Alphabet Cards

Binary Classification

Sorting

Basic Prep:

In this PDF, you will find instructions for both the Binary Classification lessons and the Sorting lessons. The cards are found on the Alphabet Cards PDF (a separate file) for you to print out, and cut along the dotted lines.

Find a space, preferably on the floor or a table that is the appropriate height for the child. This should be a space where you can easily lay out all of the cards, without immediate clutter or distraction.

While all lessons can be adapted for ages 3 - 9, the Binary Classification lessons may be best suited for younger children (3 - 6 years) while the Sorting lessons work well with 6 - 9 year olds. We encourage you to read through the lessons and adapt as you see fit.

This PDF includes lessons for two concepts: **Binary Classification** and **Sorting**.

Sorting is slightly different from classification. When we classify the items in binary classification, we group them into two groups, each based on some characteristic that they have in common. With sorting, we are going to take a group of items, and put them in a specific order.

Binary Classification

Binary Classification is the process of sorting elements into 2 categories. To make this simple, we can organize elements according to YES or NO. For example, we could classify clothing items. You could ask, *is this a sock?* If YES, then we can put it in the sock drawer. And if NO, we know that it will belong somewhere else. *Is this a coat?* If YES, we may put it with the other coats, in the coat closet.

Context

Classification is an important part of computer science, particularly in machine learning. Computers classify items by recognizing similarities and differences. People are particularly good at this—but computers have to learn how to classify items in a much different way. One way we can think about this process is through binary classification. This is a way of simplifying the problem into yes and no questions.

Materials and Preparation

- cut out alphabet cards (ask your little one to help!)
- cut out the YES and NO cards; these will be markers for your classifications.
- find a spot that is clear of distractions, such as a table appropriate for the child's height or on the floor.

Binary Classification, part 1

Objective

Demonstrate an understanding of Binary Classification by grouping cards into two groups: living and non-living.

Setting Up

1. Together, you and the child start by arranging the cards in your space (on the floor or the table), image side up. You may want to start with half of the cards (13).

Key Questions

2. You may ask some introductory questions like, *What do you notice about these elements? In what ways are some of them similar? And in what ways are some of them different?*

3. Explain to the child that we are going to learn about classification. What is classification? Classification is the process of grouping things by their similarities. Can you think of some things here at home that are classified? (Think of spices in the cupboard, or socks together in the sock drawer). Why do you think that we classify those things? (Think of outdoor play equipment that is stored in the garage, while indoor play equipment, like board games are in the closet.)

Process

4. Place a YES and a NO card some distance apart; you will be placing the alphabet cards under the YES and NO cards. Today we are going to use these alphabet cards to understand how we can classify different items. First, let's classify them into two categories: living and not-living. In order to do so, we will ask: *Is this living?*

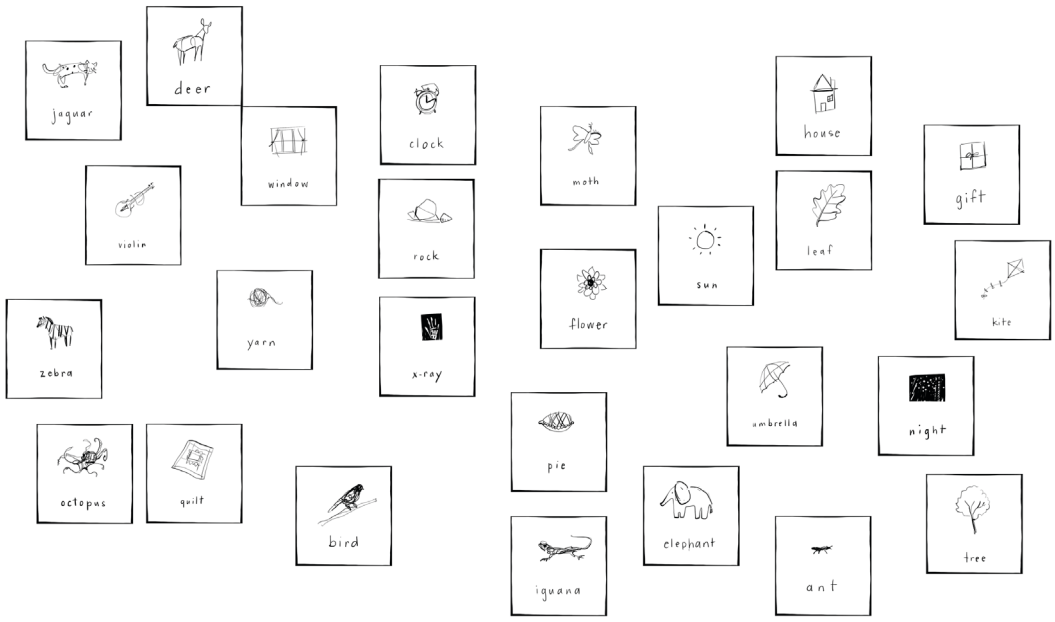
5. Pick up a random card and ask, *Is this living?* Allow the child to answer. If the answer is YES, then we can place the card in the YES area. If the answer is NO, then we can place the card in the NO area. Place the card in the corresponding area.

6. Pick up another random card, and ask: *Is this living?* Allow the child to choose, and to place it either in the YES category or the NO category.

7. Ask the child to classify the remainder of the cards by first picking up an unsorted card, and asking if the thing is living.

Checking for Errors

8. When all of the cards are classified, you may look at them and check to see that they are correct. If there are any items that are misclassified, ask the child to check again, going through each card and asking, *is this living?*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clock
violin
rock
yarn
zebra
x-ray
octopus
quilt
bird
moth
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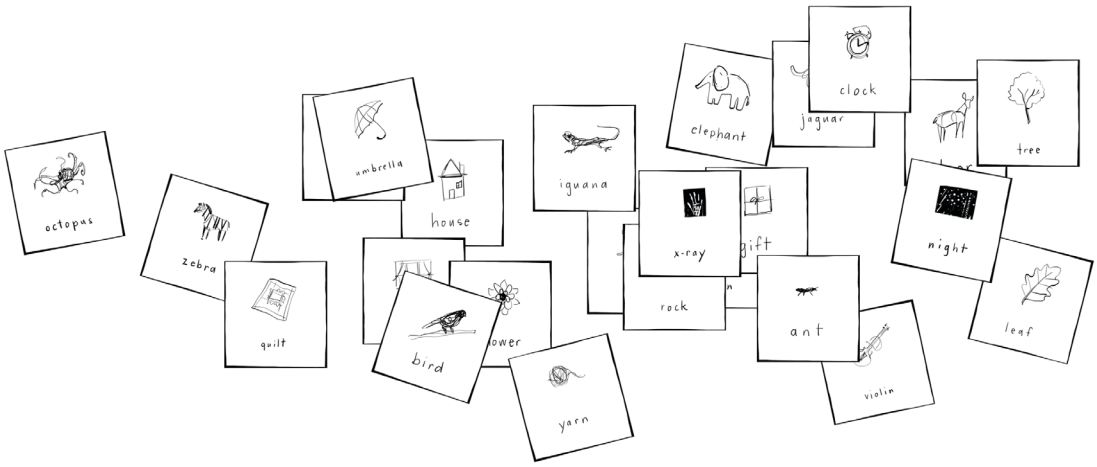
night
pie
elephant
tree
iguana
ant

YES

NO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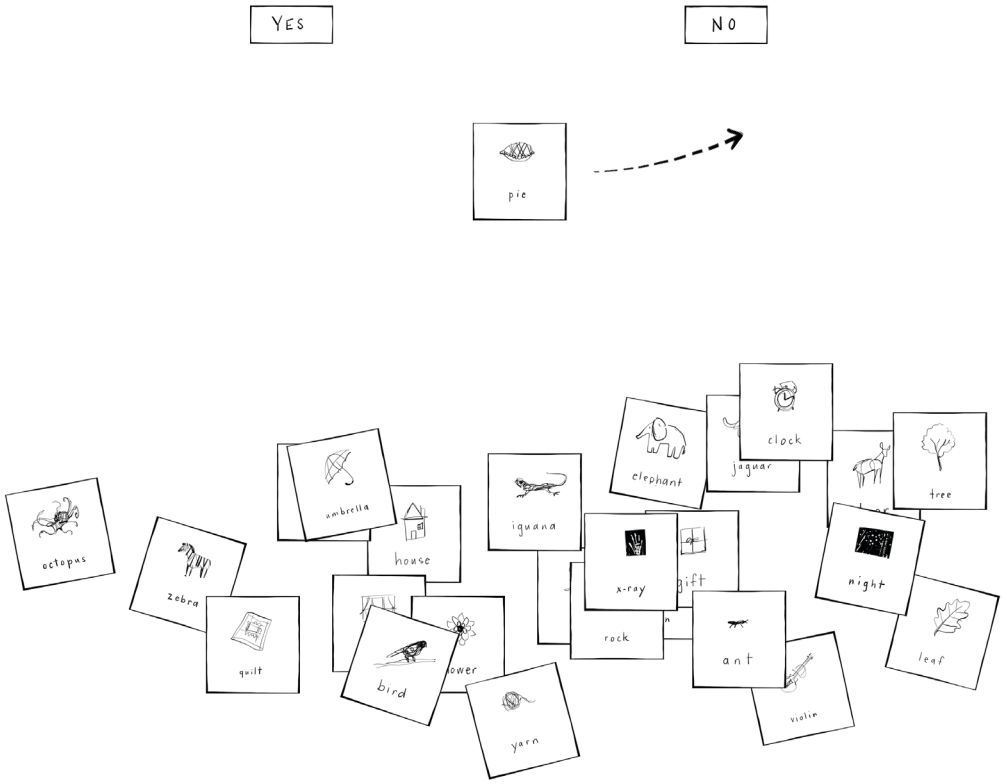
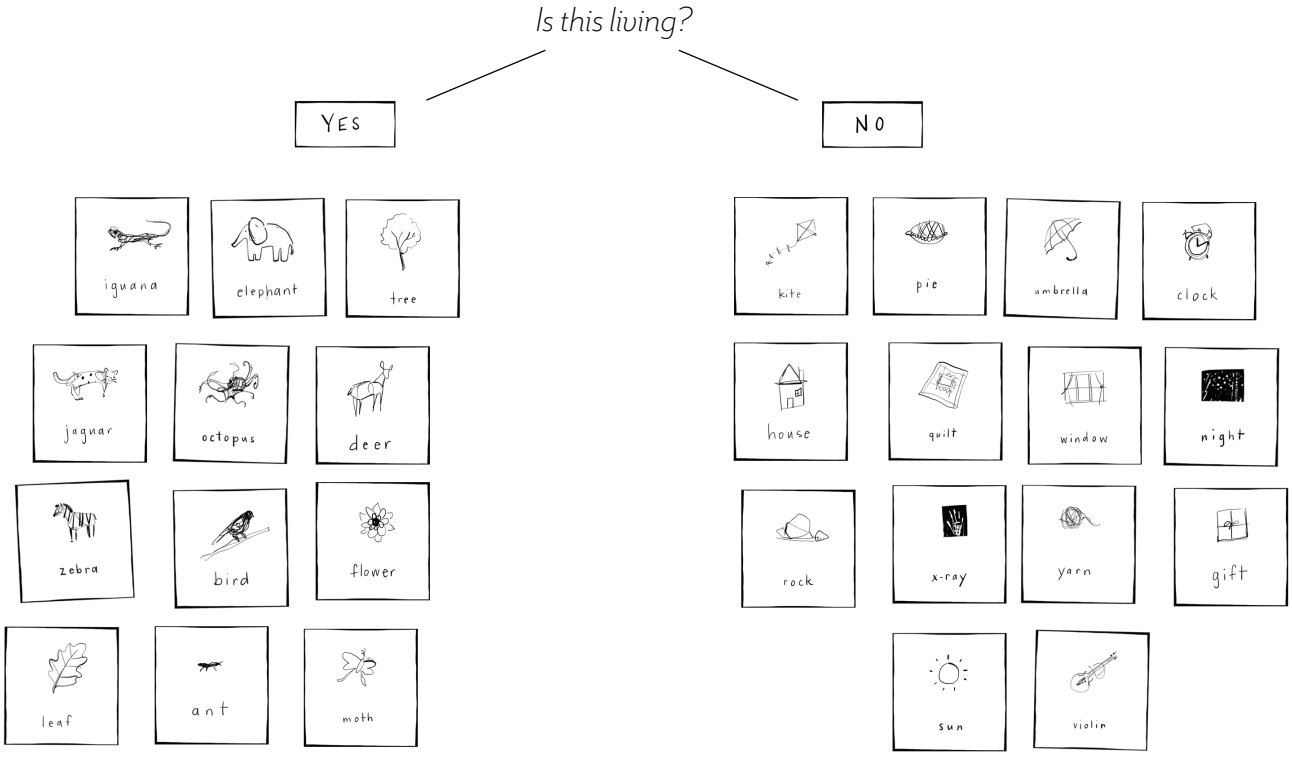
violin
yarn

Is this living?



Is this living?

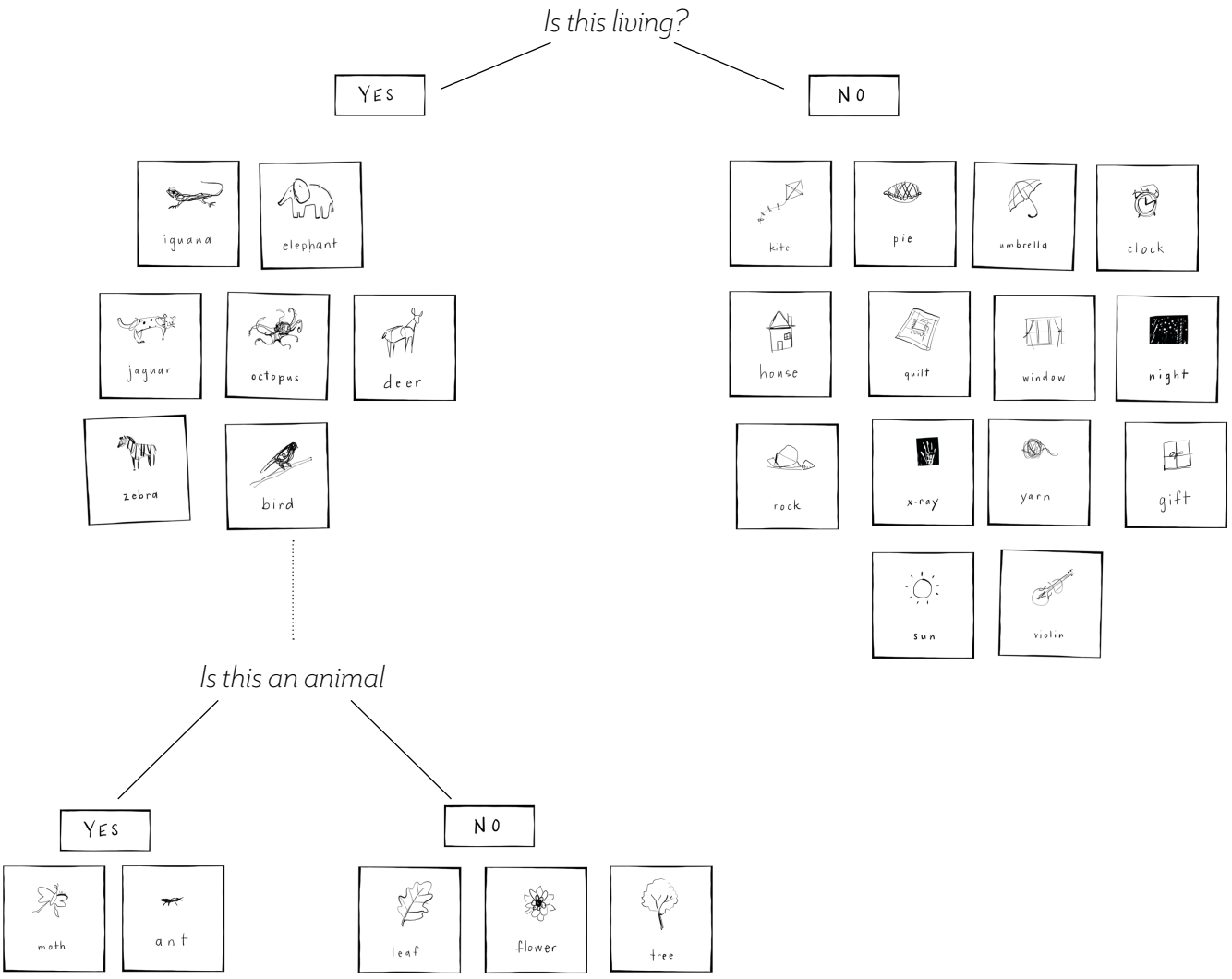


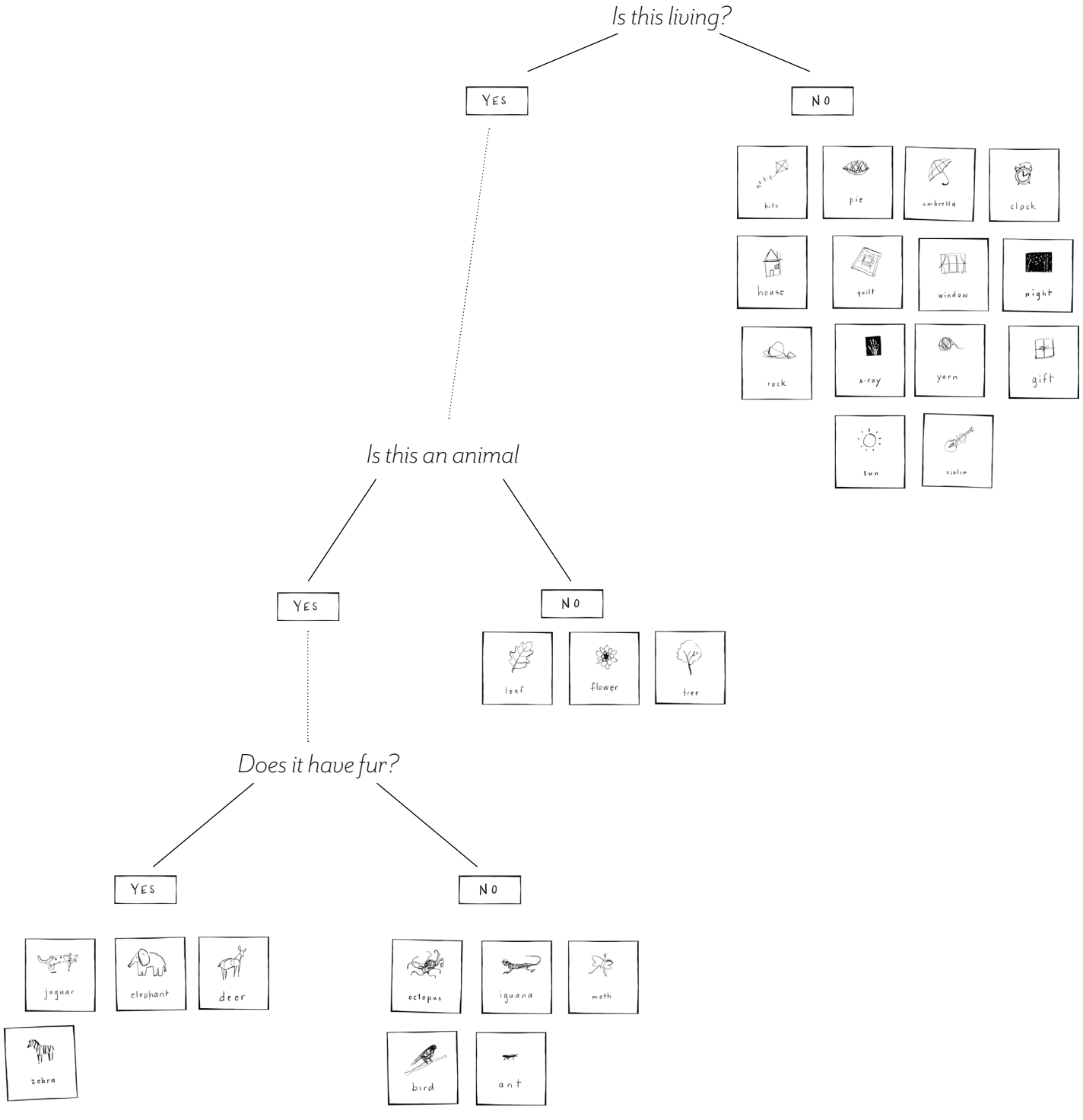
Binary Classification, part 2

1. After the cards are classified, you have two groups. You may further classify each group into sub-groups. To do this, start by placing an additional YES card and a NO card under the first YES card.

2. Now, you can ask again—*Is this an animal?* Going through a similar process, ask the child to classify the living (YES) group into animal (YES) and not-animal (NO).

3. Ask, are there ways that you can further classify these (*Does it have fur*)? There are extra YES and NO cards, so you can keep thinking of other ways to classify and sub-classify.




Is this living?
YES
NO
kite
pie
umbrella
clock
house
quilt
window
night
rock
x-ray
yarn
gift
sun
violin
Is this an animal
YES
NO
leaf
flower
tree
Does it have fur?
YES
NO
jaguar
elephant
deer
zebra
octopus
iguana
moth
bird
ant

Sorting Algorithms

Sorting Algorithms are the processes that computers use to put items in a specific order. There are many different processes that computers use to sort lists—we call these instructions *sorting algorithms*, and they are useful for many things such as sorting emails by date, or alphabetizing lists.

Context

When information is sorted, it can be more easily retrieved (or located) when you need it. But there are also advantages and disadvantages to different sorting algorithms, particularly the time that each one takes. When there are more steps involved in sorting, it will take longer to carry out the sorting task. We can calculate an algorithm's speed by determining the number of steps. But the basic concept here is this: we can create a set of instructions for computers to follow in order to sort a list of items, and some sets of instructions will require more steps than others.

Materials and Preparation

- cut out alphabet cards (ask your little one to help!)
- find a spot that is clear of distractions, such as a table appropriate for the child's height or the floor.

* note that you will not need the YES and NO cards.

Introduction and Discussion

Using the same cards, we can learn how a computer sorts information. Sorting is slightly different from classification. When we were classifying the items, we grouped them into two groups, such as living and not living. With sorting, we are going to take all of those items, and put them in a specific order.

Can you think of things that are organized in a specific order? Ask the child for examples (you can prompt them with examples like books in the library). Ask the child—*Why do you think that we put things in order?* Discuss.

Today we are going to learn a few ways that computers sort information. The cards contain information—each is a different item that has a word and a picture to represent it.

Start by putting the cards face up, scattered on the floor or the table.

If I asked you to put them in alphabetical order, how would you go about doing it? Ask the child to go ahead and put them in alphabetical order, A to Z (by the word on the card). After they have completed this, ask them to describe how they did it.

Most likely, the child did it differently than a computer would. A computer uses specific processes, *called sorting algorithms*. Sorting algorithms are instructions that a computer follows to put items in a particular order. Computers need very specific instructions, with steps, to carry out tasks–we can't just say, *put these in alphabetical order*, like I just asked you!

Today we are going to learn some of the instructions that computers use to sort items.

Sorting Algorithms

Sorting Algorithm #1: Bubble Sort

Objective

Demonstrate an understanding of the Bubble Sort Algorithm, by using these instructions to alphabetize the set of cards from A to Z.

Setting Up

1. Mix up the cards so that they are in random order (in case you had alphabetized them). Line up all of the cards, randomly, so that they are lying face up in a line. (You may also use half of the cards to start, in order to simplify the exercise.)

Process

2. Compare the first two cards. If the card on the right is closer to the beginning of the alphabet, swap them. If the card on the right is not closer to the beginning of the alphabet (meaning it comes after the first alphabetically), then leave both cards as they are.

3. Compare the second and the third cards. If the card on the right is closer to the beginning of the alphabet, swap them.

4. Continue to the third and the fourth, and then the fourth and the fifth, et cetera. At each comparison, if the card on the right is closer to the beginning of the alphabet, swap them. Continue until you are all the way to the end. This is one loop.

5. Now you will do the whole process again. Return to the beginning of the line, with the first and second cards. Carry out the same process until you reach the end of the line. This was a second loop.

6. Continue the process (keep looping) until you make it through the entire line without swapping any cards.

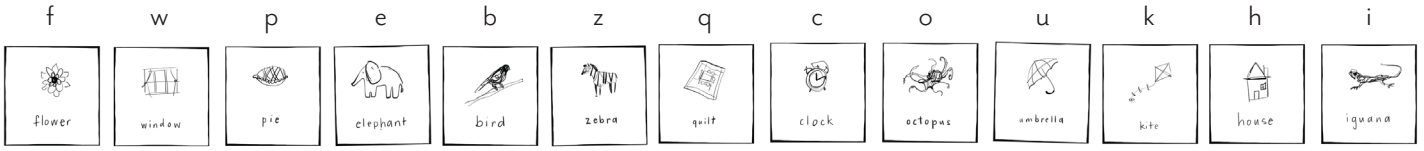
Checking for Errors

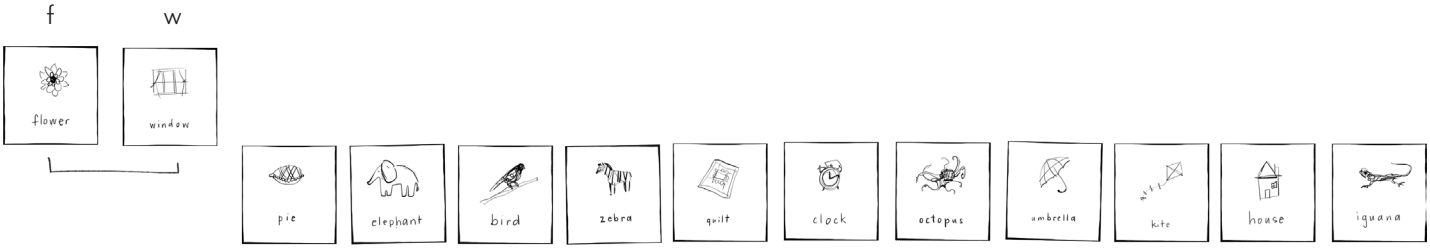
7. Ask the child to check and confirm that they are alphabetized. (There is one card for each letter of the alphabet when using all of the cards.)

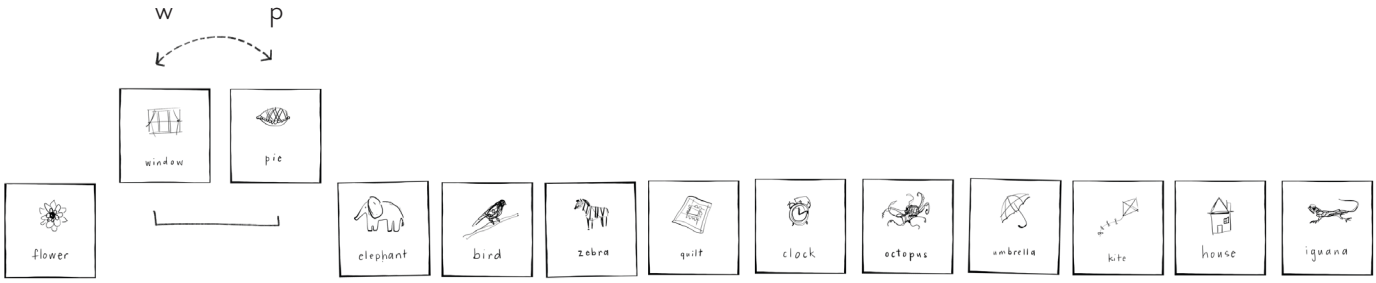
Key Questions

If you had started with having the child simply alphabetize the cards (without a specific set of instructions) you may ask questions like: *How did this process of following specific instructions differ from when I asked you to simply alphabetize the cards? Did it take more or less time? Which was easier for you to do?*

Shown here with half of the cards (13).







Sorting Algorithm #2: Insertion Sort

Objective
Demonstrate an understanding of the Insertion Sort Algorithm, by using these instructions to alphabetize the set of cards from A to Z.

Setting Up
1. Shuffle the cards so that they are in random order. Place them face down, in a line side-by-side. (You may also use half of the cards to start, in order to simplify the exercise.)

Process
2. Pick up the first card on the left, and flip it over. We will be going down the line, flipping over each card, and determining where it should go in relation to the other cards that have been flipped over. With the first card flipped over, it is already sorted, since it is the only card we are looking at.

3. Flip over the second card, so that the first two cards are face up now. Take the second card and determine if it should go before the first card or stay as it is. If it needs go before the first card, slide the first card to the right so that there is a position to place the card on the left.

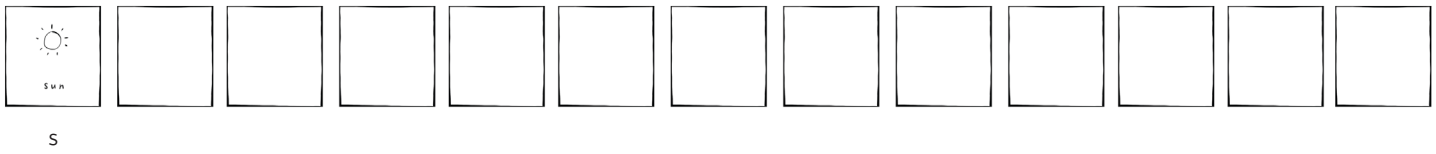
4. Flip over the third card, and determine where it should go in relation to the cards that have been flipped over. When you need to place the card in a new position, slide the cards in order to make room for it.

5. Carry this out with the remaining cards.

Checking for Errors
6. When you have made it through the entire line, check for errors. Are the cards now sorted alphabetically?

Key Questions
How does this process compare to the Bubble Sort? Was one faster than the other?

Shown here with half of the cards (13).



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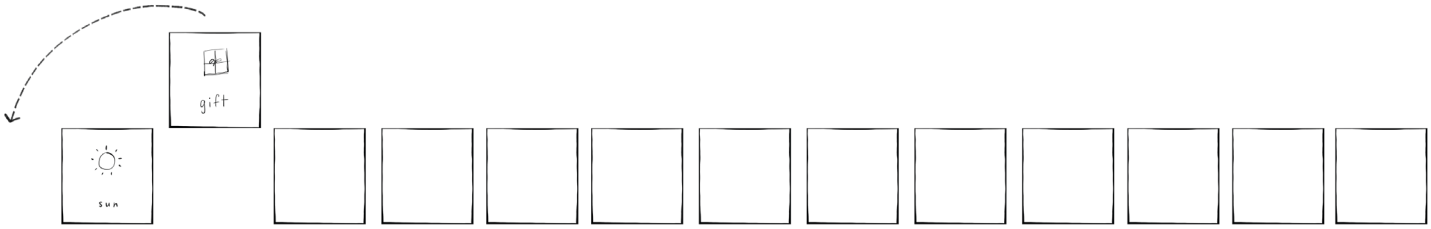

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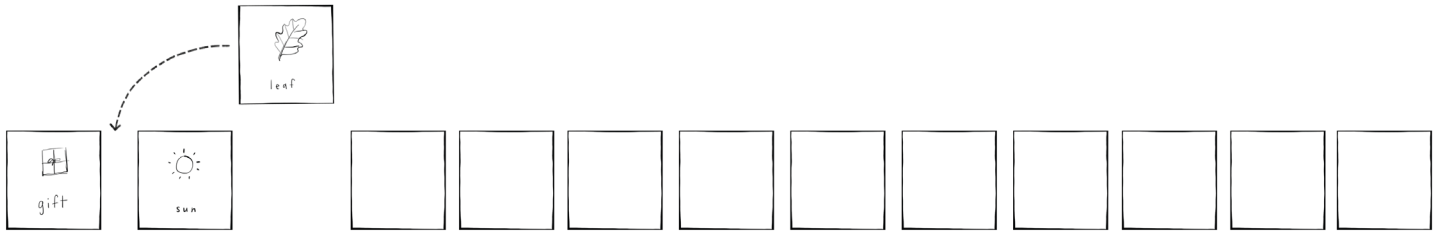

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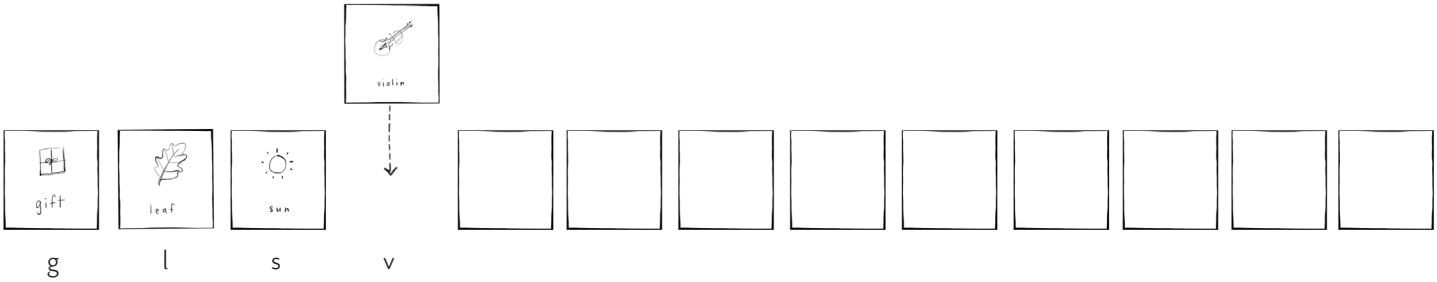

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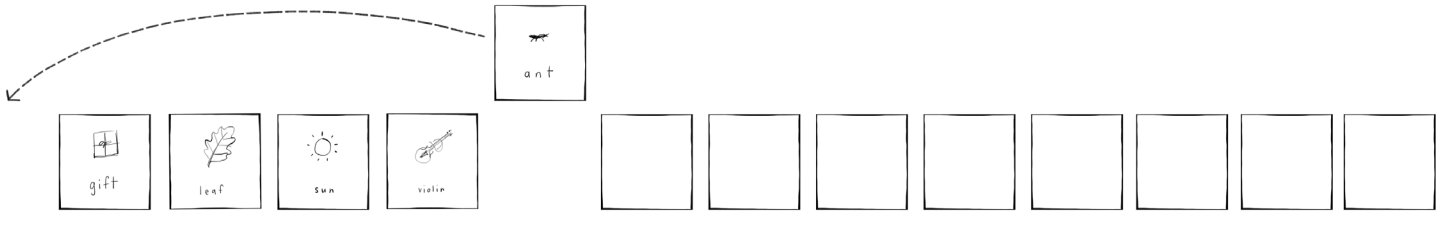

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Sorting - Extensions

a. You can incorporate the Classification and the Sorting lessons together; one way would be to go through the classification lesson, and then sort each of the groups alphabetically (for example, animals sorted A to Z).

b. If you don't have a printer, you can create your own cards by writing numbers or letters on them. You can also use stickers, or cut out images from magazines.

c. Find or make objects around the house that can be classified or sorted. You can sort things by weight or length, for example.