Workshop 02 - BIOS to OS by our Bootstraps

This workshop re-enforces hardware skills developed in workshop 01.

- How to troubleshoot and fix boot failure
- Customising the BIOS
- Installing an Operating System from a USB stick

We introduce the next stage of self-reliance; understanding what happens in the few seconds between pressing the power button and seeing your computer is 'alive'.

The key to understanding this mysterious process is the concept of bootstrapping or 'booting'. Starting with the power button, your computer follows a series of steps, each more complex than the last, until you have a working Operating System.

Troubleshoot and Fix boot failure

Now your PC is back together we will:

- Make sure your computer powers on
- Troubleshoot any errors thrown up by the Power On Self Test (POST)
- Boot to the Basic Input Output System (BIOS), and finally
- Begin the install of our Operating System (OS).

By the end of this workshop you will be able to locate and identify all the hardware you've installed in the first workshop without opening the case.

Power On

- Make sure your case is closed, and fits tightly.
- Plug in your USB keyboard and mouse.
- Set-up your monitor, plug in the VGA cable.
- Plug the power cables into the monitor and case last.
- Then try the power button!

If you have assembled your computer correctly you should see:

- The green power and hard drive LEDs flash
- Then the power LED stays on and
- The fans start up (quietly)
- The **BIOS** screen flash up

Success!!

If your computer is working correctly, congratulations! Now it's time to give someone else a hand.

Fail....?

If your computer won't turn on, don't panic. There are a few simple steps to use to troubleshoot:

• Do you have an 'air gap'? This is a polite way of saying is your computer plugged in?

Check the power cables are properly connected.

• Does the front panel power switch click?

If not, take off the front panel and press the power button directly.

• The power switch connection to the motherboard is the next thing to check.

Unplug the power lead then open your case and check the front panel power header is connected.

• Next check the power cables from the PSU to the motherboard.

The plugs only fit in one direction, just jamming them in won't work. Trust us. We've tried.

Getting Past the POST

The Power On Self Test (POST) is a check your computer runs through every time it turns on. Most of the time we never notice the POST process. It takes a few seconds and only stops on errors.

If your computer turns on but doesn't pass POST, it will let you know through flashing lights and beeps.

The table below is adapted from the 8100 service manual and should give you an idea of what to try next. Most errors can be fixed using the things you learned in workshop 01.

Two Beeps

BEEPS	Power LED	Probable Cause
2 beeps	Blinks red 2 times @ 1 Hz	Processor thermal shut down. Check air flow, fan operation, and CPU heatsink

• Have you plugged the fan cable back in? Is the air guide installed correctly? Are the heatsink screws tight?

Three Beeps

3 beeps	Blinks red 3 times @ 1 Hz	Processor not installed. Install or reseat CPU.
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• This usually means your processor is not sitting in the socket firmly, or the heatsink screws are not firmly tightened.

Four Beeps

4	Blinks red 4 times	Power failure (power supply is overloaded). Check storage devices, expansion cards and/or
beeps	@ 1 Hz	system board (CPU power connector P3).

• Have you plugged in the CPU power connector?

Five Beeps

5 beeps Blinks red 5 times @ 1 Hz Pre-video memory error. Incompatible or incorrectly seated RAM.	
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- This is an easy one, make sure your RAM is in the black slots and firmly clicked into place.
- Try testing the RAM one slot at a time.

Six, Seven or Eight Beeps

6 beeps	Blinks red 6 times @ 1 Hz	Pre-video graphics error. On system with integrated graphics, check/replace system board. On system with graphics card, check/replace graphics card.
7 beeps	Blinks red 7 times @ 1 Hz	PCA failure. Check/replace system board.
8 beeps	Blinks red 8 times @ 1 Hz	Invalid ROM (checksum error). Reflash ROM using CD or replace system board.

• All these errors are difficult to fix. Ask your facilitator for a hand.

Nine Beeps

Check your PSU cable headers on the motherboard.

Ten Beeps

10 beeps	Blinks red 10 times @ 1 Hz	Bad option card
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• This won't usually apply unless you have installed a PCI expansion card. If you have installed a PCI card, take it out and reboot.

BIOS

Powered on and got through POST? Great - your computer will now continue the booting process by activating the BIOS. So what is the BIOS?

- The BIOS is firmware, and works between the hardware and software of your computer.
- It is an *embedded* program, meaning it is permanently attached to your computer's hardware.
- A battery is used to keep BIOS settings for up to 10 years.
- The BIOS settings are accessed in the System Configuration.

The BIOS will now attempt to boot your computer, running a few further checks. As you have taken your computer apart it may be confused and ask for some information.

It may ask you to confirm hardware changes.

4096 MB		
Initializing Intel(R) Boot Agent PXE 2.1 Build 088 (WfM 2.0)	GE v1.3.40	
	ptions were automatically updated: 3160318AS	
	you need to configure your system	
F1: Save Changes	<f9=boot menu=""> <f10=setup> <f12=netwo< td=""><td>rk></td></f12=netwo<></f10=setup></f9=boot>	rk>
or warn you to set the date and time		

4096 MB	
of a hard drive, etc Pressing F1 will rec	Set ation has changed since your last boot. Addition ., or loss of power to the Real Time Clock has occurred. Ford the new configuration. If this message persists, ace the onboard battery.
PXE 2.1 Build 088 (WfM	2.0)
The following config Memory: 4096 MB	uration options were automatically updated:
Disk: 160 GB	ST3160318AS
CD-ROM :	hp DVD A DH16AAL
	ing Unix, you need to configure your system er Setup Utility (F10).
CMOS checksum inval	id, default values loaded
F1: Save Changes	

before trying the operating system from the internal hard drive.



But remember, the hard drive in your computer has been wiped.

There is no way for the computer to continue to boot and so the boot process ends as soon as the BIOS discovers the hard drive is empty.

Now we need to access the System Configuration and set the BIOS to make your computer boot off a USB stick, where we will install our operating system.

System Configuration

To get into your computers System Configuration, we have to 'catch' your computer just at the right moment with a well-timed key press.

The exact keys to press are shown in a 'splash' screen, which displays the manufacturer's logo and a list of keys to press to interrupt the booting process. This splash usually goes by very quickly, so we'll show the screen here.



This may take a couple of attempts to catch, so it's time to learn the three-fingered salute to force your computer to reboot. Press and hold the Ctrl and Alt keys, then press the Delete key. You can keep doing this as many times as you like, there is no way to harm your computer by rebooting at this early stage of the boot process.



Lets step through the screens one by one before we choose an option. Reboot your computer and press F9 continuously....

* F9 will bring up the boot menu where you choose a device to boot from, instead of going with what is stored in the BIOS.



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Now reboot and press F12.....

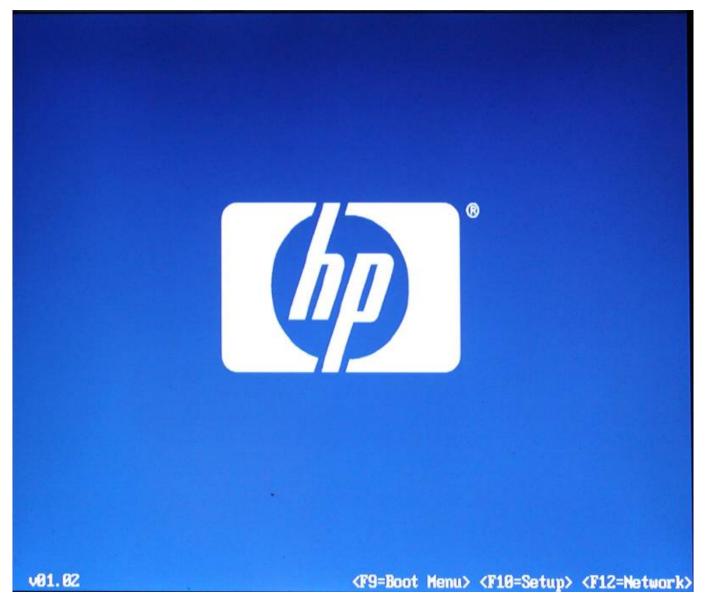
F12 forces the computer to boot from the network card. Network booting is an advanced option, your computer will look at the ethernet port for a connected network device to boot from.

9

Intel(R) Boot Agent GE v1.3.40 Copyright (C) 1997-2009, Intel Corporation Intel(R) Boot Agent PXE Base Code (PXE-2.1 build 088) Copyright (C) 1997-2009, Intel Corporation Initializing and establishing link..._

Now reboot and press F10...

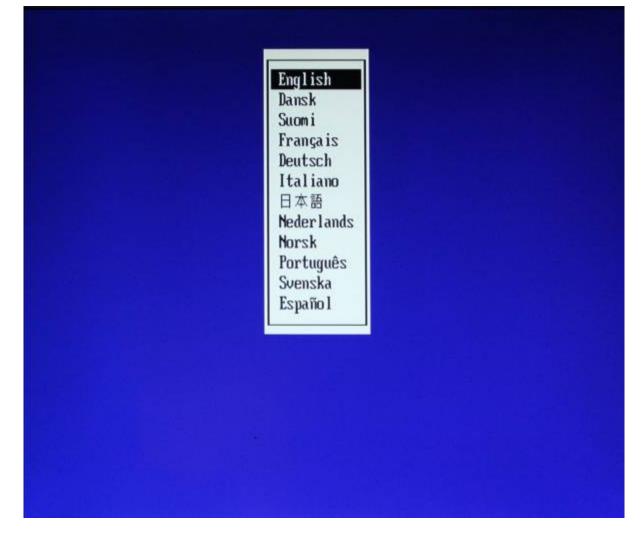
F10 starts the BIOS set-up page where we customise how we want the computer to start and check on the hardware. If you miss the BIOS key set-up then just keep rebooting till you get it.



BIOS Set up

The first screen you'll get is for language selection. You move around by using the arrow keys, and press enter to select.

Select English



This is the main set-up utility menu. The first screen we want is System Information in the File menu. Select this option.

Hei	lett-Packard Setup Utility
File Storage Security	Power Advanced
System Information	
About	
Set Time and Date	
Flash System ROM	
,	
Replicated Setup	
	그는 것 같은 것 같은 것 같은 것 같은 것 같은 것 같아요. ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ?
Default Setup	
Apply Defaults and Exit	
Ignore Changes and Exit	
Save Changes and Exit	
,	
Service of the service of Medical Andrew March	

LOCAL: <F1=Help> REMOTE: F1=ESC+1, F5=ESC+5, F10=ESC+0

System Information displays information about the components in our computer, without having to open the case.

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	- System Information
Product Name SKU Number	HP Compaq 8100 Elite SFF PC AY032AU
Temory Size Channel A Channel B Integrated MAC System BIOS Chassis Serial Number Asset Tracking Number	64KBx2 / 256KBx2 / 4096KBx1 4096 MB DDR3/1333 MHz/Dual Channel XMM1 2048 MB / XMM2 0 MB XMM3 2048 MB / XMM4 0 MB 6C626D027401 786H1 v01.02 AUD02209B3 AUD02209B3
1E Firmuare Version Tanagement Mode	ANT
	Press any key to contin

You should recognise the Processor Type and Processor speed from Workshop 01. Also the Memory Size will be familiar. Press any key to exit System Information.

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ile Storage Security	Power Advanced
	System Information
Product Name	HP Compaq 8100 Elite SFF PC
SKU Number Processor Type	AY032AV Intel(R) Core(TM) i5 CPU 650 @ 3.20GHz
Processor Speed Processor Stepping	3.200 GHz 00020652 0000009
Cache Size (L1/L2/L3)	64KBx2 / 256KBx2 / 4096KBx1
Memory Size Channel A Channel B	4096 MB DDR3/1333 MHz/Dual Channel XMM1 2048 MB / XMM2 0 MB XMM3 2048 MB / XMM4 0 MB
Integrated MAC	6C626D027401
System BIOS Chassis Serial Number	786H1 001.02 AUD02209B3
Asset Tracking Number	AUD02209B3
ME Firmware Version Management Mode	6.0.3.1195 AMT
	Press any key to contin

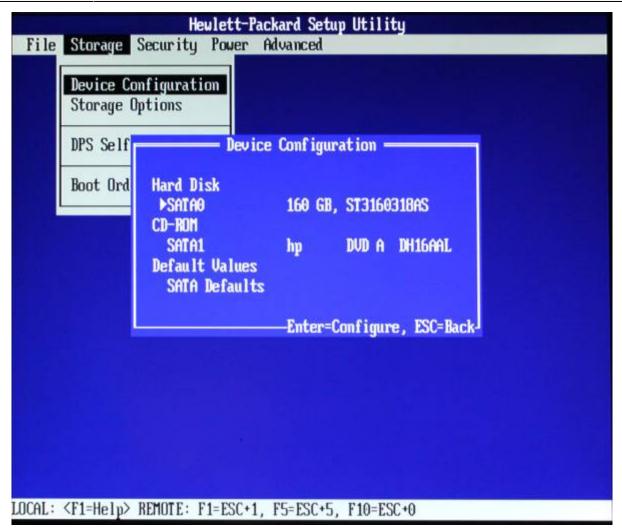
Now go to Set Time and Date and make sure your system clock is correct. This is important for your computer to function correctly and be able to 'talk' on the internet.

No other computers will trust yours if your system clock is set to 2001...

	Hewlett-Packard Setup	Utility
ile Storage Secu	urity Power Advanced	
System Information About		
Set Time and Date	Set Time and Dat	e
Flash System ROM		
-	Time (hh∶mm) ▶12	
Replicated Setup	Date (mm/dd/yyyy) 01	/21/2016
Default Setup	F10=Accept,	ESC=Cance 1
Apply Defaults and	Fuit	
Ignore Changes and		
Save Changes and Ex		
bave onanges and b		
CAL: <f1=helm> REM</f1=helm>	TE: F1=ESC+1, F5=ESC+5, F	10 802 0

Now select the Storage menu, then Device Configuration.

You should recognise your hard disk and DVD drive. Once again you can identify the type of component without opening your case.



Exit device configuration and select Storage Options. Make sure Removable Media Boot is enabled. We need this to boot your computer from the USB stick later in this workshop.

File Storage Sec	Hewlett-Packard Setu urity Power Advanced	Utility	
Device Config Storage Optic	puration		
DPS Self-tes	Storage Option	ns ———— 2n	
Boot Order	Removable Media Boot Max eSATA Speed SATA Emulation	▶Enable 1.5 Gbps IDE	
	F10=Acce	pt, ESC=Cancel	
LOCAL: <f1=helu> REM</f1=helu>	DTE: F1=ESC+1, F5=ESC+5,	F10=ESC+0	

Exit Storage Options and Select Boot Order. Here you will see a list of devices your computer can use to boot.



We will be booting from a USB stick, so let's move the USB device to the top by pressing Enter, then the up arrow.



We can also disable network booting if you don't need it.



Press F10 to confirm and exit Boot Order.

Go back to File menu, then down to Save Changes and Exit.

He	wlett-Packard Setup Utility
File Storage Security	
System Information About	
Set Time and Date Flash System ROM	- Save Changes and Exit
Replicated Setup	Are you sure you want to Save Changes and Exit?
Default Setup	F10=Yes, ESC=No
Apply Defaults and E Ignore Changes and Exit Save Changes and Exit	
DCAL: <f1=help> REMOTE: F</f1=help>	1=ESC+1, F5=ESC+5, F10=ESC+0

Press F10 to confirm, and your computer will restart and begin the boot process again, looking for a USB device. Will it find one?

Installing the Operating System

For this series of workshops we will being using an Operating System (OS) called Xubuntu. Your facilitator has a USB stick for you which contains a Xubuntu Live System and Installer.

We will learn all about your OS in the next workshop, all you need to know right now is:

- A Live System means that we can boot and use your computer from just the USB stick with no need to use the internal hard drive.
- The installer is used to install the Xubuntu onto your hard drive.

In later workshops you will use the live system process to make your own custom version of Xubuntu. Right now we will go straight to installing the OS.

Boot From USB

Take a USB stick from your facilitator and plug it into any USB port and restart your computer using ctrl-alt-delete.



If you see a small logo down the bottom,



then a Xubuntu flash screen,



you are booting from USB.

If not, you'll need to double check your BIOS settings. Ask your facilitator for help.

Installing Xubuntu

You can use your mouse or keyboard to select options here. Select English, then select Install Xubuntu.

Bosanski Català Čeština Cymraeg Dansk Deutsch Esti Español Galego Galego Hrvatski Íslenska	Welcome		
Español Try Xubuntu Install Xubuntu Esperanto Euskara Install Xubuntu Euskara You can try Xubuntu without making any changes to your computer, directly from this CD. Gaeilge Gaeilge Or if you're ready, you can install Xubuntu alongside (or instead of) your current operating system. This shouldn't take too long. Hrvatski Íslenska	Bosanski Català Čeština Cymraeg Dansk Deutsch Eesti	\odot	
Français You can try Xubuntu without making any changes to your computer, directly from this CD. Gaeilge Or if you're ready, you can install Xubuntu alongside (or instead of) your current operating system. This shouldn't take too long. Hrvatski Islenska	Español Esperanto	Try Xubuntu	Install Xubunțu
Gaeilge Or if you're ready, you can install Xubuntu alongside (or instead of) your current operating system. This shouldn't take too long. Hrvatski Íslenska		You can try Xubuntu without making any change	s to your computer, directly from this CD.
Íslenska	Gaeilge		ide (or instead of) your current operating system. This
You may wish to read the <u>release notes</u> .		You may wish to read the <u>release notes</u> .	

The next menu suggests the amount of hard disk space Xubuntu should use and the installer recommends connecting to the internet while installing. We usually don't have internet access for this

workshop. Finally, check the box 'install this third-party software' - this will let us use MP3s.

- Ir	stall ×		
Preparing to install Xubuntu			
For best results, please ensure that this computer:			
🎻 has at least 6.0 GB available drive space			
🚽 is connected to the Internet			
Download updates while installing Xubuntu uses third-party software to play Flash, MP3 and other med	is and to work with come graphics and wilf bardware. Some of this		
software is proprietary. The software is subject to license terms include			
✓ Install this third-party software Ruendo MP3 plugin includes MPEG Layer-3 audio decoding technology licensed from Fraunhofer IIS and Technicolor SA.			
	Oquit Gack Contin		

Installation Type

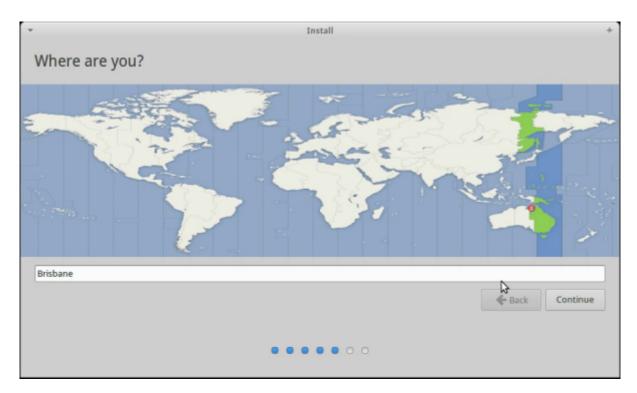
This menu lets you select how you to treat the hard disk you are installing onto. As you are starting from scratch with a new system you select 'Erase and install', then click 'Install now'.

*	Install		×
Insta	llation type		
This corr	puter currently has no detected operating systems. What would you like to do?		
	Erase disk and install Xubuntu Warning: This will delete all your programs, documents, photos, music, and any other files in all operating systems.		
	Encrypt the new Xubuntu installation for security You will choose a security key in the next step.		
	Jse LVM with the new Xubuntu installation This will set up Logical Volume Management. It allows taking snapshots and easier partition resizing.		
	Something else You can create or resize partitions yourself, or choose multiple partitions for Xubuntu.		
	Quit	🗲 Back	Install Now

Where are You?

Now you need to tell your computer where in the world you are. The installer will recognise all standard timezones and Australian State Capitals.

In this case we are in Queensland, so begin typing Brisbane in the text box, then select Brisbane time. Or use your mouse to click on the map, then continue.



Keyboard Layout

Please keep the default keyboard layout as English (US). This is the most compatible layout for us. Then click continue.

Who are you?

Fill in your personal details and create a password. Please do not forget your password, you will need it regularly! Select log in automatically, and then click continue. Your system will begin installing.

•	Install		
Who are you?			
Your name:	ccc-opal	4	
Your computer's name:	cccopal-VirtualBox		
	The name it uses when it talks to other computers.		
Pick a username:			
Choose a password:			
Confirm your password:	••••		
	Log in automatically Require my password to log in		
	Encrypt my home folder		
		🗲 Baci	Continue

Complete the Install

When the install is completed you will be prompted to 'Remove the installation media' - this is your USB stick - and restart your computer. At this point you should go into the BIOS again and change your first boot device to your internal hard disk.

Setting Up the CCC Network

Before we go any further, it's time to setup our local CCC network. We will use this network for updating and installing software, without having to use an internet connection.

The CCC facilitator laptop will act as a server, and store all the files you need. You'll also be able to access this wiki and our version of simple wikipedia. Your facilitator will show you where to find the network cables and explain what to do next.

End of Workshop 02

Well done! You've made it through Workshop 02. Your facilitator will have workshop 03 printed out for you to read as homework.

NEXT WORKSHOP -->