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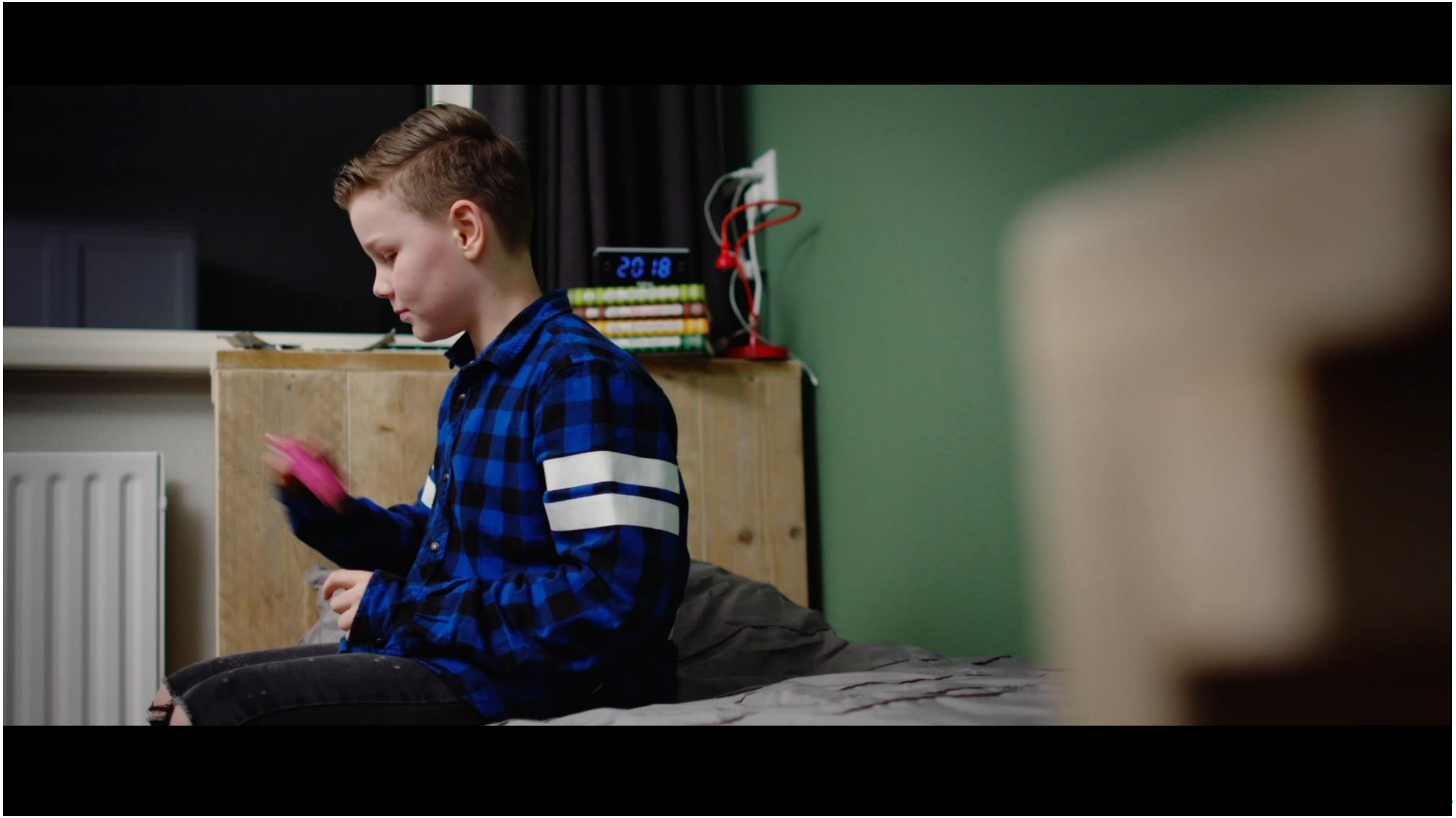
Arm人工智能技术发展与STEM教育

陈炜博士

Aug 2019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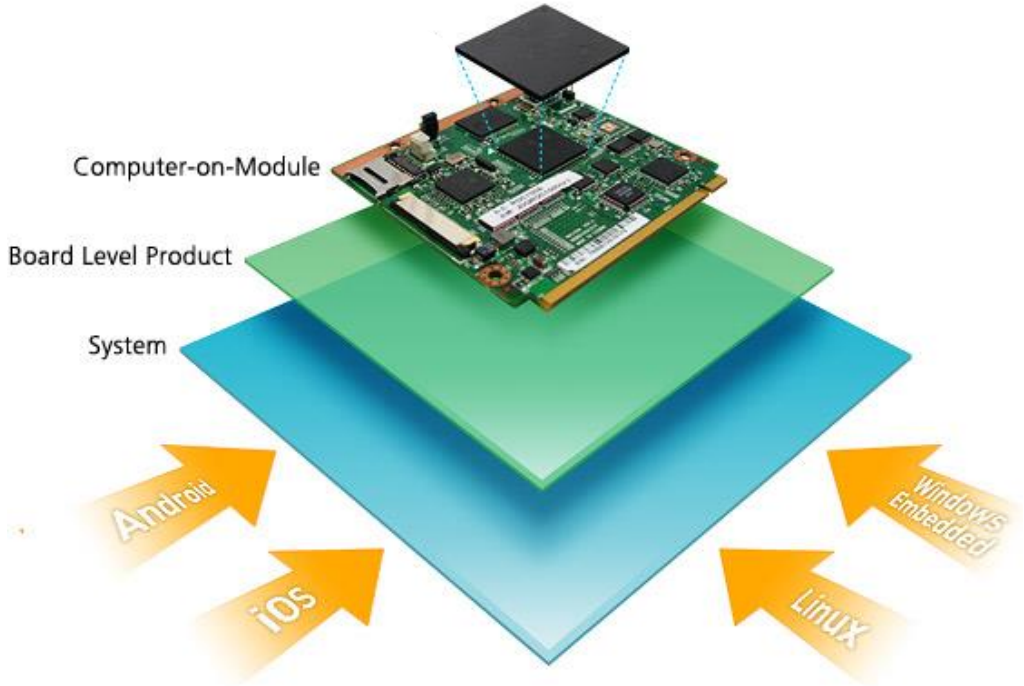

芯片，无处不在
与我们密不可分，却不为人知
全球分工，没有一个企业，一个国家可以垄断
从设计，到单晶硅，到晶圆，光刻，到封装，每一道工艺的背后，是人类最顶尖智力的结晶

通俗地说，芯片是我们众多机器设备的心脏；没有心脏，我们周边的众多机器设备就无法使用，比如手机、洗衣机、电冰箱等

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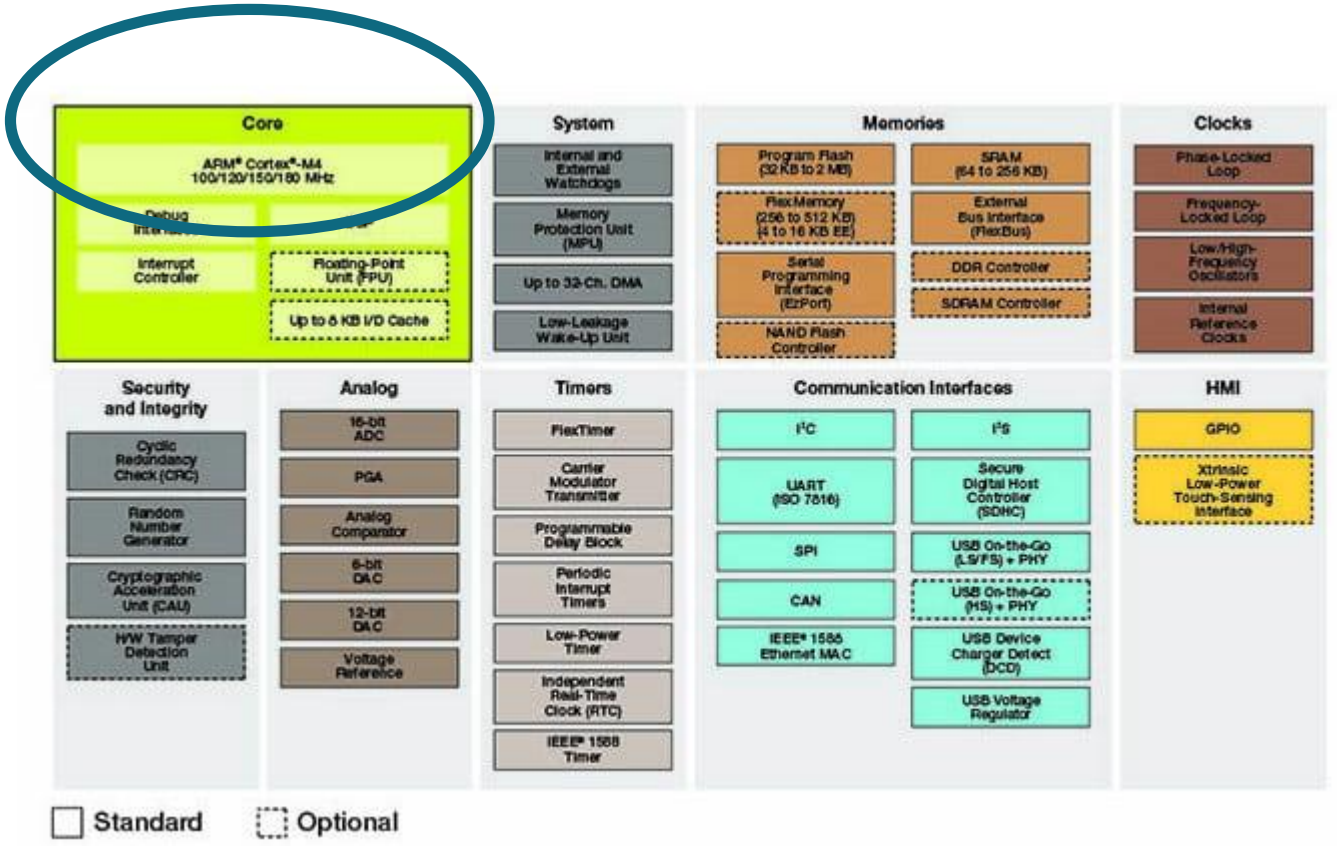
一部智能小车里的芯片



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无所不在的Arm：全球最大科技生态系统

>95% market share

智能手机
smartphone

>90% market share

可穿戴
wearables

>90% market share

存储
storage

>95% market share

车载信息娱乐
Automotive infotainment

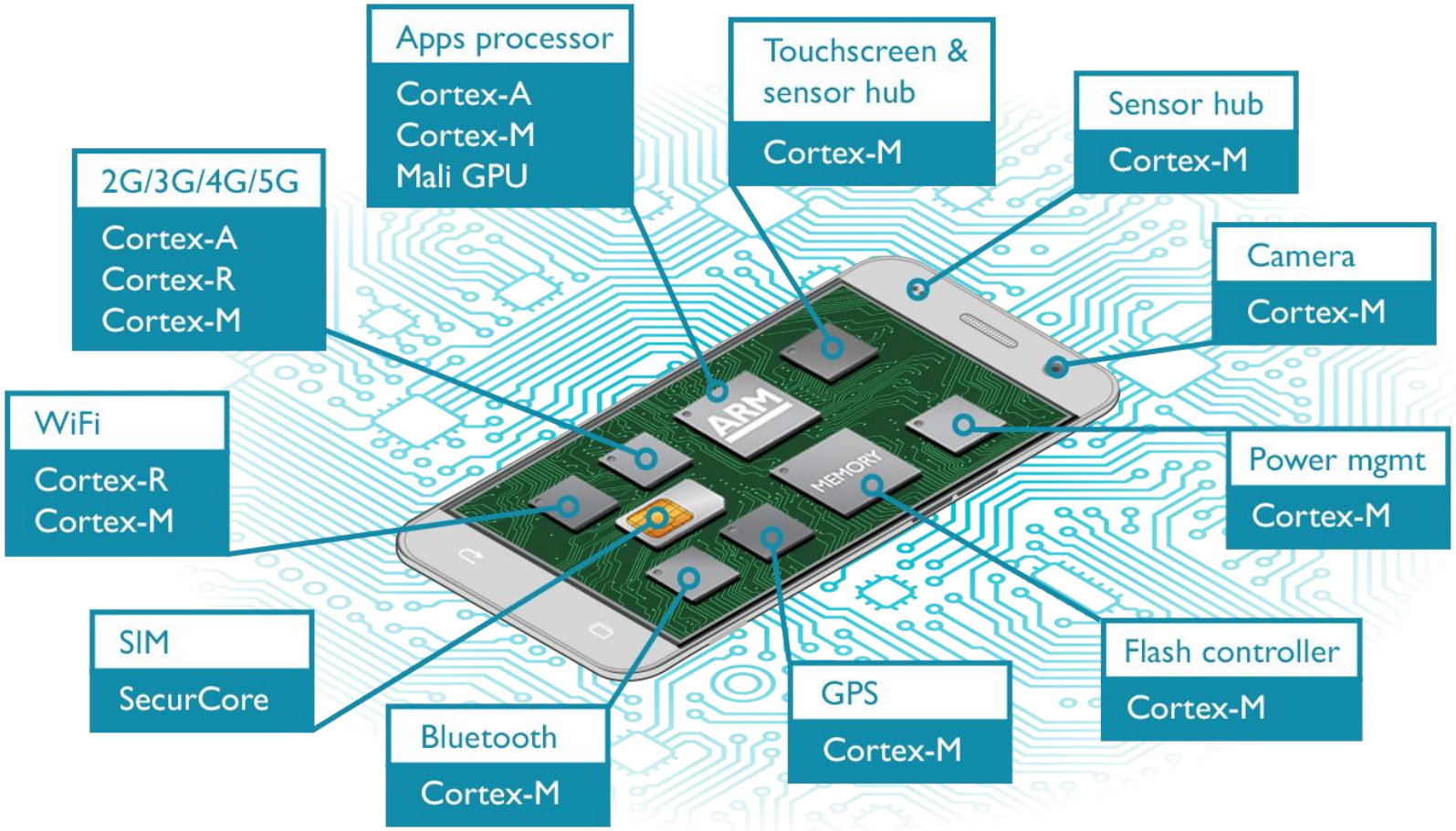
>90% market share

物联网设备
IoT Devices

>90% market share

移动连接
Mobile connectivity

一部智能手机里的芯片



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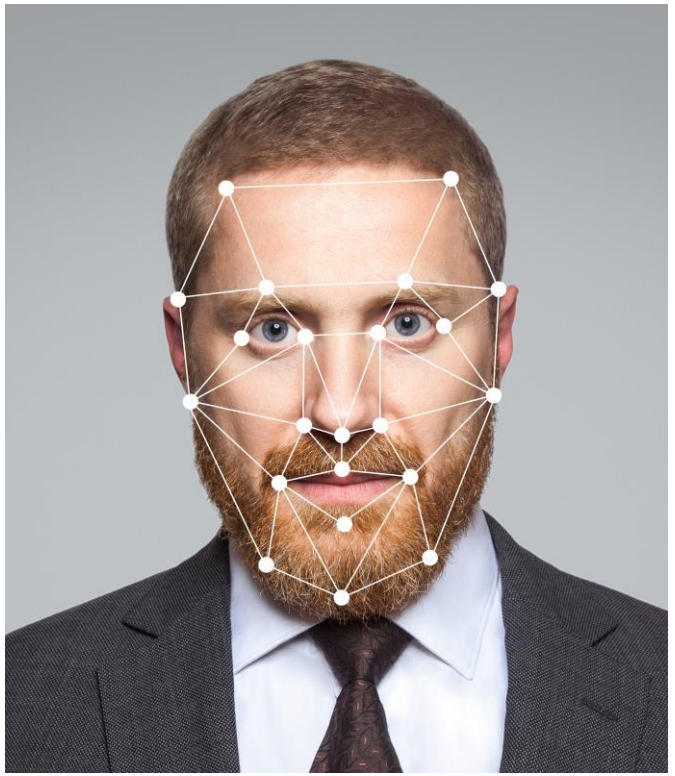
Example: IP Selection for Face Unlock

Face unlock use case

- Detect real faces, extract features, and filter false positive
- Within reasonable wait time

Feature extraction takes majority of the compute

- 90% compute in feature extraction
- Different networks were analyzed for compute and accuracy



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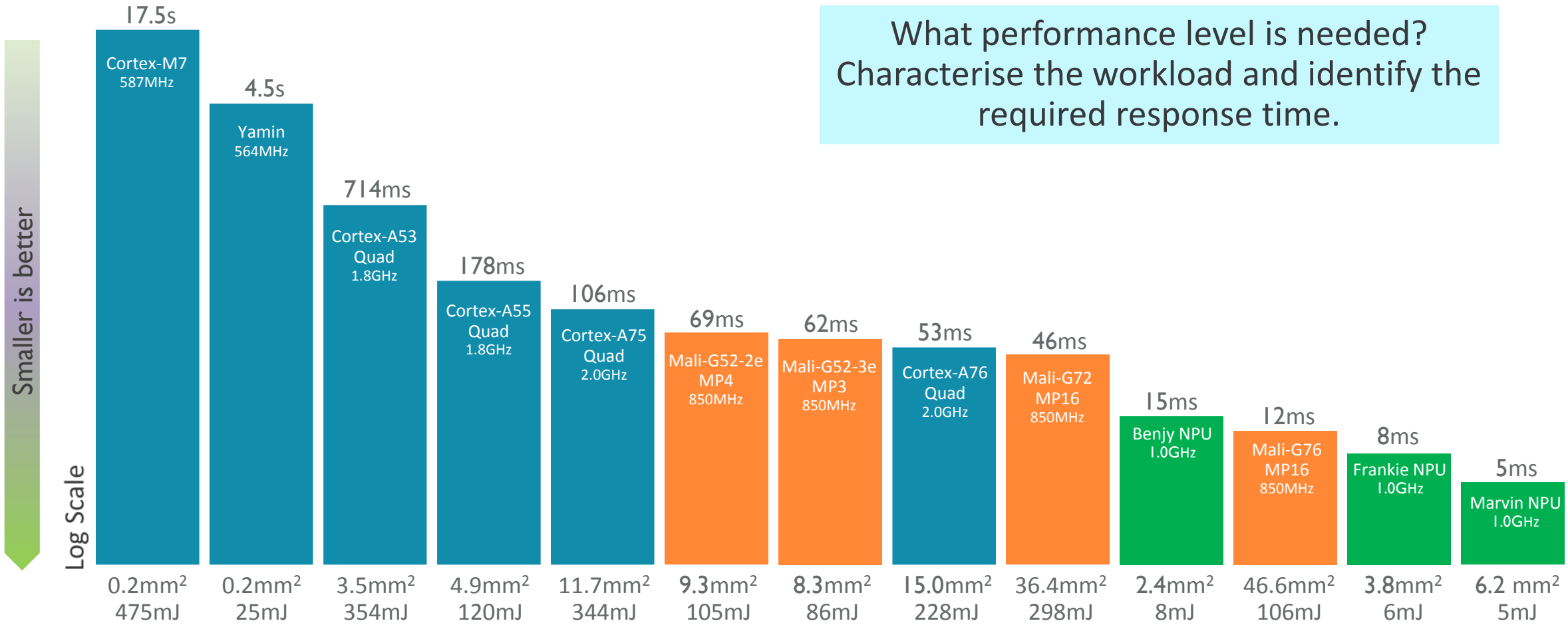
Face Unlock (ResNeXt-50) : Performance



What performance level is needed?
Characterise the workload and identify the required response time.

Data quoted at 16nm
Initial data – subject to change

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Choosing the Optimum Heterogeneous Platform

- Detailed analyses of key ML end-to-end use cases across multiple platforms

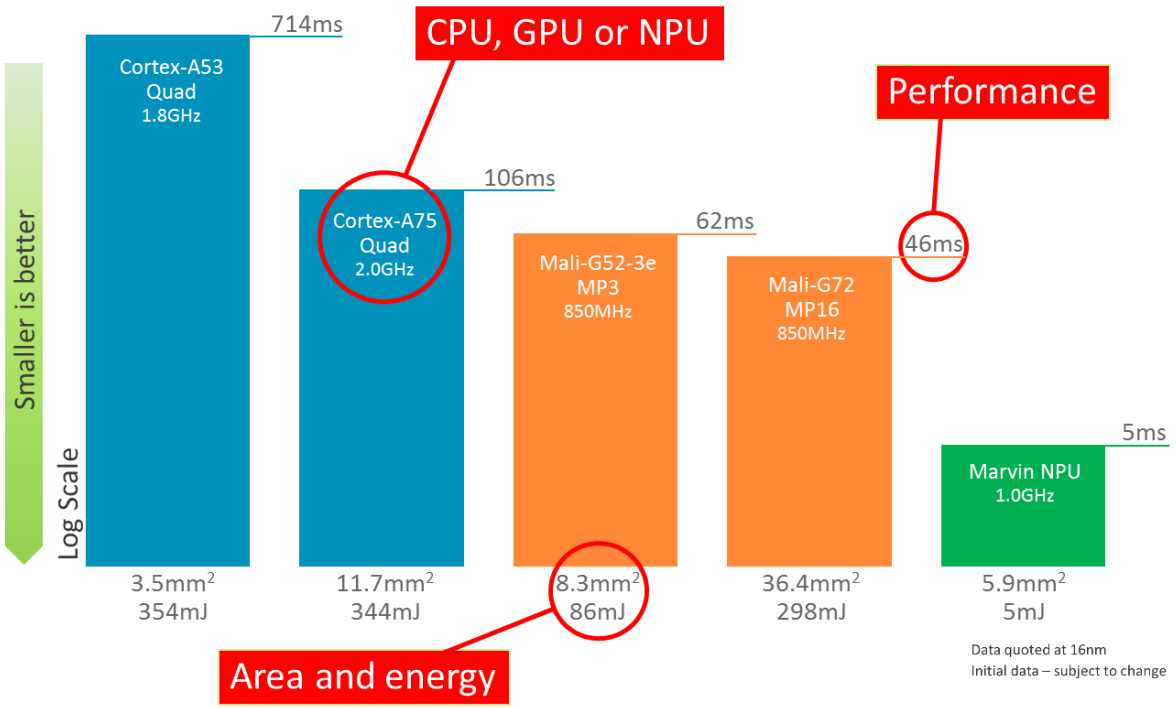

Image Processing

- Face unlock[1]
- Object detection[2]
- Noise reduction
- Subject tagging
- Upscaling (Super Resolution)
- Foreground/background select

Speech/audio

- Keyword spotting
- Natural Language Processing (NLP)
- Text to Speech (TTS)

Automotive

- Autonomous driving
- IVI
- Driver assistance

[1]Detailed analysis available now

[2]Likely next priority use case

Use cases run across this platform

Application	Use Case	CPU and GPU alone	CPU and GPU and dedicated AI hardware
Access control	Face identification	✓	
Camera stills	Object detection	✓	
	Noise reduction		✓
	Super resolution	✓	
	Semantic segmentation	✓	
Video	Super resolution		✓
	Semantic segmentation		✓
Voice assistants	Keyword spotting	✓	
	Natural language processing	✓	
	Text to speech	✓	
Driving	Autonomous driving		✓
	Driver assistance	✓	

Not every problem needs to be solved with a dedicated accelerator.

A combination of good software and hardware is needed to deploy machine learning successfully and easily.

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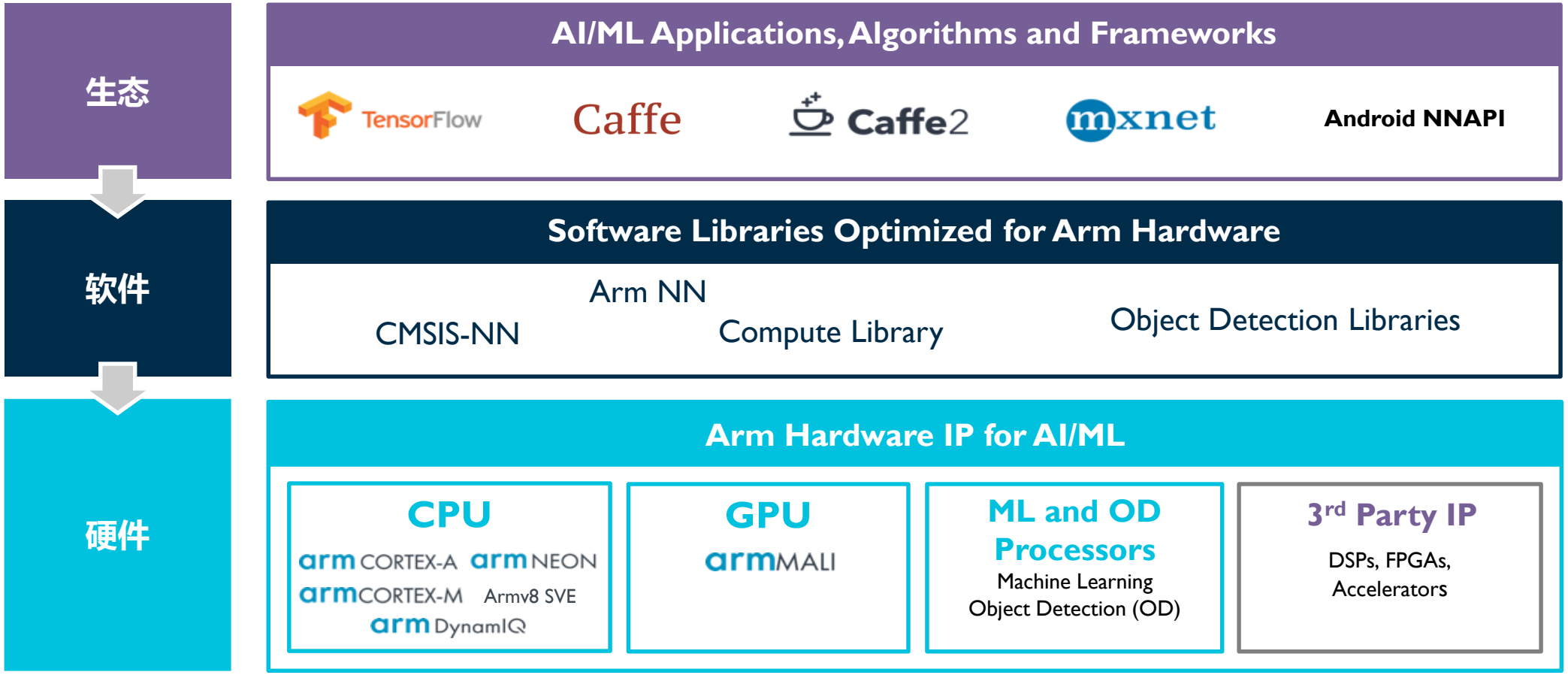
AI 远不仅是加速器



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芯片在哪里?

Smartphone

Tablet

Laptop Processors

Hard disk drive

Computer peripherals

Digital TVs

Automotive

Other digital products

Servers

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Arm：地球上唯一万亿量级科技创新生态系统

下一个基于Arm的一千亿即将出货完成： 2017 + 2018 + 2019 + 2020

Arm教育：
打造核心AIOT课程

机器人/人工智能

AR/VR

Mobile Computing

arm CORTEX

Cortex-A

arm

Internet of Things

Little Devices and Little Data/
Big Data and the Cloud

arm CORTEX Cortex-M

Devices + Applications + Big Data

智慧医疗

智能家居

IEEE 802.15.4

Wi Fi

Bluetooth SMART

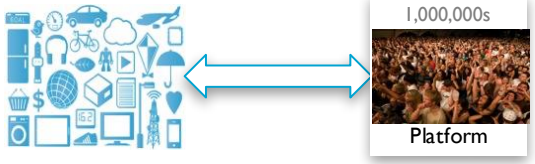
LTE

ZigBee

3G

Standards that enable Internet scale

arm MBED



Cloud and Community Based Development

智慧城市

智能汽车

arm CHINA

Arm EECS核心课程内容 – 50门

	Undergraduate University Studies	Postgraduate University Studies	Research
Core EE/CS/CE courses	• **Embedded Systems** • **SoC Design** • **Computer Architecture** • **DSP** • **Linux/OS** • Compiler Design • Non-ARM specific courses e.g. general programming, logic design, discrete maths etc.	• HPC • Green computing • Cloud computing • Networking • Machine Learning • Computer Vision • Speech Processing • Artificial Intelligence • Compiler Design • Analogue Mixed Signal Design • RF Engineering • Security • Cryptography • Micro and Nano electronics • Data Science • **DSP** and Communications • **IoT** • **Robotics/Control** • Low power electronics • **VLSI Design** • System Modelling	Master courses
Elective courses / specialised UG degrees	• HPC • Networking • **Graphics/Gaming** • **RTOS** • **Robotics/Control** • **IoT** • **VLSI Design** • Communications • Machine Learning • Computer Vision • Analogue Mixed Signal Design		

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Arm大学计划 – 全球最大EECS课程体系

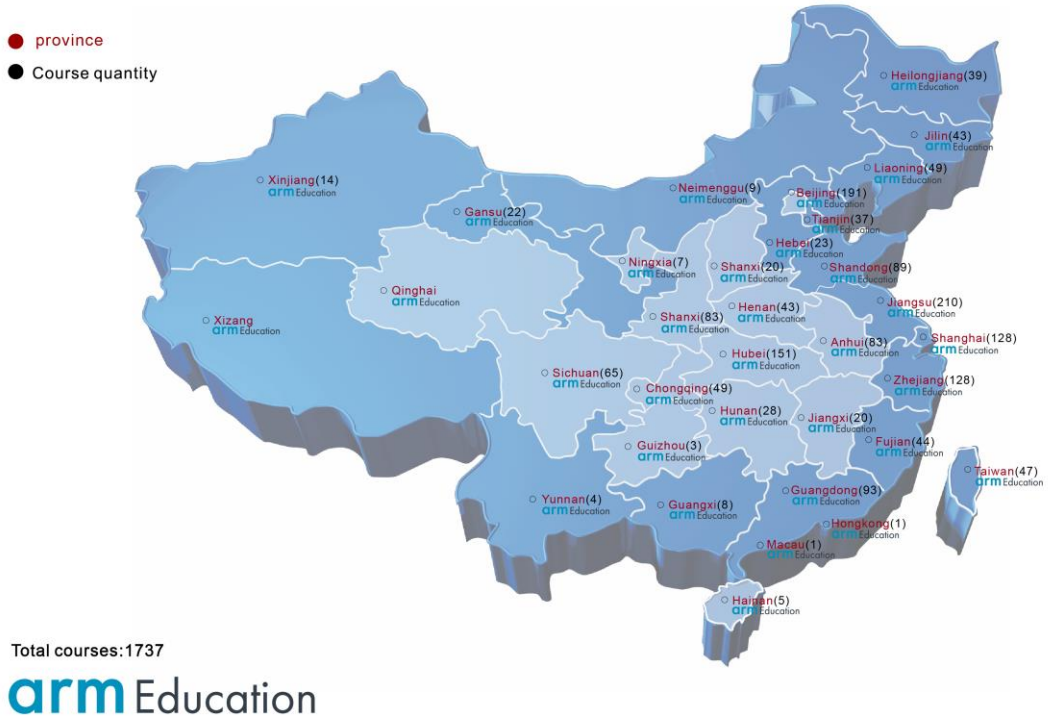
	2013	2014	2015	2016	2017	2018
新的教育套件	2	5	2	2	**2**	**2**
累计的教育套件		7	9	11	13	15
课程（含实验室）数量	305	998	2202	3061	4598	5392

34 省市自治区直辖市

600 余所高校

每年100,000+学生

1737门课程正在使用Arm教育计划自行研发的套件及技术



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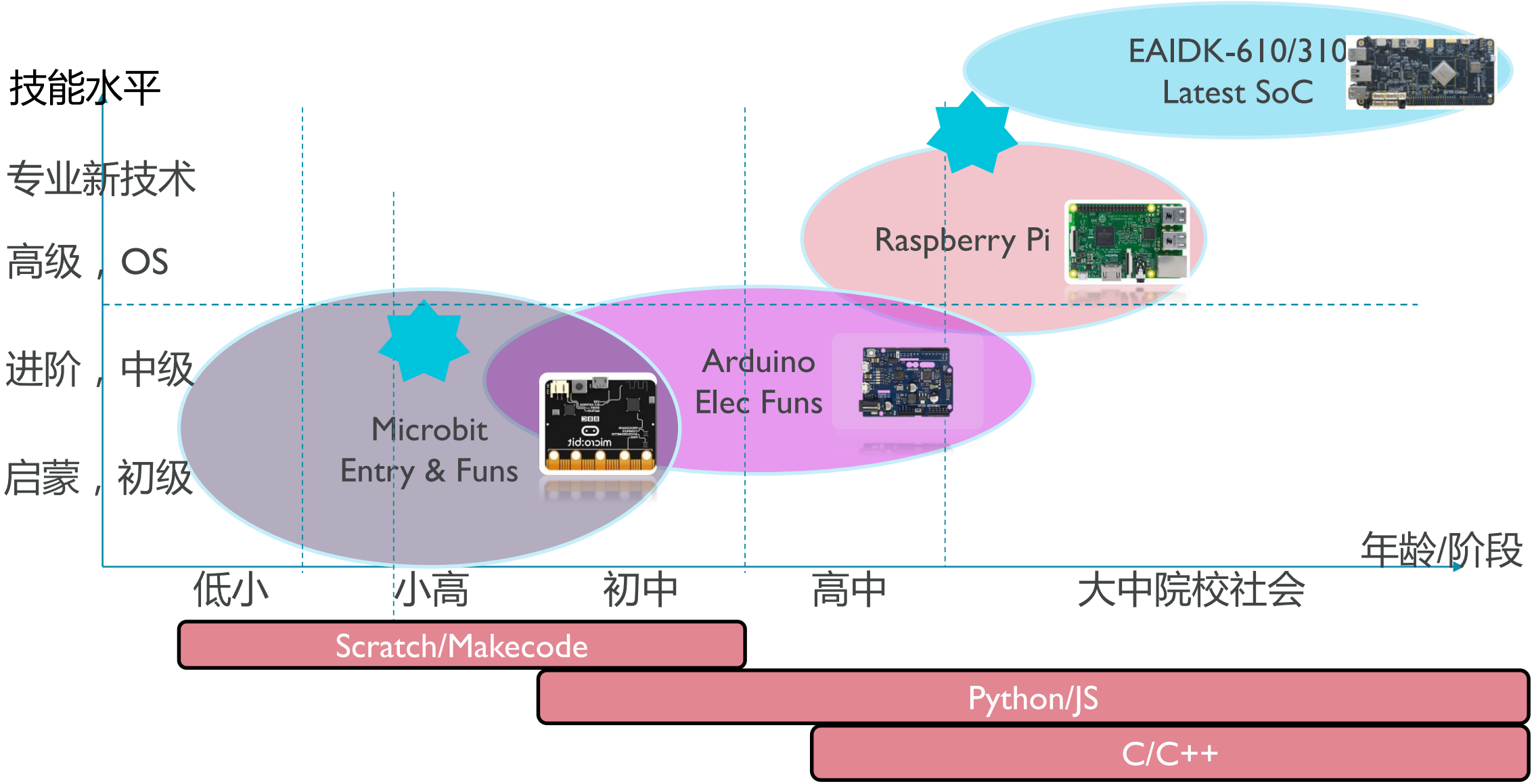
嵌入式人工智能贯通学习平台



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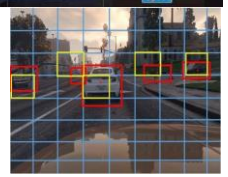
Arm嵌入式人工智能教育建设总览



人脸识别
目标检测
表情、性别
机器视觉应用

语音唤醒
自然语言处理

IoT
机器人
无人机
AR/VR

AI 场景与应用

AI开发平台

基础软件

操作系统
（Linux，ubuntu，ROS，Android）

设备驱动

嵌入式AI硬件平台
EAIDK（RK3399）

本地语音库
（Speech）

机器视觉库
（BladeCV）

嵌入式深度学习框架
（Tengine）

异构计算库
（HCL）

基于EAIDK-610板卡的人工智能微工厂三部曲

1. 实现e.do机器人声控和视觉的结合

1. E.do和EAIDK板块的通讯实现
2. 通过EAIDK开发板驱动以太网摄像头、HMI触摸屏获得识别的图像
3. 将e.do的声控和视觉结合起来,实验可否加入视觉引导以及声控示教。
4. 实现不同这种类的物体识别，或者同物种的不同型号识别（列入车型识别）

利用声控接受识别命令，以视觉实现位置判断，最后实现e.do抓取到命令物体

2.实现e.do机器人和带EAIDK-610板卡智能小车的结合，搭建各行业微工厂应用场景（汽车生产线体搭建）

1. 实现e.do机器人和智能小车的通讯
2. 按照汽车四大生产工艺布局输送台
3. 小车负责送运工件，机器人负责冲压，焊接，涂装，总装工艺执行
4. 在这整个环节里面添加人工智能元素（声控，视觉，深度学习后的检测）

3.实现微工厂内IOT

1. 各个设备数据采集
2. 数据的处理

1. 执行命令的传输
2. 执行任务过程的监测

1. 设备状态的反馈

嵌入式人工智能培养体系（本科）

专业方向层

- AIoT：窄带物联网技术、物联网通信、工业物联网、智慧交通、智能控制、智能嵌入式硬件系统
- AI：智能家居、智能无人系统、智慧交通、5G移动通信、安全与隐私保护、智能系统设计

专业技术层

- 关键技术：计算机视觉、计算智能、自然语言处理、大数据技术、数据处理、脑科学导论、知识图谱
- 理论计算法：图像处理及Python实现、机器学习原理及实现、深度学习

专业基础层

- 平台基础：人工智能导论、计算机网络通信、嵌入式处系统及应用、数据库、操作系统、数据结构
- 编程语言：Python、Java、C/C++
- 数学基础：高等数学、概率论与数理统计、应用统计学……

嵌入式人工智能培养体系（高职）

专业方向层	AIoT	窄带物联网技术及应用	RFID原理及应用	工业物联网技术及应用	嵌入式系统及应用	智能家居设计与应用	智能嵌入式硬件系统开发
	AI	智能家居案例及应用	智能系统设计与实现	智慧交通案例及应用	5G移动通信技术导论	安全与隐私保护	智能机器人系统
专业技术层	技术及实现	图像处理及Python实现	自然语言处理与Python实现	计算机技术技术及应用			
	关键技术	机器学习基础	大数据技术	Python网络爬虫	脑与认知科学		
专业基础层	专业导引	人工智能导论	智能开发程序基础（C/Python）	数学基础（概率/统计……）			
	公共基础	计算机基础	计算机网络通信	操作系统	数据库原理	数据结构	

嵌入式人工智能课程建设

一、基础模块

1.数据结构

2.程序设计基础（C/Python）

3.计算机网络与通信

4.操作系统

5.微型计算机原理及应用

6.单片机基础

7.数据库系统原理

二、智能科学与技术模块

1.人工智能导论

2.人工智能原理

3.机器学习

4.计算机视觉

5.智能机器人

6.模式识别

7.数据挖掘

8.自然语言处理

9.智能移动软件开发技术

10.数据科学

11.深度学习框架及应用

三、物联网技术模块

1.物联网技术导论

2.物联网通讯技术

3.自动识别技术及应用

4.传感器原理及应用

5.物联网中间件技术

6.物联网应用系统设计

7.窄带物联网

8.工业物联网

四、嵌入式系统模块

1.Linux操作系统基础

2.Linux高级编程

3.嵌入式微处理器技术及应用

4.开源硬件应用开发

5.嵌入式系统设计

6.嵌入式操作系统

7.嵌入式软件设计及开发

中小学嵌入式人工智能课程建设

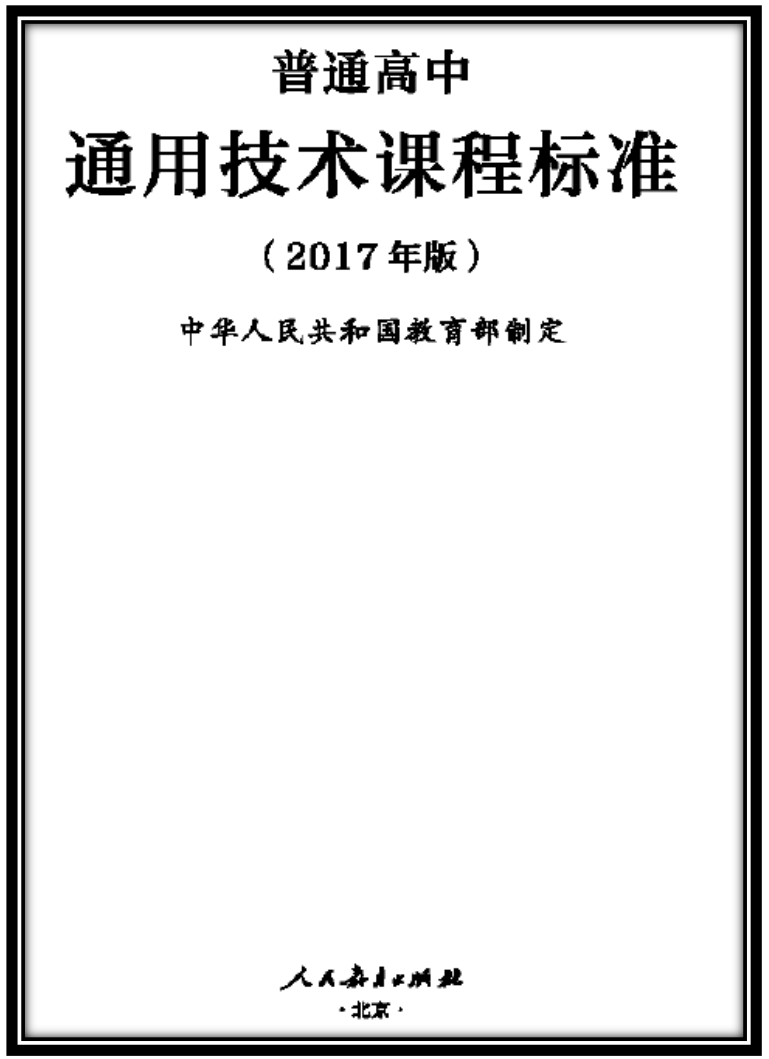
Department for Education

Computing programmes of study: key stages 3 and 4

National curriculum in England

Purpose of study

A high-quality computing education equips pupils to use computational thinking and creativity to understand and change the world. Computing has deep links with mathematics, science, and design and technology, and provides insights into both natural and artificial systems. The core of computing is computer science, in which pupils are taught the principles of information and computation, how digital systems work, and how to put this knowledge to use through programming. Building on this knowledge and understanding, pupils are equipped to use information technology to create programs, systems and a range of content. Computing also ensures that pupils become digitally literate – able to use, and express themselves and develop their ideas through, information and communication technology – at a level suitable for the future workplace and as active participants in a digital world.



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中小学嵌入式人工智能课程建设

Department for Education

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Micro:pet lesson plan

The big picture – why is this relevant?	Learning objectives:
• This is an open project to make use of all the skills developed in the previous projects • Learners will deal with a real-world problem and try to solve it using technology	• Design and create a pet that people can interact with • Program some interactive features • Build and test the pet

Micro:math lesson plan

The big picture – why is this relevant?	Learning objectives:
• This project introduces interaction which is a vital part of physical computing • This program has real world utility and could be used by younger learners to revise math • Variables are introduced which are a key concept of computer science	• Understand what are success criteria • Create a simple user interface • Use the button inputs to control the program • Understand what a variable is, how to name it and use one in a program • Use simple math operators in a program • Learn how to generate random numbers within a range • Learn how to test a program
Engagement – How can I engage learners?	**Assessment for learning**
• This program involves lots of interaction and learners should be encouraged to thoroughly test the program to ensure it works as expected • A simple case can be made for the micro:bit and it should be decorated mathematically • This program can have real world utility for younger learners, encourage learners to consider the needs of another learner using their program and hardware • This project could be done in pairs with one programming and one making	**Expected progress:** • Learners will produce a simple multiplication program **Good progress:** • Learners create the program and test it thoroughly. Learners will extend the program to include other math operators and will evaluate their work against the success criteria **Exceptional progress:** • Learners will complete all stretch tasks and will improve the program beyond the success criteria

Quickstart project lesson plan

The big picture – why is this relevant?	Learning objectives:
• Physical computing is the future • Programming is an important skill but programming physical devices allows much more creativity and engagement	• Understand what a micro:bit is • Understand how to use the makecode website • Know that a .hex file is a micro:bit program • Understand how to make a simple program, download it to a PC and upload the program to a micro:bit • Use some basic blocks in makecode to make a "Hello World" program
Engagement – How can I engage learners?	**Assessment for learning**
• This project makes code instantly visible on the micro:bit, let learners have fun with changing the text and icons • Inspire learners by explaining what can be done with a micro:bit and how it can be programmed using blocks and real code • Give examples of micro controllers in the real world and how they could be useful to the learners	**Expected progress:** • Learners create a "Hello world" program and save the .hex file to the micro:bit **Good progress:** • Learners attempt the stretch tasks and complete some of them successfully **Exceptional progress:** • Learners complete the stretch tasks and move onto the next project
Key concepts:	**Key words:**
• Micro:bit programs can be written on the makecode website • A micro:bit is a microcontroller • A program is a file that needs to be uploaded to the micro:bit to work • Programs should be named appropriately • Programs can be developed iteratively • What sensors are • What inputs/outputs a micro:bit has	• Micro:bit • Microcontroller • Program • USB • .hex • Download/Upload • Copy and Paste • Blocks • LED • Sensor
Differentiation:	**Resources:**
Most learners will be able to follow the instructions however adding a program to a microcontroller maybe a new concept to some learners and they may need support with getting the files onto the micro:bit initially.	• 1 micro:bit per learner • 1 USB cable to connect the micro:bit to a PC • A PC • Access to https://makecode.microbit.org/

Teacher guide

Learning objectives

Each project has defined learning objectives and these objectives link directly to the success criteria defined in the project worksheets.

Pedagogy

All the projects are designed to be delivered in order as they build in complexity and cover different skills and techniques in an order that is accessible to learners. However more able learners or learners who are already familiar with the micro:bit could skip the Quick start project as this is an introduction only.

The resources have been designed to be delivered in a flexible manner where learners can work through them independently or it can be accessed through small groups as most projects involve some design and making as well as programming and the two must work together. The projects are designed to require minimum directed teaching but a "Lesson flow" is provided to give the sessions some structure and to introduce some of the more challenging topics and concepts. As the teacher is doing minimal delivery of the content they are free to circulate amongst the learners and troubleshoot where needed, this allows weaker learners to be better supported and more able learners to be pushed harder when appropriate. There are stretch activities in every project that extend the knowledge and application of the skills for these learners.

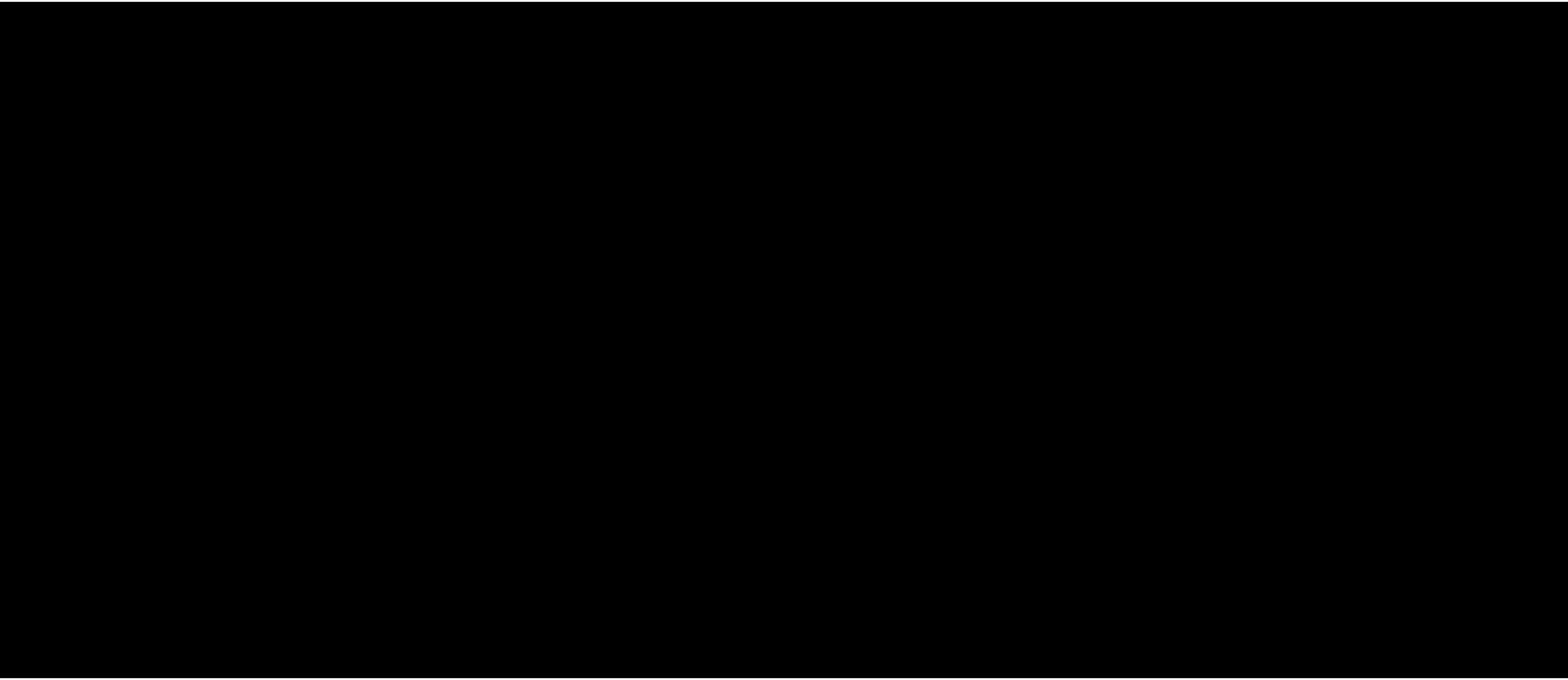
Whilst circulating amongst learners teachers should be mindful of the "Key concepts" and "Key words" and should quiz learners at appropriate times on their knowledge of the concepts by getting them to explain the code/blocks they are using and also the thinking behind their designs for the making activities. Learners also may need reminding of the success criteria.

ives

	knowledge and understanding of technology
AO2	Apply knowledge and understanding of technology
AO3	Analyse and evaluate problems
AO4	Demonstrate application of knowledge and understanding to solve problems

Grade scale and descriptors

Pass	• Learners will have demonstrated limited knowledge and understanding of the concepts and principals involved in the course. • Learners will have applied the principals and concepts using some analytical and evaluative thinking and practice to solve a problem. • Learners will have demonstrated some ability to apply knowledge and understanding to solve problems. • Learners will have collaborated with their peers and demonstrated some communication and teamwork.
Intermediate	• Learners will have demonstrated mostly accurate knowledge and understanding of the concepts and principals involved in the course. • Learners will have appropriately applied the principals and concepts using analytical and evaluative thinking and practice to solve a range of problems. • Learners will have demonstrated their ability to apply knowledge and understanding to solve problems. • Learners will have collaborated reasonably successfully with their peers and demonstrated mostly effective communication as well as effective teamwork.
Higher	• Learners will have demonstrated relevant and comprehensive knowledge and understanding of the concepts and principals involved in the course. • Learners will have effectively applied the principals and concepts using sustained analytical and evaluative thinking and practice to solve a range of problems. • Learners will have successfully demonstrated their ability to apply knowledge and understanding to solve substantial problems in an efficient manner. • Learners will have collaborated successfully with their peers and demonstrated effective communication as well as efficient and effective teamwork.



科普活动

2018年9月17日至19日,首届世界公众科学素质促进大会在北京召开。在科学传播与企业社会责任实践分论坛上，Arm有限公司全球教育计划经理尼古拉斯·保罗·桑普尔就“科技企业在校园STEM教育中承担的角色”进行主题发言。

中英教育文化交流

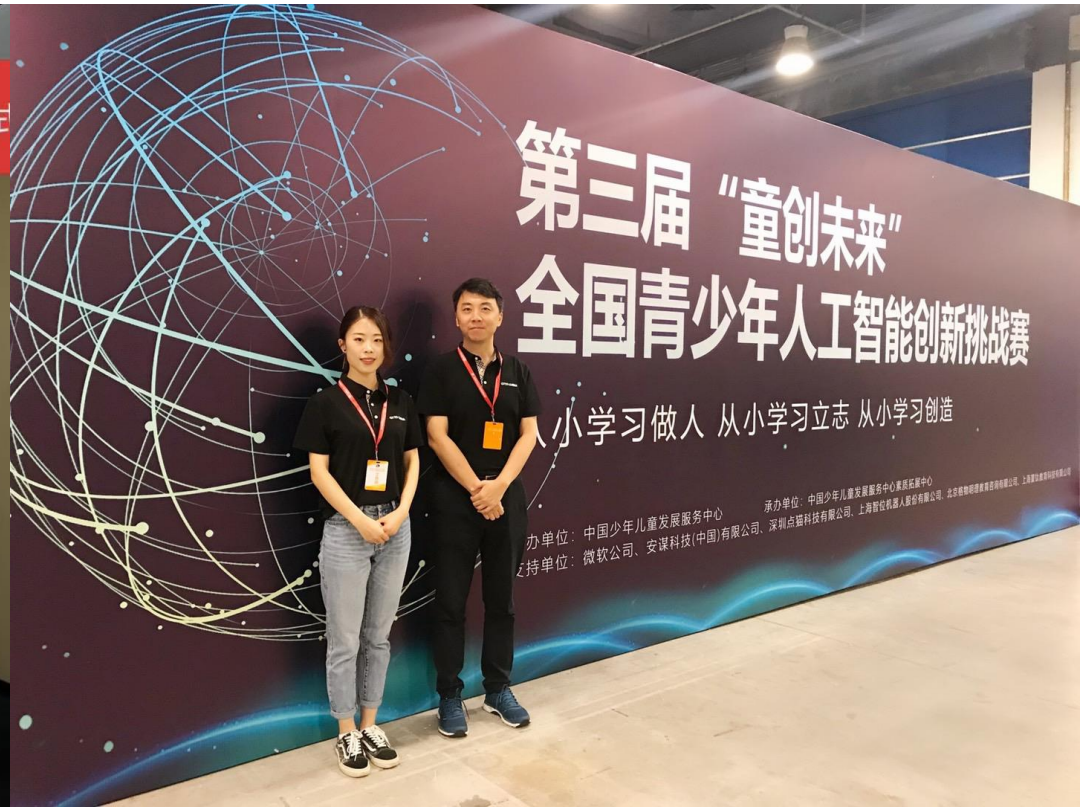
“灵动青春” 活动

1月31日，特雷莎·梅一行抵达武汉大学，出席“中英灵动青春盛典”之湖北英国教育文化交流展。其间梅参观了武汉大学的展台，ARM 大学经理陈炜博士向首相展示了基于ARM平台的智能机器人写下了“新年快乐”4个汉字。 对话中，首相非常关注AI技术，希望看到更多的合作。

创客联盟

arm CHINA

Arm中小学人工智能教育合作项目



全国青少年电子信息智能创新大赛，“童创未来”全国青少年人工智能创新挑战赛

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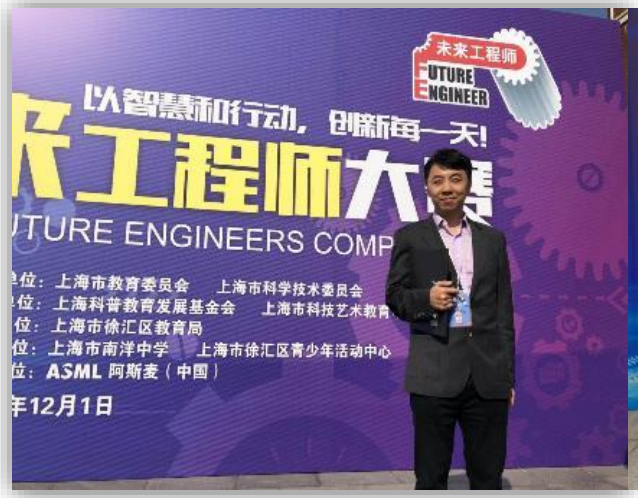
人工智能挑战赛& 未来工程师大赛



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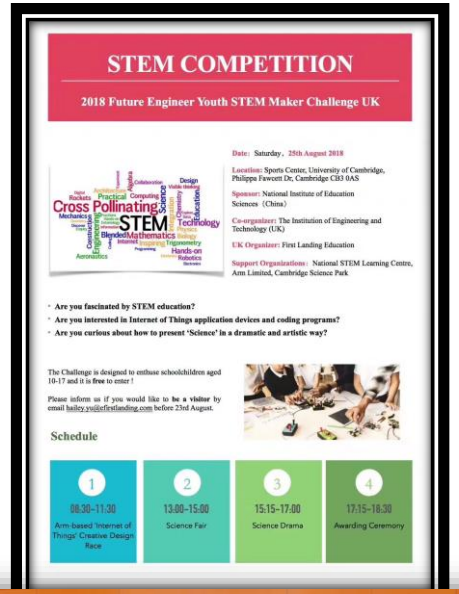
未来工程师大赛（英国站）



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科技扶贫

Arm中国教育：全方位教育服务及合作

师资培训证书

课程证书

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“如果我看得更远的话，
那是因为我站在巨人的肩膀上”
(If I have seen further it is by standing on ye shoulders of Giants)。

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