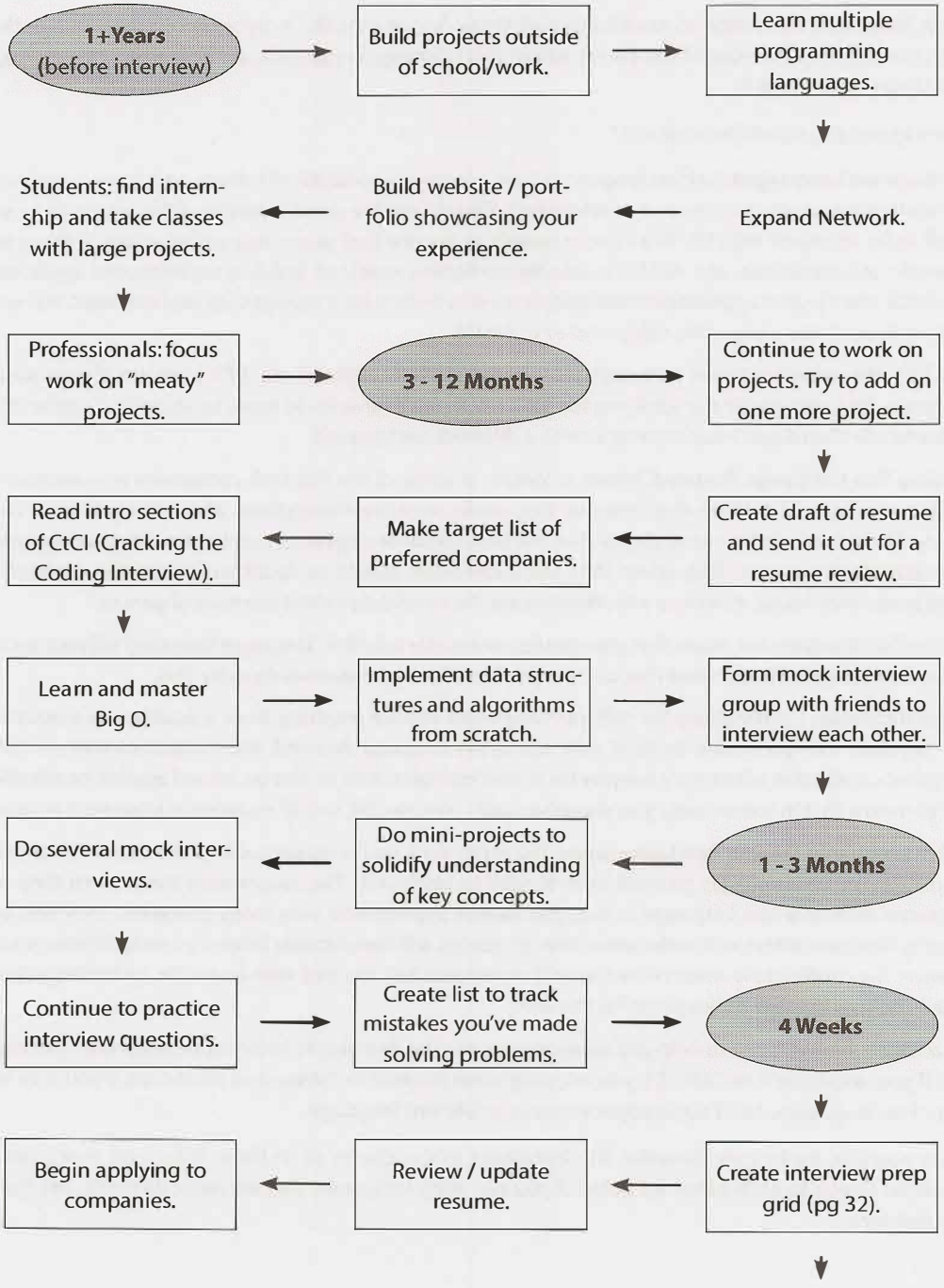
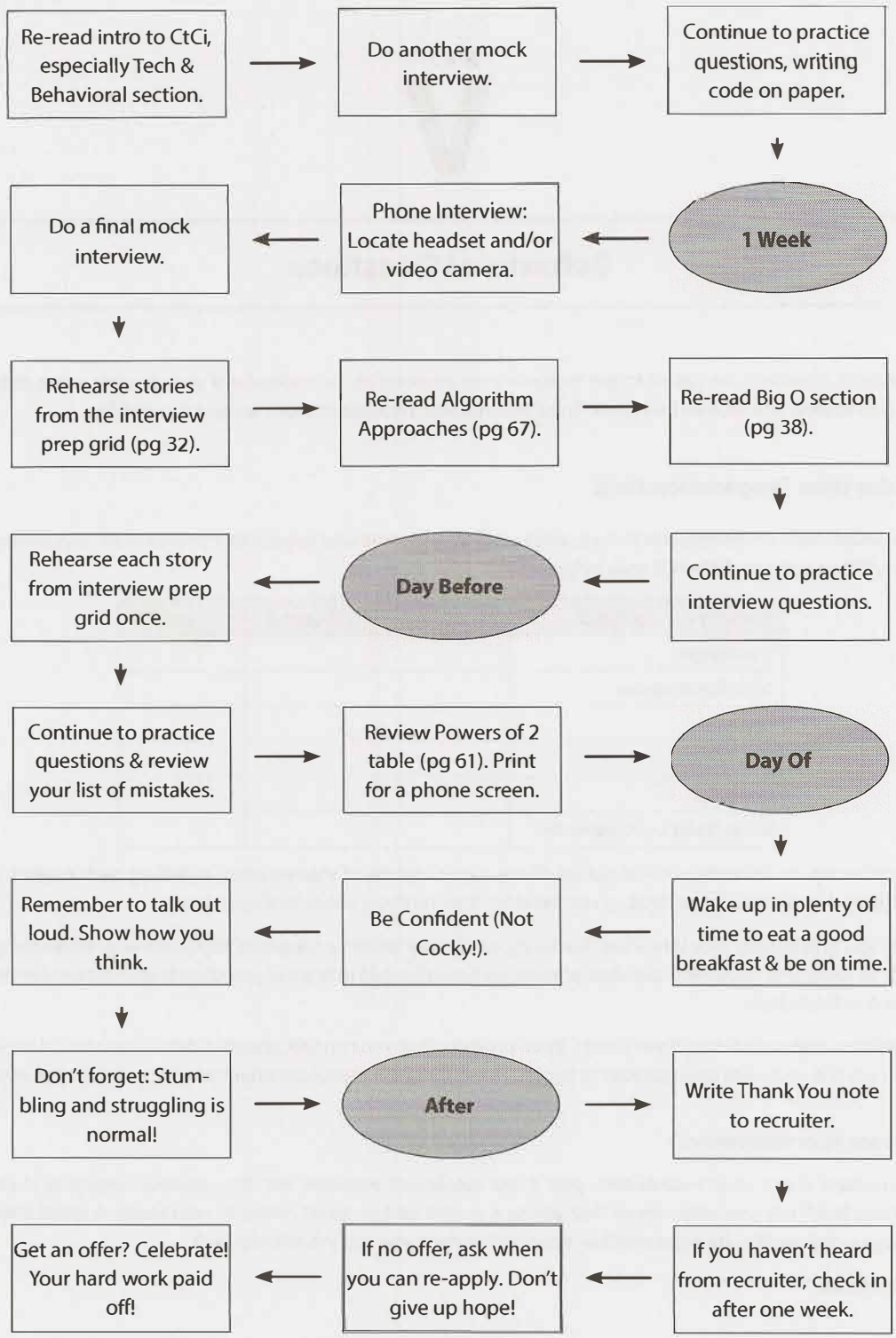
Preparation Map

The following map should give you an idea of how to tackle the interview preparation process. One of the key takeaways here is that it's not just about interview questions. Do projects and write code, too!




Re-read intro to CtCi, especially Tech & Behavioral section.
Do another mock interview.
Continue to practice questions, writing code on paper.
1 Week
Phone Interview: Locate headset and/or video camera.
Do a final mock interview.
Rehearse stories from the interview prep grid (pg 32).
Re-read Algorithm Approaches (pg 67).
Re-read Big O section (pg 38).
Continue to practice interview questions.
Day Before
Rehearse each story from interview prep grid once.
Continue to practice questions & review your list of mistakes.
Review Powers of 2 table (pg 61). Print for a phone screen.
Day Of
Wake up in plenty of time to eat a good breakfast & be on time.
Be Confident (Not Cocky!).
Remember to talk out loud. Show how you think.
Don't forget: Stumbling and struggling is normal!
After
Write Thank You note to recruiter.
If you haven't heard from recruiter, check in after one week.
If no offer, ask when you can re-apply. Don't give up hope!
Get an offer? Celebrate! Your hard work paid off!

V

Behavioral Questions

Behavioral questions are asked to get to know your personality, to understand your resume more deeply, and just to ease you into an interview. They are important questions and can be prepared for.

Interview Preparation Grid

Go through each of the projects or components of your resume and ensure that you can talk about them in detail. Filling out a grid like this may help:

Common Questions	Project 1	Project 2	Project 3
Challenges			
Mistakes/Failures			
Enjoyed			
Leadership			
Conflicts			
What You'd Do Differently			

Along the top, as columns, you should list all the major aspects of your resume, including each project, job, or activity. Along the side, as rows, you should list the common behavioral questions.

Study this grid before your interview. Reducing each story to just a couple of keywords may make the grid easier to study and recall. You can also more easily have this grid in front of you during an interview without it being a distraction.

In addition, ensure that you have one to three projects that you can talk about in detail. You should be able to discuss the technical components in depth. These should be projects where you played a central role.

What are your weaknesses?

When asked about your weaknesses, give a real weakness! Answers like "My greatest weakness is that I work too hard" tell your interviewer that you're arrogant and/or won't admit to your faults. A good answer conveys a real, legitimate weakness but emphasizes how you work to overcome it.

For example:

> "Sometimes, I don't have a very good attention to detail. While that's good because it lets me execute quickly, it also means that I sometimes make careless mistakes. Because of that, I make sure to always have someone else double check my work."

What questions should you ask the interviewer?

Most interviewers will give you a chance to ask them questions. The quality of your questions will be a factor, whether subconsciously or consciously, in their decisions. Walk into the interview with some questions in mind.

You can think about three general types of questions.

Genuine Questions

These are the questions you actually want to know the answers to. Here are a few ideas of questions that are valuable to many candidates:

1. "What is the ratio of testers to developers to program managers? What is the interaction like? How does project planning happen on the team?"
2. "What brought you to this company? What has been most challenging for you?"

These questions will give you a good feel for what the day-to-day life is like at the company.

Insightful Questions

These questions demonstrate your knowledge or understanding of technology.

1. "I noticed that you use technology X. How do you handle problem Y?"
2. "Why did the product choose to use the X protocol over the Y protocol? I know it has benefits like A, B, C, but many companies choose not to use it because of issue D."

Asking such questions will typically require advance research about the company.

Passion Questions

These questions are designed to demonstrate your passion for technology. They show that you're interested in learning and will be a strong contributor to the company.

1. "I'm very interested in scalability, and I'd love to learn more about it. What opportunities are there at this company to learn about this?"
2. "I'm not familiar with technology X, but it sounds like a very interesting solution. Could you tell me a bit more about how it works?"

▸ Know Your Technical Projects

As part of your preparation, you should focus on two or three technical projects that you should deeply master. Select projects that ideally fit the following criteria:

- The project had challenging components (beyond just "learning a lot").
- You played a central role (ideally on the challenging components).
- You can talk at technical depth.

For those projects, and all your projects, be able to talk about the challenges, mistakes, technical decisions, choices of technologies (and tradeoffs of these), and the things you would do differently.

You can also think about follow-up questions, like how you would scale the application.

Responding to Behavioral Questions

Behavioral questions allow your interviewer to get to know you and your prior experience better. Remember the following advice when responding to questions.

Be Specific, Not Arrogant

Arrogance is a red flag, but you still want to make yourself sound impressive. So how do you make yourself sound good without being arrogant? By being specific!

Specificity means giving just the facts and letting the interviewer derive an interpretation. For example, rather than saying that you "did all the hard parts," you can instead describe the specific bits you did that were challenging.

Limit Details

When a candidate blabbers on about a problem, it's hard for an interviewer who isn't well versed in the subject or project to understand it.

Stay light on details and just state the key points. When possible, try to translate it or at least explain the impact. You can always offer the interviewer the opportunity to drill in further.

> "By examining the most common user behavior and applying the Rabin-Karp algorithm, I designed a new algorithm to reduce search from `O(n)` to `O(log n)` in 90% of cases. I can go into more details if you'd like."

This demonstrates the key points while letting your interviewer ask for more details if he wants to.

Focus on Yourself, Not Your Team

Interviews are fundamentally an individual assessment. Unfortunately, when you listen to many candidates (especially those in leadership roles), their answers are about "we", "us", and "the team." The interviewer walks away having little idea what the candidate's actual impact was and might conclude that the candidate did little.

Pay attention to your answers. Listen for how much you say "we" versus "I." Assume that every question is about your role, and speak to that.

Give Structured Answers

There are two common ways to think about structuring responses to a behavioral question: nugget first and S.A.R. These techniques can be used separately or together.

Nugget First

Nugget First means starting your response with a "nugget" that succinctly describes what your response will be about.

For example:

- Interviewer: "Tell me about a time you had to persuade a group of people to make a big change."
- Candidate: "Sure, let me tell you about the time when I convinced my school to let undergraduates teach their own courses. Initially, my school had a rule where..."

This technique grabs your interviewer's attention and makes it very clear what your story will be about. It also helps you be more focused in your communication, since you've made it very clear to yourself what the gist of your response is.

S.A.R. (Situation, Action, Result)

The S.A.R. approach means that you start off outlining the situation, then explaining the actions you took, and lastly, describing the result.

Example: "Tell me about a challenging interaction with a teammate."

- **Situation:** On my operating systems project, I was assigned to work with three other people. While two were great, the third team member didn't contribute much. He stayed quiet during meetings, rarely chipped in during email discussions, and struggled to complete his components. This was an issue not only because it shifted more work onto us, but also because we didn't know if we could count on him.
- **Action:** I didn't want to write him off completely yet, so I tried to resolve the situation. I did three things.

  First, I wanted to understand why he was acting like this. Was it laziness? Was he busy with something else? I struck up a conversation with him and then asked him open-ended questions about how he felt it was going. Interestingly, basically out of nowhere, he said that he wanted to take on the writeup, which is one of the most time intensive parts. This showed me that it wasn't laziness; it was that he didn't feel like he was good enough to write code.

  Second, now that I understand the cause, I tried to make it clear that he shouldn't fear messing up. I told him about some of the bigger mistakes that I made and admitted that I wasn't clear about a lot of parts of the project either.

  Third and finally, I asked him to help me with breaking out some of the components of the project. We sat down together and designed a thorough spec for one of the big component, in much more detail than we had before. Once he could see all the pieces, it helped show him that the project wasn't as scary as he'd assumed.
- **Result:** With his confidence raised, he now offered to take on a bunch of the smaller coding work, and then eventually some of the biggest parts. He finished all his work on time, and he contributed more in discussions. We were happy to work with him on a future project.

The situation and the result should be succinct. Your interviewer generally does not need many details to understand what happened and, in fact, may be confused by them.

By using the S.A.R. model with clear situations, actions and results, the interviewer will be able to easily identify how you made an impact and why it mattered.

Consider putting your stories into the following grid:

	Nugget	Situation	Action(s)	Result	What It Says
Story 1			1. ... 2. ... 3. ...		
Story 2					

Explore the Action

In almost all cases, the "action" is the most important part of the story. Unfortunately, far too many people talk on and on about the situation, but then just breeze through the action.

Instead, dive into the action. Where possible, break down the action into multiple parts. For example: "I did three things. First, I..." This will encourage sufficient depth.

Think About What It Says

Re-read the story on page 35. What personality attributes has the candidate demonstrated?

- **Initiative/Leadership:** The candidate tried to resolve the situation by addressing it head-on.
- **Empathy:** The candidate tried to understand what was happening to the person. The candidate also showed empathy in knowing what would resolve the teammate's insecurity.
- **Compassion:** Although the teammate was harming the team, the candidate wasn't angry at the teammate. His empathy led him to compassion.
- **Humility:** The candidate was able to admit to his own flaws (not only to the teammate, but also to the interviewer).
- **Teamwork/Helpfulness:** The candidate worked with the teammate to break down the project into manageable chunks.

You should think about your stories from this perspective. Analyze the actions you took and how you reacted. What personality attributes does your reaction demonstrate?

In many cases, the answer is "none." That usually means you need to rework how you communicate the story to make the attribute clearer. You don't want to explicitly say, "I did X because I have empathy," but you can go one step away from that. For example:

- **Less Clear Attribute:** "I called up the client and told him what happened."
- **More Clear Attribute (Empathy and Courage):** "I made sure to call the client myself, because I knew that he would appreciate hearing it directly from me."

If you still can't make the personality attributes clear, then you might need to come up with a new story entirely.

So, tell me about yourself...

Many interviewers kick off the session by asking you to tell them a bit about yourself, or asking you to walk through your resume. This is essentially a "pitch". It's your interviewer's first impression of you, so you want to be sure to nail this.

Structure

A typical structure that works well for many people is essentially chronological, with the opening sentence describing their current job and the conclusion discussing their relevant and interesting hobbies outside of work (if any).

1. **Current Role [Headline Only]:** "I'm a software engineer at Microworks, where I've been leading the Android team for the last five years."
2. **College:** My background is in computer science. I did my undergrad at Berkeley and spent a few summers working at startups, including one where I attempted to launch my own business.
3. **Post College & Onwards:** After college, I wanted to get some exposure to larger corporations so I joined Amazon as a developer. It was a great experience. I learned a ton about large system design and I got to really drive the launch of a key part of AWS. That actually showed me that I really wanted to be in a more

entrepreneurial environment.

4. **Current Role [Details]:** One of my old managers from Amazon recruited me out to join her startup, which was what brought me to Microworks. Here, I did the initial system architecture, which has scaled pretty well with our rapid growth. I then took an opportunity to lead the Android team. I do manage a team of three, but my role is primarily with technical leadership: architecture, coding, etc.
5. **Outside of Work:** Outside of work, I've been participating in some hackathons—mostly doing iOS development there as a way to learn it more deeply. I'm also active as a moderator on online forums around Android development.
6. **Wrap Up:** I'm looking now for something new, and your company caught my eye. I've always loved the connection with the user, and I really want to get back to a smaller environment too.

This structure works well for about 95% of candidates. For candidate with more experience, you might condense part of it. Ten years from now, the candidate's initial statements might become just: "After my CS degree from Berkeley, I spent a few years at Amazon and then joined a startup where I led the Android team."

Hobbies

Think carefully about your hobbies. You may or may not want to discuss them.

Often they're just fluff. If your hobby is just generic activities like skiing or playing with your dog, you can probably skip it.

Sometimes though, hobbies can be useful. This often happens when:

- The hobby is extremely unique (e.g., fire breathing). It may strike up a bit of a conversation and kick off the interview on a more amiable note.
- The hobby is technical. This not only boosts your actual skillset, but it also shows passion for technology.
- The hobby demonstrates a positive personality attribute. A hobby like "remodeling your house yourself" shows a drive to learn new things, take some risks, and get your hands dirty (literally and figuratively).

It would rarely hurt to mention hobbies, so when in doubt, you might as well.

Think about how to best frame your hobby though. Do you have any successes or specific work to show from it (e.g., landing a part in a play)? Is there a personality attribute this hobby demonstrates?

Sprinkle in Shows of Successes

In the above pitch, the candidate has casually dropped in some highlights of his background.

- He specifically mentioned that he was recruited out of Microworks by his old manager, which shows that he was successful at Amazon.
- He also mentions wanting to be in a smaller environment, which shows some element of culture fit (assuming this is a startup he's applying for).
- He mentions some successes he's had, such as launching a key part of AWS and architecting a scalable system.
- He mentions his hobbies, both of which show a drive to learn.

When you think about your pitch, think about what different aspects of your background say about you. Can you can drop in shows of successes (awards, promotions, being recruited out by someone you worked with, launches, etc.)? What do you want to communicate about yourself?

VI

Big O

This is such an important concept that we are dedicating an entire (long!) chapter to it.

Big O time is the language and metric we use to describe the efficiency of algorithms. Not understanding it thoroughly can really hurt you in developing an algorithm. Not only might you be judged harshly for not really understanding big O, but you will also struggle to judge when your algorithm is getting faster or slower.

Master this concept.

An Analogy

Imagine the following scenario: You've got a file on a hard drive and you need to send it to your friend who lives across the country. You need to get the file to your friend as fast as possible. How should you send it?

Most people's first thought would be email, FTP, or some other means of electronic transfer. That thought is reasonable, but only half correct.

If it's a small file, you're certainly right. It would take 5 - 10 hours to get to an airport, hop on a flight, and then deliver it to your friend.

But what if the file were really, really large? Is it possible that it's faster to physically deliver it via plane?

Yes, actually it is. A one-terabyte (1 TB) file could take more than a day to transfer electronically. It would be much faster to just fly it across the country. If your file is that urgent (and cost isn't an issue), you might just want to do that.

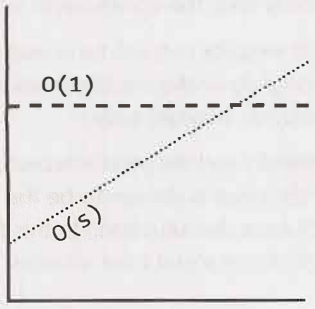
What if there were no flights, and instead you had to drive across the country? Even then, for a really huge file, it would be faster to drive.

Time Complexity

This is what the concept of asymptotic runtime, or big O time, means. We could describe the data transfer "algorithm" runtime as:

- Electronic Transfer: `O(s)`, where `s` is the size of the file. This means that the time to transfer the file increases linearly with the size of the file. (Yes, this is a bit of a simplification, but that's okay for these purposes.)
- Airplane Transfer: `O(1)` with respect to the size of the file. As the size of the file increases, it won't take any longer to get the file to your friend. The time is constant.

No matter how big the constant is and how slow the linear increase is, linear will at some point surpass constant.



There are many more runtimes than this. Some of the most common ones are $O(\log N)$, $O(N \log N)$, $O(N)$, $O(N^2)$ and $O(2^N)$. There's no fixed list of possible runtimes, though.

You can also have multiple variables in your runtime. For example, the time to paint a fence that's w meters wide and h meters high could be described as $O(wh)$. If you needed p layers of paint, then you could say that the time is $O(whp)$.

Big O, Big Theta, and Big Omega

If you've never covered big O in an academic setting, you can probably skip this subsection. It might confuse you more than it helps. This "FYI" is mostly here to clear up ambiguity in wording for people who have learned big O before, so that they don't say, "But I thought big O meant..."

Academics use big O, big Θ (theta), and big Ω (omega) to describe runtimes.

- **O (big O):** In academia, big O describes an upper bound on the time. An algorithm that prints all the values in an array could be described as $O(N)$, but it could also be described as $O(N^2)$, $O(N^3)$, or $O(2^N)$ (or many other big O times). The algorithm is at least as fast as each of these; therefore they are upper bounds on the runtime. This is similar to a less-than-or-equal-to relationship. If Bob is X years old (I'll assume no one lives past age 130), then you could say $X \leq 130$. It would also be correct to say that $X \leq 1,000$ or $X \leq 1,000,000$. It's technically true (although not terribly useful). Likewise, a simple algorithm to print the values in an array is $O(N)$ as well as $O(N^3)$ or any runtime bigger than $O(N)$.
- **Ω (big omega):** In academia, Ω is the equivalent concept but for lower bound. Printing the values in an array is $\Omega(N)$ as well as $\Omega(\log N)$ and $\Omega(1)$. After all, you know that it won't be *faster* than those runtimes.
- **Θ (big theta):** In academia, Θ means both O and Ω. That is, an algorithm is $\Theta(N)$ if it is both $O(N)$ and $\Omega(N)$. Θ gives a tight bound on runtime.

In industry (and therefore in interviews), people seem to have merged Θ and O together. Industry's meaning of big O is closer to what academics mean by Θ, in that it would be seen as incorrect to describe printing an array as $O(N^2)$. Industry would just say this is $O(N)$.

For this book, we will use big O in the way that industry tends to use it: By always trying to offer the tightest description of the runtime.

Best Case, Worst Case, and Expected Case

We can actually describe our runtime for an algorithm in three different ways.