# ACM Workshop on Raspberry Pi – Ouline

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**June 27 – Showing what can it do and suggestions for what to buy**

In short, it is a fully-capable computer. See

`http://yosemitefoothills.com/ACM_Workshop_Notes/RaspberryPiModels.pdf`

and see

http://yosemitefoothills.com/ACM_Workshop_Notes/PurchaseRecommendation.html

for initial purchasing suggestions. Later, I will suggest a baggie of microprocessor and additional components for less than $10.

Vast amounts of open source software is available for free download and use. This includes very sophisticated networking, programming, database software as well as software for editing audio, graphics, and video data.

Its GPIO (general-purpose input/output) pins are available for control of electronic hardware at the chip level. Computer processors are easily damaged by incorrect voltages being applied to their GPIO pins so those pins are usually hidden from the owner. Without access to GPIO pins, the electronics enthusiast has a much restricted ability to use the computers to interact with sensors, solenoids, lights, and motors. Since the Raspberry Pi is relatively inexpensive, the worst that can happen if is is damages is that you need to buy another. Your damaged Raspberry Pi is probably still usable for applications that don't need the damaged pins. Use of these pins is well-documented and encouraged by the creators of the Raspberry Pi.

It can act as web server using `apache2`, a mail server using `postfix`, and as a wireless access point using `hostapd`.

It can be used for writing programs in C, C++, Python, Java, Assembly, and more. The entire source code for the operating system (except for some processor firmware) is open source. Your Pi can compile its own custom version of its operating system.

When a PiCamera is attached, it can take 8 megapixel stills, time-lapse sequences, and HD videos. Allowing use as a critter cam, security cam, and time-lapse camera. The near infrared version of its camera can be used for night vision when coupled with a matching infrared floodlight. Because it is very inexpensive, it can be bought for a special purpose and left in place for months. Since the camera lens can be removed (with care), it can be used at the focal plane of a telescope or microscope, making those into network-capable, programmable, digital-imaging devices.

It uses very low power and can be solar powered where electricity is unavailable.

It can connect to HDMI or a small LCD monitor as well as old-fashioned analog televisions. It is commonly used as a media center for displaying movies.

It has audio output, but audio input must be added using a USB device or using the GPIO pins.

**June 29 - Exploring Program Examples**

Python 3 without graphics
Python 3 with graphics
Python 3 programs that create animations of statistical physics simulations.
Very powerful linear algebra and scientific routine libraries allow Python to do serious scientific calculations and statistical analyses.
A Python 3 library to control the GPIO pins allows easy manipulation to attached hardware devices.

Simple C programs
C programs that control hardware

Simple C++ programs

Creating, assembling, and uploading machine code to ATmega328P microprocessor for real-time hardware monitoring and control. These are explained in detail during July 11 and July 13 sessions.

**July 6 - Setting it up – Those who want to buy CanaKits or Pi's should now have received them.**

Setting up a clean SD card with our examples and useful software including making a Raspberry Pi 3 a wireless access point with an apache web server.

During this process, some bash command-line instructions and use of the vi editor will explained.

**July 11 - Assembly Language**

Detailed line-by-line explanation of programs that blink LEDs using, with and without using interrupts.

**July 13 - Assembly Language**

Discussion of SPI interface and how it is used in a program to make the ATmega328P read voltages and return values on command.

Detailed analysis of an assembly program that uses the ATmega328P to log ticks of a Geiger counter, a Python 3 program that retrieves the results, and another Python 3 program that graphs those results.

**July 18 - Video Conferencing**

Explanation of a set of C programs that take images from the camera, send them via the network, and display them on another Pi using the frame buffer interface.

Explanation of a companion set of C programs for taking in audio from a USB microphone, sending it via the network and playing it on another Pi.

Part of this discussion is how to set up `iptables` in a local firewall to seamlessly pass incoming ports to a receiving/transmitting Pi on the local network. One end must have a static IP address, but the other end can have a temporary address assigned by their Internet service provider.

**July 20 – Debugging of attendee programs and Raspberry Pi Systems**