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Logic Flow/Schematics

// Logic Flow Charts (part 1)

Logic Flow Charts are a great way to sketch out how you want a circuit or chunk of code to act once it is completed. This way you can figure out how the whole project will act without getting distracted or confused by little details like electricity or programming. It's kind of like a game plan that a coach will put together before a game.

There are four major pieces that you will use over and over again when creating Logic Flow Charts. The four Logic Flow pieces are represented by a circle, a square, a diamond and lines connecting all the circles, squares and diamonds.

The **circle** is used to represent either a starting point, or a stopping point. This is easy to remember since you start every single Logic Flow Chart with a circle containing the word Start or Begin. Often you will end a Logic Flow Chart with an End or Finish circle, but sometimes there is no end to the chart and it simply begins again. This is the case with any circuits that never turn off, but are always on and collecting data.

The **square** is used to represent any action which has only one outcome. For example, when a video game console is turned on it always checks to see what video game is in it. It does this every time after it starts up and it never checks in a different way. This kind of action is represented by the square, it never changes and there is always only one outcome.

The **diamond** is used to represent a question or actions with more than one possible outcome. For example, once your

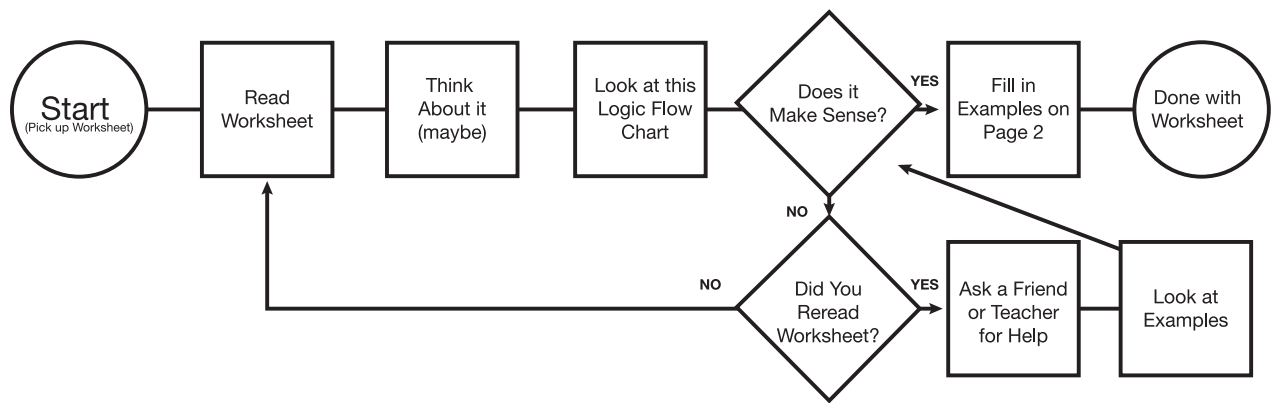
video game has loaded there is often a menu with a bunch of options. This would be written in a Logic Flow Chart as a diamond with something like the words "Start Up Menu" written inside of it. Each action the user can take from this menu would be represented by lines coming off the diamond leading to another square, diamond, or circle. Maybe our example Logic Flow Chart would have three options leading away from the "Start Up Menu" diamond, one line to start a new game, one to continue a saved game and another for game settings. In the Logic Flow Chart each option is written beside the line leading away from the diamond. It is possible to have as many options as you like leading away from a diamond in a Logic Flow Chart.

The **lines** in a Logic Flow Chart connect all the different pieces. These are there so the reader knows how to follow the Logic Flow Chart. The lines often have arrows on them and lead to whichever piece (circle, square, diamond) makes the most sense next. The lines usually have explanation of what has happened when they lead away from diamonds, so the reader knows which one to follow. Often some of these lines will run to a point closer to the beginning of the Logic Flow Chart. For example, the "Save Game" option might lead back to the "Start Up Menu" diamond, or it might lead straight to "Save and Quit." It's up to you, you're the one making the Logic Flow Chart! All it has to do is make sense to you. Use the first Logic Flow Chart on the next page to help figure out how to use a Logic Flow Chart. Look at the second example, then complete the remaining Logic Flow Chart examples.

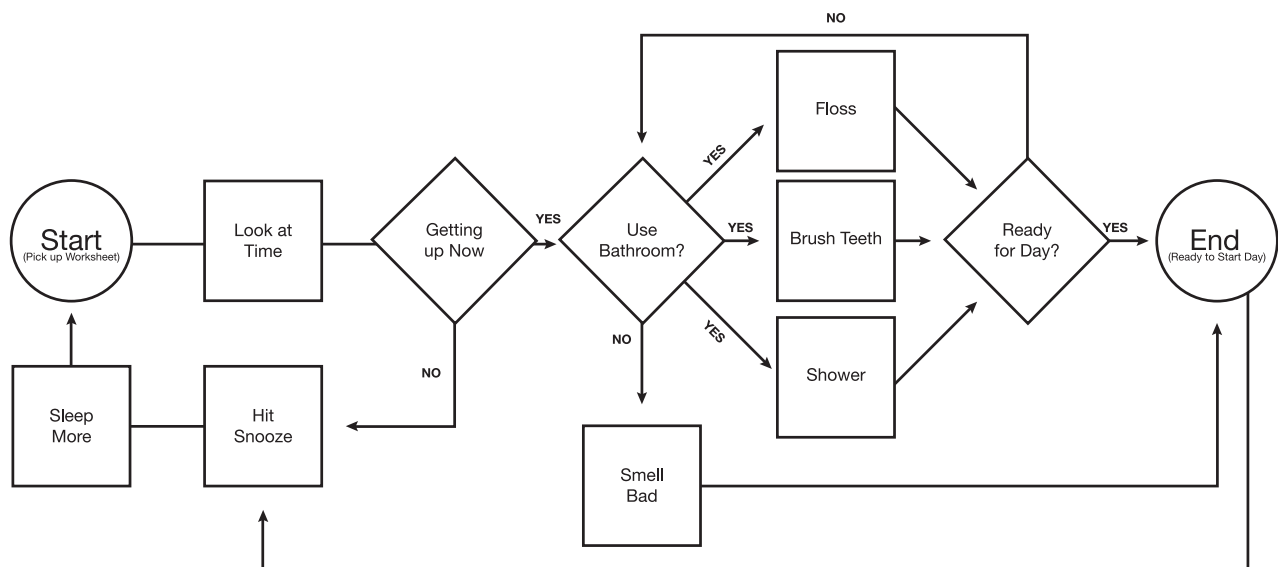
// Logic Flow Charts (part 2)

Circles represent either start or end. Squares represent actions with one outcome. Diamonds represent a question or action with multiple possible outcomes. Lines and arrows represent logical paths between the circles, squares and diamonds.

Example 1:



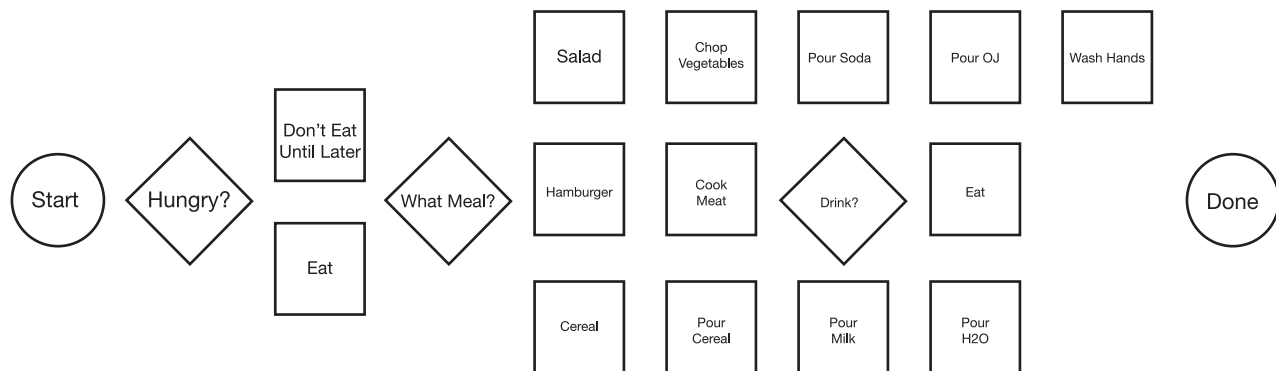
Example 2:



// Logic Flow Charts (part 3)

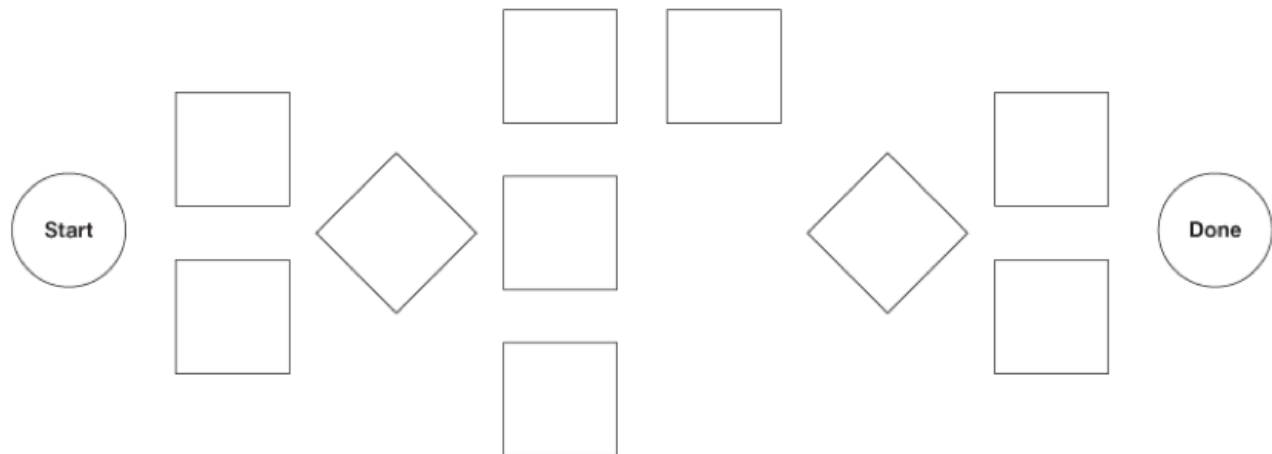
Example 3:

Fill in the lines and arrows. There is no right answer, but it must make sense.



Example 4:

Fill in the lines and text. Write outside of the boxes as necessary or use the back of the worksheet.



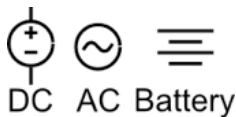
// Schematics

An electrical schematic is a bunch of symbols representing one or more electrical circuits. Electrical schematics are a great way to sketch out the physical layout of a circuit. With a schematic it is possible to share circuit and prototypes ideas without giving away your electronics or creating an overlay. Being able to read schematics is definitely a useful skill anytime electronics are involved. Once you are able to read schematics, creating schematics just takes practice and a sharp eye when looking at wires and components.

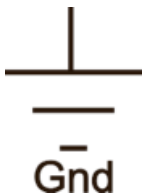
There are four major pieces that you will use over and over again when creating schematics. The four schematic pieces are power source, ground, components and the wire (or whatever your conductive connecting material is) connecting all the different parts. While schematics can be created by hand, these days electrical schematics are usually created using Electrical CAD software. Electrical CAD software is used to make sure that all schematics follow the same guidelines, making them easier to understand. While electrical schematics show how circuits are connected, they do not show what the completed circuit will look like. Schematics are guidelines, not physical representations of the circuits.

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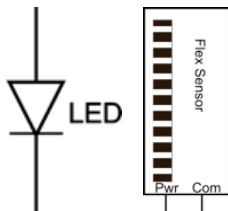
other types:



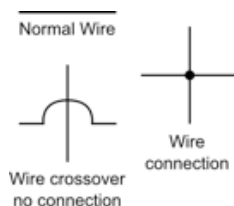
The power source symbol is a small circle with the voltage written beside it. Power sources come in all sizes, but the S.I.K. mainly uses a 5V power source. Arduino output pins can also be used as power sources, so even though they are categorized as components (or at least a part of a component, the Arduino) they are often treated as power sources. Power sources are where the electricity necessary to make circuits work comes from.



The ground symbol used in the S.I.K. is three horizontal lines, which decrease in width as they get closer to the bottom of the symbol with the letters Gnd beside or below them. In an electrical schematic ground can have a couple different types, this worksheet explains the most common, earth ground. An earth ground is a return path for electrical current as well as a reference point for measuring voltage. The term “earth ground” implies that the ground is a physical connection to the earth. This is sometimes true, but often ground is simply a connection to the lowest voltage value in a circuit or piece of equipment. The voltage value of ground will never change no matter how much electrical current it is absorbing.






















Components are represented by a bunch of different symbols. There are tons of different components with new types being invented every day! These are the parts of the circuit that use the electrical current to make stuff happen. This can be input or output, digital or analog, complicated (Arduino board) or very simple (resistor). These components can do many different things and it is important to understand the particular component in the schematic if you really want to know what the circuit is doing and how it uses electrical current.



Wires are represented by simple lines. The wires in a schematic connect all the different pieces. Pay attention to what wires look like in a schematic when they cross. If the wires are connected the lines will be straight with a circle where they cross, if the wires are not connected one of the wires will form a semi-circle where the lines cross.

// Common Schematic Symbols

Common Schematic Symbols			
Power / Battery / Cell			
Ground			
Resistor (Colored bands indicate resistive strength - see cheatsheet for details)			
Capacitor (Electrolytic on left; Ceramic on right)			
Diode			
Light Emitting Diode (LED)			
Inductor			
Transistor (arrow pointing out is NPN, pointing in is PNP)			
Switch			
Speaker	