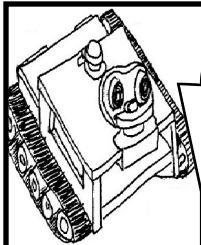


# CHAPTER:001

## PROJECT OVERVIEW



Howdy friends! I'm College Bot. You get to make me. That'll be pretty awesome because I want to live and because you're going to learn some cool things about engineering along the way! AWESOME!

First, though, let's go over what we're going to cover in this chapter.

# 1

You will learn about "layers of abstraction" and "modularity". These are two key ideas or concepts used to solve engineering problems.



Yeah...so...uh...that's actually abstract art. Not really the same thing as abstraction dude.

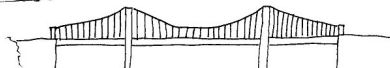


# 2

We'll cover the six parts or "layers of abstraction" you'll need to think about to make College Bot, starting with the "lowest" layer, physical design.



That has a physical design, but I don't like being compared to bridges. EERP!

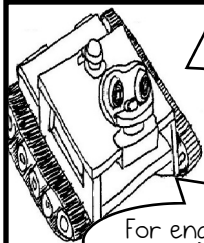


# 3

You'll learn about how we're going to run this class...and why you should read this guide (ahead of time) before each lesson.



Mostly because I'm AWESOME!  
(More awesome than my cousin over there.)



Got it?! All right, let's get on with it already!!!  
We're going to start with abstraction.

For engineers, abstraction is a way of thinking about things to make life simpler. Complicated things have many ways to think about them or "layers of abstraction". Your puny human mind works better with one layer at a time.

### LAYER

### DESCRIPTION

Here's an example you know: the different layers of speech

Ideas	<u>Concepts in your head</u> (that you want to share)
Sentences	<u>Complete short statements</u> Usually strung together to make sense.
Words	<u>Single ideas or concepts</u> The smallest that make sense.
Sounds	<u>Each sound in English</u> (or other language) that is needed for all possible words
Physical	<u>Sound waves</u> created by vocal cords (and captured by someone else's ears)



Most of the time, you only worry about one of these things :



**Ideas** Concepts in your head (that you want to share)

When you talk with friends and family, most of the time, this is where you focus. Sentences, words, etc. all come automatically. But...sometimes the other layers matter more than usual. Here are a few examples.

## Sentences

Complete short statements. Usually strung together to make sense.

You might focus on these more when you're in English class or trying to talk your way out of something. This layer is important whenever you need to say something just right.

## Words

Single ideas or concepts. The smallest that make sense.

You'll focus on this layer more when you're talking about something you've just learned or that you don't discuss often. (Is it "layers of obstruction, or abstraction?" )

## Sounds

Each sound in English (or other language) that is needed for all possible words

When you're speaking a new language. Or using an accent.



A

E



## Physical

Sound waves created by vocal cords (and captured by someone else's ears.)

When you whisper, or do ventriloquism.



So, those are layers of abstraction. Now, let's talk about modularity. Here's the difference :

## Abstraction

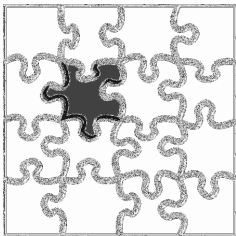
For one thing, focus on different aspects or layers

## Modularity

Break a thing into pieces, where each piece has a specific role and a defined way of interacting with other pieces. Worry about one piece at a time



The colored piece is a single module that interacts with four others: one on each side.

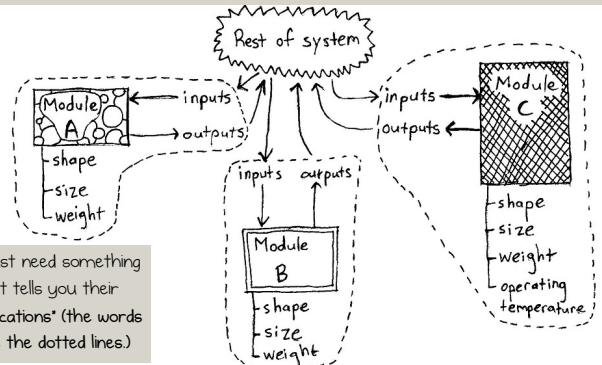


The way it interacts is also clear :

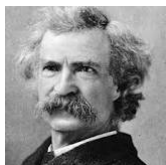
- Accept a tab to the top
- Accept a tab to the right
- Attach to the piece on the left
- Attach to the piece below

All the pieces together make the puzzle, but for any given piece, you only worry about its neighbors.

Here's a more "engineering" example. Without knowing how modules A, B, and C actually work, you can build a system with them.



You just need something that tells you their "specifications" (the words inside the dotted lines.)



Mark Twain

Every man is a moon and has a side which he turns toward nobody : you have to slip around behind it if you want to see it.



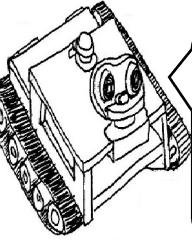
Did this Twain guy invent layers of abstraction?



To carry the analogy to modularity, though, the moon is a module in the solar system.


$$F = Gm_1m_2 / r^2$$






For most of our work, we'll be thinking first about a specific layer of abstraction, and then use modularity within that layer to help keep it all straight (for your tiny human brain.)

Stop making fun of me! What are the layers already?




For the robot we plan to build, here are the different layers of abstraction.	Behavior	What we want our robot to do "Drive around until something is in the way"
	Logic	Rules for behavior: <i>If &lt;this&gt; happens, then do &lt;that&gt; Wait for &lt;that #&gt;.</i>
	Software	Computer language: <code>if (somethingInMyFace==TRUE) {beep();}</code>
	Signal	The electrical "language": 0's and 1's (0 or 5 volts) that change when it <u>senses</u> or <u>acts</u>
	Physical action	<u>Actuators</u> that do something (e.g. motors) <u>Sensors</u> that detect the world (e.g. button)
Physical structure		How the parts of the robot <u>fit together</u> . Where it <u>senses</u> or <u>acts</u> .



Whoa, that's AWESOME! Can you talk about one at a time, though? ...it's hard for me to keep all that straight...

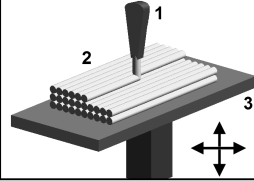
Heh. Told you so. You're right, though, it is AWESOME!

Here's more detail on each one. We'll have more chapters for each of these



**Physical Structure** How the parts of the robot fit together.  
Where it senses or acts.

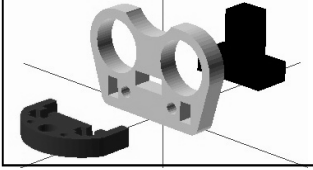
**3D PRINTING**



Most of the physical structure of College Bot is created with 3D printing, where a 3D model is "sliced" into layers and each layer is then printed with melted plastic, each layer on top of the last one.

**Physical Structure** How the parts of the robot fit together.  
Where it senses or acts.

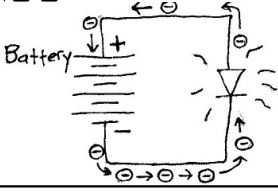
**CAD DESIGN**



The 3D models that we slice for printing are created with Computer Aided Design, or CAD for short. College Bot is designed with a CAD tool using programming or software called OpenSCAD.

**Signal** The electrical "language": 0's and 1's (0 or 5 volts) that change when it senses or acts

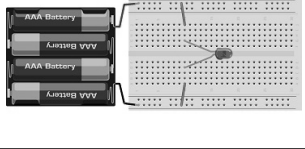
**ELECTRICITY**



College Bot runs on electricity, which is caused by the motion of electrons from one place to another. You've probably heard about "0's and 1's" used by computers. We'll talk about what that means.

**Signal** The electrical "language": 0's and 1's (0 or 5 volts) that change when it senses or acts

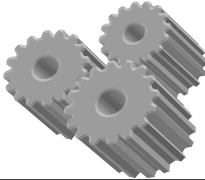
**PROTOTYPING**



A breadboard is a tool used to create different electrical circuits very quickly. All of College Bot's electrical parts will sit on a breadboard.. We'll learn how to use them.

**Physical action** Actuators that do something (motors)  
Sensors that detect the world (buttons)

**GEARS**



College Bot moves with the help of two gearmotors that drive its tank treads. We have to assemble these from a kit and we'll take a look at how they work while we do it.

## Software

Computer language :

```
if (somethingInMyFace==TRUE) {beep();}
```



College Bot is controlled by a computer chip that runs software compatible with a system called "Arduino." We'll learn how to write these instructions.



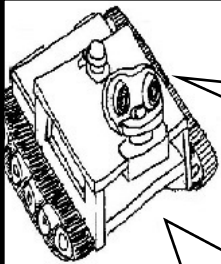
Finally, we won't have chapters on these, but we'll use them to make me super smart!

## Logic

Rules for behavior: If <this> happens, then do <that>. Wait for <something>.

## Behavior

What we want our robot to do: "Drive around until something is in the way."



So, friends. That's everything you're going to learn. Sounds good, right? Seeya later?

Hey DUMMY! Aren't you forgetting something?

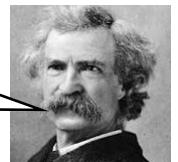
EEPP! Whatdoyoumean?

What about all that "I want to LIVE!" stuff?

Says the disembodied (and kind of creepy) brain...



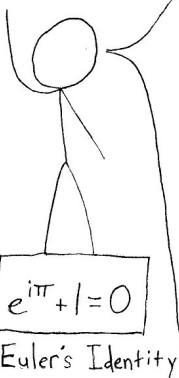
OK, yes, creepy, but what I believe our friend here is getting at is we haven't talked about building YOU yet! Care to enlighten?



Mark Twain

Oh, right! JeeZ, this is soooo embarrassing. Here's the plan :

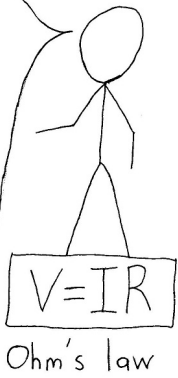
- First, try to read these chapters before every class session as they're assigned. They'll give you the key ideas you need to know so your time with the robot parts (ME!) will be as productive as possible.
- Second, we'll spend our time in class working on different parts of me in the order outlined in this chapter.
- For those of you who know what's covered in these chapters before class, you'll be more likely to earn the extra prizes by doing well during our class activities. An example prize is a speech chip so yours truly can actually talk.
- Got that? Read these chapters. Do the interactive lessons in class. Towards the end of the quarter, it will all come together and we'll build me!!! I can't wait! OK, now, seeya later! Ciao!



Hey everyone! Thanks for reading this. I'm the creator of College Bot and the author of this comic. I've worked as a few different kinds of engineer and am excited to share more about engineering. Mostly that will be through these lessons and through building College Bot, but I'll also try to share something about engineering as a set of careers.

So, at the bottom of each of these lessons, I'll try to give you a few tips about engineering careers (so read to the end.) Also, sorry about the brain up there. That was a little silly.

P.S. About the equations under me. Most of these aren't related to the lesson, but they're awesome, so I'm sharing



Ohm's law