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| **Lesson Plan for Grades:** High School  **Length of Lesson:** 90 minutes |
| **Authored by:** UT Environmental Science Institute  **Date created:** 10/07/2024 |
| **Subject area/course:**   * Computer Science I |
| **Materials:**   * Slideshow of the lesson: <https://utexas.box.com/s/bacndyh58s48x0k3e2buj6xrjgnd7pvh> * Reinforcement Learning game worksheets:   + Note sheet: <https://utexas.box.com/s/41xlb51byly14qv0s44vggpl1tkqkcu7>   + Game board: <https://utexas.box.com/s/25ew8t5p3pntkqzajkva5ip0olqg88i5>   + Instructions for the players: <https://utexas.box.com/s/d66iggyejo012rgb93b3x6vddfzuewod>   + Instructions for the moderator and teacher: <https://utexas.box.com/s/z8h3z7n5j4jmivvm2sxk5yf2utt0ufcs> * *Optional*: Worksheets of the evaluation questions (if the teacher wants the students to have the poll questions on the slideshow as a physical copy) <https://utexas.box.com/s/n7du47x8wnux75tcmmogweb9nwhh3d2s> |
| **TEKS/SEs:**  **§127.789 Computer Science I**  (2) Communication and collaboration. The student communicates and collaborates with peers to contribute to his or her own learning and the learning of others. The student is expected to:  (A) participate in learning communities as a learner, initiator, contributor, and teacher/mentor;  (4) Critical thinking, problem solving, and decision making. The student uses appropriate strategies to analyze problems and design algorithms. The student is expected to:  (A) use program design problem-solving strategies such as flowchart or pseudocode to create program solutions;    **§127.750. Robotics II (Grades 10-12)**  (B)(3) In Robotics II, students will explore artificial intelligence and programming in the robotic and  automation industry.  **§127.767. Game Programming and Design (Grades 9-12)**  (C)(6)(Q) demonstrate an understanding of artificial intelligence and develop and implement  artificial intelligence; |
| **Lesson objective(s):**   * Student will be able to comprehend the basics of reinforcement learning using visual tools such as a flowchart. * Students will be able to identify the “optimal policy” through interactive learning * Students will be able to apply principles of reinforcement learning and reflect on the “nature of intelligence” * Students will be able to connect artificial intelligence to human intelligence, and how different areas of study incorporate AI into their work today |
| **Differentiation strategies to meet diverse learner needs:**   * The teacher should ask students whether they prefer to read or watch videos to learn about concepts; then have students learn in their preferred learning style. However, the teacher may assign students certain methods to improve their skills. For example, if a student prefers reading, teachers may have them watch a video and take notes to improve their listening skills. * ELL students and students with learning disabilities should have multiple forms of instruction including visual and written instruction sheets as well as a verbal instruction and demonstration. Give students additional time as accommodation allows. |
| **ENGAGEMENT (5 minutes)**   * The teacher will begin class with a warm up discussion question. *“Have you ever taught your pet to do a trick? How did you do that? If you don’t have a pet, what would you do to teach one?”* * The teacher will spark curiosity by showing the video of the robots playing soccer. (<https://www.youtube.com/watch?v=xkoXeF9oVH4&t=368s> , (5:15-6:04) * After watching a minute of the video, the teacher will give the class 2 minutes to discuss with their shoulder partner/ student next to them how they think the robots were able to learn how to play soccer. * After time is up, the teacher will ask students to share some of their answers.   + The teacher will take a mental note of the class’s responses to see what the students already know. * Segway: “Today, we will learn just how those robots were able to learn to perform human activities all on their own.” |
| **EXPLORATION (35 minutes)**  In this section, students will collaborate as a class to identify an optimal *policy* through **an interactive learning game**   * The teacher will ask the students to form groups of 4-5 and to choose one student to be a “moderator.” * The teacher will explain how this student will be the one leading the players in their group. The teacher should go through the [moderator's instructions](https://utexas.box.com/s/z8h3z7n5j4jmivvm2sxk5yf2utt0ufcs) with the chosen moderators. Other students will collect the appropriate player [supplies](https://utexas.box.com/s/25ew8t5p3pntkqzajkva5ip0olqg88i5).   + After explaining the rules, the teacher will ask the moderators to repeat the instructions back to the teacher to ensure understanding. Afterwards, the moderators can head back to their groups.   + Each group will read the [player’s instructions](https://utexas.box.com/s/d66iggyejo012rgb93b3x6vddfzuewod) together. Once each group is done reading the instructions, the teacher will ask students to repeat back the guidelines to ensure understanding.   + Once each group understands the way the game will work, the teacher will start the 10 minute timer. * The students will fill out the [worksheet](https://utexas.box.com/s/9hob1kd211pllsfzf9aab34wpw1nox2a) provided to create a graphic organizer in which they are identifying the optimal *policy*   + Probing questions: *Why would you not go to box X? Which path gives you the most amount of points? Why? How do you know?* * **Challenge**:   + Once time is up, the teacher will have the class do a challenge with the game. The teacher will ask the students to find the optimal policy using only 5 moves, 4 moves, then 3 moves. The teacher will start a timer for 5 minutes. Students who get the highest amount of points in each specific number of moves will “win”. * Once the class is done with this challenge, the teacher will explain the meaning behind the game.   + The teacher can say “You just found the optimal policy, and that is exactly how AI works. Remember those puppies you trained? How they were able to recognize a pattern to obtain their reward (a treat). Similarly, AI works to find patterns to achieve their award.” |
| **EXPLANATION (15 minutes)**  In this section, students will learn the basics of reinforcement learning, data, input, and output   * Following the teacher’s explanation of the game, the teacher may play a clip from [Dr. Peter Stone’s talk](https://www.youtube.com/watch?v=gnVXXoXUcuc) to provide an alternate perspective and lead into reinforcement learning. * The teacher will play [Dr. Peter Stone’s explanation](https://www.youtube.com/watch?v=gnVXXoXUcuc) (37:08-40:18)from the talk. (If you want to play the entire game in the video, the timestamp is (25:50-34:40)).   + The teacher will pause the video a few seconds after Dr. Stone says the word “data” and ask the class if anyone can define data.   + The teacher will take note of the students’ response, if any, and then introduce the definition of reinforcement learning and basic computer components.   + Introduce and propel a conversation over data, input, and output.     - “In our everyday lives, we are thrown with new information and experiences “data”. We use what we have “input” to react to these experiences “output” * To check for understanding, the teacher will ask the class how they believe the game and *reinforcement learning* are connected. Students will discuss their thoughts in groups then share their answers out loud. * To check for understanding, the teacher will have the students answer evaluation questions after each slide on the “Explanation” section of the Powerpoint presentation. (Also available on a [paper worksheet)](https://utexas.box.com/s/n7du47x8wnux75tcmmogweb9nwhh3d2s)   + Students can answer the then on their own, then in pairs. The teacher may have students either write down their answer and show them after 1 minute, or the teacher can have students use “Total Physical Response” by showing a 1,2, or 3 with their fingers to present their answer.     - The teacher will take a mental note of students who are understanding the new terms and those who are not. The teacher will explain the answer and ask if anyone has any questions after the students answer each evaluation question. |
| **ELABORATION (30 minutes)**  In this section, students will learn how artificial intelligence is used in a variety of real-world industries. Students will be able to connect artificial intelligence to human intelligence to explore the emerging topic.   * The teacher will play a (5:23-6:39) from the beginning of the [talk](https://www.youtube.com/watch?v=gnVXXoXUcuc)) where Dr. Stone discusses the “nature of intelligence” * The teacher will have the students use a blank sheet of paper to create a Venn diagram to compare and contrast human intelligence to artificial intelligence for 5-10 minutes.   + Once the class is done creating the venn diagram, the teacher will ask the class to discuss their answers with a partner/ student next to them. * Following the diagram, the teacher will explain how fast artificial intelligence is growing with the infographic. * The teacher will then split students into groups of 3-5 and have them create “[one pagers](https://www.cultofpedagogy.com/one-pagers/)” on a specific “nature of intelligence”. The teacher will give students about 5 minutes to write down as much information they can find.   + Students will learn about the different connections of these fields to artificial intelligence, how AI is incorporated in each field, etc. Students can find information on their laptops/ computer lab computers. Students will do research on a variety of topics such as those included in the video:     - Neuroscience     - Psychology     - Philosophy * Upon completion of these “one pagers” students will share pieces of the information they found to the class. The teacher will finally wrap up the lesson by explaining how artificial intelligence is rapidly growing and high in demand. Students will leave class with the understanding that a basic knowledge of AI will be highly important and useful for their futures. |
| **EVALUATION (throughout entire lesson)**   * The teacher will check for understanding by inputting evaluation questions throughout the lesson. Students can receive a final grade for this lesson by answering these questions correctly, and/ or for participating. * The teacher will observe the students’ responses to the evaluation questions. The teacher will ask probing questions throughout the lesson. The teacher will encourage students to explain concepts in their own words   + “Why did you decide to go that way” (when the students are playing the game)   + “How did you figure that out” * Teacher may collect the Venn Diagrams, game worksheet, or one pager as a grade or have students keep them as notes * At the end of the lesson, the teacher may wrap up the class with a discussion on what the students learned that day. Teacher may also ask how student’s perspective on artificial intelligence has changed. This can be an “exit ticket” if the teacher has that system in place. |
| **SOURCES AND RESOURCES**   * **Dr. Stone’s *Hot Science – Cool Talks #130*** [**https://www.youtube.com/watch?v=gnVXXoXUcuc**](https://www.youtube.com/watch?v=gnVXXoXUcuc) |

Additional resources

* <https://www.seattleschools.org/wp-content/uploads/2022/03/AVID_Instructional_Strats.pdf>

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