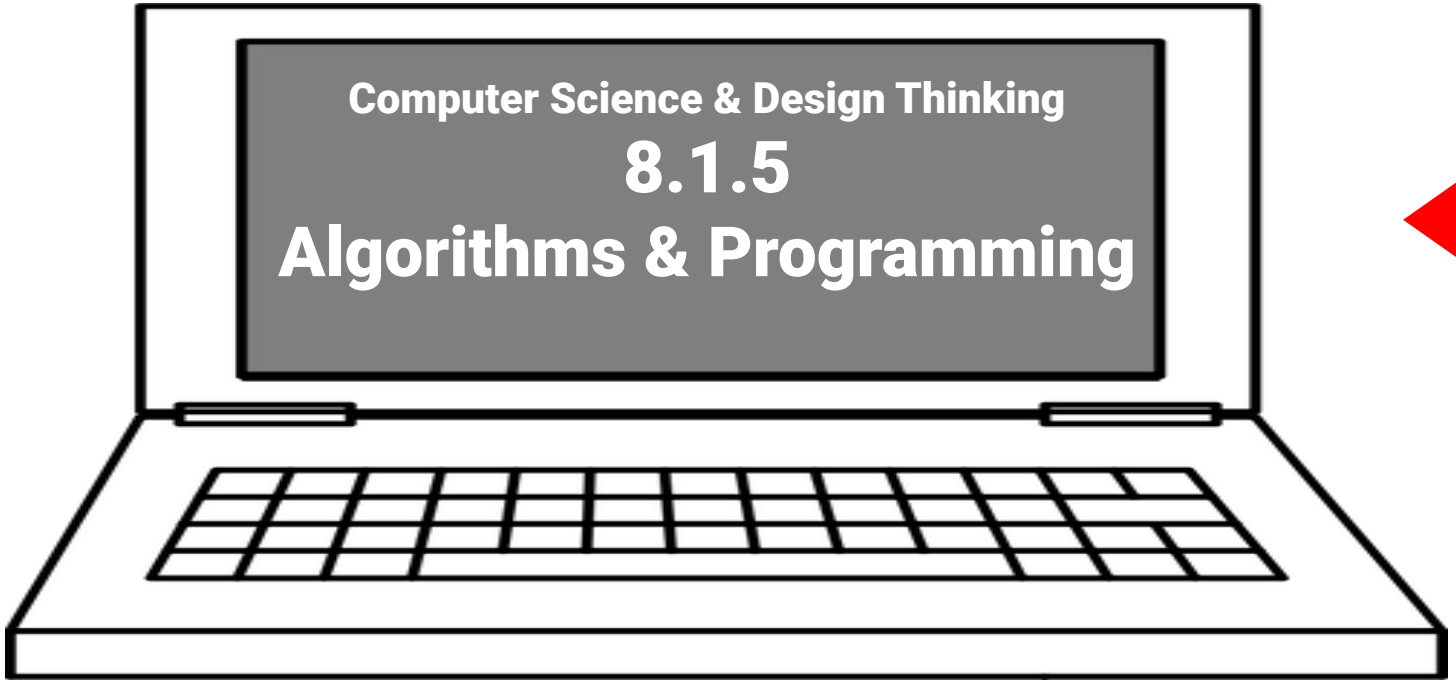
The New Jersey Student Learning Standards



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Computer Science for Everyone, Everywhere

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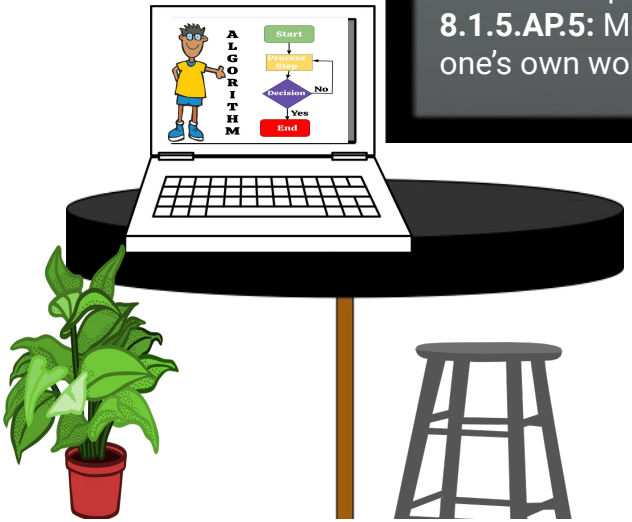
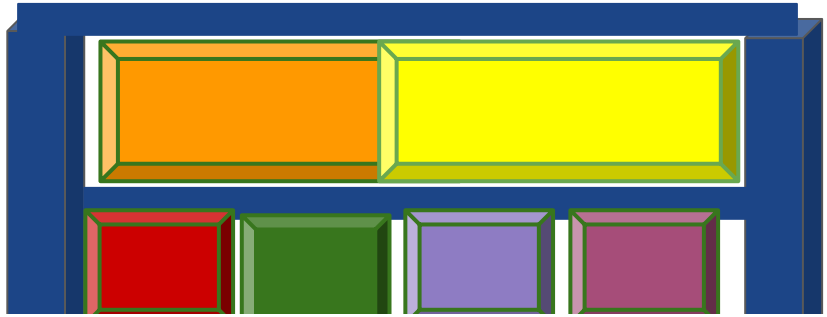
New Jersey Student Learning Standards

Technology:

8.1.5.AP.1: Compare and refine multiple algorithms for the same task and determine which is the most appropriate.
8.1.5.AP.2: Create programs that use clearly named variables to store and modify data.
8.1.5.AP.3: Create programs that include sequences, events, loops, and conditionals.
8.1.5.AP.4: Break down problems into smaller, manageable sub-problems to facilitate program development.
8.1.5.AP.5: Modify, remix, or incorporate pieces of existing programs into one's own work to add additional features or create a new program.





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Core Concept 8.1.5 Algorithms & Programming

An algorithm is a sequence of steps designed to accomplish a specific task. Algorithms are translated into programs, or code, to provide instructions for computing devices. Algorithms and programming control all computing systems, empowering people to communicate with the world in new ways and solve compelling problems.

AP

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Topics Covered

- Communication Between Humans
- Algorithms
- Debugging
- Programming
- Computer Programming
- Works Cited

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Communication Between Humans

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Communication Between Humans

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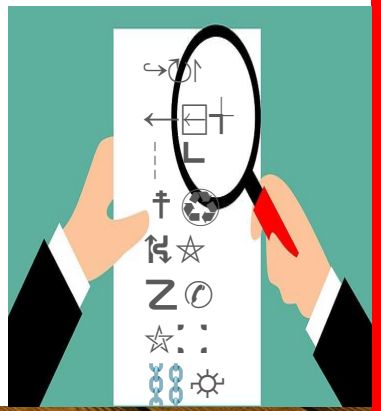
People have always created methods to communicate in nonverbal ways. People create codes with ***pictures*** and ***symbols*** to share secret messages!



Communication Between Humans

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People use flashlights in the dark to send and receive secret messages!

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Communication Between Humans

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Fire and smoke signals have been used share secret messages!

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Writing Algorithms

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People create and use ***pictographs*** to represent letters or words in order to share secret messages.

Mrs. Nash's Pictograph Chart

Symbol	Meaning	Symbol	Meaning
	a		m
	b		e
	c		h
	o		l
	g		f
	r		t
	s		e
	t		i
	d		s

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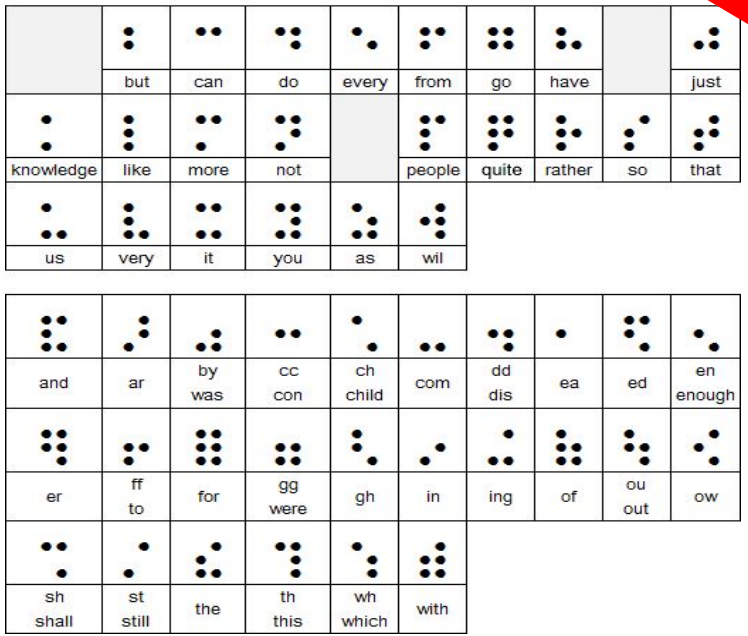
Communication Between Humans

Braille is a reading and writing system for ***blind and vision impaired people***, made up of raised dots that can be 'read' by touch.



	but	can	do	every	from	go	have		just
knowledge	like	more	not		people	quite	rather	so	that
us	very	it	you	as	wil				

and	ar	by was	cc con	ch child	com	dd dis	ea	ed	en enough
er	ff to	for	gg were	gh	in	ing	of	ou out	ow
sh shall	st still	the	th this	wh which	with				

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Communication Between Humans

Sign language is ***used by people who are deaf.*** The gestures or symbols in sign language are organized in a linguistic way. ***Each individual gesture is called a sign.***

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Communication Between Humans

Sign language Each sign has three distinct parts:

- **the handshape,**
- **the position of the hands, and**
- **the movement of the hands.**

American Sign Language (ASL) is used most in our country. Other countries have their own sign language.

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Communication Between Humans

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Again, people have always found ways to communicate nonverbally!

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Algorithms

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What Is An Algorithm?

List three tasks or things you do everyday?

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What Is An Algorithm?

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Examples of Daily Tasks

- ★ getting ready for school
- ★ brushing teeth
- ★ tying sneaker strings
- ★ travelling to or from school
- ★ school day
- ★ structure of a class
- ★ participating in clean-up time

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What Is An Algorithm?

Take one item from your list and write the steps you use to complete that task.

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What Is An Algorithm?

Congratulations!

You have just created your first algorithm!

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What Is An Algorithm?

A P

Sooooo! What is an algorithm?

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What Is An Algorithm?

An **algorithm** is a recipe book! In the recipe book, you have list the ***step by step instructions*** on how to make your favorite sandwich.

The **sequence** is the ***specific order instruction of your instructions.***

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What Is An Algorithm?

In fact, the instructions are so good, that anyone who follows the recipe can make the same, exact sandwich!

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What Is An Algorithm?

A **computer algorithm** is like a ***set of instructions that tell the computer what to do***!

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What Is An Algorithm?

So, just like your recipe book tells you how to make a sandwich, a ***computer algorithm*** is a list of step by step instructions that a computer program follows in order to complete a task (run a program).

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Writing Algorithms

Pseudocode

People use **pseudocode** (a notation resembling a simplified programming language, used in program design), to create and assess an algorithm before coding.

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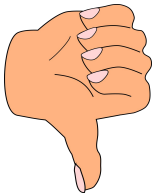
Writing Algorithms

Representing Yes or No	
Yes	No
	
1	2

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Writing Algorithms

Directional Arrows	
left	
right	
up	
down	
Clockwise turn	
Counter clockwise turn	

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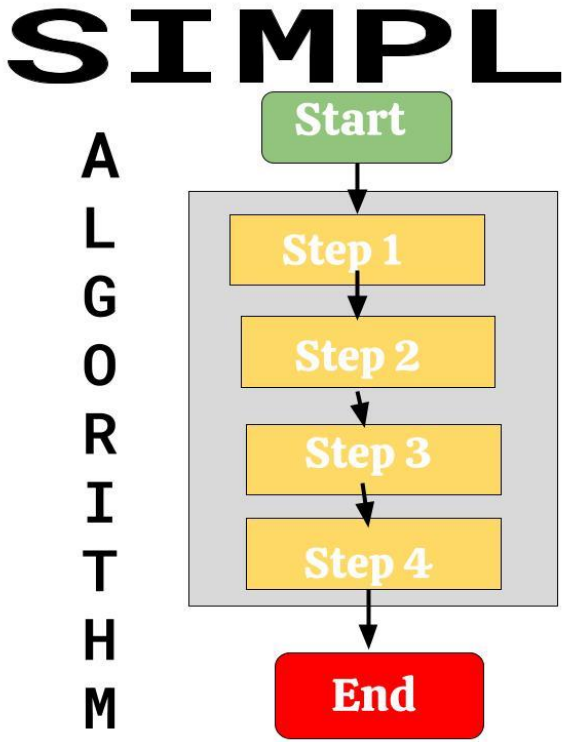
Types of Algorithms

Simple algorithms, start, complete a sequence of steps then stop.



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Types of Algorithms

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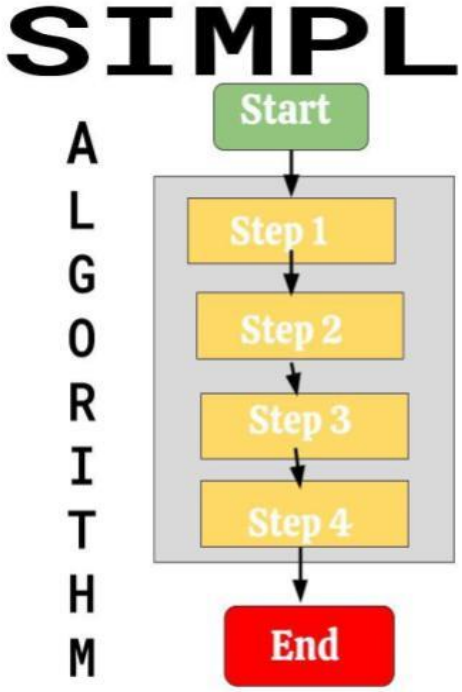

Pseudocode

1. Start
2. Stand in cafeteria line.
3. Pick up tray.
4. Pick up spork and napkin packet.
5. Place on left side of tray.
6. Pick up milk.
7. Place on right side of tray.
8. Pick up prepared hot meal.
9. Place in center, bottom part of the tray.
10. Pick up fruit.
11. Place in center, top of tray.
12. Go to your seat.
13. End

What Is An Algorithm?

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In order for your algorithm to work you must use provide, ***clear, precise*** and ***efficient steps!***

8.1.5

Writing Algorithms

Use the box below to write a dance algorithm that makes your human robot dance. It must last for at least 15 seconds.

Dance Algorithm

AP

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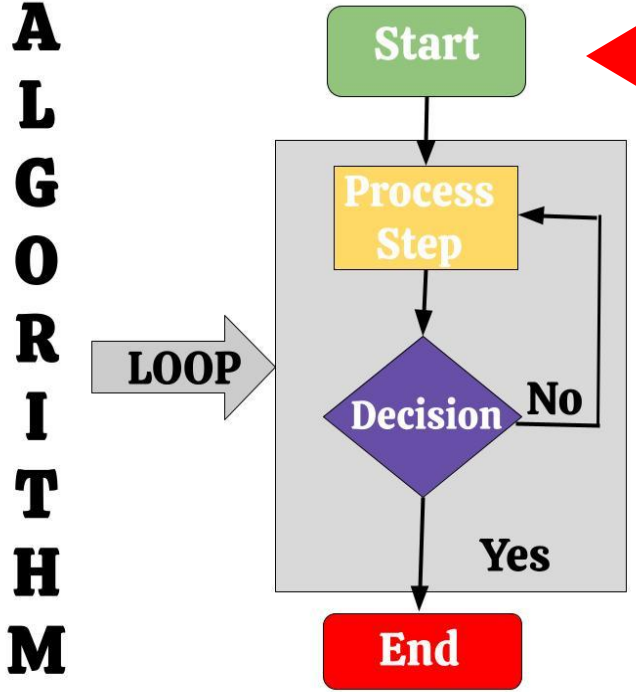
Types of Algorithms

Algorithms with a **loop** allow you to repeat sets of instructions without having to write them out multiple times.



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Writing Algorithms

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Revisit your dance algorithm. Look for steps that you repeat for example “step to the left three times”. Revise your algorithm to include loops.

Dance Algorithm Revision#1

Types of Algorithms

Repetitive Algorithms or "Do Loop" requires a program to run multiple times.

Repetitive Algorithm or "Do Loop"

```
int product = 3;

while (product <= 100)
  product = 3 * product;
```

Repetition (the action of repeating something) in a program means that lines of code will be run multiple times. ***Iteration*** is a term similar to repetition, it means to continue repeating an action until you achieve the correct outcome.

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Writing Algorithms

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Repetitive Algorithm or "Do Loop"

```
int product = 3;

while (product <= 100)
  product = 3 * product;
```

Repetition (the action of repeating something) in a program means that lines of code will be run multiple times. ***Iteration*** is a term similar to repetition, it means to continue repeating an action until you achieve the correct outcome.

Pseudocode

Objective: Multiple a number until it the product exceeds 100.

1. Start
2. Product is 3.
3. Is product less than or equal to 100?
   a. Yes! Go to 7.
   b. No! Go to 4.
4. Multiple by 3 * product.
5. You have a new product.
6. Go to 3.
7. End

Writing Algorithms

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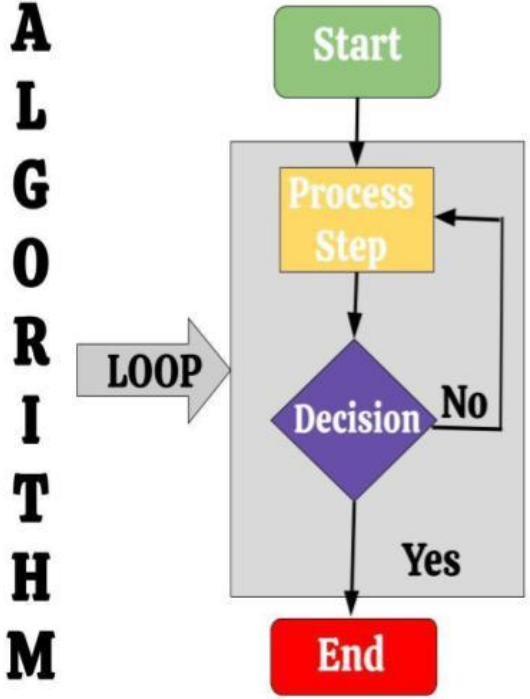


Pseudocode

Objective: Find the 5 of diamonds in a deck of cards.

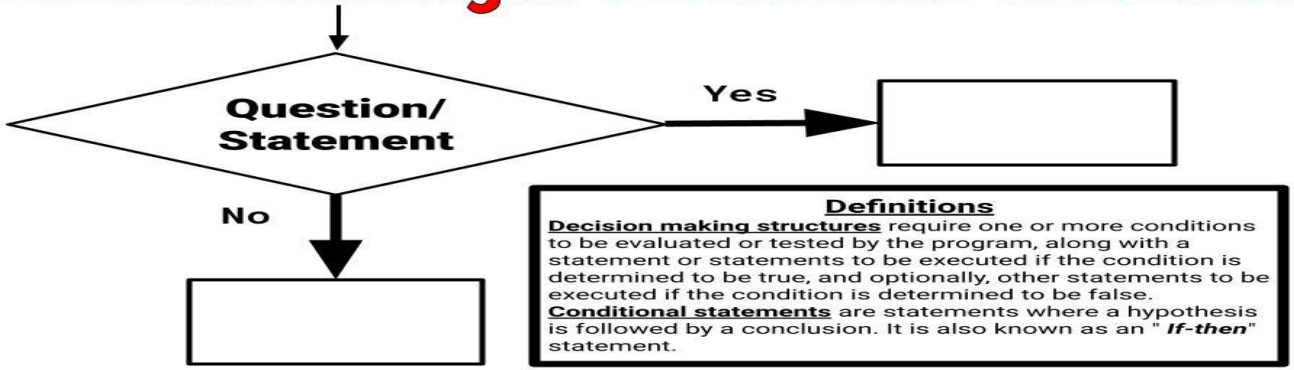
1. Start-
2. Select a card from the deck.
3. Is it the 5 of diamonds?
   a. Yes go to 4.
   b. No go back to 2.
4. End

Types of Algorithms

Decision Making or Conditional

Algorithms allow selection, making different things happen based on different conditions. You use this process everyday to make decisions.

Decision Making or Conditional Statement



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Writing Algorithms

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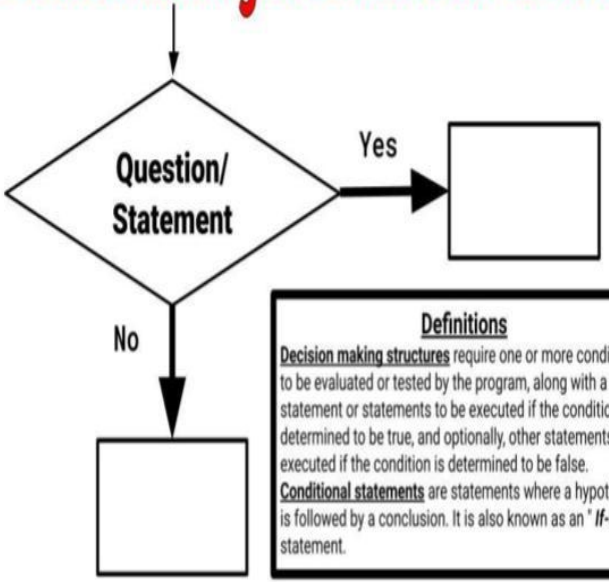
Decision Making or Conditional Statement



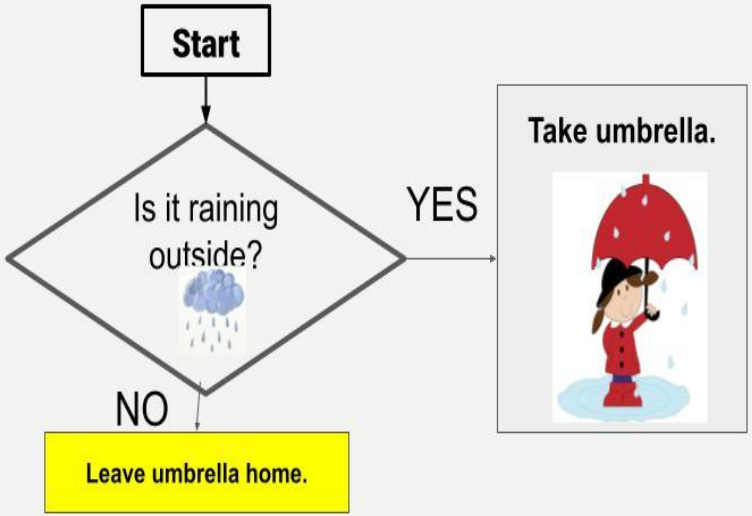
Definitions

Decision making structures require one or more conditions to be evaluated or tested by the program, along with a statement or statements to be executed if the condition is determined to be true, and optionally, other statements to be executed if the condition is determined to be false.

Conditional statements are statements where a hypothesis is followed by a conclusion. It is also known as an "***If-then***" statement.

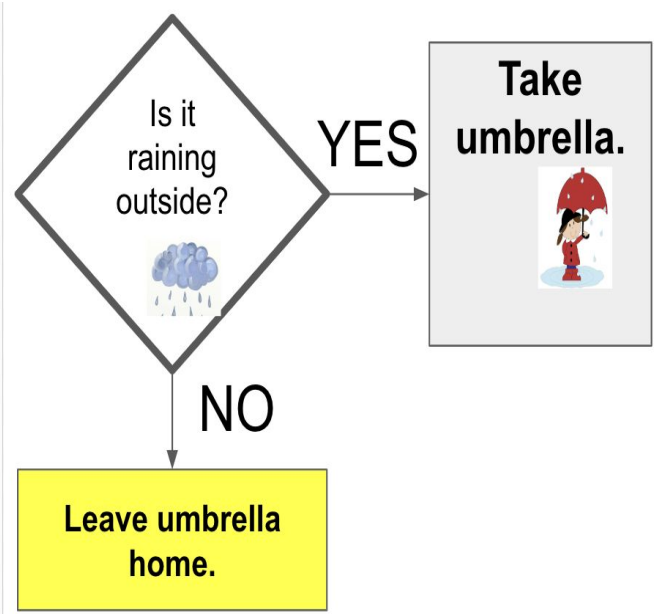
Pseudocode

Objective: Decide if you need an umbrella.



Writing Algorithms

Pseudocode



Decision Making

Written as pseudocode in programming.

```
If (raining outside)
    Take umbrella
Else
    Leave it home
```

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Writing Algorithms

Decomposition

Sometimes, a problem is too big. In this case, we **decompose** or ***break down a problem or task into smaller, more manageable parts.***

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Debugging

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Debugging

Debugging is the process of finding and fixing errors. A bug is present anytime your program does not function as expected.

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Debugging

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Errors stop your program from working correctly. Possible errors could be:

- **Logic** - testing for being to hot when you meant to test for being too cold.
- **Sequence** - steps are in the wrong order.
- **Spelling** mistakes

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Writing Algorithms

Debugging your dance algorithm. Were there any parts that confused your human robot? Go through and clarify, DEBUG confusing steps.

Dance Algorithm Revision#2
DEBUGGING

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Programming

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Programming

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Let's look at the way **people communicate** with **computers**!

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Programming

Programs store and manipulate data by using numbers or other symbols to represent information. Let's go through a few examples.

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Programming

Human-Computer Communication

ASCII (American Standard Code for Information Interchange) ***is the most common character encoding format for text data in computers and on the internet.***

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Programming

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ASCII TABLE

Decimal	Hex	Char	Decimal	Hex	Char	Decimal	Hex	Char	Decimal	Hex	Char
0	0	[NULL]	32	20	[SPACE]	64	40	@	96	60	`
1	1	[START OF HEADING]	33	21	!	65	41	A	97	61	a
2	2	[START OF TEXT]	34	22	"	66	42	B	98	62	b
3	3	[END OF TEXT]	35	23	#	67	43	C	99	63	c
4	4	[END OF TRANSMISSION]	36	24	$	68	44	D	100	64	d
5	5	[ENQUIRY]	37	25	%	69	45	E	101	65	e
6	6	[ACKNOWLEDGE]	38	26	&	70	46	F	102	66	f
7	7	[BELL]	39	27	'	71	47	G	103	67	g
8	8	[BACKSPACE]	40	28	(	72	48	H	104	68	h
9	9	[HORIZONTAL TAB]	41	29	)	73	49	I	105	69	i
10	A	[LINE FEED]	42	2A	*	74	4A	J	106	6A	j
11	B	[VERTICAL TAB]	43	2B	+	75	4B	K	107	6B	k
12	C	[FORM FEED]	44	2C	,	76	4C	L	108	6C	l
13	D	[CARRIAGE RETURN]	45	2D	-	77	4D	M	109	6D	m
14	E	[SHIFT OUT]	46	2E	.	78	4E	N	110	6E	n
15	F	[SHIFT IN]	47	2F	/	79	4F	O	111	6F	o
16	10	[DATA LINK ESCAPE]	48	30	0	80	50	P	112	70	p
17	11	[DEVICE CONTROL 1]	49	31	1	81	51	Q	113	71	q
18	12	[DEVICE CONTROL 2]	50	32	2	82	52	R	114	72	r
19	13	[DEVICE CONTROL 3]	51	33	3	83	53	S	115	73	s
20	14	[DEVICE CONTROL 4]	52	34	4	84	54	T	116	74	t
21	15	[NEGATIVE ACKNOWLEDGE]	53	35	5	85	55	U	117	75	u
22	16	[SYNCHRONOUS IDLE]	54	36	6	86	56	V	118	76	v
23	17	[ENG OF TRANS. BLOCK]	55	37	7	87	57	W	119	77	w
24	18	[CANCEL]	56	38	8	88	58	X	120	78	x
25	19	[END OF MEDIUM]	57	39	9	89	59	Y	121	79	y
26	1A	[SUBSTITUTE]	58	3A	:	90	5A	Z	122	7A	z
27	1B	[ESCAPE]	59	3B	;	91	5B	[	123	7B	{
28	1C	[FILE SEPARATOR]	60	3C	<	92	5C	\	124	7C	|
29	1D	[GROUP SEPARATOR]	61	3D	=	93	5D	]	125	7D	}
30	1E	[RECORD SEPARATOR]	62	3E	>	94	5E	^	126	7E	~
31	1F	[UNIT SEPARATOR]	63	3F	?	95	5F	_	127	7F	[DEL]

Programming

Human-Computer Communication

AP

Binary code is one type of coding that uses only **0** and **1** to represent letters, numbers, and symbols. It is called binary code because it's made of only two symbols. The "***bi***" in binary ***means two!***

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Programming

Human-Computer Communication

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The hardware of computers has only two electrical states, on or off. These can be represented by

- 0 or zero (off), *or*
- 1 or one (on).

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Programming

Human-Computer Communication

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Letters, numbers, and symbols are translated to eight-character binary numbers (0 and 1) as you work with them through the software on your computer.

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Programming

Human-Computer Communication

BINARY CODE ALPHABET REFERENCE

1	A	00001	14	N	01110
2	B	00010	15	O	01111
3	C	00011	16	P	10000
4	D	00100	17	Q	10001
5	E	00101	18	R	10010
6	F	00110	19	S	10011
7	G	00111	20	T	10100
8	H	01000	21	U	10101
9	I	01001	22	V	10110
10	J	01010	23	W	10111
11	K	01011	24	X	11000
12	L	01100	25	Y	11001
13	M	01101	26	Z	11010

OUR FAMILY CODE

Number	Binary Code	Number	Binary Code
0	0	16	10000
1	01	17	10001
2	10	18	10010
3	11	19	10011
4	100	20	10100
5	101	21	10101
6	110	22	10110
7	111	23	10111
8	1000	24	11000
9	1001	25	11001
10	1010	26	11010
11	1011	27	11011
12	1100	28	11100
13	1101	29	11101
14	1110	30	11110
15	1111	31	11111

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Programming

Human-Computer Communication

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Unicode provides a ***unique number***. This means that text can be shared and displayed across different systems without loss of information or character corruption.

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Programming

Human-Computer Communication

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Unicode assigns each character a unique code point. Look at the example below:

"A" is U+0041

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Programming

Human-Computer Communication

Dec	Hx	Oct	Char		Dec	Hx	Oct	Html	Chr	Dec	Hx	Oct	Html	Chr	Dec	Hx	Oct	Html	Chr
0	0	000	NUL	(null)	32	20	040		Space	64	40	100	@	@	96	60	140	`	`
1	1	001	SOH	(start of heading)	33	21	041	!	!	65	41	101	A	A	97	61	141	a	a
2	2	002	STX	(start of text)	34	22	042	"	"	66	42	102	B	B	98	62	142	b	b
3	3	003	ETX	(end of text)	35	23	043	#	#	67	43	103	C	C	99	63	143	c	c
4	4	004	EOT	(end of transmission)	36	24	044	$	$	68	44	104	D	D	100	64	144	d	d
5	5	005	ENQ	(enquiry)	37	25	045	%	%	69	45	105	E	E	101	65	145	e	e
6	6	006	ACK	(acknowledge)	38	26	046	&	&	70	46	106	F	F	102	66	146	f	f
7	7	007	BEL	(bell)	39	27	047	'	'	71	47	107	G	G	103	67	147	g	g
8	8	010	BS	(backspace)	40	28	050	(	(	72	48	110	H	H	104	68	150	h	h
9	9	011	TAB	(horizontal tab)	41	29	051	)	)	73	49	111	I	I	105	69	151	i	i
10	A	012	LF	(NL line feed, new line)	42	2A	052	*	*	74	4A	112	J	J	106	6A	152	j	j
11	B	013	VT	(vertical tab)	43	2B	053	+	+	75	4B	113	K	K	107	6B	153	k	k
12	C	014	FF	(NP form feed, new page)	44	2C	054	,	,	76	4C	114	L	L	108	6C	154	l	l
13	D	015	CR	(carriage return)	45	2D	055	-	-	77	4D	115	M	M	109	6D	155	m	m
14	E	016	SO	(shift out)	46	2E	056	.	.	78	4E	116	N	N	110	6E	156	n	n
15	F	017	SI	(shift in)	47	2F	057	/	/	79	4F	117	O	O	111	6F	157	o	o
16	10	020	DLE	(data link escape)	48	30	060	0	0	80	50	120	P	P	112	70	160	p	p
17	11	021	DC1	(device control 1)	49	31	061	1	1	81	51	121	Q	Q	113	71	161	q	q
18	12	022	DC2	(device control 2)	50	32	062	2	2	82	52	122	R	R	114	72	162	r	r
19	13	023	DC3	(device control 3)	51	33	063	3	3	83	53	123	S	S	115	73	163	s	s
20	14	024	DC4	(device control 4)	52	34	064	4	4	84	54	124	T	T	116	74	164	t	t
21	15	025	NAK	(negative acknowledge)	53	35	065	5	5	85	55	125	U	U	117	75	165	u	u
22	16	026	SYN	(synchronous idle)	54	36	066	6	6	86	56	126	V	V	118	76	166	v	v
23	17	027	ETB	(end of trans. block)	55	37	067	7	7	87	57	127	W	W	119	77	167	w	w
24	18	030	CAN	(cancel)	56	38	070	8	8	88	58	130	X	X	120	78	170	x	x
25	19	031	EM	(end of medium)	57	39	071	9	9	89	59	131	Y	Y	121	79	171	y	y
26	1A	032	SUB	(substitute)	58	3A	072	:	:	90	5A	132	Z	Z	122	7A	172	z	z
27	1B	033	ESC	(escape)	59	3B	073	;	;	91	5B	133	[	[	123	7B	173	{	{
28	1C	034	FS	(file separator)	60	3C	074	<	<	92	5C	134	\	\	124	7C	174			|
29	1D	035	GS	(group separator)	61	3D	075	=	=	93	5D	135	]	]	125	7D	175	}	}
30	1E	036	RS	(record separator)	62	3E	076	>	>	94	5E	136	^	^	126	7E	176	~	~
31	1F	037	US	(unit separator)	63	3F	077	?	?	95	5F	137	_	_	127	7F	177	&#127;	DEL

Source: www.LookupTables.com

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MONTCLAIR STATE UNIVERSITY
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Learn More

Computer Science for Everyone, Everywhere

Angela Williams-Nash, Certified Instructional Designer
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Programming

Human-Computer Communication

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Unicode supports over a million code points, which can represent characters from various scripts, symbols, emoji, and more.

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Programming

Human-Computer Communication

AP

One of the key advantages of **Unicode** is its universality and inclusivity, allowing for the representation of text in numerous languages and scripts, including those that are not traditionally supported by older encoding standards like ASCII.

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Programming

Human-Computer Communication

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This makes Unicode very important for multilingual computing, internationalization, and globalization of software and content.

8.1.5

Computer Programming

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Computer Programming

What is Computer Programming?

Imagine you have a big box of colorful building blocks. Each block is like a little instruction for the computer to follow. When you put these blocks together in a certain order, they tell the computer what to do, just like when you follow the steps to build a tower with your blocks.

Now these blocks are special because

AP

8.1.5

Computer Programming

What is Computer Programming?

Now, these blocks are special because they're made for the computer. They tell it how to do things like play a game, draw a picture, or even talk to other computers far away. When you press a button on the computer or a tablet, it follows the instructions from these blocks to do what you want, like open a game or show a video.

A P

8.1.5

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Computer Programming

What is Computer Programming?

So, ***computer programs are like sets of instructions that tell the computer what to do***, just like you use instructions to build something with your building blocks!

```
// Function to collect numbers from the user
function collectNumbers() {
    let numbers = [];
    for (let i = 1; i <= 4; i++) {
        let input = prompt("Enter number " + i + ":");
        let number = parseFloat(input);
        if (!isNaN(number)) {
            numbers.push(number);
        } else {
            alert("Invalid input. Please enter a valid number.");
            return null;
        }
    }
    return numbers;
}

// Function to calculate sum of numbers
function calculateSum(numbers) {
    let sum = 0;
    for (let number of numbers) {
        sum += number;
    }
    return sum;
}

// Function to calculate average of numbers
function calculateAverage(numbers) {
    let sum = calculateSum(numbers);
    return sum / numbers.length;
}

// Main function
function main() {
    let numbers = collectNumbers();
    if (numbers !== null) {
        let sum = calculateSum(numbers);
        let average = calculateAverage(numbers);
        alert("Sum: " + sum + "\nAverage: " + average);
    }
}

// Call the main function
main();
```

AP

8.1.5

Works Cited

1. OpenAI. 2024. ChatGPT (2023) Algorithms & Programming. Retrieved from https://www.openai.com/
2. What is Braille?
3. What is Sign Language?
4. What is ASCII?
5. What is Binary Code?

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8.1.5