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Codes and Computers

Using technology

Commands

Programming

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Codes and Computers

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Codes and Computers

Table of Contents

What Is Computer Hardware?

Chapter 1

Jenni wants a pet cat more than anything, but she is allergic to cats. Jenni's mom has a plan to get a pet cat that will not make Jenni sneeze. They go to the store and get a new robot cat! Jenni names it Algo.

Now Jenni takes care of Algo a lot like a real cat. Algo has a controller with buttons that Jenni uses to communicate with him. She gives him instructions. Jenni feeds Algo computer food and pets him. She makes sure he gets enough playtime and sleep. Algo purrs to let Jenni know he is happy and healthy. Jenni has also taught Algo to give a kitty high five!

Jenni loves her robot cat Algo! She cares for him in some ways like a real cat. Algo has a computer inside of him. That lets Jenni do some things with him that she could do with a live cat.

She can program Algo to surprise her with a different mood each day! Sometimes he is cuddly. Sometimes he is playful. Sometimes he is lazy. Her favorite is when he is a sweet cat.

Mom tells Jenni how lucky she is to have Algo. “When I was a girl with allergies,” Mom says, ”there was no such thing as a robot pet! Computer **technology** has changed things so much!”

Jenni’s mom talks about the time when she was Jenni’s age. “We did not have email.”

“How did you send things to people?” asks Jenni.

“By putting paper mail in the mailbox,” Mom responds. “People who have the job of mail carrier carry paper mail and other packages from one place to another.”

All mail in the past

Most mail now

Vocabulary

technology, n. the use of scientific knowledge in devices or processes

One day, Jenni gives Algo directions to move through an obstacle course to get to his food bowl. Algo moves the wrong way and spins in circles. Jenni knows that sometimes she just needs to **reboot** Algo for him to work properly. She turns off his power button and then starts him back up. Then Algo is ready to play again!

Vocabulary

reboot, v. to shut down and restart

Algo is a toy that is a piece of computer **hardware**. It can be programmed to do certain things. The programming inside that makes the hardware work is called **software**.

Vocabulary

hardware, n. parts of a computer device that can be touched

software, n. instructions that computer hardware follows

Other computing devices are designed to accomplish different tasks. They also have hardware and software. Hardware includes the parts of a computing device that you can touch. Software provides the instructions that are followed by the hardware.

What is each type of hardware in the picture used for? What can software programs tell the hardware to do?

“Technology makes things so much faster and easier,” Mom says.

“And more fun, too!” Jenni adds.

“Yes,” Mom says, “but it’s important to balance our screentime with technology-free time too, right?”

Jenni adds, “I love that too, Mom. Can we go for a walk and look for real animals in the woods?”

“Let’s go !” says Mom, and both put on their shoes.

Computer technology has changed the ways that people do many things. Look at the collections of older devices and other things that you still use now. Think about how computer devices do the things that they do.

What Are Computer Networks?

Chapter 2

Jenni wants to show her robot cat Algo to her grandmother. But Grandma lives far away. Jenni's mom sets up a video call over the **internet** for Jenni and Grandma. Algo purrs, plays, and pounces when Jenni instructs him to. Grandma has fun watching!

Vocabulary

internet, n. many computers all over the world that are connected together and share information with each other

Grandma wants a picture of Jenni with Algo. Mom takes a picture with a digital camera and saves it on her computer. Then she shows Jenni how to open an email and attach the photo to send it to Grandma. Jenni asks, "How does the email get to Grandma?"

Mom explains that the internet is a **network** of many connection points that let computers all over the world pass information between them.

Vocabulary

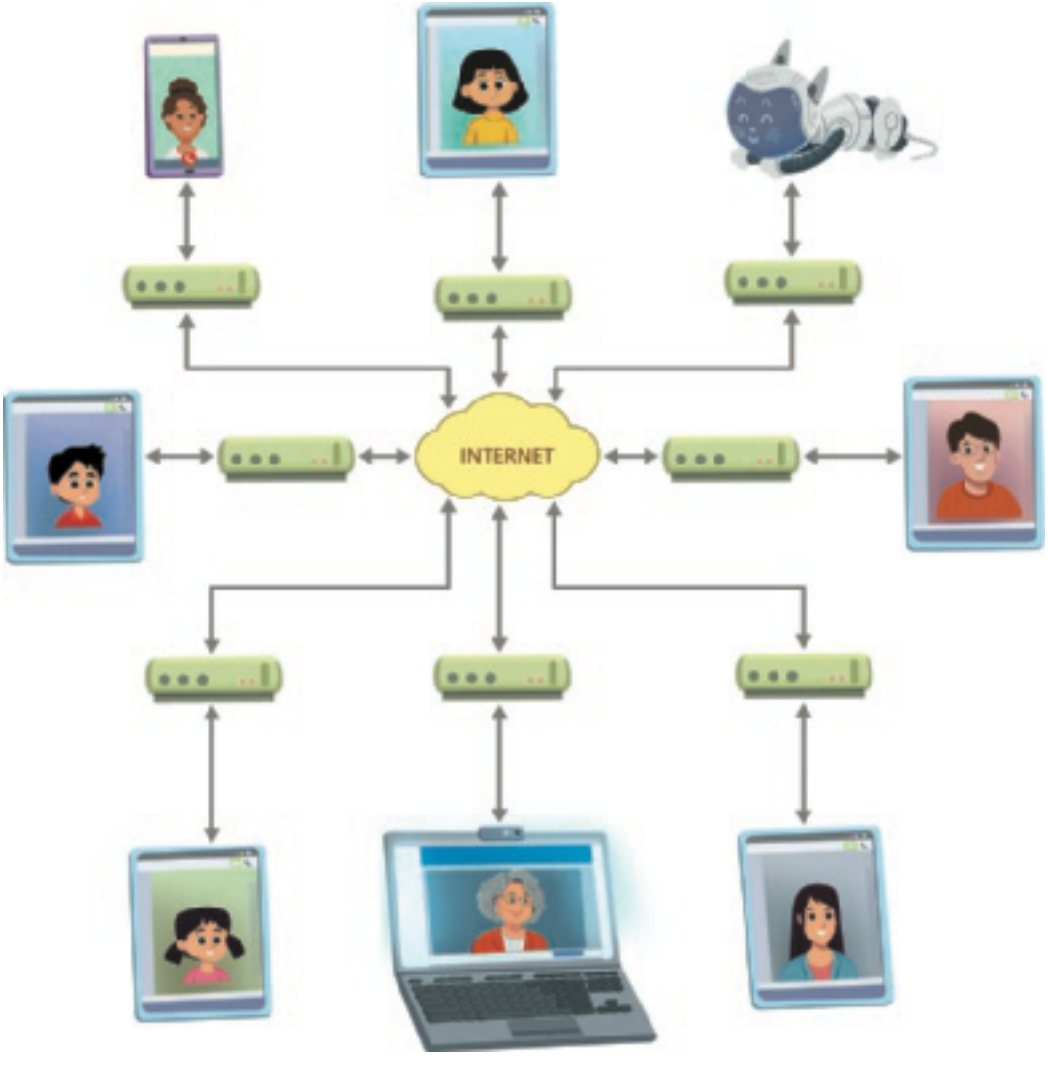
network, n. a system of computers that communicate with each other

Jenni likes chatting with Grandma and other friends over the internet. Mom reminds Jenni that it is important to be responsible and safe when she uses the internet to communicate with others. She says, "Always be kind and respectful. And never share your **password** or information that your friends don't already know."

Vocabulary

password, n. a secret sequence of characters needed to access a computer device or program

Computer devices must connect to the internet or other networks through a modem. The green devices in the diagram are modems. Most connections to modems are wireless. They happen through invisible radio signals. Use your finger to trace the path of Jenni's message to Grandma through the internet.



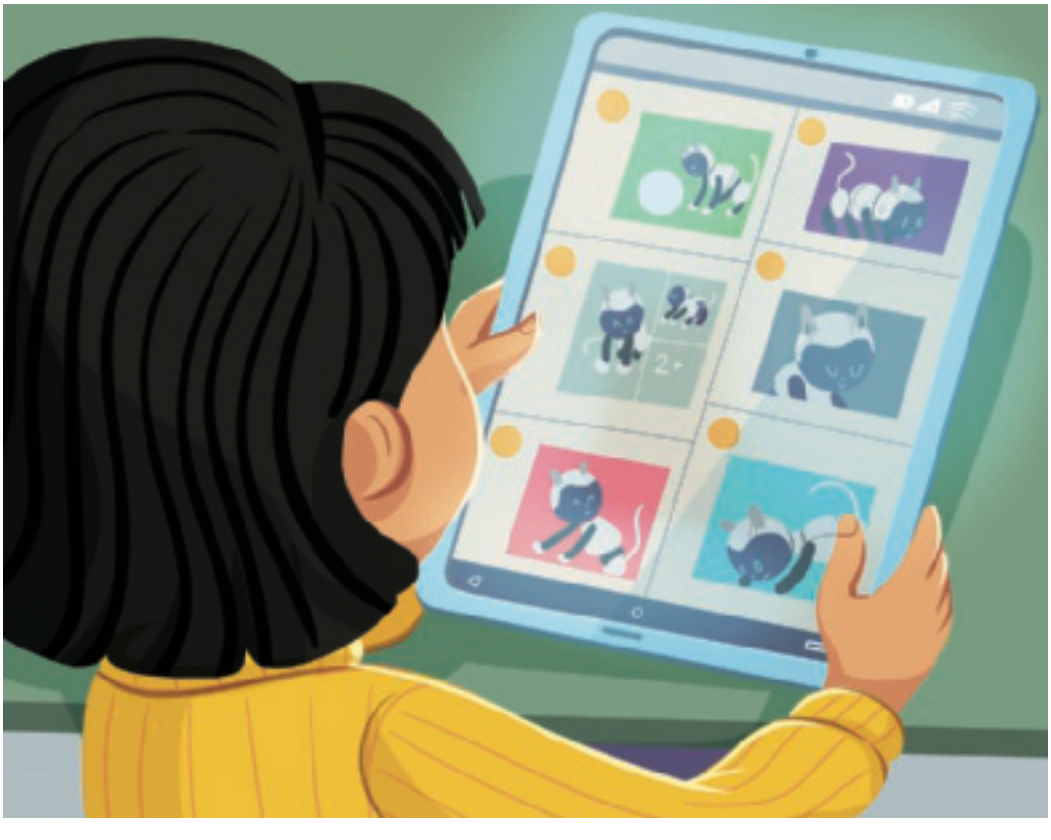
What Should I Share Online?

Chapter 3

Jenni wants to talk to other kids who also have robot cats. She asks her mom to join the **online** RoboCat community. Mom replies, "We can try it. But first you must learn about online manners and safety." Mom says that it's important to not post any unkind messages. "You also need to promise to show me if anyone is ever mean or rude to you online," her mother says. Jenni agrees, and Mom helps her use their tablet to send messages to other kids online.

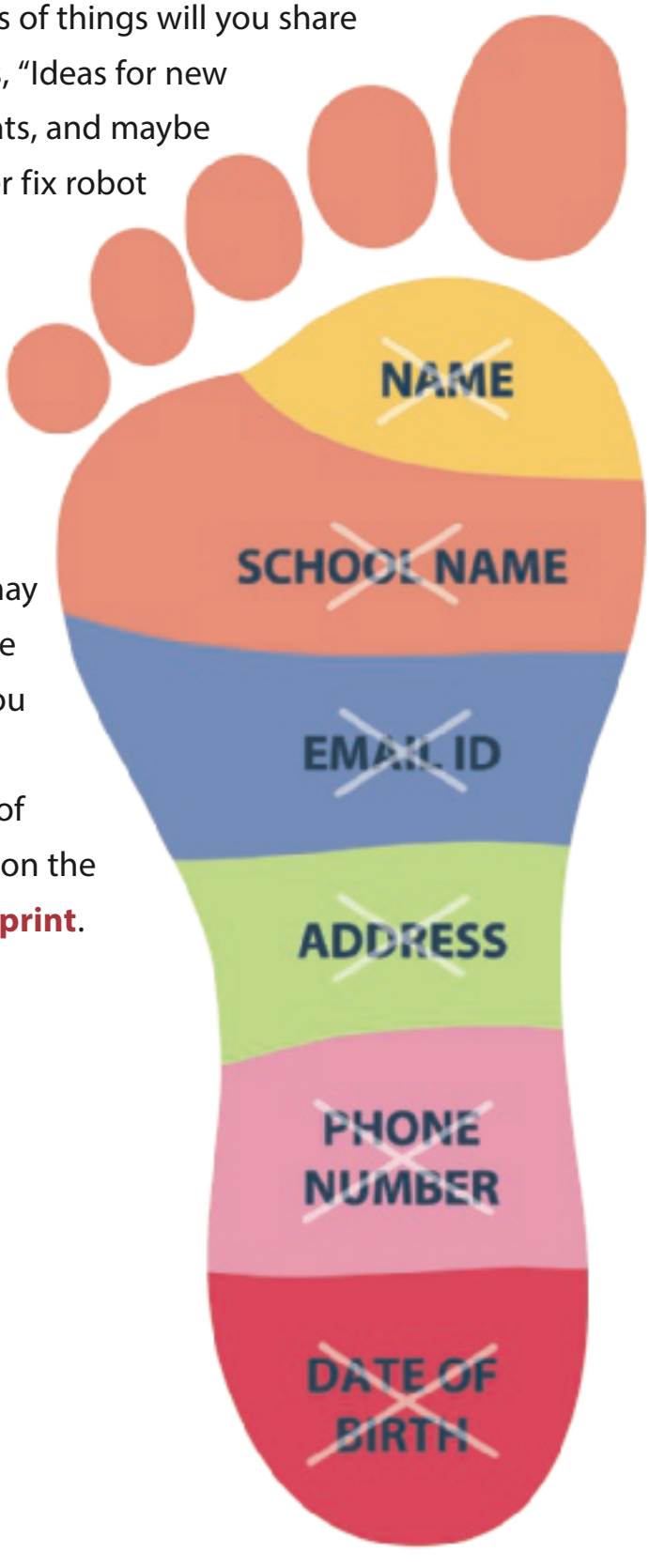
Vocabulary

online, adj. connected to the internet



Mom asks, "What kinds of things will you share online?" Jenni answers, "Ideas for new tricks, photos of our cats, and maybe we can help each other fix robot problems."

"It is really important to never share private information like your full name or where you live," Mom says. "Anything you share may always stay somewhere on the internet, and you can't control who sees it." Mom calls the trail of information that stays on the internet a **digital footprint**.



Vocabulary

digital footprint, n. data about an internet user that remains on other computers connected to the internet even when the user is not online

Jenni makes up a name to go by in her online robot cat group so that she does not share her real name. She chooses the name J_robocat_123. This is her **username**. Mom says, "Now let's make up a strong password."

Jenni laughs. "How can a word be strong?"

Mom explains that a strong password is one that is hard for anyone else to figure out. "It's important to keep your passwords private," Mom says.

Jenni and Mom create a strong password that only the two of them know so nobody else can access her account. She also learns to log off each time she finishes visiting the robot cat online group so no one else can use her account.

Vocabulary

username, n. a unique sequence of characters that identifies a user of a computer program

Which passwords for Jenni follows all the rules?

Algo1234	Jennigarcia1
catbot#54	AlgoCat#12
jenni&algo	JGac@198
8005889345	*&@@GH23=1

What Is Digital Data?

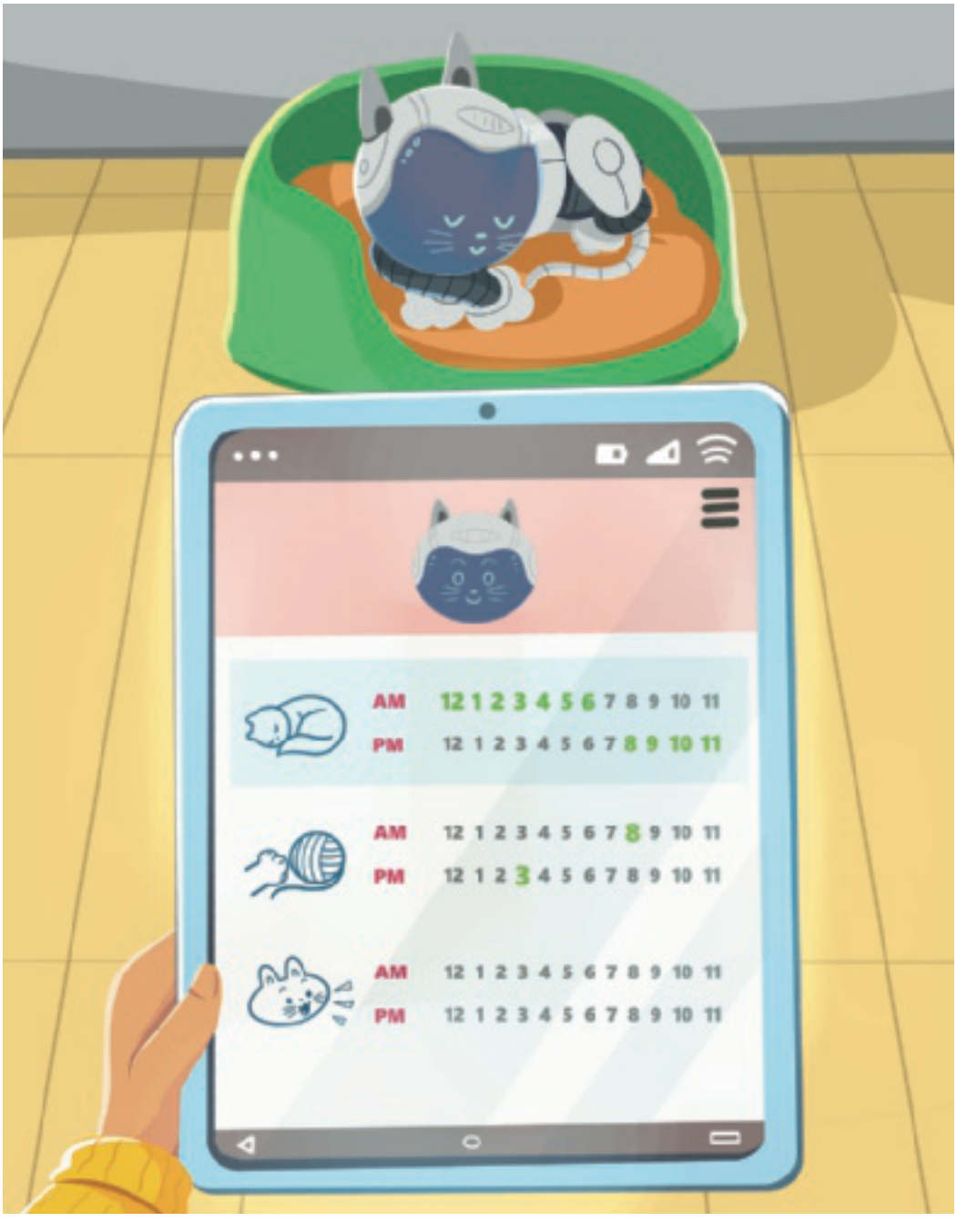
Chapter 4

Jenny feeds Algo two times a day. The robot cat does not eat real food. But Jenni programs Algo to visit his food bowl. She opens the feeding settings on Algo's controller. She turns the setting to ON for 7:00 in the morning and 5:00 in the evening. She leaves all the other hours set to OFF.

How can you tell when the setting is set to ON?

Look at more of Algo's settings:

- What hours is Algo set to sleep?
- What hours is Algo set to play?
- When is Algo set to meow?



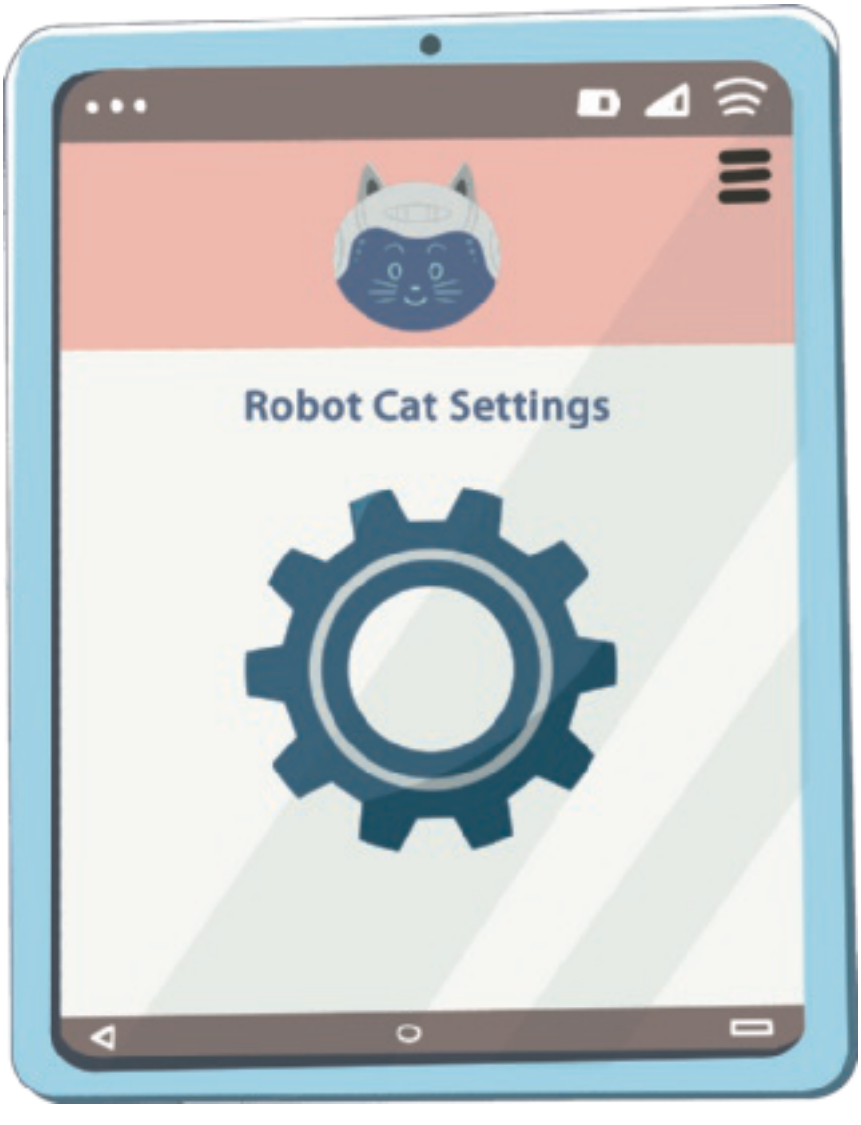
Algo's behaviors can only be set to ON or OFF. This is an example of **binary data**. Binary means information that can be only one of two possible values. It must be one or the other.

Binary data makes up the instructions in a computing device. A **code** of binary data tells the device what tasks to do and what information to store.

Vocabulary

binary data, n. information made from only two symbols or

code, n. a set of symbols for communicating a message



Binary code is built from bits. Just like Algo's feeding schedule, each bit can only be set to ON or OFF. The code uses 1 to mean ON and 0 to mean OFF. When a lot of bits are combined, they can make up letters, numbers, and other symbols. Here are some examples:

a: 01100001	0: 0
A: 01000001	1: 1
b: 01100010	2: 10
B: 01000010	3: 11
c: 01100011	4: 100
C: 01000011	5: 101

Vocabulary

binary code, n. computer data made up of bits

bit, n. a single character of computer data; either a 1 or a 0

Very long strings of binary code make up directions that computers process and store.

How Can Data Be Organized?

Chapter 5

Algo doesn't eat real food, but he does need energy. He runs on batteries. Like many electronic devices, Algo must sometimes be plugged into an electric source so his batteries can recharge.

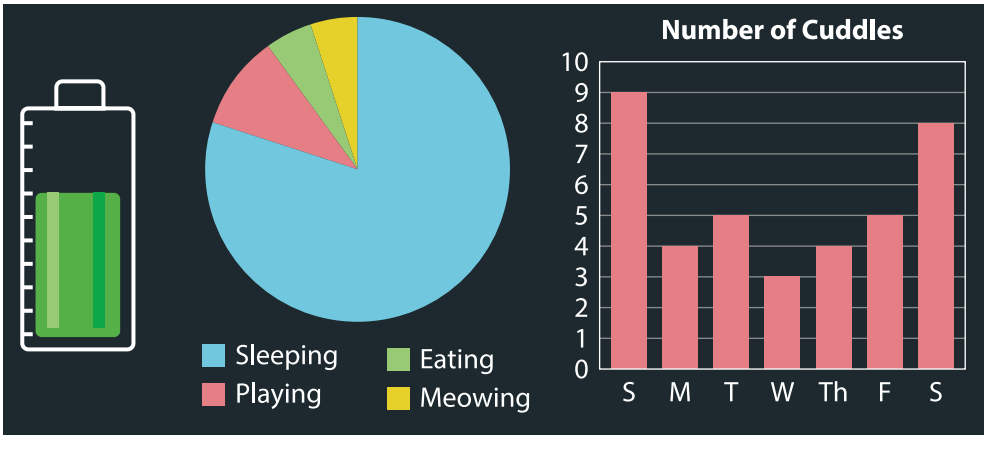
When Jenni plugs Algo into the computer to recharge, he also exchanges information with the computer. A program on the computer keeps track of how Algo has been working. The program can send Algo new instructions, too. The new instructions are called an **update**.

The computer program that came with the robot cat shows Algo's **digital data**. But it does not display the data in bits as 0s and 1s. The program shows Algo's data in ways that make it easier to understand. Algo's data is displayed in colorful charts and graphs.

Vocabulary

update, n. new instructions to change or improve performance of a computing device

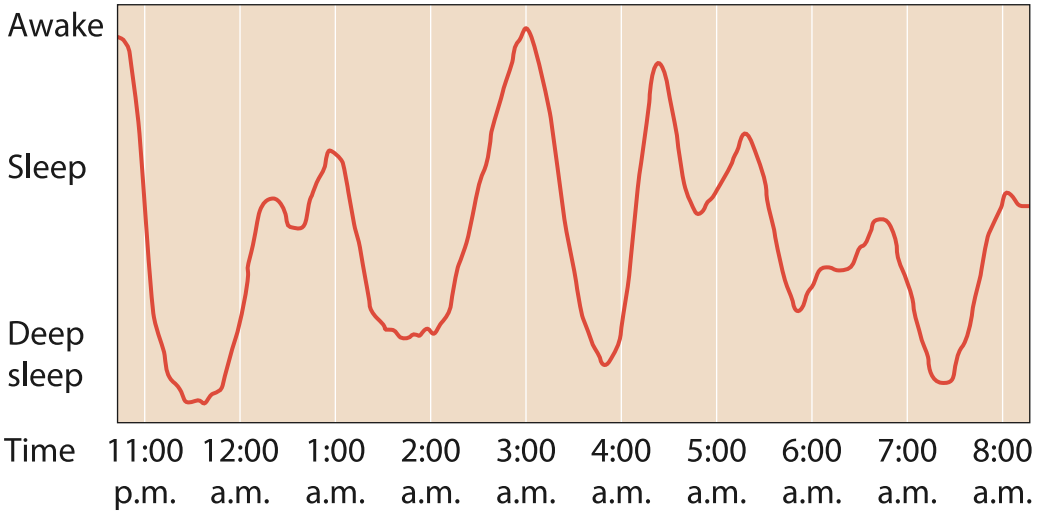
digital data, n. information in digital format stored or processed in an electronic device



What can you tell about Algo from looking at his data displays?

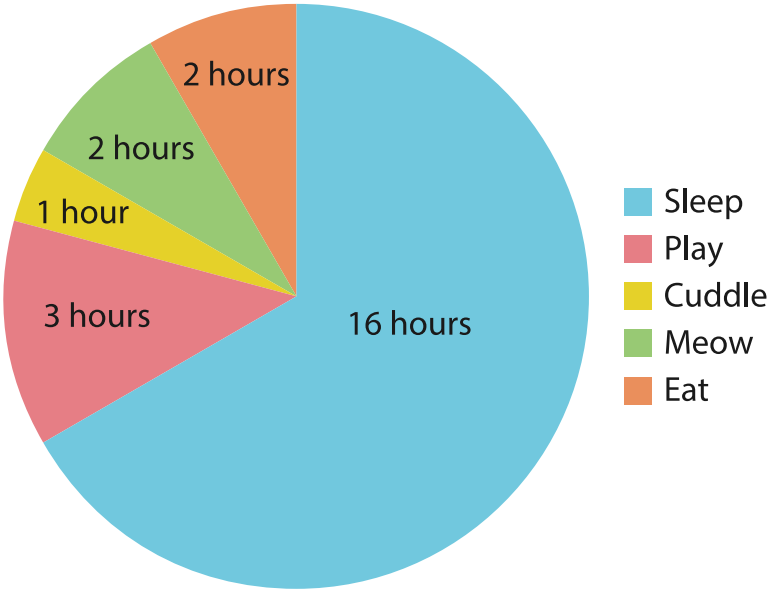
Algo's program shows how much he sleeps. Jenni's mom has a fitness tracker that shows how much she sleeps, too. Mom wears the fitness tracker around her wrist. It shows how much exercise she gets. It is also a watch for telling time.

Like Algo, the fitness tracker sends its data to a computer program. And like Algo's program, the fitness program displays its data in graphs. A graph shows when Mom is sleeping through the night and when she wakes up.

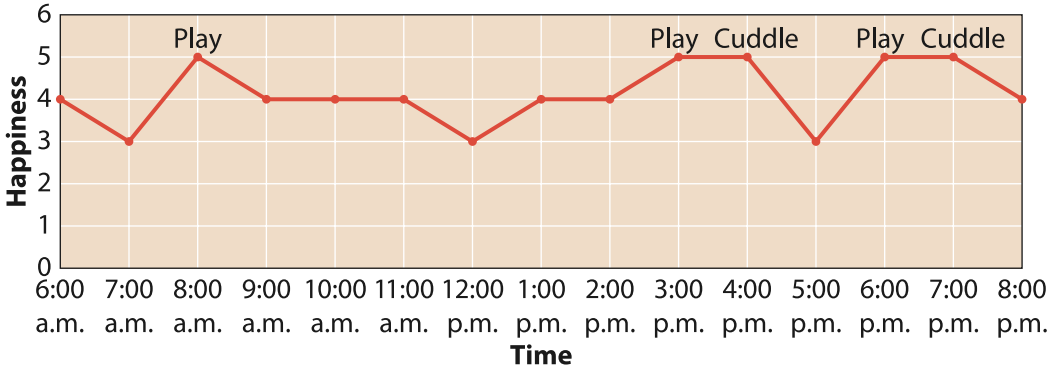


When was Jenni's mom in the deepest sleep? When was she awake?

Jenni looks at the data to make sure Algo has the right amounts of sleep, food, playtime, and cuddling.



When Algo is happy, he purrs. His program also shows Algo's happiness on a chart.



From the graph of Algo's data, what makes him happiest?

Symbols to Communicate

Chapter 6

Live pets communicate their needs and feelings by barking, meowing, purring, or hissing. They can respond to human voices by following their instructions. They can also ignore commands and do what they want!

Algo cannot understand instructions like a live pet. He must be programmed to follow instructions using **computer code**.

Vocabulary

computer code, n. strings of symbols that make up instructions for computers to follow

Jenni and Algo use symbols to represent information and communicate with each other. Jenni can ask Algo simple questions by pressing certain buttons. Instead of communicating his needs with sounds, Algo can tell Jenni things using **symbols**. She knows he wants to play when he shows a ball of yarn on the screen. She knows he is hungry when he shows her a food bowl symbol.

Vocabulary

symbol, n. a mark that represents something else

When Jenni wants to give Algo a task to do, she uses symbols to give him instructions. To program him to move, she presses arrows to represent directions. If she presses arrows together in a **sequence**, she can make him seem to dance!

Vocabulary

sequence, n. the order of steps or instructions

What needs does Algo communicate with these symbols?

There's a saying that goes, "A picture is worth a thousand words." It points out that it is often easier to understand an idea from a simple picture than it is from words. It can take many words to describe something that a person can understand almost instantly from glancing at an image.

This is the idea behind icons and symbols for computer applications. You have probably used icons or symbols to communicate with electronic devices without even thinking about it. For example, a remote control allows you to operate a television that has built-in computer technology. You make choices from a menu of options. The icons make searching faster and easier than if you had to read words describing all the choices.

Computer Devices Follow Steps

Chapter 7

When she gets ready for school, Jenni gets dressed, brushes her teeth, has breakfast, then packs her school bag. It is a step-by-step process that leads to a result. You could say that Jenni is following an **algorithm**. An algorithm seems like something complicated. But an algorithm is a just set of steps to follow.

Sometimes the steps need to be done in a precise order. For example, Jenni always puts her socks on before she puts her shoes on.

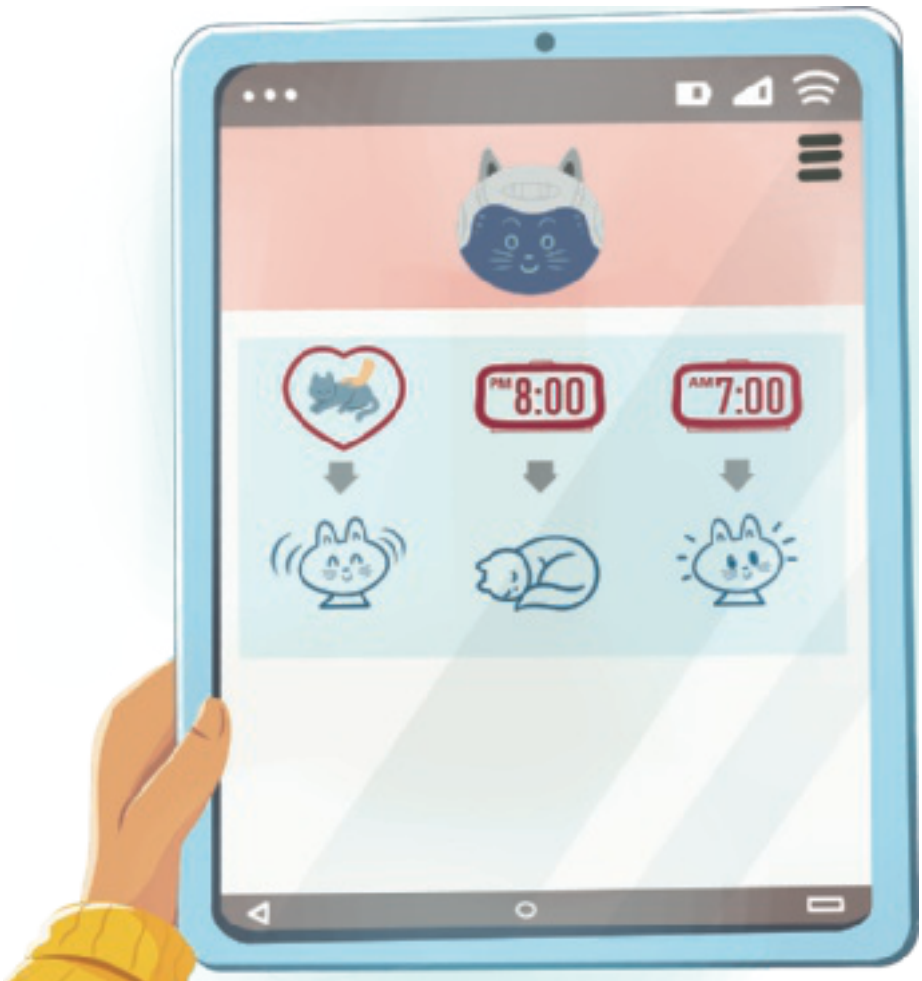
Vocabulary

algorithm, n. set of steps to follow

Computer algorithms are sets of steps or rules that tell computer devices what to do and when. Jenni uses commands to tell Algo to perform tasks. The commands execute algorithms in the computer's coded program if certain conditions are met. For example, if she wants him to purr when his head is petted, she adjust his programming to do that. If she wants him to go to sleep at 8:00 p.m. and wake up at 7:00 a.m., she can make those rules in his settings.

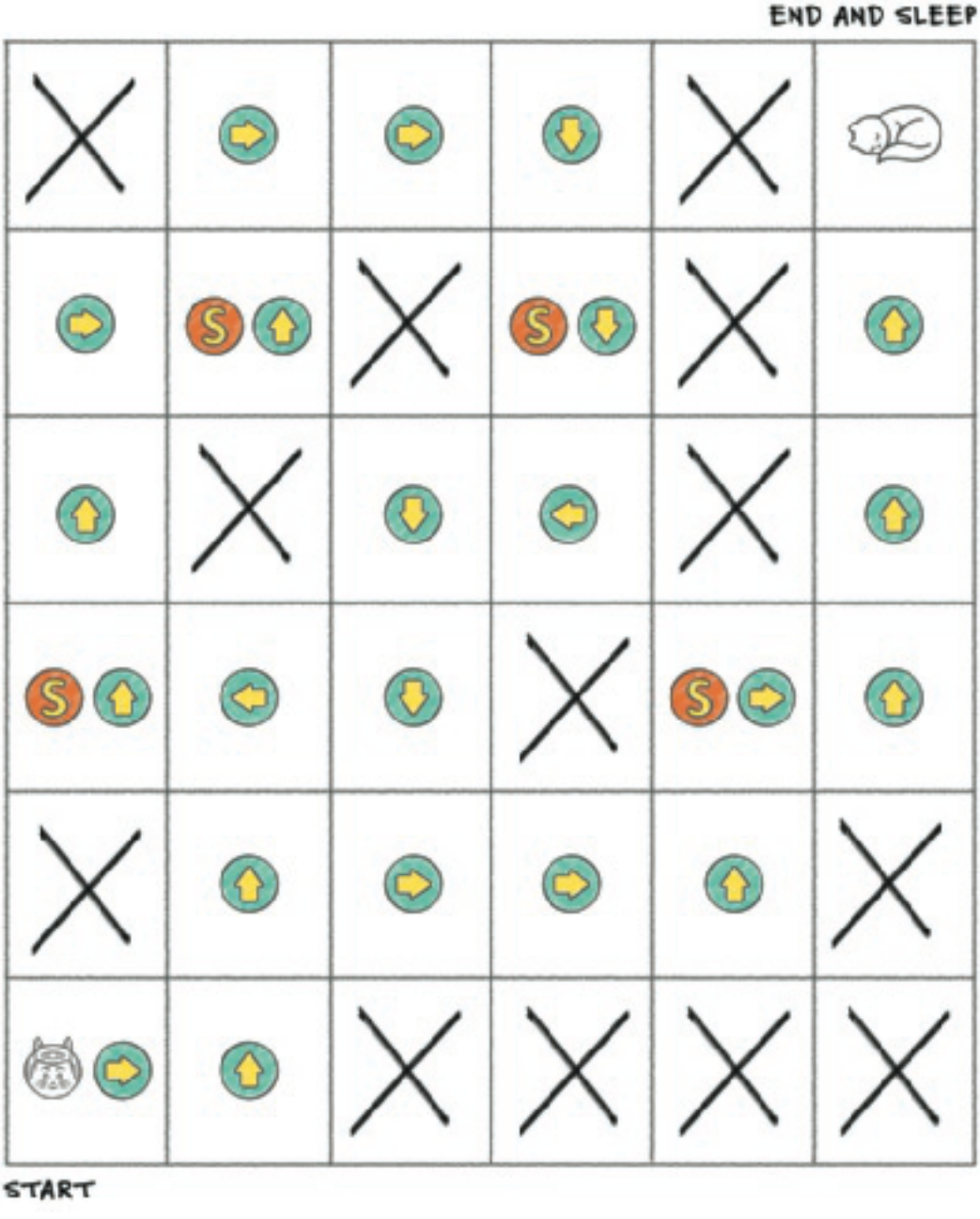
Think about the conditions like this:

- IF petting, THEN purr.
- IF 8:00 p.m., THEN sleep.
- IF 7:00 a.m., THEN wake.



Jenni likes to set up mazes for Algo to follow. She uses the direction symbols to tell Algo to walk forward or make turns. She leaves digital treats along the way for him to find. She programs him to stop and eat if he detects a treat. When he reaches his target at the end of the maze, she programs him to lie down and sleep.

Jenni could use a diagram like this to plan her maze. An X represents something that Algo must move around. An S represents a snack she wants him to find on the way to his bed. Each arrow is a command that Jenni gives Algo to move him through the maze. Algo cannot move backward.



Steps Can Repeat

Chapter 8

Jenni and her mom like to bake cookies. They follow a recipe. The steps to make cookies have numbers. The steps must happen in a certain order. Numbered steps remind Jenni of the way she programs her robot cat to follow a maze.

Jenni and Mom are almost done baking. Jenni has scooped many balls of cookie dough onto the pan. She says to Mom, “I wish I didn’t have to do this so many times. We are making six dozen cookies! This is a lot of repeating steps.”

Repeating steps also reminds Jenni of programming Algo. She enters the same command into his controller over and over for things she wants him to repeat.

But Mom helps Jenni program Algo to do some things over again without entering the same code many times. In Algo's user booklet, Mom and Jenni read about **loops**.

Jenni programs a sequence for Algo to do these things:

- crouch down
- lower his head
- make a licking sound
- then stand up

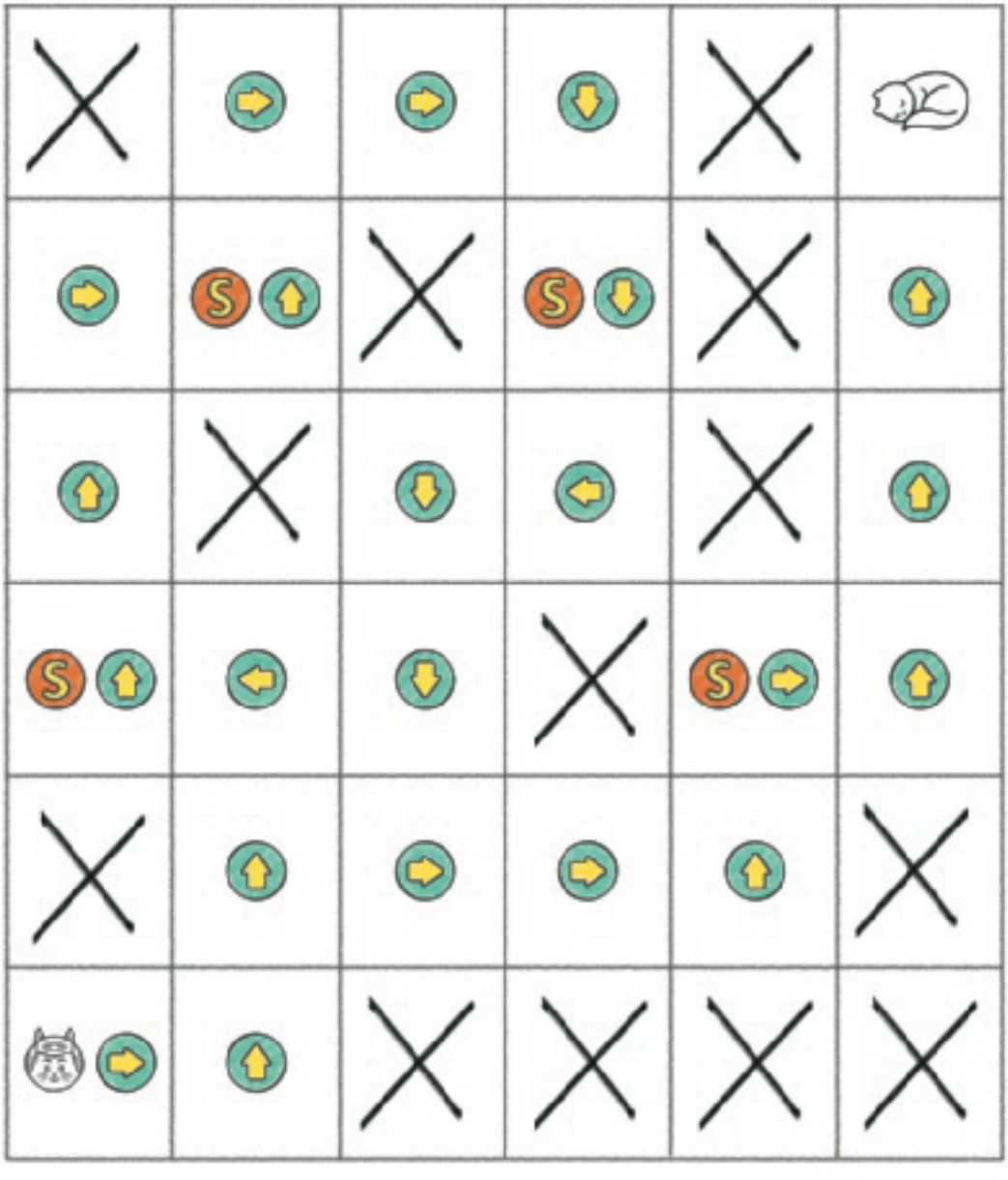
She makes that sequence into a loop for Algo. He repeats the loop every time he finds a treat or visits his food bowl.

Vocabulary

loop, n. repeated instructions

Look at the maze Jenni programmed for Algo. Remember that S shows a place where Algo will find a snack. How many times will he perform the loop of these commands?

- crouch down
- lower his head
- make a licking sound
- then stand up



Series of Commands

Chapter 9

Jenni has fun making new loops of commands for Algo to follow. Jenni also thinks it is fun when she can solve problems with a friend! Jenni and her friend Nataly try programming different steps to see what will happen.

Nataly thinks it would be fun to make Algo do cat yoga. The two friends work together. They plan Algo's poses. They plan the order of his movements.

Then Jenni shows Nataly how to program the steps into Algo's controller. They look for ways to use loops whenever they want Algo to move in a way they have already had him move before.

The friends try out Algo's routine many times. They adjust the code of steps until they get it just the way they want it. Then they ask Jenni's mom to follow along and do Algo's yoga poses with him.

Jenni's mom follows the cat's routine four times. She has fun and gets a great stretch!

"I'm proud of you for figuring out how to make Algo do so many things," Jenni's mom says. Jenni thinks it is funny because her mom's face is upside down!

Jenni makes sure to give **credit** to Nataly. After all, it was Nataly's great idea to make Algo do yoga. She helped plan Algo's poses. Nataly and Jenni worked as a team to code the yoga moves.

Vocabulary

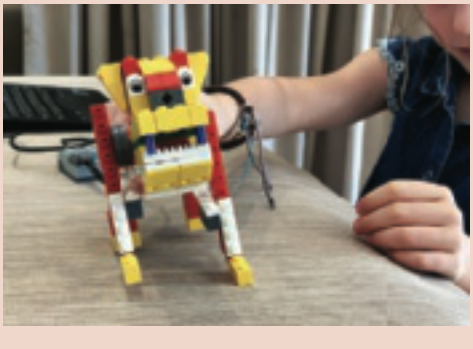
credit, n. acknowledgment or recognition

The story about Jenni and her robot cat is fiction. The idea of a robot cat provides many examples to help you to learn about computer science. But are there robot pets in the real world?

Yes! There are electronic toy dogs. They can be programmed to do things like walk, sit, wag their tails, and fetch toys.

There are also robot watchdogs. A robot dog with cameras, microphones, and motion detectors can patrol a property to alert its owner to intruders.

Robots are operated by computer programming. With the right parts, you could build your own robot dog and teach it to walk and sit!



Glossary

A

algorithm, n. a set of steps to follow

attribute, n. to give credit, explain the cause of something

B

binary code, n. computer data made up of bits

binary data, n. information made from only two symbols or values

bit, n. a single piece of computer data; either a 1 or a 0

break down, v. separate into smaller parts or steps

C

characteristic, n. a quality or feature of something that can be used to describe it

code, n. a set of symbols for communicating a message

commands, n. instructions

communicate, v. to share thoughts, ideas, or information

component, n. a part or piece of something

computer, n. an electronic device that is used to store, organize, and work with data at a very high speed

computer code, n. strings of symbols that make up instructions for computers to follow

computing device, n. any type of machine that stores, organizes, and works with digital data at a high speed, such as computers, tablets, and calculators

composition, n. the combination of smaller tasks into more complex tasks

connection, n. a link enabling data transfer between computing devices

credit, n. acknowledgment or recognition

D

digital data, n. information in digital format stored or processed in an electronic device

debug, v. to fix problems or errors

design, v. to plan how to arrange or construct a solution

digital, adj. describing information within electronic devices that is composed of binary data

digital citizenship, n. the practice of behaving kindly, respectfully, and safely during internet activity

digital footprint, n. data about an internet user that remains on other computers connected to the internet even when the user is not online

F

function, n. job; what an object is meant to do

G

graph, n. a diagram that organizes and displays data in a way that reveals patterns and makes the data easier to understand

H

hardware, n. parts of a computer device that can be touched

I

icon, n. a small image or symbol that represents an app or program

interaction, n. an event in which two or more things affect each other

internet, n. many computers all over the world that are connected together and share information with each other

L

language, n. spoken or written words that are used to communicate with others

log off, v. to exit a website and close a user's access to a program

loop, n. repeated instructions

N

network, n. a system of computers that communicate with each other

O

online, adj. connected to the internet

P

password, n. a secret sequence of characters needed to access a computer device or program

pattern, n. characteristics that reoccur in a similar way

permanent, adj. lasting or meant to last for a very long time

prediction, n. a statement that something might happen in the future

program, n. steps or list of instructions that tells computer how to do a task

R

reboot, v. to shut down and restart

repeat, v. to do or say the same thing over again

routine, n. a regular series of steps in an activity

S

safety, n. the state of being protected from harm

security, n. conditions that provide protection

sequence, n. the order of steps or instructions

software, n. instructions that computer hardware follows

step-by-step, adj. describing the breakdown of the parts of a larger process

storage, n. the capacity for saving something for use later

symbol, n. a mark that mean something

T

task, n. an action that needs to be completed

technology, n. the use of scientific knowledge in devices or processes

testing, n. the process of trying out a solution in a controlled way to see if it works as planned

U

unauthorized, adj. without permission

update, n. new instructions to change or improve performance of a computing device

username, n. a unique sequence of characters that identifies a user of a computer program

V

visualize, v. to form a picture of something in the mind

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