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Part A. Analyzing a "Kind" Task and Describing Expertise

d. Interpret-Evaluate-Reinterpret

For interpret, this could be the student considering all possible options, namely, deciding whether to apply for the job, not apply for the job, or shortlist the job to consider later. For evaluate, this could be the student assessing these three different options and determining which constraints receive highest priority, for instance if the job aligns with their interests and career goals or considering how much time they have left to apply or not, leading to a reinterpretation of the possible options before making a final decision.

g. Execute

If the student decides to apply for the job, then execute is the act of clicking the apply button on WaterlooWorks, but if they decide to not apply for the job, then execute is the act of clicking away from the job posting and not applying. Lastly, if the student decides to shortlist the job, then execute is the act of clicking on the shortlist button to bookmark the job for later.

h. Shortcut Between System State and Goal State

An expert shortcut that might happen between System State and Goal State could occur for upper year students, where they have already seen the same job posting in previous terms and can immediately make the decision of whether or not to apply to it. The influence of expertise in this case is utilizing the knowledge and experience gained from assessing the job posting already in a previous term and making an informed decision without having to thoroughly go through interpretation and evaluation.

i. Shortcut Between Execute to Alert

Assuming this is in main round with the 50-application limit, and the student intends to use all applications (which is a common practice), an expert shortcut that might happen between Execute and Alert could occur for students who have already narrowed down their search to 50

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and have all the postings opened and ready. The influence of expertise in this case: having them all opened, this allows the student to execute the task of applying to a job, and then immediately being presented with the next job posting they want to apply to, hence the shortcut from execute straight back to alert.

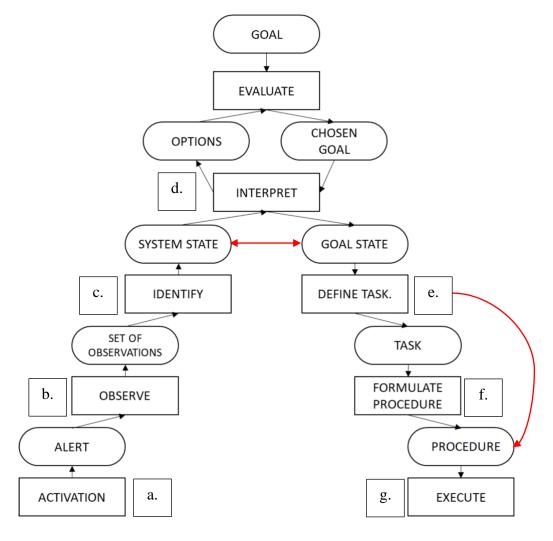## j. Shortcut Between Activation to Set of Observations

An expert shortcut that might happen between Activation and Set of Observations could occur for students who are able to read the immediate information such as the job title and company, and immediately derive an educated and informed set of conclusions about the job. The influence of expertise in this case is that for more experienced students, they are able to more easily deduce whether or not they want the job just based on the job title and company, since they are able to compare them to their previous experience, since the intention of co-op is to gain more relevant and useful experience, and hence, they can form a set of observations without having to read through the job descriptions.

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Part B. Drafting and Analyzing a "Wicked" Task

1. **Decision Makers of Interest**

   The project for this question will be the same as what was used for assignment 1, namely that of my FYDP on robotic urban delivery. The scope of this system is that it is intended to autonomously deliver packages by navigating dense urban environments. With such a task like this, there are many crucial decisions to be made such as when to stop, when to turn, and when to keep going, hence it is important to study the decision-making capabilities of this robot. Since it is intended to function autonomously, the main decision maker in this case is the robot itself. The robot is meant to be programmed to navigate all on its own, with minimal input from developers only for emergency situations such as emergency stops. Thus, the decision-making abilities of the robot will be analyzed.

2. **Decision Ladder**

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3. **Annotations**

   a. Activation: Detect an object through its camera in front of its current field of view. The robot is constantly capturing events that draw it to the need to make a decision, and in this case, it is constantly detecting whether or not objects are in front [1].

   b. Observe: Determine where the object is relative to its current path of motion. The robot creates a list of elements such as where the object actually is in front it, whether or not it is moving, and how close it is to itself, in order to gain an understanding of the current situation.

   c. Identify: Check how many objects there are and map each of them out in real-time. The robot gains a perceived understanding of the work system based on information, and in this case, it now knows the state of each individual object as well as how many there are in its view.

   d. Interpret-Evaluate-Reinterpret: For each object, calculate and determine which ones could result in a collision and consider these only, while ignoring the ones that are safe from it. This is an iterative process because as the robot is moving, objects are constantly entering and leaving its field of view, therefore it has to continuously determine which ones are safe and which ones are not on-the-fly.

   e. Define Task: Decide whether or not to stop to avoid the object/obstacle. To achieve the target state while maintaining the overall goal, the robot has to make the decision of whether or not it has to stop to avoid an incoming obstacle, in order to complete its delivery safely and on time.

   f. Formulate Procedure: Utilize the object detection algorithms to figure out whether a stop needs to be made, and if so, prepare the stop procedure, else continue on its path. The robot has to determine a detailed action plan, namely that if indeed it has to stop, then ensure that one can be made by prepping its stop functionalities, but if not, then anticipate this and continue its navigation.

   g. Execute: If a stop is required then perform the stop procedure, else continue on its current path of motion. The robot has evaluated the situation and came to a conclusion as to whether or not it needs to stop, so take the result of this plan and carry out the corresponding action, i.e., stop or continue.

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4. Shortcuts

a. The first shortcut between system state and goal state represents a more advanced robot that uses machine learning to progress over time and obviate the need for constant calculations of objects in its field of view. With machine learning techniques, a more expert robot will be able to automatically determine whether or not objects in its path are safe, whereas a more novice robot will have to individually determine if each object is safe, which requires more computing power and time. The second shortcut from define task to procedure represents a more advanced robot capable of making the object avoiding decisions without the need for readying or preparing a stop procedure if it is required. A more expert robot, such as robots powered by Google AI, will have the ability to stop on-the-fly without having to prepare for it, whereas a more novice robot would have to prepare a stopping procedure due to its already complex functionality of navigation and lack of on-the-fly decision-making [2].

b. The first shortcut represents knowledge, as the machine learning techniques would utilize its previous navigation experiences and transfer its knowledge for subsequent deliveries for use later on. As mentioned previously, more advanced robots will be able to take advantage of its past deliveries by storing and remembering the objects it has already seen before and using that knowledge to more quickly identify those same or similar objects in future missions. The second shortcut also represents knowledge, as enhanced capabilities due to more sophisticated programs allow the robot to forgo the need of constant computations for more robust knowledge-based strategies; furthermore, as depicted by Rasmussen's decision ladder, going down the right side of the tree, namely from define task to procedure, is knowledge-based movement [3].

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5. References

[1]   D. P. Jenkins, M. Boyd and C. Langley, "Using the decision ladder to reach a better design," DCA Design International, 2016. [Online]. Available: https://learn.uwaterloo.ca/content/enforced/635025-SYDE543_y457li_1211/Wk.8%20Expertise/Jenkins%20-%202016%20-%20Using-the-decision-ladder-to-reach-a-better-design.pdf?_&d2lSessionVal=vFBSgiS3SxVSbfCLwJecmNz7k&ou=635025. [Accessed 24 March 2021].

[2]   K. Wiggers, "Google's AI enables robots to make decisions on the fly," VentureBeat, 15 April 2020. [Online]. Available: https://venturebeat.com/2020/04/15/googles-ai-enables-robots-to-make-decisions-on-the-fly/. [Accessed 24 March 2021].

[3]   J. M. Flach and F. Voorhorst, "What matters: Putting common sense to work," 2016. [Online]. Available: https://learn.uwaterloo.ca/content/enforced/635025-SYDE543_y457li_1211/Wk9.%20Expertise%20part%20II/Extracted%20from%20What%20Matters__%20Putting%20Common%20Sense%20to%20Work.pdf?_&d2lSessionVal=vFBSgiS3SxVSbfCLwJecmNz7k&ou=635025. [Accessed 24 March 2021].

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