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Raspberry Pi
A Quick-Start Guide

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A Quick-Start Guide
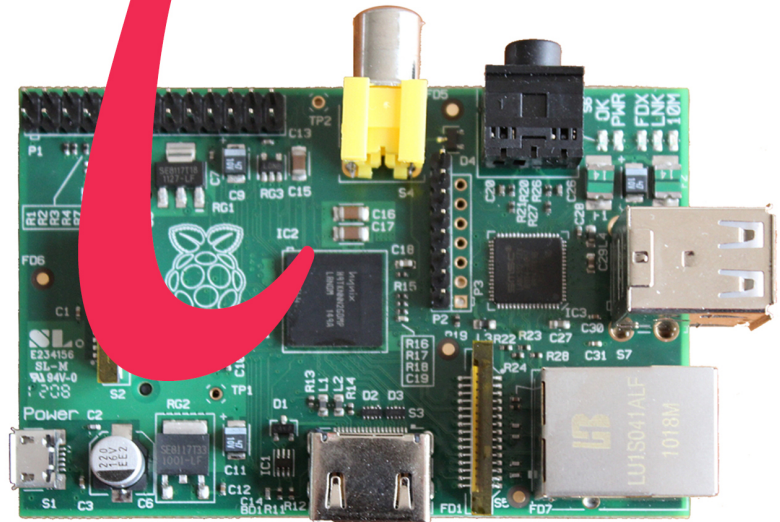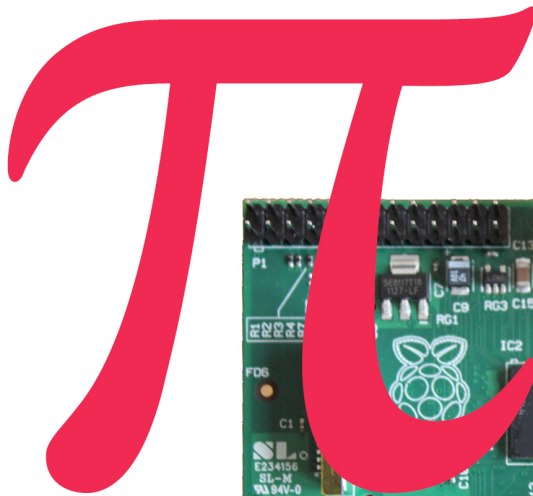
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9.2 Meet the Pi's GPIO Pins

To connect your own electronics projects to the Pi, you can use the expansion header in the top-left corner of the Pi (see Figure 1, *The front side of a Model B (Revision 1),* on page ?). It consists of 26 pins arranged in two rows containing 13 pins each. The top row contains the even-numbered pins, and the other row contains the odd-numbered pins. That is, the first pin in the lower row is pin 1, and you can find the label "P1" on the Pi below the pin.

In Figure 33, *The Pi's GPIO pins,* on page 5, you can see the meaning and the numbering of the pins. Note that the meaning of some pins has changed between revision 1 and revision 2. With the pins labeled Ground, the Pi can share a common ground with your electronics projects. Using the pins labeled 3v3 and 5V, you can power external devices connected to the Pi with 3.3 volts or 5 volts. The Pi limits the output of pin 1 to 50mA, while pin 2 allows for a current draw that depends on the USB input current. If you power the Pi with a 1A power supply, for example, you can draw up to 300mA from pin 2, because the Pi Model B needs 700mA for itself.

Rev 2	5V	5V	Ground	GPIO14	GPIO15	GPIO18	Ground	GPIO23	GPIO24	Ground	GPIO25	GPIO8	GPIO7
Rev 1	5V	-	Ground	GPIO14	GPIO15	GPIO18	-	GPIO23	GPIO24	-	GPIO25	GPIO8	GPIO7
	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Pin	2	4	6	8	10	12	14	16	18	20	22	24	26
Pin	1	3	5	7	9	11	13	15	17	19	21	23	25
	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
Rev 1	3v3	GPIO0	GPIO1	GPIO4	-	GPIO17	GPIO21	GPIO22	-	GPIO10	GPIO9	GPIO11	-
Rev 2	3v3	GPIO2	GPIO3	GPIO4	Ground	GPIO17	GPIO27	GPIO22	3v3	GPIO10	GPIO9	GPIO11	Ground

Figure 33—The Pi's GPIO pins

In revision 1, pins 4, 9, 14, 17, 20, and 25 were reserved for future enhancements, so you could not use them in your own projects. The remaining pins are general-purpose input/output (GPIO) pins that you can use as digital input or output pins. Note that the GPIO pin names do not correspond to the pin numbers of the expansion header.

You can use the GPIO pins, for example, to read the state of a push button or to turn an LED on and off. For this chapter's examples, you can assume that all GPIO pins work the same, but you should know that some of the Pi's pins are special. Pin 12, for example, supports Pulse Width Modulation (PWM),[6] which can be handy for controlling motors. If you're going to build more

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6. http://en.wikipedia.org/wiki/Pulse_width_modulation

complex projects, you should take a look at a more detailed description of the Pi's pins.[7]

9.3 Build a Basic Circuit

To warm up, you'll build one of the most basic circuits possible. You'll connect an LED to the Pi and make it shine as long as the Pi is running. For this you need an LED, a resistor, a breadboard, and two female/male jumper wires. Using these parts, you'll build the circuit in Figure 34, *A basic circuit*.
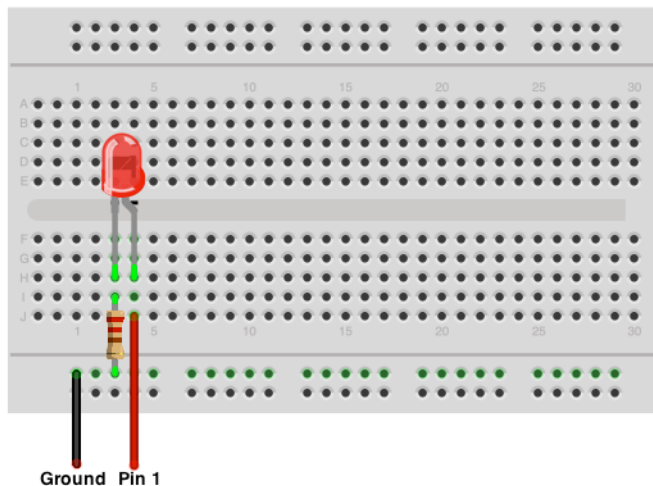

Figure 34—A basic circuit

Before you actually build the circuit, you should know what all the parts are for and how they work. Breadboards are useful tools for prototyping circuits. You can simply plug in parts like LEDs and resistors, so you do not have to solder them. Breadboards come in various sizes, but they all look very similar. On all of them, you can find many sockets arranged in columns. Most breadboards also have two rows of sockets at the top and at the bottom.

The main trick of a breadboard is that it automatically connects the sockets belonging to a certain column and to a certain row. In the basic circuit in Figure 34, *A basic circuit*, on page 6, you connect the Pi's Ground pin to the second-to-last row of the breadboard. This automatically connects all sockets in this row to the Pi's ground (that's why all the sockets in this row have a light green color). The same happens in the two columns connected to the

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7.   http://elinux.org/RPi_Low-level_peripherals

LED. The resistor indirectly connects the Pi's Ground pin to one of the LED's connectors. In addition, you connect the Pi's pin 1 directly to the other connector of the LED by plugging it into a socket in the same column.

By the way, LED stands for light-emitting diode, so an LED is basically a diode. Diodes are very useful, because they let electricity pass in only one direction. That's true for LEDs, too, and in addition, LEDs emit light as a side effect.

Working with LEDs isn't very difficult, but you have to take care of a few things. First, you have to connect them the right way. LEDs have two wires, and one of them is a bit shorter than the other. The shorter wire is named *cathode* (negative), and you have to connect it to the Pi's ground pin. The longer wire is named *anode* (positive), and you have to connect it to one of the Pi's power supply or GPIO pins. You can also identify the anode and cathode by taking a close look at the LED's case. The flat side belongs to the cathode and the round side to the anode. In Figure 34, *A basic circuit*, on page 6, the anode is slightly bent.

Also, you always have to put a resistor in front of an LED. If you don't, the LED consumes too much power and will be destroyed. Simply put, a resistor limits the amount of current that flows through an electric connection and protects the LED. Calculating the resistor value for a certain type of LED is not difficult, but it's beyond the scope of this book. Simply keep in mind that the lower the resistor value, the brighter the light will shine. When in doubt, use a 330Ω or 470Ω resistor.

Now it's time to actually build the circuit. First, connect the LED to the breadboard. Make sure that the direction of the LED is right, and plug it in. You have to press firmly but not too hard—otherwise, you'll bend the connectors, and they won't fit. It's usually easier to plug parts in after you've shortened the connectors. When cutting the connectors, wear safety glasses to protect your eyes!

The resistor is next, and this time the direction doesn't matter. Before plugging the resistor in, you have to bend its connectors. Also, it usually helps to shorten them.

Finally, connect the two jumper wires to the Pi and to the breadboard. Connect the female side to the Pi and the male side to the breadboard. Make sure you're using the right pins on the Pi, and then turn on the Pi. If you've connected everything correctly, the LED will turn on, too. Otherwise, take a look at Section 9.7, *What If It Doesn't Work?*, on page ?.