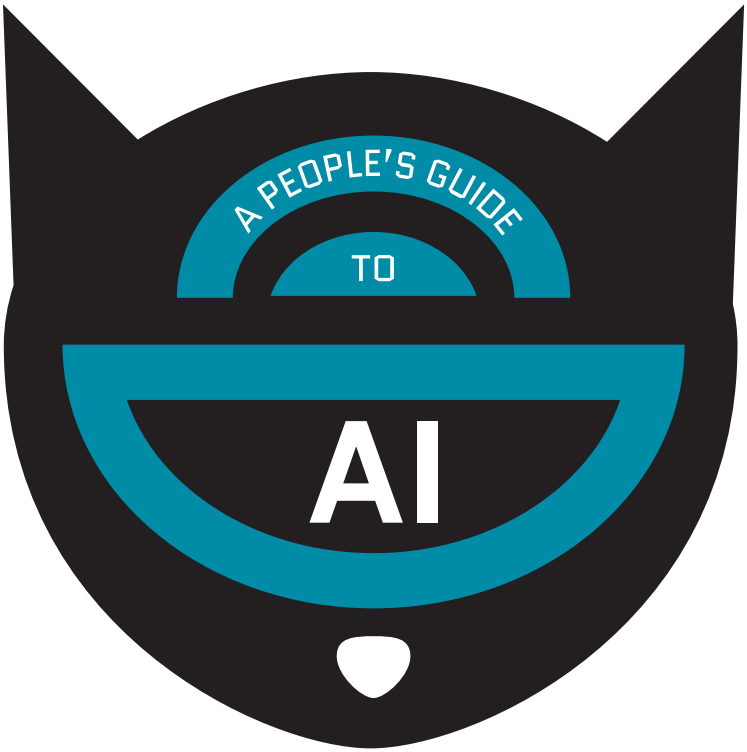

ARTIFICIAL INTELLIGENCE

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A NOTE FROM THE AUTHORS

Artificial Intelligence (AI) is changing our society.

What do listening to music, taking a flight, and getting stopped by the police all have in common? You might not realize it, but these actions could all involve artificial intelligence (AI) at work.

From cars that drive themselves to computer programs that can talk with humans, AI-based technologies are being deployed across all parts of society. This means that they're used in everyday spaces (like typing a text message) and in more serious situations (like deciding who is more likely to commit crime).

Because these technologies can process lots of information and make complex tasks more efficient, AI presents huge opportunities for societal change. But who gets to decide what that change looks like and who it will affect? As we learn to deal with new technologies, we also have to learn how to deal with the challenges that surround them. AI, in particular, prompts two big questions for us as a public to consider:

- What does fairness look like when computers shape decision-making?

- Who is creating the future, and how can we ensure that these creators reflect diverse communities and complex social dynamics?

The consequences of AI affect everyone, but especially traditionally disadvantaged communities like low-income groups and people of color. The exact populations who are not widely included in current conversations about the technology are the ones who face the greatest risk. What does a future of widespread AI mean for cities like Detroit, Michigan, where 40% of the population is without Internet? What does it mean for undocumented people in rural and urban areas who fear deportation? What does it mean for people working in industries where AI has the potential to replace jobs?

We may not be able to answer all these questions, but we can offer a perspective on how to begin this conversation. We are inspired by the legacy of popular education, which insists that in order for people to begin thinking critically, they must first have an understanding of the topic in relation to their own lives.

With that in mind, this booklet aims to fill the gaps in information about AI by creating accessible materials that inform communities and allow them to identify what their ideal futures with AI can look like. Although the contents of this booklet focus on demystifying AI, we find it important to state that the benefits of any technology should be felt by all of us. Too often, the challenges presented by new technology spell out yet another tale of racism, sexism, gender inequality, ableism, and lack of consent within digital culture.

The path to a fair future starts with the humans behind the machines, not the machines themselves. Self-reflection and a radical transformation of our relationships to our environment and each other are at the heart of combating structural inequality. But understanding what it takes to create a fair and just society is the first step. In creating this booklet, we start from the belief that equity begins with education.

This booklet can be used in a number of ways. Because each section builds off the last, it can be read sequentially, in the style of a

traditional book. For those who wish to learn more about specific topics, we recommend looking at the table of contents and choosing sections to read. For more hands-on learners, we have also included a number of workbook activities that allow the material to be explored in a more active fashion.

We hope that this booklet inspires and informs those who are developing emerging technologies to reflect on how these technologies can impact our societies. We also hope that this booklet inspires and informs black, brown, indigenous, and immigrant communities to reclaim technology as a tool of liberation.

With love and solidarity,

Mimi Onuoha and **Mother Cyborg**

ABOUT THE AUTHORS

MIMI ONUOHA

is a Brooklyn-based artist, researcher, and technologist investigating the social implications of data collection. Her work uses text, code, performance, and objects to explore missing data and the ways in which people are abstracted, represented, and classified.

MOTHER CYBORG (ALSO KNOWN AS DIANA NUCERA)

is here to escort you into the future with love. In 2017 she released her debut album, Pressure Systems, an opus to the power of self-transformation. She is an organizer and artist whose work focuses on developing popular education materials that empower communities to use media and technology to investigate, illuminate, and develop visionary solutions to challenges. Her music and laser performance build opportunities to connect stories, invigorate the soul and elevate our collective consciousness of technology.

CHAPTER 1

EVERYDAY AI

GLOSSARY OF TERMS

Because this book contains terms that not everyone may be familiar with, we've included a glossary below.[1]

ALGORITHM A series of steps (or set of rules) for solving or performing a task.

ANDROID (In science fiction) A robot with a human appearance.

ARTIFICIAL Made or produced by human beings rather than occurring naturally, typically as a copy of something natural.

ARTIFICIAL INTELLIGENCE The theory and development of computer systems able to perform tasks that normally require human intelligence.

AUTOMATION The technique, method, or system of controlling a process by reducing human intervention to a minimum.

COMPUTATION The use or operation of a computer.

CONSCIOUSNESS The fact of awareness by the mind of itself and the world.

CYBORG A person whose physical abilities are extended beyond normal human limitations by mechanical elements built into the body.

DATA Individual facts, statistics, or items of information.

DEVICE A thing made or adapted for a particular purpose, especially a piece of mechanical or electronic equipment.

DIVERSITY Diversity has come to refer to the various backgrounds and races that comprise a community, nation or other grouping. In many cases the term diversity does not just acknowledge the existence of variations in background, race, gender, religion, sexual orientation and so on, but implies an appreciation of these differences. The structural racism perspective (see below) can be distinguished from a diversity perspective in that structural

1 The definitions were gathered from a series of sources including: The Aspen Institute, Wikipedia.com, & Webster's Dictionary.

analysis takes account of the striking disparities in wellbeing and opportunity that come with being a member of a particular group, and works to identify ways in which these disparities can be eliminated.

INEQUITY Lack of fairness or justice.

INTELLIGENCE The ability to acquire and apply knowledge and skills.

MACHINE LEARNING A branch of artificial intelligence in which a computer generates rules and predictions based on raw data that has been fed into it.

MARGINALIZED COMMUNITIES Social marginalization is social disadvantage and relegation to the fringe of society. Marginalized communities are those which are prevented from participating fully in the economic, social, and political life of the society in which they live.

NATURE The phenomena of the physical world collectively, including plants, animals, the landscape, and other features and products of the earth, as opposed to humans or human creations.

NATURAL Existing in or caused by nature; not made or caused by humankind.

PREDICTIVE POLICING The usage of mathematical, statistical and analytical techniques in law enforcement to identify potential criminal activity before it occurs.

RACIAL EQUITY Racial equity refers to what a society genuinely free from racism would look like. In a racially equitable society, the distribution of society's benefits and burdens would not be skewed by race; in other words, racial equity would be a reality in which a person is no more or less likely to experience society's benefits or burdens because of the color of their skin. (This is in contrast to the current state of affairs in which a person of color is more likely to live in poverty, be imprisoned, drop out of high school, be unemployed and experience poor health outcomes like diabetes, heart disease, depression and other potentially fatal diseases.) Racial equity demands that we pay attention not just to individual-level discrimination, but to overall social outcomes.

ROBOT A machine capable of carrying out a complex series of actions automatically, especially one programmable by a computer.

SENSORS A device that detects and responds to some type of input from the physical environment.

SOCIAL DECISION-MAKING

The act of making decisions that have social consequences, or ramifications that can be felt by individual people.

STRUCTURAL RACISM

A system in which public policies, institutional practices, cultural representations, and other norms work in mutually reinforcing ways to perpetuate racial group inequity. A structural analysis of racism identifies dimensions of our history and culture that have allowed privileges associated with "whiteness" and disadvantages associated with "color" to endure and adapt over time. Structural racism is not something that a few people or institutions choose to practice. Instead it is a feature

AI AND THE QUEST TO COMPUTE THE HUMAN BRAIN

of the social, economic and political systems in which we all exist.

When you hear the words **"Artificial Intelligence"**, what are the first four things that come to your mind?

1. _____

2. _____

3. _____

4. _____

It is through science fiction that many of us first learn how to think about technology. Popular films and shows like *Terminator, 2001: A Space Odyssey, I Robot, Ex Machina, The Matrix, Westworld,* and *Her* may have shaped how you think about what a future with AI will look like.

Lots of popular narratives focus on machines that are conscious (meaning that they can think for themselves), and are working for or attacking their human creators. As a result, these stories push us away from seeing where AI is being used now and from considering the potential of AI to unite us and help to solve large-scale problems.

In a sense, AI represents a quest to imitate the human brain. It's about making a machine brain that can mimic the kinds of tasks that we think are unique to humans. In other words, AI is about developing machines that can do what humans can. Considering how complicated the human brain is, it's no wonder that we have only recently been able to get machines to do this. After all, the human brain is so complex that we as humans have not yet tapped into its full potential.

What we do understand about the brain is that there are multiple intelligences within humans and that our social environment influences how these intelligences are regarded. If AI is about imitating human intelligence, which forms of intelligence are we actually trying to mimic? As you read the list below, think about what it would look like to design a system with these attributes. What kind of information would be needed?

Below is a list of multiple intelligences that are present within humans:[2]

1. NATURALIST INTELLIGENCE

Naturalist intelligence designates the human ability to discriminate among living things (plants, animals) as well as sensitivity to other features of the natural world (clouds, rock configurations). This ability was clearly of value in our evolutionary past as hunters, gatherers, and farmers; it continues to be central in roles such as botanist or chef.

2 These intelligences were discovered Howard Earl Gardner, an American developmental psychologist and the John H. and Elisabeth A. Hobbs Professor of Cognition and Education at the Harvard Graduate School of Education at Harvard University.

2. MUSICAL INTELLIGENCE

Musical intelligence is the capacity to discern pitch, rhythm, timbre, and tone. This intelligence enables us to recognize, create, reproduce, and reflect on music, as demonstrated by composers, conductors, musicians, vocalist, and sensitive listeners.

3. LOGICAL-MATHEMATICAL (AKA COMPUTATIONAL) INTELLIGENCE

Logical-mathematical intelligence is the ability to calculate, quantify, consider propositions and hypotheses, and carry out mathematical operations. It enables us to perceive relationships and connections and to use abstract, symbolic thought, sequential reasoning skills, and inductive or deductive thinking patterns.

4. EXISTENTIAL INTELLIGENCE

Existential intelligence refers to the capacity to tackle deep questions about human existence, such as the meaning of life, why we die, and how our species arose.

5. INTERPERSONAL INTELLIGENCE

Interpersonal intelligence is the ability to understand and interact effectively with others. It involves effective verbal and nonverbal communication, the ability to note distinctions among others, sensitivity to the moods and temperaments of others, and the ability to entertain multiple perspectives.

6. BODILY-KINESTHETIC INTELLIGENCE

Bodily-kinesthetic intelligence is the capacity to manipulate objects and use a variety of physical skills. This intelligence also involves a sense of timing and the perfection of skills through mind-body union.

7. LINGUISTIC INTELLIGENCE

Linguistic intelligence is the ability to think in words and to use language to express and appreciate complex meanings. Linguistic intelligence allows us to understand the order and meaning of words and to apply meta-linguistic skills to reflect on our use of language.

8. INTRAPERSONAL INTELLIGENCE

Intrapersonal intelligence is the capacity to understand oneself and one's thoughts and feelings, and to use such knowledge in planning and directioning one's life. Intrapersonal intelligence involves not only an appreciation of the self, but also of the human condition.

9. SPATIAL INTELLIGENCE

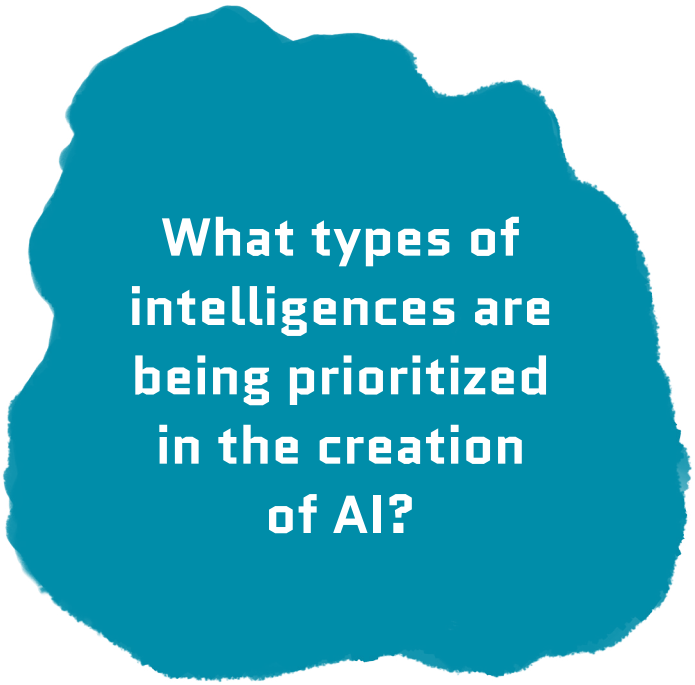
Spatial intelligence is the ability to think in three dimensions. Core capacities include mental imagery, spatial reasoning, image manipulation, graphic and artistic skills, and an active imagination.

Which intelligences do you identify with the most?

Which intelligence would you prioritize if you were in charge of developing an artificial intelligence system?

AI today is far from being conscious, but it is worth thinking about what types of intelligences are being prioritized in the creation of AI. After all, the intelligence we prioritize in our machines likely lines up with the intelligence that we prioritize in our societies.

We know that AI involves developing computer systems that can do things that humans are able to do. But to really understand AI, we need to look at how it is already being used today.



AI IN ACTION

Pointing to exactly what counts as AI and where it is being used is a surprisingly hard thing to do. This is because many examples of AI aren't about the creation of entirely new things. Instead, they are about adding AI to existing things. Adding AI can speed up a process, eliminate the need for humans to do something, or make a system more efficient.

Take the example of self-driving cars. Maybe you've heard about companies like Waymo, Uber, and BMW that are all trying to build cars that can drive themselves. This idea may sound crazy and futuristic, but when we break it down, we can see that it's really just an extension of something that we have been doing for years: automating our cars. When you automate something, you make it work with little to no human control. Over time, we've automated more and more parts of our cars. Older cars had manual transmission, or stick shift, where

the human driver sets the gear the car is driving in. Today we have automatic transmission: you just put the car in one gear and go.

Self-driving cars push this idea to the extreme: why not just automate *everything* in a car? This used to seem impossible—we thought that the process of driving a car was so complicated that only a human could do it. But AI is quickly changing things. Self-driving cars cars have sensors that can take in information about exactly what is around them, and AI is being used to sort through that information and determine how to react (for example, we want our cars to respond differently to a stop sign than to a yield sign).

We've provided more examples of ways in which AI shows up in your life. These show the many roles that AI plays—not in creating new objects or applications, but in improving existing ones.

Read the list and check the box next to the applications you have experienced.

☐ VIRTUAL ASSISTANTS

Nowadays many companies have created AI personal assistants that do some of the work that human assistants do. These AI assistants can take on tasks like scheduling meetings, figuring out how long it will take people to respond to emails, and finding files in email inboxes.

Chatbots are a common example of virtual assistants. If you've ever logged onto a website and had a window pop up asking if you want to chat with a customer advisor, keep in mind that you might be interacting with an AI system! Already these assistants are quite sophisticated, able to handle all types of questions and respond with accuracy.

☐ HANDWRITING RECOGNITION

For humans, recognizing handwriting seems simple. But for computers, it's way more challenging. A computer has to be able to make sense of all ways that humans can write the same character differently. However, handwriting recognition is one example of AI that has been integrated into our lives. When you deposit checks from your mobile phone or into an ATM, AI is behind that ability for the machine to make sense of the letters and numbers.

☐ FACIAL RECOGNITION

Facial recognition systems can identify people through digital images or video footage. Though the technology has existed for a long time, in recent years it has improved dramatically . When you upload a photo to a social media site or save it to your phone and the system can successfully tell who is in the picture, AI is involved in the process.

Facial recognition is being applied in all sorts of different areas. On Facebook, it is used to identify people in images so that it can be easier for users to tag their friends in photos. In China, some city governments have started using facial recognition to identify jaywalkers from street cameras, with plans to issue fines automatically via text message. At the beginning of 2018, Amazon opened its first Amazon Go store in Seattle. Amazon Go stores don't have cashiers or check-out machines—instead, an AI system monitors the video feeds to identify who is choosing which items from the shelves.

☐ MACHINE TRANSLATION

Machine translation is language translation done by a machine instead of a human. In the past, if you were traveling to a part of the world where people spoke a different language, you had to pull out a translation dictionary and hope for the best. Now you can take out your phone, open Google Translate, and be able to translate signs, menus, and phrases. Though the technology isn't perfect, it's thanks to advances in AI that computers have become so much more effective at translating between languages.

☐ SPAM FILTERING

Email spam filtering is an older example of AI. If you have an email address and don't find yourself constantly getting spam emails, then you have AI to thank! Rcognizing which emails are the ones you want to receive and which are likely to be spam is a task that is only becoming easier because of AI techniques for classification.

☐ CONVERSATIONAL SYSTEMS

Have you ever asked Siri, Alexa, Cortana, or Google Home a question? These computer systems communicate with people in ways that feel natural. They are powered by speech recognition systems that use AI to recognize what you're asking.

☐ RECOMMENDATION ENGINES

This is one form of AI that is all over the web. Have you ever shopped on Amazon, decided to add something to your cart, and then seen suggestions for things other customers have bought after buying the same item? Or maybe you've watched a video on YouTube and been given recommendations for a video to watch afterwards, or searched for images online and been shown other "visually similar" images. Recommendation Engines use AI to figure out which things are similar to other things, and then predict what you'll like based on things that you've looked at or bought before.

Did any of these applications of AI surprise you?

What are other places where you suspect AI is present?

UNDERSTANDING AI

Hopefully the examples in the previous section have shown that AI isn't just one thing. This is exactly why AI is so powerful: because it is a number of different technologies that can be incorporated into almost any digital space to make things work more efficiently.

With this in mind, one way to think of AI is as salt rather than its own food group. It's less interesting to consider it on its own. But once you add salt to your food it can transform the meal.

Over the course of this booklet we'll bring up more examples of AI in our everyday lives. But as it turns out, the definition of AI is a moving target. As we've already mentioned, AI is the development of computer systems that can do tasks that normally would require human intelligence.

In 1950, computer scientist Alan Turing developed the Turing test to define what it meant for a computer to be considered "intelligent". A machine passes the Turing test if a human interacting with it is unable to tell whether they are talking with a human or a machine.

In many ways, the forms of AI that we use today do pass this test. In fact, some of Google's AI assistants try *intentionally* to sound like humans, so that people won't know they're speaking to a computer.[3]

AI has existed as a field of research since the early 1900s, and the ideas that inform it—which we'll talk about in later chapters and explore in the workshops at the end of the book—go back centuries. But in recent times, the field has had a huge surge in popularity. It is only in the last ten years that we have seen the availability of huge amounts of information, computers that are powerful enough to make sense of that information, and people who know how to write code that can put both of those things together.

These things have brought about the creation of a field called **machine learning**, which is responsible for some of the larger innovations in AI (like the software powering cars that can drive themselves). But to understand how machine learning works and why it's so important, we have to take a step back, and learn about the rules that are at the heart of these systems.

3 Some journalists and researchers have pointed out that machines trying to trick humans is not ethical. https://www.theverge.com/2018/5/9/17334658/google-ai-phone-call-assistant-duplex-ethical-social-implications

EVERYDAY AI ACTIVITY

AI is present in most of our everyday lives. It doesn't look like the robots we see on TV—instead, it's the name for a broad field with lots of applications that can take many forms. Let's explore what AI in our everyday life looks like and identify what the potential impact of it can be.

Think about the devices and/or digital services you use daily. Write below a list of the top three that are present in your life.

1. _____

2. _____

3. _____

Have these things ever surprised you by guessing something about you that you didn't expect? Here are some examples:

"One morning I noticed my phone created a heartfelt recap of the year with my photos that made me tear up a little."

"One time I got an email and my email inbox suggested how I should reply to it."

See if you can recall a similar moment and write about it below.

AI is very present in smartphones and Internet-based applications we use everyday. Sometimes, it might feel strange when you notice an application of AI—it might feel like someone is listening in on you and keeping track of your habits. Other times, you might think that it's useful, or helpful for something to know your patterns. Either way, being able to identify the many roles that AI can play can help you begin to think about how it impacts your daily life.

Take a moment to see if you can identify what function AI plays in the following list. If you get lost, go back to the examples of AI In Action on **page 17.**

DEVICE OR DIGITAL SERVICE WITH AI	AI FUNCTION(S)
Email inbox	
Check depositing	
Texting and mobile keyboards	
Netflix	
Google (search function)	
Social media platforms (Instagram, Facebook, Twitter, etc)	
Automated message systems	

Now that you have a better idea of what applications of AI in everyday life look like, let's think about the impact that they have.

What do we gain by having AI in our everyday lives?

What do we lose by having AI in our daily lives?

Sometimes, AI seems magical in how it can easily transform difficult tasks. But right now, AI is designed and implemented by large companies or governments. It is more like a bulldozer than a hammer. What we mean by this is that it's a tool, but not a common one that everyone can use, like a hammer. Like a bulldozer, it is something that you need special training to work with and lots of money and resources to use on a meaningful level.

But what if it were more widely available? What if there were tool kits that allowed you to access the materials needed to develop AI systems, just like there are tools that allow people to create websites? What would you build?

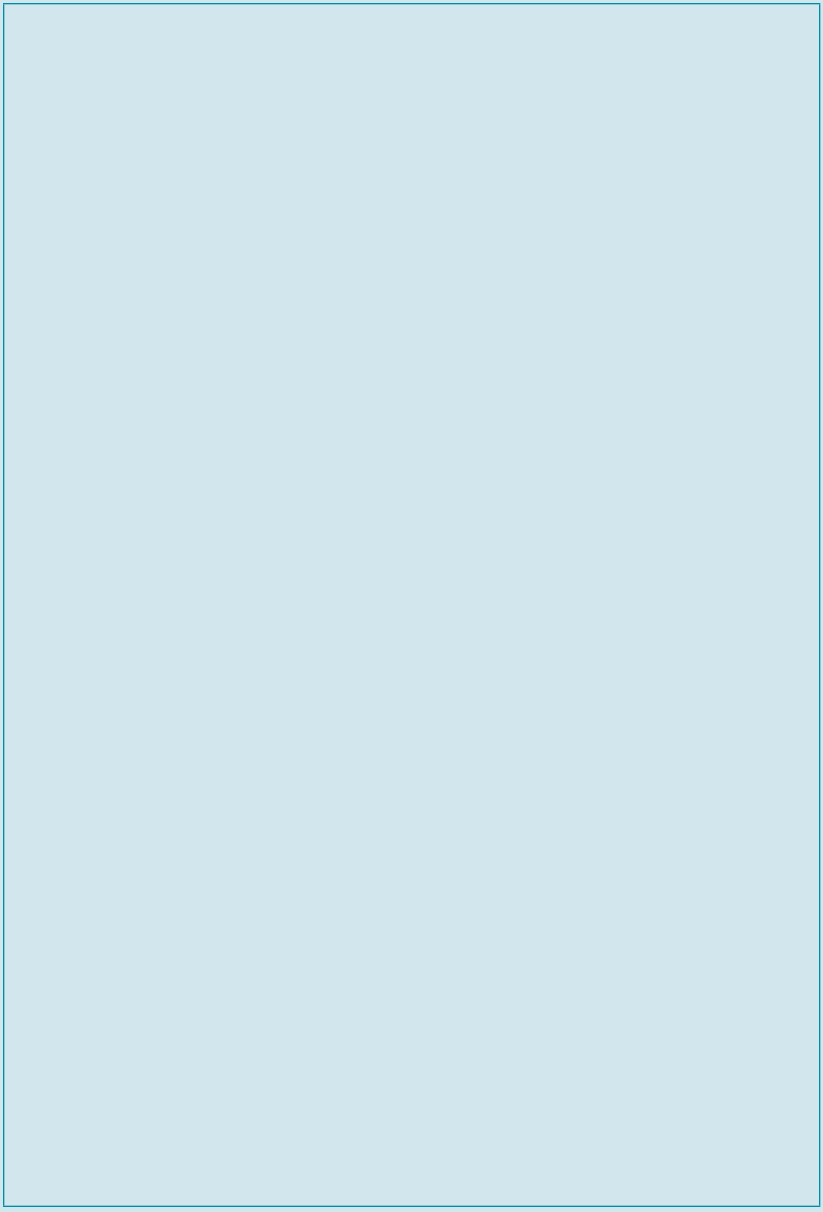
Think about what you have learned so far about what AI is and how it shows up in our daily lives. Your task is to identify a problem that you see in your life, neighborhood, or community and design an AI system that could help address this problem.

Use the prompts below to help design an AI system.

WHAT PROBLEM ARE YOU TRYING TO ADDRESS ?	
HOW CAN AI HELP SOLVE THIS ISSUE?	
WHAT ROLE WILL HUMANS HAVE IN ADDRESSING THIS ISSUE?	
WHAT DATA DO YOU NEED TO CREATE AN AI TO HELP YOU ADDRESS YOUR ISSUE?	
HOW WILL YOU RESPONSIBLY GATHER THIS DATA IN A WAY THAT RESPECTS INDIVIDUALS' PRIVACY AND CONSENT?	

Now that you have your AI systems framework, take a moment to draw your system. This can look like a flow chart, or be a drawing of what you think the system will look like and where it will live. It's up to you! Try to be creative.

Use the box below to design your prototype system.



CHAPTER 2

ALGORITHMS

WHAT IS AN ALGORITHM?

We can't talk about AI or machine learning without talking about algorithms.

This is because algorithms are the basic building blocks of AI. In fact, algorithms are the building blocks of computer programs in general. But even more than that, they're the building blocks of how many of us live our lives.

When you get ready in the morning, what do you do? Maybe you have a set routine: you might wake up, take a shower, brush your teeth, then eat breakfast. These are the steps you take so that you can be ready for the day ahead of you.

This is what an algorithm is: a series of steps that allow you to perform a particular task.

In this case, the task is getting yourself ready for the day. But the task an algorithm solves can be much simpler or much more complicated.

As a result, most of us don't even realize how much of our lives are organized by algorithms.

Every algorithm takes in defined inputs (the things being acted upon) and has the goal of producing defined outputs (the results you want). For example, maybe you have a set algorithm for making yourself a sandwich for lunch. Your goal, or output, might be to make a sandwich that will fill you up. The inputs are all of the ingredients that will go into the sandwich, and your algorithm is how you order and arrange these things so that you can get your desired result, or output, of a sandwich for lunch.

Cleaning your room could be another example of a personal algorithm. The goal, or output, is a clean room, and the input is your room as it currently is, containing the items in the room that you will manipulate in some way. You might have a specific order for how you clean your room. Maybe you start by sweeping the floor, then you clean the windows, then you make the bed, then dust the dresser, and then your room is clean. This is your room-cleaning algorithm, or the steps you take to get to the desired output of a clean room.

But let's say you find that by sweeping the floor before dusting, you end up sweeping the floor twice because it gets dirty from the dust. Someone else who has their own room cleaning algorithm might

suggest doing things in a different way. They may start by making the bed, then cleaning the windows, dusting the counters, then sweeping the floor. And they might argue that their algorithm is more efficient because it's faster, since they only have to sweep the floor once.

This gives us a couple of key points about algorithms:

1. Different algorithms can exist for accomplishing the same task.

2. Algorithms are often judged by their efficiency, and efficiency can be evaluated in different ways. For example, you could judge the efficiency of an algorithm by how long it takes to do a task, how well it does a task, how much energy it uses to do a task, and so on.

Take a second to think about your algorithm for cleaning your room. What are the steps you follow?

TASK: ***Clean your room***

INPUT(S): ***Your room in its current state***

OUTPUT: ***A clean room***

Steps for algorithm:

1. _____

2. _____

3. _____

4. _____

5. _____

COMPUTER ALGORITHMS

So far we've been talking about personal algorithms. But the main space where you are likely to hear about algorithms is in relation to computers. The programs that computers run are full of algorithms. Like the personal algorithms that humans use, these computational algorithms exist to solve problems or perform tasks.

But the big difference between the algorithms that computers use and the informal ones that we use is that we can't describe our problems to computers in the same way that we describe them to ourselves. Instead, we have to be more direct and explicit with a computer about the problems we want it to solve.

There's a simple reason for this. Computers exist to make our lives easier. They tend to be very good at doing things that we're not good at (think how much more quickly you can do math on your cell phone, which is a just a tiny computer, than you can in your head). But computers tend to be pretty bad at the things that we're good at, like understanding context and nuance.

What this means is that if you tell a computer to sort a huge list of numbers from smallest to largest or to compute the shortest possible distance between two places, it can do the task easily. But if you try to ask a computer to clean your room, it won't know what you mean, because it doesn't know what it means to "clean", the equipment needed to "clean" or even what a room is.

In other words, computer algorithms have to be specific and clear. You can't tell a computer to clean your room, but you can tell a device programmed by a computer to pick up an object that is close to the ground and place it on the table (but keep in mind that you'll also have to tell it that a table is a flat surface that is above the ground, since it won't know what that is either).

Bubble Sort is the name of a common algorithm used to sort a list of numbers from smallest to largest. It starts at the beginning of a list, compares each pair of numbers in the list and swaps them if they are in the incorrect order, then repeats once it's reached the end of the list until the numbers are all sorted correctly. Here's what it would look like using our personal algorithm format:

TASK: ***Sort a list of numbers from smallest to largest***

INPUT(S): ***List of numbers: [7, 1, 40,_3, 5]***

OUTPUT: ***Sorted list of numbers***

Steps for Algorithm:

1. Compare the first element (7) with the second element (1).
2. 7 is larger than 1, so swap the order of the two. If not, do nothing.
3. Get a new list of **[1, 7, 40, 3, 5].**

4. Now compare the second element of the new list (7) with the third element of the new list **(40).**

5. If 7 is larger than 40, swap their order. If not, do nothing.

6. Get new list of **[1, 7, 40, 3, 5].**

7. Now compare the third element of the new list **(40)** with the fourth element of the new list **(3)**.

8. If 40 is larger than 3, swap their order. If not, do nothing.

9. Get new list of **[1, 7, 3, 40, 5].**

10. Compare the fourth element of the new list **(40)** with the fifth element of the new list **(5)**.

11. If 40 is larger than 5, swap their order. If not, do nothing.

12. Get new list of **[1, 7, 3, 5, 40].**

13. There are no more elements within the list. The sorted list is **[1, 7, 3, 5, 40]**. We can see that the last element is in the right place, but we still need to sort the others. From here, we start again from the beginning .

14. Compare the first element **(1)** with the second element **(7).**

15. If 1 is larger than 7, swap their order. If not, do nothing.

16. Get new list of **[1, 7, 3, 5, 40].**

17. Repeat until the entire list is sorted.

This is what computational thinking looks like. It involves breaking down a problem to its most basic parts and thinking sequentially to solve that problem.

Ordering a list is a perfect example of a problem that can be easily solved by a computational algorithm. But there are many problems which we will talk about later in the booklet that can't be solved as easily in the same way.

EMBODYING SOCIAL ALGORITHMS

Use the chart below to think through how algorithms show up in your everyday life.

DESCRIBE A PERSONAL ALGORITHM THAT YOU USE IN YOUR LIFE.	DESCRIBE ANOTHER ALGORITHM THAT YOU COULD USE TO DO THE SAME TASK.	WHICH OF THE TWO ALGORITHMS IS THE MOST EFFICIENT? HOW ARE YOU EVALUATING ITS EFFICIENCY?

You already use algorithms in your personal life. But what does it look like when algorithms are used in social spaces? What do we as a society or group gain or lose from allowing algorithms to inform or make our decisions? To begin answering these questions, let's design our own social algorithm.

Here is a prompt to help set the framework for your algorithm.

Think of the living people you would most like to meet in this world. This evening there is a large event taking place that will definitely contain all of those people. It will also contain access to other important people and opportunities that could impact the lives of all of your friends and family.

*The organizers of the event have given you only **5** invites to the event. They trust you enough that they've asked you to invite the five most **interesting and fun** people you know. However, to keep things fair, they've decided that rather than just choosing the people yourself, you have to design an algorithm, or a series of steps and conditions, for identifying who the 5 most interesting and fun people who you know are.*

Your task is to design an algorithm that will **choose the five most interesting and fun people** of the group. You can only work with information that is publicly available, for example, social media public posts, comments, likes, follows, hashtags, events, the number of platforms they're on, and so on.

✡**IMPORTANT**✡ You are not allowed to actually look at people's social media to grab the data, you have to figure out what you would look for to determine **what is "fun" and what is "interesting".**

Use this chart below to brainstorm what data you need to create this algorithm.

WHAT DATA OR INFORMATION CAN YOU USE TO FIGURE OUT IF SOMEONE IS FUN?	WHAT DATA OR INFORMATION CAN YOU USE TO FIGURE OUT IF SOMEONE IS INTERESTING?

Now sift through your brainstorm to create an algorithm. Use the prompts below to help you in your design. If you get confused about what algorithms are, re-read the start of this chapter to help you out.

Fun people can be found with the following 4 data sets

LOCATION OF DATA				
WHAT IT IS AND HOW IT IDENTIFIES FUN				

Interesting people that can be found with the following 4 data sets

LOCATION OF DATA				
WHAT IT IS AND HOW IT IDENTIFIES INTERESTING				

Before moving on, take a moment to rate the importance of each data set. This will create a weight or sense of priority. Use the numbers 1–5 to rate your sets. 1 is the most important data and 5 is the least important.

Now that you have your data sets or "inputs" for your algorithm and a rating of their importance, the next step is to identify the "outputs" and create a series of steps that direct your algorithm's function. Be-

low is a template to help you make these decisions.

TASK: *Create the list of people who will be invited to the party*

INPUT(S): *The data you have about your friends and family*

OUTPUT: *A list of the five most interesting and fun people you know*

What are the steps your algorithm needs to take in order to generate your desired output?

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

If you forget what this is, check out the example of how bubble sort works on **page 34**. Just remember, the idea is to make a set of directions that your algorithm will follow to help you sort through the data you have identified. You may have just a few steps or have more than 10, it is up to you.

Now that you've written your algorithm, take a look at it. Based on the algorithm, would you be invited to the party?

Which types and groups of people do you know would be left out of your algorithm?

TO SUM IT UP

If you were able to come up with a social algorithm that can determine who is interesting and fun in an equitable way... amazing! We suspect that you may have stopped at some point and questioned the activity. Maybe you thought that there was no good way of telling how fun or interesting someone is. Or maybe you considered that ideas of "fun" and "interesting" are contextual, and might be different for different people. Maybe you just designed an algorithm that would make it so you could attend the party!

This activity is meant to show just how complex humans are and how attributes like "interesting" and "fun" are relative to whoever is designing the algorithm.

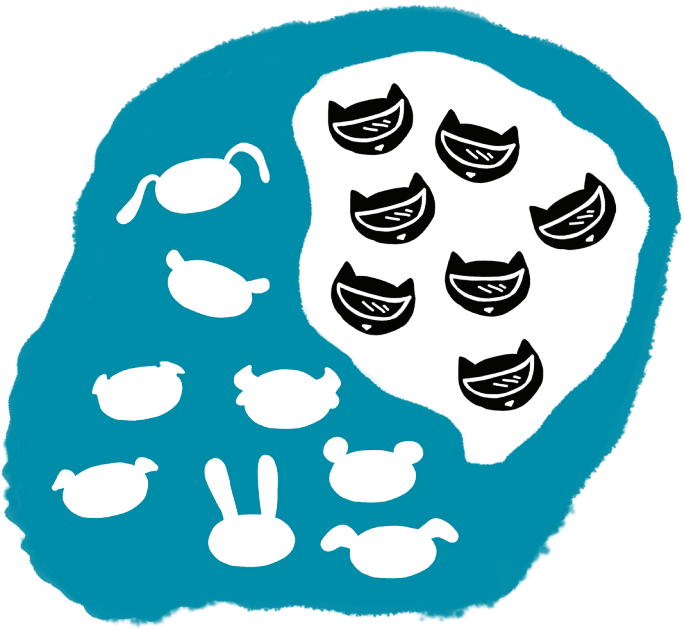
An activity like this is simple and doesn't have many consequences. But if people could fall through the cracks in an algorithm that determines party invitations, what would happen if you were using the same ideas of algorithmic decision-making for deciding things like policing, safety, or education? In fact, this is already happening, and we'll talk more about the impact of such things later on.

CHAPTER 3

MACHINE LEARNING

THE DIFFERENCE BETWEEN AI AND MACHINE LEARNING

When we talk about AI, sometimes we are actually talking about a field called "machine learning." These two concepts are often grouped together because machine learning makes up part of the field of artificial intelligence. Just as every cat is an animal, but not every animal is a cat, every machine learning algorithm is an example of AI, even though not everything in AI is machine learning. But the real difference between the two comes down to the different algorithms that make them up, and what those algorithms try to do.



AI is the development of computer systems that do things we would normally think only humans could. Over time, as our computer programs have become more sophisticated, our ideas of which tasks require human intelligence have also evolved. This means that now AI refers to a large field of tasks.

Machine learning is even more specific. It is also a branch of AI, which means that it too involves computers doing things that normally require human intelligence. But machine learning also includes tasks that even humans might not be able to do, or that would require much more time if humans did them. Generally speaking, in AI, humans set the terms for the algorithm that a computer will use, while in machine learning the computers construct the algorithms themselves.

The reason this can happen in machine learning comes down to one key thing that the programs are able to do: successfully recognize

PATTERN RECOGNITION AND PREDICTION

patterns and predict what is likely come next.

Pattern recognition is at the heart of the human brain; it is one of the traits that has been most helpful to us as a species. It's also a skill that you use every day.

Imagine that you are given this pattern:

0 2 4 6 8 ?

Now you are asked to predict what the next number in the series will be. You might correctly guess that the answer is 10. But how are you really able to do this? You can guess the next number by taking in the information that you've been given (the list of numbers) and recognizing the pattern behind them (each time we add 2 to the previous number). Because you can look at the data and recognize the pattern organizing it, you can predict what comes next.

This is what machine learning is about, but on a much larger scale.

In machine learning, we give computer programs lots of information and those programs use specific algorithms to see the patterns in the information.

Once they are able to recognize the patterns, they can then predict what is likely to happen next—assuming that the pattern stays the same.

Historically, the desire for prediction dates back to ancient times. For example, being able to predict the weather has allowed farmers to grow and harvest crops for thousands of years. In ancient times, those who were thought to have the power of seeing what would happen in the future were considered to be spiritual leaders such as oracles, shamans, and even healers. Prediction meant the ability to not be caught off-guard by the future, which meant higher chances of success.

In what ways do you think prediction can give you an advantage over others today?

What would you like to be able to predict?

EXAMPLES OF MACHINE LEARNING ALGORITHMS

We call the information that we give to computer algorithms data. For machine learning to work, computers need lots and lots of data, more data than humans would be able to keep track of. So although humans can recognize patterns in data (like you did with the series of even numbers above), machine learning programs can track and make sense of far more data than we humans can hold in our heads.

Look back at the AI in Action list on **page 17**. As you saw there, you have probably already experienced AI in action. Now that you know the difference between machine learning and general AI, we can be more specific about which examples are powered not just by AI, but machine learning systems.

NETFLIX

As you watch TV and movies on Netflix, the machine learning algorithms used by the website try to recognize the patterns in what you are watching so that they can recommend other things you might like.

SPOTIFY

The music application Spotify is similar to Netflix. In this application, machine learning algorithms try to recognize what songs are similar to the ones you're listening to so that you'll enjoy new songs that are automatically selected to play. (However, although these might match the pattern of your listening, they won't be able to expose you to genres that you haven't already opted into.)

HOSPITALS

Some hospitals are trying to use machine learning to be able to predict whether certain medical emergencies will happen to patients based on matching their medical data and symptoms with those of other patients who have had similar emergencies.

MACHINE TRANSLATION

Machine learning is being used for fast translation between languages. If you use Google Translate to understand another language, you're making use of a machine learning algorithm. These algorithms are better now than they ever have been, but can still unintentionally perpetuate gender biases and miss out on newer slang terms. They also can only work for languages and dialects that have enough data.

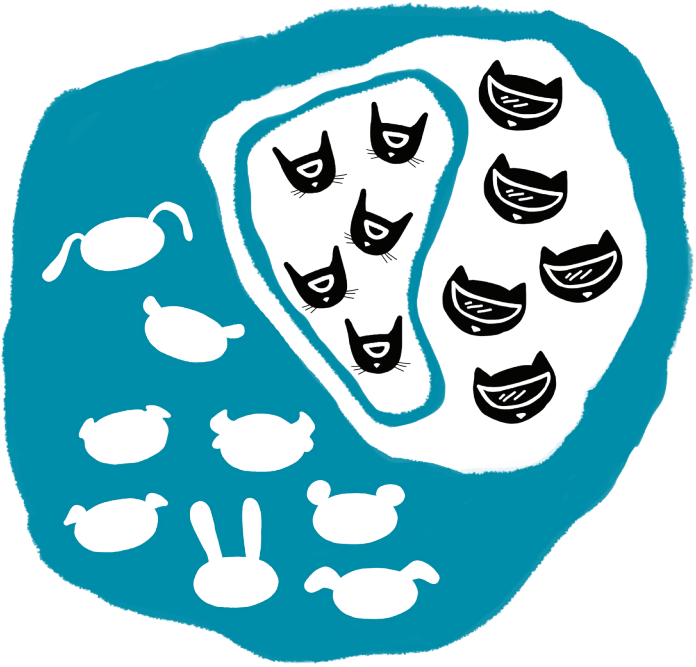
These are just a few examples of machine learning, but every day more and more are being developed.

If you could teach a machine to recognize a pattern, what would that pattern be?

DEEP LEARNING: COMPUTERS THAT "LEARN"

One important aspect of machine learning is a field called deep learning. Deep learning is a sub-field of machine learning. Just as all Siamese cats are cats, but not all cats are Siamese cats, all examples of deep learning are examples of machine learning, even though not all machine learning is deep learning.

Deep learning is different than just machine learning because of the idea of scale: deep learning requires more data so that the programs can make more connections and do more complex operations. In deep learning, what is important is not just that the computer programs can recognize the patterns in data and predict what comes next, but that the programs get better at doing this while they're being trained on existing data. Thus, deep learning is also about this ability of certain computer programs to improve on their own. The programs seem like they're "learning" because they get better at their tasks over time, just like humans do when we are learning.



The field is called "deep learning" partly because the learning process is, well, deep. The actual ways that these programs improve can sometimes be a mystery to us. While humans are the ones who write the algorithms behind these programs, the work that the algorithms are doing involves layers and layers of very complicated math. As a result, we can't always directly understand what patterns the algorithms are identifying. Like all algorithms, their goal is to present outputs, not necessarily the processes behind those outputs.

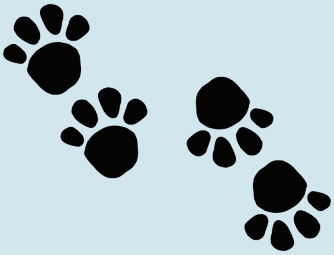
But what we can effect is what this technology is being used for. This means influencing the idea behind the process of recognizing patterns, predicting what might come next, and improving at this prediction. Right now, while AI is pretty prevalent in the world, most machine learning technologies are in the hands of big companies with deep pockets. This is why we see so many examples of technology companies like Netflix, Spotify, Google, Amazon, and Facebook using machine learning.

But in most of cases, while machine learning applications might have a *specific* goal like suggesting the next song you'll want to listen

to or choosing the film you want to watch next, they also have bigger goals. Those goals are usually in line with the company's profit needs. These are things like getting you to stay longer on a website, or getting you to buy more of a product. These larger aims are the direct result of who has control and power in the space. In other words, lots of modern-day AI is driven by the needs of large corporations, not the needs of the people.

How would machine learning applications be different if more people could think and dream about other uses for machine learning technologies?

What would you develop if you could leverage the powers of machine learning and AI however you wanted? Are there any problems you think you could solve in your local or international community?



PATTERN FINDER ACTIVITY

Our societies have always placed importance on the ability of being able to predict future events. In machine learning, machines make predictions about the future based on patterns they find within data from the past. This activity explores what the uses and impact of machine learning are.

Before we dive into pattern recognition and machine learning, let's first look at how patterns are already a part of our lives. Take a moment to think about what patterns you've seen in your own life and what data informs those patterns.

Use the space below to identify a few patterns you observe. Then, work backwards to think about what information revealed those patterns.

A PATTERN YOU'VE NOTICED	WHAT MADE YOU NOTICE THIS PATTERN?
Example: On weekdays, traffic always gets more intense around 8am	*Example: On mornings I leave at 8am it takes me twice as long to get to work as when I leave at 8:30.*

Recognizing patterns helps us make sense of our lives. Understanding the patterns of the Earth's weather allows farmers to plan their growing seasons and helps people plan events like outdoor weddings or family reunions. On a larger scale, learning historical patterns of weather allows us to identify climate change.

To understand the complexity of pattern recognition and predictive algorithms, let's take a moment to unpack how they work and identify where there are flaws in relying on machines to predict outcomes. Below are a few word problems. Your task as a group is to predict what the following people will do next.

Dana is a musician who loves music. This morning she listened to Whitney Houston's *"I Will Always Love You"*, after that she listened to Rihanna's *"Love On The Brain"*, then she listened to Nirvana's *"Smells Like Ten Spirit"*, then she listened to Selena's *"Techno Cumbia"*. Can you guess what she might want to listen to next?

Mini loves to cook. She ate a vegetable scramble for breakfast, had some carrots and hummus for snacks, then a grilled cheese sandwich with an apple and cookie for lunch. What do you think she will want to eat for dinner? BONUS: Does Mini have any diet restrictions or preferences?

Did you have enough information to make a decision that you think is right? If not, what information would have been helpful?

The way that deep learning and machine learning work is by first training machines on data for things that we know already happened, so that we can guess what will happen next. But we need lots of data for this to work. Here's the data for the other songs Dana listened to and the food that Mini ate over the past week.

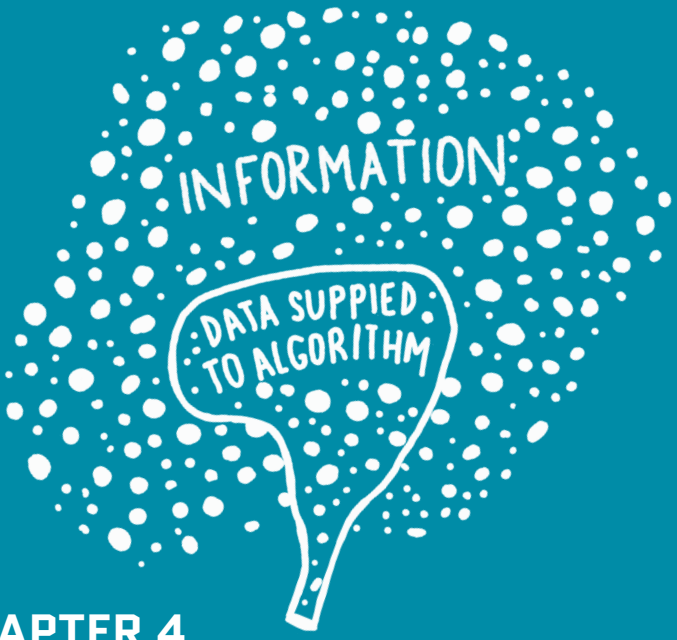
See if you can guess what genres of music or type of food they will listen to and eat on Friday:

WEEKDAY	MONDAY	TUESDAY
DANA	**1. Whitney Houston** *I Will Always Love You* **2. Rihanna** *Love On The Brain* **3. Nirvana's Smells** *Like Teen Spirit* **4. Selena** *Techno Cumbia*	**1. Mariah Carey** *Vision of Love* **2. Amy Winehouse** *Back to Black* **3. Radiohead** *Creep* **4. Madonna** *Spanish Lullaby*
MINI	**Breakfast** *Vegetable scramble and toast* **Snack** *Carrot and hummus* **Lunch** *Grilled cheese sandwich with apple and cookie*	**Breakfast** *Biscuit and eggs* **Snack** *Carrot and ranch dip* **Lunch** *Avocado panini with orange and brownie*

WEDNESDAY	THURSDAY	FRIDAY
1. Lizzo *Worship me* **2. Aretha Franklin** *RESPECT* **3. Cranberries** *Zombie* **4. Bomba Estereo** *Fiesta*	**1. SZA** *Love Galore* **2. No Name** *NF* **3. Fiona Apple** *Criminal* **4. Buena Vista Social Club** *Dos Gardenias*	**1.** _____ **2.** _____ **3.** _____ **4.** _____
Breakfast *Bagel and scrambled eggs* **Snack** *Celery and hummus* **Lunch** *Grilled veggie sandwich with grapes and ice cream*	**Breakfast** *Omelette with french toast* **Snack** *Celery and hummus* **Lunch** *Mozzarella sandwich with pear and apple pie*	**Breakfast** _____ **Snack** _____ **Lunch** _____

It becomes a lot easier to see the patterns of Dana and Mini's habits once you have more information about those habits! Computers work in the same way: the more data they have, the easier it is for them to predict future examples.

However, computers can only predict things based on the data or information they have. Our lives are complex, and our habits can change. If Mini or Dana change their minds about what they want to listen to or eat, it would make things more difficult to predict what was next.



CHAPTER 4

EQUITY

Because we live in a society that is built on top of structural racism and inequity, these technologies don't always end up being good for everyone

AI IN SOCIAL SPACES

How do we make AI equitable for all of us?

When we talk about equity, we are speaking about the idea that every human should have equal opportunities to participate in and benefit from economic and governance structures. We particularly like the definition of racial equity created by the Aspen Institute:

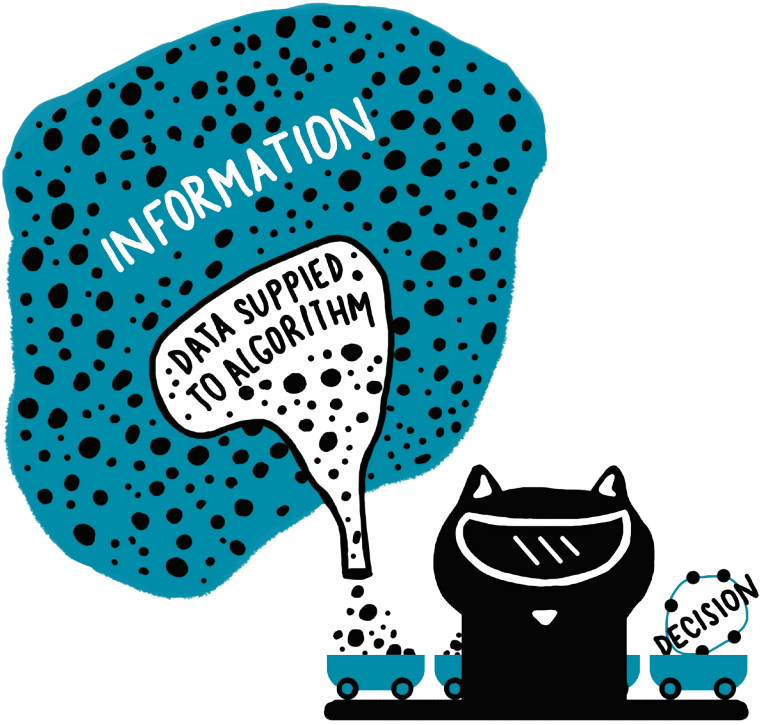
> *Racial equity refers to what a genuinely non-racist society would look like. In a racially equitable society, the distribution of society's benefits and burdens would not be skewed by race. In other words, racial equity would be a reality in which a person is no more or less likely to experience society's benefits or burdens just because of the color of their skin. This is in contrast to the current state of affairs in which a person of color is more likely to live in poverty, be imprisoned, dropout of high school, be unemployed and experience poor health outcomes like diabetes, heart disease, depression and other potentially fatal diseases. Racial equity holds society to a higher standard. It demands that we pay attention not just to individual-level discrimination, but to overall social outcomes.*

The potential of AI and machine learning is huge. AI taps into the ongoing human need for greater efficiency and more tools that can allow us to better to the things we want to do. Machine learning taps into our ability to recognize patterns and extends our ever-present desire for prediction.

On their own, these ideas are powerful. They can open doors for reimagining our present and future. But because we live in a society that is built on top of structural racism and inequity, the applications of these technologies don't always end up being good for everyone.

For example, one current application of machine learning is **predictive policing**. Predictive policing algorithms decide where police should be sent based on where computer programs predict crime will happen (just like in the movie *Minority Report*, but with algorithms instead of precogs). The idea is that if we can predict where crime occurs, we can be more efficient about where we send police. In fact, predictive policing advocates even think that crime could be prevented by sending more police to the areas where it might occur.

Predictive policing perfectly illustrates the difficulties of applying AI to social spaces. An idea as simple as making policing more efficient seems smart on the surface, but in practice it can have surprising—and even dangerous!—effects.



LIMITED DATA

When you make decisions, what information do you use to guide your choices? For example, if you wanted to buy a car, how would you decide which one to get?

You might go online and look at a website about different types of cars, how much gas they use, and what their mileages are. Or maybe you would talk to a friend or family member who just bought a car and ask them which ones they considered. You might even try to buy a book on cars, or think back to your experience if you bought a car in the past.

As humans, we're constantly using our senses to take in details about the world around us, but we also have lots of different sources that we can consult if we want to absorb even more information.

In this way, computers aren't like humans. They can't quite understand context, and they don't have access to the experiences that we

use to influence our decisions. Unlike us, a machine learning algorithm can't draw on a lifetime of living in the world. The only information it can use is the data that it's been given by the people who created it.

So what happens if a machine learning algorithm is given data that's wrong or incorrect in some way? Even if it's programmed exactly right, the predictions that the program makes will be inaccurate. Some computer programmers call this the "garbage in, garbage out" problem: the output of a machine learning or AI algorithm can only be as good as the data it's given.

In the case of predictive policing, algorithms are given data about where crimes have happened in the past. This might seem simple, but we always have to take a deeper look at the data algorithms work with. When it comes to policing, research has shown that some groups (like minorities, undocumented people, immigrants, and marginalized people) are less likely to call the police than others. So data about where crime happens is always going to include far less of this information, which means that it will reflect the needs of the groups that do feel safe calling the police.

On top of that, the algorithms we're talking about can't do what individual police officers do, which is use their judgement to decide what counts as crime. Research[4] has shown that being caught doing the same illegal activities doesn't result in the same charges for different people. People in richer communities are more likely to receive lenient responses after being caught doing some types of activity (like smoking marijuana). So the data for "crime" doesn't show where it happens, but just where it's charged.

Undocumented people, immigrants, and people of color in lower-income spaces also tend to be over-surveilled. In other words, they're more likely to have data and information collected about them without their consent, or they're forced to give it up to get access to basic needs. For example, if you qualify for food stamps in the US, you know that you had to share a lot of information about yourself with the local government, whereas your wealthier neighbor likely hasn't been forced to in the same way.

4 http://www.asanet.org/sites/default/files/attach/journals/oct16asrfeature.pdf

This overcollection of data *about* some people and undercollection of data that *serves* those people results in a cycle of data violence that is passed on to these algorithms.

TRANSPARENCY AND POWER

While it is easy to see the outputs of machine learning algorithms, it can be difficult to see why an algorithm makes the prediction it makes. The algorithms are so complicated that the processes behind them are hidden, even to the people creating them.

In the real world, many machine learning algorithms are not available for the general public to examine, even if they are about the general public. Many large-scale algorithms are protected as "trade secrets". The companies that create them don't want to share them or the data that they've given the algorithms because they worry that they'll lose their business advantage over competitors.

In the case of predictive policing, this creates even more complications. The companies creating predictive policing algorithms are doing so in order to make money and sell the software to police departments. But the people who will be affected by the algorithms (such as the people who live in the areas that are classified as high-crime or the people who might be affected as a result of increased police presence in their neighborhoods) don't have a say in these algorithms. Even worse, many of these people don't know that their data has been collected or that these algorithms are being used in the first place. These people will not even have the opportunity to access the data or algorithms and determine for themselves whether or not they are fair.

The use of AI comes down to the question of who has power.

Considering the power that is tied to AI and machine learning forces us to have to think about difficult things. In some cases, it means that a company might have to ask itself whether its AI or machine learning initiative should even exist. After all, just because something can be done doesn't mean it *should be*.

It's important for people and communities to identify their own problems, and decide on their own uses for technology. But in cases like

predictive policing, where an outside company is deciding on algorithms that will affect certain communities disproportionately, then those communities should be able to have a say in those decisions.

We're still at a moment where we can decide what types of algorithms we want to be used in our social spaces. But that means doing the (sometimes hard) work of thinking about all the ways in which a machine learning algorithm can make things easier for some while making things more difficult for others.

IMAGINE: Use the example of predictive policing to imagine a similar algorithm for deciding which students should be allowed to go to which schools. How would it work?

What questions could you ask that would help you think about who this algorithm is harming or benefiting?

When we are dreaming up our own machine learning algorithms, how do we make sure that they aren't causing harm or reinforcing existing structural inequalities in society? What are three big questions one could ask to see if an algorithm is fair?

1. _____

2. _____

3. _____

There are many scholars, designers, researchers, journalists, and lawyers who are working hard on the issue of algorithmic accountability. In late 2017, New York City passed a law about algorithmic transparency that was the first of its kind. This law was designed to make the information behind algorithms more available and transparent. But it also faced some pushback from experts and companies who didn't want to give up their competitive advantage.

We don't think that algorithms should be treated as easy solutions. Sometimes we humans trust in the ability of computers to solve our problems without considering the fact that these computers are running algorithms that have been built in a society where things already aren't fair for everyone. We want to emphasize the ability for efficiency that these algorithms can give us, while also recognizing that they're not enough on their own.

A predictive policing algorithm that centered the people whose data it uses might not exist unless its creators had spoken with the people in areas designated as high-crime to discuss their existing experiences with the police. It might involve using community-collected data, and making sure the people whose data is being used have ownership and a say over its usage. It might even involve resistance to the very idea of being able to predict something like crime, which we have already seen is more contextual than it seems.

The work that is behind AI algorithms is difficult and complicated. As it is now, there's a small group of people who know how to create deep learning and machine learning systems. With this in mind, it can be easy to see the work of programming and designing such systems as the hardest there is.

But it's important to remind ourselves that there are other types of work that are just as important. One of these is the ability to dream up uses for machine and deep learning systems that are imaginative and aware of all the trade-offs these systems have to work with. Another is the work of considering the effects that the things we design can have on the world.

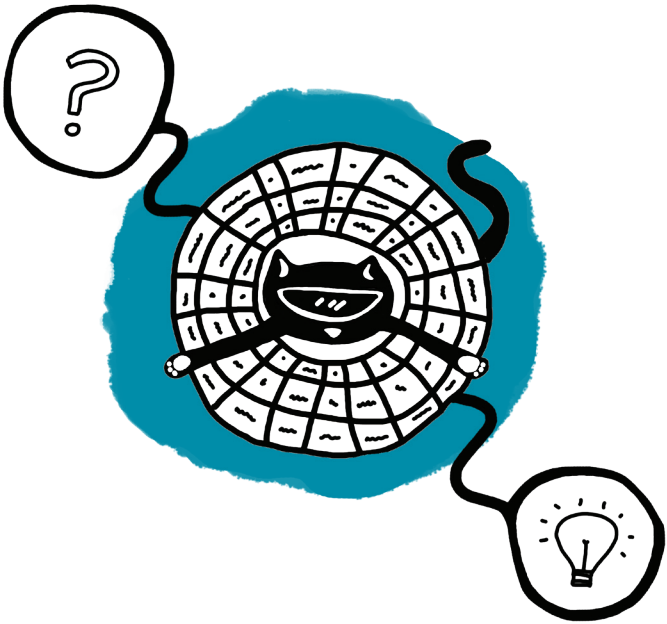
Because we live in a society where not everyone experiences things in the same way, if we create new things without deeply thinking about the effects they can have, it is more likely that those creations will end up making things harder for people who are already struggling than it is that they will end up being fair for everyone.

How do you prepare for a future that is the complete opposite of what you know?

A PARADIGM SHIFT

In 1974 Pamela McCorduck, an AI researcher and writer, explained AI's birth as "an ancient wish to forge the gods."[5] In her book, *Machines Who Think*, she traces the concept of automation to the mid 8th century BCE with Homer's *The Iliad*, reminding us that our hopes and fears around AI are as old as our ancient ancestor.

5 Machines Who Think: A Personal Inquiry into the History and Prospects of Artificial Intelligence (2nd ed.). Natick, Mass.: A.K. Peters. 2004. ISBN 1-56881-205-1.



The seeds of modern AI were planted by classical philosophers and astrologers who wanted to describe the process of human thinking as the mechanical manipulation of symbols. In the 5th century a device called the Za'irajah, or the *paper machine*, that was composed of paper disks with combinations of number values associated with letters and categories, created a coded language system used by astrologers, leaders and philosophers in thinking through problems.[6] Its function was to reconfigure "notions" into "ideas" through a process of randomization and resonance. In other words, you could input a question and it would output a sort of mythical poem or riddle to inspire thought.

Our relationship with automation throughout history has evolved from paper disks provoking ideas to an industrial revolution of mechanical automation. Each step of the way, one thing led to another, creating a shift in the ways that humans worked, lived, and communicated. The Za'irajah inspired expansion of thought and perception. The paper machine went on to inspire the creation of the Ars Magna, a book that first laid out the rules of algebra, which in turn was

6 Ibn Khaldūn. 1958 *The Muqaddimah: An introduction to history*. Translated from the Arabic by Franz Rosenthal. 3 vols. New York: Princeton. Chapter 6 section 28

connected to the Renaissance, an age of new thinking that manifested in new types of art, architecture, politics, science and literature. All of this laid the foundation for the development of the math and science that make up automation and AI today.

Over a decade before Pamela McCorduck released her ancient AI timeline, political activist James Boggs published *American Revolution: Pages from a Negro Worker's Notebook* in 1963. In this compilation of essays and speeches, Boggs shares his personal experience with automation as an auto worker at Ford Motor Company and activist in Detroit, MI. He writes about the cultural and social impacts industry has on life and the role automation will play in revolutionizing the United States:

> *"Automation replaces men. This of course is nothing new. What is new is that now, unlike most earlier periods, the displaced men have nowhere to go. The farmers displaced by mechanization of the farms in the 20's could go to the cities and man the assembly lines. As for the work animals like the mule, they could just stop growing them. But automation displaces people, and you don't just stop growing people even when they have been made expendable by the system."*
> **—James Boggs, 1963**

James Boggs' writing from the 1960's is proof that conversations about work, automation, and jobs being taken over by machines have been happening for decades. But Boggs also reminds us that this question gives us an opportunity to completely re-imagine what the relationship between society and work could be in the future.

What if we dared to imagine a future where there is no more work? How would this paradigm shift change us?

We can look at the economic impact of automation from the 1940's until now and try to predict what the future of work is. We might hope that we could create an algorithm or teach a machine to figure it out for us, but the truth is that there will always be complex social situations that are hard to quantify. So how do you prepare for a future that is the complete opposite of what you know?

A SPECULATIVE SCI-FI ACTIVITY

Below is an activity to help envision what a holistic workless society can look like. In this activity you will write your own sci-fi story, using the worst case scenario to create the best possible outcome for the evolution of humankind.

THE YEAR IS 2084 and you've just been thawed from a frozen chamber (cryptofreezer) you entered 60 years ago after you decided enough was enough. At the time that you entered the cryptofreezer, the economy had dramatically collapsed and there were only five years of fossil fuels left for the entire planet. The dystopian future you had read about in sci-fi novels was upon you. You remember a deep panic worldwide followed by a global economic crash and neighborhoods rapidly turning into ghost towns as people fled to find their families and loved ones. Due to an accident from years ago, you didn't have a family to go to. You were single with no kids or pets, just a sole person trying to get through the hard times that were upon you.

You remember seeing the cryptofreezers pop up across the street from the artisan cupcake shop next to the restaurant you worked at but you didn't think anything of it until the day you realized the world as you knew it was no more. You decided to freeze yourself until the chaos passed. You didn't want to go at it alone.

All of that is behind you now. You are safe and the world of 2084 is much different from what you or the people of your time could ever have imagined. The workers in the cryptofreezer clinic suggest you take some time to gather your bearings before jumping into society. Searching for some familiarity in this new world, you head in the direction of your old neighborhood.

What is something you see on your way to your old neighborhood that blows your mind? Draw it in the box below.

What does it do? How does it work?

You finally arrive and recognize the public library you used to go to. You walk in thinking that you might find someone there who can help you understand the history that you missed while in the cryptofreezer. When you walk in the door you are baffled by what you see.

What do you see when you walk into the public library in 2084?

Finally you find another person who can help you. They are very friendly and see that you are in a bit of distress. You begin asking the burning questions that have been spinning in your head since you woke up.

What are the first five questions you ask?

1.
2.
3.
4.
5.

These questions begin a deeper conversation. The person you're speaking to is fascinated by you choosing to be a "late thawer." They explain that "late thawers" are the people who chose the cheapest cryptofreezer package that ended up taking an extra 20 years to thaw.

You learn that everyone in society receives a monthly stipend no matter what they do, that most of what you used to know as "work" is done by machines now. You learn about the new ways in which food is created and how governance and the economy work. You are delighted by what you hear and realize that there is a different type of relationship between technology and humans that is far different from what the world was like when you left it behind 60 years ago. You are finally able to put the pieces together as to how the world evolved in the time you were gone. Use the prompts below to share what you have learned.

In what ways do you notice society is different?

How do people pass their time in this new world?

What role do machines play in the world?

What was the paradigm shift that created a new relationship between humans and technology?

THE AGENCY WE HAVE

No matter where the future takes us, there will always be fundamental human needs that must be met. Encouraged by people like James Boggs and Pamela McCorduck, we look to our past to help us envision the future of work, culture, and life.

We are still in the beginning of our time with widespread AI. For this reason, our current moment is extremely important. The rules and policies surrounding the technology haven't been written yet, and we don't completely know what the long-term effects of AI and machine learning technologies will be within our societies. But we do know that we can affect the trajectory of the future if we are aware of what changes we seek and what we are collectively working towards.

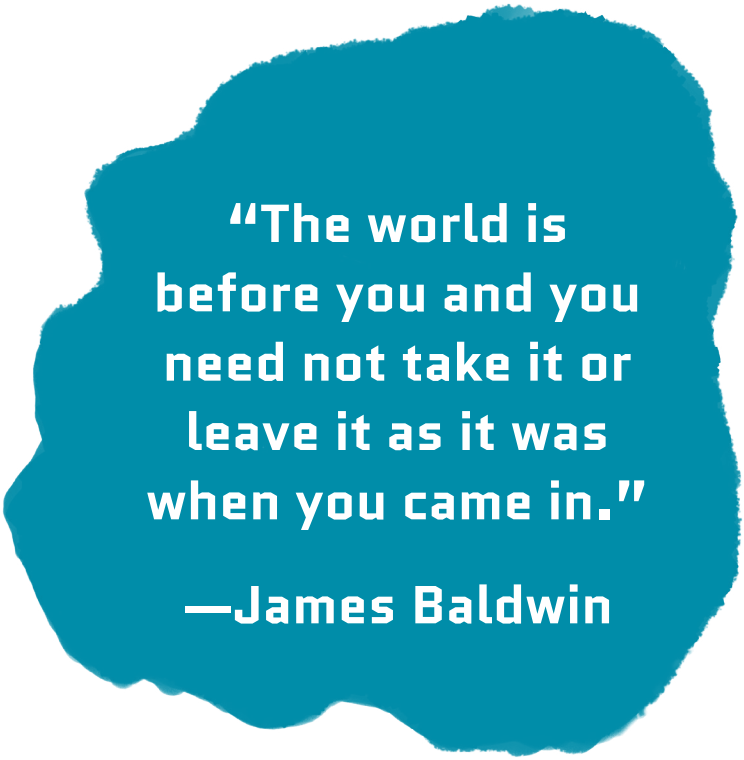
It can be hard for those who have been heavily impacted by violence, discrimination, or unfairness to think of futures that are free of those things. To do this, we have to understand the problems we face and commit to the hard work of considering the world differently. This work lies in educating ourselves, our peers and our loved ones. In order to speak and lead by example, we must take ownership of the technology and transform it to be purposeful, meaningful and intentional in our communities.

But we are not alone. Even today, there are uses of AI that are doing this exact thing. One of the biggest problems in Mexico today involves *desaparecidos*, or the more than 30,000 people who have gone missing because of drug-related violence. In 2017, a group of researchers from Mexico and the United States teamed up to use machine learning to predict where these missing graves are located, addressing one of the hardest parts of a huge country-wide problem.

Over in Iceland, a company has been working hard on creating prosthetics that use AI technology to work better. These prosthetic limbs are able to work more smoothly and powerfully because they can learn and adjust as they are used by amputees. These prosthetics have the ability to make limbs that are "smarter" than flesh ones.

And within creative practices, a number of artists, designers, and technologists are creating works that engage with, critique, and use machine learning and AI to change the ways that we approach these technologies.

These applications are just a few of many that prove that even though we are in a time where it's difficult to get access to the resources for large-scale AI projects, the technologies can still be used in ways that focus on groups and people who are outside of the mainstream.



We are inspired by the words of those who came before us. Essayist and author James Baldwin once said, *"The world is before you and you need not take it or leave it as it was when you came in."* Organizer and philosopher Grace Lee Boggs has taught us that, *"You cannot change any society unless you take responsibility for it, unless you see yourself belonging to it, and responsible for changing it."*

In the spirit of these and countless others who were brave enough to dare to dream of different worlds, we honor their legacies by continuing the work of creating change. Artists, activists, technologists, and educators all have a role to play in shaping the future of technology. We each have a role to play in shaping the future of technology.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