving the agent a 32-percentile rank for a 30-year-old and an IQ of 93.

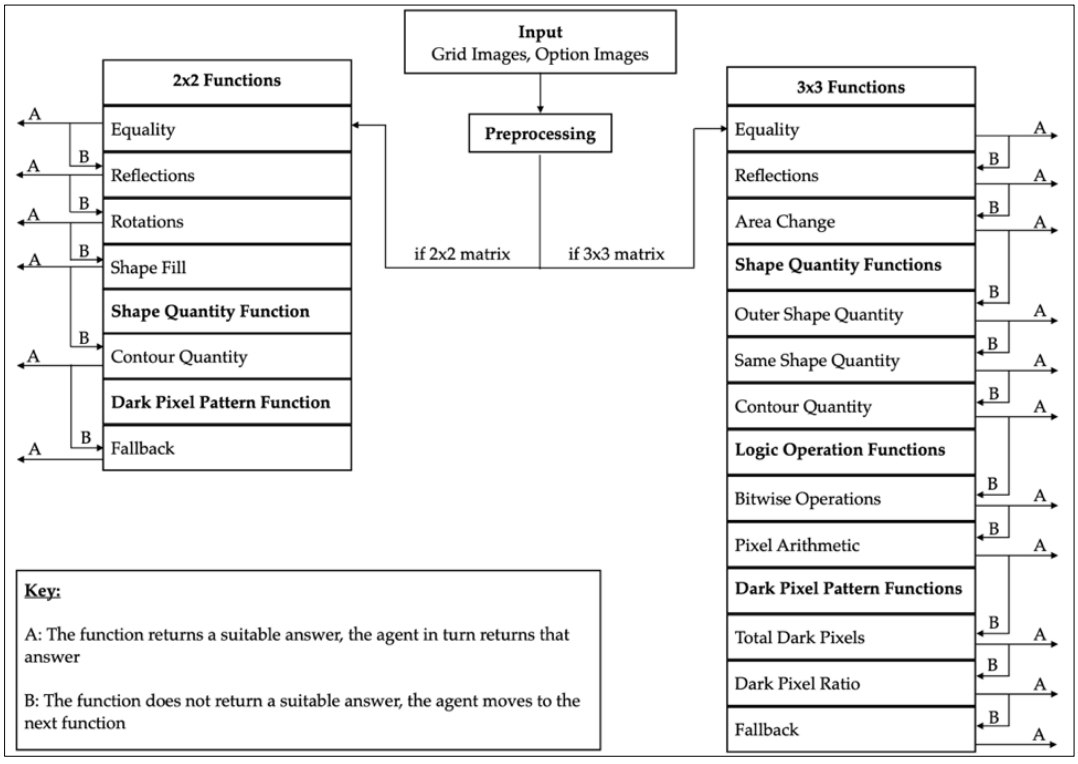

Figure 1 — The RPM AI agent's solving process

Table 1 — The RPM AI agent's performance on the different types and sets of problems

Sets	**Basic**	**Test**	**Raven's**	**Challenge**	**Basic and Test**	**Basic, Test, Raven's, and Challenge**
Set B	12/12	11/12	7/12	4/12	23/24	34/48
Set C	12/12	8/12	9/12	8/12	20/24	37/48
Set D	12/12	10/12	4/12	1/12	22/24	27/48
Set E	12/12	7/12	9/12	4/12	19/24	32/48
Total	48/48	36/48	29/48	17/48	84/96	130/192
Success Rate	100%	75%	60.42%	35.42%	87.50%	67.71%

3 REFERENCES

1. Peck, D. F. (1970). The conversion of Progressive Matrices and Mill Hill Vocabulary raw scores into deviation IQ's. *Journal of Clinical Psychology, 26*(1), 67–70. https://onlinelibrary.wiley.com/doi/abs/10.1002/1097-4679%28197001%2926%3A1%3C67%3A%3AAID-JCLP2270260117%3E3.0.CO%3B2-T