Chapter 1: Baby Steps

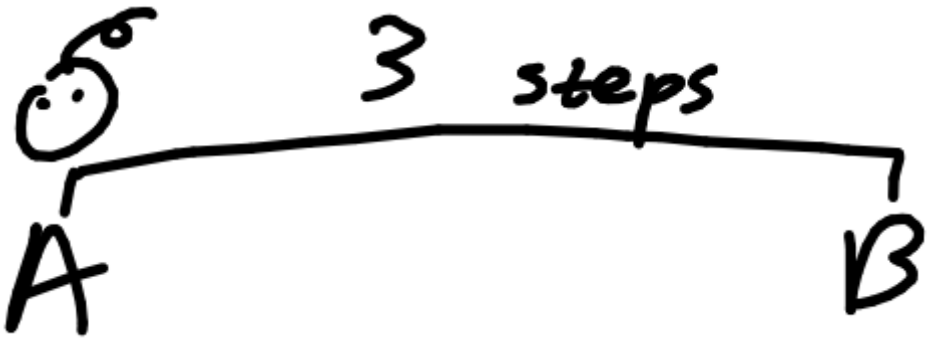
As promised, this tutorial on recursion will start with the basics. It's still a new topic, so don't be discouraged if you struggle.

Recursion problem #1: Step

Imagine a baby that's at point A, and the baby wants to get to point B.

Let's say the baby is around... 3 steps away from point B. For the sake of simplicity,

Point B = Point A + 3 steps



Seems manageable so far, right? Let's try to frame this problem in a recursive mindset... and to do that, we'll define a function **step** which aims to take the baby from point A to point B. The function has one parameter, **baby_location**, which is the baby's current location. (This isn't going to be working code, just a framework for us to think inside of.)

```
1  def step(baby_location):
```

```
    #this doesn't do anything...
```

In computer science, recursion refers to a function that uses itself inside its own definition. So, if we're solving this problem recursively, we're going to have to call **step** inside the definition somewhere. This might seem weird, but lets see what that looks like.

```
def step(baby_location):
    step(baby_location)
```

What happens when we call **step(point_A)**?

step would call itself endlessly; that doesn't seem good! The baby would just stay at point A like so...

```
step(point_A) -> step(point_A) -> step(point_A) -> step(point_A) -> step(point_A)
```

However, if you think about it, a function that repeats over and over again is actually really useful for solving problems.

For example, you've seen this before in the form of **while** loops:

```
#increase x from 0 to 3
x = 0
while x != 3:
    x = x + 1
```

This loop repeatedly executes `x = x + 1` until x is 3. What's important about this is that:

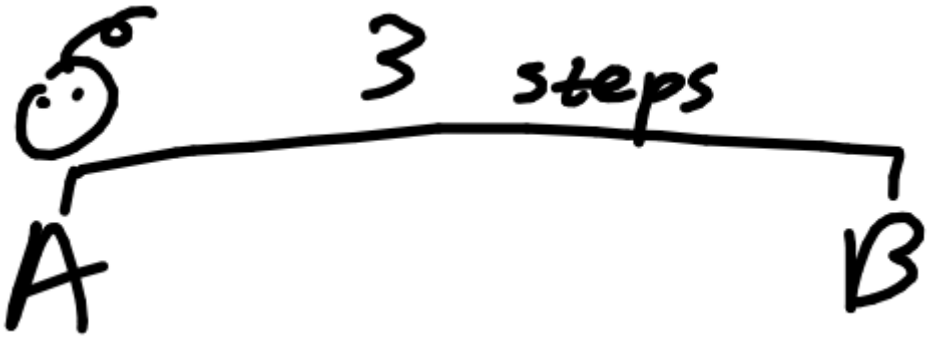
1. every time it loops, it gets x closer to 3
2. it stops when x = 3

Going back to **step**, **step** could be useful to us if it had the same properties:

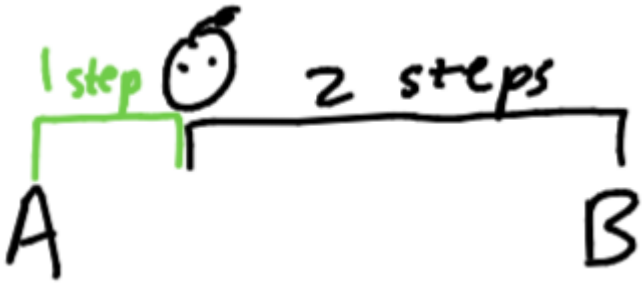
1. Each time we **step**, the baby gets closer to point B
2. The program stops when the baby has reached point B

Let's try it out.

As a reminder, this is our baby:



If we want our baby to get closer to point B, we should probably tell it to take a step closer to point B!



Wow! Now our baby is only 2 steps away from point B! We've successfully allowed the baby to get closer to point B.

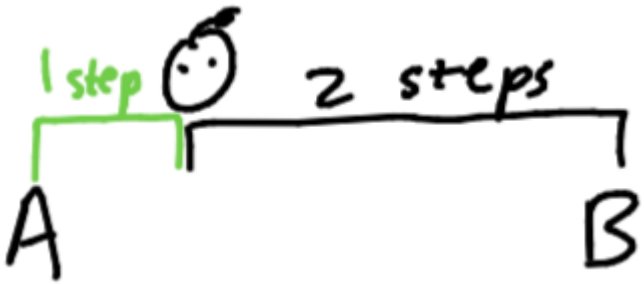
Let's represent that in our code:

```
def step(baby_location):
    step(baby_location + 1_step)
```

As a reminder, this code makes no sense in real life, but the idea should be clear. Every time we **step**, we calculate the baby's location if it was one step closer, and then we **step** again with the new location. The parameter, **baby_location**, comes closer to Point B, step by step.

```
step(point_A) -> step(point_A + 1_step) -> step(point_A + 1_step + 1_step) -> ...
```

Let's continue **step**ping!



almost there...

He made it!

But with our current code, the baby would keep **step**ping past point B. He's just a baby, he doesn't know when to stop! So, let's tell him when to stop.

```
def step(baby_location):
    if baby_location == point_B:
        return

    step(baby_location + 1_step)
```

Now, we check first if the baby has reached point B, at which point the function should stop, so we **return.** This time, we don't reach the call to **step** again, so the program ends. And we're done!

If you're still a bit confused, here's a recap to help you understand what's happening:

```
step(point_A) -> Is baby at point B? NO -> step(point_A + 1_step)
```

```
step(point_A + 1_step) -> Is baby at point B? NO -> step((point_A + 1_step) + 1

step(point_A + 2_step) -> Is baby at point B? NO -> step((point_A + 2_step) + 1

step(point_A + 3_step) -> Is baby at point B? YES -> return
```

How is this useful?

You might be thinking to yourself, "Well, sure. I've written a recursive function that moves a baby from point A to point B. How is that ever going to help me?" The answer to that is that the basic ideas behind this function are the exact same for nearly **every** recursive function you will write.

As a reminder, the properties of **step** that allowed us to solve the problem were:

1. Each time we call **step**, the baby gets a little closer to point B
2. The program ends when the baby reaches point B

In fact, if we generalize these two properties, we can use them as a guideline for solving all problems recursively:

1. Each time we call our recursive function, **we make the problem smaller.**
2. When the problem is solved or is small enough to be solvable instantly, **we finish the problem and stop.**

In most kinds of recursion you'll encounter, we make the problem smaller inside the **recursive call**. And when we check if the problem is solved or solvable instantly, we are considering whether any of the **base cases** have been reached. If you can identify these two things, you are well on your way to mastering recursion.