FIRST® at Home Activity

Algorithms

PROBLEM STATEMENT

Game designers for video games, board games and sports games create various rules for how to play the game. In each of these types of games rules look different and are also incorporated in how the game is designed. Video game rules are written using computer programming and allow for many outcomes based on different inputs from a player. Outcomes based on inputs are called algorithms. In your challenge, how can you design a game that contains two different types of algorithms by creating an at-home game?

CRITERIA & CONSTRAINTS

- Design a game for a teammate or someone else at home to complete that contains two different types of algorithms.
- Design an algorithm that contains specific directions that are repeatable by another person.
- At least one algorithm should have a sequence of directions that does not require feedback.
- At least one algorithm should have decisions based upon feedback or input.
- The game should involve solving at least one problem or puzzle.
- There should be different outputs based upon an input.

ENGINEERING DESIGN PROCESS & *FIRST*® CORE VALUES

FIRST Engineering Design Process | Explore *FIRST* Core Values

BUILDING THE BACKGROUND & BRAINSTORMING

What is an algorithm?
A sequence of directions that are executable and create a specific outcome every time.

How can algorithms have different outcomes and make decisions?
Input, Processing, Output

You experience things every day that use algorithms to make things work around your home, and in life. Algorithms can be used to achieve different outputs or outcomes based on input, processing, and output. Inputs are sensors or data that can alter the path of the directions and create a different outcome. For instance, if your mom tells you to go to your friend's house, your room needs to be cleaned. The input is a clean room, if it is clean, then you get to go to your friends; if it is not clean, then you stay home.

Different outcomes or decisions are based upon a condition. Processing is the decision or condition that needs to be met to achieve the desired outcome. For example, complete steps 1-3 and then end, or if the temperature is 50, complete step 2. Robots and many electronics around your home use processing with specific conditions to achieve outcomes that make your home comfortable.

How are algorithms used in our everyday life?
Consider what occurs for you to bake something in your home. Most people will follow a recipe. Looking at the definition above, is a recipe an algorithm? If you follow the recipe for mixing your ingredients, you then put it into the oven to cook for a specific amount of time.

How does your oven know what to do?
How does it know the temperature to cook at?
How does it maintain that temperature?

How do algorithms create different outcomes?

When you set the dials or digital temperature you want the oven to cook at, that is an input. It has a thermostat that measures the temperature. The circuit (analog or digital) in the oven turns on the burner until the thermostat reaches a specific temperature, then it turns off; it kicks on again when the temperature drops below a certain point, and the process repeats until the time limit is reached. If the input you give the oven (temperature and time) is different, then you get a different outcome: your recipe is overdone (burned) or underdone (still raw)!!!

Algorithms and programs can be expressed in words (pseudocode or “false code”) versus a machine code or electronic circuit. It is called pseudocode because it cannot run on the machine, but these algorithms or programs can be written out on paper.

Example of pseudocode would be a recipe: if you can read, you can follow the recipe. Computers also must be able to read the code; they do this through different computer languages. The languages convert algorithms to binary code, the language the computers use to process information. Since learning a language and translating languages can be difficult, pseudocode allows you to think through an algorithm in the language that you know.

Develop a pseudocode

Develop a pseudocode or directions for making your favorite recipe. Include the algorithm that the oven needs to operate.

DESIGN YOUR OWN GAME WITH ALGORITHMS

Now it is time to use your knowledge to have some fun. Developing algorithmic thinking skills using games and strategy can be a fun way to improve directions and decision-making skills. Problem-solving using math or other logic problems can also be a fun way to increase algorithmic thinking skills.
Ex. A maze, word problem, puzzle or game.

You can be as creative with your game as you want. Look around your home or another environment for objects to have fun with them using them as inputs to make decisions. For example, getting a ball in a box or shooting a ball in a hoop.

Then design a game that incorporates the criteria and constraints from above.

SKETCH YOUR DESIGN

Using the criteria and constraints for the problem develop a pseudocode for your game. Sketch the flow of your game and decisions that could be made.

TEST YOUR IDEAS

As you improve and test your idea, be sure to record what works and what didn't. Test your algorithms with someone else at home or virtually with a teammate. Reflect as you watch them go through the process how might you improve the directions?

SHARE AND COLLABORATE ON YOUR IDEAS

Using online collaboration or a parent, share your ideas with them.

Discuss with them how you might improve your design to increase your algorithms and directions.

REFLECTION QUESTIONS

1. How did you use detailed directions for people to complete your game?
2. How do inputs and feedback allow decision making and different outcomes in algorithms?
3. When you combined algorithms with feedback, how did it increase innovation in the outcome of your program?
4. What other devices or processes around your home use algorithms?

GO FURTHER!

Make your home smart!

Research the idea of the Internet of Things and explore how smart technologies increase the complexity of an algorithm. Design a smart room in your house, write out the algorithms and explain how devices will communicate with each other. What inputs are from humans, what are from other machines?

CORE VALUES SELF-REFLECTION

	Amazing Skill	Great Job	Making Progress	Could Be Better
Discover	I approached the tasks looking for all possible answers independently and used perseverance to discover the answer on my own.	I approached the tasks and asked questions from one other person but persevered to discover the answer on my own.	I approached tasks but needed assistance multiple times to reach a point of discovery.	I depended on others to make the discovery for me.
Innovation	I used creativity and perseverance to solve problems on my own, coming up with unique solutions for the tasks I was given.	I used creativity and perseverance to solve problems on my own coming up with different solutions for the tasks I was given.	I used creativity but struggled with perseverance to solve problems on my own.	I struggled with being creative and only used the information given and needed a lot of encouragement from others to complete the task.
Impact	I approached the tasks applying understanding of the information with the impact it can have on me and my future as well as how I could help others.	I approached the tasks knowing and applying the information with impact it can have on me and my future.	I understand the tasks but struggle to apply how it will help me in my future or to influence others.	I understand the tasks but did not approach it with understanding the impact it can have on my future or others.
Inclusion	I approached all tasks with inclusion of others' ideas, I showed tremendous kindness by including others' views in my projects and work. I approached my solution thinking how all people would interact with the solution.	I approached most with inclusion of others' ideas, I tried to understand others' views and include them in my projects and work. My solution mostly incorporates needs of others.	I approached some tasks with inclusion of others' ideas, I tried to understand others' views and include them in my projects and work. My solution meets only a few needs of others.	I did not approach tasks with inclusion of others' ideas, I tried to understand others' views and include them in my projects and work. My solution is not inclusive of different types of people.
Teamwork	I used collaboration, communication and project management to get all tasks accomplished for myself as well as the others.	I used collaboration, communication and project management to get most tasks accomplished for myself as well as the others.	I used collaboration, communication and project management to get some tasks accomplished for myself as well as the others.	I only sometimes used collaboration, communication and project management and accomplished a few tasks for myself as well as the others.
Fun	I kept a positive attitude throughout and found opportunities to have fun even through struggle. I looked for additional opportunities to have fun in my tasks.	I kept a positive attitude throughout and found opportunities to have fun even through struggle.	I saw the enjoyment and fun after the activity but struggled to see it during.	I only saw struggle in completing my tasks and did not look for times to have fun.