Raspberry Pi – A Learning Experience (For me!)

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K3SR

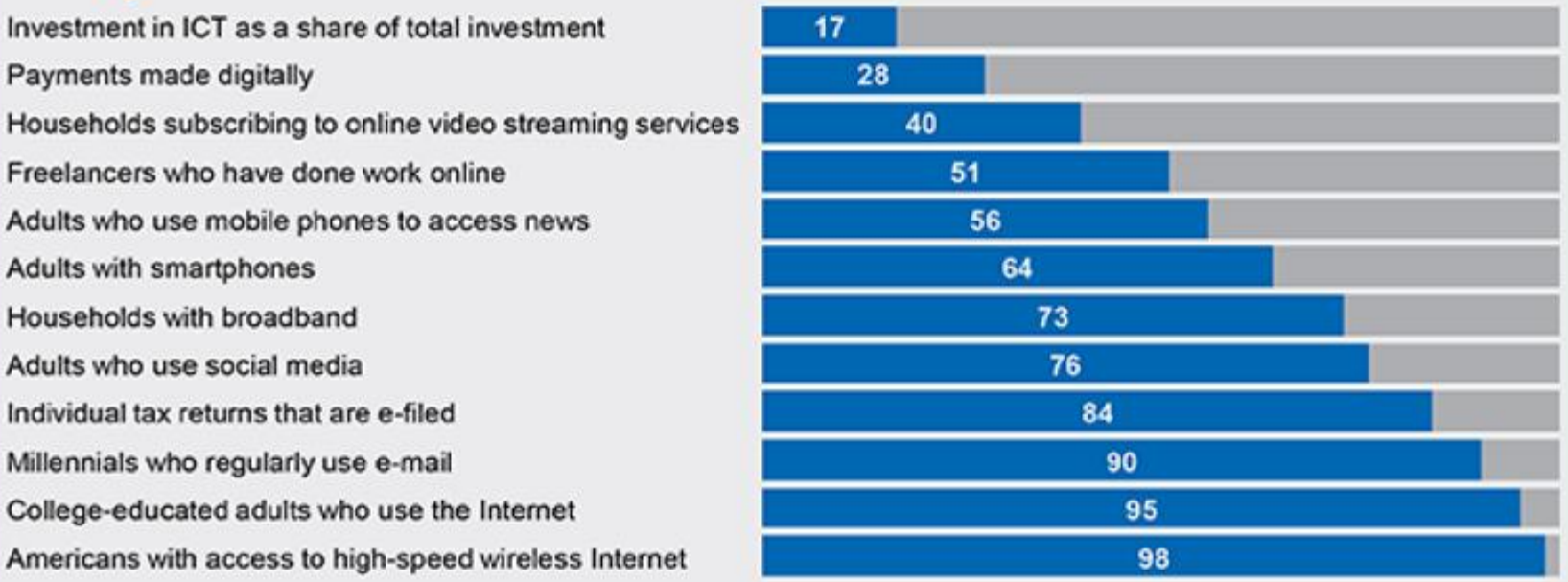
The Digital Revolution

Share of U.S. Economy Impacted by Digitization—Various Metrics, 2014 or Latest

5% ICT as a share of GDP, as measured in official statistics

10% ICT as a share of GDP, taking into account price effects[1]

Up to **98%** Based on various metrics for measuring digitization in the economy



1 Factoring in real price declines in ICT goods and estimating the benefits to non-ICT sectors based on their ICT purchases, adjusting for price elasticity of demand.

SOURCE: BEA; BLS; Pew Research Center; the White House; Nielsen; IRS; US Census Bureau; McKinsey social technology survey; McKinsey Payments Map; McKinsey Global Institute analysis

The Accelerating Digitization of the U.S. Economy

Geewhiz Statistics
-Digital is changing the world
-Tech companies are ~10+% of US employment and the fastest wage growth segment.

Hams are inextricably intertwined and run the risk of being part of both the problem & solution

Hams hold a lot of VERY valuable spectrum

Tenets of the digital revolution:

-communications — Amateur radio
-processing — Amateur radio + Information Technology – enter Raspberry Pi
-memory — Amateur radio + Information Technology – enter Raspberry Pi
-storage — Amateur radio + Information Technology – enter Raspberry Pi

Why the Pi excites me!

The technology sector is Information & Communications Technology (ICT) Sector

Quick Survey

- How many of you own computers?
- How many have heard about raspberry pi?
- How many of you are raspberry pi owners?
- How many of you work with LINUX?
- How many of you are programmers or write software?
- How many of you belong to the ARRL?
- Value of the ham spectrum?

Raspberry Pi - Agenda

- Introduction & History
- Meet the Board
  - Technical dribble
  - Set up and Use
- Things You Can Do besides eating Pi
  - Entertainment, Productivity & Web Server
  - Programming
    - Machine code, command line, Scratch & Python
  - Auxiliary Boards & Devices
    - General Purpose Input/Output (GPIO)
  - Applications/Demonstration

Raspberry Pi – Introduction & History

Plan, Plan, Plan, Execute vs.
Plan, Execute, Execute, Execute!

- Education Resources abound
  - – www.raspberrypi.org -- Amazing documentation

  History – UK product

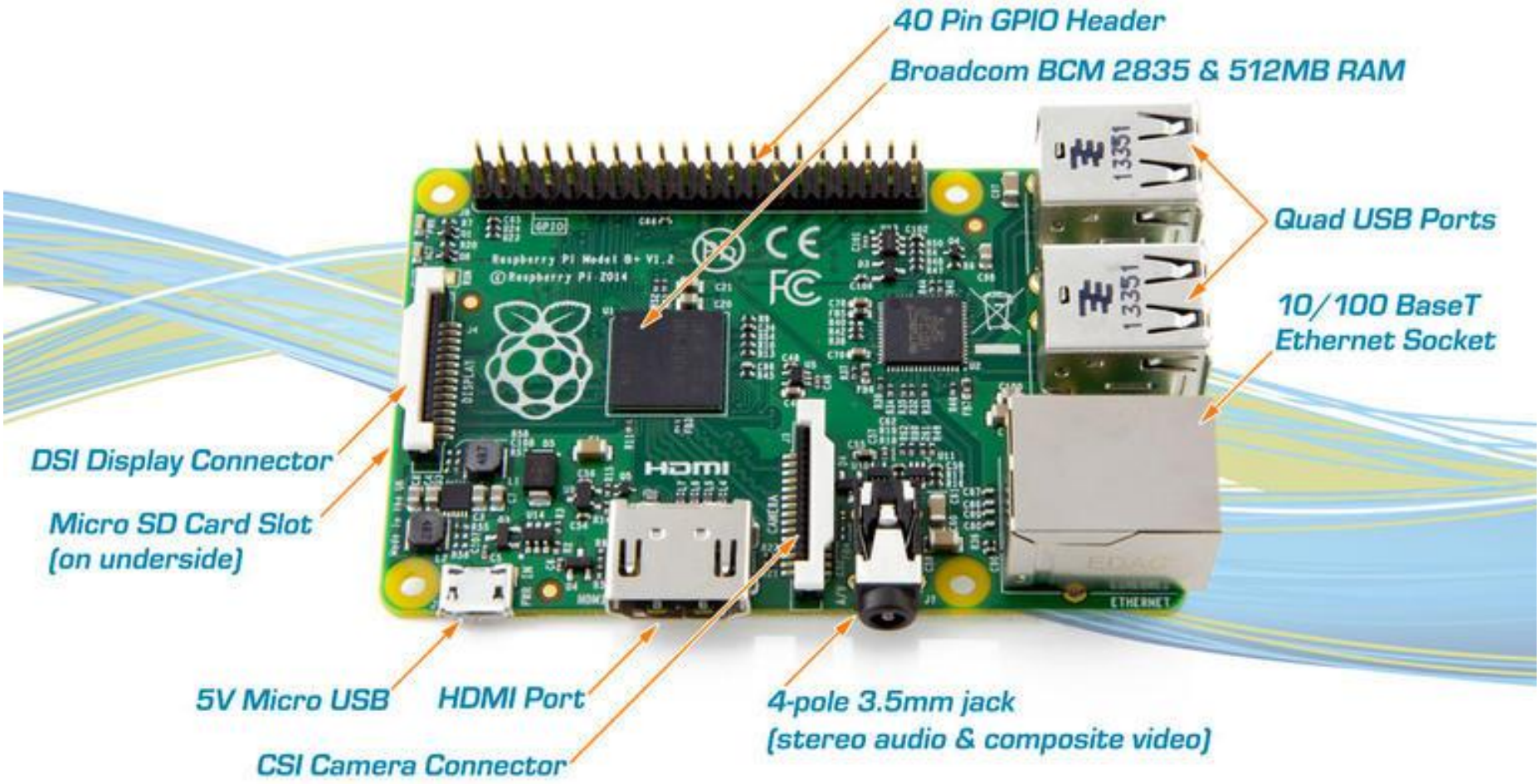
  Eben Upton ComSci professor @ Cambridge
    - Rory Cellan-Jones Blog went viral over night
    - Promised a $25 computer
    - To date over 5 million sold
    - Pricing : <$10 to $100

Reference: Raspberry Pi Users Guide
Eben Upton Gareth Halfacre

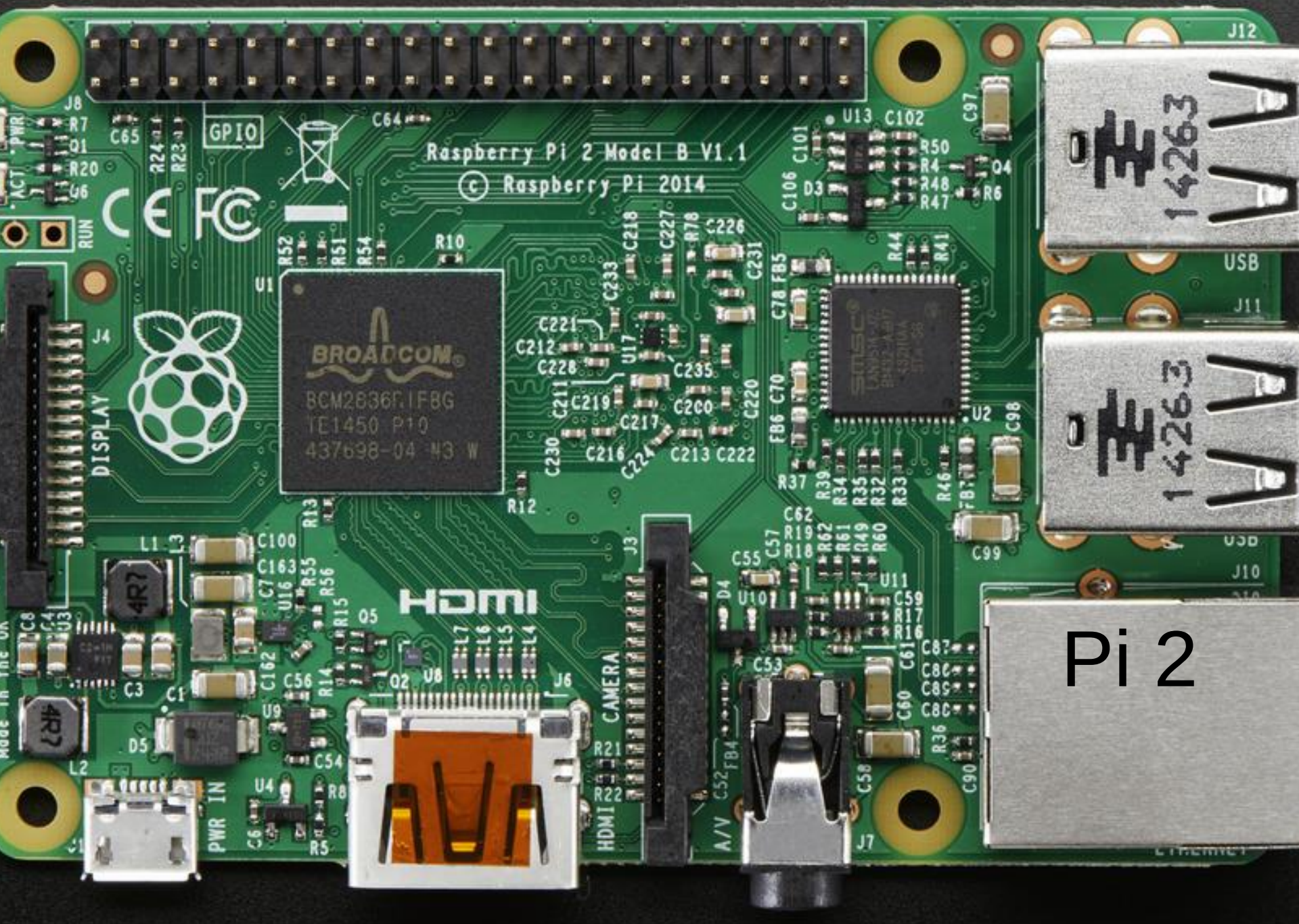
Raspberry Pi – Meet the Board

- Technical dribble
  - Pi 2 B+ Broadcom 2836 Quad core SoC operating at 900 Mhz
    - Further detail Broadcom Spec Sheet 2836
  - ARM (architecture used in cell phones and portable devices) Not common in desktop PC's
    - Advanced RISC Machine – ARM
    - RISC (Reduced instruction set computing)
    - Low power consumption
    - Designed around ARM V7 32 bit processing
  - Linux OS (NOOBS a Raspian variant)

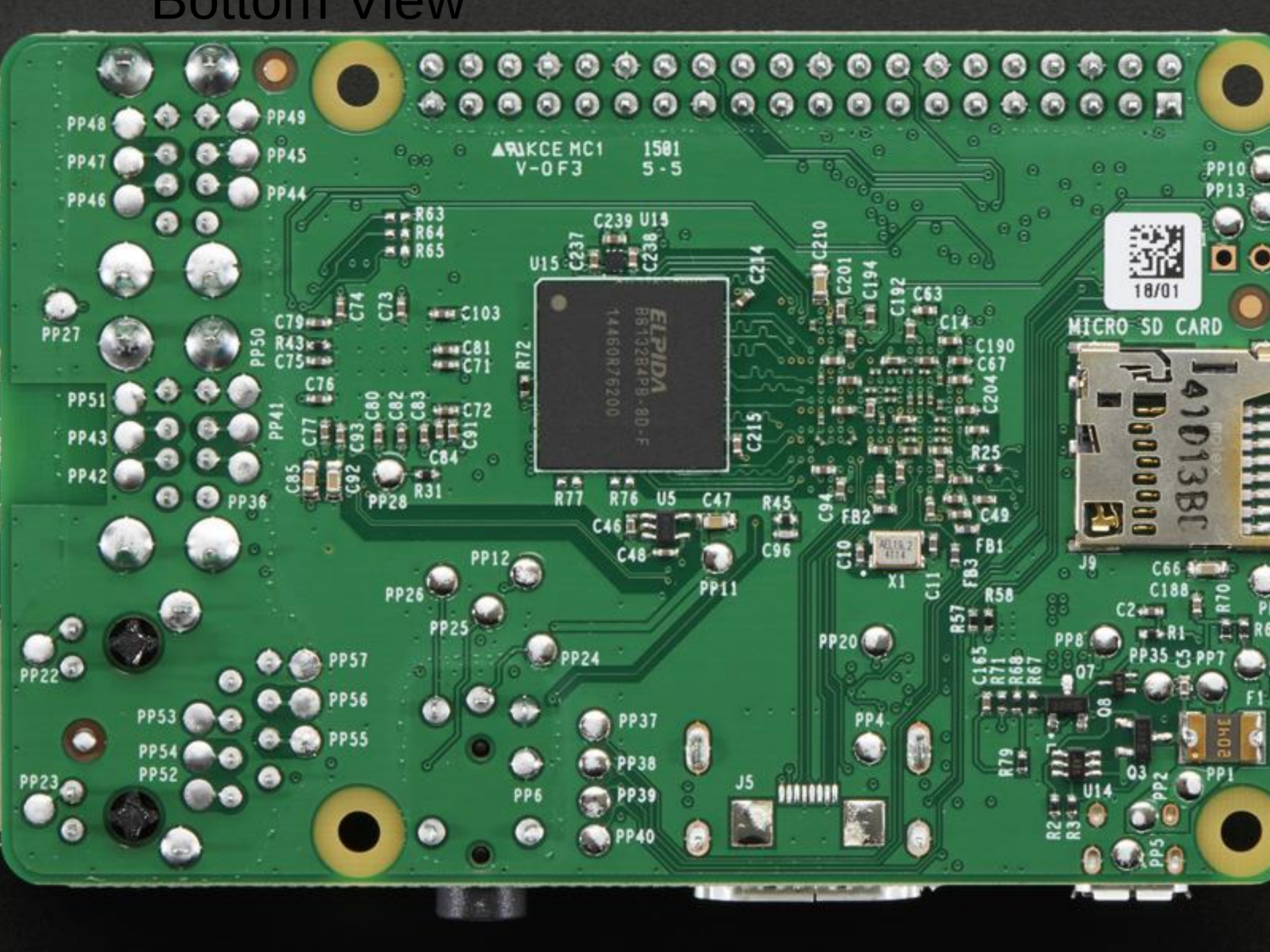
Picture of B+ pi 2 2836 with ram on bottom of the board

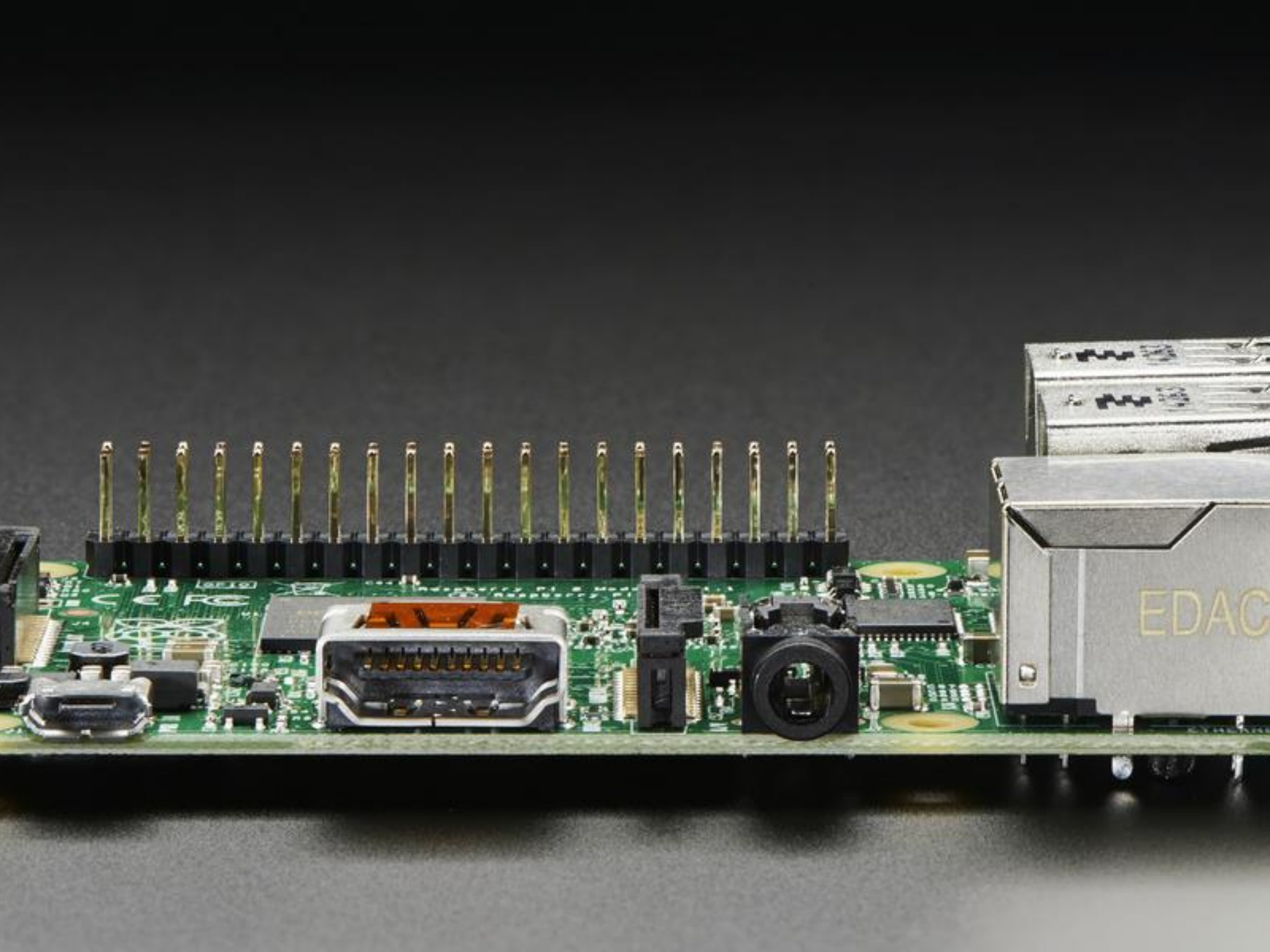


Pi Board Top View



Bottom View




EDAC

Raspberry Pi – Meet the Board

- Set up and Use
  - Connect video (Composite, DVI & HDMI (H.264))
  - Connect audio (1/8” phone jack – requires powered speakers) Audio out no mic input
    - Need a sound card for PSK
  - Keyboard & Mouse (USB)
  - Load OS from SD card (NOOBS)
  - Connect external storage (Thumb drive up to 64Gbs)
  - Connect to network
    - Wireless (USB Thumb drive)
    - Wired (Ethernet Cable)
  - Connect Power

Raspberry Pi – Linux

- Command Line
  - Cd – change directory
  - Mkdir – make directory
  - Rmdir – remove directory
  - Ls – short for listing
- Directories
  - /Boot – kernel + other packages to start pi
  - /bin – OS related binary files required to run the GUI
  - /dev - Virtual directory all devices that connect to the system including storage, sound card and HDMI
  - /etc – Miscellaneous configuration files
  - /home – each user gets a sub directory to store personal files
  - /lib – file library
  - Many others
- “Manual” followed by the command

Raspberry Pi – Linux

- How to install applications from the command line
  - Installation tool called apt
    - E.g. to find a game to play *apt –cache search game*
    - E.g. to load a game *sudo apt-get install thrust* (thrust is the name of the game)
    - E.g. to remove thrust *sudo apt-get remove thrust*
    - E.g. to purge thrust *sudo apt-get purge thrust*
- Install applications from the GUI interface
  - Download from the internet and install
    - E.g iceweasel from Mozilla

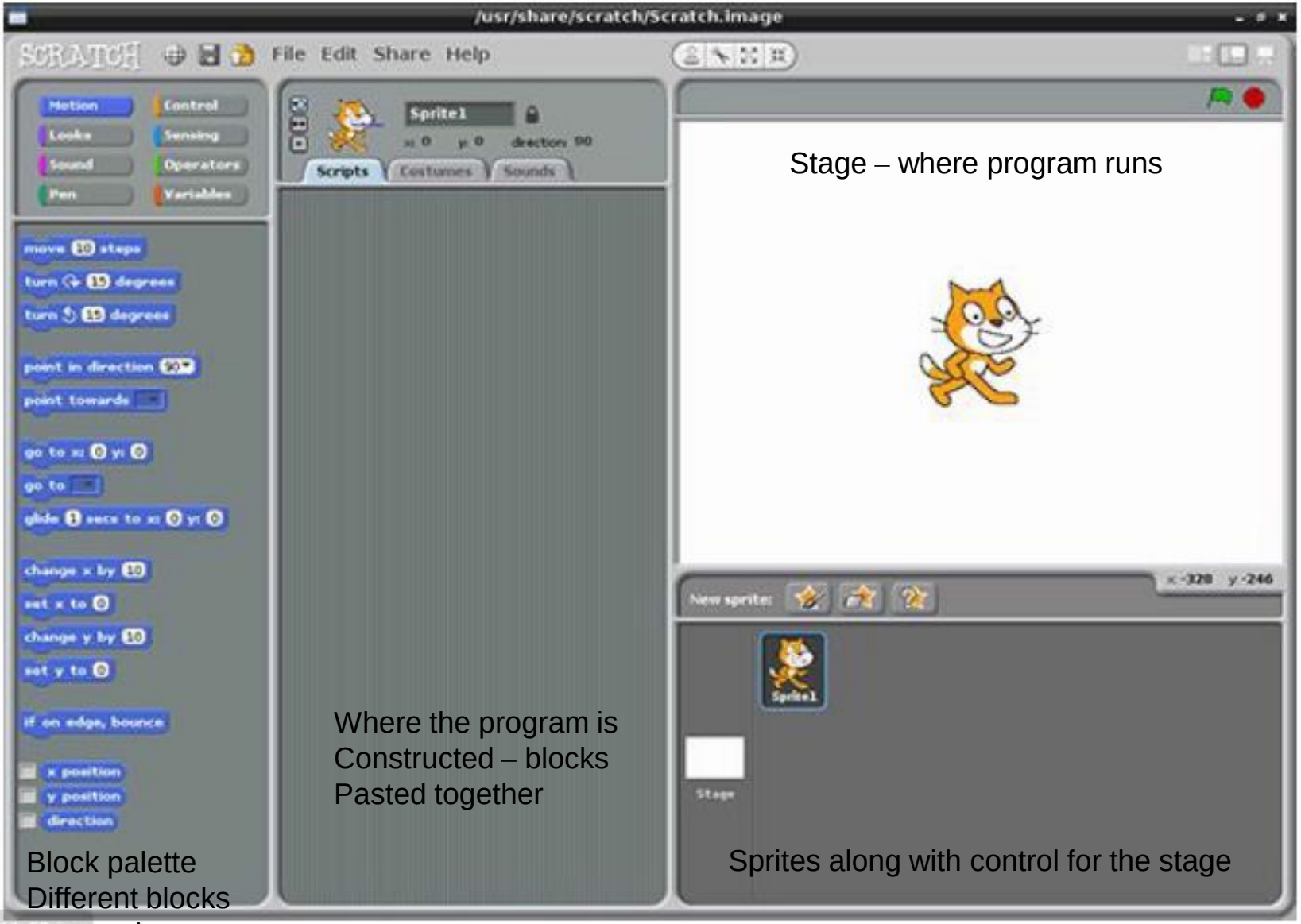
Raspberry Pi – Things You Can Do besides eating Pi

- Entertainment, Productivity & Web Server
  - Entertainment - Streaming internet Audio and H.264 Video + Analog audio
  - Productivity – Open Office, image editing with GIMP
  - Web Server - LAMP stack, command line not GUI
    - LAMP Linux, Apache, MySqL & PHP
    - Memory and processing power limited
    - Word Press – open source platform to create interactive websites
- Programming
  - Scratch & Python
- Auxiliary Boards & Devices
  - GPIO (General Purpose Input/Output)
  - Interface boards stack on top of 40 (26?) pin GPIO

Raspberry Pi – Things You Can Do besides eating Pi

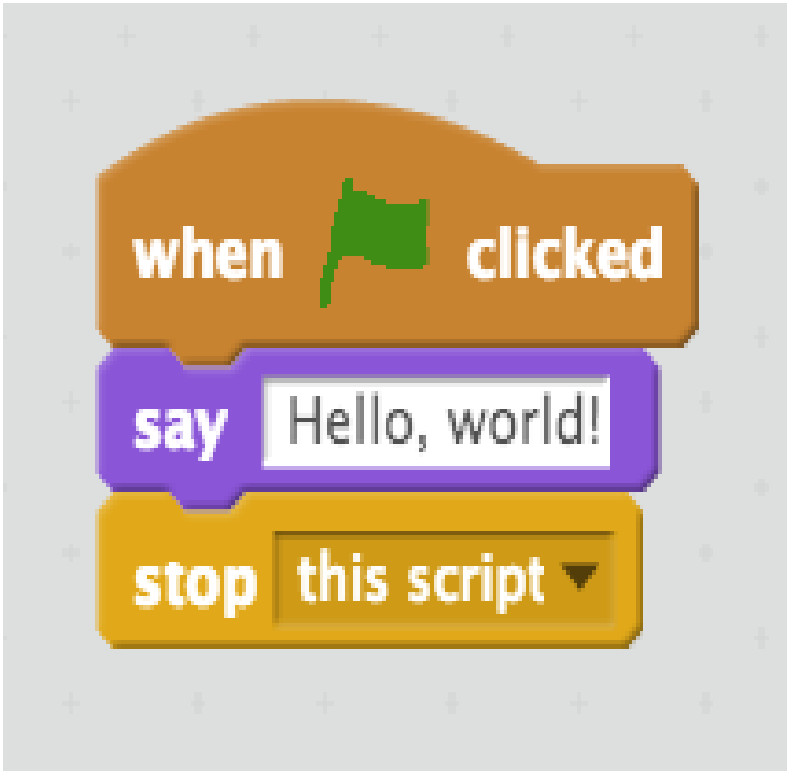
Programming

- Scratch – Flowgraph programming for ages 8+
  - Created by MIT
  - Website http://scratch.mit.edu
- Useful to teach programming
  - Games
  - Animations – create cartoons (Aural & Visuals)
  - Interactive stories
  - Supports robotics
- Helps Young People (All people)
  - Think creatively
  - Reason systematically
  - Work collaboratively
- Further information - http://info.scratch.mit.edu/support,


/usr/share/scratch/Scratch.image
SCRATCH
File Edit Share Help
Motion
Control
Looks
Sensing
Sound
Operators
Pen
Variables
move 10 steps
turn 15 degrees
turn 15 degrees
point in direction 90
point towards
go to x: 0 y: 0
go to
glide 1 secs to x: 0 y: 0
change x by 10
set x to 0
change y by 10
set y to 0
if on edge, bounce
x position
y position
direction
Sprite1
x: 0 y: 0 direction: 90
Scripts
Costumes
Sounds
Stage – where program runs
New sprite:
x: -328 y: -246
Sprite1
Stage
Where the program is
Constructed – blocks
Pasted together
Block palette
Different blocks
are used to create
program
Sprites along with control for the stage

Scratch “Hello World”

High level flowchart programming



almost everything is done by dragging and dropping blocks of code and arranging them into a logical pattern.

Raspberry Pi – Things You Can Do besides eating Pi

Programming

- Python
  - Named for Monty Python?
  - General purpose high level language
  - Readable code
  - Memory management
  - Interpretative language
  - http://wiki.python.org/moin/BeginnersGuide.
- Python Hello World Program
  - #! /usr/bin/env python Sets up $PATH directory location where executable programs are stored
  - Print “Hello World!”
  - Final Hello World code
    - » #! /usr/bin/env python
    - » Print “Hello World!”

#! She bang

Raspberry Pi – Things You Can Do besides eating Pi

  - Auxiliary Boards & Devices
    - GPIO (General Purpose Input/Output)
    - Interface boards stack on top of 40 pin GPIO
- Pins access includes
  - I2C Inter-integrated Circuit Bus – communication between integrated circuits
    - Pin 3 Serial Data Line(SDL) with internal pull up resistors,
      Pin 5 Serial Clock Line (SCL)
  - SPI Serial Peripheral Interface for (ISP) in System Programming of other devices
    - 4 wire bus with multiple chip select lines
    - Pins 19 SPI Master output, slave input, pin 21 Master Input, slave output and pin 23 Serial clock (SLCK); pins 24 and 26 select lines for other devices
  - UART Universal Asynchronous Receiver/Transmitter
    - Access to kernel
    - Pin 8 transmit pin 10 receive
    - Speed set via cmdline.txt Usually 115,200 Bps
  - 3.3V Max - Further details in Broadcom 2836 spec sheet
  - Python library available to support utilizing GPIO

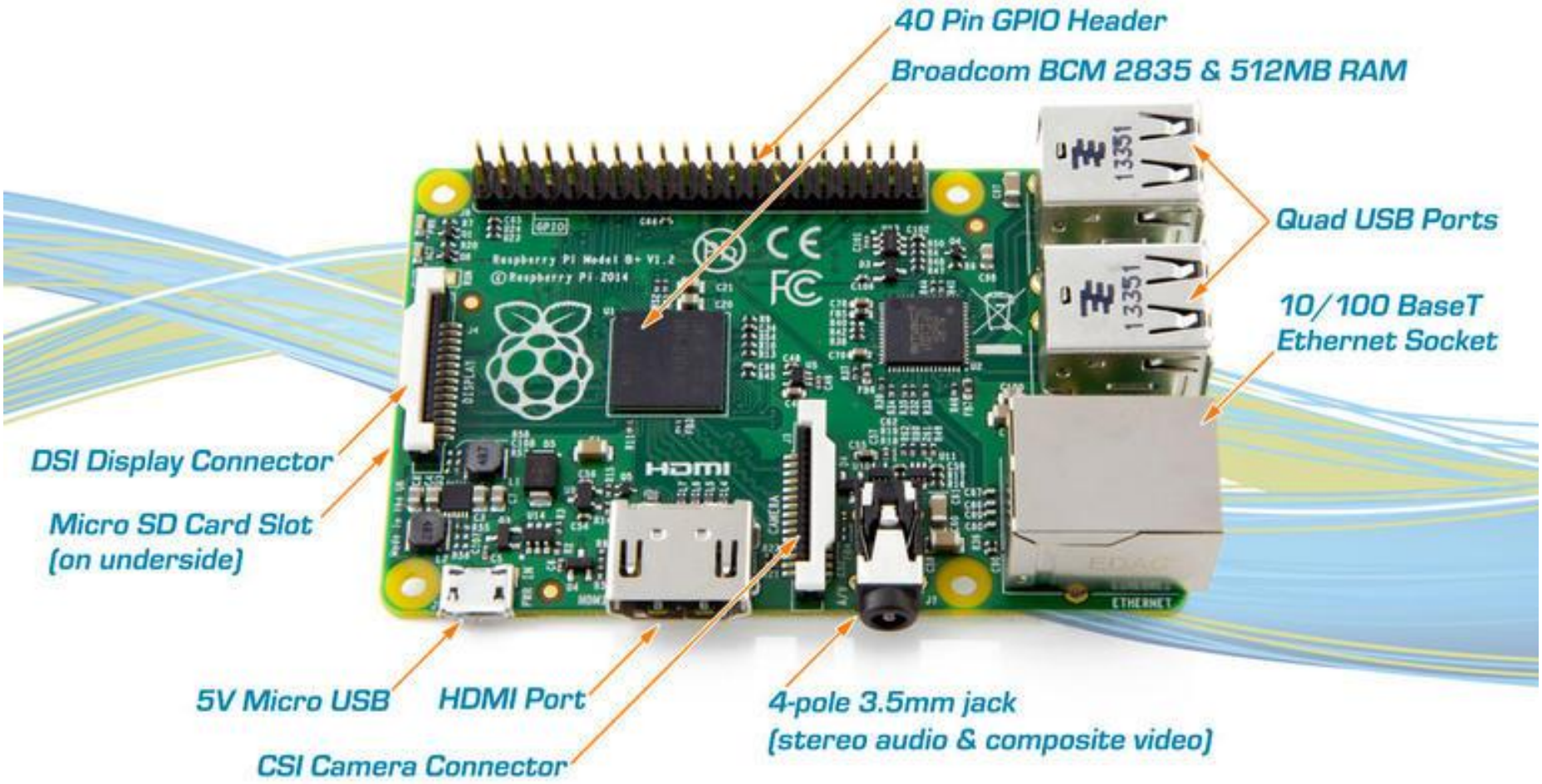
RASPBERRY PI
Revision 2
Pinout

http://www.pinballsp.com

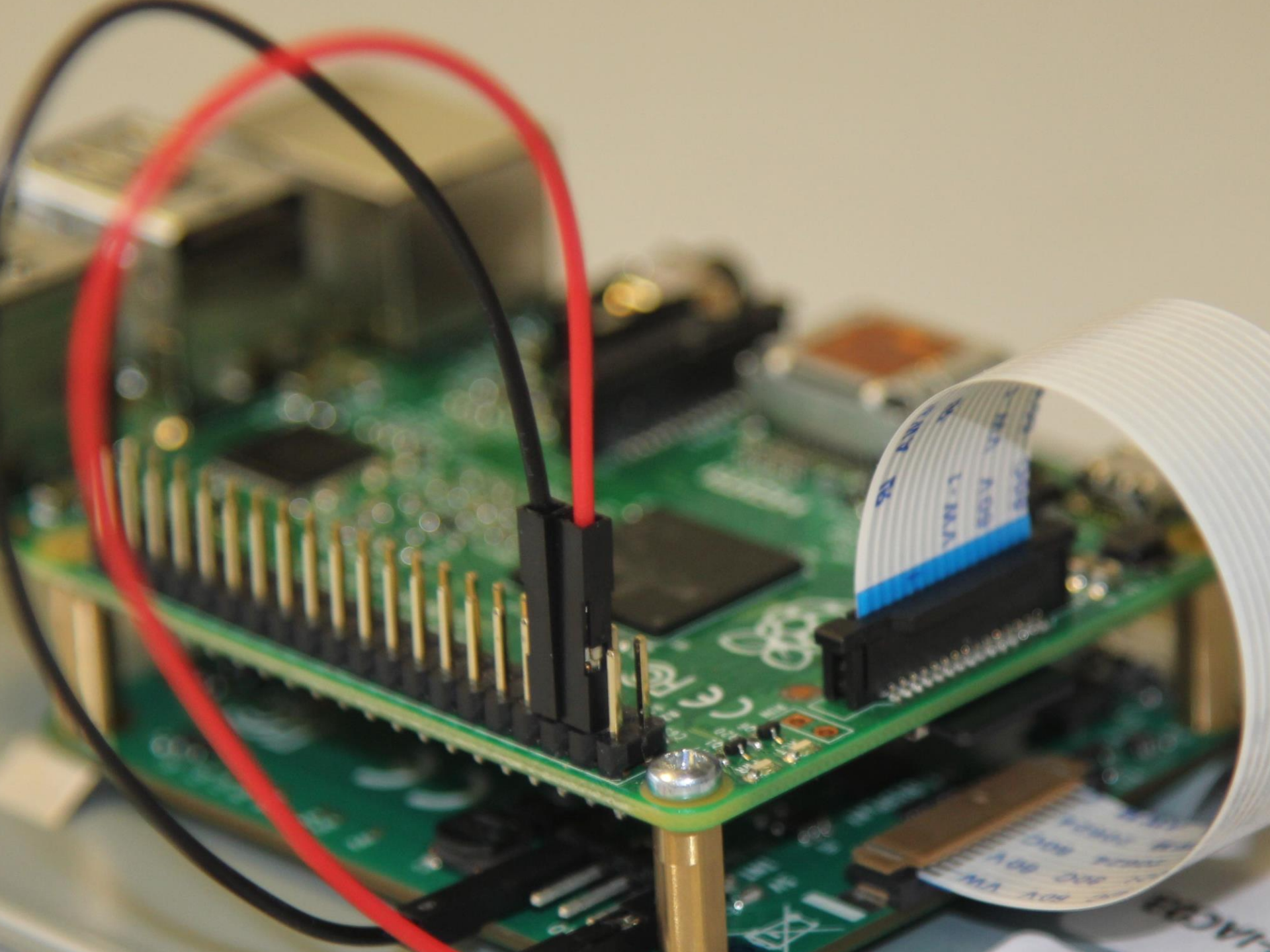
	3V3	1	2	5V	+5v
I2C PULL-UP	GPIO2 SDA	3	4	5V	
	GPIO3 SCL	5	6	Ground	GND
	GPIO4	7	8	GPIO14 TXD	UART
	Ground	9	10	GPIO15 RXD	
UART-RTS	GPIO17	11	12	GPIO18	PWM
	GPIO27	13	14	Ground	
	GPIO22	15	16	GPIO23	
	3V3	17	18	GPIO24	
SPI	GPIO10 MOSI	19	20	Ground	
	GPIO9 MISO	21	22	GPIO25	
	GPIO11 CLK	23	24	GPIO8 CE0	SPI
	Ground	25	26	GPIO7 CE1	

Revision 2.0

s://www.facebook.com/pages/PinballSP/336137879799788


40 Pin GPIO Header
Broadcom BCM 2835 & 512MB RAM
Quad USB Ports
10/100 BaseT
Ethernet Socket
DSI Display Connector
Micro SD Card Slot
(on underside)
5V Micro USB
HDMI Port
CSI Camera Connector
4-pole 3.5mm jack
(stereo audio & composite video)

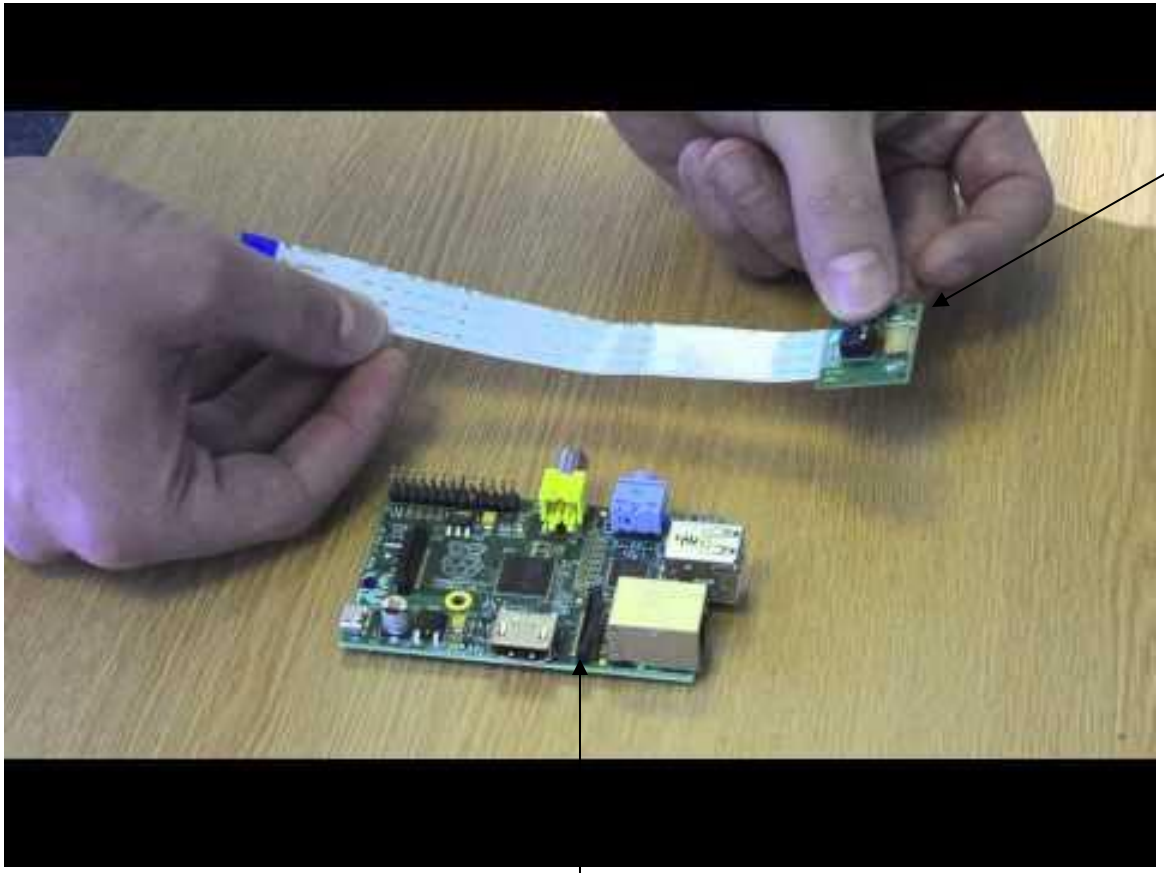

ETHERNET



Raspberry Pi – Demonstration

- Camera – Used for hi-def pictures (5 mpxl)
  - Video Streaming
- Need to install camera into the Pi
- Need to activate the software
- Demo pictures

Raspberry Pi Camera Module



Raspberry Pi – Wrap Up – Potential Applications

- PSK31/RTTY
- APRS
- Panadaptor
- Remote control of radio(s)
- Camera
- OBD II
- http://www.raspberryconnect.com/raspbian-packages-list/item/71-raspbian-hamradio

Raspberry Pi – Future Plans

- OBD 2
- High definition camera – surveillance
- LINUX
- Python or other high level programming
- Tie to digital ham applications

- Work in progress…

Sometimes the very people who no one imagines anything of are the ones who do things that no one can imagine…

Alan Turing

Broadcom 2836 Quad Processor

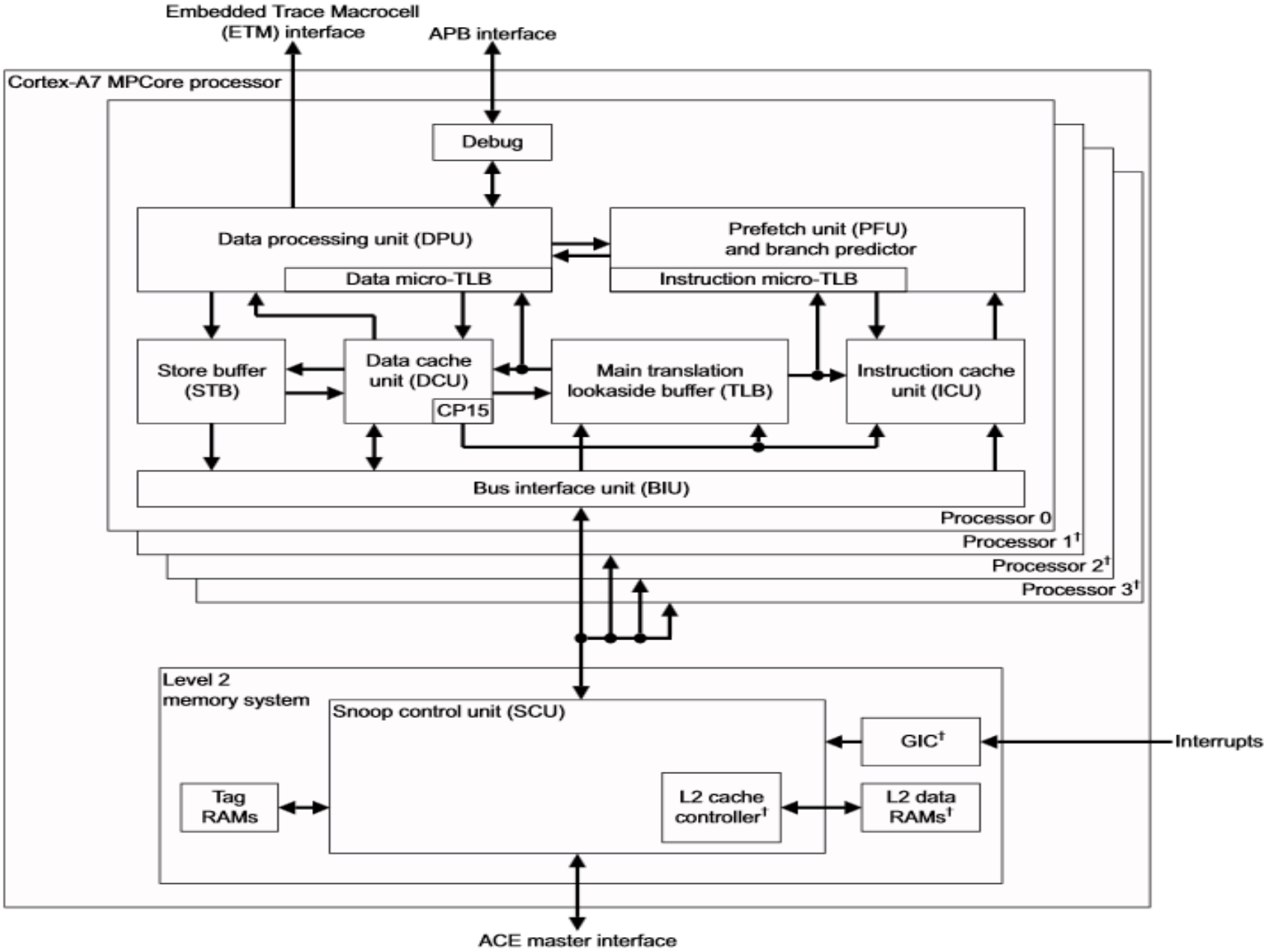
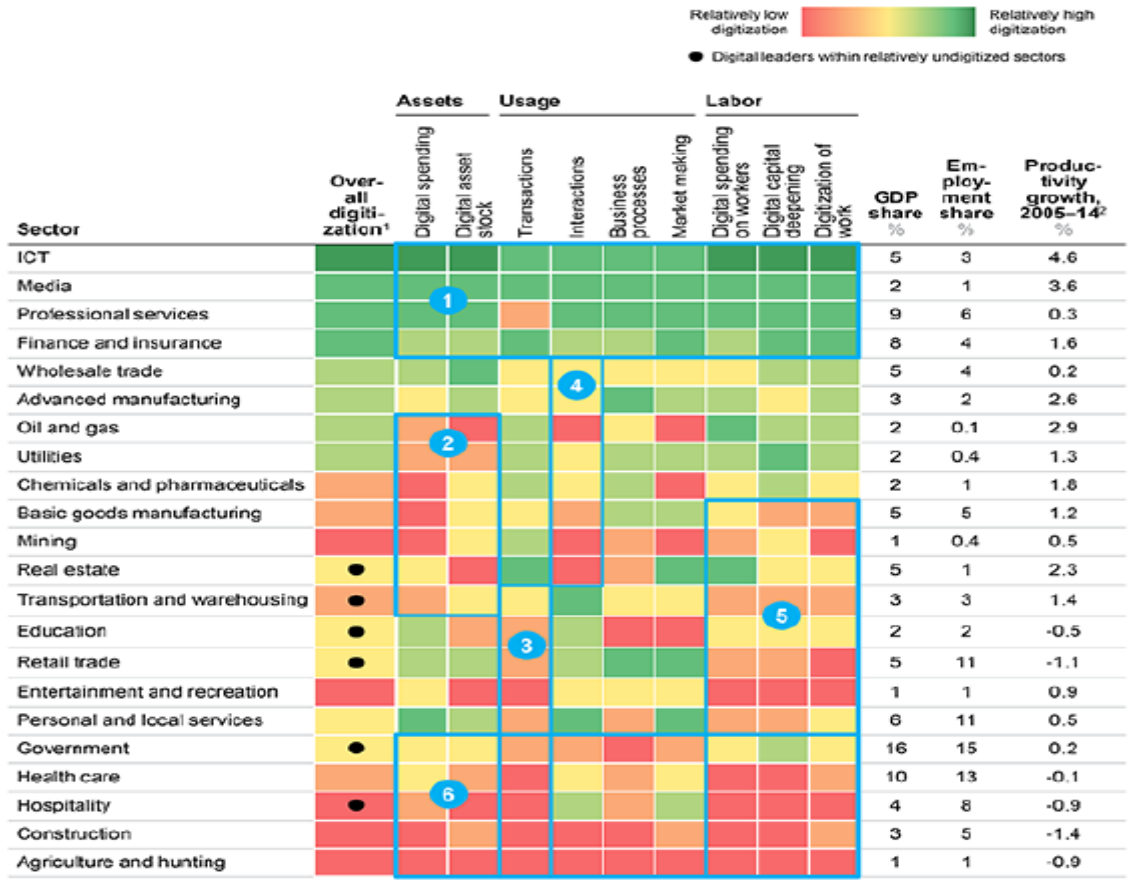


Figure 2-1 Cortex-A7 MPCore processor top-level diagram

The MGI Industry Digitization Index
2015 or Latest Available Data



Sector	Overall digitization[1]	GDP share %	Employment share %	Productivity growth, 2005–14[2] %
ICT		5	3	4.6
Media		2	1	3.6
Professional services		9	6	0.3
Finance and insurance		8	4	1.6
Wholesale trade		5	4	0.2
Advanced manufacturing		3	2	2.6
Oil and gas		2	0.1	2.9
Utilities		2	0.4	1.3
Chemicals and pharmaceuticals		2	1	1.8
Basic goods manufacturing		5	5	1.2
Mining		1	0.4	0.5
Real estate	●	5	1	2.3
Transportation and warehousing	●	3	3	1.4
Education	●	2	2	-0.5
Retail trade	●	5	11	-1.1
Entertainment and recreation		1	1	0.9
Personal and local services		6	11	0.5
Government	●	16	15	0.2
Health care		10	13	-0.1
Hospitality	●	4	8	-0.9
Construction		3	5	-1.4
Agriculture and hunting		1	1	-0.9

1. Knowledge-intensive sectors that are highly digitized across most dimensions
2. Capital-intensive sectors with the potential to further digitize their physical assets
3. Service sectors with long tail of small firms having room to digitize customer transactions
4. B2B sectors with the potential to digitally engage and interact with their customers
5. Labor-intensive sectors with the potential to provide digital tools to their workforce
6. Quasi-public and/or highly localized sectors that lag across most dimensions

1 Based on a set of metrics to assess digitization of assets (6 metrics), usage (11 metrics), and labor (6 metrics); see technical appendix for full list of metrics and explanation of methodology.
2 Compound annual growth rate.

SOURCE: BEA; BLS; US Census; IDC; Gartner; McKinsey social technology survey; McKinsey Payments Map; LiveChat customer satisfaction report; Appbrain; US contact center decision-makers guide; eMarketer; Bluewolf; Computer Economics; industry expert interviews; McKinsey Global Institute analysis

Mathematica

Modern Technical Computing

Coverage

Core Technologies

The *Mathematica* Trajectory

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Coverage

Mathematica is based on the breakthrough Wolfram Language.

Full Wolfram Language Documentation & Reference »

- Symbolic Language
- Mathematical Computation
- Numerics
- Visualization
- Algebraic Manipulation
- Number Theory
- Data Analysis
- Graph Computation
- Image Computation
- Geometric Computation

Mathematica is a symbolic mathematical computation program, sometimes called a computer algebra program, used in many scientific, engineering, mathematical, and computing fields. It was conceived by Stephen Wolfram and is developed by Wolfram Research of Champaign, Illinois.[5][6] The Wolfram Language is the programming language used in Mathematica.[7]